ABB MEASUREMENT & ANALYTICS | USER MANUAL

User Manual | ICOS
GLA351 Enhanced Performance QC Rackmount Analyzers

Table of Contents

Disclaimer

This document contains product specifications and performance statements that may be in conflict with other ABB published literature, such as product flyers and product catalogs. All specifications, product characteristics, and performance statements included in this document are suggested specifications only. In case of conflict between product characteristics in this document and specifications in the official ABB product catalogs, the latter takes precedence.

ABB reserves the right to make changes to the specifications of all equipment and software, and to the contents of this document, without obligation to notify any person or organization of such changes. Every effort has been made to ensure that the information contained in this document is current and accurate. Please contact ABB-LGR if you find any error in this document, so we can make appropriate corrections.

Cyber Security

This product is designed to be connected to and to communicate information and data via a network interface. It is your sole responsibility to provide and continuously ensure a secure connection between the product and your network or any other network (as the case may be). You shall establish and maintain any appropriate measures (such as, but not limited to, the installation of firewalls, application of authentication measures, encryption of data, etc.) to protect the product, the network, its system and the interface against any kind of security breaches, unauthorized access, interference, intrusion, leakage and/or theft of data or information. ABB and its affiliates are not liable for damages and/or losses related to such security breaches, any unauthorized access, interference, intrusion, leakage and/or theft of data or information.

Patent

The analyzer technology is protected by patents:

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

Copyright

Safety

The following pages provide important safety precautions.

Class of Laser Equipment

The analyzer is a Class 1 laser instrument when the case cover is closed for normal operation, and the lock is installed.

Certification

The analyzer certifications are listed in Table 1.

Table 1: Safety Certifications

Symbols	Standards Tested and Met
CE	2004/108/EU (EMC), EN61326-1
FDA	Title 21 Code of Federal Regulations, chapter 1, sub-chapter J

WEEE Directive

The analyzer 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.

Labels

The following labels are at specific locations on or in the analyzer to identify hazardous areas. (Figure 1)

Figure 1: Radiation Labels

These labels are located on the enclosure covering the ICOS cell. The fiber laser is visible only when the insulated enclosure is removed from the ICOS cell.

Operator Safety

When the case cover is closed and locked into position, the analyzer runs safely, without risk to the operator. Modifying the analyzer to operate with the case cover open can injure personnel.

WARNING!

Bypassing the analyzer interlock switch to open the case cover during analyzer operations can cause serious bodily injury. Even though the analyzer provides a second layer of protection, such as a laser cover to prevent the user from the invisible laser beam or any secondary reflection from the laser on a reflective surface, it is not recommended to modify the analyzer to operate in an unsafe condition.

Electrical Hazards

The analyzer poses no electrical hazards. The analyzer components operate at ≤ 6.8 V DC.

Laser Hazards

The analyzer is a Class 1 laser product that complies with:

- 21 CFR 1040.10 and 1040.11
- EN 60825-1:2014

The laser is classified as a Class IIIb when exposed.
Only trained service personnel are authorized to open the housing or service the laser.

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

Only authorized persons may open the analyzer cover or perform internal maintenance. Contact ABB-LGR for maintenance instructions and maintenance kits. Make sure the analyzer is unplugged before working with the internal components. Failure to do so may result in damage to the analyzer and electric shock.

Safety Provisions for a Chemical Spill

Follow these precautions when dealing with all chemicals:

- Keep all chemical containers away from heat, sparks, and open flames.
- Use only on grounded equipment and with non-sparking tools.
- Store in a cool, dry, and well-ventilated place, away from incompatible materials.

If a spill occurs:

- 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.

Text Formats and Warning Icons

Text Formats

This section describes text formats and warning icons used in this manual.

- *Italicized* text is used for emphasis in text and also to emphasize the names of screens or text fields.
- Bold text is used to show text that you type in fields and also button choices that you enter.

Warning Icons

Table 2 shows and describes the warning icons used in this manual.

Table 2: Warning Icon Descriptions

Icon	Meaning
 NOTE	Emphasizes facts and conditions important to analyzer operation.
 WARNING!	General Warning Icon: gives general safety information that must be followed to avoid hazardous conditions.
 WARNING!	Electrical Warning Icon: warns of potential electrical shock hazard.
 WARNING!	Laser Warning Icon: warns of potential laser hazard.

Transportation and Storage of Boxed Analyzers

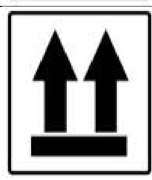
When transporting and storing boxed analyzers:

- Analyzers may be shipped in non-pressurized aircraft.
- Analyzers are fragile: Do not drop or smash boxed analyzers.
- Do not store analyzers outside in wet weather.
- Do not stack boxes more than five high.
- Analyzers may be safely stored at temperatures between -20°C and +60°C.

Save the original shipping materials to use when returning the analyzer to ABB-LGR if factory service or repair is needed.

Table 3 lists and describes the safety icons on ABB-LGR shipping boxes. Follow these instructions when transporting and storing boxed analyzers.

Table 3: Transportation and Storage Icon Descriptions

Icon	Meaning
	Store your analyzer in a sheltered, dry area. Do not let the box get wet.
	Transport and store the analyzer box with the arrows on the box pointing up.
	The analyzer is fragile. Transport carefully. Do not drop the box.

Positioning the analyzer

Positioning the analyzer is a two-person task. With one person on each side, lift the analyzer out of the box and onto a flat surface. Leave four inches of free space on each side of the analyzer for proper ventilation.

Warranty

Each ABB-LGR analyzer is warranted by ABB-LGR to be free from defects in material and workmanship. However, our sole obligation under this warranty shall be to repair or replace any part of the analyzer, which our examination discloses to have been defective in material or workmanship without charge and only under the following conditions:

1. The defects are called to the attention of ABB-LGR in writing within one year after the shipping date of the analyzer.
2. The analyzer has not been maintained, repaired or altered by anyone who was not approved by ABB-LGR.
3. The analyzer was used in the normal, proper, and ordinary manner and has not been abused, altered, misused, neglected, involved in an accident or damaged by an act of God or other casualty.
4. The purchaser (whether a distributor or direct customer of ABB-LGR, or a distributor's customer), packs and ships or delivers the analyzer to ABB-LGR's main office within 30 days after ABB-LGR has received written notice of the defect. Unless other arrangements have been made in writing, transportation to ABB-LGR is at customer's expense.
5. No-charge repair parts may be sent at ABB-LGR's sole discretion to the purchaser for installation by purchaser.
6. ABB-LGR's liability is limited to repair or replace any part of the analyzer free of charge if ABB-LGR's examination discloses the part to be defective.

The laws of some locations may not allow the exclusion or limitation on implied warranties or on incidental or consequential damages, so the limitations herein may not apply directly. This warranty gives you specific legal rights, and you may already have other rights, which vary from location to location. All warranties that apply, whether included by this contract or by law, are limited to the time period of this warranty, which is a twelve-month period commencing from the analyzer customer ship date or eighteen months from the date of shipment to an ABB-LGR authorized distributor, whichever is earlier.

Further information concerning this warranty may be obtained by writing or telephoning the Warranty Manager at ABB-LGR Customer Service.

ABB-LGR provides direct assistance in the use and application of all of its analyzers through email, telephone, and if necessary, in person.

Please contact icos.support@ca.abb.com and your local sales representative for more details.

Warranty Returns

If your product is defective, you may return it during its designated warranty period for a prompt exchange or repair. To return a product, please contact your local sales representative and ABB service support to request a Return Material Authorization (RMA) number. Requests for refunds and exchanges cannot be processed without a valid RMA number.

Please have the following information available when requesting an RMA number:

- Part Number
- Serial Number (Located on the back panel of the analyzer)
- Description of the Problem

The company-issued RMA number must be prominently displayed on the return package.

No returns will be accepted collect or C.O.D. On all warranty returns, ABB-LGR will pay the shipping charges on the return of the merchandise to the customer.

Customer Support

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 contact icos.support@ca.abb.com and your local sales representative for more details.

NOTE

Please provide the serial number or sales order number of the analyzer.

1 Analyzer Overview

The ABB-LGR GLA351 series are Enhanced Performance QC Rackmount Analyzers that measure concentrations of gas in parts per billion (ppb) and parts per million (ppm). Isotope ratios are shown in parts per thousand (‰).

NOTE

This analyzer is a Class 1 laser product.

Performance Specifications

Ambient Humidity

- <99% relative humidity non-condensing

Operating Temperature

- 0 - 45°C

Maximum Altitude

- 6,000 Feet

Power Requirements

- 115/230 VAC, 50/60hz
- 300 W (steady state)
- 420 Watts with the ACC DP3H external pump (steady state) – Applicable for the GLA351-CCIA3 analyzer

Power Requirements with External Pump

- 420 W with the optional ACC DP3H external pump

Fuse Ratings

- 250 VAC
- 10 Amps

Cable Plugs and Voltage for EC Countries

- See page 126

WARNING

Always use the power supply cord provided by ABB-LGR. See page 126 for a description of power cords for a specific country.

Standard Components

This section describes the analyzer components. Verify that each of the system components has arrived before installation.

Basic free-flow system:

- GLA351 Series analyzer
- Analyzer power cord
- User Guide (this document)
- USB flash drive
- Serial port connection cable (null modem type)
- Exhaust muffler

Applicable for the GLA351-CCIA3

- External Pump System
  - External pump (ACC-DP3H)
  - Pump power cord
- Pretreatment box with five Teflon connecting tubes:
  - Two 6' x 1/4"
  - Two 6' x 3/8"
  - One 3' x 1/4"

Optional Components

NOTE Available on select analyzers.

- External Pump System (includes connection kit and power cord); Options include:
  - 3-head diaphragm vacuum pump (ACC-DP3H)
  - 4-head diaphragm vacuum pump (ACC-DP4H)
  - 3-head diaphragm vacuum pump- Europe only (ACC-DP20)
  - Dry Scroll Vacuum Pump (ACC-DS10)
- Multiport Inlet Unit (MIU-16 or MIU-8)
  - Power cable
  - 25-pin connection cable for control signal
- Batch Injection System (OPT-BATCH-INJECTION)
  - Injection port to provide capability for discrete sample measurements via syringe injection. Accessories include:
    - Syringe injection port
    - 140 mL syringe
    - Centering needle
    - Septa (box of 50)
    - Septum puller
- External Dynamic Dilution System (EDDS)
  - Power cable
  - BNC Control Cable
  - ¼" x 6' Teflon connection tube with Swagelok tee connector

WARNING

This analyzer has been CE certified using data cables three meters long or less. Connecting the analyzer using longer data-cables is not recommended.

If you have not received all of these components, contact ABB-LGR at icos.support@ca.abb.com.

Figure 2 shows the front panel of the GLA351 Series.

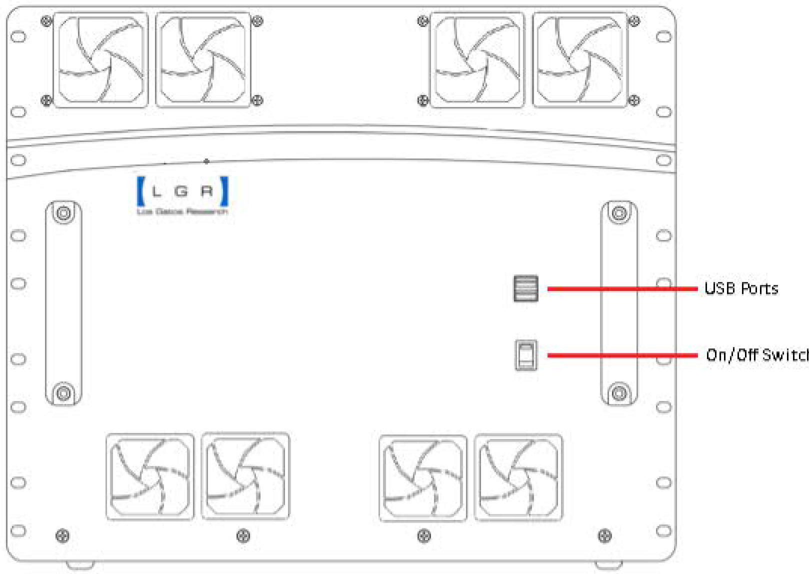


Figure 2: Front Panel

Figure 3 shows the back of the GLA351 Series analyzers with connections. Port locations may vary for different analyzer types.

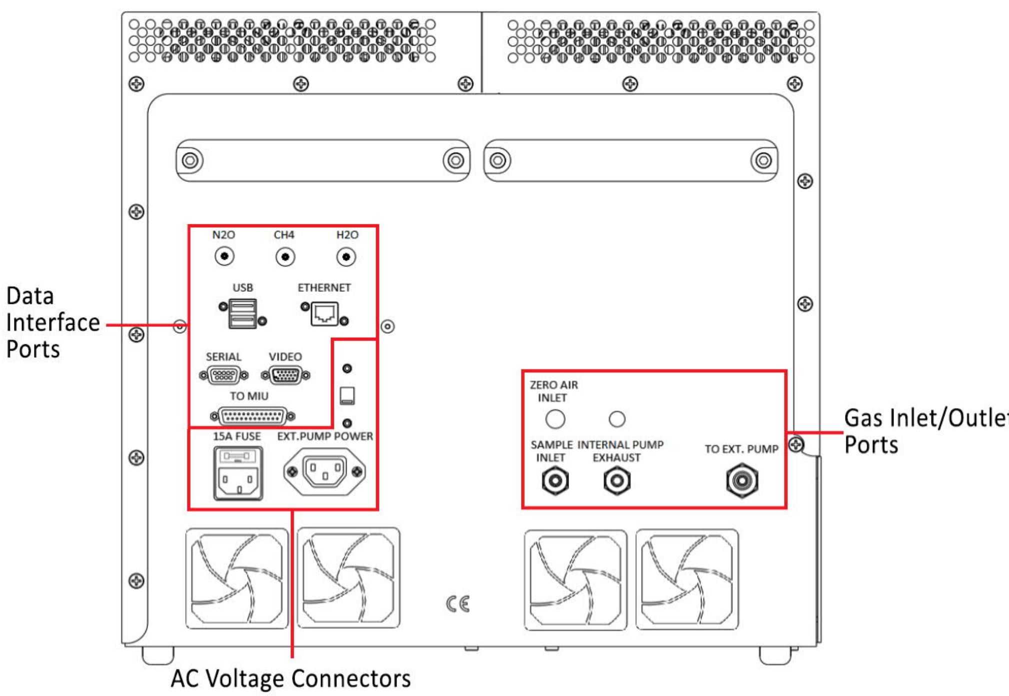


Figure 3: Back Panel (GLA351-N2OM1)

Power Connections

Figure 4 shows the power connections on the back panel, and Table 4 describes the connections.

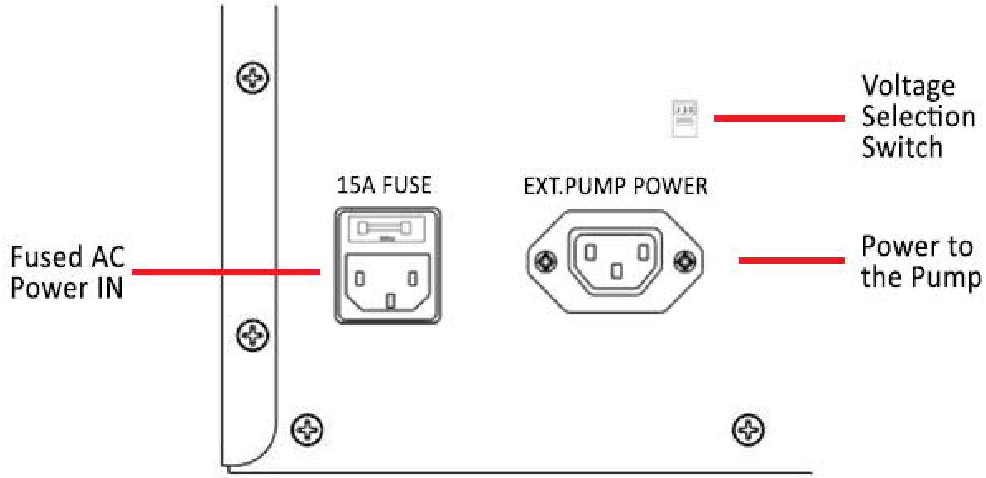


Figure 4: Power Connections

Table 4: Power Connections and AC Voltage Selection Switch Description

Connector	Description
AC Power In	Connects the analyzer to the power supply
AC Voltage Selection	Toggles the input voltage to the analyzer's power supply between 115 VAC and 230 VAC, determined by the country where the analyzer is used. Setting an incorrect voltage may damage the analyzer. When changing the supply voltage verify that both the: • Analyzer is powered off or not connected to power. • AC voltage selection on the analyzer matches the AC voltage being supplied from your power supply.
EXT. Pump Power	Provides power to an external pump when operating the analyzer.

NOTE If you require a different power source, please contact ABB-LGR.

Data Interface Connection Ports

This section describes the data interface connections for the GLA351-N2OCM and the GLA351-N2OM1. These connections vary from analyzer to analyzer depending on the ordered configuration.

- Analog ports – Provides a DC voltage proportional to the measured gas concentration. If these outputs are connected to an external device, it must be terminated into a moderate to high impedance (>1 kOhm).
- USB ports – Used for transferring data to a USB memory device, or to connect a USB keyboard and mouse.
- Ethernet port – Connects the analyzer to a local area network (LAN) and allows access to the data directory using an external computer.
- Serial port (9 pin D-sub) – For real-time digital measurement output.
- Video port (15 pin D-sub) – Connects an external monitor to the analyzer.
- TO MIU port (25-pin data port) – For connecting to a Multiport Inlet Unit (optional).
- DCS port (BNC male port) – Used to control the optional External Dynamic Dilution System (EDDS). (Applicable for the GLA351-CCIA3)

Figure 5 shows an example of the *Data Interface Connection Ports* of a GLA351-N2OCM.

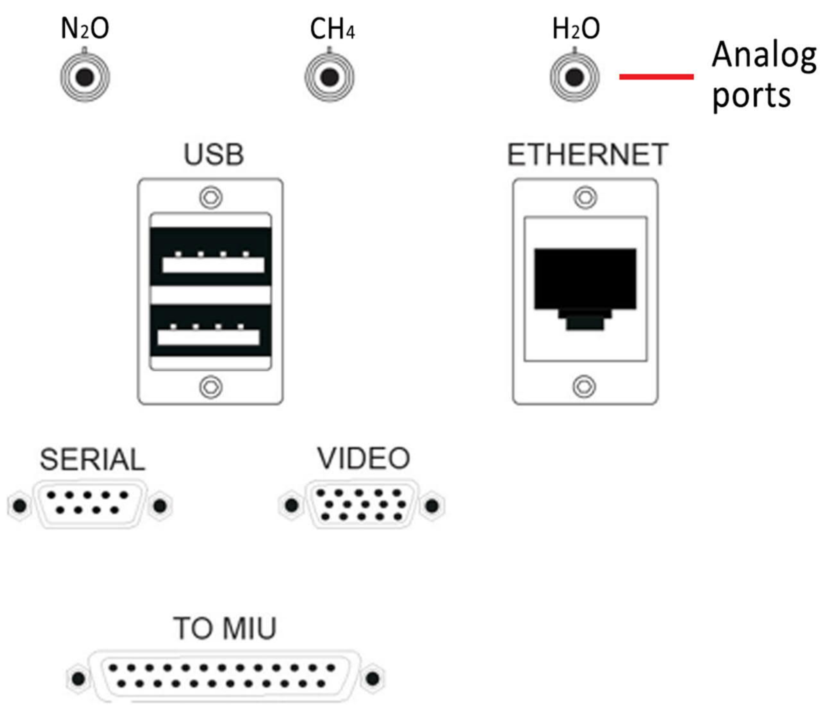


Figure 5: Data Interface Connection Ports (GLA351-N2OCM)

Plumbing Diagram

The plumbing diagram measures the internal flow of gas through the analyzers.

Standard Plumbing

Figure 6 shows an example of the internal flow of gas in standard plumbing analyzers. Configurations will vary depending on the analyzer type and may not include an external pump.

For standard operation, the internal pump draws gas through the *Sample Inlet* Swagelok port on the back panel of the analyzer. The gas is filtered through a filter before entering the pressure controller, which determines the analyzer flow rate. The gas then travels through the optical cell and is exhausted through the Internal Pump Exhaust port. The acceptable inlet gas pressure range is 1 to 5 psig.

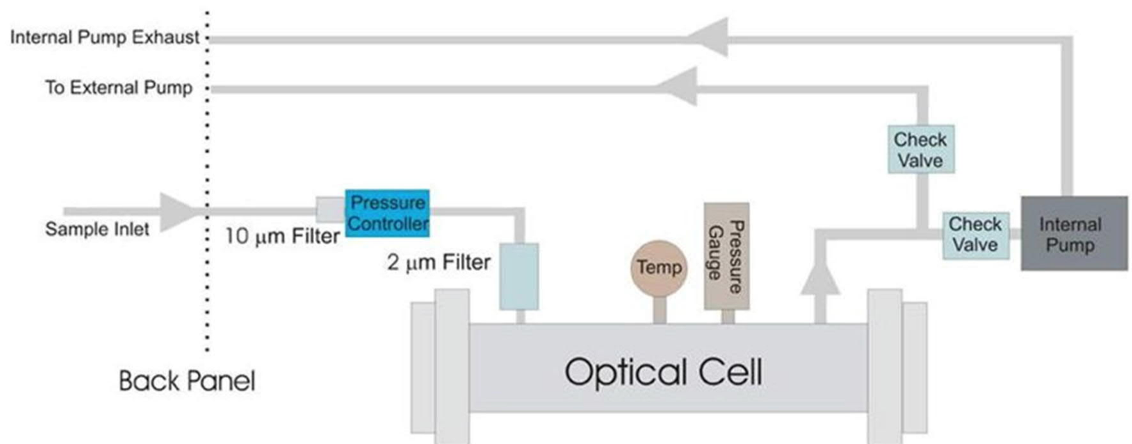


Figure 6: Standard Plumbing Diagram for a GLA351-N2OCM

Optional Fast Flow Mode

Analyzers with fast flow capabilities (external pump on/internal pump off) measure data at a higher flow rate. Fast analyzers are equipped with an external throttle valve (Figure 7) to tune the pressure of the system so the pressure in the gas cavity remains within the pressure control range of the internal pressure controller during measurement. Details on how to adjust the throttle valve are located in Appendix F: Fast Flow Operation on page 107.

The gas exiting the cell flows through the external pump pathway during fast flow. Both the internal pump and external pump outlet flow paths are isolated by check valves to prevent leakage from the flow path that is not in use.

NOTE Cap the *Internal Pump Exhaust* port with the provided ¼" Swagelok cap during Fast-Flow operation.

Figure 7 shows the optional external high-flow throttle valve.

