ABB MEASUREMENT & ANALYTICS | USER MANUAL

User Manual | ICOS

GLA231 Series Performance Rackmount Gas Analyzer

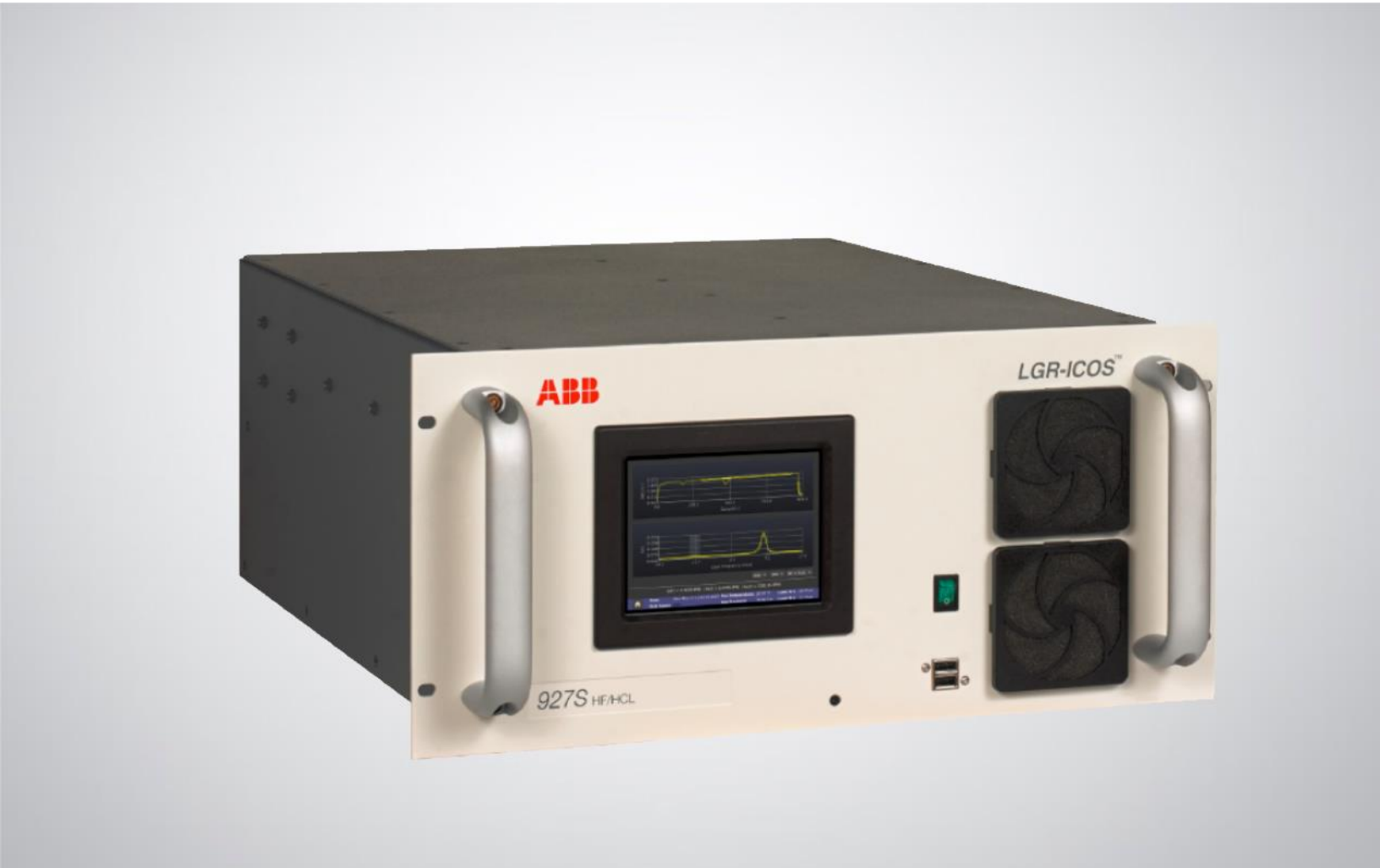

Table of Contents

Only authorized persons may open the analyzer cover or perform internal maintenance. Verify the analyzer is unplugged before working with the internal components. Failure to do so may result in damage to the analyzer and electric shock.

Patent

The GLA231 Series Rackmount Gas Analyzer™ technology is protected by patents:

- 7,468,797
- 6,839,140
- 6,795,190
- 6,694,067

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ABB provides product support services worldwide. To receive product support, either in or out of warranty, contact the ABB office that serves your geographical area, or the office indicated below:

ABB Inc. Measurement & Analytics
3400, rue Pierre-Ardouin
Quebec, (Quebec) G1P 0B2 Canada
Tel: 1 800 858 3847 (North America)
Tel: +1 418 877 2944 (Worldwide)
Fax: +1 418 877 2834
Technical Support: icos.support@ca.abb.com

Please be prepared to provide the serial numbers of all units.

Introduction

This document describes usage, installation, operational safety, maintenance, and troubleshooting details for the GLA231 Series Rackmount Gas Analyzer.

Details of this manual include:

- Menus and data screens
- Calibration instructions
- Data sampling rate adjustments
- Data file transfer instructions

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Safety

The following pages provide important safety precautions.

Class of Laser Equipment

This analyzer is a Class 1 laser product when the top panel is secured.

Certification

Safety certifications of the GLA231 analyzer include:

Table 1: Safety Certifications

Symbols	Standards Tested & Met
CE	EN61326-1:2013
FDA	Title 21 Code of Federal Regulations, chapter 1, sub-chapter J

WEEE Directive

The GLA231 analyzer product is not subject to WEEE Directive 2002/96/EC (Waste Electrical and Electronic Equipment) or relevant national laws (e.g. ElektroG in Germany).

The product must be disposed of at a specialized recycling facility. Do not use municipal garbage collection points. According to the WEEE Directive 2002/96/EC, only products used in private applications may be disposed of at municipal garbage facilities.

Symbols

Important safety symbols include:

Table 2: Documentation Symbols

Symbols	Meaning
	**Note:** Important information
	**Danger:** Failure to comply may result in death. **Warning:** Failure to comply may result in serious injury. **Caution:** Follow instructions carefully to avoid equipment damage or personal injury.
	High voltage

Labels

The following labels are placed on the analyzer to identify hazardous locations:

Heavy Object Label

This label is affixed to the outer covers of the analyzer. Total weight = 29 kg. (Figure 1)

Figure 1: Heavy Object Label

Pinch Point Label

This label is located on the outer cover enclosure covering the internal components. It is held in place with screws. (Figure 2)

Figure 2: Pinch Point Label

High Voltage Label

This label is located on the rear panel, next to the AC power terminal block. (Figure 3)

Figure 3: High Voltage Label

Laser Radiation Label

These labels are located on the top cover. The fiber laser is visible only when the top cover is removed. (Figure 4)

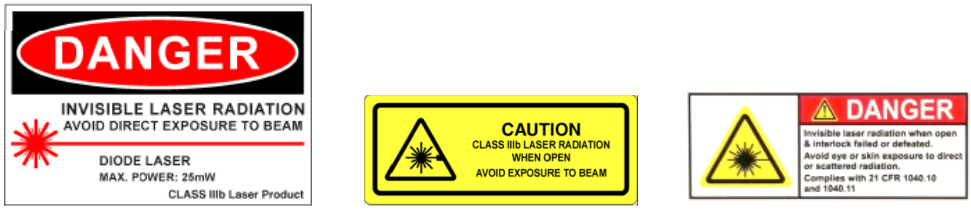

Figure 4: Laser Radiation Label

Operator Safety

When the top panel is closed and locked into position, the analyzer runs safely without risk to the operator. Operating the analyzer in any other condition can damage the equipment or injure personnel. Follow these general safety guidelines at all times.

The GLA231 Series analyzer is a Category II (Overvoltage Category) installation.

Do not operate the analyzer when the top enclosure panel is removed.

- The top enclosure panel protects against electrical shock.
- The analyzer has a laser interlock switch attached to the top enclosure panels. Do not disable the laser interlock switch when powered on. The laser interlock switch protects the user from a class IIIb laser.

Bypassing the laser interlock switch is not recommended. If the top enclosure is open, the primary or secondary reflection of a class IIIb laser can cause eye damage.

Heavy Objects

The rack-mount analyzer weighs approximately 29 kg, and qualifies as a heavy object. Figure 5 shows the *Heavy Object label*.

WARNING

The analyzer should not be hand-carried. ABB recommends the unit be rolled to its final mounting site on a wheeled table. Use a minimum of two people when lifting.

When lifting the analyzer:

- Use a mechanical hoist, if available.
- Use a minimum of two people for lifting, moving, and mounting, while using proper lifting techniques:
  - Do NOT lift with your legs straight or from a forward bent position.
  - Bend your knees and lower your hips, using your leg muscles to lift.
- Test the load to make sure that you are able to lift it safely. Lift the load while keeping it as close to your body as possible.
- Avoid sudden movements and NEVER twist your body. A bending and twisting motion can cause discs in your spine to rupture. If you have to rotate the analyzer:
  - Your hips and shoulders should be aligned.
  - Move your feet first so that you face the area where you can safely set the analyzer down.
- When two or more people are performing the lift, make your actions synchronized.
  - Communicate with each other to avoid injury.
  - Have one person provide direction, so that you can lift together.
- Avoid lifting heavy objects with one hand. Always try to balance the load in both hands, or get a cart.

Figure 5 shows the warning label that is attached to the analyzer.

Figure 5: Heavy Object Label and Location

Pinch Point Hazards

Pinch point hazards are locations on the analyzer where a user can accidently be pinched or cut. Pinch point hazard locations are on the top cover and marked with a pinch point label. (Figure 6) Use caution when lowering the top cover back into place.

Figure 6: Pinch Point Label and Location

Hazardous Voltages

There are three voltage potentials operating above 30 volts RMS on the analyzer.

- The 115 V AC and 220 V AC are located at the power entry module that feeds the two (2) DC power supplies.
- The solid-state relay is located under the top panel and only poses a risk when removed.

These components are marked with the electrical hazard label. This label is located on the rear panel, next to the AC power terminal block. (Figure 7)

Figure 7: Electrical Hazard Label

Safety Provisions

The insulation and enclosure protect operators from contact with hazardous voltages during normal system operation. If a short circuit or over-current condition occurs, the internal fuse disconnects the power line from the incoming power supply.

Location of Hazardous Voltages

Electrical hazard warning labels are applied wherever the removal of the panel can create an opportunity for contact with hazardous voltages.

Electrical Safety Task Types

During a procedural task where direct exposure to electricity may occur, the task type is identified according to the *SEMI S2-93A* standard.

The operator must be aware of the electrical task type encountered while performing these connections.

Table 3 provides a list of SEMI S2-93A task types and their definitions.

Table 3: Electrical Safety Task Types

Type	Definition
Type 1	• Equipment is fully de-energized (electrically “cold”)
Type 2	• Equipment is energized • Live circuits are covered or insulated • Work is performed at a remote location to preclude accidental shock
Type 3	• Equipment is energized • Live circuits are exposed and accidental contact is possible • Potential exposures are less than 30 volts RMS, 42.2 volts peak, 240 volt-amps, and 20 joules
Type 4	• Equipment is energized • Live circuits are exposed and accidental contact is possible • Voltage potential is greater than 30 volts RMS, 42.2 volts peak, 240 volt-amps, 20 joules, or radio frequency (RF) is present
Type 5	• Equipment is energized • Measurements and adjustments require physical entry into the equipment, or equipment configuration will not allow the use of clamp-on probes

Electrical Hazards During Normal Operation

When the top enclosure panel is closed, the analyzer is a Type 2 electrical safety task.

The insulation and panels protect operators from electrical hazards. The top panel must remain in place during normal operation.

- A laser interlock is installed to shut down power to the laser should the top cover be removed for servicing. This is to protect operators from accidental exposure.
- Should the top cover be removed while powered on, the operator will be exposed to Type 4 electrical hazards.

Electrical Hazards During Service Operation

Service should only be performed by a person that has completed service training.

Electrical Hazard Types:

- Type 3 electrical hazard
    - Exposure to live circuits occurs when the top panel is opened while powered on.
    - Most service tasks require opening the top panel.
- Type 4 electrical hazard
    - Occurs when validating AC power from the facility at the power entry module to the AC/DC power supply converter.
- Type 5 electrical hazard
    - There are no Type 5 tasks required for the analyzer.

Laser Hazards

The GLA231 Series analyzer will contain 1 or 2 lasers, depending on the gases to be measured. The gas types determine the laser wavelength. Under normal operation, with the enclosure top panel closed, the analyzer is a *Class 1 Laser Product* in accordance with *Title 21 Code of Federal Regulations, chapter 1, sub-chapter J*.

The lasers are rated *Class 3B* (> 5 mW). They are enclosed and not accessible unless the enclosure is removed for servicing. Warning labels are affixed to the enclosure covering the lasers.

Figure 8 shows the laser warning labels.

Figure 8: Laser Radiation Labels

NOTE

Laser replacement requires the removal of the ICOS module from the main enclosure. The laser is contained within the ICOS module. The removed ICOS module can be shipped back to ABB for repair.

Internal Laser Interlock Switch

The analyzer is equipped with an internal laser interlock switch. It disables laser power when the analyzer top cover is removed to prevent exposure and eye damage caused by a class IIIb laser through primary and secondary reflections in the ICOS module.

The laser interlock is located on the left side panel toward the front top corner of the analyzer. When inserted into the switch key slot, it will enable a signal to the Laser Controller Driver board to allow power to reach the laser(s).

Safety Provisions

Follow these precautions when dealing with chemicals:

- Keep all chemical containers away from heat, sparks, and open flames.
- Use on grounded equipment and with non-sparking tools.
- Store in a cool, dry, well-ventilated place, away from incompatible materials.
- In case of a spill:
    - Make sure all handling equipment is electrically grounded.
    - Mop or wipe up, and then place all chemical-soaked items in containers approved by the US Department of Transportation (DOT), or the appropriate local regulatory agency.

Facilities Interface Requirements

Table 4 shows the *Electrical Power Interface Requirements*.

Table 4: Electrical Power Interface Requirements

Parameter	Specification
Power Equipment	The power circuit should not experience dips and surges
Supply Point Interconnect	3 wires AC wall outlet
Supply Voltage	115 V AC model will operate between 90 V AC and 140 V AC 230 V AC model will operate between 190 V AC and 250 V AC
Phase	47/63 Hz, single phase
FLA Amps	0.68 A @ 117 V AC
ACT Interrupt Rating	10 kA
Short Circuit Current Rating (SCCR)	1 kA
Peak Current	In-rush current at power-on: 1 A peak @ 24 ms
Operating KVA	Average running load over 24-hour typical manufacturing cycle: 0.08 kVA
Wire	Provided with the instrument
Grounding	Dedicated ground, not neutral. Must be earth grounded.
Main Disconnect	Supplied by the customer at the Supply Point Interconnect. Circuit breaker able to support 10 A.

Table 5 shows *the Inlet Gas and Exhaust Interface Requirements*.

Table 5: Inlet Gas and Exhaust Interface Requirements

Requirements	Specification
Exhaust Gas Capacity	Up to 2.8 SLPM on a 0.25 inch OD, 0.1875 inch ID pipe
Exhaust Gas Fitting	0.25 inch (6.35 mm) Tube Swagelok
Inlet Gas Line Fitting	0.25 inch (6.35 mm) Tube Swagelok
Inlet Gas Maximum Temperature	50 °C
Inlet Gas Maximum Gauge Pressure	5 psig
External Exhaust Pump Fitting	0.375 inch (9.525 mm) Tube Swagelok

Do not use liquid products for leak detection. Liquid can travel into the line at the point of the leak, contaminate the measurement source, and impact measurement performance.

Power Service

To ensure reliability of the analyzer, its power circuit should not serve other loads. Transient-producing devices (such as motors and induction heaters) should be powered from a separate feeder to eliminate potential sources of noise interferences.

Failure of the analyzer due to voltage transients will void warranty and service contract agreements. If a problem is known to exist, an isolation transformer may be required.

Grounding

The GLA231 Series analyzer is grounded through the AC power plug to the customer AC power source. This ground must be tied into one main grounding conductor. This ground wire is a dedicated ground (not a neutral) and must be carried back to a service ground that is earth grounded.

The ground wire should not be shared with other equipment between the power supply and the service ground point. Conduits must not be used as the only means of grounding.

External (Chassis) ground should match the shielded wire gage used for the main AC power connected to the analyzer. This external ground should be an independent wire connected to protective earth.

Potential Power Problem Areas

All reasonable efforts have been made to ensure satisfactory operation from AC power supplied by most power companies. There are outside variables which neither the company nor ABB has any control. Power malfunctions can be caused by outside (radiated or conducted) transient electrical noise signals superimposed on the AC line.

The two basic types of power source failures are:

- Power outages: These include voltage sags exceeding SEMI F47 requirements and prolonged outages. If the frequency of such power failures is not acceptable for your operation, it may be necessary to install a standby power system or an uninterruptable power supply (UPS) that the customer can purchase on its own, based upon the analyzer's electrical requirements as a baseline reference.
- Transient electrical noise superimposed on power lines: This may be caused by transient-producing equipment in the vicinity of the power company's distribution lines, or within or adjacent to your facilities. Lightning is another source of power transients.

The customer can install an optional standby power system or UPS. In such case, the UPS drives the EMO circuit leading to the analyzer. Further power isolation is not required, because the EMO circuit voltage presents no hazard.

Location Relative to Solvents and Acids

The sensitive optics in the analyzer must not be exposed to fumes from acids and solvents. Position the analyzer at least 72 in (1.83 m) from the source of such fumes.

Equipment Facility Drawings

This section provides drawings for the GLA231 series analyzer. This is a rack-mount analyzer.

The front (Figure 10) and back (Figure 11) views show the required facilities and their specifications for:

- Exhaust gas
- Inlet gas
- AC power connection point.

Figure 9 shows the *isometric view*.

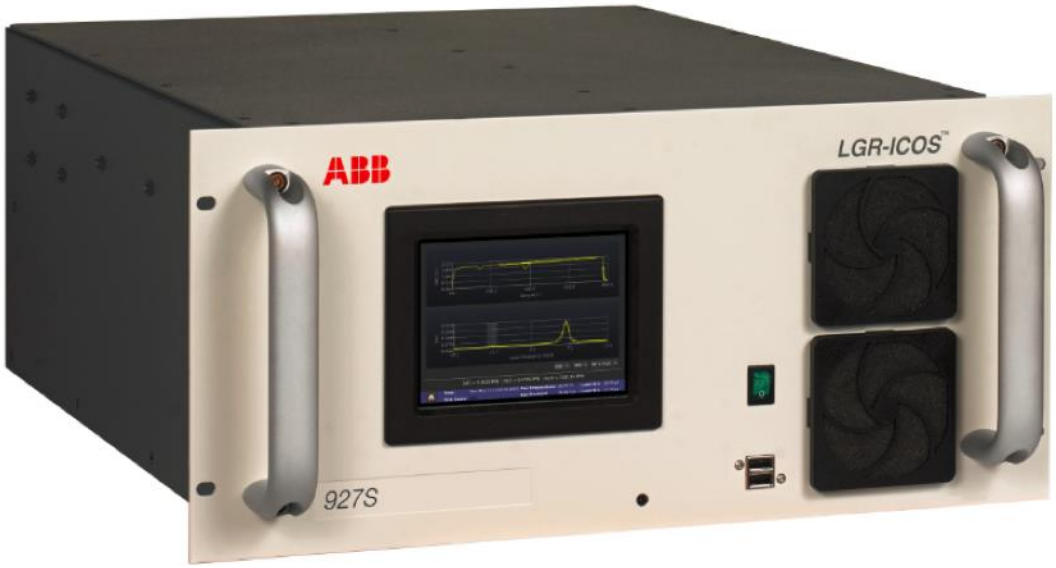

Figure 9: GLA231 Series Isometric View

Figure 10 shows the front of the analyzer.

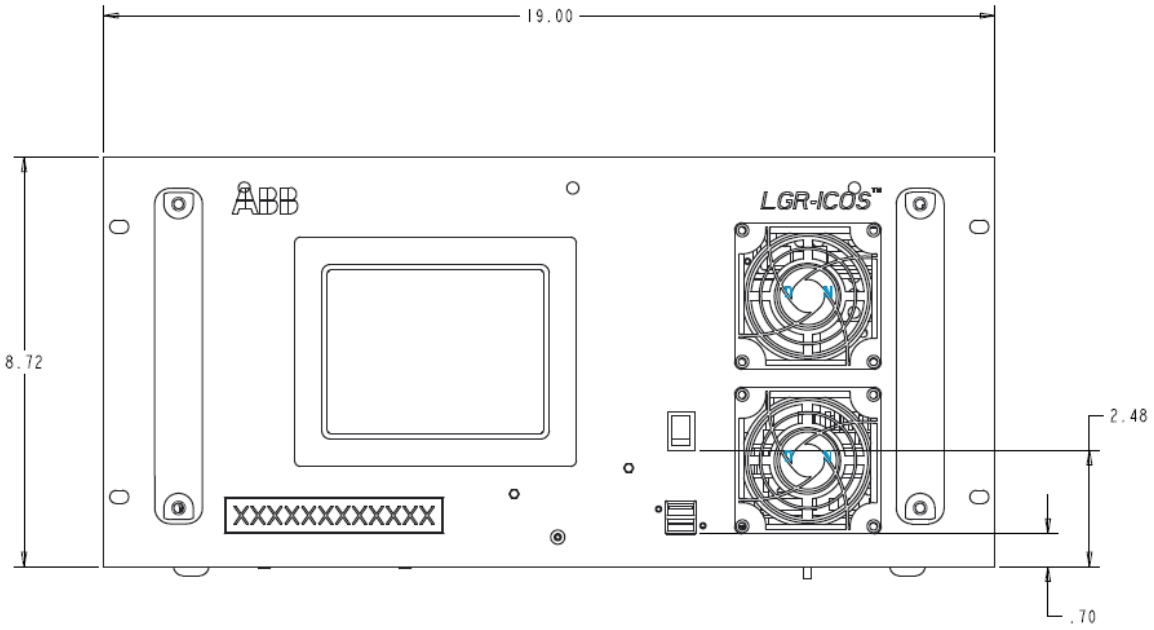

Figure 10: Front Panel

Figure 11 shows the back of the analyzer.