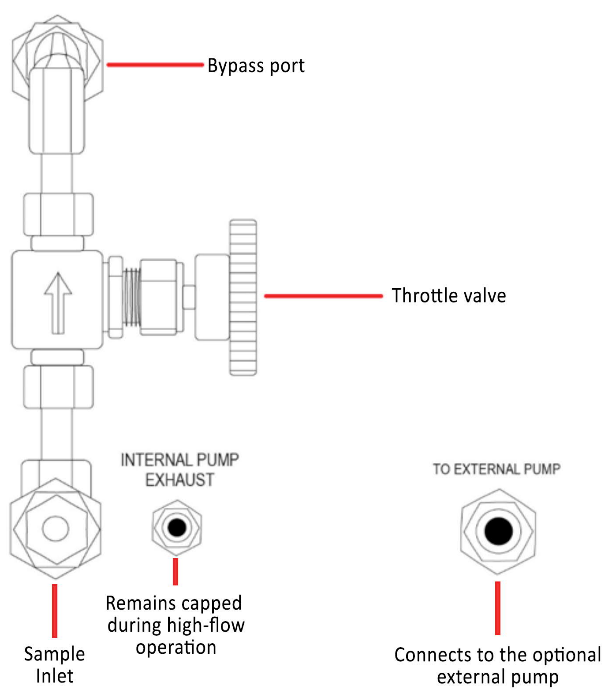


Figure 7: High-Flow Throttle Valve

The optional external pump draws gas through the *Sample Inlet* Swagelok port on the back panel of the analyzer, and the waste is exhausted through the *To External Pump* Swagelok port when set to Fast Flow Mode.

Figure 8 shows the optional fast flow plumbing diagram. Configurations may vary depending on analyzer type.

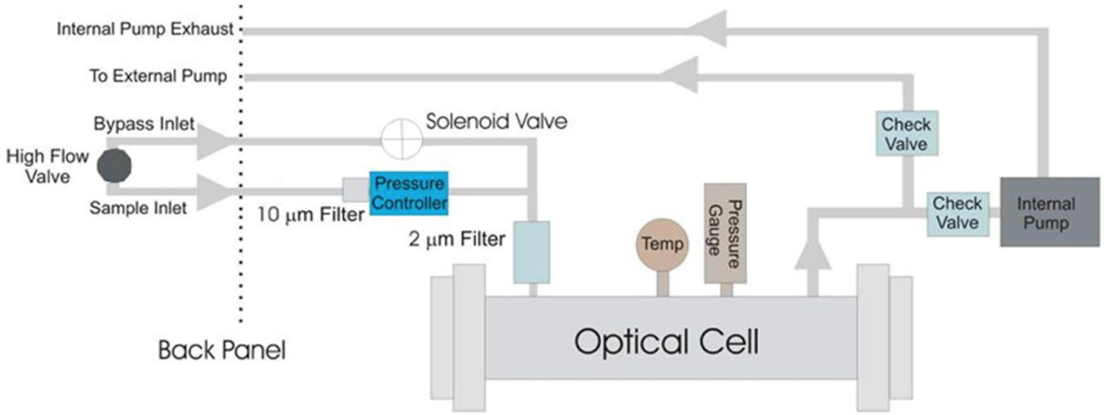


Figure 8: Plumbing Diagram for Fast Flow Mode analyzers

Fast and Slow Flow Pump Options

Some analyzers come equipped with an internal pump. However, the optional external pump provides the ability to achieve a faster flow response.

In fast-flow mode, you must connect a compatible external pump to the analyzer. Table 5 describes the compatible pump options.

Flow-through times of the available external pumps:

- 3-head diaphragm vacuum pump (ACC-DP3H)
  - Provides flow-through (1/e) time = 1.2 seconds
- 4-head diaphragm vacuum pump (ACC-DP4H)
  - Provides flow-through (1/e) time = 0.5 seconds
- Dry Scroll Vacuum Pump (ACC-DS10)
  - Provides flow-through (1/e) time = <0.1 seconds

Table 5: Pump Options

Modes of Operation	Internal	ACC-DP3H	ACC-DP4H	XDS-35	Remarks
Standard Mode	X	X			
Fast Flow Mode	X	X	X	X	See Appendix Fast Flow Operation on page 107.

Plumbing Diagram with a Pretreatment Box

For the GLA351-CCIA3, the external pump draws gas through the *SAMPLE INLET* port (1/4" Swagelok) on the back panel of the analyzer. The gas is filtered through a 10µm filter before entering the pressure controller, which throttles the flow to maintain the optical cell at its' target pressure. The gas is exhausted through the *TO EXT. PUMP* port (3/8" Swagelok).

Figure 6 shows the plumbing diagram for the GLA351-CCIA3.

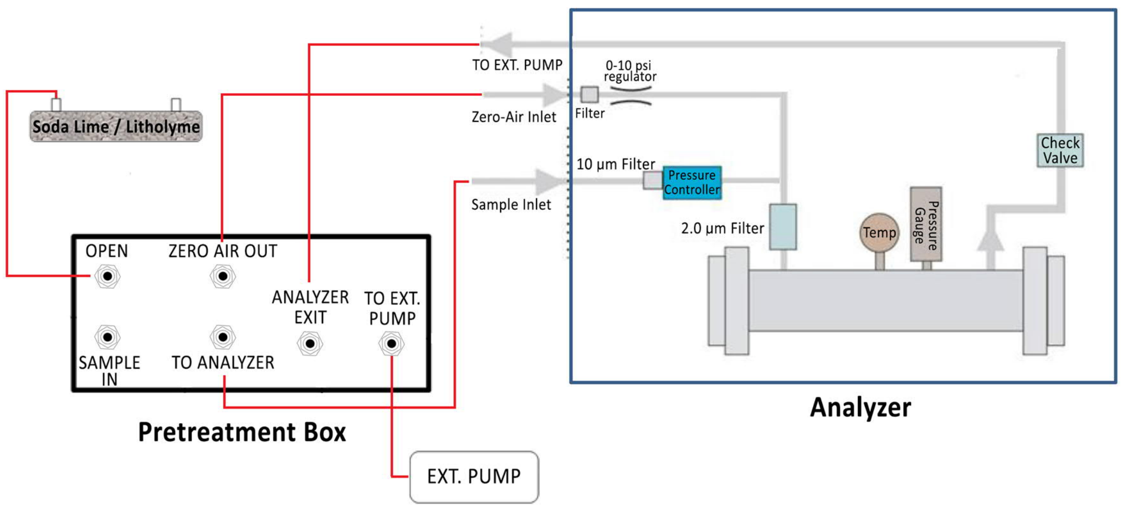


Figure 9: Plumbing Diagram (GLA351-CCIA3)

Gas Inlet / Outlet Connections

The gas inlet and outlet ports are located on the back panel of the analyzer. (Figure 3) Configurations will vary among analyzer types. These ports are shown in detail in Figure 10.

The unit ships with inlets and outlets capped for protection. The connections use Swagelok fittings ISO thread size 1/4”, 3/8” and ½”.

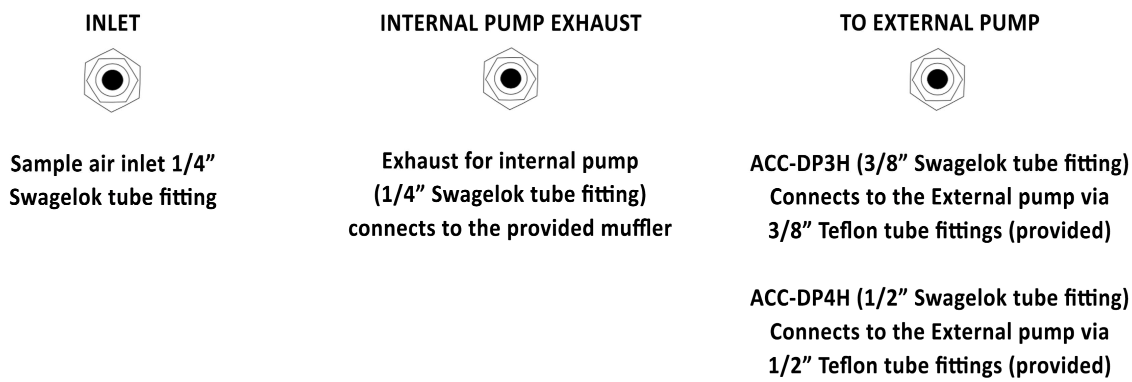


Figure 10: Gas Inlet / Outlets

NOTE

For standard use with the internal pump, the optional TO EXTERNAL PUMP port must remain capped with the provided cap.

Figure 11 shows the configuration for the GLA351-CCIA3 analyzer. The gas inlet and outlet ports are located on the back panel of the analyzer. (Figure 3)

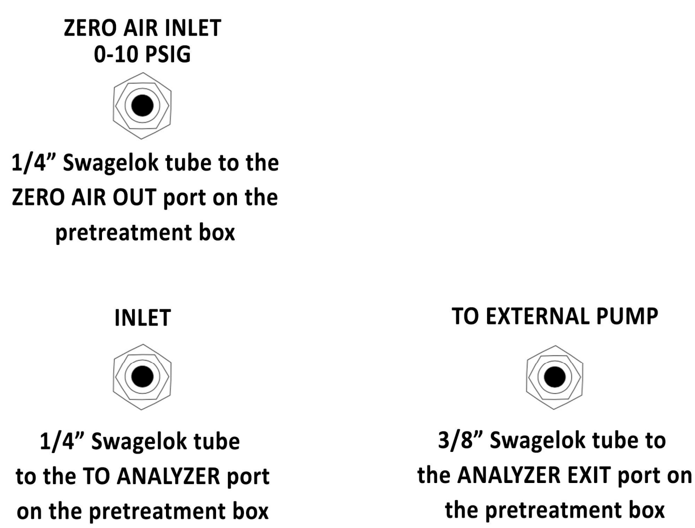


Figure 11: Gas Inlet / Outlets

Exhaust ports:

- The *Internal Pump Exhaust* port is located on the back panel of the analyzer. It can either be connected to the provided muffler (Figure 12) to expel exhaust into the room air, or the exhaust can be routed to the facility ventilation system using ¼" tubing.
- In optional Fast-Flow mode, the exhaust is located on the external pump. It can either be connected to the provided muffler to expel exhaust into the room air, or the exhaust can be routed to the facility ventilation system.

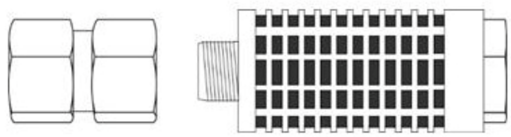


Figure 12: Exhaust Muffler

Warning Labels and Descriptions

This section describes the warning labels shown on the analyzer.

- Table 6 gives a description of the warning labels.
- Figure 13 shows the location of the labels on the analyzer.

Table 6: Warning Labels and Descriptions

Label	Description
	The laser is rated Class 3 (invisible laser radiation) when the housing is open. Only trained maintenance personnel may open the analyzer housing.
	General laser warning label.

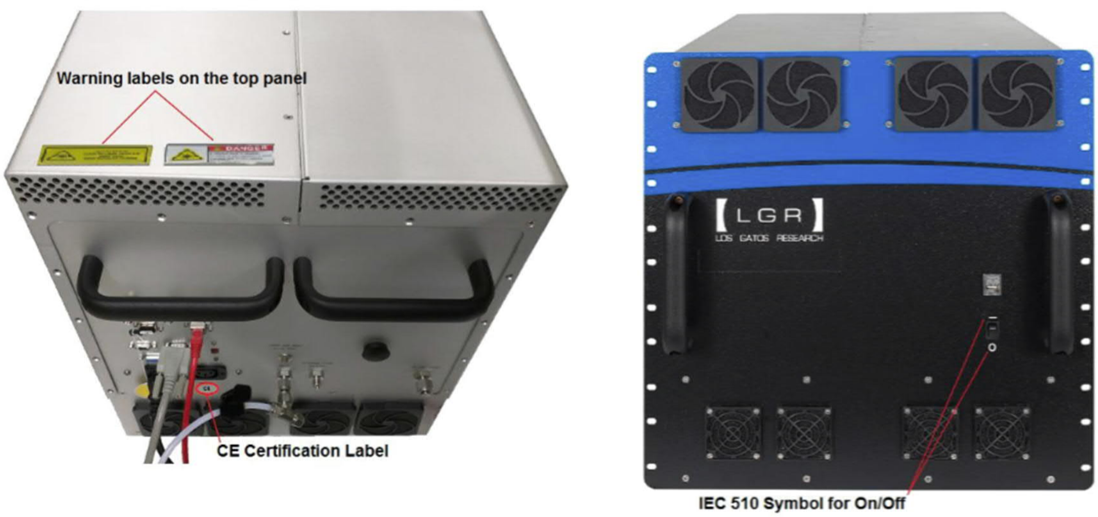


Figure 13: Warning Label Locations

2 Mount the Analyzer

Mounting Specifications

This section provides the weight and dimensions of the analyzer related to rack mounting. Figure 14 shows the mounting-hole dimensions.

External Dimensions:

19.5”H x 19”W x 34”D

Weight:

68 kg

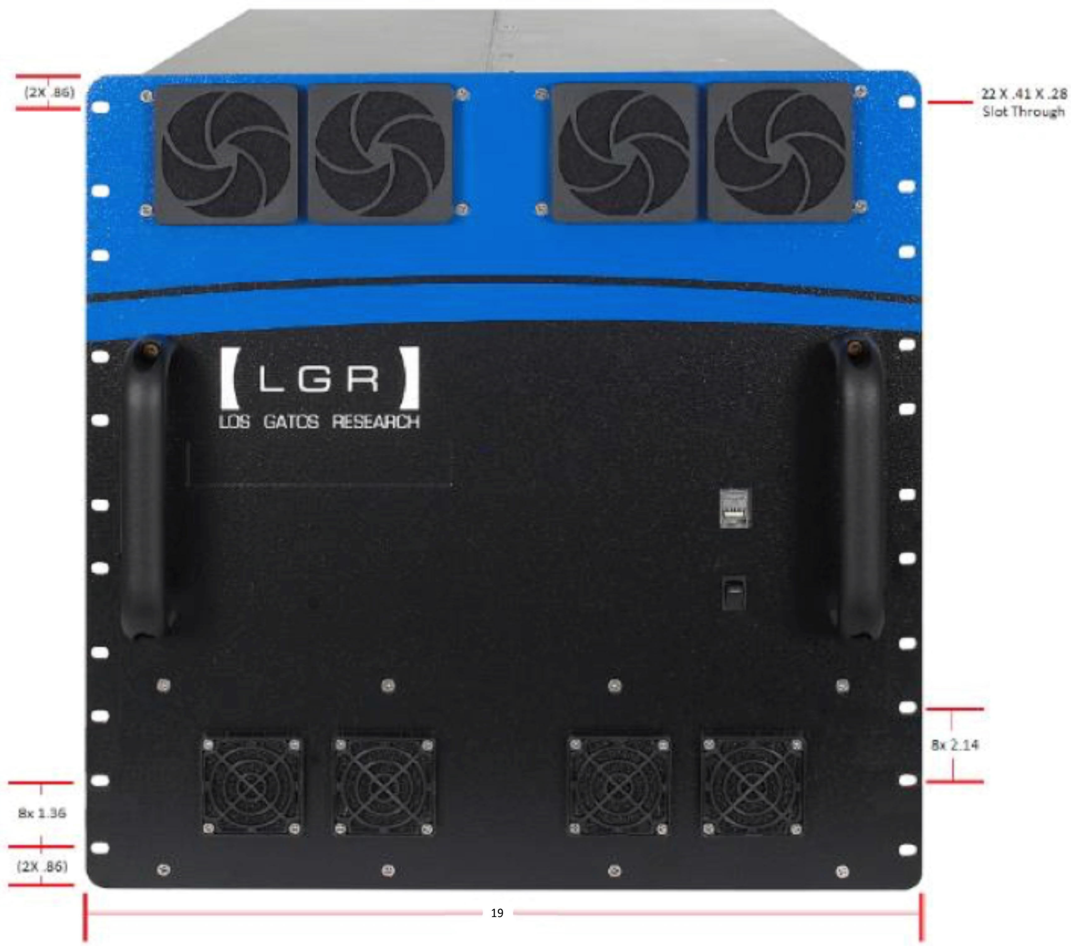


Figure 14: Front Panel Dimensions and Mounting Holes

Rack-Mount Installation

1. With one person on each side of the analyzer (two people total), lift the rear of the analyzer onto the user provided L-brackets.
2. Push the analyzer fully into the rack until the flanges on the front panel of the analyzer are flush with the outer edge of the rack. Make sure that the mounting holes on the rack match with the mounting holes on the analyzer's front panel.
3. Insert the user provided mounting hardware through the mounting holes on the rack and analyzer front panel.
4. Secure the hardware.

Rack Mounting Ventilation and Power Requirements

A continuous flow of air is pumped through the inlet port and out through the *TO EXT PUMP* port on the back panel of the analyzer. When mounting the analyzer:

- Do not block the front or back panels.
- Leave at least four inches of free space at the front and back of the analyzer for proper ventilation and cooling.
- Leave sufficient space behind the rack to unplug the analyzer power cord.
- When mounting the analyzer in an equipment rack, no side clearance is required.

The analyzer is equipped with a three-prong power plug. The third prong of the facility electrical outlets must be grounded. Failure to ground the third prong may result in electrical damage to the analyzer and electrical shock to the operator.

Emergency Shutdown Procedure

If the analyzer malfunctions and requires emergency shutdown:

1. Turn off the analyzer using the front panel on/off switch. (Figure 2)
2. Unplug the power cord from the analyzer. (Figure 4)
3. Notify trained service personnel that the analyzer needs repair or servicing.

3 Analyzer Setup

Connect the Power Cords

1. Connect the analyzer power cord from the AC power port on the back panel to a grounded outlet of your power supply. (Figure 4)
2. If applicable, (for optional Fast-Flow mode), connect the external pump's power cord from the pump to the EXT. PUMP POWER port on the back panel of the analyzer. (Figure 4)

Connect the Data Interface Connections

1. See Figure 5 for a detailed description of the connections.

Connect the Inlet / Outlet Plumbing Connections

1. Connect the provided exhaust muffler with Swagelok adaptor to the INTERNAL PUMP EXHAUST port to exhaust into the room air, or route to your facility ventilation system, using ¼" tubing. (Figure 15)

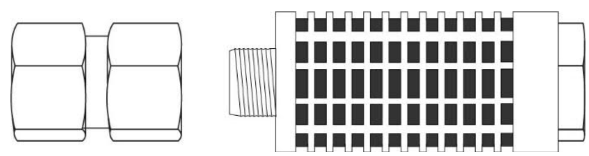


Figure 15: Exhaust Muffler with ¼' Swagelok Adaptor

2. If applicable, connect a ¼" sample tube (not provided) from the INLET port on the back panel of the analyzer to your sample source.
3. If applicable, (for optional Fast-Flow mode), connect the External Pump's 6'x 3/8" Teflon tubing with Swagelok fittings from the external pump to the TO EXT PUMP port on the back panel of the analyzer. (Figure 4)
    a. Cap the Internal Pump Exhaust port with the provided ¼" Swagelok cap during Fast-Flow operation. (Figure 10)

Connect the GLA351-CCIA3 analyzer to the pretreatment box

1. Connect the provided 6' x 3/8" tubing from the external pump to the pretreatment box TO EXT. PUMP port.
2. Connect the pretreatment box from the ANALYZER EXIT port to the analyzer's TO EXT. PUMP port, using the provided 6' x 3/8" Swagelok connector and tubing.
3. Connect the pretreatment box ZERO AIR OUT port to the ZERO AIR INLET port on the analyzer, using the provided 6' x 1/4" Swagelok connector and tubing.
4. Connect the pretreatment box TO ANALYZER port to the INLET port on the analyzer, using the provided 6' x 1/4" Swagelok connector and tubing.
5. Attach the pretreatment box OPEN port to the external Soda Lime / Litholyme canister, using the 3'x1/4" Swagelok connector and tubing.
    a. Leave the opposite end of the canister open to the atmosphere.
6. Connect the provided exhaust muffler to the exhaust port of the external pump to expel into the room air, or route to your facility ventilation system. (Figure 15)

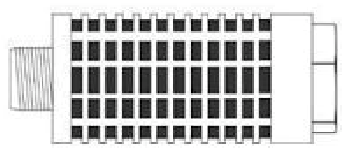


Figure 16: Exhaust Muffler

7. Connect a ¼" sample tube (not provided) from the SAMPLE IN port on the pretreatment box to your sample source.

Figure 17 shows the pretreatment box plumbing diagram.

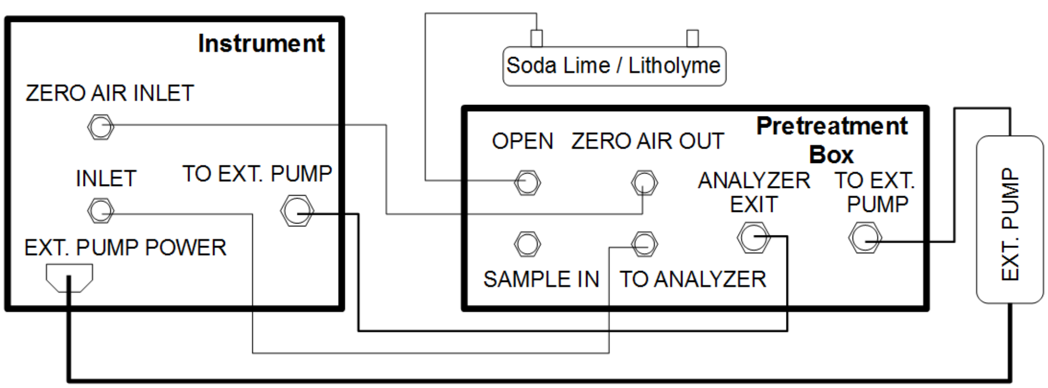


Figure 17: Pretreatment Box Plumbing Diagram

Attach and Tighten the Swagelok Connectors

1. Tighten the Swagelok connections to between 1/4 and 1/2 turn past finger tight. Leave a gap of at least 3.5 mm as shown in Figure 18.
2. Table 7 lists the Swagelok fitting sizes and recommended wrench sizes.

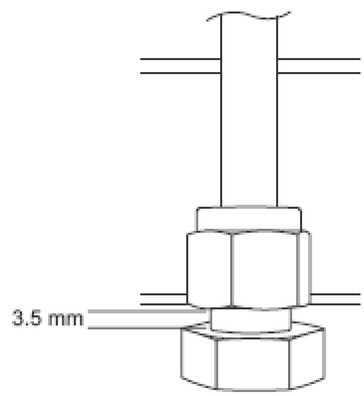


Figure 18: Swagelok Connection Gap

Table 7: Recommended Wrench Sizes for Swagelok Fittings

Swagelok Fitting Size	Recommended Wrench Size
1/8”	7/16”
1/4”	9/16”
3/8”	11/16”
1/2”	7/8”

The Pretreatment Box for the GLA351-CCIA3

The pretreatment box dries the sample so the water concentration is maintained below 500 ppm.

The Pretreatment box:

- Removes water from the sample
- Removes water and CO_2 from the atmosphere to generate zero air

---

NOTE

Replace the soda lime filter as needed (normally at six week intervals). When the LithOlyme in the canister turns purple, it needs to be replaced.

The Soda Lime/Litholyme has a finite lifetime and will need to be replaced periodically. Under continuous operation, one canister lasts approximately six weeks. The pretreatment system includes a canister inside the box, which is sufficient for CO_2 scrubbing. However, ABB-LGR recommends using an additional canister external to the pretreatment box as a redundancy and to make monitoring and replacement easier. As the scrubber is exhausted, it will change color from white to purple. (Figure 19) Since there is an additional canister inside the pretreatment box, the Soda Lime/Litholyme in the external canister can be replaced without any analyzer down-time.

Figure 19 shows LithOlyme in both fresh and depleted conditions.

Figure 19: LythOlyme (Fresh and Depleted)

4 Initialize and Run the Analyzer

To initialize the analyzer:

1. Press the power switch on the front of the analyzer to the ON position. (0 = OFF / - = ON) The internal computer initializes, and a screen (Figure 20) displays as the program loads. The *Launch Service* screen displays after initialization. (Figure 22)
2. Click on the launch button to manually launch the analyzer.
   a. The launch button is the abbreviated name of the gas analyzer. For example, the GLA351-N2OCM button displays N2O-CO. (Figure 22)
   b. If you don't make a selection within 120-seconds, the analyzer automatically defaults to the *Main Panel Numeric* display. (Figure 28)
3. Click on the maintenance SERVICE button (Figure 22) if you need more time or need to choose a *maintenance setting*. (Figure 23)

Important!

Once a month, the analyzer automatically performs a thorough file system integrity check during startup. This maintenance takes approximately one to two minutes before it continues to load the software.

Do not turn off the computer during the monthly maintenance!

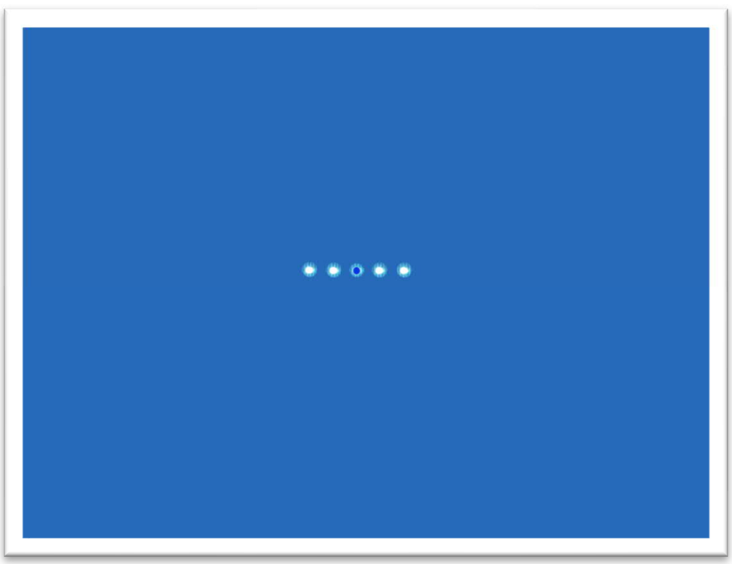


Figure 20: Start up Screen in Busy Mode

File System Integrity Check

Once a month, the analyzer automatically performs a file system integrity check following initialization. Figure 21 shows the screen you see while the integrity check runs. The integrity check runs for one to two minutes before launching the analyzer's control software.

WARNING

Do not turn off the computer while the integrity check is running.

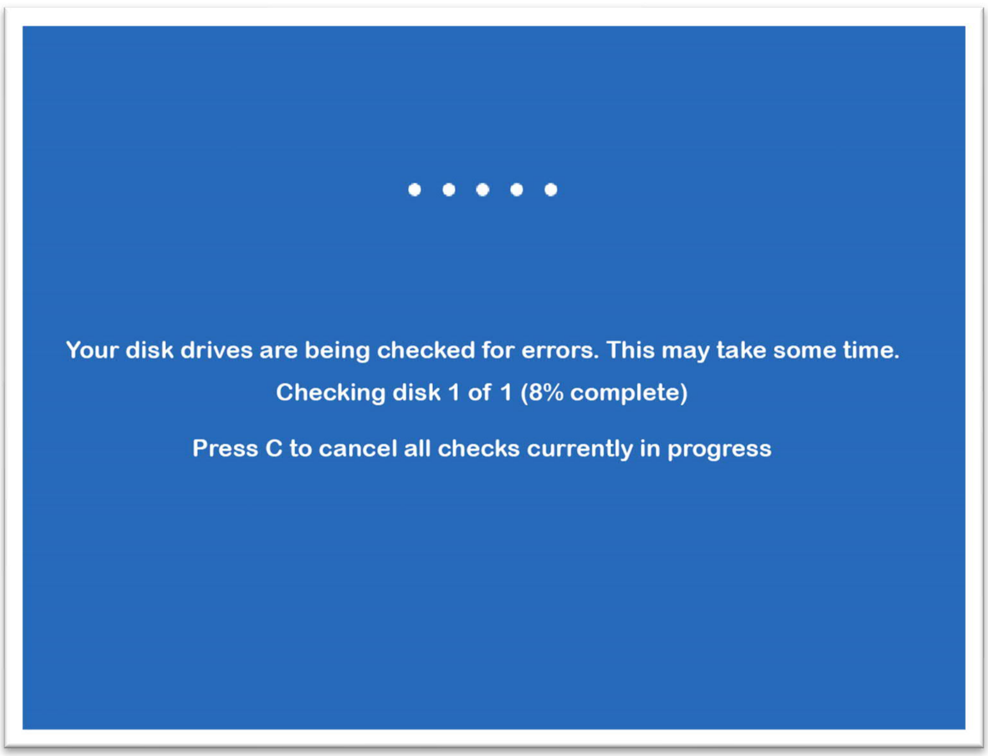


Figure 21: File System Integrity Check Screen

Thermal Stabilization

Run the analyzer for four hours before collecting data. This allows the internal temperature to stabilize. The exact final cell temperature will be analyzer specific (~40-45°C).

The Launch Service Screen

The *Launch Service* screen displays when initialization is completed. (Figure 22) From this interface, you can:

- Bypass the auto launch countdown to manually start recording measurements by clicking the launch button.
  - o The launch button is the abbreviated name of the gas analyzer. For example, the GLA351-N2OCM launch button displays N2O-CO as shown in Figure 22.
- Open the auto launch window by clicking Service.
- Turn off the analyzer by clicking Shutdown.

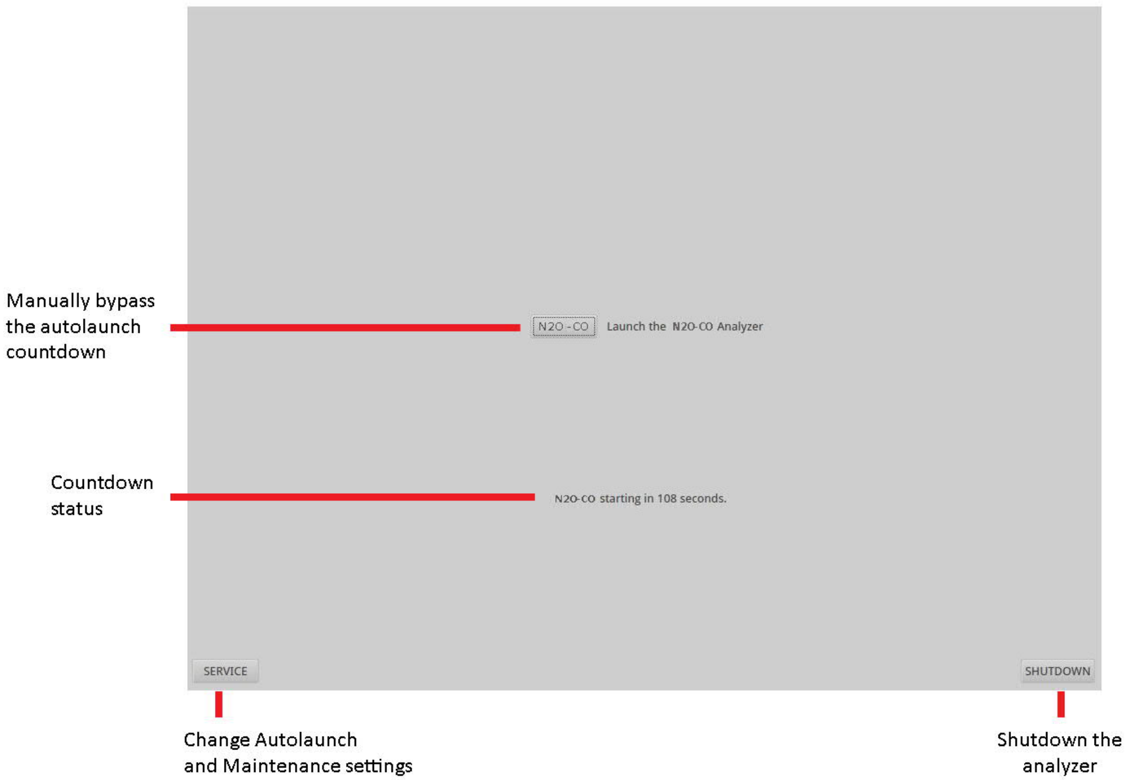


Figure 22: Launch Service Screen

The Auto Launch Screen

The Auto Launch and Maintenance settings are available when you click the Service button on the *Launch Service* screen. From this interface, you can:

- Change the auto launch delay timing.
- Transfer files from the internal hard drive to an external storage device connected via USB by clicking Files.
- Restore the analyzer's factory settings by clicking Restore.

Figure 23 shows the *Auto Launch* screen for the GLA351-N2OCM.

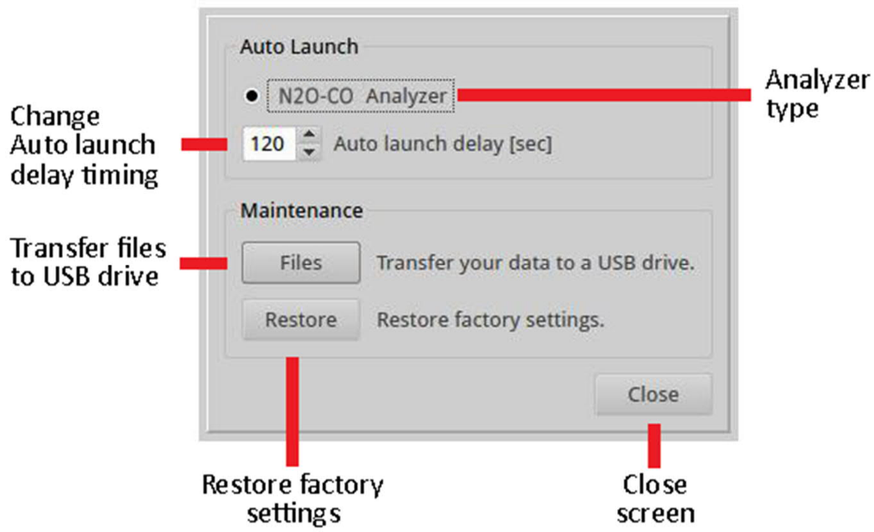


Figure 23: Auto Launch Screen (GLA351-N2OCM)

Login to Access Menu Options

To access the analyzer user interface features, log into the system as follows:

1. Click the Security button on the *User Interface Control Bar*. (Figure 24)

Figure 24: Control Bar Security Button

2. For initial login, use the default Linux credentials for the username and password (Figure 25), as follows:

   User: lgr

   Password: 3456789

If you change and forget this password, you will not be able to recover it without a factory restore.

There is only one Linux account.

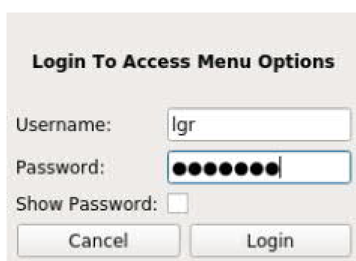


Figure 25: Login Dialog Box

3. Click Login.

Main Panel

After the software launches, the *Main Panel* is displayed. Figure 26 shows the *Main Panel* for the GLA351-N2OCM. The gases displayed are dependent on the type of analyzer.

The operational status of the analyzer is displayed at the bottom of the main panel:

- 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.

NOTE

Refer to the *Alarm Status Display* section on pages 41 - 43 for detailed Temperature Status and Analyzer Status descriptions.

This panel contains the *User Interface Control Bar* (Figure 27) and *Numeric* Display. (Figure 28)

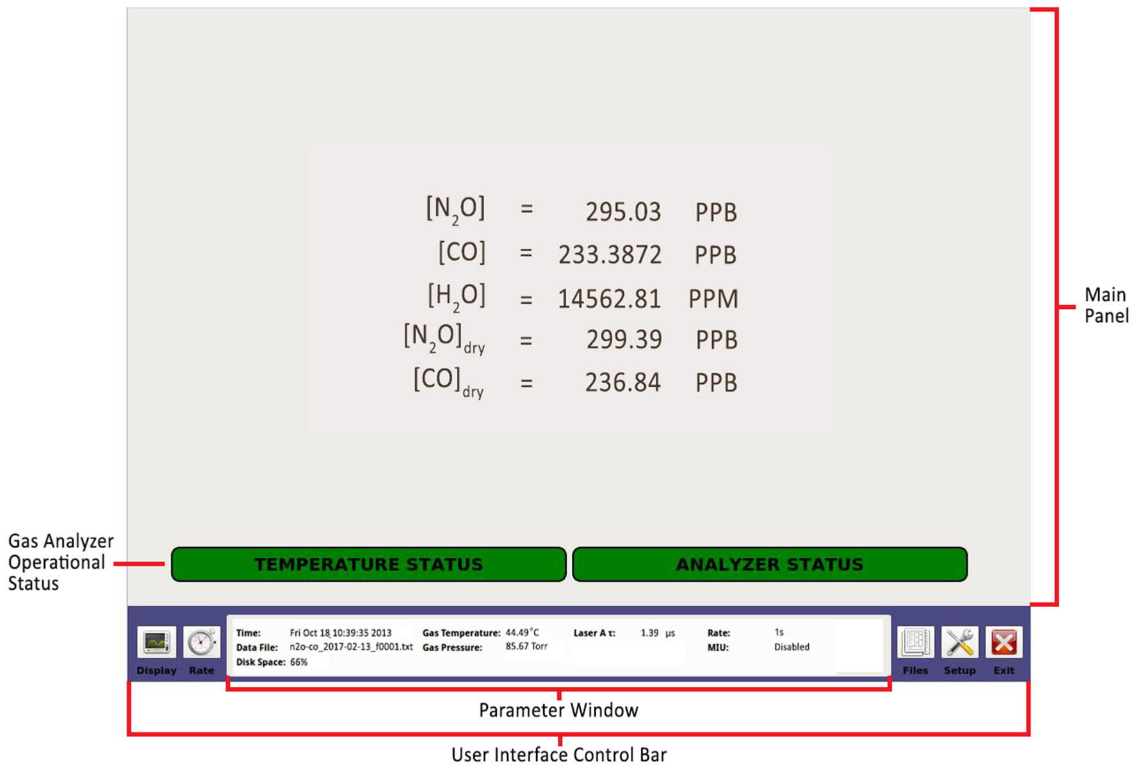


Figure 26: Main Panel

User Interface Control Bar

Use the control bar to operate the analyzer. (Figure 27)

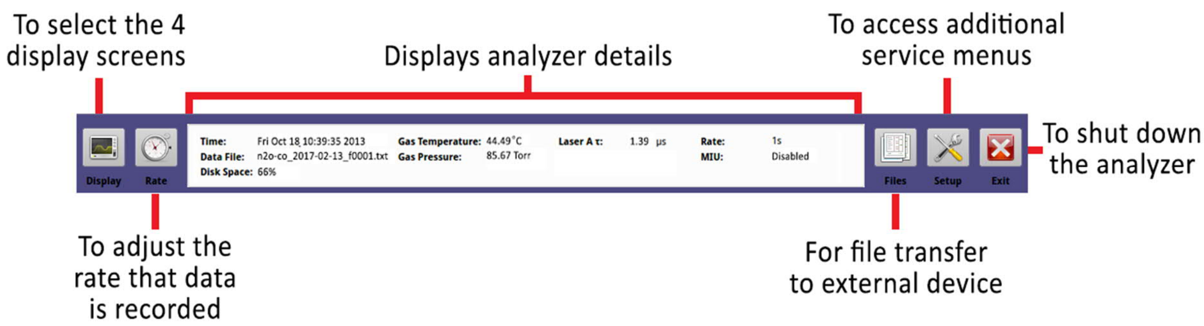


Figure 27: User Interface Control Bar

Display – Toggles through the four *Main Panel* display formats:

- *Numeric Display* – Default display. Displays the numeric readout of the last measurement. (Figure 28)
- *Alarm Status Display* – shows the operational status of the analyzer. (Figure 29)
- *Spectrum Display* – Displays the raw and fitted spectral scans. (Figure 30)
- *Time Chart Display* – Displays the concentration over time. (Figure 31)

Rate – Adjusts the rate at which data is written to the log file. (Figure 32)

Parameter Window – Displays the:

- Time – Current time
- Data File – Current filename to log data
- Gas Temperature – Temperature in Cell (Celsius - °C)
- Gas Pressure – Pressure in Cell (Torr)
- Laser A τ – Laser A ring-down time (micro-seconds - µs)
- Laser B τ – Laser B ring-down time (micro-seconds - µs)
  - Only applicable for two laser systems
- MIU– Multiport Inlet Unit
- Rate – Sampling Frequency
- Disk Space – Remaining hard-drive space

Files – Allows easy transfer of files onto USB storage devices.

Setup – Accesses additional configuration and service menus.

Exit – Exits the application and shuts down the analyzer.

Main Panel Displays

Click the Display button to change the display in the *Main Panel*. Clicking the Display button multiple times lets you cycle through the four main panel displays. When the analyzer is launched, it defaults to the *Numeric Display*. The four displays within the display function are:

- Numeric
- Alarm Status
- Spectrum
- TimeChart

This section describes the displays.

Numeric Display

The *Numeric Display* is the default display. It appears when the analyzer is first turned on or re-initialized.

Figure 28 shows an example of the *Numeric Display* screen for the GLA351-N2OCM. It displays the numeric readout of the last measurements of gas at a specific concentration. Concentrations vary depending on the type of analyzer.

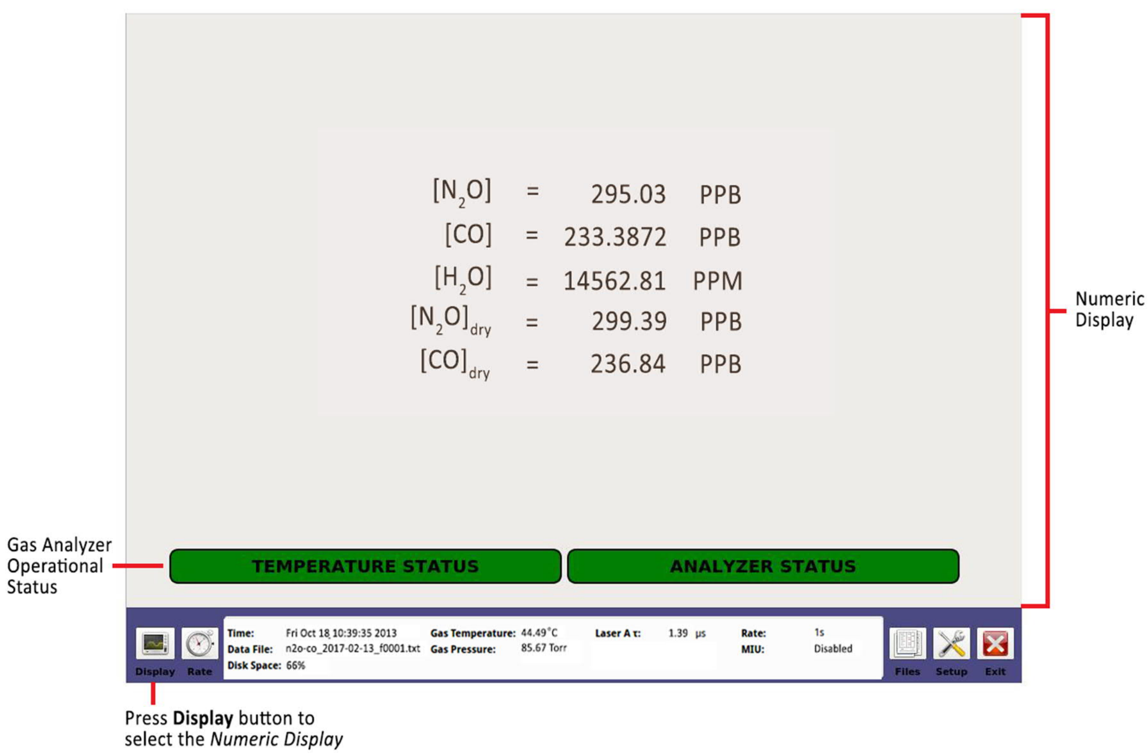


Figure 28: Numeric Display (GLA351-N2OCM)

Alarm Status Display

The *Alarm Status* display (Figure 29) shows the detailed operational status of the analyzer.

The *Alarm Status* is color-coded:

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

Figure 29 shows the *Alarm Status Display* with all parameters functioning properly.