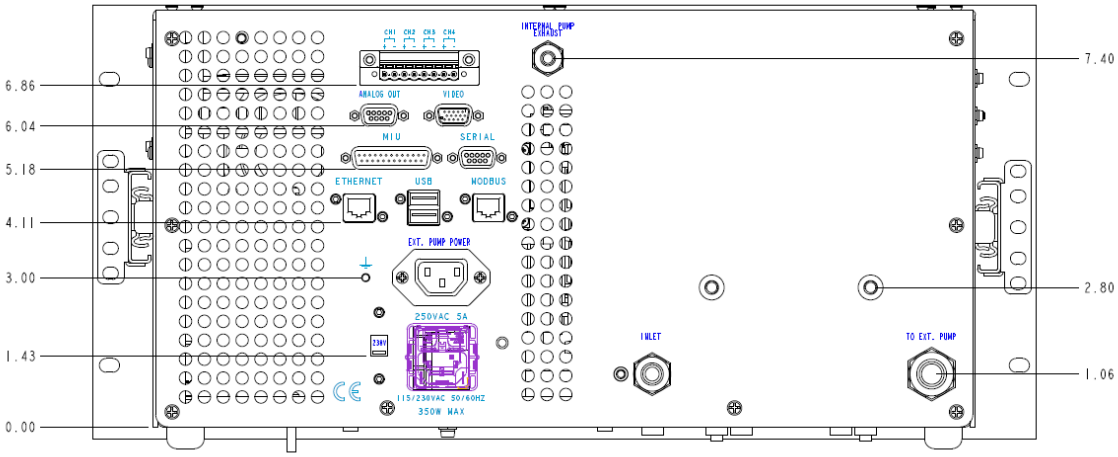

Figure 11: Back Panel

Figure 12 shows the right side panel of the analyzer.

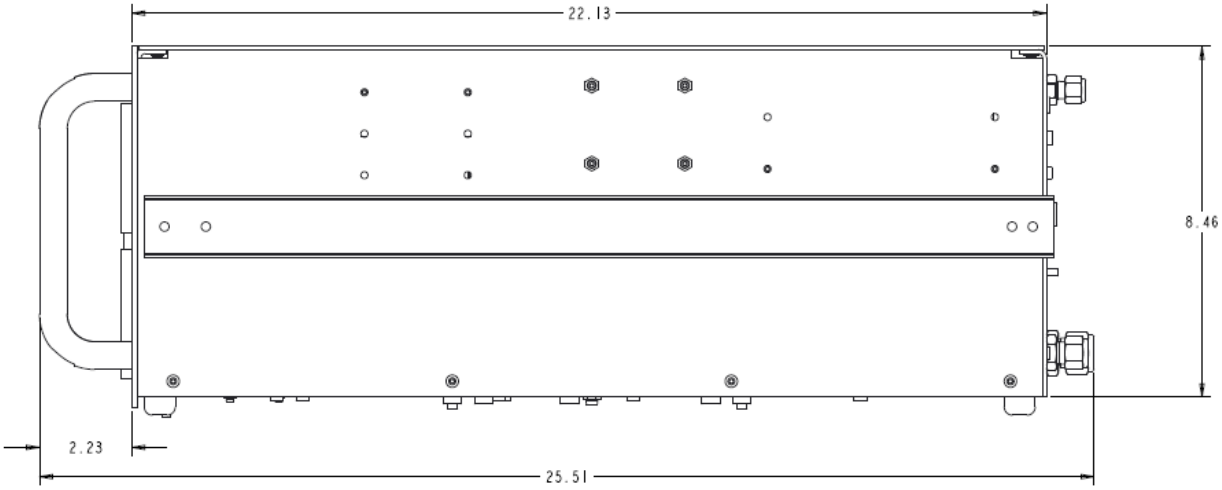

Figure 12: Right Side Panel

Figure 13 shows the left side panel of the analyzer.

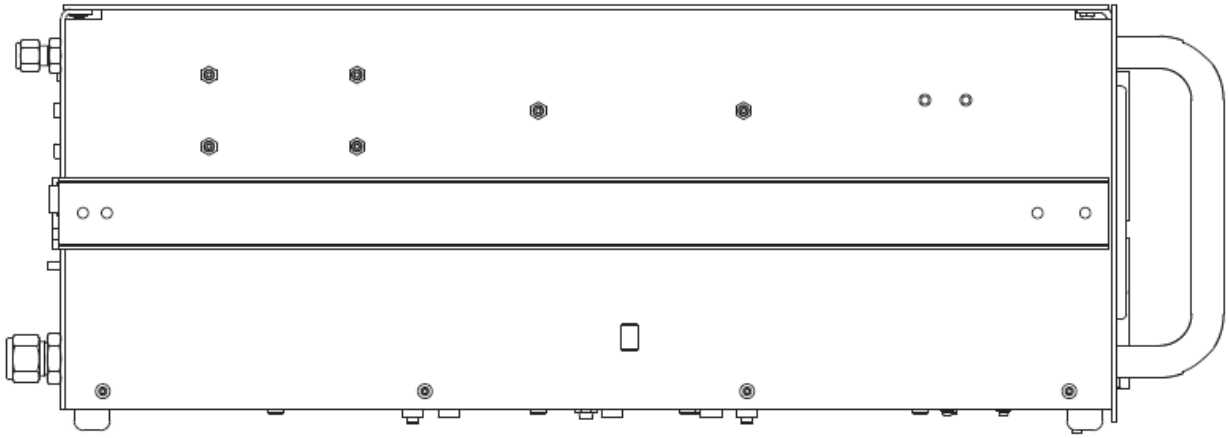

Figure 13: Left Side Panel

Figure 14 shows the bottom panel of the analyzer.

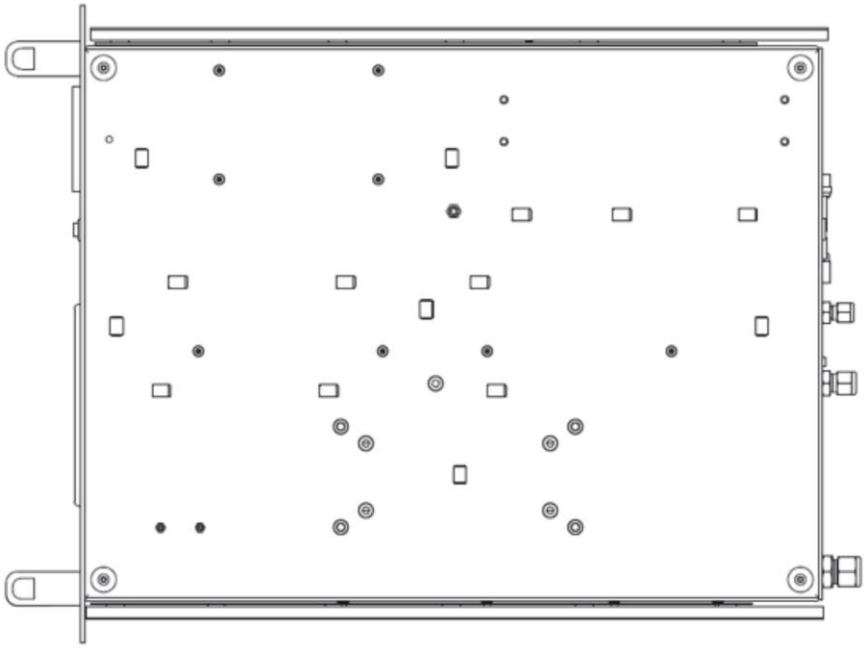

Figure 14: Bottom Panel

NOTE

All drawings in this manual are for reference only. All critical dimensions or criteria must be confirmed on the latest revision of controlled drawings.

Data Interface Connection Ports

This section describes the data interface connections as shown in Figure 15. These connections vary from analyzer to analyzer depending on the ordered configuration.

- Analog Out port (9 pin D-sub) – Provide a DC voltage proportional to the measured gas concentration. If these outputs are connected to an external device, they must be terminated into a moderate to high impedance (>1 kOhm).
- Video port (15 pin D-sub) – Connects an external monitor to the analyzer.
- MIU port (25-pin data port) – For connecting to a Multiport Inlet Unit (optional).
- Serial port (9 pin D-sub) – For real-time digital measurement output.
- Ethernet port – Connects the analyzer to a local area network (LAN) and allows access to the data directory using an external computer.
- USB ports – Used for transferring data to a USB memory device, or to connect a USB keyboard and mouse.
- Modbus – Used for customer-configured analog gas concentration output data.

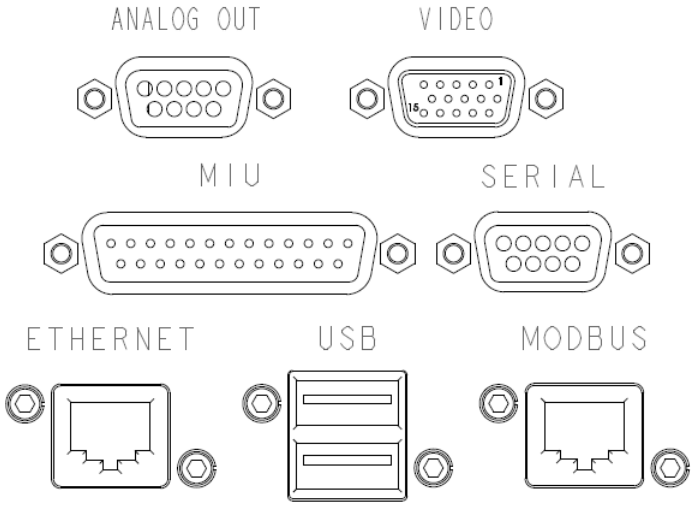

Figure 15: Data Interface Connection Ports

Plumbing Diagram

GLA231 analyzers are “backside” controlled, so they have a fixed orifice upstream that limits the flow rate into the cell. The maximum inlet pressure is the highest pressure at which the analyzer maintains pressure control.

The pressure control valve between the ICOS cell and the pump adjusts the pump flow rate to match the inlet flow rate and maintain the cell pressure. When the inlet pressure increases, the flow rate through the orifice increases. Eventually the flow rate into the cell is faster than the flow rate out of the cell from the pump for a given cell pressure. As the cell pressure increases, the pump flow rate increases because the pump flow rate is a function of the base vacuum pressure. The exact pressure at which this happens depends on the orifice size, the pressure set point, and the type of vacuum pump.

Figure 16 is the plumbing diagram for the Back Control Flow System.

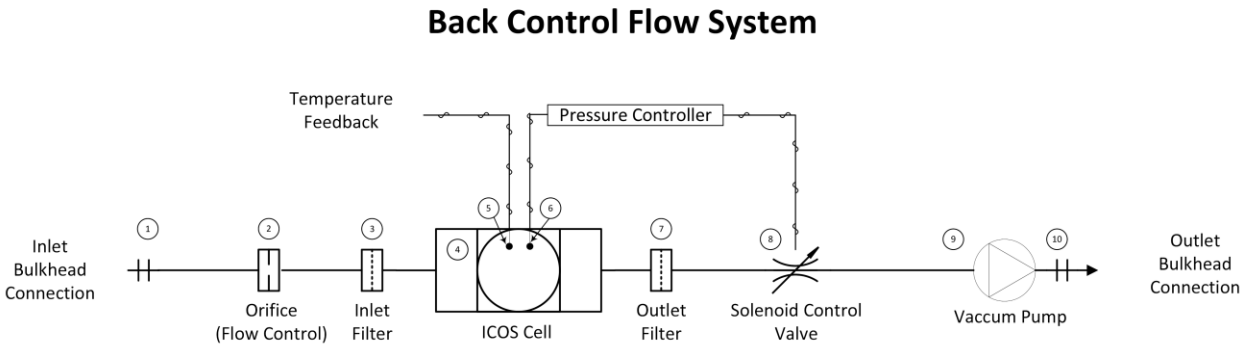

Figure 16: Back Control Flow System

Environmental Controls for Storage

The analyzer requires specific transportation to maintain tool integrity. The requirements for tool transportation from the ABB site to the customer's location are as follows:

- Humidity control range from 10% to 80% with no condensation.
- To prevent condensation, the analyzer must be stabilized to room temperature before opening any of the bags. The length of time required to stabilize it depends upon the temperature of the analyzer upon receipt.
- The analyzer (in or out of the crate) must be stored out of the weather, preferably in a temperature-controlled environment.
    - Between –40 °C and 70 °C.
- It is recommended that the shipping box be stored for future transportation.

Installation

Visually inspect the shipping box for damages caused by shipping.

Place the box where the temperature is similar to that of the analyzer's place of operation.

- When unboxing the analyzer, allow time for the analyzer's internal temperature to match the temperature inside the enclosed area to prevent condensation from forming on the surface when removing the protective bags.

Shipping Package Removal

Tools required for package removal:

- Box Cutter
- Wheeled table or cart capable of carrying no less than 45 kg
- ESD wrist grounding strap

Follow the steps below to unpack the analyzer:

1. Cut the shipping tape from the top of the box carton.
2. Remove the top shipping foam from inside the box.
3. Position the wheeled table or cart next to the opened box.
4. Using 2 persons, carefully lift the analyzer from its shipping box to the wheeled table.
5. Remove the plastic covering from the gas analyzer.
6. Move the analyzer to the location to be installed.

Gas Analyzer Mounting & Facilitation

1. Connect the facility communication lines to the back panel of the analyzer. (Figure 15)
2. Do not connect the sample gas line to the gas inlet port at this time.

There is no rear USB communication port. All USB communication ports are on the front panel of the analyzer.

All cables connected to the IO ports at the rear panel should be shielded. For both the Ethernet and Modbus cables, it is recommended to use double-shielded Category 6 S/FTP or SF/UTP type cable. Shielding of communication cable is required to suppress possible radiated and conductive interference affecting the electronics function.

System Power Up & Communication Checks

For GLA231 927T model analyzers:

1. Unscrew the plugs on the *Sample Gas Inlet* port and the *Internal Pump Exhaust* port located on the back panel of the analyzer. (Figure 11) Store the plugs for future use should the analyzer be moved to a new location.
2. For GLA231 927S model gas analyzers, attach the supplied external exhaust pump inlet through a vacuum line to the TO EXT. PUMP port on the back panel of the analyzer. (Figure 11)
    a. The line size is 0.375 in (9.525 mm) tube Swagelok. The inlet is marked by the arrow symbol on top of the pump pointing in the direction of the airflow it will be drawing in and exhausting out.
    b. Attach the exhaust pump exhaust line to the facility exhaust port.
3. If applicable, connect a keyboard and mouse to the USB port on the front panel of the analyzer. (Figure 10)
4. If applicable, connect a monitor VGA cable to the Video port on the back panel of the analyzer. (Figure 11)
5. Power the analyzer on, using the **On/Off** switch on the front panel of the analyzer. (Figure 10)
6. The internal computer initializes, and a screen displays as the program loads. (Figure 17)

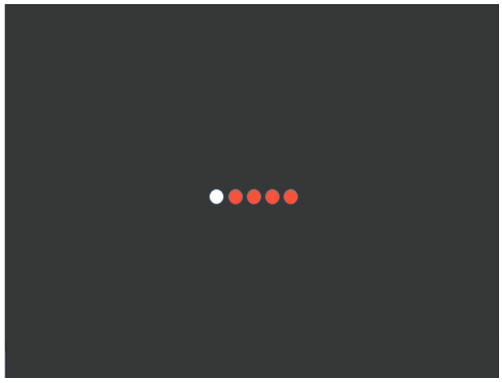

Figure 17: Program Loading Screen

7. After the software completes the booting sequence, the *Main Display* screen will appear. (Figure 20)
8. In the *Main Display* menu, tap on the **Numeric Display** icon. (Figure 20)
9. Below the *Numeric Display*, the warning/alarm indicator shows green, indicating there is no operational issue. (Figure 29)
10. The Gas Pressure reading (Torr) on the *Numeric Display* screen should be similar to the Gas Pressure value recorded in the data package. Figure 18 shows an example of the Gas Pressure reading.

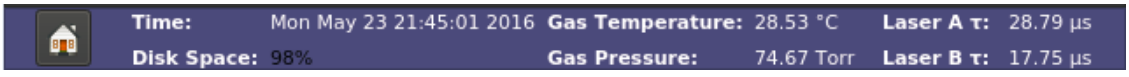

Figure 18: Gas Pressure reading on the HMI Dashboard

11. Connect the facility exhaust gas line to the Internal Pump Exhaust port. The exhaust line should draw a minimum of 3.0 SLPM.

12. Open the valve (if applicable) to the sample gas line. The concentration of the sample gas will be displayed.
13. If disconnecting the monitor, keyboard and mouse:
    a. Exit the operating software by selecting the **Exit** icon on the main display.
    b. Select **Yes** when the analyzer prompts the "*Do you wish to Shutdown*?" message.
    c. The "*You may turn off the Analyzer now"* message will appear.
    d. Press the **On/Off** switch on the analyzer front panel to the **Off** position.
    e. Disconnect the monitor's VGA cable from the back panel of the analyzer.
    f. Disconnect the keyboard and mouse from the USB ports on the front of the analyzer.

NOTE

Failure to follow the exit sequence before disconnecting the keyboard and mouse may lock up the software.

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14. Connect the 4-20 mA gas concentration cable, Modbus connector, and/or Ethernet line to their respective ports on the analyzer back panel.
    a. The 4-20 mA setup is a passive circuit requiring the customer to supply +12 to +24 V DC to the gas concentration contacts at the rear of the analyzer. Figure 19 shows the 4-20 mA Passive Circuit Connection Diagram.

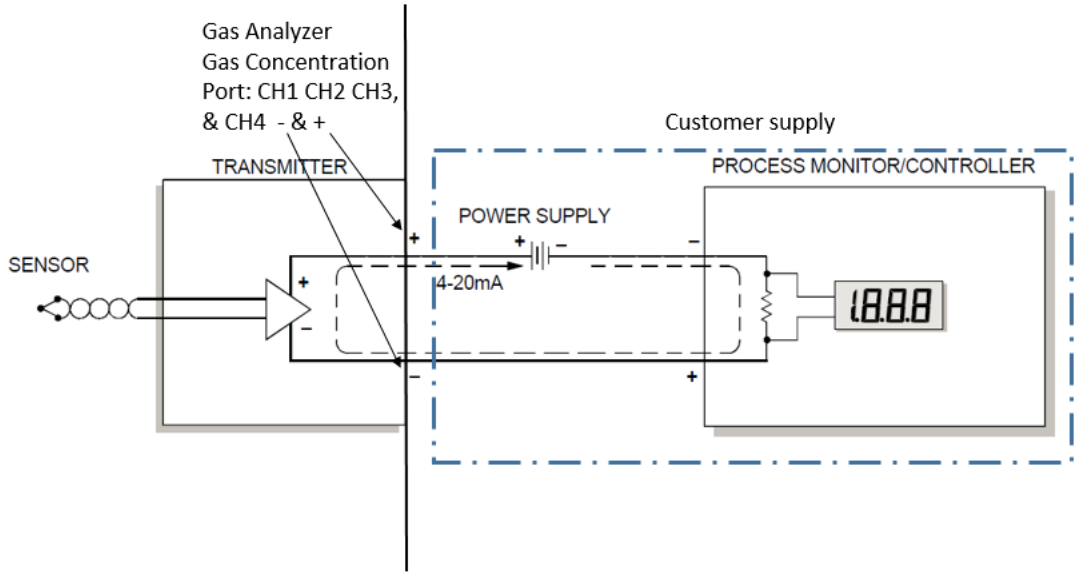

Figure 19: 4-20mA Passive Circuit Connection Diagram

15. Reboot the analyzer to take gas measurements.

User Interface Operation

The *User Interface* screen displays gas concentrations and shuts down the software during system power down.

A second VGA port is provided on the analyzer back panel. With the VGA monitor connected to the VGA port, menus to be utilized include:

- Display screens
- Data sampling rate
- Data transfer
- System calibration
- Main Display

In the *Main Display* screen, available icons let you select the type of displays and setup features. The *Main Display* screen icons include: (Figure 20)

- **Spectra Chart** -- shows the spectrum of the laser. (Figure 23)
- **Time Series** -- provides the absorption of the sample gas measured. (Figure 28)
- **Numeric Display** -- shows the numeric readout of the last measurement. (Figure 29)
- **Alarm Status** -- shows the operational status of the analyzer. (Figure 30)
- **Setup Tools** – access additional configuration and service menus.
- **Exit** – exits the application and shuts down the analyzer.

Main Display Screen

After the program loads, the *Main Display* screen will appear. (Figure 20)

From this screen you can:

- Measure data in several different formats
- View system alarms
- Configure the external communication interface

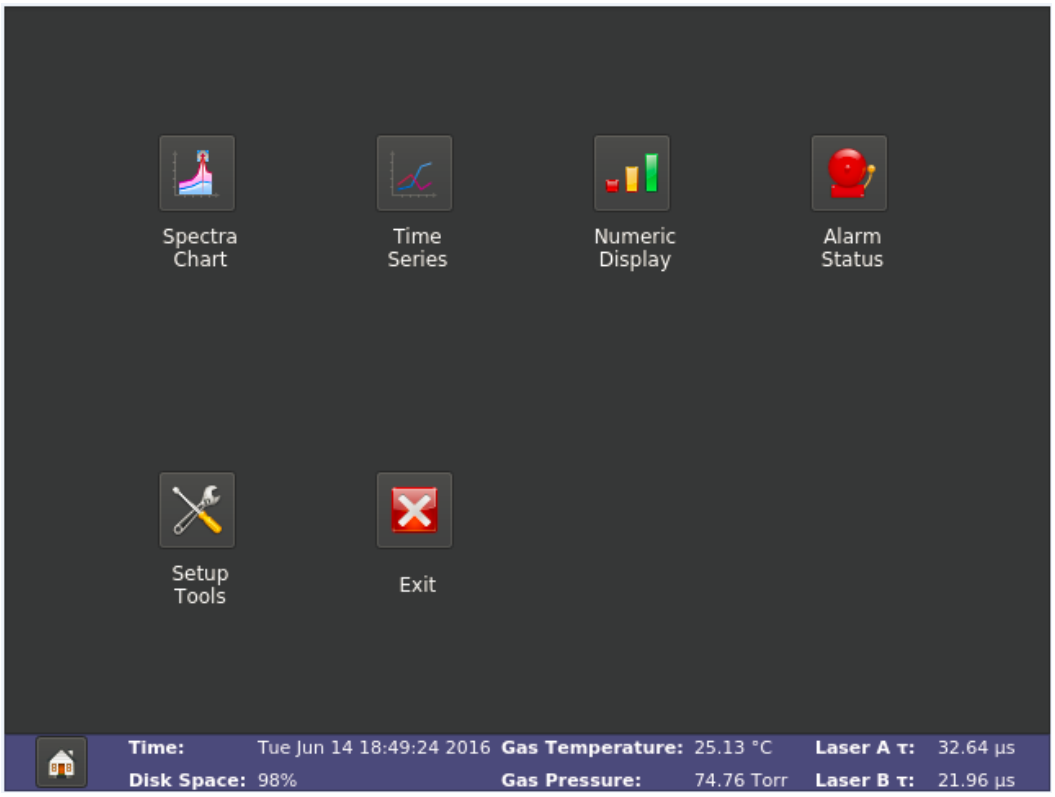

Figure 20: Main Display Screen

HMI Dashboard

The *HMI Dashboard* is located on the bottom panel of the *Main Display* screen. It displays the current operating parameters of the analyzer. (Figure 21)

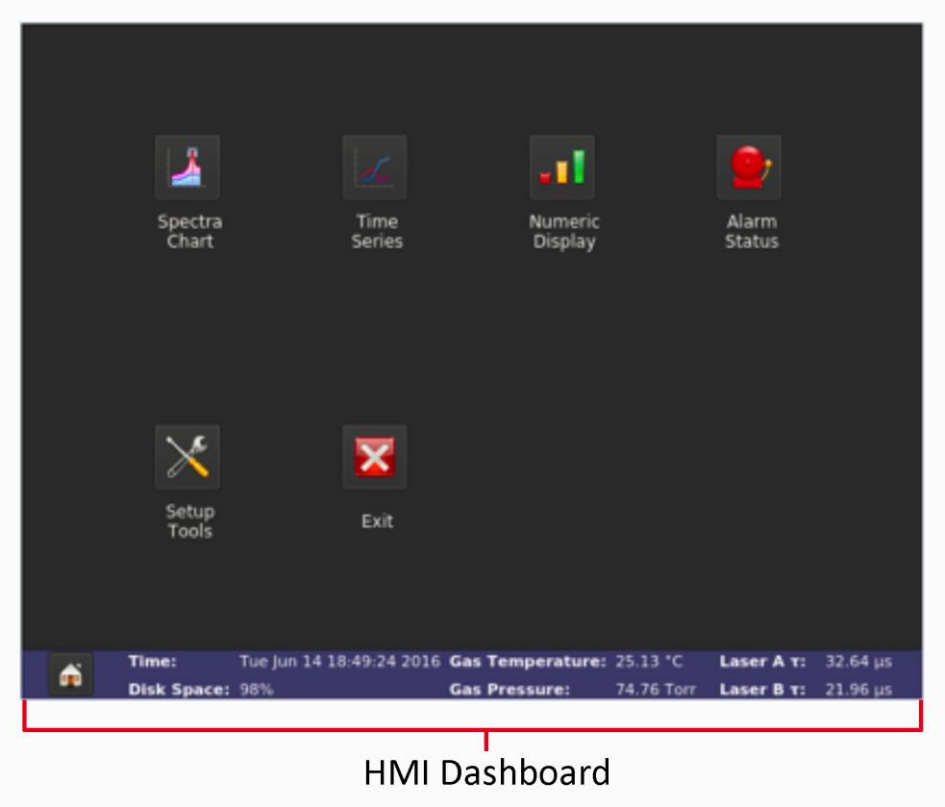

Figure 21: HMI Dashboard on the Main Panel

The Parameter Window displays the:

- Time – Current time
- Disk Space – Remaining hard-drive space
- Gas Temperature – Temperature in Cell (Celsius - °C)
- Gas Pressure – Pressure in Cell (Torr)
- Laser A τ – Laser A ringdown time (micro-seconds - µs)
- Laser B τ – Laser B ringdown time (micro-seconds - µs)

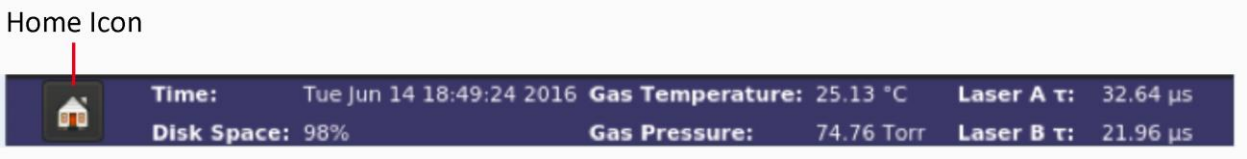

Figure 22: HMI Dashboard

NOTE

Tapping the Home icon on the left side of the *HMI Dashboard* will return the software application to the *Main Display* screen.