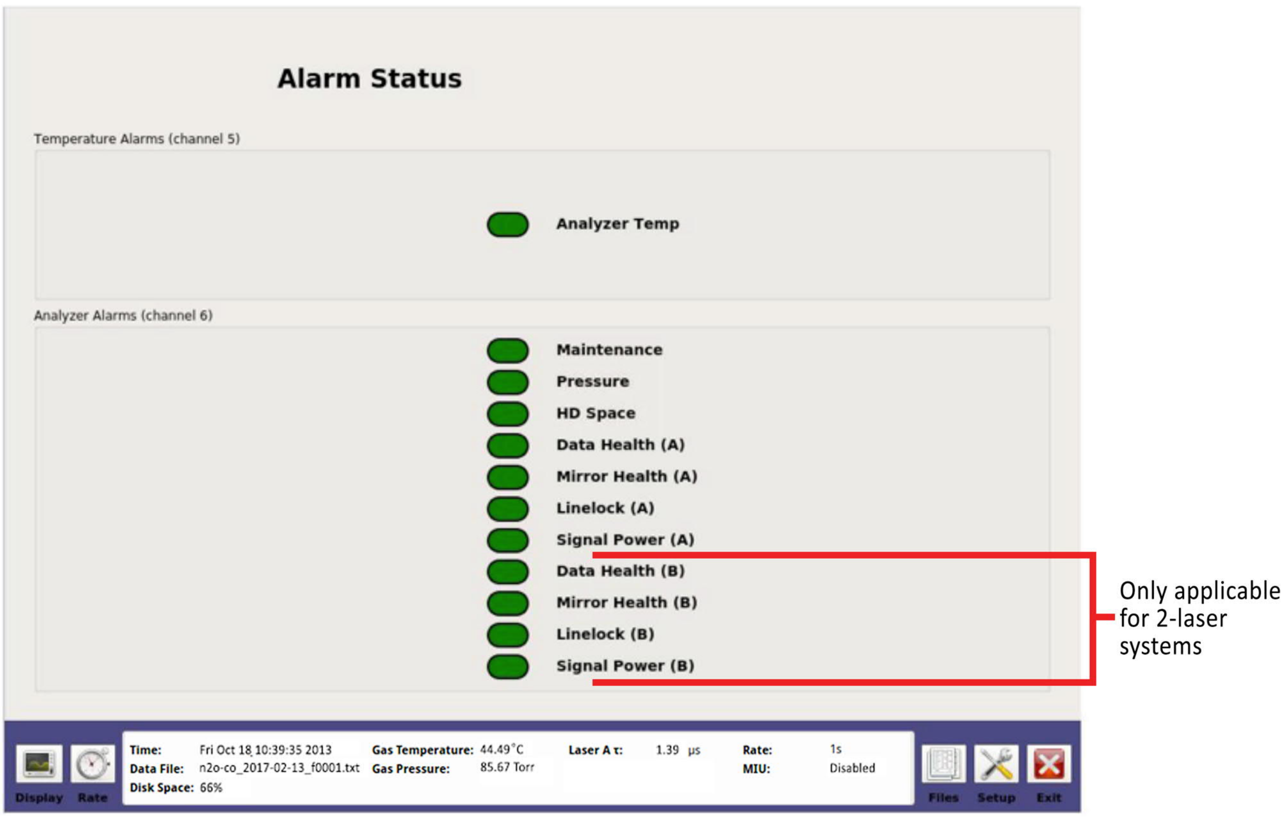


Figure 29: Alarm Status

Table 8 describes fault criteria for the Temperature Alarms.

Table 8: Fault Criteria for Temperature Alarms

Status	Sensor Read	Fault Condition	Description
10	Analyzer Temp	Temperature High/Low Alarm	The temperature exceeds the operating temperature range.
11	CROSS OVER		
14	Analyzer Temp	Temperature High/Low Warning	The temperature is > the high warning set point. The temperature is < the low warning set point.
17	Fault	NaN reading	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

NOTE

If the *Alarm Status* is Yellow or Red please refer to the *Maintenance* section on page 72. If issue continues, please contact icos.support@ca.abb.com.

Table 9 describes fault criteria for the Analyzer Alarms.

NOTE

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

Table 9: 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.
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

NOTE

If the *Alarm Status* is Yellow or Red please refer to the *Maintenance* section on page 72. If issue continues, please contact icos.support@ca.abb.com.

Spectrum Display

Click the Display button on the *User Interface Control Bar* to switch to *Spectrum Display*.

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 displayed as black circles and the peak fit resulting from signal analysis as a blue line.

The measured concentrations are shown in parts per million (ppm), parts per billion (ppb) or ‰ (permil) on the bottom of the *Spectrum Display*.

Figure 30 shows the *Spectrum Display* for the GLA351-N2OCM.

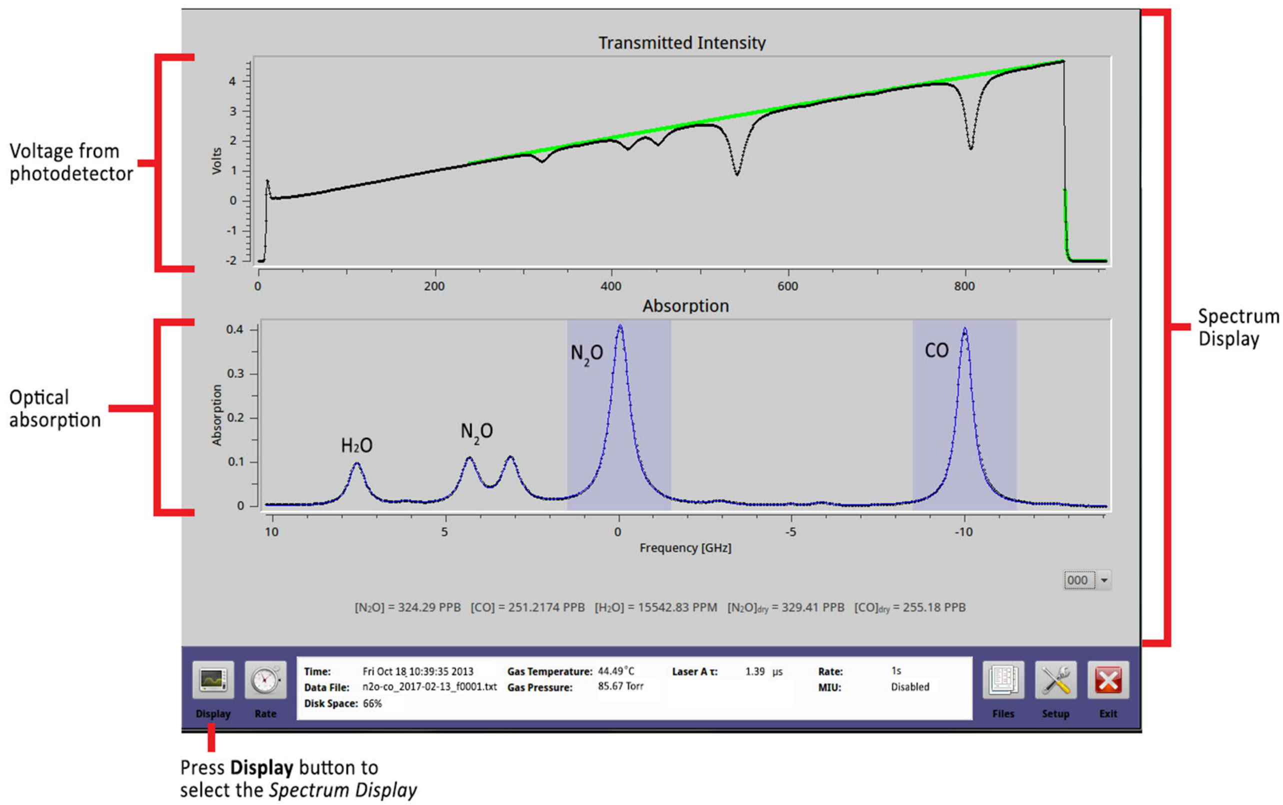


Figure 30: Spectrum Display (GLA351-N2OCM)

Refer to Appendix I:Spectrum Displays on page 121 - 123 to view the *Spectrum Displays* for different analyzer types.

Table 10: Spectrum Displays for different analyzer types

Analyzer Type	Figure for Reference
GLA351-CCIA3	Figure 119
GLA351-N2OCM	Figure 120
GLA351-N2OM1	Figure 121

TimeChart Display

Click the Display button on the *User Interface Control Bar* to switch to the *TimeChart* Display.

The *TimeChart* Display is a real-time measurement of concentration vs. time.

Figure 31 shows the *TimeChart* with a continuous flow of gas. A 10-point running average (in black) is shown going through the raw data (shown in blue).

Click on the drop-down box in the lower-right corner of either window to toggle between available gases, and to adjust the number of significant figures.

The data is saved to the file indicated in the left corner of the *parameter window*.

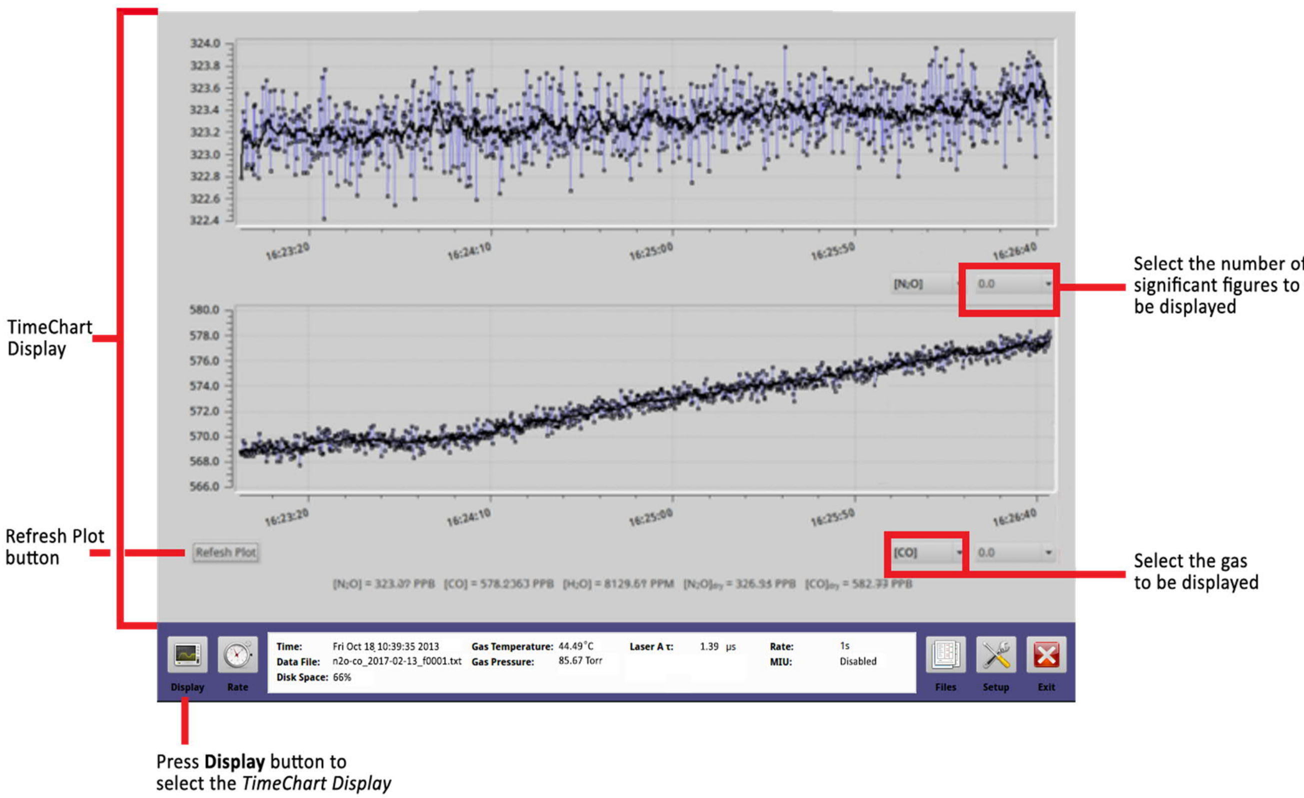


Figure 31: TimeChart Display (GLA351-N2OCM)

Rate Control

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

When the Rate button (clock icon) on the *User Interface Control Bar* (Figure 27) is selected, a pop-up box appears to allow rate control adjustments to the operating mode and plot frequency. Figure 32 shows the *Rate Control Screen* for the GLA351-N2OCM.

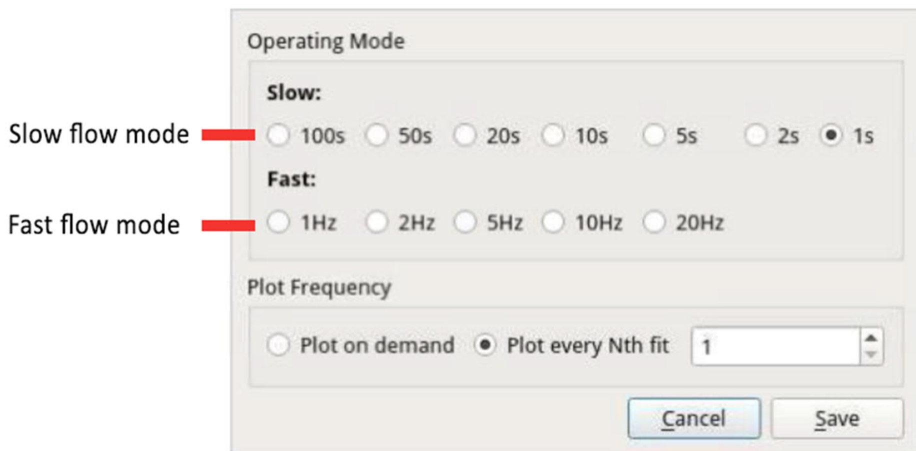


Figure 32: Rate Control Screen (GLA351-N2OCM)

The *Operating Mode* radio buttons allow you to change the rate at which data is written to the log file. To adjust the rate:

1. Click the Rate button (clock icon) on the *User Interface Control Bar.* (Figure 27) The *Data Rate Control Adjustment* panel appears. (Figure 32)
2. Click the Operating Mode radio buttons to select the rate at which data is acquired.
    a. Slow-flow mode
        i. The internal pump is powered on.
        ii. The (optional) external pump is powered off.
    b. Fast-flow mode (optional) (Not available for the GLA351-CCIA3)
        i. The internal pump is powered off.
        ii. The (optional) external pump is powered on.
3. Click Save.

The *Plot Frequency* radio buttons allow you to select between manually or automatically plotting the data. (Figure 32)

To adjust the frequency:

1. Click the Rate button (clock icon) on the *User Interface Control Bar.* (Figure 27) The *Data Rate Control Adjustment* panel appears. (Figure 32)
2. Click the Plot on Demand radio button to manually plot the data.
    a. When selected, the *Refresh Plot* button appears on the *Main Panel* display. When Refresh Plot button is selected, (Figure 31), current data is added to the *Main Panel* display.
3. Click the Plot every Nth fit radio button to automatically set the rate at which the data is updated on the *Main Panel* display.
    a. For example, if you set the value to 5, a data point will be saved every 5 seconds.
4. Click Save.

NOTE

The analyzer restarts sampling at whatever rate was set last.

File Transfer Menu

Use the *File Transfer* menu to access data collected by the analyzer.

- Each time the analyzer is re-started, the most recent file name is displayed in the form: xxx_2020-12-29_f0001.txt, where the:
  - o First characters represent the analyzer model (Example: n2o-co)
  - o Next 10 characters represent the date (yyyy-mm-dd)
  - o Last four numbers are a serial number.
- The serial number counts upward to provide up to 10,000 unique file names each day.
- If the analyzer is left in continuous operation, a new data file will automatically be created every 24 hours to keep data file sizes manageable.

Standard Data File

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)
- Ring-Down Time (microseconds)

The format can be changed in the *Time/Files* menu of the *Setup* panel. (Figure 40)

Figure 33 shows a typical data file for the GLA351-N2OCM.

```
VC:4d207bb BD:Sep 18 2013 SN:LGR-13-0237
                       Time,      [H2O]_ppm,   [H2O]_ppm_sd,       [CO]_ppm,    [CO]_ppm_sd,      [N2O]_ppm,   [N2O]_ppm_sd,      [CO]d_ppm,   [CO]d_ppm_sd,     [N2O]d_ppm,  [N2O]d_ppm_sd,
  10/18/2013 11:37:15.979,    9.45331e+03,    0.00000e+00,    4.73549e-01,    0.00000e+00,    3.28641e-01,    0.00000e+00,    4.78069e-01,    0.00000e+00,    3.31778e-01,    0.00000e+00,
  10/18/2013 11:37:16.975,    9.46334e+03,    0.00000e+00,    4.73581e-01,    0.00000e+00,    3.28602e-01,    0.00000e+00,    4.78106e-01,    0.00000e+00,    3.31741e-01,    0.00000e+00,
  10/18/2013 11:37:17.970,    9.45821e+03,    0.00000e+00,    4.73584e-01,    0.00000e+00,    3.28577e-01,    0.00000e+00,    4.78106e-01,    0.00000e+00,    3.31714e-01,    0.00000e+00,
  10/18/2013 11:37:18.965,    9.46073e+03,    0.00000e+00,    4.73525e-01,    0.00000e+00,    3.28569e-01,    0.00000e+00,    4.78048e-01,    0.00000e+00,    3.31707e-01,    0.00000e+00,
  10/18/2013 11:37:19.960,    9.46820e+03,    0.00000e+00,    4.73472e-01,    0.00000e+00,    3.28551e-01,    0.00000e+00,    4.77998e-01,    0.00000e+00,    3.31692e-01,    0.00000e+00,
  10/18/2013 11:37:20.956,    9.46467e+03,    0.00000e+00,    4.73659e-01,    0.00000e+00,    3.28607e-01,    0.00000e+00,    4.78185e-01,    0.00000e+00,    3.31747e-01,    0.00000e+00,
  10/18/2013 11:37:21.951,    9.48063e+03,    0.00000e+00,    4.73766e-01,    0.00000e+00,    3.28544e-01,    0.00000e+00,    4.78301e-01,    0.00000e+00,    3.31689e-01,    0.00000e+00,
  10/18/2013 11:37:22.946,    9.47657e+03,    0.00000e+00,    4.73736e-01,    0.00000e+00,    3.28652e-01,    0.00000e+00,    4.78269e-01,    0.00000e+00,    3.31796e-01,    0.00000e+00,
  10/18/2013 11:37:23.942,    9.48514e+03,    0.00000e+00,    4.73723e-01,    0.00000e+00,    3.28633e-01,    0.00000e+00,    4.78259e-01,    0.00000e+00,    3.31780e-01,    0.00000e+00,
  10/18/2013 11:37:24.937,    9.49822e+03,    0.00000e+00,    4.73569e-01,    0.00000e+00,    3.28585e-01,    0.00000e+00,    4.78110e-01,    0.00000e+00,    3.31736e-01,    0.00000e+00,
  10/18/2013 11:37:25.933,    9.50015e+03,    0.00000e+00,    4.73699e-01,    0.00000e+00,    3.28559e-01,    0.00000e+00,    4.78243e-01,    0.00000e+00,    3.31711e-01,    0.00000e+00,
  10/18/2013 11:37:26.927,    9.50055e+03,    0.00000e+00,    4.73882e-01,    0.00000e+00,    3.28487e-01,    0.00000e+00,    4.78427e-01,    0.00000e+00,    3.31638e-01,    0.00000e+00,
  10/18/2013 11:37:27.923,    9.50546e+03,    0.00000e+00,    4.73997e-01,    0.00000e+00,    3.28561e-01,    0.00000e+00,    4.78545e-01,    0.00000e+00,    3.31714e-01,    0.00000e+00,
  10/18/2013 11:37:28.918,    9.50069e+03,    0.00000e+00,    4.74064e-01,    0.00000e+00,    3.28545e-01,    0.00000e+00,    4.78612e-01,    0.00000e+00,    3.31696e-01,    0.00000e+00,
  10/18/2013 11:37:29.914,    9.51435e+03,    0.00000e+00,    4.73880e-01,    0.00000e+00,    3.28526e-01,    0.00000e+00,    4.78432e-01,    0.00000e+00,    3.31682e-01,    0.00000e+00,
  10/18/2013 11:37:30.909,    9.51289e+03,    0.00000e+00,    4.73871e-01,    0.00000e+00,    3.28578e-01,    0.00000e+00,    4.78422e-01,    0.00000e+00,    3.31734e-01,    0.00000e+00,
  10/18/2013 11:37:31.904,    9.51420e+03,    0.00000e+00,    4.73611e-01,    0.00000e+00,    3.28691e-01,    0.00000e+00,    4.78160e-01,    0.00000e+00,    3.31848e-01,    0.00000e+00,
  10/18/2013 11:37:32.899,    9.50555e+03,    0.00000e+00,    4.73912e-01,    0.00000e+00,    3.28664e-01,    0.00000e+00,    4.78460e-01,    0.00000e+00,    3.31818e-01,    0.00000e+00,
  10/18/2013 11:37:33.895,    9.50847e+03,    0.00000e+00,    4.73909e-01,    0.00000e+00,    3.28590e-01,    0.00000e+00,    4.78459e-01,    0.00000e+00,    3.31744e-01,    0.00000e+00,
  10/18/2013 11:37:34.890,    9.51129e+03,    0.00000e+00,    4.73901e-01,    0.00000e+00,    3.28630e-01,    0.00000e+00,    4.78452e-01,    0.00000e+00,    3.31786e-01,    0.00000e+00,
```

Figure 33: The Beginning of a Typical Data File

For each measurement there is an adjacent column reporting the standard deviation of the measurement (with sd suffix).

- The standard deviation is zero when the analyzer is running at 1 Hz, as no averaging of data has taken place.
- At speeds slower than 1 Hz, the standard error of the average is reported.
- At the end of each data file are encoded listings of settings used by the analyzer for that data file. Settings are typically stored for diagnostic or troubleshooting purposes.

Transfer Data Files

To transfer data files from the analyzer hard drive to a USB storage device:

1. Click the Files button on the *User Interface Control Bar* (Figure 27) to access the *File Transfer Menu*. (Figure 34)
2. Insert a USB storage device into the USB port on the front or back panel of the analyzer.
3. Click on the Mount USB button. (Figure 34)

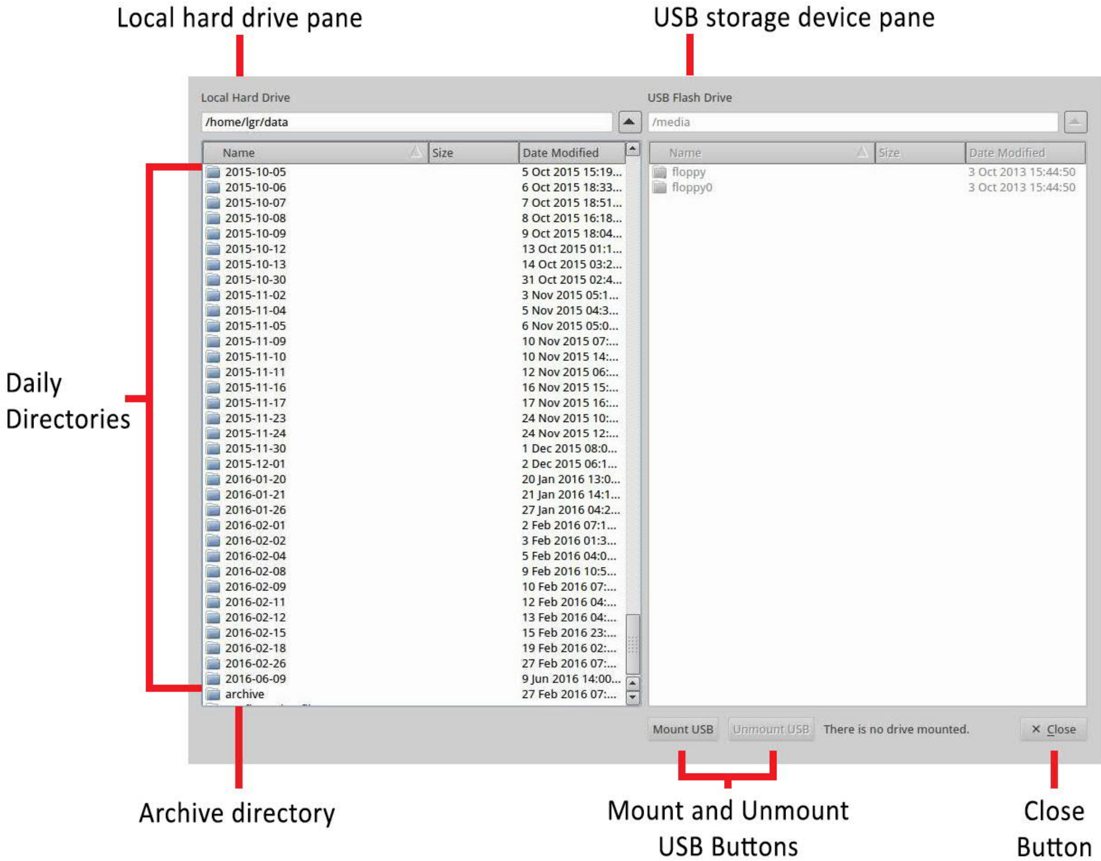


Figure 34: File Transfer Menu: Local Hard Drive (left pane) and USB Flash Drive (right pane)

4. Transfer data files from the analyzer hard drive to a USB storage device by dragging and dropping the files from the hard drive pane to the USB device pane. Use the left mouse button to highlight one or multiple files in the window.
   The directory windows default to the local hard drive on the left screen and the USB memory device on the right.
   Navigate through folders, create new folders, and delete files and folders.