Spectra Chart Display

The *Spectra Chart* display shows the spectrum of the laser.

The top plot shows the voltage from the photo-detector as the laser scans across the absorption features.

The bottom plot shows the corresponding optical absorption, and the peak fit resulting from signal analysis.

GLA231-HFHC Performance Rackmount Hydrogen Fluoride / Hydrogen Chloride Analyzer

For example, Figure 23 and Figure 24 show the *Spectra Chart* display for the GLA231-HFHC. The GLA231-HFHC is a dual-laser system. The drop-down selector in the lower right portion of the *Spectra Chart* display lets you toggle between the two lasers:

- Laser 1 (also referred to as laser A) displays HF and H_2O peaks.
- Laser 2 (also referred to as laser B) displays HCl and H_2O peaks.

The measured HF and HCl concentrations are shown in parts per billion (ppb) and H_2O in parts per million (ppm) on the bottom of the *Spectra Chart* display.

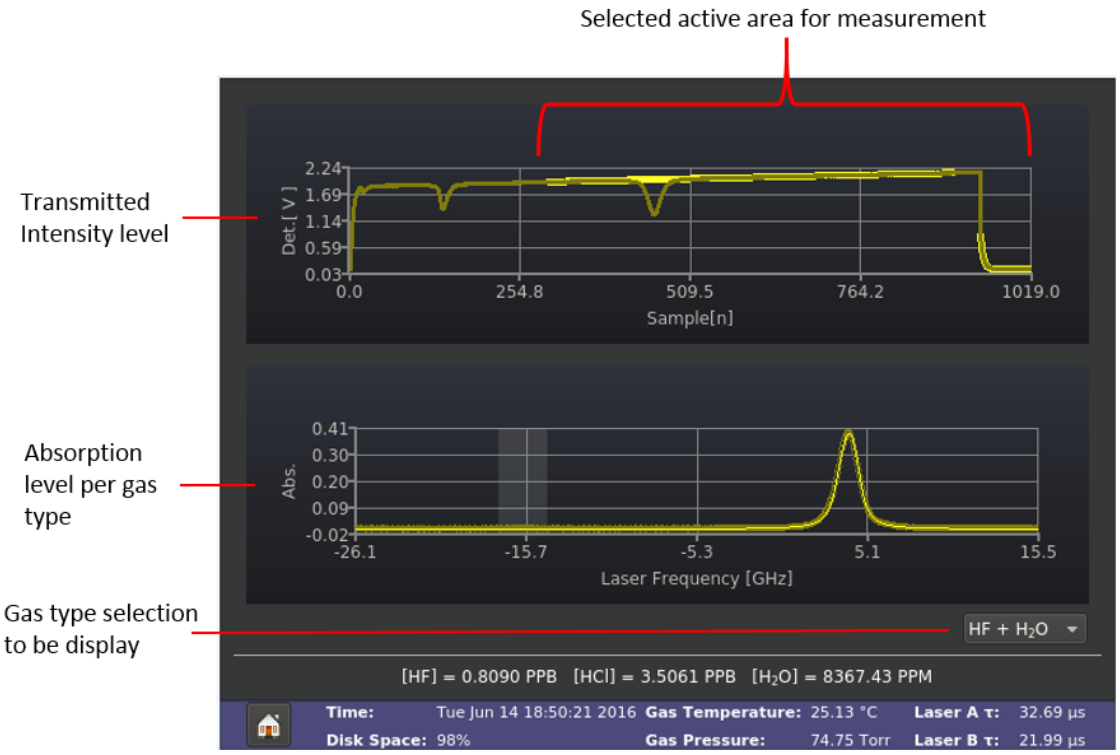

Figure 23: Spectra Chart Display for Laser 1 (GLA231-HFHC)

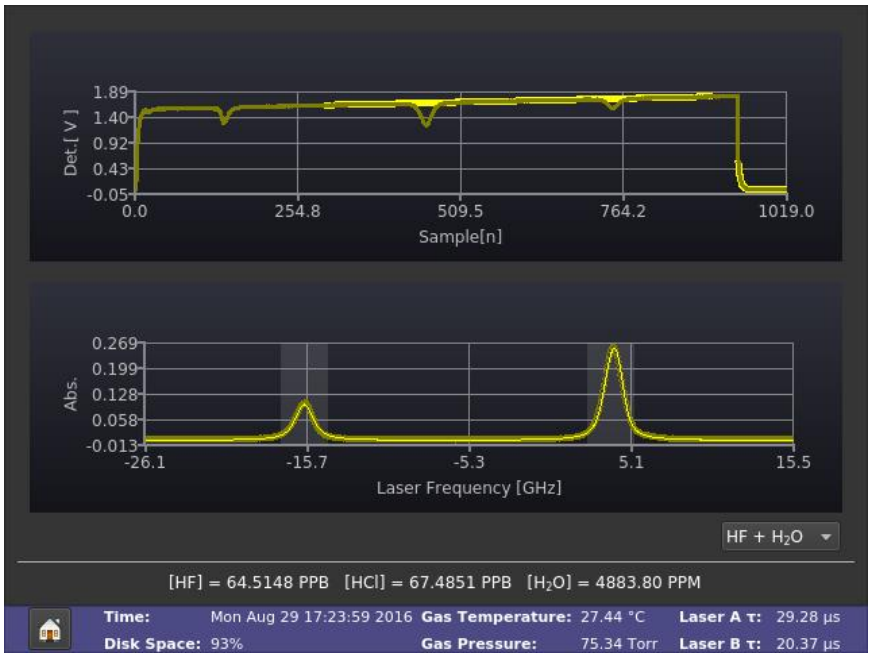

Figure 24: Spectra Chart Display for Laser 2 (GLA231-HFHC)

GLA231-EAA Performance Rackmount Ammonia Analyzer

Figure 25 shows the *Spectra Chart* display for the GLA231-EAA. The measured NH_3 concentration is shown in parts per billion (ppb) and H_2O in parts per million (ppm) on the bottom of the *Spectra Chart* display.

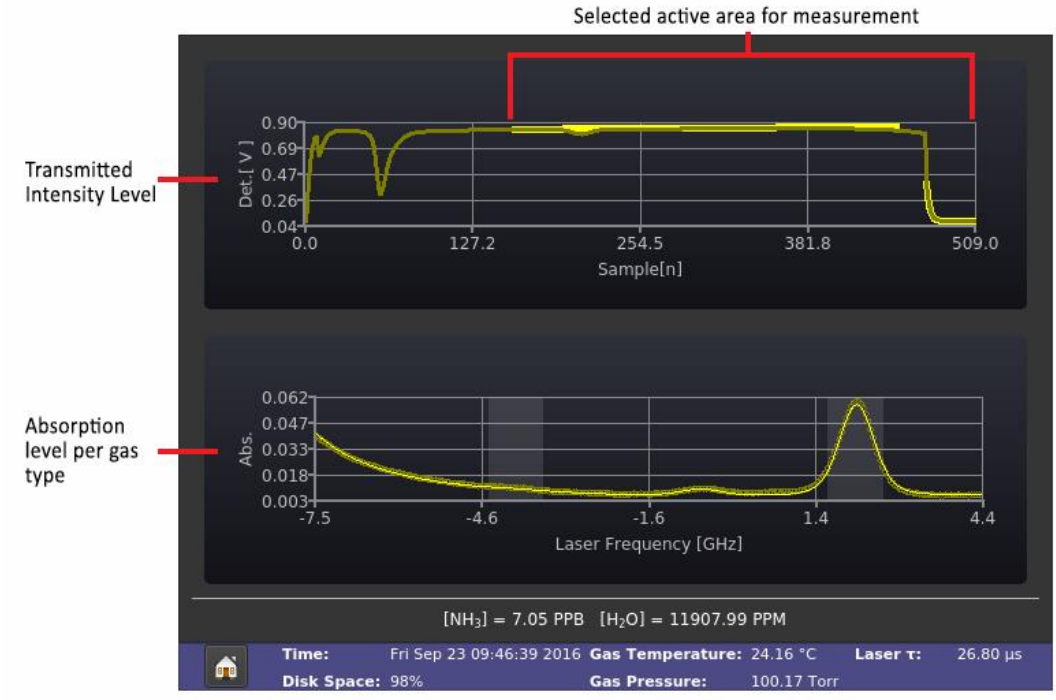

Figure 25: Spectra Chart Display for Laser 1 (GLA231-EAA)

GLA231-GGA Performance Rackmount Methane/Carbon Dioxide Analyzer

Figure 26 shows the *Spectra Chart* display for the GLA231-GGA Laser 1. The measured CH_4 concentration is shown in parts per million (ppm) and H_2O in ppm on the bottom of the *Spectra Chart* display.

Figure 27 shows the *Spectra Chart* display for the GLA231-GGA Laser 2. The measured CO_2 concentration is shown in ppm and H_2O in ppm on the bottom of the *Spectra Chart* display.

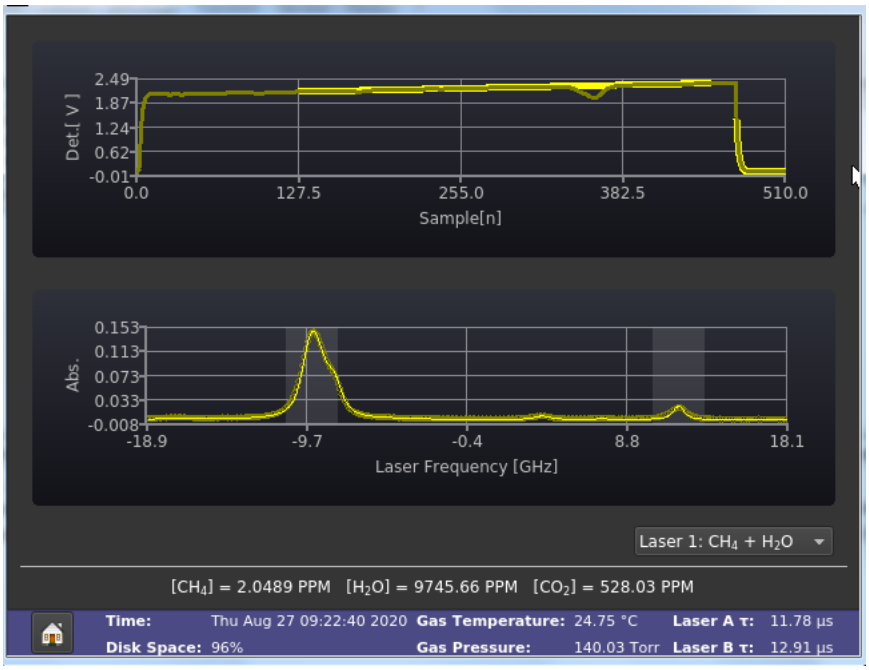

Figure 26: Spectra Chart Display for Laser 1 (GLA231-GGA)

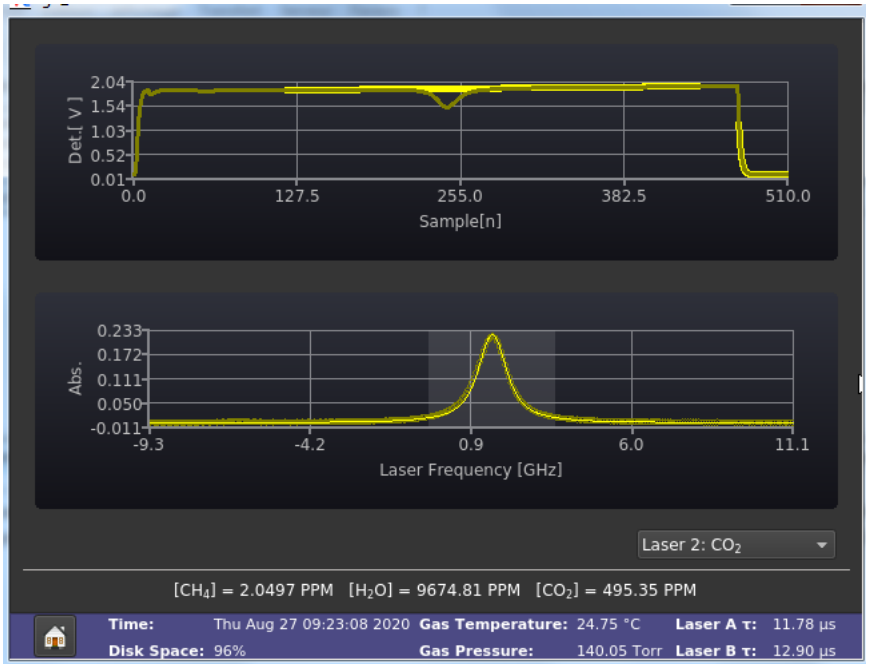

Figure 27: Spectra Chart Display for Laser 2 (GLA231-GGA)

Time Series Display

The *Time Series* display provides the absorption (in ppm or ppb) of the sample gas measured. Each dot represents a measured level at a customizable interval rate. (Figure 28)

Click on the **drop-down box** in the lower-right corner of either window to change displays of gas concentrations and to adjust the number of significant figures.

Figure 28 shows an example of the *Time Series* for the GLA231-HFHC with a flow of H_2O.

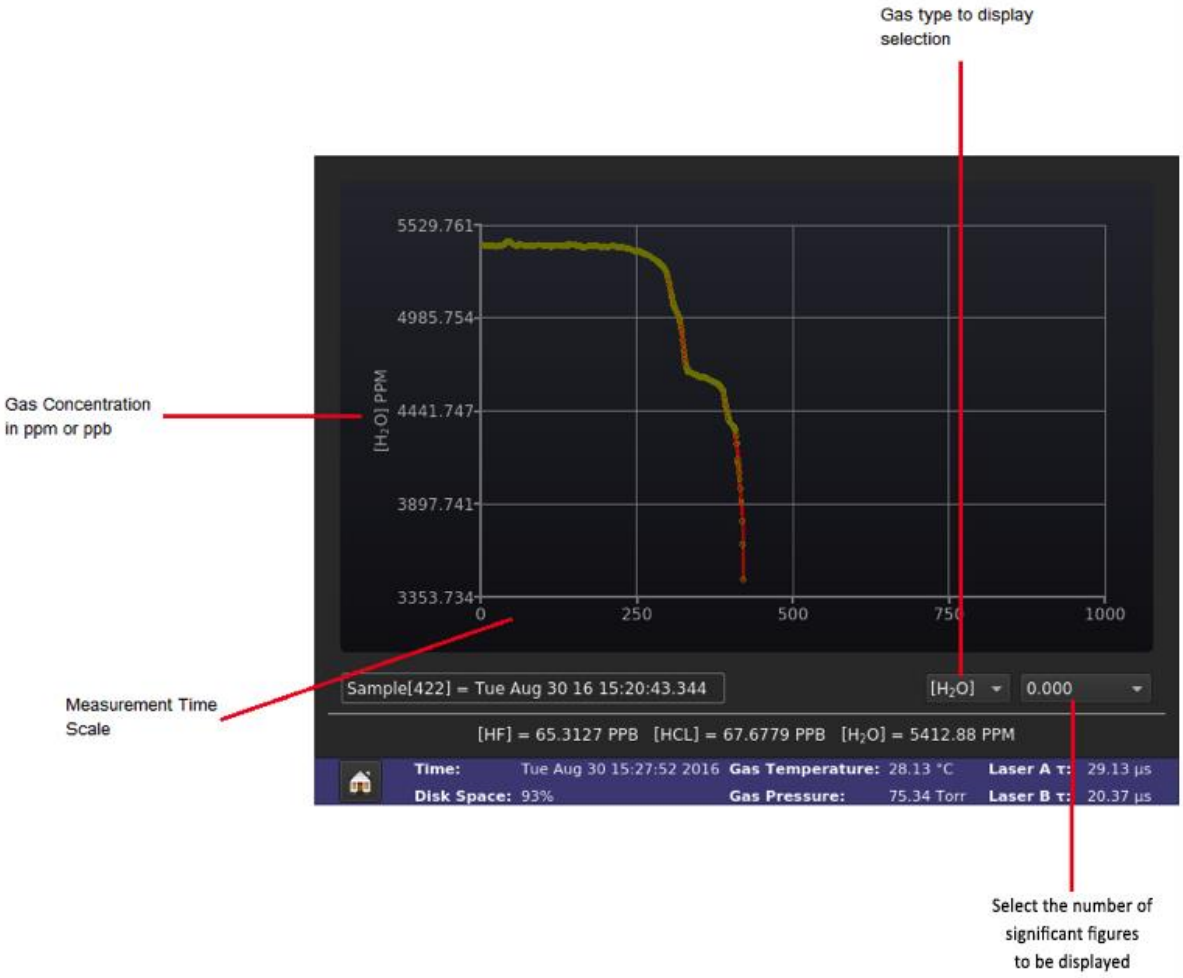

Figure 28: Time Series Display

Numeric Display

The *Numeric Display* shows the numeric readout of the last measurement of gas at a specific concentration. Sample gases are measured in parts per million (ppm) and parts per billion (ppb). Concentrations vary depending on the type of analyzer.

Figure 29 shows an example of the *Numeric Display* measuring three gas samples.

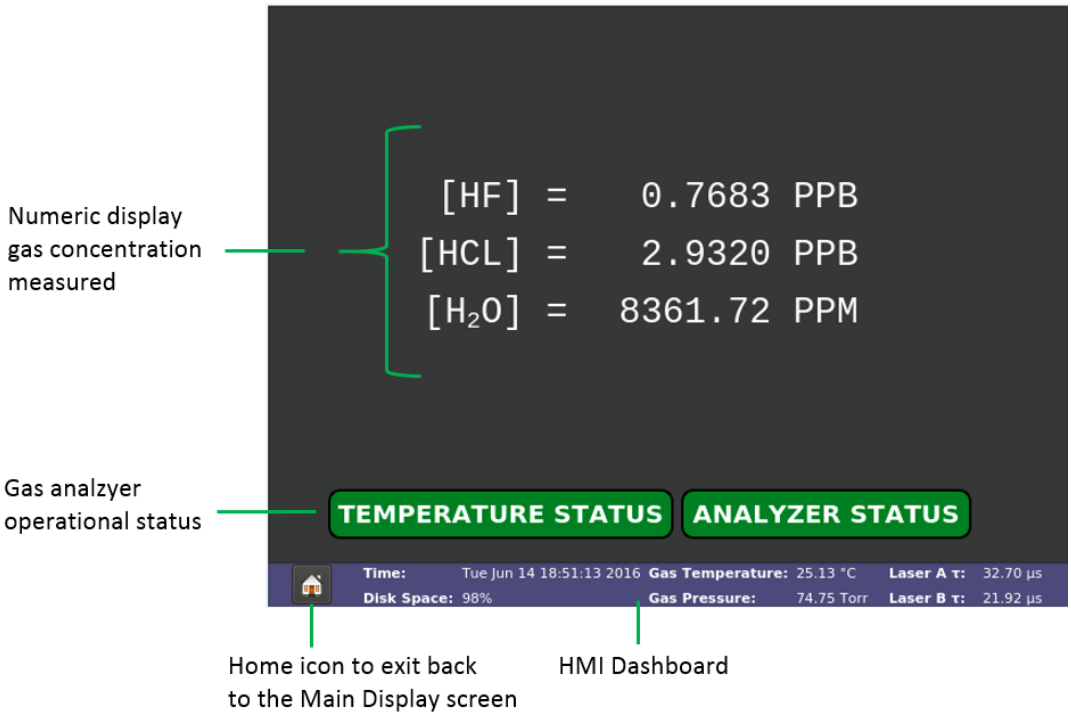

Figure 29: Numeric Display Screen

Alarm Status Display

The *Alarm Status* display (Figure 30) shows the operational status of the analyzer. The alarm status is color-coded:

- Green: The analyzer is functioning properly.
- Yellow: The data may not be reliable, or maintenance is required soon.
- Red: The analyzer requires maintenance to correct an identified fault.

A description of the cause of the alarm is displayed by selecting the relevant alarm button.

Figure 30 shows the *Alarm Status* display with all parameters functioning properly.

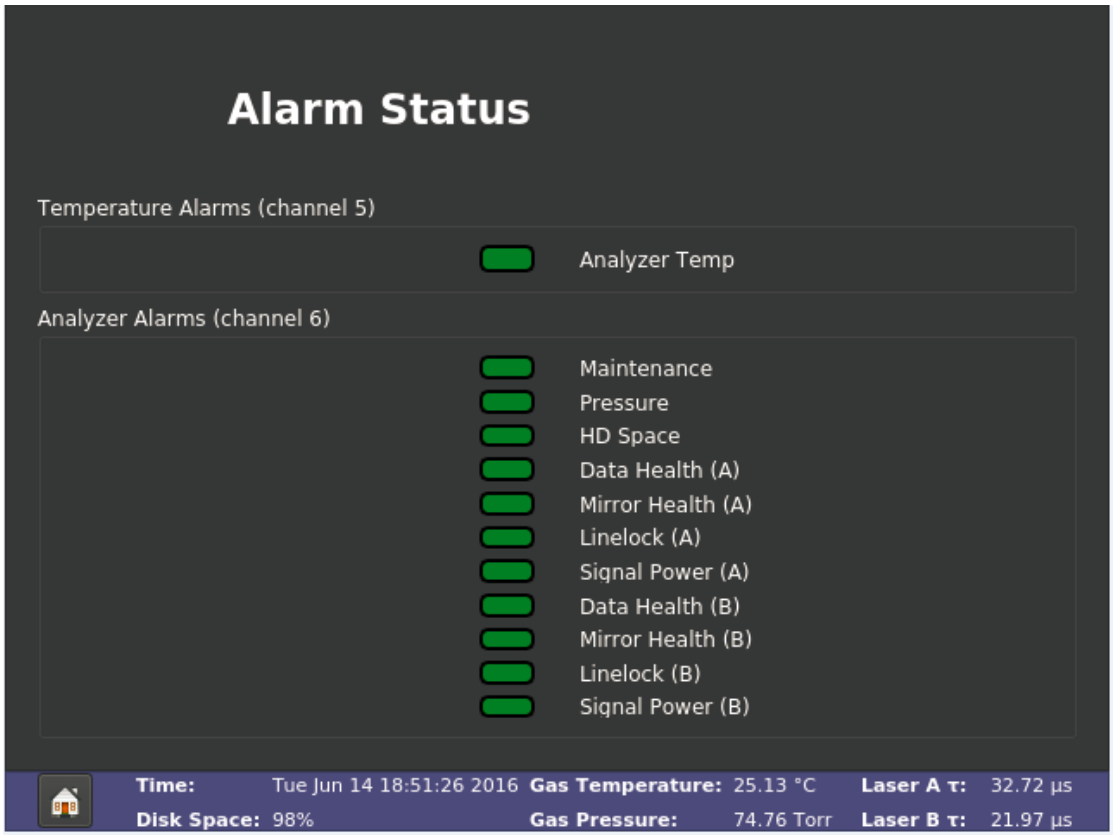

Figure 30: Alarm Status Display

Table 6 describes the fault criteria for the *Temperature Alarms*.

Table 6: Fault Criteria for Temperature Alarms

Status	Sensor Read	Fault Condition	Description
10	Analyzer Temp	Temperature High/Low Alarm	Occurs when analyzer heater temp is > high alarm set point. Occurs when analyzer heater temp is < low alarm set point.
11	**CROSS OVER**		
14	Analyzer Temp	Temperature High/Low Warning	Occurs when analyzer heater temp is > high warning set point. Occurs when analyzer heater temp is < low warning set point.
17	Fault	NaN reading on any temp	Occurs when there is a false or undefined value. (NaN = not a number)
19	**Dead Band**		
20	Acceptable Range	No warning/alarm	No warning/alarm

Table 7 describes fault criteria for the *Analyzer Alarms*.

'A' refers to Laser 1 and 'B' refers to Laser 2. Not all analyzers are equipped with 2 lasers.

Table 7: Fault Criteria for Analyzer Alarms

Status	Sensor Read	Fault Condition	Description
4	Data Health (A/B)	Fit is not optimal	The laser fitting condition is poor. Occurs when fit is no longer working, peaks have been lost, or spectrum is unknown.
5	Pressure	Not within operating range	Occurs when pressure is outside of the operating range.
6	HD Space	Limited hard drive space	Occurs when the internal hard drive has < 10% of space left. Delete unnecessary data files.
7	Mirror Health (A/B)	Mirrors have declined in reflectivity	Occurs when the ringdown time has degraded by > 20% of the factory value. Mirror cleaning is required.
8	Linelock (A/B)	Peak is outside control range	Occurs when linelock control voltage is no longer able to control.
9	Signal Power (A/B)	Signal power has degraded	Occurs when laser signal power has degraded by > 20% of the factory value.
10	Maintenance	Maintenance needed now	Occurs when the analyzer requires maintenance (every 381 days).
11	**CROSS OVER**		
12	Data Health (A/B)	Fit is not optimal	The laser fitting condition is not optimal. Occurs when residuals of fit go above normal operational values.
13	Pressure	Noisy	Occurs when the specified operational pressure is not optimal.
14	HD Space	Low space	Occurs when the internal hard drive has < 20% space left. Delete unnecessary data files.
15	Mirror Health (A/B)	Mirrors have declined in reflectivity	Occurs when the ringdown time has degraded by > 10% of the factory value.
16	Linelock (A/B)	Peak is drifting	Occurs when linelock control voltage is approaching control range limit.
17	Signal Power (A/B)	Signal power is degrading	Occurs when laser signal power has degraded by > 10% of the factory value.

Status	Sensor Read	Fault Condition	Description
18	Maintenance	Maintenance needed soon	Analyzer maintenance will be needed soon (every 360 days).

19	Dead Band		
20	Performance	No warning/alarm	No warning/alarm

Setup Tools Display

The *Setup Tools* display (
Figure 31) contains measurement settings, calibration routine, and external communication. The *Setup Tools* display provides the following options:

- *Time & Files* -- Configure the NTP server to which it is connected. (Figure 32)
- *Laser Adjust* -- Tune the laser wavelength. (Figure 33)
- *Calibrate* -- Calibrate to a local gas standard. (Figure 35)
- *Serial* -- Configure serial communication. (Figure 36)
- *Analog Outputs* -- Set the 4–20 mA output corresponding to the measured gas concentration for each gas type. (Figure 37)
- *Service* -- Update changes made to the analyzer. (Figure 38)
- *MIU* -- An optional accessory that allows automated control of 8 or 16 inlet ports. (Figure 39)
- *About* -- Lists analyzer-specific information. (Figure 40)
- *Measure Rate* -- Changes the rate at which data is written to the log file. (Figure 41)
- *File Transfer* -- Transferring measurement data saved by the analyzer. (Figure 42)

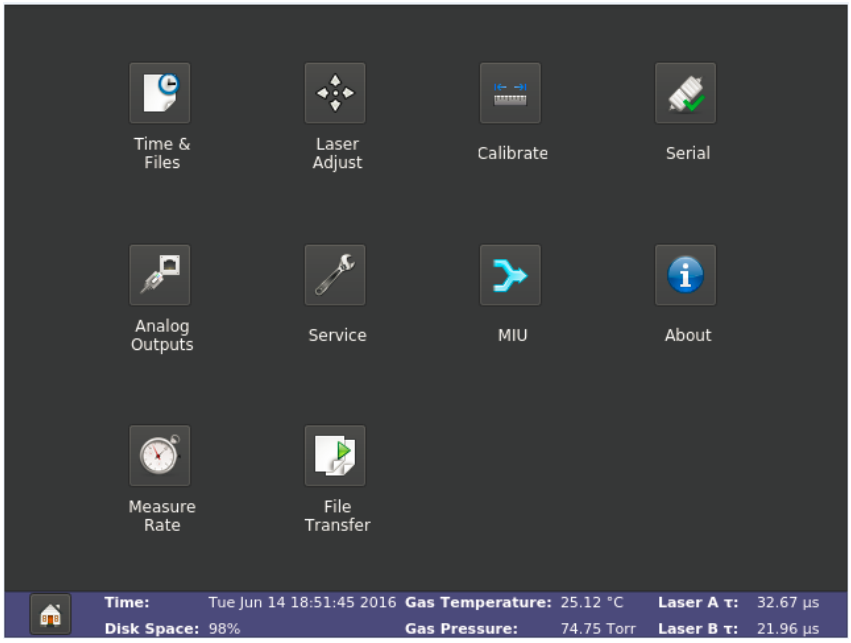

Figure 31: Setup Tools Display

Time & Files

The *Time & Files* screen allows operators to configure the NTP server to which it is connected. This allows for automatic time synchronization. (Figure 32)

The *Set Clock* section lets operators manually adjust:

- Current time and date for the analyzer
- Time zone and daylight savings

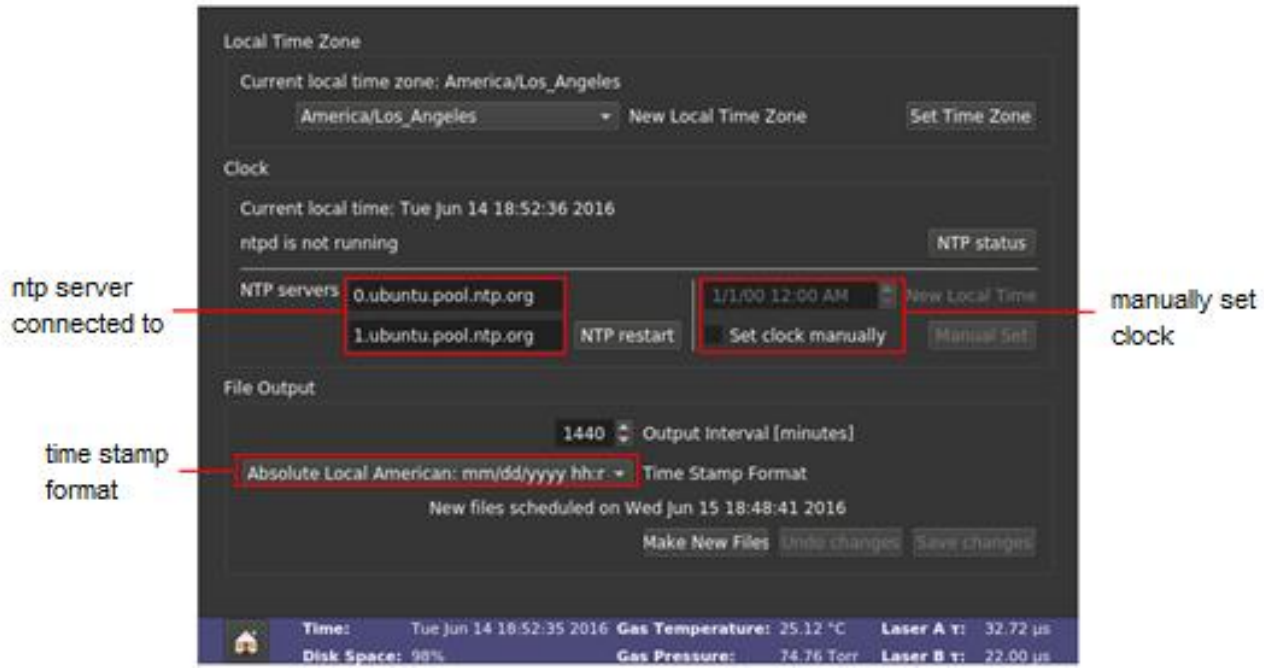

Figure 32: Time/Files Screen

The available time stamp formats are listed in Table 8.

Table 8: Time Stamp Formats

Time Stamp Name	Format
Absolute Local American	mm/dd/yyyy, hh:mm:ss.sss
Absolute Local European	dd/mm/yyyy, hh:mm:ss.sss
Absolute GMT American	mm/dd/yyyy, hh:mm:ss.sss
Absolute GMT European	dd/mm/yyyy, hh:mm:ss.sss
Relative Seconds After Power On	ssssss.sss
Relative Seconds in Hours, Minutes, Seconds	hh:mm:ss.sss

Laser Adjust

The *Laser Adjust* screen allows operators to tune the laser wavelength.

Laser adjustment may be needed for the following reasons:

- The laser's wavelength has drifted beyond the target range of the analyzer.
- The analyzer is operated outside the recommended temperature range.
- The analyzer has been turned on and is operating within a different ambient temperature than the previous shutdown sequence.

In Figure 33, the *Laser Adjust* screen displays the current gas sample measurement intensity profile and the corresponding absorption frequency by dips in the profile. The vertical dotted lines in the same profile screen are the expected target absorption line. When the absorption line is locked into the dip, it is referred to as *Linelock*. If the line and the dip are not aligned, the laser wavelength is modified to have the bottom of the profile dip to center around the dotted line, the theoretical target. To achieve this, the voltage driving the laser temperature is modified to move the laser to the operating wavelength. If the analyzer has two lasers, each laser can be fine-tuned to have the measured absorption in line with the theoretical target.

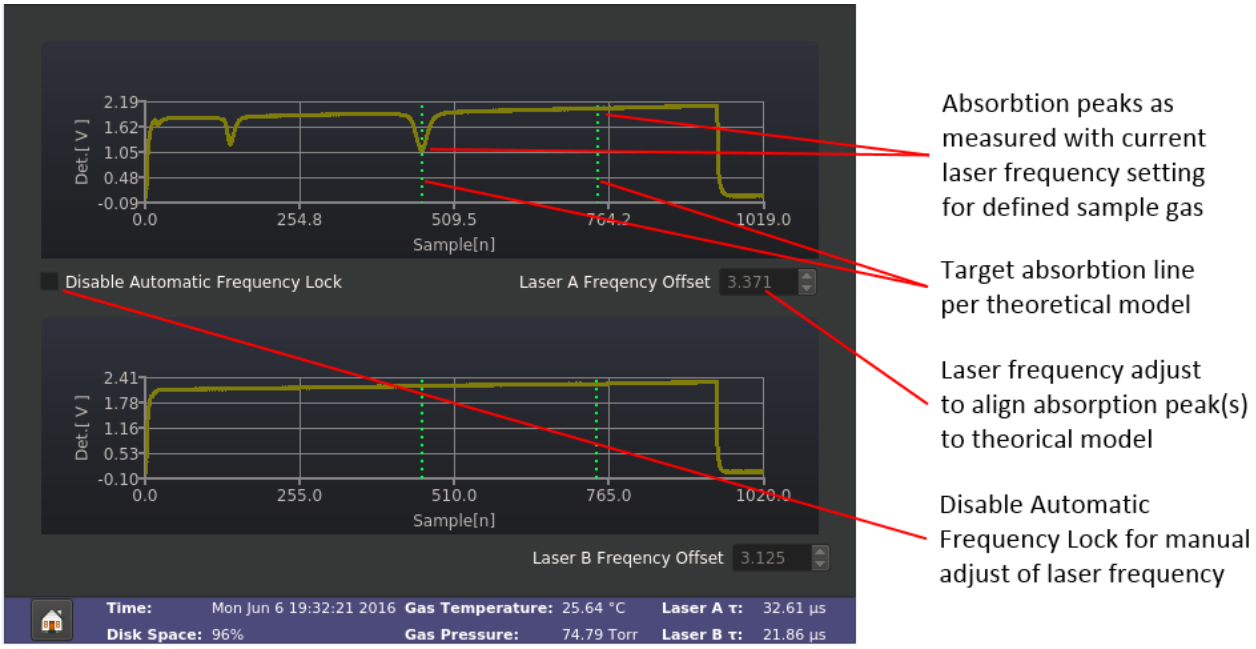

Figure 33: Laser Adjust for Optimizing Measurement Calibration

To adjust the laser wavelength:

1. Select the **Disable Laser Frequency Lock** check box to allow manual control of the laser. (Figure 34)
2. Adjust the *Laser A Frequency Offset*, using the **arrow buttons** to shift the peaks until they are centered on their respective target lines.
    a. Up Arrow: Peaks adjust to the right.
    b. Down Arrow: Peaks adjust to the left.
3. Adjust the *Laser B Frequency Offset*, using the **arrow buttons** to shift the peaks until they are centered on their respective target lines.
    a. Up Arrow: Peaks adjust to the right.
    b. Down Arrow: Peaks adjust to the left.
4. Deselect the **Disable Laser Frequency Lock** check box. The software resumes automatic tracking and control of the laser wavelength.

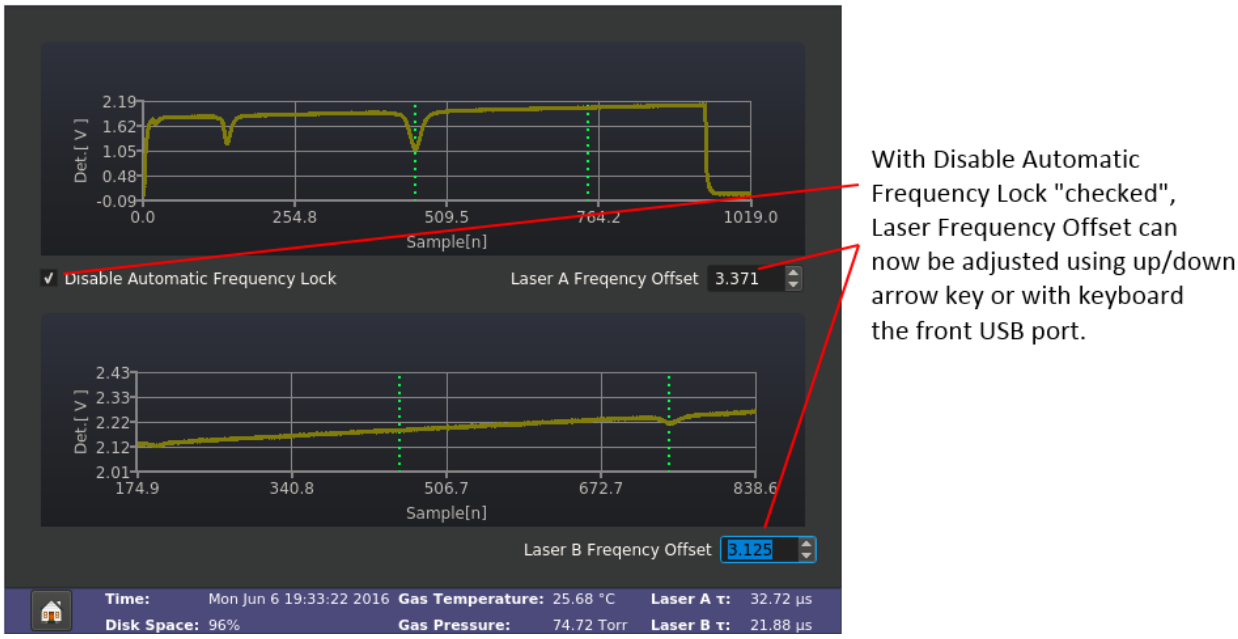

Figure 34: Laser Frequency Offset Adjust

Calibration

ABB recommends periodic referencing rather than calibration to ensure measurement accuracy and consistency. When calibration is necessary, follow the procedure detailed below.

Before performing calibration, have the following information available:

- Traceable regulated gas type
- Known concentration of the gas

To perform a gas calibration:

1. Connect the traceable regulated gas to the analyzer gas inlet line.
2. Select the **Calibrate** icon. (Figure 35)
3. Check the **Calibrate** box in the *Reference Gas Settings* pane.
4. Enter the gas concentration for the gas type listed to the left of the gas concentration entry box.
5. Click **Start** to begin the calibration.
6. Repeat these steps for all gases measured.
7. After calibration is complete, click **OK**. The analyzer will resume its normal measurement mode.
8. Select the **Home** icon to exit the *Calibration* screen.

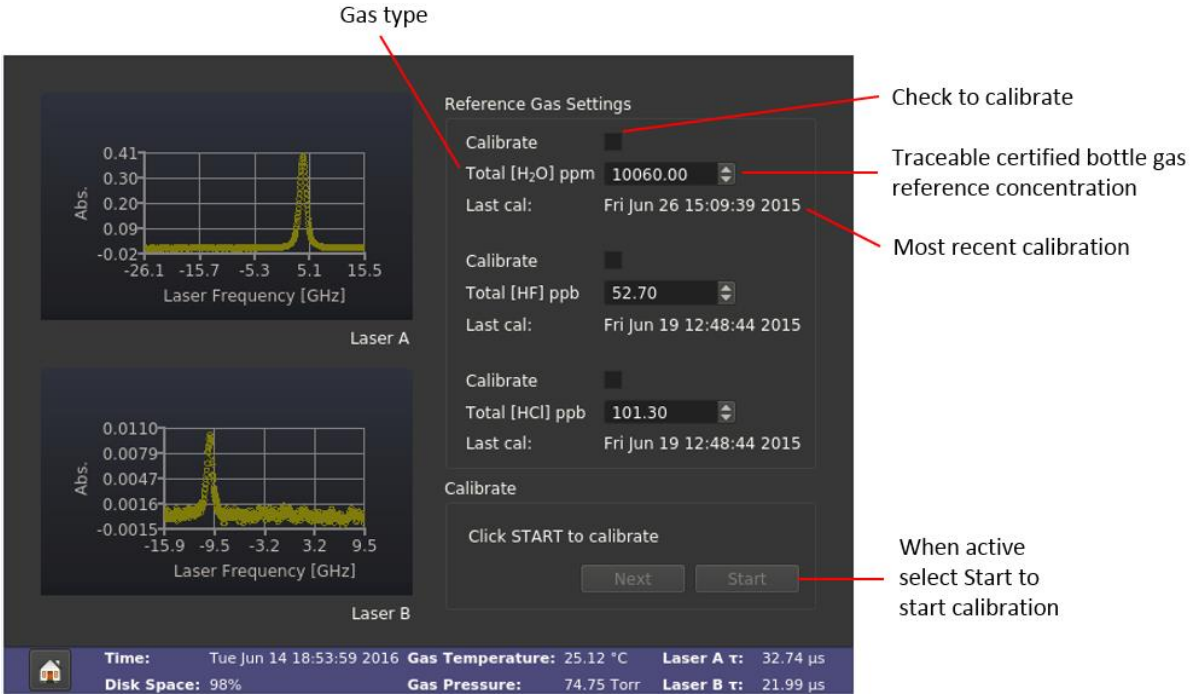

Figure 35: Calibration Screen

Serial Communication

The Serial port is located on the back panel of the analyzer.