NOTE USB drives should be no larger than 8GB. They must be FAT32 formatted.

When you have finished transferring files:

5. Click the Unmount USB button.
   Wait for the *Safe to Remove USB Memory Device* message before removing the USB memory device.

6. Click Close to exit the *File Transfer Menu*.

NOTE

Removing the USB memory device before seeing the *Safe to Remove* pop-up message may result in loss of data.

Types of directories in the local hard drive

The analyzer hard drive contains two types of directories:

- Daily Directory
- Archive Directory

Daily Directory

The local hard drive (Figure 34) creates a daily folder containing new data files for each day that the analyzer operates.

To access the data files for a specific date, double-click the folder. Each file from that day is displayed in chronological order. (Figure 35)

Each file is a single zipped .txt file, using the following convention:
Example: XXX_YYYY-MM-DD_f0000.txt.zip.

Examples of files in the daily directory are shown in Figure 35.

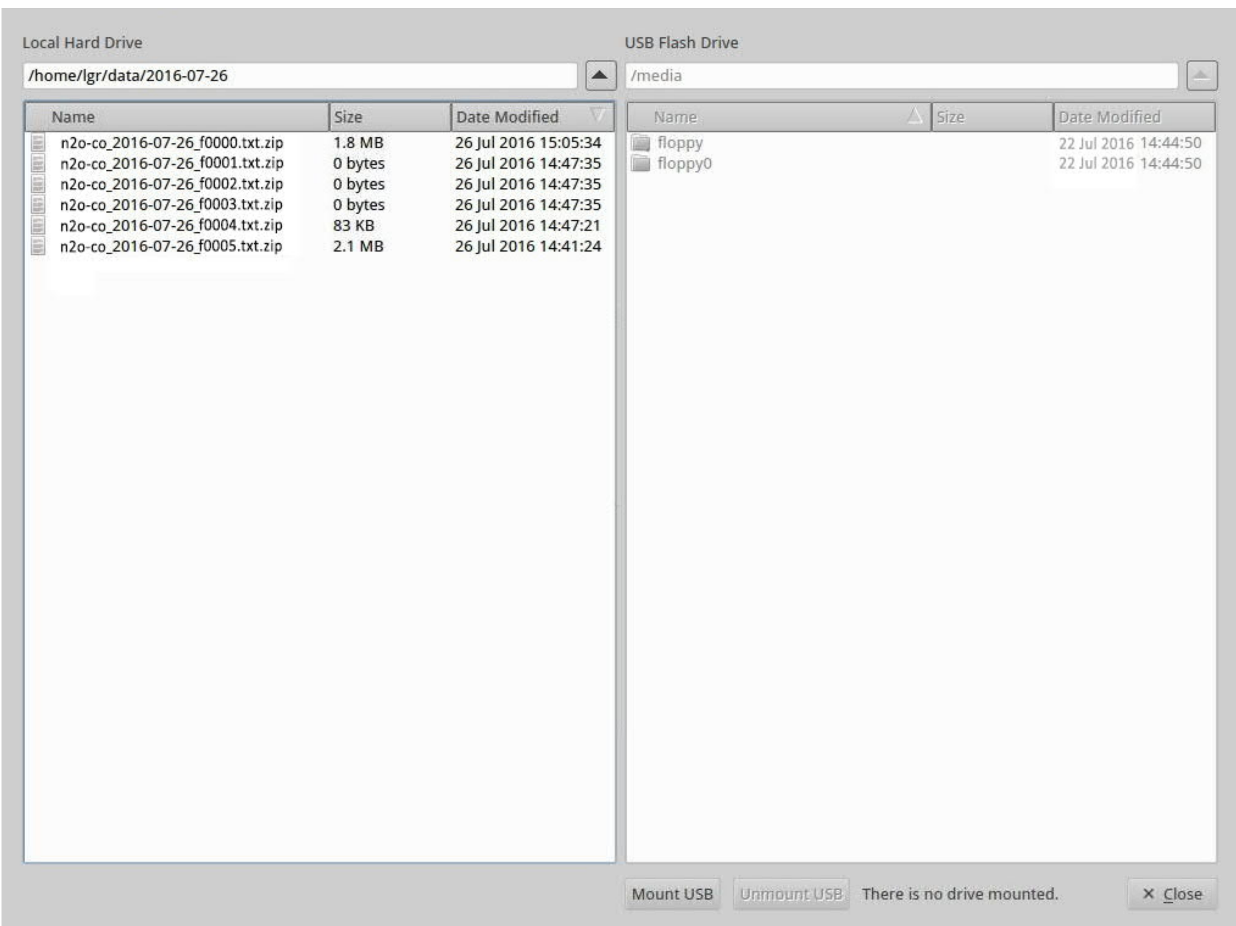


Figure 35: Daily Directory

Archive Directory

The local hard drive (Figure 34) creates an archived folder containing zipped files organized by date. (Figure 36)

To access the archived files, double-click the Archive folder. (Figure 34)

Each file is a single zipped .txt file, using the following convention: YYYY-MM-DD.zip. Each zipped file contains the data files for the day that the analyzer operated.

Examples of files in the archive directory are shown in Figure 36.

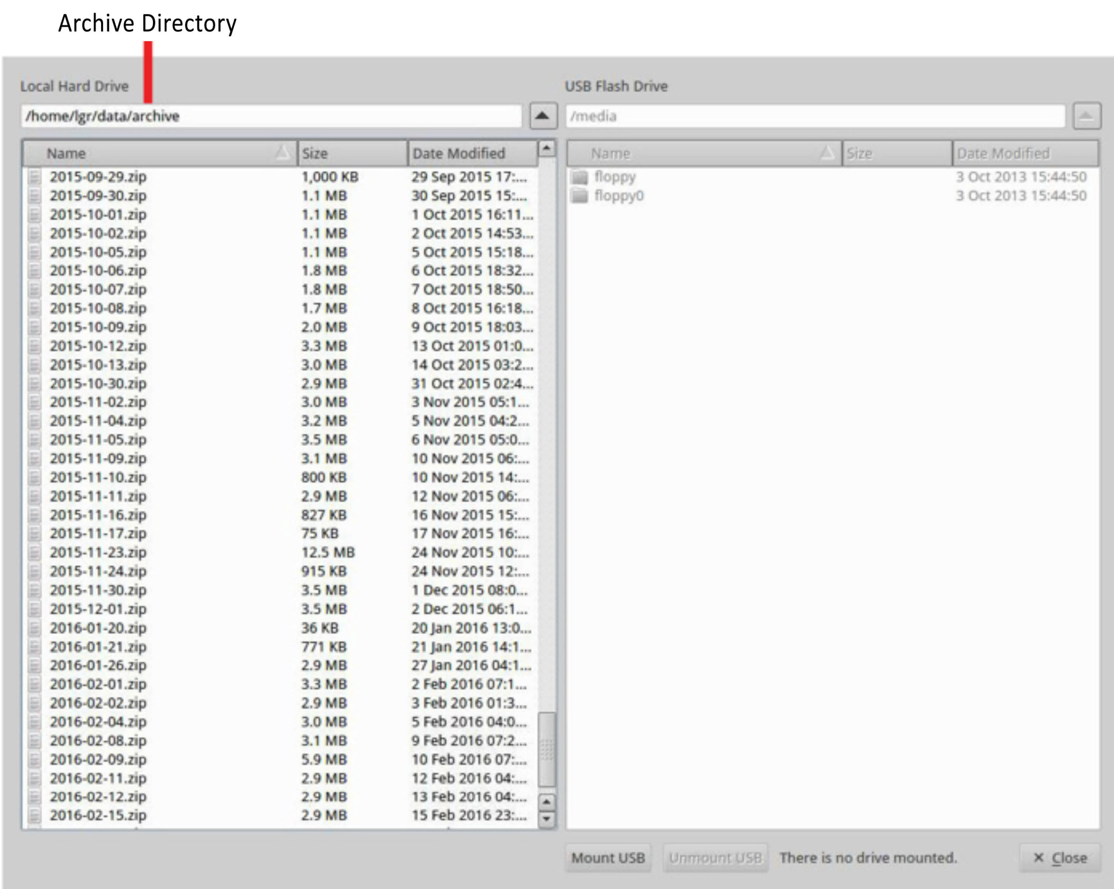


Figure 36: Archive Directory

File Transfer Error Screen

The *File Transfer Error screen* (Figure 37) displays when:

- The USB Key does not have enough storage space.
- The device is not recognized.

Try again with a correctly inserted USB device.

Figure 37: File Transfer Error

Setup Menu

The *Setup* menu allows access to additional configurations and services.

To enter *Setup* mode:

1. Click the Setup button on the *User Interface Control Bar*. (Figure 38)

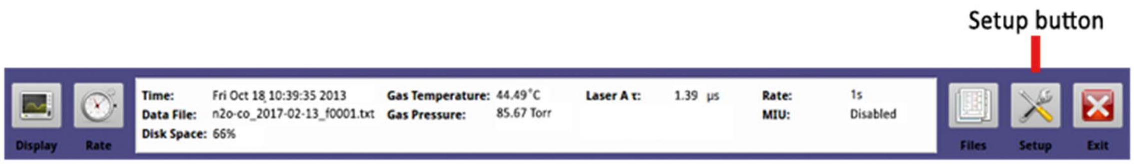


Figure 38: Setup Button on the User Interface Control Bar

2. The default *Time/Files* screen is displayed. (Figure 39)

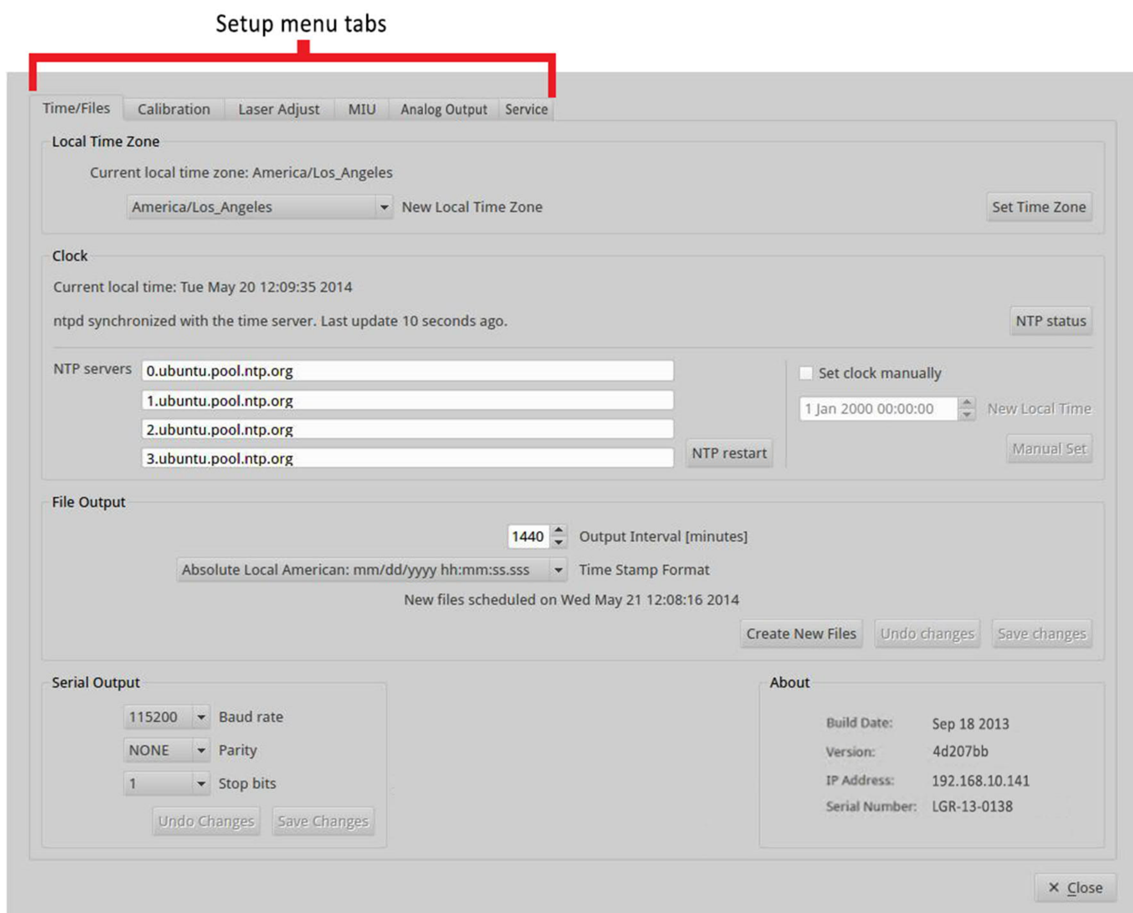


Figure 39: Setup Menu Tabs with Time/Files Screen Selected

The *Setup* menu has function tabs at the top of the screen that allows you to configure the analyzer mode and settings. (Figure 39) These tabs will vary among analyzer types.

These tabs let you:

- Manage file saving settings
- Adjust the current time / date settings
- Configure the Serial Output
- Calibrate the analyzer to a local gas standard
- Enable the laser-offset adjustment
- Configure the optional Multi-Port Inlet Unit
- Configure the Analog Output
- Configure the optional External Dynamic Dilution System (DCS)
- Service screen for technicians to check on the status of the analyzer

Use these function tabs to make adjustments to the analyzer and its' operation.

Time/Files Tab

The *Time/Files* menu allows you to adjust the time zone, manually set the clock, adjust the format of data files, and adjust the Serial Configuration. Contents may vary, depending on the type of analyzer.

Figure 40 shows the *Time/Files* menu for the GLA331-GGA.

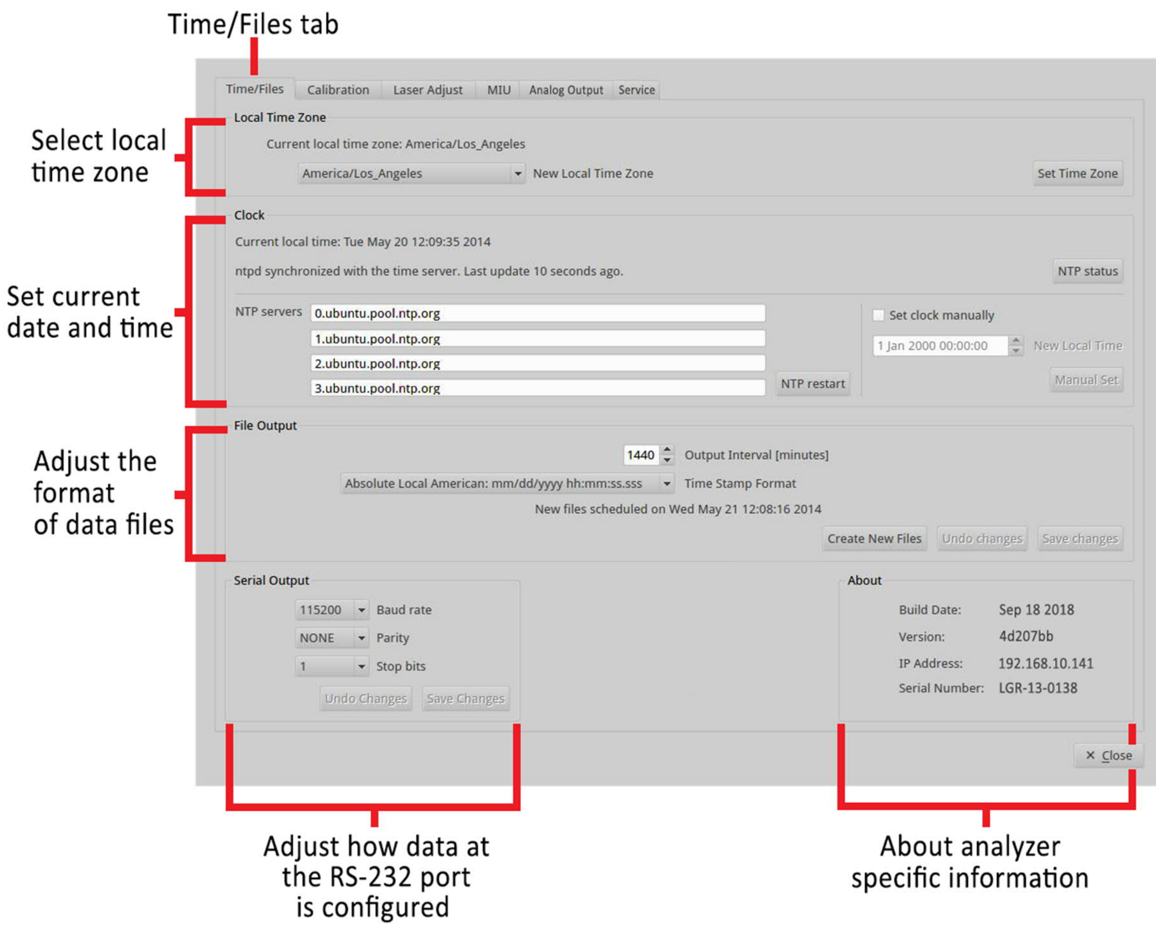


Figure 40: Functions of the Time/Files Menu

Local Time Zone

The *Local Time Zone* menu lets you adjust the current local time zone by selecting an option from the drop-down selection box.

Clock

The *Clock* menu lets you manually adjust the current time and date settings.

File Output

The *File Output* menu lets you adjust the timestamp format of the data files. The available timestamp formats are shown in Table 11.

New file creation intervals (when running continuously) can be set by adjusting the value in the Output Interval [minutes] spinner control box.

Table 11: Available 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

Serial Output

The *Serial Output* menu lets you change how the data reported at the RS-232 port is configured. Standard settings are provided for:

- Baud Rate
- Parity
- Stop Bits

The actual rate of the serial output is equal to the Logged File Rate (i.e. 1 Hz) divided by the Rate specified in the *Time/Files* menu.

NOTE

Use a null modem serial cable to connect the analyzer serial port to an external computer.

About

The *About* section displays analyzer specific information, such as the:

- Build Date of the current software
- Version of the code
- IP Address
- Serial Number of the analyzer

Calibration Tab

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

Calibration Procedure:

1. Click the Setup button on the *User Interface Control Bar*. (Figure 38)
2. Select the Calibration tab at the top of the screen to enter the *Calibration* menu. (Figure 41)

Figure 41 shows the *Calibration* screen for the GLA351-N2OCM.

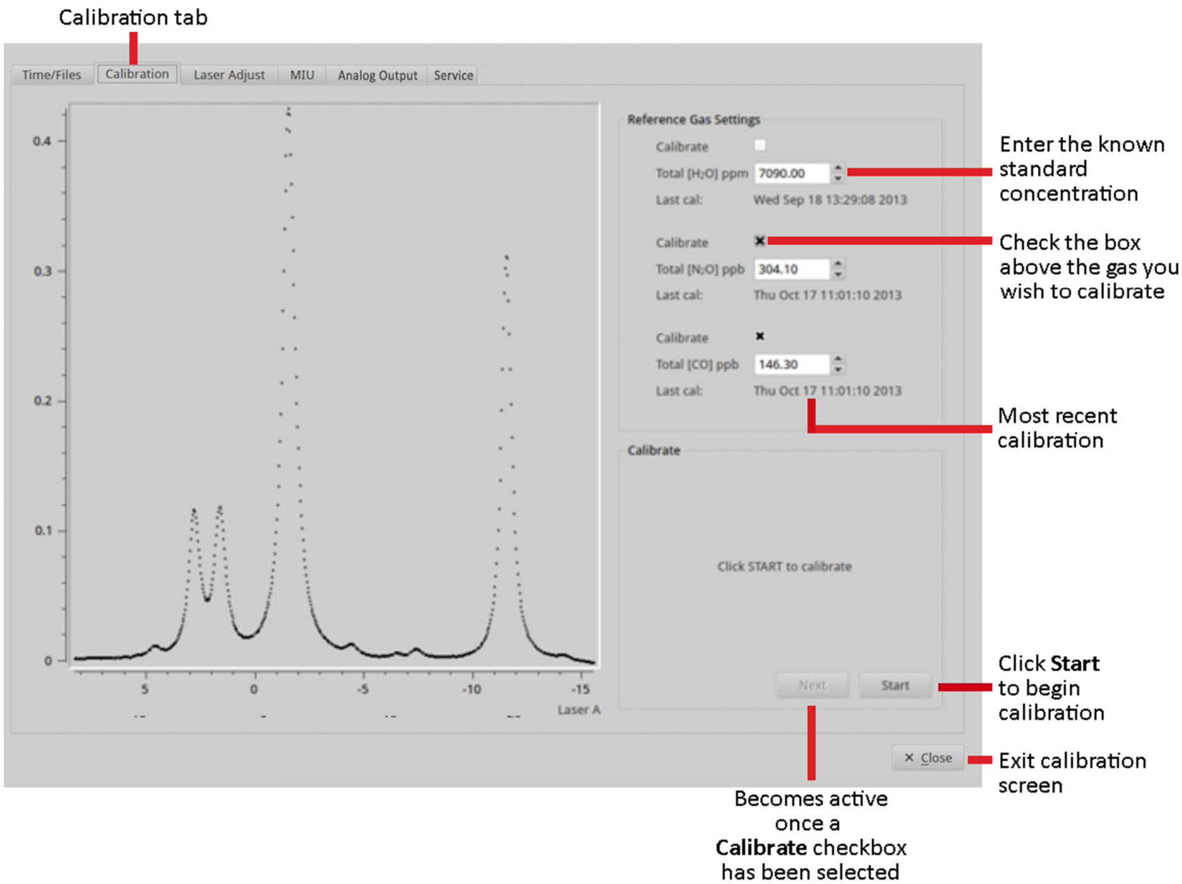


Figure 41: Calibration Setup Screen (GLA351-N2OCM)

3. On the top, right panel of the screen under *Reference Gas Settings*, select the checkbox next to the gas you want to calibrate.
4. Enter the known concentration for your local gas standard.
5. Connect your reference gas supply to the ¼" Swagelok inlet port on the back panel of the analyzer. (Figure 3)
6. Open the valve on your gas supply.
7. Click the NEXT button on the lower, right panel of the screen to begin calibration. (Figure 41)

8. Each step is displayed in the lower-right panel of the calibration screen as the analyzer performs the calibration. Figure 42 shows the calibration process as a flow chart.