Select the **Serial** icon to configure serial communication. The *Serial Output* area lets you adjust the:

- Baud rate
- Parity
- Stop bits

For proper serial communication, the analyzer settings must match the settings of the device that it is connected to. (Figure 36)

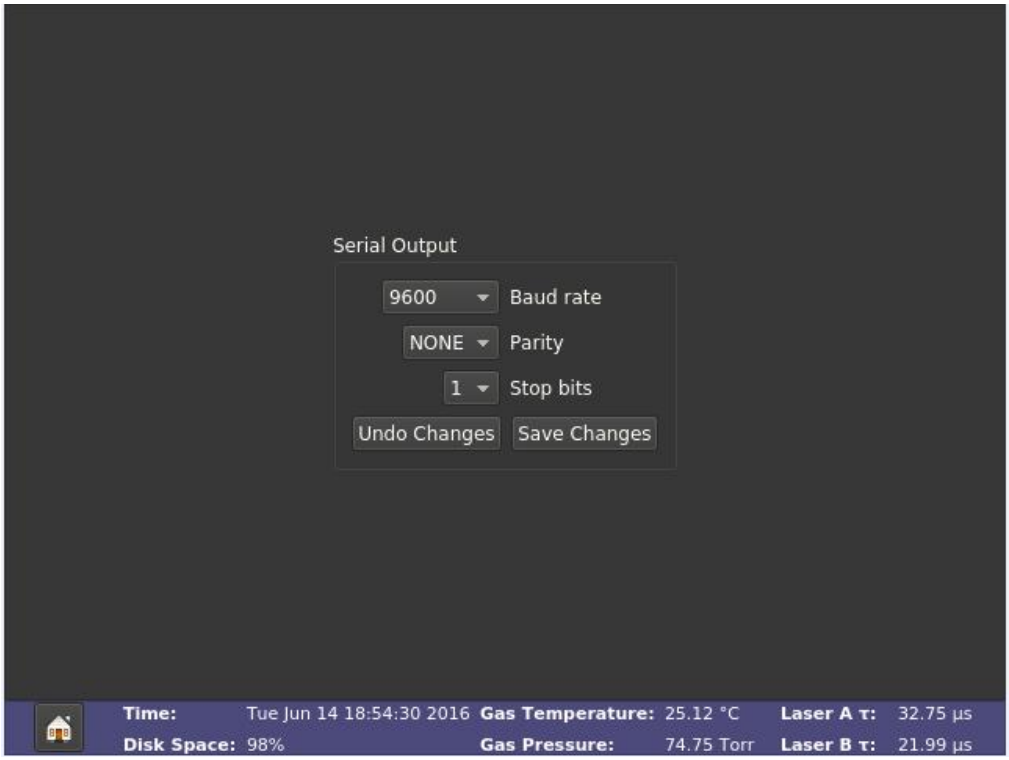

Figure 36: Serial Screen

Analog Outputs

The **Analog Output** icon allows operators to set the 4–20 mA output corresponding to the measured gas concentration for each gas type. The number of available 4–20 mA output adjustable channels is dependent on the analyzer model.

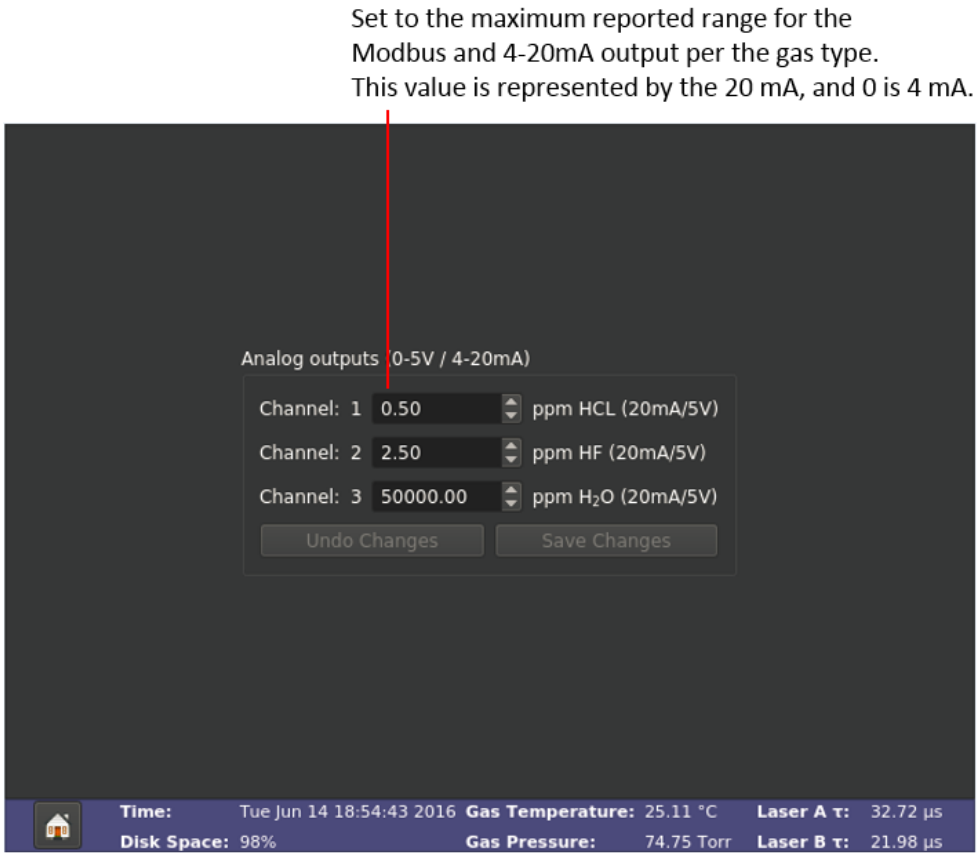

Figure 37: Analog Output Adjustment

The *Analog Out* is a 9-pin D connector located on the analyzer back panel. It provides 0-5 volts voltage level prior to signal conversion to the 4-20 mA format. The 9-pin D Analog Out configuration is listed in Table 9.

Table 9: Analog Out Pin Configuration

Pin Assignment	Analog Out Signal
Pin 1	Gas Concentration #1 +V
Pin 6	Gas Concentration #1 RETURN
Pin 2	Gas Concentration #2 +V
Pin 7	Gas Concentration #2 RETURN
Pin 3	Gas Concentration #3 +V
Pin 8	Gas Concentration #3 RETURN
Pin 4	Gas Concentration #4 +V
Pin 9	Gas Concentration #4 RETURN

Service

The *Service* menu (Figure 38) is only to be modified by ABB-trained field service engineers for updating changes made to the analyzer.

- These settings determine the level of change that could affect measurement performance.
- The alarm threshold levels are set based upon the last fixed setting.

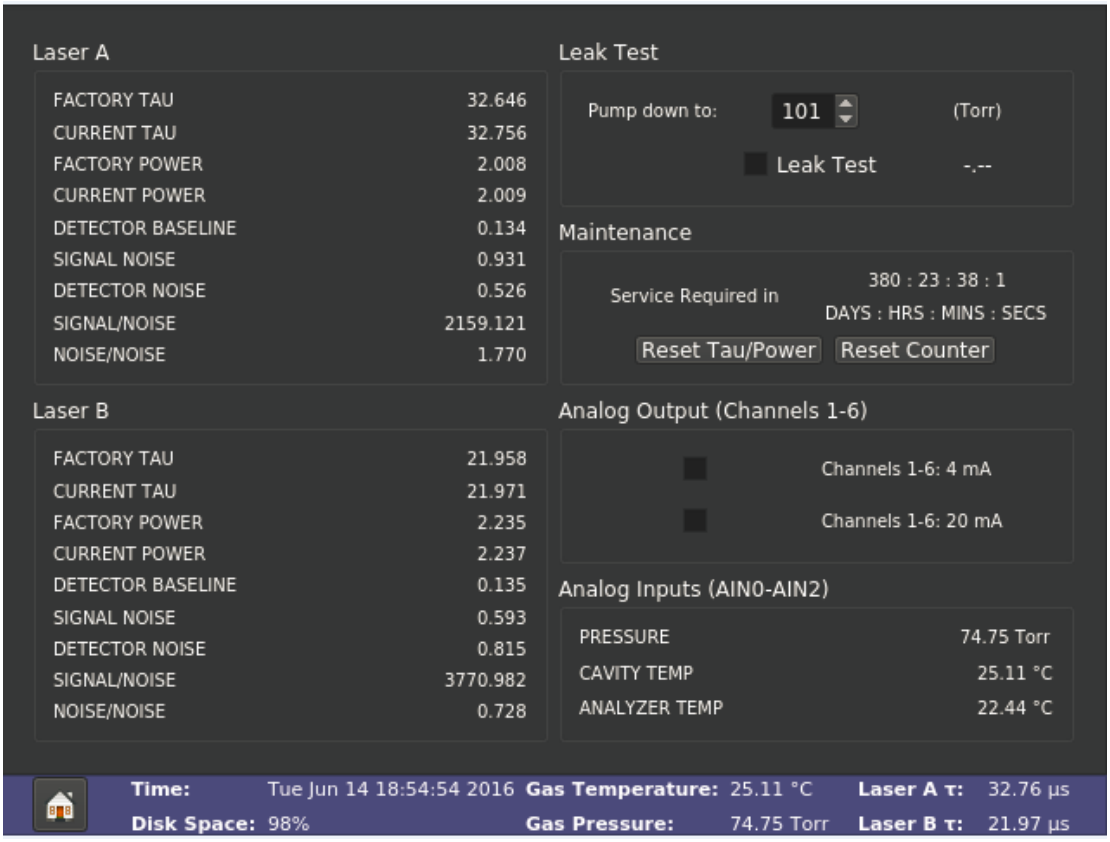

Figure 38: Service Menu Screen

MIU Application

The (optional) *Multi-Port Inlet Unit* (MIU) is an accessory that allows automated control of 8 or 16 inlet ports (depending on the ordered configuration). These ports are directed to the inlet port of the analyzer for sampling unknown gasses and reference gasses.

The *MIU* menu can be configured to control the duration of each gas being sampled. (Figure 39)

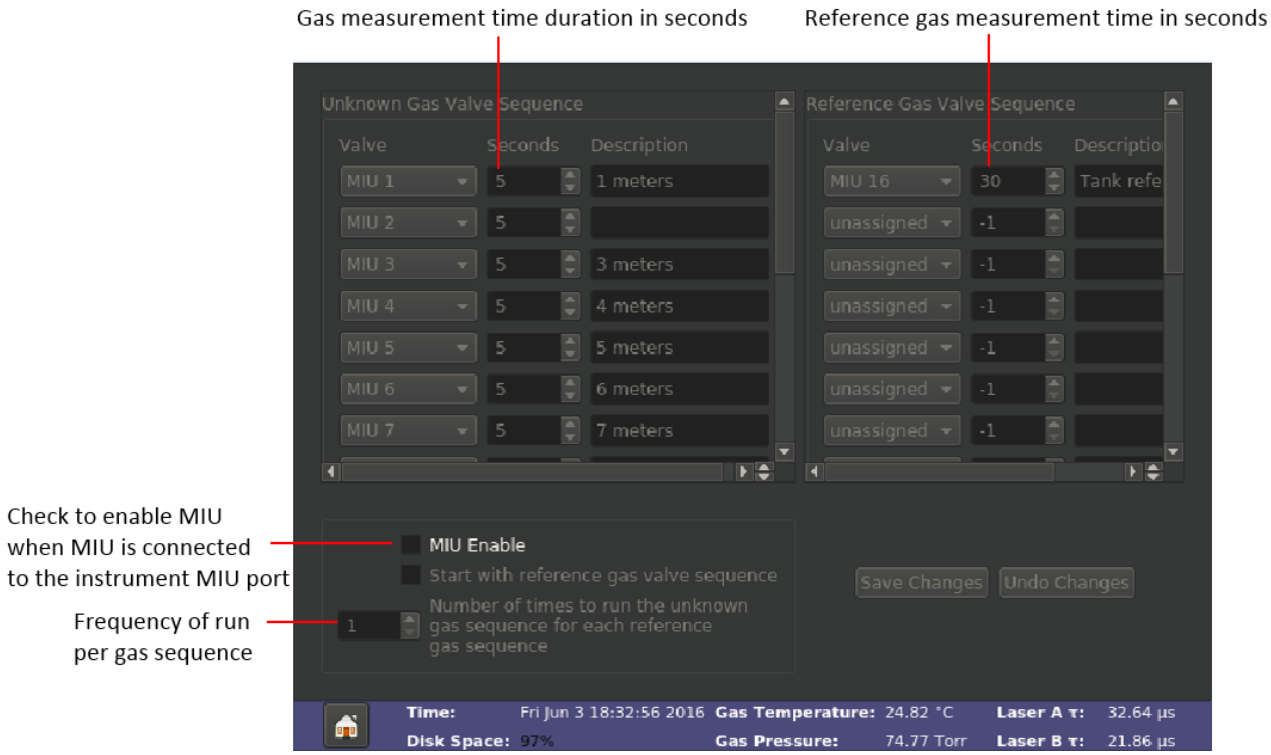

Figure 39: MIU Setup Screen

About

Select the **About** icon to identify analyzer specific information. (Figure 40)

The *About* section displays the:

- Build date of the current software
- Serial number of the analyzer
- IP address
- Version of the code

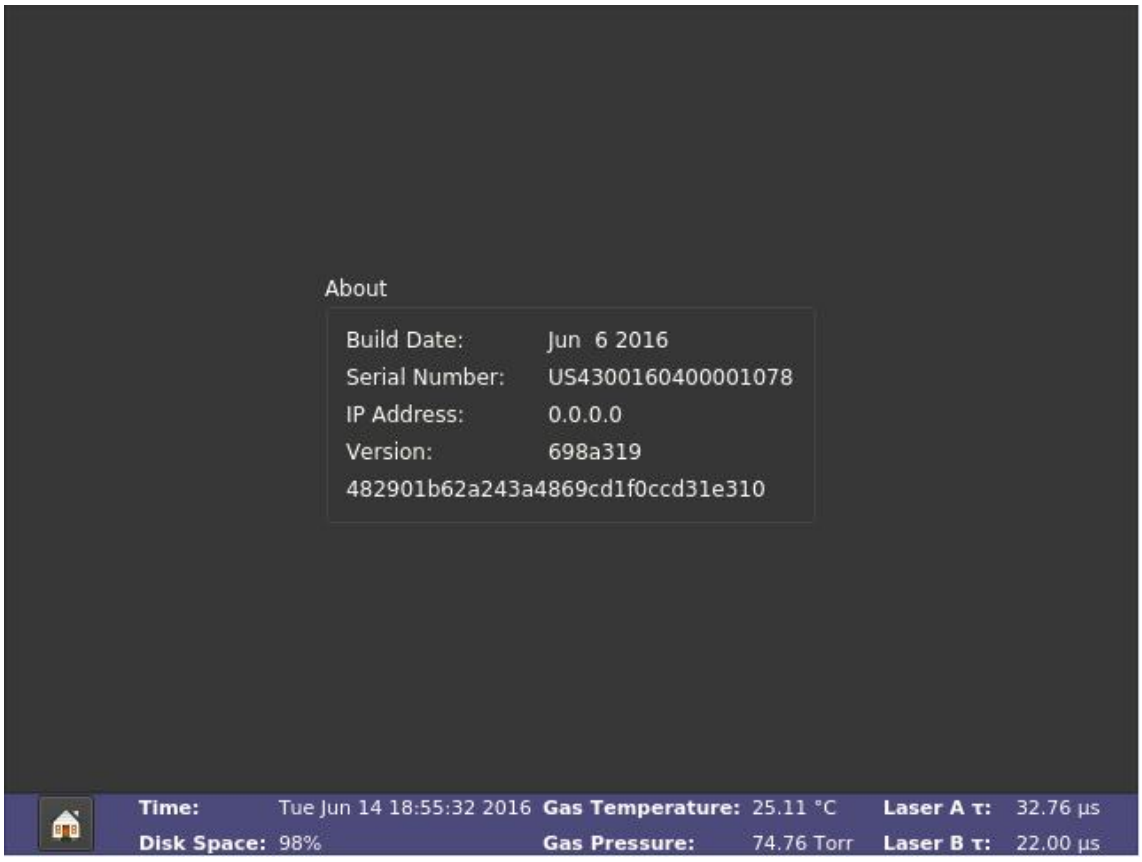

Figure 40: About Screen

Measure Rate

Select the **Measure Rate** icon in the *Setup Display* screen to change the rate at which data is written to the log file.

1. Click the **Operating Mode** radio buttons to select the rate at which data is acquired.
2. Click the **Plot on Demand** or **Plot every Nth fit** radio buttons to adjust the plot frequency.
3. Click **Save**.

Figure 41 displays the *Rate Control Adjustment* panel.

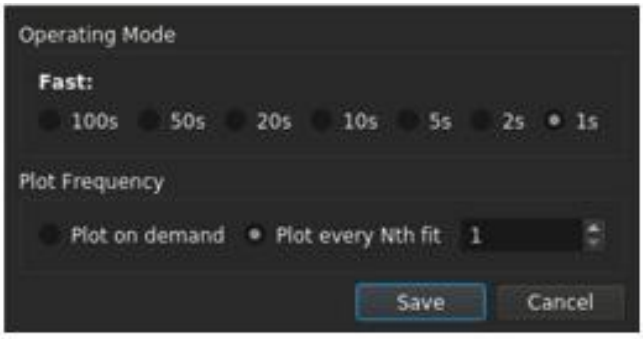

Figure 41: Rate Control Screen

Data is acquired at a rate of 1 Hz and averaged for a selected interval (1 to 100 seconds) before being written into the data file and plotted on the time chart. Longer averaging periods (or equivalently, slower data acquisition rates) yield better measurement precision than shorter averaging periods.

File Transfer

The *File Transfer* menu is used for transferring measurement data saved by the analyzer. Select the **File Transfer** icon in *Setup Tools* to access the *File Transfer* menu.

Whenever the software is launched, the analyzer will automatically create a file name to save the measured data. New file names are automatically generated every 24 hours. The file name is set in the following order:

- The first 6 characters represent the analyzer model.
- The next 10 characters represent the date (yyyy-mm-dd).
- The last set of characters is a serial number, defining the sequence of the data taken.

Data files are written in text (ASCII) format and contain labeled columns displaying:

- The time stamp of each recorded measurement
- Gas concentration
- Cell pressure (Torr)
- Cell temperature (Celsius)
- Ambient temperature (Celsius)
- Ringdown time (microseconds)

Transferring Files

To transfer files, the USB memory stick must be in a FAT32 format before any file is transferred. Once the USB memory stick is properly formatted to receive data files:

1. Install the USB memory stick into the USB port on the front panel of the analyzer. (Figure 15)
2. Click on **Mount USB**. (Figure 42)

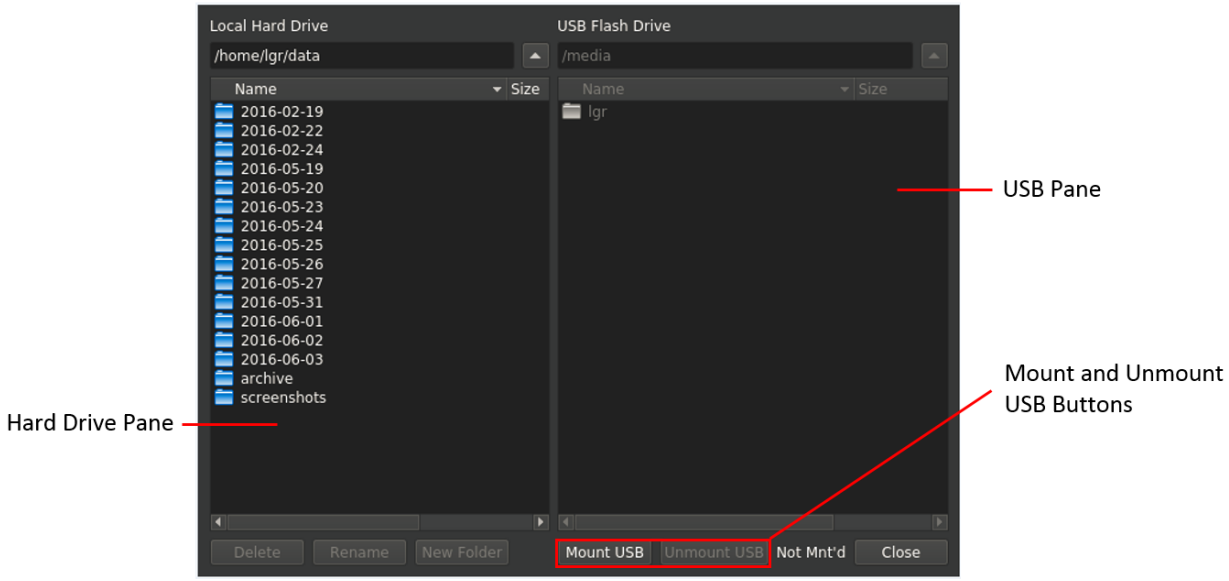

Figure 42: File Transfer Screen

3. Transfer files by dragging them from the Local Hard Drive pane (left) and dropping them to the USB Flash Drive pane (right).
4. Click **Unmount USB** to stop communication with the USB memory stick before removing from the analyzer.
5. Click **Close** to exit the *Data Files screen*.

When the hard drive is showing > 75% full, it is recommended to perform data clean-up. To perform this clean up:

1. Use the touchscreen to highlight the files to be deleted.
2. Select **Delete** on the *File Transfer* screen.

Communications – Data and Alarms

I/O Interfaces

The input/output interfaces on the analyzer back panel include:

- Ethernet (RJ-45)
- Modbus/TCP (RJ-45)- Optional
- 4–20 mA analog out (5.08mm terminal block)
- RS232 serial data in ASCI format
- 9 Pin D Analog Data out
- Multiport Inlet Unit (MIU)- optional accessory

Remote I/O Data Access

Ethernet

The GLA231 Gas Analyzer is designed to run a Linux operating system. Data files stored on the internal hard drive can be accessed via a Windows Share Drive over a local area network (LAN) Ethernet connection. For this feature to work, the analyzer must:

- Be connected to a local area network (LAN) via the RJ-45 Ethernet connection through the cable, located on the left side of the enclosure.
- Receive a response from a Dynamic Host Configuration Protocol (DHCP) request when the analyzer is initialized. If the analyzer does not receive a reply, it will:
    - Disable the Ethernet port
    - Not attempt another DHCP request until the analyzer is restarted

When both conditions are met, the data directory can be accessed using a Windows computer on the same LAN. To access the Windows Share Drive:

1. Select **Start → Run** and enter: \\IP-ADDRESS (IP Address can be found in the *About Panel* shown in Figure 40.)
2. Press **Enter.**
3. After the communication link is established, a Windows Share Drive directory will appear as subdirectory *lgrdata*.
4. Double-click the lgrdata directory to display the data files stored on the internal hard drive.
5. Open or transfer any of the data files.

Additional Notes

The data file that is currently being written can be open during measurement without interrupting the analyzer operation. The current data file is updated occasionally (every four KB of data), so a new data file will appear empty until enough data is collected and written to the disk.

If a LAN is not available, plug the analyzer into a standalone broadband router (such as, Netgear Model RP614) to enable the analyzer to obtain a DHCP address from the router when the analyzer is started. Plug any Windows computer into the same broadband router and access the data directory.

A crossover Ethernet cable will NOT allow an external computer to access the shared data directory, because the analyzer will not obtain a DHCP address on initialization and will shut down its Ethernet interface.

The shared data directory can be accessed from computers running operating systems other than Windows. The analyzer uses a Samba server to share the data directory, which can be accessed by appropriate Samba client applications.