Figure 42: Calibration Flow

9. When the *Calibration Complete* message is displayed, click the CLOSE button.
10. Enter *TimeChart* by selecting the Display button on the *User Interface Control Bar*, and verify that the displayed concentration correctly corresponds to your local gas standard.
11. Repeat steps 1-10 for each gas you want to calibrate.

NOTE

The time of latest calibration is stored in *Reference Gas Settings* within the *Calibration* menu for future reference.

Laser Adjust Tab

Use the *Laser Adjust* tab to manually adjust the laser's wavelength to compensate for any cumulative drift. (Figure 43)

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.

Figure 43 shows the offset between absorption peaks and target lines for the GLA351-N2OCM. For a 2-laser system, both lasers need adjustment. In a 2-laser system, Laser A is the top plot and laser B is the bottom plot.

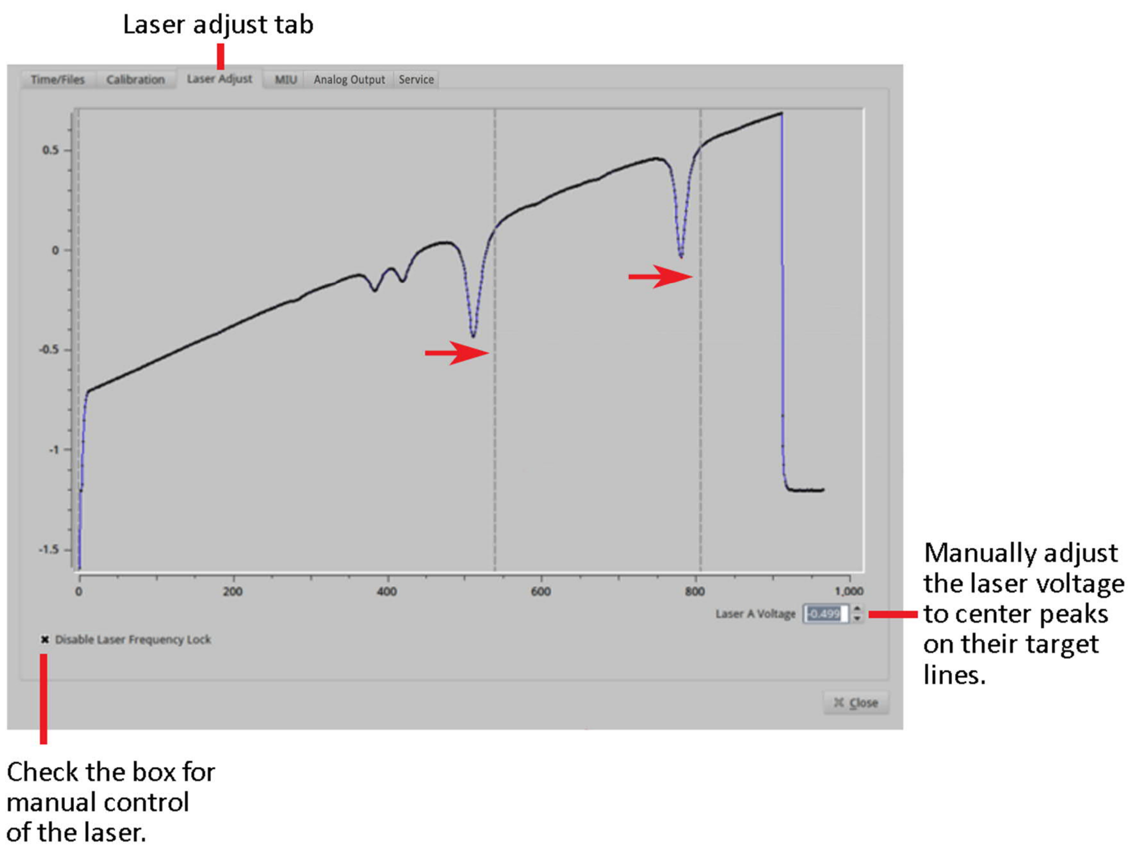


Figure 43: Absorption peaks off of target lines. Laser voltage adjustment needed.

Manually Adjust the Laser Offset

1. Click the Setup button on the *User Interface Control Bar*. (Figure 38)
2. Select the Laser Adjust tab at the top of the screen. (Figure 43)
3. Select the Disable Laser Frequency Lock check box to allow manual control of the laser.
4. Adjust the Laser A Voltage 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
5. If applicable, adjust the Laser B Voltage (bottom plot) 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
6. Deselect the Disable Laser Frequency Lock check box. The software resumes automatic tracking and control of the laser wavelength.
7. Click Close to exit the menu and return to the *Main panel*.

Figure 44 shows the laser voltage adjusted so that the absorption peaks are centered on the target lines.

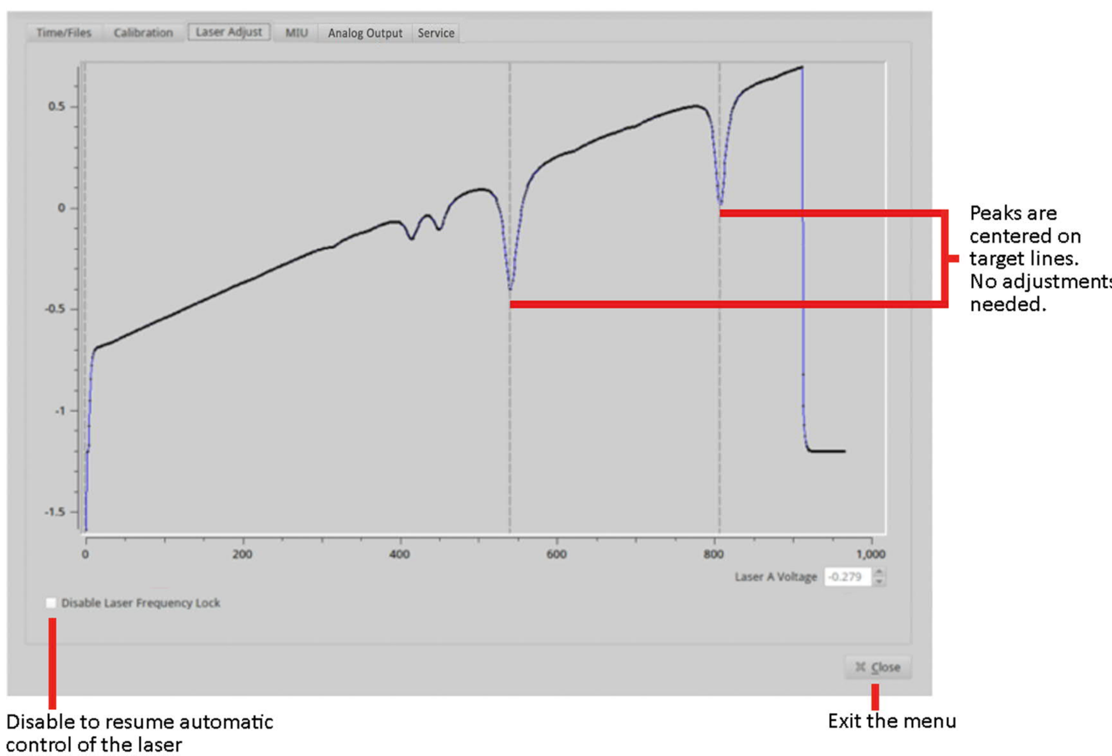


Figure 44: Absorption Peaks Centered Correctly on Target Lines (GLA351-N2OCM)

MIU tab

The (optional) Multi-Port Inlet Unit (MIU-8 or MIU-16) is an ABB-LGR 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 gases and reference gases.

The *MIU* menu can be configured to control which gases are introduced to the analyzer and for how long. (Figure 45)

See Appendix E: Multi-Port Inlet Unit (Optional) on page 97 for detailed instructions on configuring and controlling the MIU.

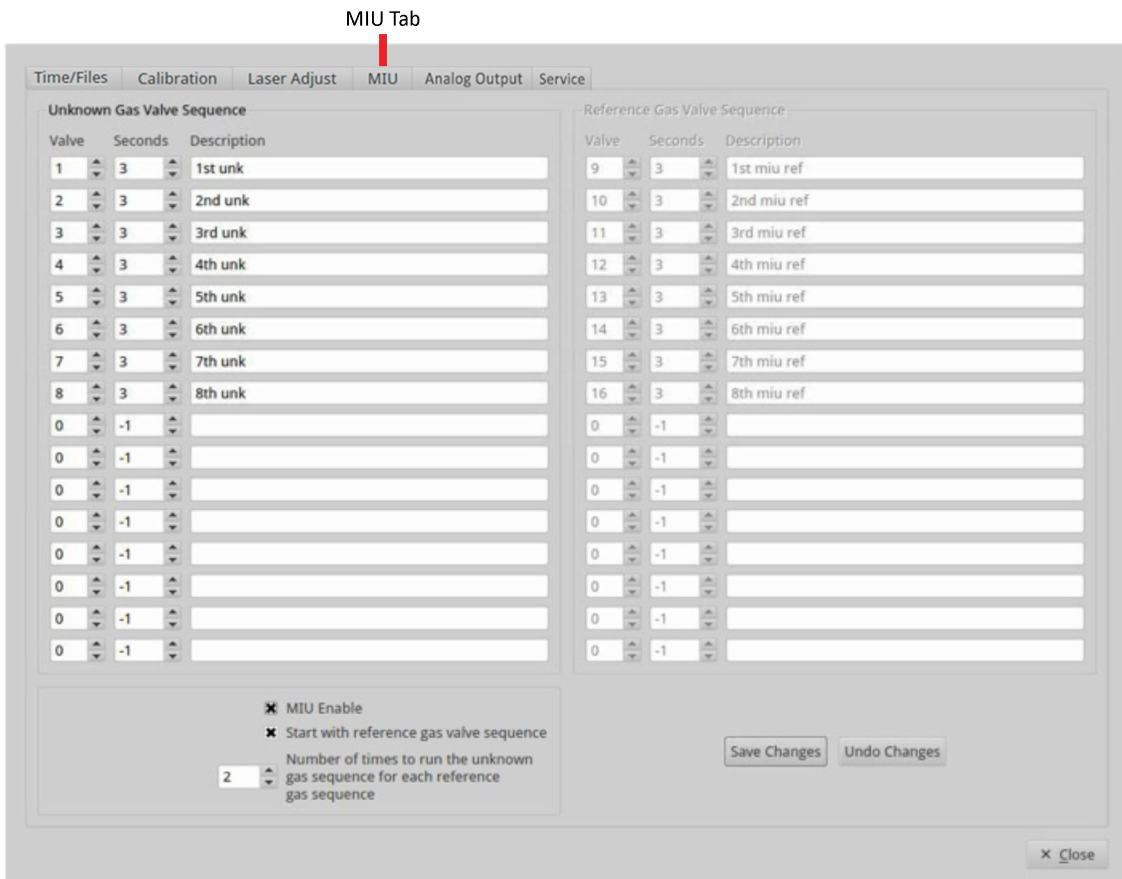


Figure 45: Control Menu for the (Optional) Multi-Port Inlet Unit MIU

Using the MIU with the GLA351-CCIA3

For the GLA351-CCIA3, the *MIU* panel is used to control the sample states. (Figure 46) Due to the strong absorption of atmospheric levels of CO_2 at this wavelength, the optical path outside of the ICOS cavity is constantly purged with CO_2-free “zero-air.” At regular intervals, the analyzer will switch from measuring the sample to measuring the zero-air so that it can record the effect of any ambient CO_2 in the purge regions. These results are passed on to the analyzer during sample measurement until the next zero-air measurement.

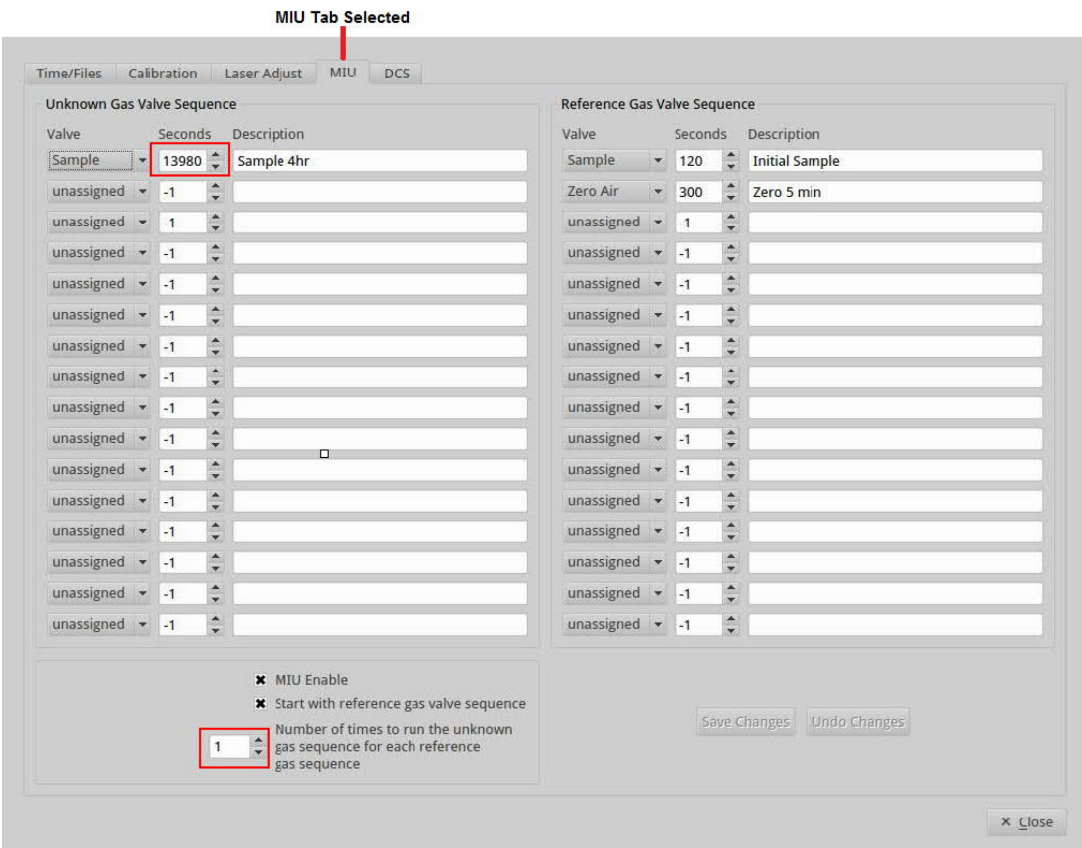


Figure 46: Control Menu for the (Optional) Multi-Port Inlet Unit MIU (GLA351-CCIA3)

When the analyzer starts, the sample is measured for 2 minutes to stabilize the laser. This initial sample is followed by 5 minutes of zero-air measurement.

NOTE

Do NOT change these settings.

Modifying Zero-Air Intervals for the GLA351-CCIA3

The factory set zero-air interval is 4 hours; however, this can be modified for the particular application. If the environment around the analyzer is relatively stable, the zero-air interval can be set to 24 hours. Alternatively, if the environment around the analyzer is unstable, it may be necessary to reduce the zero-air interval.

- Altering the number of seconds for the sample changes the interval. (Figure 46)
- Or, the *number of times to run the unknown gas sequence for each reference gas sequence* may be changed. (Figure 46)

Factors that influence the stability of the environment include CO_2 concentration, humidity, and barometric pressure.

Preventing the Zero-Air Sequence from Running for the GLA351-CCIA3

If you wish to prevent the zero-air sequence from running during an experiment, choose one of these two methods:

- If you know the duration of your experiment, change the number of seconds for the sample under the *Unknown Gas Valve Sequence* column. Before beginning the test, force the analyzer to measure zero-air first so that the full time for the sample will pass before the zero-air is measured again. To do this:
    1. Uncheck the MIU Enable checkbox
    2. Click Save Changes
    3. Check the MIU Enable checkbox
    4. Click Save Changes again

  This will start the sequence from the beginning.

- The second method involves temporarily suspending the zero-air sequence.
    1. Uncheck the MIU Enable checkbox
    2. Click Save Changes
    3. Check the MIU Enable checkbox
    4. Click Save Changes
    5. After 7 minutes, the zero air measurement will be complete.
    6. Uncheck the MIU Enable checkbox
    7. Click Save Changes.
    8. Begin your experiment
    9. After the experiment is complete, check MIU Enable
    10. Click Save Changes so that the automated zero-air sequence will resume.

Analog Output Tab

The *Analog Output* port has a 16-bit voltage range from 0 to 5 volts.

The user can specify a conversion between gas concentrations and the analog output voltage, using the spinner controls, or by manually typing a number into the field. The dropdown spinner controls let you select the concentration value that will correspond to the maximum 5 VDC analog output.

For example:

- Set 5 Volts = 10 ppm on the expectation that the gases measured will be in the range near 2 ppm, with occasional bursts up to almost 10 ppm.
- Set 5 Volts = 5 ppm to get exactly two times greater sensitivity on the analog output, with the expectation that the concentration will not go above 5 ppm.

NOTE

If the measured concentration goes above the maximum expected value for the Analog Output, the on-screen displays and data files continue to record the correct measured concentration, but the Analog Output will saturate at its maximum value of 5.0 volts until the concentration drops back into the expected range.

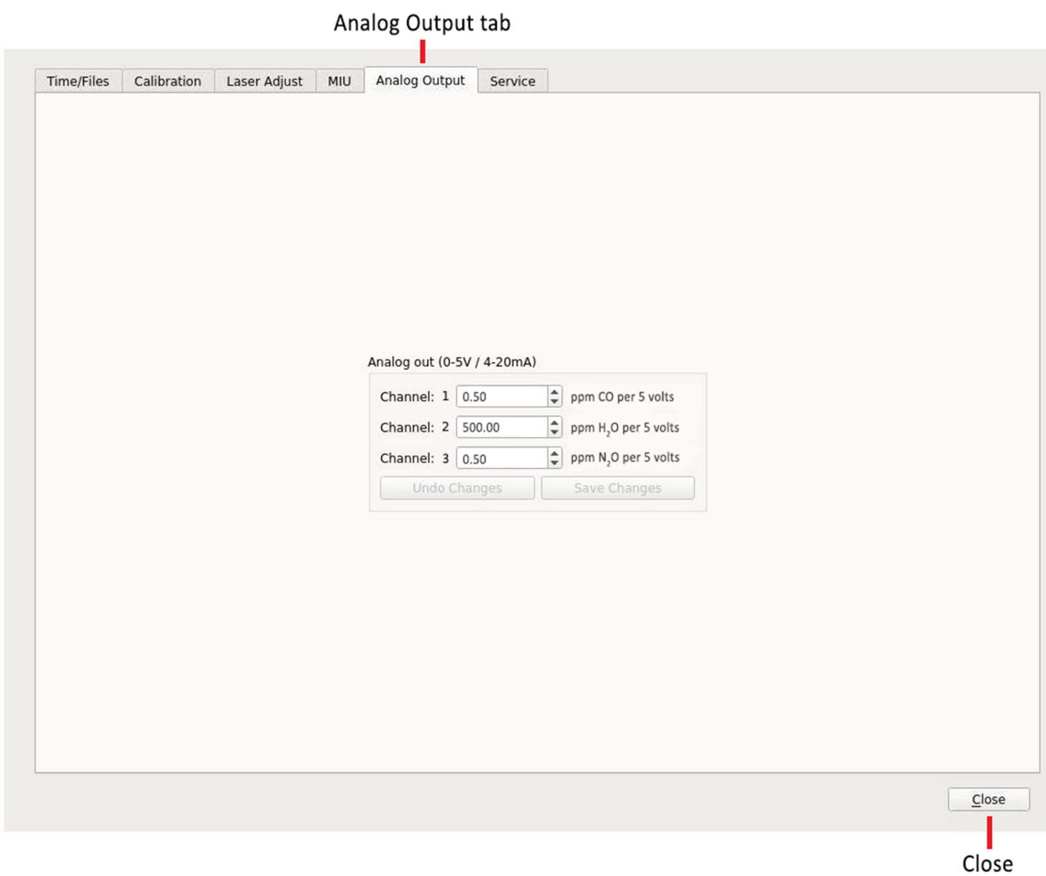


Figure 47: Analog Output Screen

DCS Tab

The External Dynamic Dilution System (EDDS) is an optional accessory.

The EDDS is an ABB-LGR accessory that dilutes sample gas with zero-air whenever the concentration rises above the target. It extends the upper range up to 100x through automated dilution and maintains the target concentration at that level.

The EDDS can be enabled/disabled using the radio buttons, and the dilution factor can be set using the drop down selection box on the DCS screen. (Figure 48)

See the Appendix F:External Dynamic Dilution System (Optional) on page 102 for detailed instructions on setting up and operating the EDDS.