Modbus

A Moxa application CD (P/N: 1112012001031) and associated instructions are shipped with each GLA231 Gas Analyzer in support of the ioLogik E1240 Modbus. This allows users to link and configure the Modbus to their desired format. Modbus outputs are the gas concentration measured signals in ppm or ppb. The Modbus measured gas concentration results are connected to input lines shown in Table 10. Instructions are provided on how to communicate with the Modbus using ioSearch.

Table 10: Modbus Gas Concentration Line Setting

Input Lines	Gas
AI0+	Gas #1 Concentration
AI0–	
AI1+	Gas #2 Concentration
AI1–	
AI2+	Gas #3 Concentration
AI2–	
AI3+	Gas #4 Concentration
AI3–	

Modbus Configuration

To communicate with the *Moxa Modbus* using a computer:

1. Install the *Moxa* application software ioSearch: The connecting computer must have its firewall disabled in order to install ioSearch.
2. Use either a straight-through or cross-over Ethernet cable to link the connecting computer and the Modbus, using the Ethernet port located at the rear panel.
3. Execute the *Moxa* application file *ioSearch*.
4. Upon executing ioSearch, the Auto Search for I/O Servers menu will be displayed. (Figure 43)
5. Select the **Start Search** button to locate the Modbus.

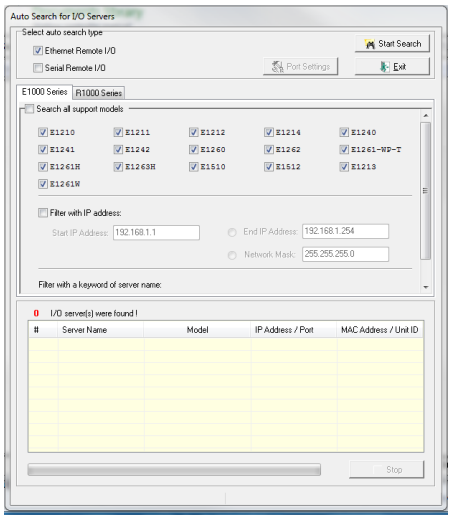

Figure 43: Auto Search for I/O Servers Menu Screen

6. Once the ioLogik Modbus device is located, the following *Remote I/O* menu screen will appear listing the ioLogik devices found. (Figure 44)

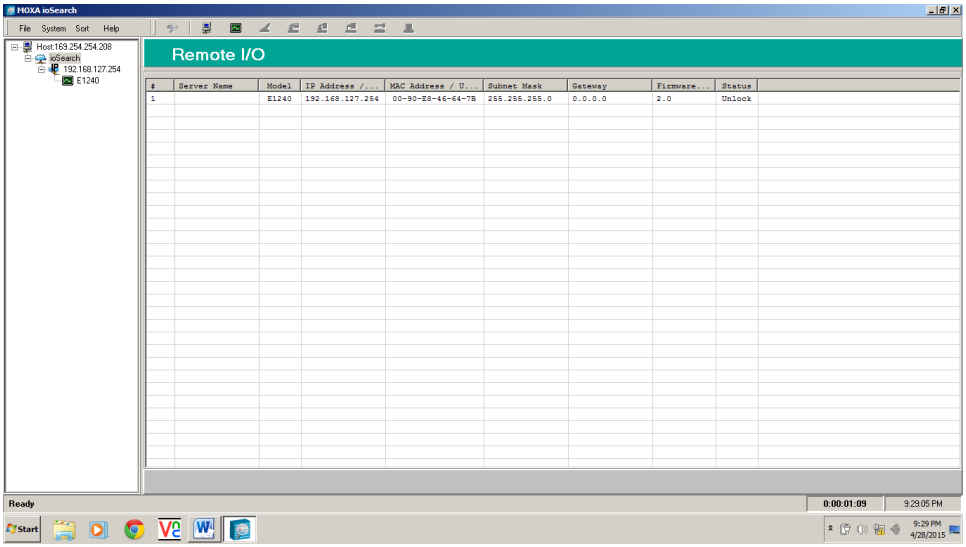

Figure 44: Remote I/O Menu Screen

7. Select **E1240** on the left side tree. The *web console* appears with the preset parameters currently loaded into the ioLogik Modbus device. (Figure 45)

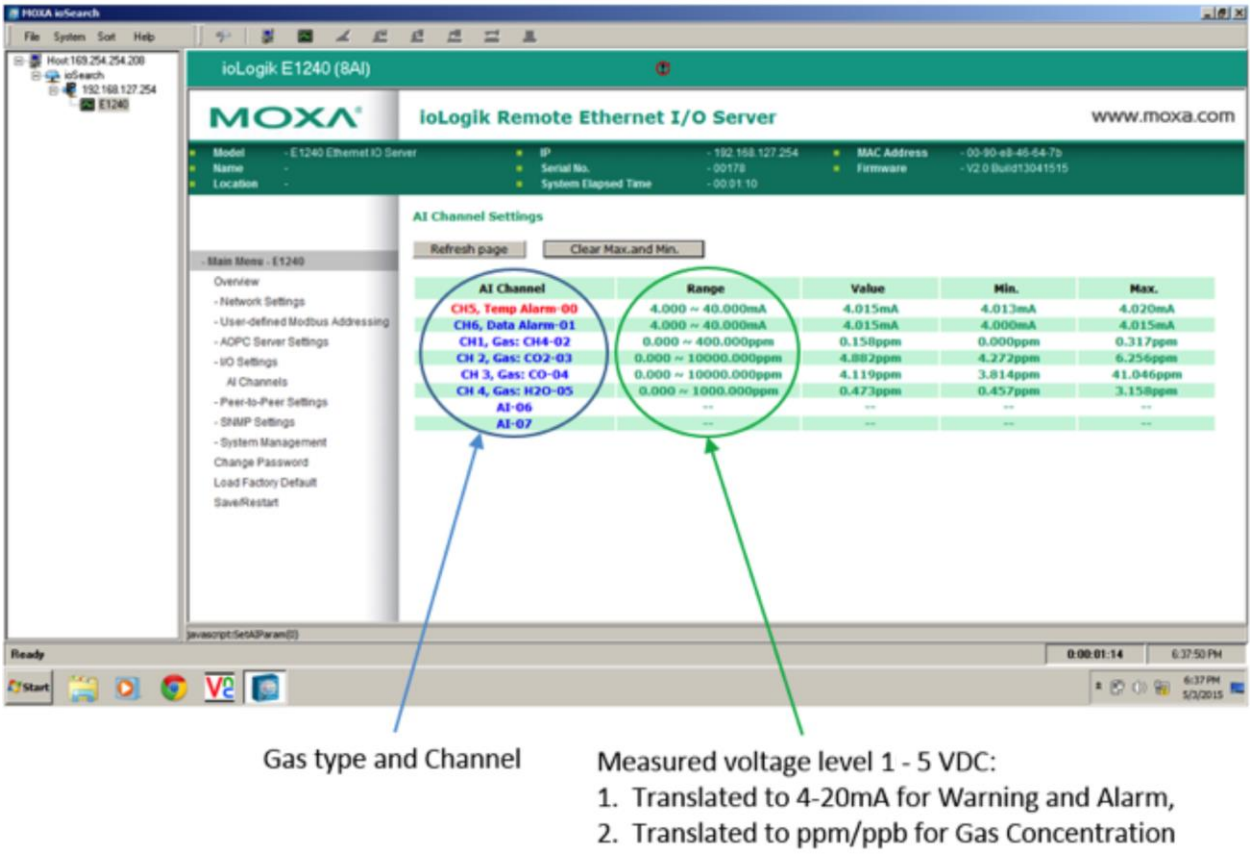

Figure 45: Analog Input Configuration Screen

8. In the *I/O Setting → AI Channel menu screen* (Figure 46) select the first item under the AI Channel
    a. In the example from Figure 45, it would be CH5, Temp Alarms-00.
    b. In the *AI menu screen* (Figure 46), it allows the user to change the scale output of the Modbus data in reference to the 1 to 5 volts. This change would result in a different output result by the Modbus.
    c. When making any changes on the *AI Channel Setting* menu screen, the user must select **Submit** at the bottom of the menu screen to lock the changes made when exiting.

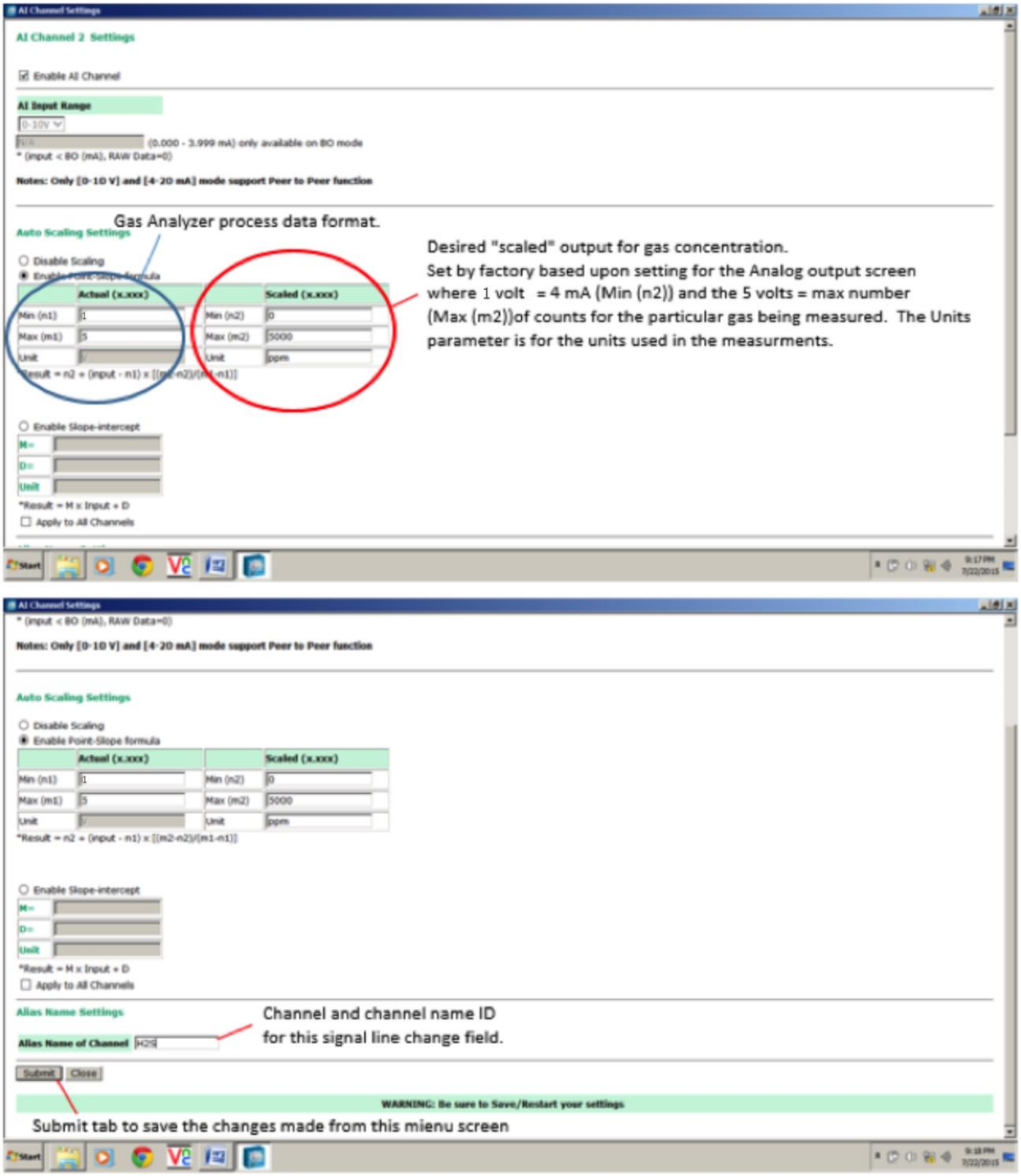

Figure 46: AI Channel Settings

Changing the Modbus IP Address

To change the *Modbus IP address*, select **Network → Ethernet Configuration,** and the following menu screen will appear. (Figure 47)

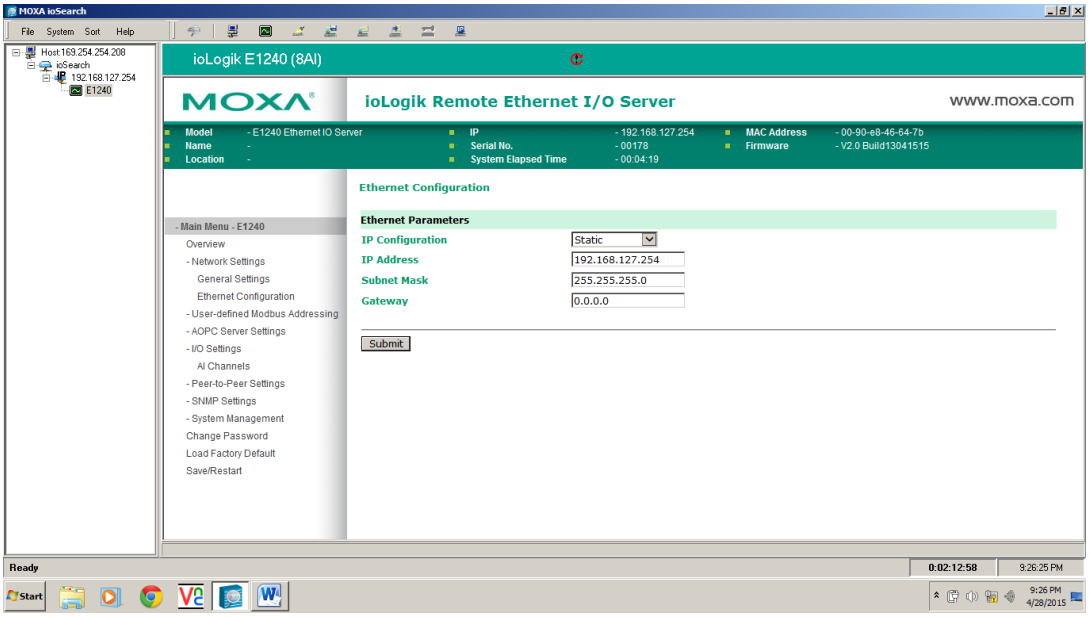

Figure 47: ioLogik Ethernet Configuration Menu Screen

If a change is made to the IP address of the ioLogik Modbus, select the **Submit** button to save changes before exiting the menu screen; otherwise, the new IP address will not be saved.

1. Quit the *ioLogik* application.
2. Disconnect the Ethernet cable from the Modbus port at the rear panel.

Modbus TCP Information for Customized Configuration

To configure the Moxa ioLogik E1240 Modbus, refer to the list in Table 11 when connecting to the device, using Modbus TCP protocol. Additional information concerning the Moxa ioLogik E1240 can be found in the Moxa user manual within the User Manual disk provided with the analyzer.

Table 11: Modbus Default Settings

Parameters	Default Settings
IP address	192.168.127.254
Modbus port	502
Device ID	1
Starting register	1
Number of registers	24

Read Only Registers Configuration:

- Each channel is output on 2 registers with different formats.
- Registers 1 - 8 are integers, where 32768 is the full scale.
- Registers 9 - 24 are floating point with the least significant bit first.
- Output on the Warning/Alarm channels are given by integer values between 4 - 20 as defined in the User Manual.
    - 4 - 10 indicates various alarms conditions
    - 12 - 18 indicates various warning conditions
    - 20 indicates status is good
- Output on the gas concentration channels are in units of ppm where the full scale is defined in the software and in the configuration of the Moxa ioLogik E1240 Modbus device.
    - Full scale is configured in the software in the *Setup Tools* screen in the *4 – 20 mA* screen where the full scale in ppm is defined for 20 mA output (or full scale of Moxa).
    - For registers 9 – 24 to report the correct gas concentration, the Moxa must be configured to have the same full scale as in the software. (The factory default scale must be set to the same value using Moxa ioSearch software included.)

Table 12: Moxa Registers, Type, Corresponding 4-20 mA Channel, and Channel Name

Register	Type	Corresponding 4-20 mA Channel	Channel Name
300001	Integer, 32768 FS	5	Temperature Warning/Alarm
300002	Integer, 32768 FS	6	Analyzer Warning/Alarm
300003	Integer, 32768 FS	1	Gas 1 Concentration
300004	Integer, 32768 FS	2	Gas 2 Concentration
300005	Integer, 32768 FS	3	Gas 3 Concentration
300006	Integer, 32768 FS	4	Gas 4 Concentration
300009	Floating, LSBF	5	Temperature Warning/Alarm
300011	Floating, LSBF	6	Analyzer Warning/Alarm
300013	Floating, LSBF	1	Gas 1 Concentration
300015	Floating, LSBF	2	Gas 2 Concentration
300017	Floating, LSBF	3	Gas 3 Concentration

Register	Type	Corresponding 4-20 mA Channel	Channel Name
300019	Floating, LSBF	4	Gas 4 Concentration

Local Data Access

USB

The GLA231 Gas Analyzer only supports up to USB 2.0.

Refer to the *File Transfer* section on page 55 for instructions on transferring data from the analyzer to a USB 2.0 memory stick.

Gas Concentrations

4–20 mA Analog Outputs

4 to 20 mA gas concentration values are ported out through the 5.08 mm terminal block.

Depending on the analyzer model purchased, up to four individual gases can be analyzed. Output results are translated into 4–20 mA values. The four individual gases are output through CH1, CH2, CH3, and CH4 on the rear panel.

Figure 48 displays the connection points used to sample gas concentrations. The information output is in real time.

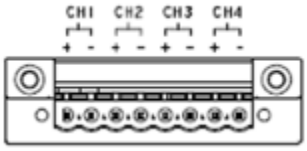

Figure 48: Gas Concentration 5.08mm Terminal Block Connection Point

Alarms

Table 13 provides the current operating status and their corresponding warning/alarm descriptions.

Table 13: Analyzer Warnings/Alarms

Warning / Alarm	UI Display	Detected Problem
Alarm	Maintenance	Maintenance is needed on system now
Alarm	Pressure	Pressure is not in operating range
Alarm	HD Space	HD Space is low, deleting oldest files
Alarm	Data Health (A)/(B)	Laser A and/or B goodness of fit is poor
Alarm	Mirror Health (A)/(B)	Mirror health has degraded, clean mirrors
Alarm	Linelock (A)/(B)	Laser A and/or B peak position is outside of control range, contact customer support
Alarm	Signal Power (A)/(B)	Laser A and/or B power has degraded, contact customer support
Alarm	Analyzer Temp	Ambient temperature is outside of alarm set point range
No issue	Maintenance	No alarm
Warning	Pressure	Pressure is noisy
Warning	HD Space	HD Space is low
Warning	Data Health (A)/(B)	Laser A and/or B goodness of fit is not optimal
Warning	Mirror Health (A)/(B)	Mirror health is degrading, clean mirrors soon
Warning	Linelock (A)/(B)	Laser A and/or B peak position is moving very fast
Warning	Signal Power (A)/(B)	Laser A and/or B is degrading. Contact ABB support.

Analyzer Shutdown

To properly shutdown the analyzer, always perform a soft shutdown:

1. Select **Exit**.
2. Click **OK** when "*Do you wish to shutdown?*" is displayed.

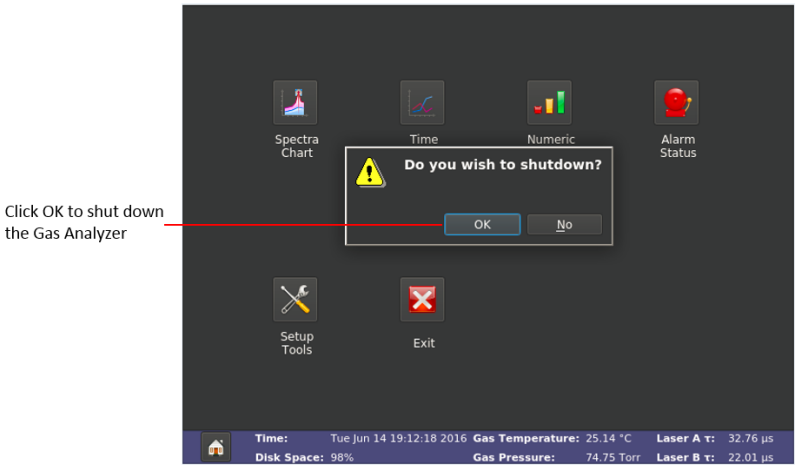

Figure 49: Shutdown Screen

3. Once **OK** is selected, the analyzer will archive the recorded spectra files. (Figure 50) Do NOT turn off the analyzer during this time.

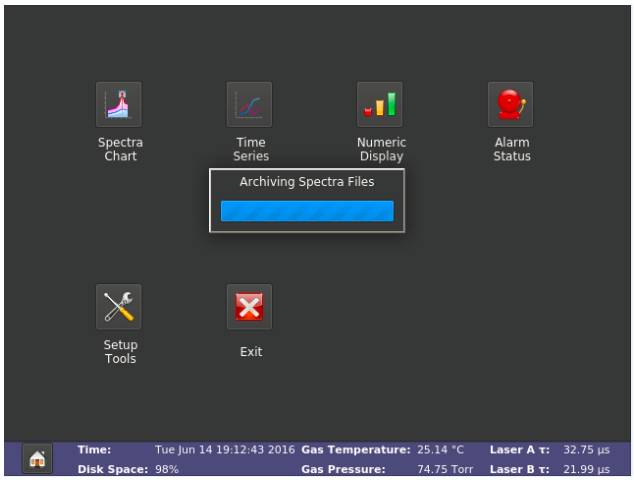

Figure 50: Archiving Spectra Files

4. Once the archiving process is complete, press the Power switch to shut down the analyzer.

NOTE

Powering down without going through this process can corrupt the operating software.

Maintenance

PC104 Stack

The GLA231 series analyzer operates with a single-board computer (PC104 Stack), equipped with an Intel Atom microprocessor. This single-board computer is integrated with a digital signal processor (DSP) board along with a multiple I/O (MIO) board that collects signals from the ICOS detector for both processing the light signal and controlling the light source to maintain the level of sensitivity of the ICOS module. All input/output communications, such as USB, Ethernet, VGA, and RS232, originate from the single-board computer. The design is focused on:

- Low noise communications between the computer and the ICOS assembly (data acquisition and processing)
- Monitoring of various control signals
- Providing an interface to operators

Laser(s) and Astigmatic Mirrors

The factors that impact measurement stability and accuracy are:

- Laser signal strength
- Operating frequencies
- Astigmatic mirrors

Mirrors have an impact on the effective path length, and the lasers have an impact on transmission intensity. This is as defined in equations 1 to 3 of the *Theory of Operation* section on page 72.

Astigmatic mirror reflectivity efficiency drops over time due to surface contamination from the particulate matter in the sample gas. When this happens, measurement results can be seen with a shorter *ringdown* time. In the short term, this will lead to reduced measurement sensitivity and, in the long term, poorer performance.

The intensity level will vary from analyzer to analyzer depending on the laser, detector, and mirror reflectivity for that individual analyzer. When lasers decay, intensity profiles move downward to a lower level. The maximum decay limit is 20% of the original recorded measurement when the product was shipped from the factory.

Table 14: Measurement Components Function & Impact

Components	Function	Impact
PC104 Stack	System communications	System operations
Pressure Valve, Fixed Orifice	ICOS pressure control	Measurement sensitivity
Laser	Gas probing light source	Transmitted intensity
Astigmatic Mirrors	Cavity length	Ringdown time

Self-Correction

Small drifts in laser wavelength are compensated by adjusting the laser temperature, thus providing a dynamic response. To deactivate this feature, uncheck the **Disable Laser Frequency Lock** box in the *Laser Adjust* screen. Deactivate this feature if the peaks are outside the target window to return the peaks to their respective targets.

Output Data

The output data collected and processed by the PC104 computer stack provides a DC signal level, representing the ppm in the *Numeric Display* of the measured gas sample. A signal isolator converts this DC voltage signal (ranging from 0 to 5 volts) to a 4–20 mA signal. This DC voltage signal is also ported to both an external 9 pin D connector, and the Modbus (optional). The 9-pin D Analog Out (Figure 15) is configured to provide gas concentration data scaled from 0-5 VDC. The pin assignments can be seen in Table 15. The scaling can be configured with the User Interface via the *Analog Outputs* screen. (Figure 37)

Table 15: 9 Pin D Raw Signal Output

Gas Concentration	9 Pin D Assigned Pins
Gas Concentration #1 analog +	Pin 1 (+)
Gas Concentration #1 analog -	Pin 6 (-)
Gas Concentration #2 analog +	Pin 2 (+)
Gas Concentration #2 analog -	Pin 7 (-)
Gas Concentration #3 analog +	Pin 3 (+)
Gas Concentration #3 analog -	Pin 8 (-)
Gas Concentration #4 analog +	Pin 4 (+)
Gas Concentration #4 analog -	Pin 9 (-)

The output signal from the Modbus is user-configurable to the desired output unit:

- mA
- Volts
- ppm
- ppb

The output units are either in ppm (parts per million) or ppb (parts per billion). The output channels of the Modbus are configured as follows in Table 16.

Table 16: 9 Pin D Raw Signal Output

Gas Concentration	Modbus Channel Assignment
Gas Concentration #1 analog +	Analog In 0+
Gas Concentration #1 analog -	Analog In 0-
Gas Concentration #2 analog +	Analog In 1+
Gas Concentration #2 analog -	Analog In 1-
Gas Concentration #3 analog +	Analog In 2+
Gas Concentration #3 analog -	Analog In 2-
Gas Concentration #4 analog +	Analog In 3+
Gas Concentration #4 analog -	Analog In 3-

Preventative Maintenance

The GLA231 Series Analyzer requires every six months to yearly preventative maintenance (PM) to maintain its measurement performance.

1. Parts requiring maintenance every year are:
    a. Astigmatic mirrors
2. Parts to check and possibly replace every six months are:
    a. Internal pump diaphragm (GLA231 927T only)
    b. Exhaust pump diaphragm (GLA231 927S only)
    c. Membrane filter
3. Parts to replace every two years are:
    a. Exhaust pump diaphragm (GLA231 927S only)
    b. Internal pump diaphragm (GLA231 927T only)
4. Parts to replace every five years are:
    a. Exhaust pump (GLA231 927T only)
    b. ICOS O-rings
5. Parts to replace every ten years are:
    a. Proportional pressure valve
    b. System hard drive
    c. Pressure controller

Cleaning the two ICOS astigmatic mirrors is required when processed gases contaminate and coat the mirrors, reducing its effectiveness and resulting in reduced measurement precision and/or inaccurate data.

Trained personnel that have successfully completed the maintenance course for the GLA231 Series Analyzer should perform preventive maintenance.

Methanol and acetone are used to clean the optical components of the analyzer, and present a fire hazard. A typical service procedure requires the use of < 25 mL of these chemicals.

- **Use in accordance with local regulations and standards.**
- **Do not use near open flames, sparks, or heat.**
- **Wipes soaked in such chemicals must be disposed of in accordance (with requirements of 40 CFR, local fire department and environmental jurisdictions).**

Appendix A: Features and Measurement Theory

The analyzer is a cavity-based spectroscopy analyzer. The cavity design enhances the absorption of laser light by the target gas molecule. The enhancement improves the signal-to-noise ratio over conventional laser sensors, enabling trace gas measurement and sensitive monitoring. The type of gas that it measures is based upon the laser wavelength. All measurements are taken in real time.

Main Features

Main features include:

- Measurement and processing time down to 1 second (for specific gases)
- Reduced data cross interference
- Sensitivity to sub-ppb levels

The external interface supports:

- Modbus/TCP (RJ-45): Customer-configured analog gas concentration output data
- Ethernet (RJ-45): Communication link with the analyzer computer
- 5.08 mm terminal block: Gas concentration and alarms: 4–20 mA analog output

Theory of Operation

For gas measurements based on conventional laser-absorption spectroscopy, a laser beam is directed through a sample, and the mixing ratio (or mole fraction) of gas is determined from the measured absorption using Beer's Law, which may be expressed with the following equation.

Equation 1 $$\frac{I_v}{I_o} = e^{-SL_xP\phi_v}$$

- I_v = the transmitted intensity through the sample at frequency v
- I_o = the (reference) laser intensity prior to entering the cell
- S = the absorption line strength of the probed transition
- L = the optical path length of the laser beam through the sample
- X = the mole fraction
- P = the gas pressure
- Φ_v = the line-shape function of the transition at frequency v

In this case:

Equation 2 $$\int \phi(v)dv = 1$$

If the laser line width is much narrower than the width of the absorption feature, high-resolution absorption spectra may be recorded by tuning the laser wavelength over the probed feature.

Integration of the measured spectra with the measured values of:

- Gas temperature
- Gas pressure
- Path length
- Line strength of the probed transition allows one to determine the mole fraction directly from the relation:

Equation 3 $$x = \frac{-1}{SLP} \int_v \ ln\left(\frac{I_v}{I_o}\right) dv$$

This equation is used to determine gas concentrations, even in hostile environments, without using calibration gases or reference standards.

The values measured are:

- Mixtures containing several species
- Flows at elevated temperatures and pressures

Calibrated gases can be used to verify measurement accuracy, as a monitor to a fix process and for troubleshooting.

ABB OA-ICOS

Off-Axis integrated-cavity output spectroscopy (OA-ICOS) uses a high-finesse optical cavity as an absorption cell. Unlike multi-pass detectors, which are typically limited to path lengths of less than two-hundred meters, an OA-ICOS absorption cell effectively traps the laser photon so that, on average, it makes thousands of passes before leaving the cell. As a result, the effective optical path length may be several thousand meters, using high-reflectivity mirrors and thus the measured absorption of light after it passes through the optical cavity is significantly enhanced. For example, for a cell composed of two 99.99% reflectivity mirrors 25 cm apart, the effective optical path length is 2500 meters.

Because the path length depends only on optical losses in the cavity and not on a unique beam trajectory (like conventional multi-pass cells or cavity-ringdown systems), the optical alignment is very robust, allowing for reliable operation in the field. The effective optical path length is determined routinely by simply switching the laser off and measuring the necessary time for light to leave the cavity (typically tens of microseconds).

As with conventional tunable-laser absorption-spectroscopy methods:

- Laser wavelength selection is based upon the selected absorption feature of the target gas to be measured.
- The measured absorption spectra is recorded and used to determine a quantitative measurement of mixing ratio directly and without external calibration when combined with the recorded:
    - Measured gas temperature and pressure in the cell
    - Effective path length
    - Known line strength

Appendix B: Material Safety Data Sheets

This appendix provides material safety data sheets (MSDS) for the chemicals typically used in GLA231 Series Analyzers. Each chemical has an MSDS, which lists the product name, supplier contacts (including emergency numbers), chemical and safety information, and other information as determined by the chemical manufacturer.

The MSDS in this appendix is for reference only. MSDS documents come from different manufacturers, and are subject to change. Refer to the site-specific MSDS at your location for additional material safety information.

Methanol MSDS

1. PRODUCT AND COMPANY IDENTIFICATION

1.1 Product identifiers

Product name:	Methanol
Product number:	414719
Brand:	Fluka
Index-No.:	603-001-00-X
CAS-No.:	67-56-1

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

Identified uses:	Laboratory chemicals, Manufacture of substances

1.3 Details of the supplier of the safety data sheet

Company:	Sigma-Aldrich 3050 Spruce Street SAINT LOUIS MO 63103 USA
Telephone:	+1 800-325-5832
Fax:	+1 800-325-5052

1.4 Emergency telephone number

Emergency Phone #:	(314) 776-6555

2. HAZARDS IDENTIFICATION

2.1 Classification of the substance or mixture

GHS Classification in accordance with 29 CFR 1910 (OSHA HCS)

Flammable liquids (Category 2), H225
Acute toxicity, Oral (Category 3), H301
Acute toxicity, Inhalation (Category 3), H331
Acute toxicity, Dermal (Category 3), H311
Specific target organ toxicity - single exposure (Category 1), H370
For the full text of the H-Statements mentioned in this Section, see Section 16.

2.2 GHS Label elements, including precautionary statements

Pictogram

Signal word: Danger

Hazard statement(s)

H225	Highly flammable liquid and vapor.
H301 + H311 + H331	Toxic if swallowed, in contact with skin or if inhaled
H370	Causes damage to organs.

Precautionary statement(s)

P210	Keep away from heat/sparks/open flames/hot surfaces. - No smoking.
P233	Keep container tightly closed.
P240	Ground/bond container and receiving equipment.
P241	Use explosion-proof electrical/ ventilating/ lighting/ equipment.
P242	Use only non-sparking tools.
P243	Take precautionary measures against static discharge.
P260	Do not breathe dust/ fume/ gas/ mist/ vapors/ spray.
P264	Wash skin thoroughly after handling.
P270	Do not eat, drink or smoke when using this product.
P271	Use only outdoors or in a well-ventilated area.
P280	Wear protective gloves/ protective clothing/ eye protection/ face protection.
P301 + P310	IF SWALLOWED: Immediately call a POISON CENTER or doctor/ physician.
P303 + P361 + P353	IF ON SKIN (or hair): Remove/ Take off immediately all contaminated clothing. Rinse skin with water/ shower.
P304 + P340	IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing.
P307 + P311	IF exposed: Call a POISON CENTER or doctor/ physician.
P322	Specific measures (see supplemental first aid instructions on this label).
P330	Rinse mouth.
P361	Remove/Take off immediately all contaminated clothing.
P363	Wash contaminated clothing before reuse.
P370 + P378	In case of fire: Use dry sand, dry chemical or alcohol-resistant foam for extinction.
P403 + P233	Store in a well-ventilated place. Keep container tightly closed.
P403 + P235	Store in a well-ventilated place. Keep cool.
P405	Store locked up.
P501	Dispose of contents/ container to an approved waste disposal plant.

2.3 Hazards not otherwise classified (HNOC) or not covered by GHS – none

3. COMPOSITION/INFORMATION ON INGREDIENTS

3.1 Substances

Synonyms:	Methyl alcohol
Formula:	CH_4O
Molecular weight:	32.04 g/mol
CAS-No.:	67-56-1
EC-No.:	200-659-6
Index-No.:	603-001-00-X
Registration number:	01-2119433307-44-XXXX

Hazardous components

Component	Classification	Concentration
Methanol		
	Flam. Liq. 2; Acute Tox. 3; STOT SE 1; H225, H301 + H311 + H331, H370	<= 100 %

For the full text of the H-Statements mentioned in this Section, see Section 16.

4. FIRST AID MEASURES

4.1 Description of first aid measures

General advice
Consult a physician. Show this safety data sheet to the doctor in attendance. Move out of dangerous area.

If inhaled
If breathed in, move person into fresh air. If not breathing, give artificial respiration. Consult a physician.

In case of skin contact
Wash off with soap and plenty of water. Take victim immediately to hospital. Consult a physician.

In case of eye contact
Rinse thoroughly with plenty of water for at least 15 minutes and consult a physician.

If swallowed
Do NOT induce vomiting. Never give anything by mouth to an unconscious person. Rinse mouth with water. Consult a physician.

4.2 Most important symptoms and effects, both acute and delayed

The most important known symptoms and effects are described in the labelling (see section 2.2) and/or in section 11

4.3 Indication of any immediate medical attention and special treatment needed

No data available

5. FIREFIGHTING MEASURES

5.1 Extinguishing media

Suitable extinguishing media

Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide.

5.2 Special hazards arising from the substance or mixture

Carbon oxides

5.3 Advice for firefighters

Wear self-contained breathing apparatus for firefighting if necessary.

5.4 Further information

Use water spray to cool unopened containers.

6. ACCIDENTAL RELEASE MEASURES

6.1 Personal precautions, protective equipment and emergency procedures

Wear respiratory protection. Avoid breathing vapors, mist or gas. Ensure adequate ventilation. Remove all sources of ignition. Evacuate personnel to safe areas. Beware of vapors accumulating to form explosive concentrations.
Vapors can accumulate in low areas.
For personal protection see section 8.

6.2 Environmental precautions

Prevent further leakage or spillage if safe to do so. Do not let product enter drains.

6.3 Methods and materials for containment and cleaning up

Contain spillage, and then collect with an electrically protected vacuum cleaner or by wet-brushing and place in container for disposal according to local regulations (see section 13).

6.4 Reference to other sections

For disposal see section 13.

7. HANDLING AND STORAGE

7.1 Precautions for safe handling

Avoid contact with skin and eyes. Avoid inhalation of vapor or mist.
Use explosion-proof equipment. Keep away from sources of ignition - No smoking. Take measures to prevent the buildup of electrostatic charge.
For precautions see section 2.2.

7.2 Conditions for safe storage, including any incompatibilities

Keep container tightly closed in a dry and well-ventilated place. Containers which are opened must be carefully resealed and kept upright to prevent leakage.

7.3 Specific end use(s)

Apart from the uses mentioned in section 1.2 no other specific uses are stipulated

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

8.1 Control parameters

Components with workplace control parameters

Component	CAS-No.	Value	Control parameters	Basis
Methanol	67-56-1	TWA	200.000000 ppm	USA. ACGIH Threshold Limit Values (TLV)
	Remarks	Headache Nausea Dizziness Eye damage Substances for which there is a Biological Exposure Index or Indices (see BEI® section) Danger of cutaneous absorption		
		STEL	250.000000 ppm	USA. ACGIH Threshold Limit Values (TLV)
		Headache Nausea Dizziness Eye damage Substances for which there is a Biological Exposure Index or Indices (see BEI® section) Danger of cutaneous absorption		
		TWA	200.000000 ppm 260.000000 mg/m3	USA. NIOSH Recommended Exposure Limits
		Potential for dermal absorption		
		ST	250.000000 ppm 325.000000 mg/m3	USA. NIOSH Recommended Exposure Limits
		Potential for dermal absorption		
		TWA	200.000000 ppm 260.000000 mg/m3	USA. Occupational Exposure Limit (OSHA) - Table Z-1 Limits for Air Contaminants
		The value in mg/m3 is approximate.		

Biological occupational exposure limits

Component	CAS-No.	Parameters	Value	Biological specimen	Basis
Methanol	67-56-1	Methanol	15.0000 mg/l	Urine	ACGIH – Biological Exposure Indices (BEI)
	Remarks	End of shift (As soon as possible after exposure ceases)			

Derived No Effect Level (DNEL)

Application Area	Exposure Routes	Health effect	Value
Workers	Skin contact	Long-term systemic effects	40mg/kg BW/d
Consumers	Skin contact	Long-term systemic effects	8mg/kg BW/d
Consumers	Ingestion	Long-term systemic effects	8mg/kg BW/d
Workers	Skin contact	Acute systemic effects	40mg/kg BW/d
Consumers	Skin contact	Acute systemic effects	8mg/kg BW/d
Consumers	Ingestion	Acute systemic effects	8mg/kg BW/d
Workers	Inhalation	Acute systemic effects	260 mg/m3
Workers	Inhalation	Acute local effects	260 mg/m3
Workers	Inhalation	Long-term systemic effects	260 mg/m3
Workers	Inhalation	Long-term local effects	260 mg/m3
Consumers	Inhalation	Acute systemic effects	50 mg/m3
Consumers	Inhalation	Acute local effects	50 mg/m3
Consumers	Inhalation	Long-term systemic effects	50 mg/m3
Consumers	Inhalation	Long-term local effects	50 mg/m3

Predicted No Effect Concentration (PNEC)

Compartment	Value
Soil	23.5 mg/kg
Marine water	15.4 mg/l
Fresh water	154 mg/l
Fresh water sediment	570.4 mg/kg
Onsite sewage treatment plant	100 mg/kg

8.2 Exposure controls

Appropriate engineering controls
Avoid contact with skin, eyes and clothing. Wash hands before breaks and immediately after handling the product.

Personal protective equipment

Eye/face protection
Face shield and safety glasses Use equipment for eye protection tested and approved under appropriate government standards such as NIOSH (US) or EN 166(EU).

Skin protection
Handle with gloves. Gloves must be inspected prior to use. Use proper glove removal technique (without touching glove's outer surface) to avoid skin contact with this product. Dispose of contaminated gloves after use in accordance with applicable laws and good laboratory practices. Wash and dry hands.

Full contact
Material: butyl-rubber
Minimum layer thickness: 0.3 mm
Break through time: 480 min
Material tested: Butoject® (KCL 897 / Aldrich Z677647, Size M)

Splash contact
Material: Nitrile rubber
Minimum layer thickness: 0.4 mm
Break through time: 31 min
Material tested: Camatril® (KCL 730 / Aldrich Z677442, Size M)
data source: KCL GmbH, D-36124 Eichenzell, phone +49 (0)6659 87300, e-mail sales@kcl.de, test method: EN374
If used in solution, or mixed with other substances, and under conditions which differ from EN 374, contact the supplier of the CE approved gloves. This recommendation is advisory only and must be evaluated by an industrial hygienist and safety officer familiar with the specific situation of anticipated use by our customers. It should not be construed as offering an approval for any specific use scenario.

Body Protection
Complete suit protecting against chemicals, Flame retardant antistatic protective clothing., The type of protective equipment must be selected according to the concentration and amount of the dangerous substance at the specific workplace.

Respiratory protection
Where risk assessment shows air-purifying respirators are appropriate use a full-face respirator with multipurpose combination (US) or type AXBEK (EN 14387) respirator cartridges as a backup to engineering controls. If the respirator is the sole means of protection, use a full-face supplied air respirator. Use respirators and components tested and approved under appropriate government standards such as NIOSH (US) or CEN(EU).

Control of environmental exposure
Prevent further leakage or spillage if safe to do so. Do not let product enter drains.

9. PHYSICAL AND CHEMICAL PROPERTIES

9.1 Information on basic physical and chemical properties

a) Appearance Form:	liquid
Color:	colorless
b) Odor	pungent
c) Odor	Threshold No data available
d) pH	No data available
e) Melting point/freezing point	
Melting point/range:	-98 °C (-144 °F) - lit.
f) Initial boiling point and boiling range	64.7 °C (148.5 °F)
g) Flash point	9.7 °C (49.5 °F) - closed cup
h) Evaporation rate	No data available

i) Flammability (solid, gas)	No data available
j) Upper/lower flammability or explosive limits	
Upper explosion limit:	36%(V)
Lower explosion limit:	6%(V)
k) Vapor pressure	130.3 hPa (97.7 mmHg) at 20.0 °C (68.0 °F) 546.6 hPa (410.0 mmHg) at 50.0 °C (122.0 °F) 169.27 hPa (126.96 mmHg) at 25.0 °C (77.0 °F)
l) Vapor density	1.11
m) Relative density	0.791 g/cm^3 at 25 °C (77 °F)
n) Water solubility	completely miscible
o) Partition coefficient: noctanol/water	log Pow: -0.77
p) Auto-ignition temperature	455.0 °C (851.0 °F) at 1,013 hPa (760 mmHg)
q) Decomposition temperature	No data available
r) Viscosity	No data available
s) Explosive properties	Not explosive
t) Oxidizing properties	The substance or mixture is not classified as oxidizing.

9.2 Other safety information

Minimum ignition energy	0.14 mJ
Conductivity	< 1 µS/cm
Relative vapor density	1.11

10. STABILITY AND REACTIVITY

10.1 Reactivity

No data available

10.2 Chemical stability

Stable under recommended storage conditions.

10.3 Possibility of hazardous reactions

Vapors may form explosive mixture with air.

10.4 Conditions to avoid

Heat, flames and sparks. Extremes of temperature and direct sunlight.

10.5 Incompatible materials

Acid chlorides, Acid anhydrides, Oxidizing agents, Alkali metals, Reducing agents, Acids

10.6 Hazardous decomposition products

Other decomposition products - No data available
In the event of fire: see section 5

11. TOXICOLOGICAL INFORMATION

11.1 Information on toxicological effects

Acute toxicity

LDLO Oral - Human - 143 mg/kg
Remarks: Lungs, Thorax, or Respiration: Dyspnea. Ingestion may cause gastrointestinal irritation, nausea, vomiting and diarrhea.

LD50 Oral - Rat - 1,187 - 2,769 mg/kg

LC50 Inhalation - Rat - 4 h - 128.2 mg/l

LC50 Inhalation - Rat - 6 h - 87.6 mg/l

LD50 Dermal - Rabbit - 17,100 mg/kg

No data available

Skin corrosion/irritation

Skin - Rabbit
Result: No skin irritation

Serious eye damage/eye irritation

Eyes - Rabbit
Result: No eye irritation

Respiratory or skin sensitization

Maximization Test (GPMT) - Guinea pig
Does not cause skin sensitization.
(OECD Test Guideline 406)

Germ cell mutagenicity

Ames test
S. typhimurium
Result: negative in vitro assay fibroblast
Result: negative
Mutation in mammalian somatic cells.
Mutagenicity (in vivo mammalian bone-marrow cytogenetic test, chromosomal analysis)
Mouse - male and female
Result: negative

Carcinogenicity

IARC: No component of this product present at levels greater than or equal to 0.1% is identified as probable, possible or confirmed human carcinogen by IARC.

ACGIH: No component of this product present at levels greater than or equal to 0.1% is identified as a carcinogen or potential carcinogen by ACGIH.

NTP: No component of this product present at levels greater than or equal to 0.1% is identified as a known or anticipated carcinogen by NTP.

OSHA: No component of this product present at levels greater than or equal to 0.1% is identified as a carcinogen or potential carcinogen by OSHA.

Reproductive toxicity

Damage to fetus not classifiable

Fertility classification not possible from current data.

Specific target organ toxicity - single exposure

Causes damage to organs.

Specific target organ toxicity - repeated exposure

The substance or mixture is not classified as specific target organ toxicant, repeated exposure.

Aspiration hazard

No aspiration toxicity classification

Additional Information

RTECS: PC1400000

Methyl alcohol may be fatal or cause blindness if swallowed.

Effects due to ingestion may include: Headache, Dizziness, Drowsiness, metabolic acidosis, Coma, Seizures.