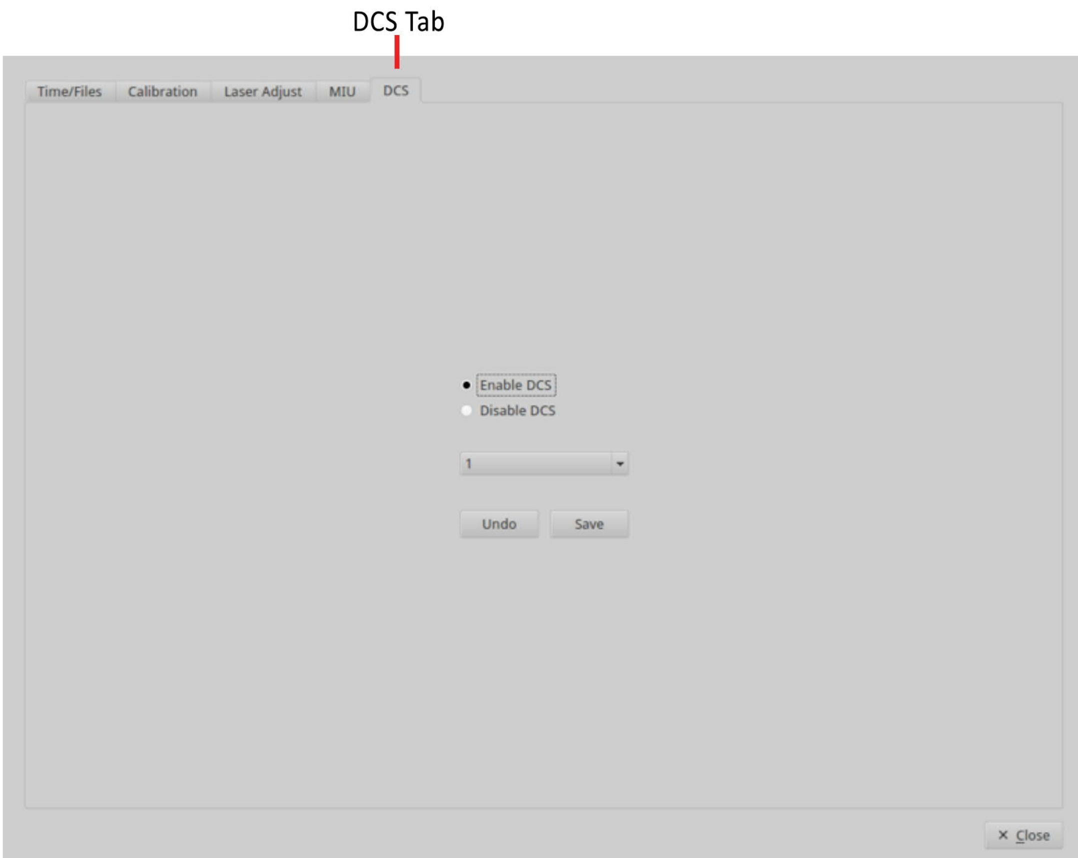


Figure 48: Dilution Control System (DCS)

Service tab

ABB-trained field service engineers monitor the performance of the analyzer via the *Service* screen. (Figure 49)

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

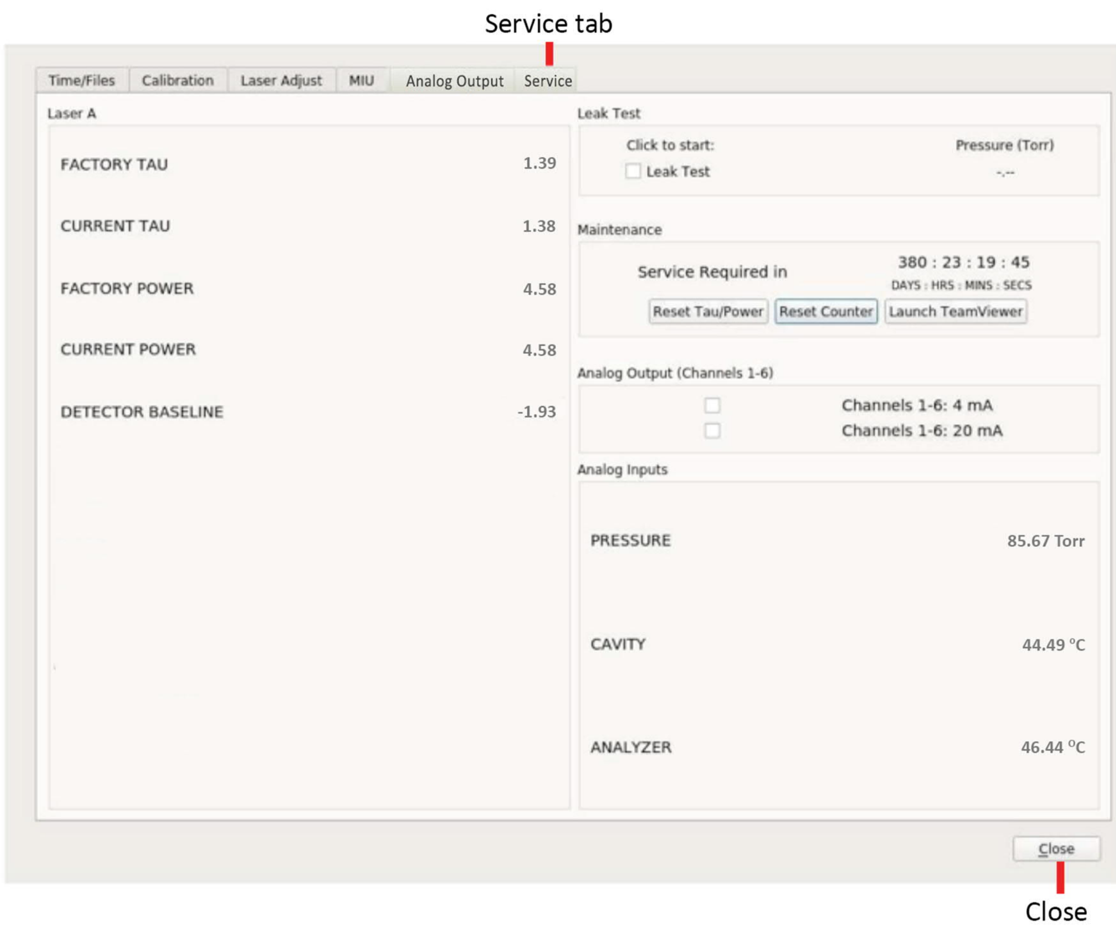


Figure 49: Service Screen

The *Service* tab contains 3 Service buttons:

- Reset Tau/Power button – resets the mirror ringdown time and laser power to current settings. This is typically done after mirrors have been cleaned.
- Reset Counter button – resets the # of days that maintenance is required. This is typically done after yearly maintenance.
- Launch TeamViewer button – TeamViewer allows service engineers to remotely access the analyzer if service needs are required.

Shutting Down the Analyzer

To shut down the analyzer:

1. Click the Exit button on the *User Interface Control Bar*. (Figure 50)
2. A pop-up box appears on the *Main Panel* and prompts you to verify that you want to shut down the analyzer to prevent accidental button presses from causing interruption in data. (Figure 51)

Figure 50: User Interface Control Bar Exit button

3. Click the OK button to halt data acquisition, close the current data file, and display the shutdown screen. (Figure 51)

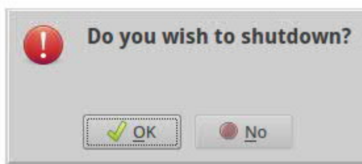


Figure 51: Analyzer Shutdown Prompt

4. When the *"You may turn off the instrument"* message displays (Figure 52), you can safely shut off power to the analyzer by pushing the OFF switch on the front of the analyzer. (Figure 2)

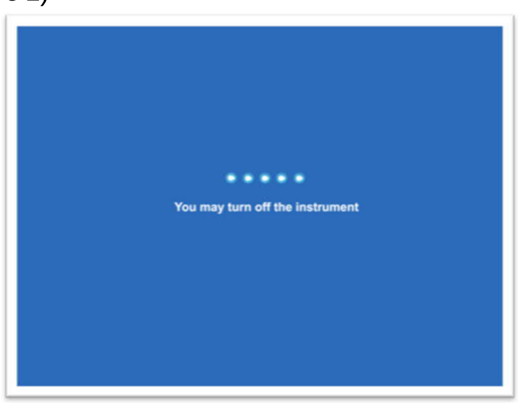


Figure 52: Final Shutdown Screen

NOTE

Failure to wait for the power down command to display before shutting off power to the analyzer may result in file system instability.

---

5 Maintenance

Daily Operation Checklist

Table 12 describes routine maintenance tasks that keep your analyzer operating smoothly.

Table 12: Maintenance Checklist

Frequency	Task
Every 1-2 days	• On the *Spectrum Display*, verify that the spectrum is correct. The spectrum should appear as shown in Figure 30. Become familiar with the normal appearance of the spectrum (the best way of diagnosing analyzer performance). Any deviations from normal could indicate a problem with the analyzer. • Log the transmitted intensity displayed in the upper panel of the spectrum screen. Any decrease in transmitted intensity could be indicative of dirty mirrors. • Log the analyzer pressure. Any decrease in pressure could be indicative of an obstruction in the flow system. An increase in pressure could be indicative of a leak in the system or a pump failure.
Every 3-6 days	• Check the Laser Offset and adjust if necessary. (Figure 43)

Mirror Ring-Down Time and Maintenance

Measurement cell mirrors are protected from contamination by an internal inlet filter. With continued use the mirrors may gradually decline in reflectivity.

Because of the relatively short path length used in the analyzers, the ring-down is too short to actively measure. To track mirror reflectivity, monitor the measured value of the reference standards and note any decrease.

If the measured value of a known reference cylinder has changed by more than 20%:

1. Request a mirror cleaning kit from ABB-LGR, and clean the mirrors.
2. Measure the reference cylinder again.
3. If the analyzer performance does not improve, contact ABB-LGR.
    - Technical Support: icos.support@ca.abb.com

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

Replace the Power Inlet Fuse

If the fuse on the power inlet blows or is otherwise damaged, the analyzer shuts down. To replace the fuse:

1. Unplug the analyzer.
2. On the back panel of the analyzer, locate the fuse above the power inlet. (Figure 53)

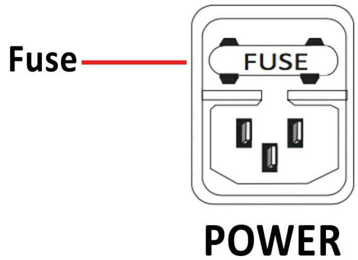


Figure 53: Analyzer Fused Inlet

3. Use a flathead screwdriver to remove the fuse.
   a. Insert the head of the screwdriver into the slot below the fuse. (Figure 54)

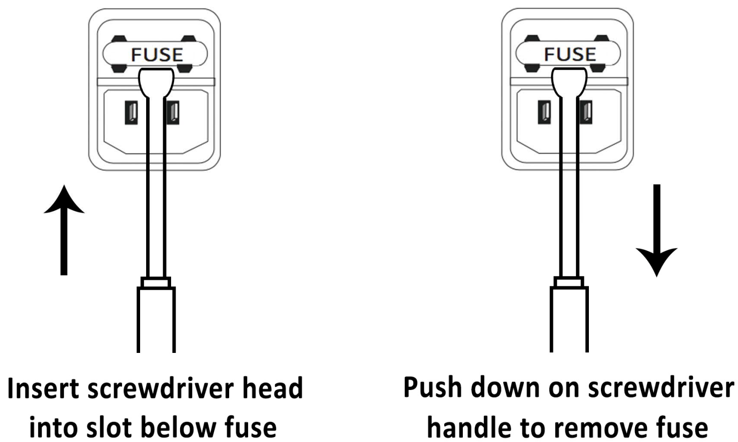


Figure 54: Remove the Fuse

   b. Push down on the screwdriver handle to remove the fuse holder from the power inlet.
   c. Remove the fuse from the fuse holder. (Figure 55)

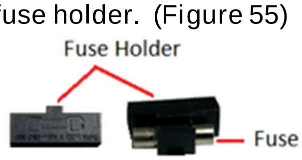


Figure 55: Remove the Fuse from the Fuse Holder

4. Insert a new fuse into the fuse holder.
5. Re-insert the holder into the power inlet. Push it in until you hear a click.
6. Plug the power cord into the back panel of the analyzer.
7. Resume analyzer operation.

Appendix A: About Gas Analyzers and Laser Absorption Spectroscopy

Conventional Laser Absorption Spectroscopy

For gas measurements based on conventional laser-absorption spectroscopy (Figure 56), a laser beam is directed through a sample, and the mixing ratio (or mole fraction) of a gas is determined from the measured absorption using Beer's Law, which may be expressed:

$$\frac{I_v}{I_o} = e^{-SL\chi P\phi_v}$$

Where:

- I_V is the transmitted intensity through the sample at frequency
- I_O is the (reference) laser intensity prior to entering the cell
- S is the absorption line strength of the probed transition
- L is the optical path length of the laser beam through the sample
- χ is the mole fraction
- P is the gas pressure
- Φ_V is the line-shape function of the transition at frequency $\boldsymbol{v}$

In this case,

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

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.

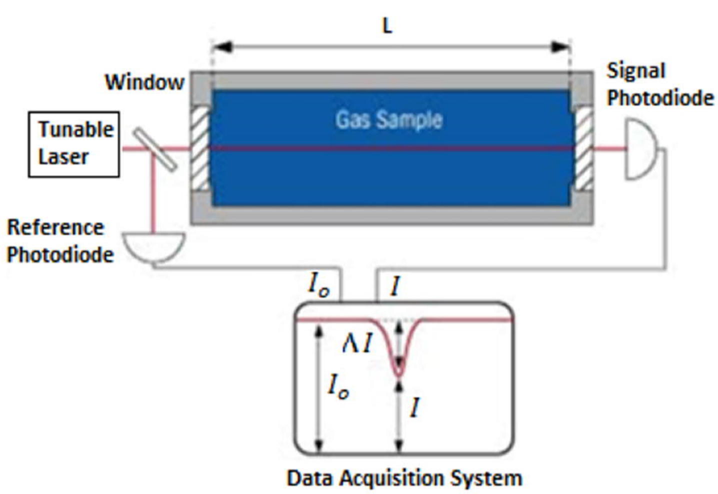


Figure 56: Typical Laser Absorption Spectroscopy Setup

Integration of the measured spectra with the measured values of:
- Gas temperature
- Gas pressure
- Path length
- Line strength of the probed transition

Enables you to determine the mole fraction directly from the relation:

$$\chi = \frac{-1}{SLP} \int_{\upsilon} ln\left(\frac{I_{\upsilon}}{I_{o}}\right) d\upsilon$$

Use this equation to determine gas concentrations, even in hostile environments without using calibration gases or reference standards. These values are measured:

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

ABB-LGR's Off-Axis Integrated-Cavity Output Spectroscopy (Off-Axis ICOS)

Off-Axis ICOS uses a high-finesse optical cavity as an absorption cell as shown in Figure 57. Unlike multi-pass detectors, which are typically limited to path lengths of less than two hundred meters, an Off-Axis ICOS absorption cell effectively traps the laser photon so that, on average, they make thousands of passes before leaving the cell.

As a result, the effective optical path length may be several thousands of 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 spaced by 25 cm, the effective optical path length is 2500 meters.

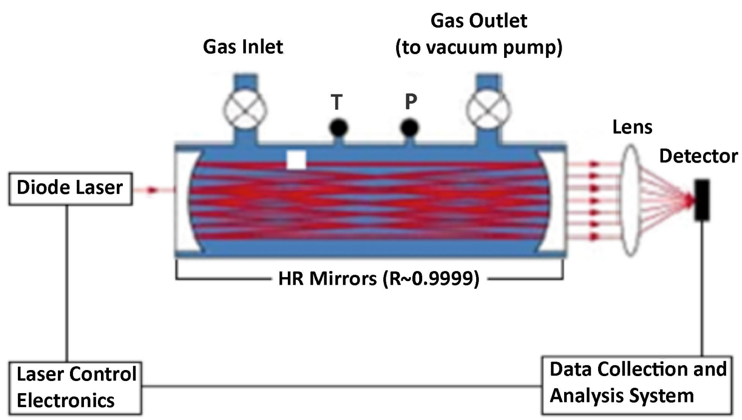


Figure 57: Schematic Diagram of an Off-Axis ICOS Analyzer

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-ring-down 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:

- The wavelength of the laser is turned over a selected absorption feature of the target species.
- 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: Accessing Data Using the Ethernet

Appendix B explains how to access the analyzer data directory as a Windows Share using an Ethernet connection on a local area network (LAN).

The data files stored on the internal hard disk drive of the analyzer can be accessed as a Windows Share over a Local Area Network (LAN) Ethernet connection. For this function to operate, the analyzer must:

- Be connected to a Local Area Network (LAN) via the RJ-45 Ethernet connection on the back panel of the analyzer.
- Receive a response to a DHCP (Dynamic Host Configuration Protocol) request when the analyzer is initialized.

If the analyzer does not receive a reply, the analyzer:
- Disables the Ethernet port.
- Does 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 data directory:
1. Click Start > Run, and enter the IP address of the analyzer:
   Example: *\\192.168.100.29*

   Refer to the *Time/Files menu* (Figure 40) for the location of the analyzers' IP address.

2. Click OK.

3. Within 10 to 60 seconds, the *Windows Share* directory displays the subdirectory lgrdata.

   Double-click on the lgrdata directory to see a listing of the data files stored on the internal hard drive of the analyzer.

   Open or transfer any of the data files, as you would with any Windows share drive.

Additional Notes

The analyzer shared data directory is in the LGR workgroup. If it is not visible, browse for it in the Windows Network Neighborhood by entering the IP address of the analyzer. Figure 40 shows the location of the IP address.

The current data file of the analyzer can be opened while measurement is in progress without interrupting the analyzer operation. The current data file is updated after every fourth KB, so a new data file will appear empty until enough data is collected to be written to the disk.

If a Local Area Network (LAN) is not available, plug the analyzer into a standalone broadband router (example: Netgear Model RP614) to enable the analyzer to obtain a Dynamic Host Configuration Protocol (DHCP) address from the router when the analyzer is started. Then, plug any Windows computer into the same broadband router to access the data directory.

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

It is possible to access the shared analyzer data directory from operating systems other than Windows. The analyzer uses a Samba server to share the data directory, which could be accessed by any appropriate Samba client application.

Appendix C: Wireless Router Setup (Optional)

The analyzer can be ordered with an optional TP-Link wireless router. If you ordered the wireless router option, it will be factory installed inside, or on the side of, the analyzer.

Configuration Options

Access-Point Mode

The router is shipped in Access-Point mode, by default. This appendix provides instructions on setting up the router in Access-Point mode. For information on other possible modes, refer to the TP-Link website at www.tp-link.com/support and enter the TP-Link model number (TL-WR802N).

NOTE

You must restart the analyzer whenever you change router modes for the mode change to take effect.

Local Connection

You can also bypass the wireless router if you want to connect the analyzer to a local network. Refer to the *Connect Analyzer to Local Network* section on page 83 for instructions on this configuration.

Wireless Control Using Remote Device

For wireless control of the analyzer using a remote device, install the appropriate Virtual Network Client (VNC) software on your remote device. Refer to page 84 (Appendix D: Set Up Devices for Remote Access Using VNC Software) for details on setting up devices for remote access using VNC software (optional).

Configure Router for Access-Point Mode

1. Using a phone, tablet, or laptop, connect to the router using the SSID and password on the router. (Figure 58)

Figure 58: Router SSID and Password Location

2. On the same device, launch a Web browser, then type http://tplinkwifi.net in the address bar. (Figure 59)

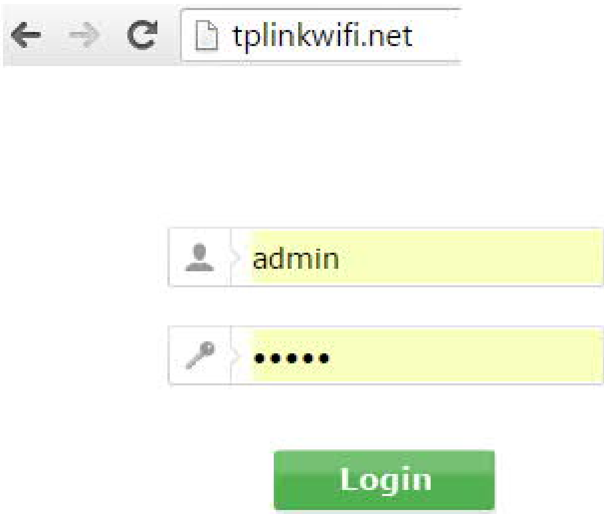


Figure 59: Logging In

3. Enter admin (in lowercase) for both the username and password.

4. Click Login.

5. On the left panel, click Quick Setup. (Figure 60)

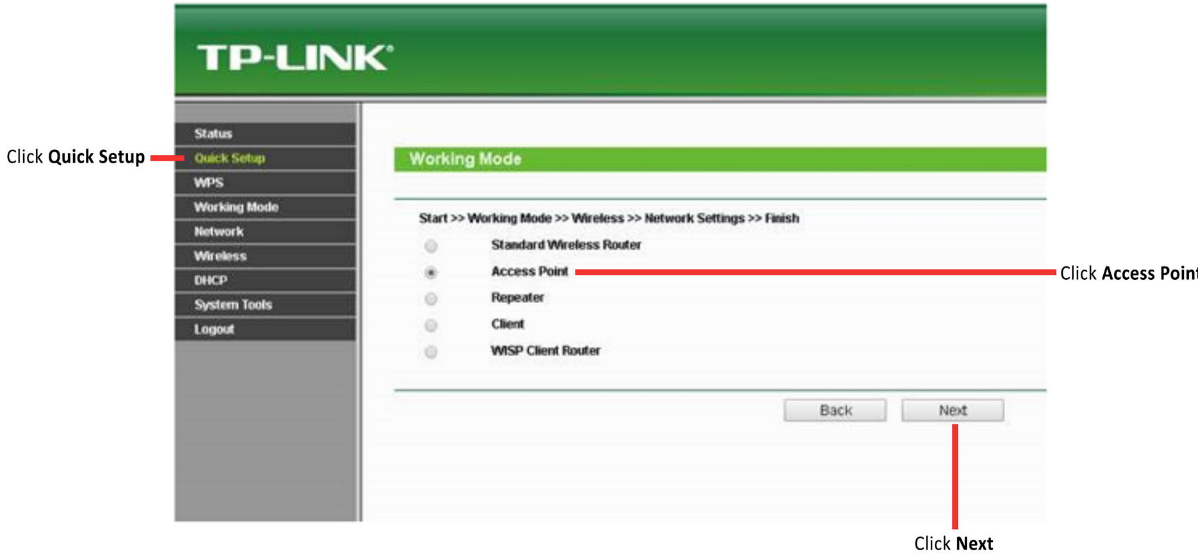


Figure 60: Start Router Configuration

6. Click Next.
7. In the *Main Panel*, select the Access Point button. (Figure 60)
8. Click Next.
9. In the *Wireless Setting* screen, do one of the following: (Figure 61)

   a. To keep the default *Wireless Network Name* and/or *AP Wireless Password*, click Next.
   b. To change the default *Wireless Network Name* and/or *AP Wireless Password*, change the names in the *Wireless Network Name* and/or *AP Wireless Password* fields, then click Next.