Symptoms may be delayed., Damage of the: Liver, Kidney

Central nervous system - Breathing difficulties - Based on Human Evidence

Stomach - Irregularities - Based on Human Evidence

12. ECOLOGICAL INFORMATION

12.1 Toxicity

Toxicity to fish mortality	LC50 - Lepomis macrochirus (Bluegill) - 15,400.0 mg/l - 96 h NOEC - Oryzias latipes - 7,900 mg/l - 200 h
Toxicity to daphnia and other aquatic invertebrates	EC50 - Daphnia magna (Water flea) - > 10,000.00 mg/l - 48 h
Toxicity to algae	Growth inhibition EC50 - Scenedesmus capricornutum (fresh water algae) - 22,000.0 mg/l - 96 h

12.2 Persistence and degradability

Biodegradability	aerobic - Exposure time 5 d
Result:	72 % - rapidly biodegradable
Biochemical Oxygen Demand (BOD)	600 - 1,120 mg/g
Chemical Oxygen Demand (COD)	1,420 mg/g
Theoretical oxygen demand	1,500 mg/g

12.3 Bioaccumulative potential

Bioaccumulation	Cyprinus carpio (Carp) - 72 d at 20 °C - 5 mg/l

Bioconcentration factor (BCF): 1.0

12.4 Mobility in soil

Will not adsorb on soil.

12.5 Results of PBT and vPvB assessment

PBT/vPvB assessment not available as chemical safety assessment not required/not conducted

12.6 Other adverse effects

Additional ecological Information	Avoid release to the environment.
Stability in water	at 19 °C 83 - 91 % - 72 h
Remarks:	Hydrolyses on contact with water. Hydrolyses readily.

13. DISPOSAL CONSIDERATIONS

13.1 Waste treatment methods

Product

Burn in a chemical incinerator equipped with an afterburner and scrubber but exert extra care in igniting as this material is highly flammable. Offer surplus and non-recyclable solutions to a licensed disposal company. Contact a licensed professional waste disposal service to dispose of this material.

Contaminated packaging

Dispose of as unused product.

14. TRANSPORT INFORMATION

DOT (US)

UN number: 1230 Class: 3 Packing group: II

Proper shipping name: Methanol

Reportable Quantity (RQ): 5000 lbs

Poison Inhalation Hazard: No

IMDG

UN number: 1230	Class: 3 (6.1)	Packing group: II EMS-No: F-E, S-D
Proper shipping name:	METHANOL	

IATA

UN number: 1230	Class: 3 (6.1)	Packing group: II
Proper shipping name:	Methanol	

15. REGULATORY INFORMATION

SARA 302 Components

No chemicals in this material are subject to the reporting requirements of SARA Title III, Section 302.

SARA 313 Components

The following components are subject to reporting levels established by SARA Title III, Section 313:

Methanol	CAS-No.	Revision Date
	67-56-1	2007-07-01

SARA 311/312 Hazards

Fire Hazard, Acute Health Hazard, Chronic Health Hazard

Massachusetts Right To Know Components

Methanol	CAS-No.	Revision Date
	67-56-1	2007-07-01

Pennsylvania Right To Know Components

Methanol	CAS-No.	Revision Date
	67-56-1	2007-07-01

New Jersey Right To Know Components

Methanol	CAS-No.	Revision Date
	67-56-1	2007-07-01

California Prop. 65 Components

WARNING: This product contains a chemical known to the
State of California to cause birth defects or other reproductive harm.

Methanol	CAS-No.	Revision Date
	67-56-1	2012-03-16

16. OTHER INFORMATION

Full text of H-Statements referred to under sections 2 and 3.

Acute Tox.	Acute toxicity
Flam. Liq.	Flammable liquids

H225	Highly flammable liquid and vapor.
H301	Toxic if swallowed.
H301 + H311 + H331	Toxic if swallowed, in contact with skin or if inhaled
H311	Toxic in contact with skin.
H331	Toxic if inhaled.
H370	Causes damage to organs.

HMIS Rating

Health hazard:	2
Chronic Health Hazard:	*
Flammability:	3
Physical Hazard	0

NFPA Rating

Health hazard:	2
Fire Hazard:	3
Reactivity Hazard:	0

Further information

 The above information is believed to be correct but does not purport to be all inclusive and shall be used only as a guide. The information in this document is based on the present state of our knowledge and is applicable to the product with regard to appropriate safety precautions. It does not represent any guarantee of the properties of the product. Sigma-Aldrich Corporation and its Affiliates shall not be held liable for any damage resulting from handling or from contact with the above product. See www.sigma-aldrich.com and/or the reverse side of invoice or packing slip for additional terms and conditions of sale.

Preparation Information

Sigma-Aldrich Corporation
Product Safety – Americas Region
1-800-521-8956

Acetone MSDS

1. PRODUCT AND COMPANY IDENTIFICATION

1.1 Product identifiers

Product name:	Acetone
Product Number:	154598
Brand:	Sigma-Aldrich
Index-No.:	606-001-00-8
CAS-No.:	67-64-1

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

Identified uses:	Laboratory chemicals, Manufacture of substances

1.3 Details of the supplier of the safety data sheet

Company:	Sigma-Aldrich 3050 Spruce Street

	SAINT LOUIS MO 63103
	USA
Telephone:	+1 800-325-5832
Fax:	+1 800-325-5052

1.4 Emergency telephone number

Emergency Phone #: (314) 776-6555

2. HAZARDS IDENTIFICATION

2.1 Classification of the substance or mixture

GHS Classification in accordance with 29 CFR 1910 (OSHA HCS)

Flammable liquids (Category 2), H225
Eye irritation (Category 2A), H319
Specific target organ toxicity - single exposure (Category 3), Central nervous system, H336
For the full text of the H-Statements mentioned in this Section, see Section 16.

2.2 GHS Label elements, including precautionary statements

Pictogram

Signal word Danger

Hazard statement(s)

H225	Highly flammable liquid and vapor.
H319	Causes serious eye irritation.
H336	May cause drowsiness or dizziness.

Precautionary statement(s)

P210	Keep away from heat/sparks/open flames/hot surfaces. - No smoking.
P233	Keep container tightly closed.
P240	Ground/bond container and receiving equipment.
P241	Use explosion-proof electrical/ ventilating/ lighting/ equipment.
P242	Use only non-sparking tools.
P243	Take precautionary measures against static discharge.
P261	Avoid breathing dust/ fume/ gas/ mist/ vapors/ spray.
P264	Wash skin thoroughly after handling.
P271	Use only outdoors or in a well-ventilated area.
P280	Wear protective gloves/ eye protection/ face protection.
P303 + P361 + P353	IF ON SKIN (or hair): Take off immediately all contaminated clothing. Rinse skin with water/shower.
P304 + P340 + P312	IF INHALED: Remove person to fresh air and keep comfortable for breathing. Call a POISON CENTER or doctor/ physician if you feel unwell.
P305 + P351 + P338	IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.
P337 + P313	If eye irritation persists: Get medical advice/ attention.

P370 + P378	In case of fire: Use dry sand, dry chemical or alcohol-resistant foam to extinguish.
P403 + P233	Store in a well-ventilated place. Keep container tightly closed.
P403 + P235	Store in a well-ventilated place. Keep cool.
P405	Store locked up.
P501	Dispose of contents/ container to an approved waste disposal plant.

2.3 Hazards not otherwise classified (HNOC) or not covered by GHS

Repeated exposure may cause skin dryness or cracking.

3. COMPOSITION/INFORMATION ON INGREDIENTS

3.1 Substances

Formula:	C_3H_6O
Molecular weight:	58.08 g/mol
CAS-No.:	67-64-1
EC-No.:	200-662-2
Index-No.:	606-001-00-8
Registration number:	01-2119471330-49-XXXX

Component Classification Concentration

Acetone

Flam. Liq. 2; Eye Irrit. 2A;
STOT SE 3; H225, H319,
H336
<= 100 %

For the full text of the H-Statements mentioned in this Section, see Section 16.

4. FIRST AID MEASURES

4.1 Description of first aid measures

General advice

Consult a physician. Show this safety data sheet to the doctor in attendance. Move out of dangerous area.

If inhaled

If breathed in, move person into fresh air. If not breathing, give artificial respiration. Consult a physician.

In case of skin contact

Wash off with soap and plenty of water. Consult a physician.

In case of eye contact

Rinse thoroughly with plenty of water for at least 15 minutes and consult a physician.

If swallowed

Do NOT induce vomiting. Never give anything by mouth to an unconscious person. Rinse mouth with water. Consult a physician.

4.2 Most important symptoms and effects, both acute and delayed
The most important known symptoms and effects are described in the labelling (see section 2.2) and/or in section 11

4.3 Indication of any immediate medical attention and special treatment needed
No data available

5. FIREFIGHTING MEASURES

5.1 Extinguishing media
Suitable extinguishing media
Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide.

5.2 Special hazards arising from the substance or mixture
Carbon oxides

5.3 Advice for firefighters
Wear self-contained breathing apparatus for firefighting if necessary.

5.4 Further information
Use water spray to cool unopened containers.

6. ACCIDENTAL RELEASE MEASURES

6.1 Personal precautions, protective equipment and emergency procedures
Use personal protective equipment. Avoid breathing vapors, mist or gas. Ensure adequate ventilation. Remove all sources of ignition. Evacuate personnel to safe areas. Beware of vapors accumulating to form explosive concentrations. Vapors can accumulate in low areas. For personal protection see section 8.

6.2 Environmental precautions
Prevent further leakage or spillage if safe to do so. Do not let product enter drains.

6.3 Methods and materials for containment and cleaning up
Contain spillage, and then collect with an electrically protected vacuum cleaner or by wet-brushing and place in container for disposal according to local regulations (see section 13).

6.4 Reference to other sections
For disposal see section 13.

7. HANDLING AND STORAGE

7.1 Precautions for safe handling

Avoid contact with skin and eyes. Avoid inhalation of vapor or mist. Use explosion-proof equipment. Keep away from sources of ignition - No smoking. Take measures to prevent the buildup of electrostatic charge. For precautions see section 2.2.

7.2 Conditions for safe storage, including any incompatibilities

Keep container tightly closed in a dry and well-ventilated place. Containers which are opened must be carefully resealed and kept upright to prevent leakage. Storage class (TRGS 510): Flammable liquids

7.3 Specific end use(s)

Apart from the uses mentioned in section 1.2 no other specific uses are stipulated

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

8.1 Control parameters

Components with workplace control parameters

Component	CAS-No.	Value	Control parameters	Basis
Acetone	67-64-1	TWA	500.000000 ppm	USA. ACGIH Threshold Limit Values (TLV)
	Remarks	Central Nervous System impairment Hematologic effects Upper Respiratory Tract irritation Eye irritation Adopted values or notations enclosed are those for which changes are proposed in the NIC See Notice of Intended Changes (NIC) Substances for which there is a Biological Exposure Index or Indices (see BEI® section) Not classifiable as a human carcinogen		
		TWA	500 ppm	USA. ACGIH Threshold Limit Values (TLV)
		Central Nervous System impairment Hematologic effects Upper Respiratory Tract irritation Eye irritation Adopted values or notations enclosed are those for which changes are proposed in the NIC See Notice of Intended Changes (NIC) Substances for which there is a Biological Exposure Index or Indices (see BEI® section) Not classifiable as a human carcinogen		
		STEL	750.000000 ppm	USA. ACGIH Threshold Limit Values (TLV)
		Central Nervous System impairment Hematologic effects		

Upper Respiratory Tract irritation
Eye irritation
Adopted values or notations enclosed are those for which changes are proposed in the NIC
See Notice of Intended Changes (NIC)
Substances for which there is a Biological Exposure Index or Indices (see BEI® section)
Not classifiable as a human carcinogen

STEL	750 ppm	USA. ACGIH Threshold Limit Values (TLV)

Central Nervous System impairment
Hematologic effects
Upper Respiratory Tract irritation
Eye irritation
Adopted values or notations enclosed are those for which changes are proposed in the NIC
See Notice of Intended Changes (NIC)
Substances for which there is a Biological Exposure Index or Indices (see BEI® section)
Not classifiable as a human carcinogen

TWA	1,000.0 ppm 2,400.0 mg/m3	USA. Occupational Exposure Limits (OSHA) - Table Z-1 Limits for Air Contaminants

The value in mg/m3 is approximate.

TWA	250.000000 Ppm 590.000000 mg/m3	USA. NIOSH Recommended Exposure Limits

Biological occupational exposure limits

Component	CAS-No.	Parameters	Value	Biological specimen	Basis
Acetone	67-64-1	Acetone	50.0000 mg/l	Urine	ACGIH - Biological Exposure Indices (BEI)

Remarks: End of shift (As soon as possible after exposure ceases)

Derived No Effect Level (DNEL)

Application Area	Exposure routes	Health effect	Value
Workers	Skin contact	Long-term systemic effects	186mg/kg BW/d
Consumers	Ingestion	Long-term systemic effects	62mg/kg BW/d
Consumers	Skin contact	Long-term systemic effects	62mg/kg BW/d
Workers	Inhalation	Acute systemic effects	2420 mg/m3
Workers	Inhalation	Long-term systemic effects	1210 mg/m3

Consumers	Inhalation	Long-term systemic effects	200 mg/m3

Predicted No Effect Concentration (PNEC)

Compartment	Value
Soil	33.3 mg/kg
Marine water	1.06 mg/l
Fresh water	10.6 mg/l
Marine sediment	3.04 mg/kg
Fresh water sediment	30.4 mg/kg
Onsite sewage treatment plant	100 mg/l

8.2 Exposure controls

Appropriate engineering controls

Handle in accordance with good industrial hygiene and safety practice. Wash hands before breaks and at the end of workday.

Personal protective equipment

Eye/face protection

Face shield and safety glasses Use equipment for eye protection tested and approved under appropriate government standards such as NIOSH (US) or EN 166(EU).

Skin protection

Handle with gloves. Gloves must be inspected prior to use. Use proper glove removal technique (without touching glove's outer surface) to avoid skin contact with this product. Dispose of contaminated gloves after use in accordance with applicable laws and good laboratory practices. Wash and dry hands.

Full contact
Material: butyl-rubber
Minimum layer thickness: 0.3 mm
Break through time: 480 min
Material tested: Butoject® (KCL 897 / Aldrich Z677647, Size M)

Splash contact
Material: butyl-rubber
Minimum layer thickness: 0.3 mm
Break through time: 480 min
Material tested: Butoject® (KCL 897 / Aldrich Z677647, Size M)
data source: KCL GmbH, D-36124 Eichenzell, phone +49 (0)6659 87300, e-mail sales@kcl.de, test method: EN374
If used in solution, or mixed with other substances, and under conditions which differ from EN 374, contact the supplier of the CE approved gloves. This recommendation is advisory only and must be evaluated by an industrial hygienist and safety officer familiar with the specific situation of anticipated use by our customers. It should not be construed as offering an approval for any specific use scenario.

Body Protection

Impervious clothing, flame retardant antistatic protective clothing. The type of protective equipment must be selected according to the concentration and amount of the dangerous substance at the specific workplace.

Respiratory protection

Where risk assessment shows air-purifying respirators are appropriate use a full-face respirator with multipurpose combination (US) or type AXBEK (EN 14387) respirator cartridges as a backup to engineering controls. If the respirator is the sole means of protection, use a full-face supplied air respirator. Use respirators and components tested and approved under appropriate government standards such as NIOSH (US) or CEN(EU).

Control of environmental exposure

Prevent further leakage or spillage if safe to do so. Do not let product enter drains.

9. PHYSICAL AND CHEMICAL PROPERTIES

9.1 Information on basic physical and chemical properties

a) Appearance Form:	liquid, clear
Color:	colorless
b) Odor	No data available
c) Odor	Threshold No data available
d) pH	No data available
e) Melting point/freezing point	
Melting point/range:	-94 °C (-137 °F) - lit.
f) Initial boiling point and boiling range:	56 °C (133 °F) at 1,013 hPa (760 mmHg) - lit.
g) Flash point	-16.99 °C (1.42 °F) - closed cup
h) Evaporation rate	No data available
i) Flammability (solid, gas)	No data available
j) Upper/lower flammability or explosive limits	
Upper explosion limit:	13 %(V)
Lower explosion limit:	2 %(V)
k) Vapor pressure	533.3 hPa (400.0 mmHg) at 39.5 °C (103.1 °F) 245.3 hPa (184.0 mmHg) at 20.0 °C (68.0 °F)
l) Vapor density	No data available
m) Relative density	0.791 g/cm3 at 25 °C (77 °F)
n) Water solubility	completely miscible
o) Partition coefficient: noctanol/water	
log Pow:	-0.24
p) Auto-ignition temperature	465.0 °C (869.0 °F)
q) Decomposition temperature	No data available
r) Viscosity	No data available
s) Explosive properties	No data available
t) Oxidizing properties	No data available

9.2 Other safety information

Surface tension	23.2 mN/m at 20.0 °C (68.0 °F)

10. STABILITY AND REACTIVITY

10.1 Reactivity
No data available

10.2 Chemical stability
Stable under recommended storage conditions.

10.3 Possibility of hazardous reactions
Vapors may form explosive mixture with air.

10.4 Conditions to avoid
Heat, flames and sparks.

10.5 Incompatible materials
Bases, Oxidizing agents, Reducing agents, Acetone reacts violently with phosphorous ox-chloride.

10.6 Hazardous decomposition products
Other decomposition products - No data available
In the event of fire: see section 5

11. TOXICOLOGICAL INFORMATION

11.1 Information on toxicological effects
Acute toxicity
LD50 Oral - Rat - 5,800 mg/kg
Remarks: Behavioral: Altered sleep time (including change in righting reflex). Behavioral: Tremor. Behavioral: Headache. Ingestion may cause gastrointestinal irritation, nausea, vomiting and diarrhea.

LC50 Inhalation - Rat - 8 h - 50,100 mg/m3
Remarks: Drowsiness Dizziness Unconsciousness

LD50 Dermal - Guinea pig - 7,426 mg/kg
No data available

Skin corrosion/irritation
Skin - Rabbit
Result: Mild skin irritation - 24 h

Serious eye damage/eye irritation
Eyes - Rabbit
Result: Eye irritation - 24 h

Respiratory or skin sensitization
- Guinea pig
Result: Does not cause skin sensitization.

Germ cell mutagenicity
No data available

Carcinogenicity
This product is or contains a component that is not classifiable as to its carcinogenicity based on its IARC, ACGIH, NTP, or EPA classification.

IARC: No component of this product present at levels greater than or equal to 0.1% is identified as probable, possible or confirmed human carcinogen by IARC.

NTP: No component of this product present at levels greater than or equal to 0.1% is identified as a known or anticipated carcinogen by NTP.

OSHA: No component of this product present at levels greater than or equal to 0.1% is identified as a carcinogen or potential carcinogen by OSHA.

Reproductive toxicity
No data available

Specific target organ toxicity - single exposure
May cause drowsiness or dizziness.

Specific target organ toxicity - repeated exposure
No data available

Aspiration hazard
No data available

Additional Information
RTECS: AL3150000

To the best of our knowledge, the chemical, physical, and toxicological properties have not been thoroughly investigated.

Kidney - Irregularities - Based on Human Evidence
Skin - Dermatitis - Based on Human Evidence

12. ECOLOGICAL INFORMATION

12.1 Toxicity

Toxicity to fish	LC50 - Oncorhynchus my kiss (rainbow trout) - 5,540 mg/l - 96 h
Toxicity to daphnia and other aquatic invertebrates	LC50 - Daphnia magna (Water flea) - 8,800 mg/l - 48 h
Toxicity to algae Remarks:	No data available

12.2 Persistence and degradability

Biodegradability	Result: 91 % - Readily biodegradable (OECD Test Guideline 301B)

12.3 Bio-accumulative potential

Does not bio-accumulate.

12.4 Mobility in soil

No data available

12.5 Results of PBT and vPvB assessment

PBT/vPvB assessment not available as chemical safety assessment not required/not conducted

12.6 Other adverse effects

No data available

13. DISPOSAL CONSIDERATIONS

13.1 Waste treatment methods

Product

Burn in a chemical incinerator equipped with an afterburner and scrubber but exert extra care in igniting as this material is highly flammable. Offer surplus and non-recyclable solutions to a licensed disposal company. Contact a licensed professional waste disposal service to dispose of this material.

Contaminated packaging

Dispose of as unused product.

14. TRANSPORT INFORMATION

DOT (US)

UN number: 1090	Class: 3	Packing group: II
Proper shipping name:	Acetone	
Reportable Quantity (RQ):	5000 lbs	

Poison Inhalation Hazard: No

IMDG

UN number: 1090	Class: 3	Packing group: II EMS-No: F-E, S-D
Proper shipping name:	ACETONE	

IATA

UN number: 1090	Class: 3	Packing group: II
Proper shipping name:	Acetone	

15. REGULATORY INFORMATION

SARA 302 Components

No chemicals in this material are subject to the reporting requirements of SARA Title III, Section 302.

SARA 313 Components

This material does not contain any chemical components with known CAS numbers that exceed the threshold (De-Minimis) reporting levels established by SARA Title III, Section 313.

Massachusetts Right To Know Components

Acetone	CAS-No.	Revision Date
	67-64-1	2007-03-01

Pennsylvania Right To Know Components

Acetone	CAS-No.	Revision Date
	67-64-1	2007-03-01

New Jersey Right To Know Components

Acetone	CAS-No.	Revision Date
	67-64-1	2007-03-01

California Prop. 65 Components

This product does not contain any chemicals known to State of California to cause cancer, birth defects, or any other reproductive harm.

16. OTHER INFORMATION

Full text of H-Statements referred to under sections 2 and 3.

Eye Irrit.	Eye irritation
Flam. Liq.	Flammable liquids
H225	Highly flammable liquid and vapour.
H319	Causes serious eye irritation.
H336	May cause drowsiness or dizziness.
STOT SE	Specific target organ toxicity - single exposure

HMIS Rating

Health hazard:	2
Chronic Health Hazard:	*
Flammability:	3
Physical Hazard	0

NFPA Rating

Health hazard:	2
Fire Hazard:	3
Reactivity Hazard:	0
Health hazard:	2
Fire Hazard:	3
Reactivity Hazard:	0

Further information

 The above information is believed to be correct but does not purport to be all inclusive and shall be used only as a guide. The information in this document is based on the present state of our knowledge and is applicable to the product with regard to appropriate safety precautions. It does not represent any guarantee of the properties of the product. Sigma-Aldrich Corporation and its Affiliates shall not be held liable for any damage resulting from handling or from contact with the above product. See www.sigma-aldrich.com and/or the reverse side of invoice or packing slip for additional terms and conditions of sale.

Preparation Information

Sigma-Aldrich Corporation
Product Safety – Americas Region
1-800-521-8956

ABB Measurement & Analytics

For your local ABB contact, visit:
abb.com/contacts

For more product information, visit:
abb.com/measurement

ABB Inc.
Measurement & Analytics
3400, rue Pierre-Ardouin
Quebec, (Quebec)
Canada G1P 0B2
Tel: +1 418 877 2944
Email: lcos.support@ca.abb.com

abb.com/analytical

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