Figure 61: Wireless Setting Screen

10. In the *Network Setting* screen, click Next. (Figure 62)

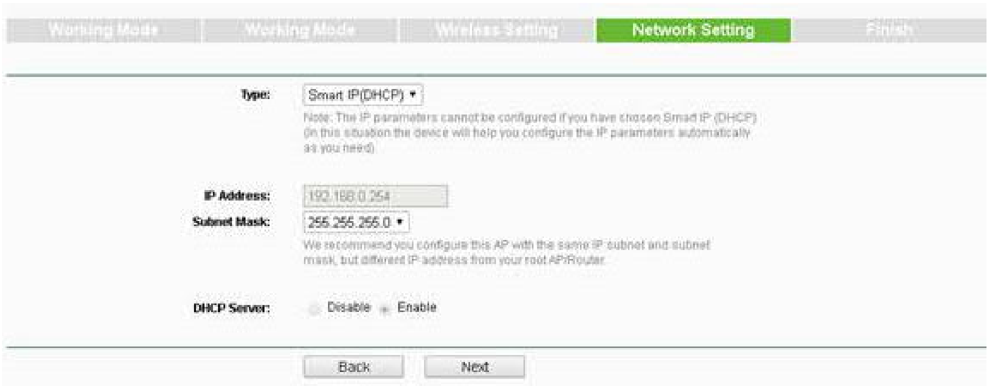


Figure 62: Network Setting Screen

11. Click Finish.
12. Restart the analyzer.

Connect Analyzer to Local Network

1. Unplug the black cable from the router *LAN/WAN* port. (Figure 63)

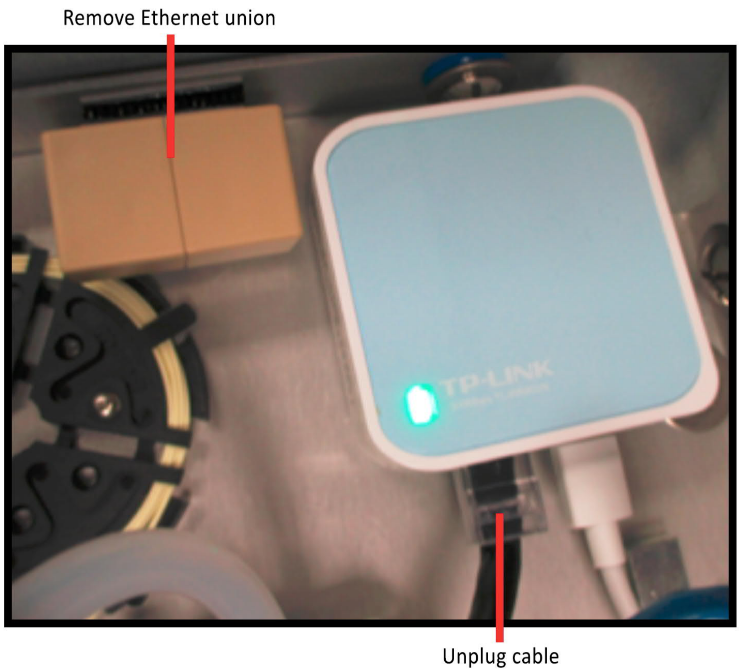


Figure 63: Unplug Cable and Remove Ethernet Union

2. Remove the Ethernet union (next to the router). (Figure 63)
3. Plug the black cable into either port of the Ethernet union. (Figure 64)

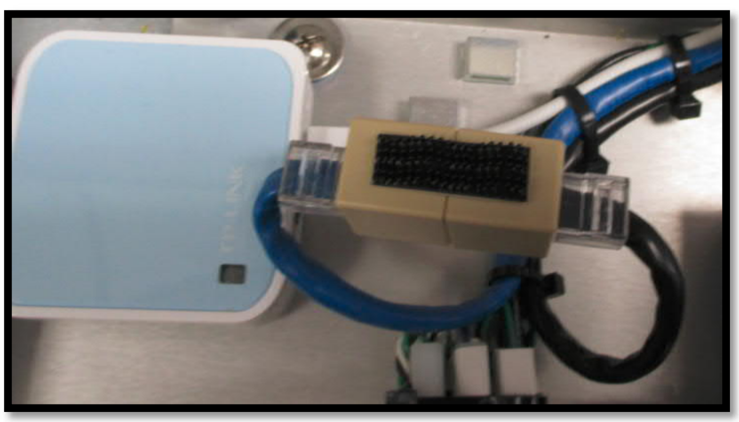


Figure 64: Plug Cables into Ethernet Union

4. Plug the blue cable into the other port of the Ethernet union. (Figure 64)
5. Connect a local area network (LAN) cable from an external computer to the analyzer Ethernet port, located on the external side panel.

Appendix D: Set Up Devices for Remote Access Using VNC Software

Listed below are three types of devices that can be connected to the analyzer through the wireless router to access information:

- Android OS based devices (smart phones and tablets)
- iOS based devices (smart phones, tablets, and laptops)
- Windows based devices (smart phones, tablets, and laptops)

Each of these devices uses Virtual Network Client (VNC) software to connect the analyzer through the router. Follow the instructions below to install and set up VNC software on the device you are connecting to the analyzer.

Set up VNC Software on Android Devices

1. On the Android device, go to Settings > WiFi > Connect to Wireless Network.

2. Connect to the wireless SSID network listed on the router sticker. Enter the TP-Link wireless router (example: TP-LINK-775C) as shown in Figure 58.
   a. For ultraportable analyzers, the TP-Link wireless router is installed inside the analyzer and may be accessed by opening the case.
   b. For all other analyzers, the optional TP-Link wireless router is attached to the outside of the case.

3. Select SSID.

4. Enter the wireless password printed on the router sticker. (Figure 58) Every router has a different, unique SSID number, and wireless password.

5. Select Connect. (Figure 65)

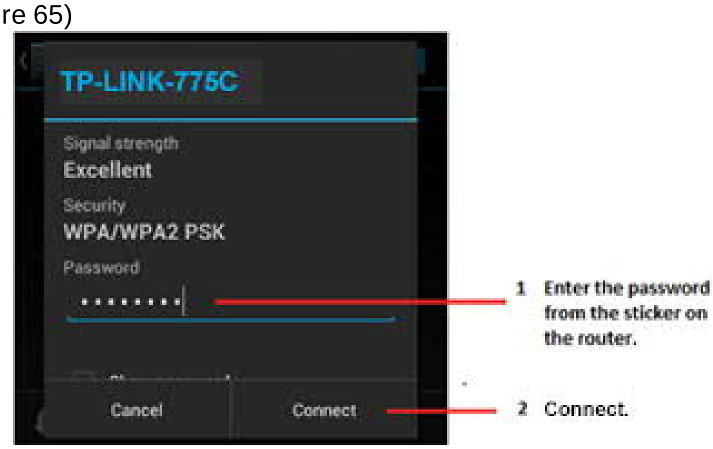


Figure 65: Password Connection Screen

6. A verification message appears, showing that the Android device is connected to the router. (Figure 66)

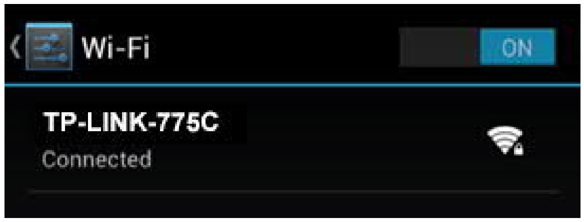


Figure 66: Connectivity Confirmation Screen

7. Ensure that the IP address of the Android device is correct by holding your finger down on the network connection icon. The IP address of the Android device is either 192.168.100.100 or 192.168.100.101.
   a. Wireless devices can compete for dynamic addresses. If the 192.168.100.100 address does not connect, then use 192.168.100.101.

8. Record the IP address of the Android device because it will be necessary to refer to it in Step 12.

9. Install the VNC software by searching and installing from the Google Play store. Search for *Android-vnc-viewer* and install the application by tapping on the Install button. (Figure 67)

NOTE An Internet connection is required for this step.

NOTE Complete instructions for installing the Android-vnc-viewer can be found online at: http://code.google.com/p/android-vnc-viewer/wiki/Documentation

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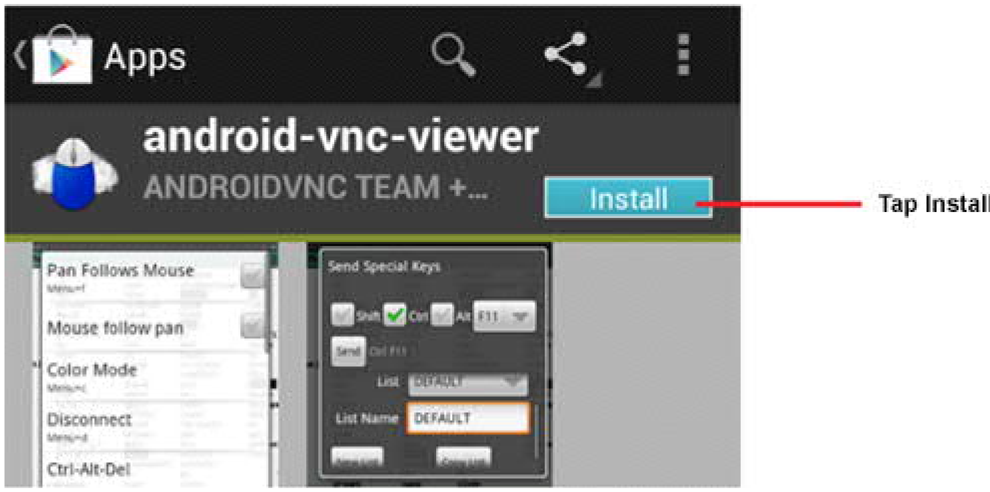

Figure 67: Android-vnc-viewer Install Screen

10. Open the VNC application on the Android device by selecting the VNC application icon. (Figure 68)

Figure 68: VNC Application Icon

11. The Android VNC screen appears. (Figure 69)

Figure 69: VNC Application Installation Setup Screen

12. In the *Address* field, enter the address of the analyzer (192.168.100.100 or 192.168.100.101) that you recorded in Step 8.

    The IP address of the analyzer will be whichever address the Android device is not. For example, if the IP address of the Android device that was displayed in Step 8 is 192.168.100.101, then the IP address of the analyzer will be 192.168.100.100.
13. In the Password field, enter lgrvnc.

14. Tap the Connect button to connect the Android device to the analyzer. The analyzer software interface screen displays on the device. The screen size is adjustable to fit the screen of the device. (Figure 70)

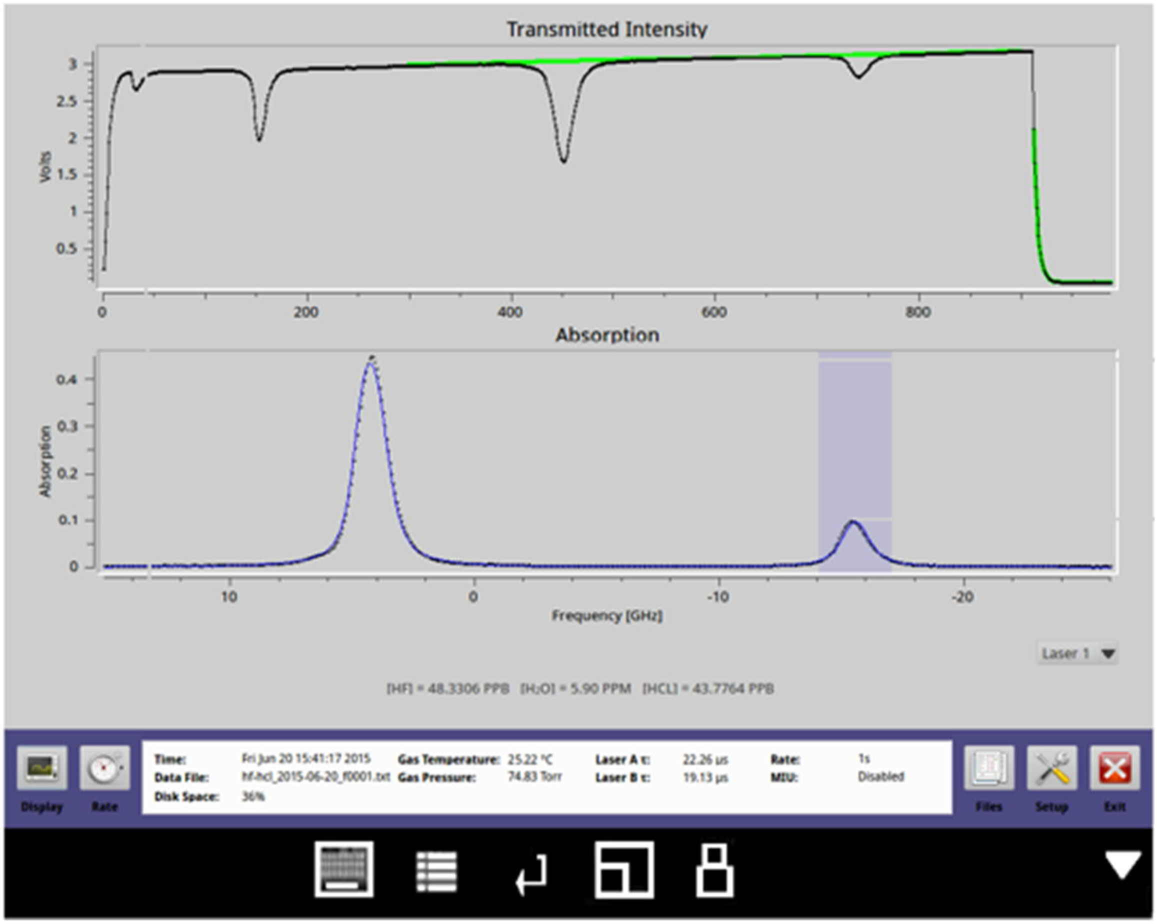

Figure 70: Analyzer Software Interface Display with Size Adjustment for Android Devices

Set up VNC Software on iOS Devices

1. On the iOS device, go to Settings > WiFi, then select the network from the list.

2. Connect to the wireless SSID network listed on the router sticker. (Figure 58) Enter the TP-Link wireless router. (example: TP-LINK-775C)
   - For ultraportable analyzers, the TP-Link wireless router is installed inside the analyzer and may be accessed by opening the case.
   - For all other analyzers, the optional TP-Link wireless router is attached to the outside of the case.

3. Select your SSID network. For example, TP-LINK-D036. (Figure 71)

Figure 71: Network Connections Screen

4. The *Enter Password* screen appears. (Figure 72) In the Password field, enter the wireless password on the router sticker. (Figure 58)

5. Select Join.

Figure 72: Router Connection Screen

6. The *Network Connections* screen confirms that the iOS device is connected to the router. (Figure 73)

Figure 73: Router Connection Confirmation Screen

7. Select the network to check the IP address (192.168.100.100 or 192.168.100.101) of the device as shown in Figure 74.
    a. Wireless devices can compete for dynamic addresses. If the 192.168.100.100 address does not connect, then use 192.168.100.101.

8. Record the IP address of the iOS device because it will be necessary to refer to it in Step 12.

Figure 74: Device IP Address Confirmation Screen

9. Install the VNC software by searching and installing it from the App store.
    a. *Mocha VNC Lite for iOS* is the software used in this example. (Figure 75)
    b. An Internet connection is required for this step.

NOTE

Complete instructions for installing *Mocha VNC Lite for iOS* can be found online at: http://www.mochasoft.dk/iphone_vnc_help2/help.htm.

Figure 75: VNC Selection Screen

10. Open the application and select Configure. (Figure 76)

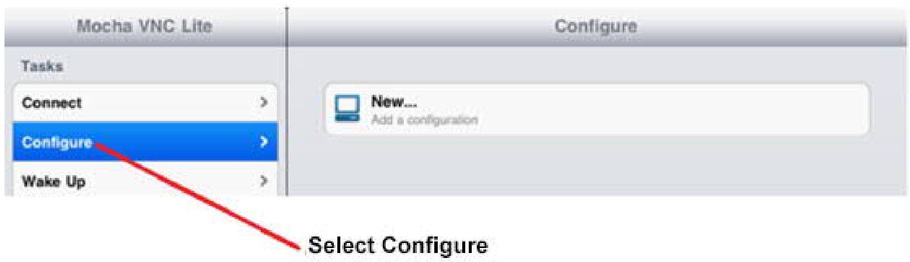

Figure 76: Mocha VNC Lite Configure (New) Screen

11. The *Configure Screen* prompts you for the server IP address and password. (Figure 77)

Figure 77: Mocha VNC Lite Configure Screen

12. Enter the analyzer's address in the *VNC server address* field (192.168.100.100 or 192.168.100.101), from Step 8.

    The IP address of the analyzer will be whichever address the iOS device is not.

    For example, if the IP address of the iOS device that was displayed in Step 8 is 192.168.100.101, then the IP address of the analyzer will be 192.168.100.100.

13. In the *VNC Password field*, enter lgrvnc.

14. Select Connect.
    The *Setup Configuration* screen displays the IP address. (Figure 78)

Figure 78: Setup Configurations Screen

15. To connect the iOS device to the analyzer, tap the IP Config you set up. The analyzer software will display on the device. (Figure 79) The screen size is adjustable to fit the screen of the device.

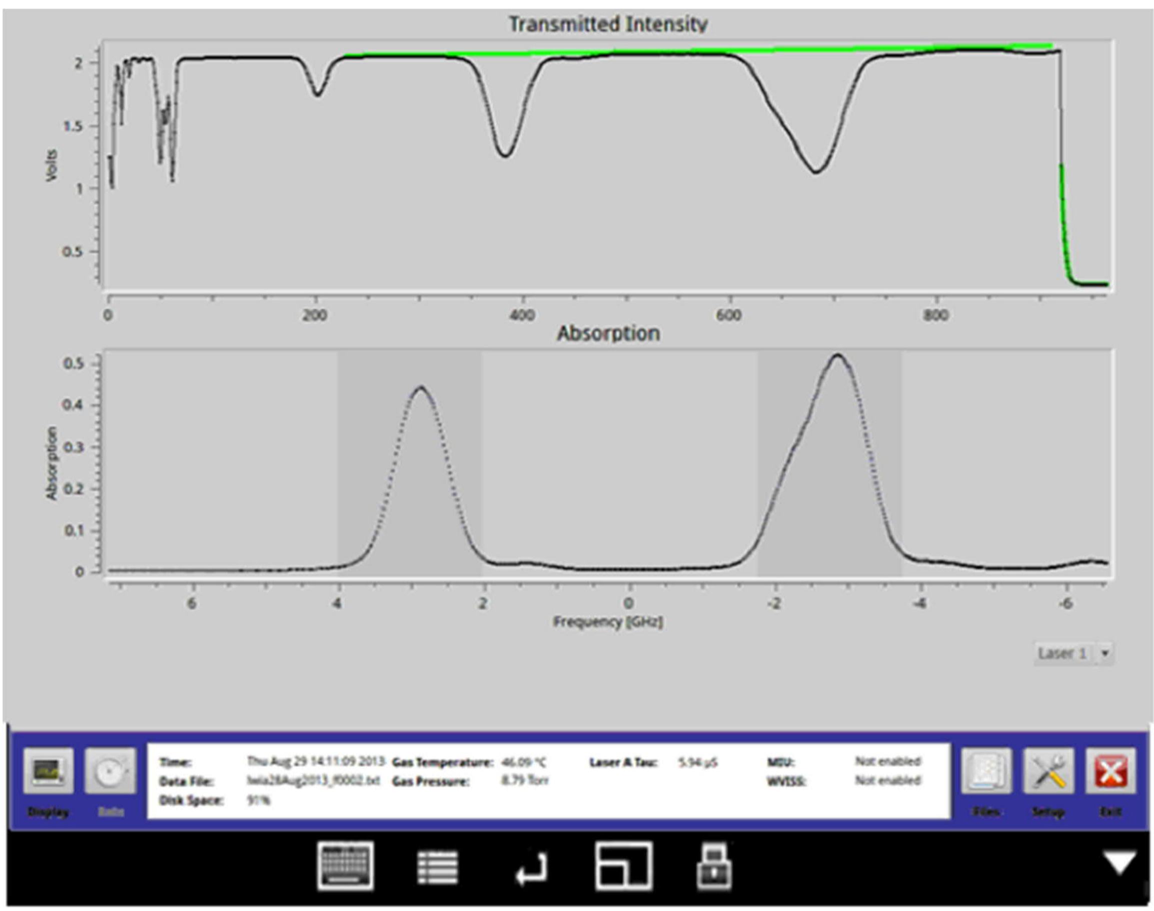

Figure 79: Analyzer Software Interface Screen (Size Adjustment for iOS Devices)

Set up VNC Software on Windows Devices

1. On the Windows device, open *Wireless Router* options.
2. Locate the sticker on the router. (Figure 58)
3. Click on the Wireless Network Connections icon in the bottom left of the screen (Figure 80) to open the *Windows Wireless Networks* dialog-box. (Figure 81)

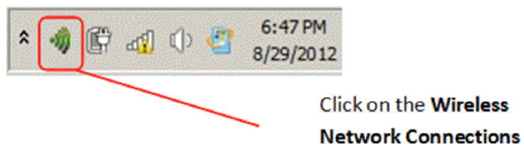

Figure 80: Wireless Connections Icon

Figure 81: Windows Wireless Networks

4. Select the SSID network name listed on the router sticker, (Example: TP-LINK-775C), to display the *Connect to a Network* dialog-box. (Figure 82)

5. In the *Security key* field, enter the wireless password located on the router sticker. (Figure 58)

6. Click OK.

Figure 82: Network Connections Security Screen

7. The *Connection Status* dialog-box displays. (Figure 83)

Figure 83: Current Connectivity Screen

8. Check the connection to make sure the device is connected through the wireless router by selecting the router. (Figure 84)

Figure 84: Wireless Network Connection Screen

9. Verify the IP address of the Windows device:
   a. Right-click on the TP-LINK-775C network connection.
   b. Click Status. (Figure 85)

Figure 85: Current Connectivity Screen

10. The *Wireless Network Connection Status* dialog-box displays. (Figure 86)

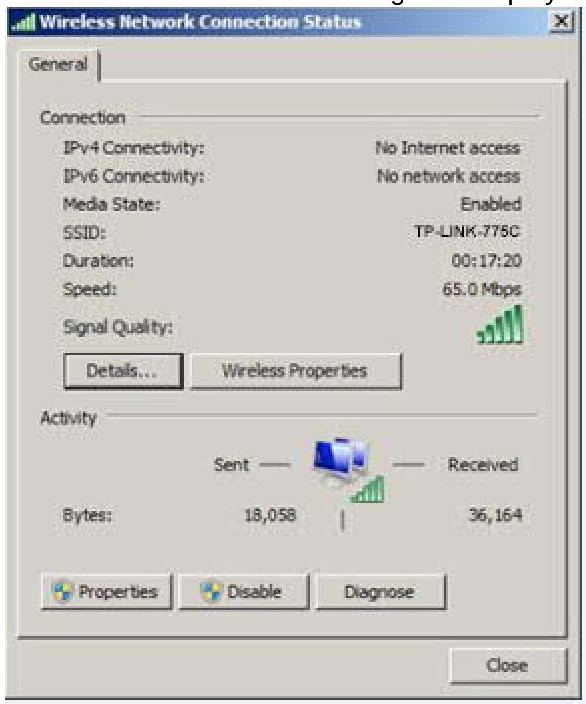

Figure 86: Wireless Network Connection Status Window

11. Click the Details button to display the *Network Connection Details* window. (Figure 87)

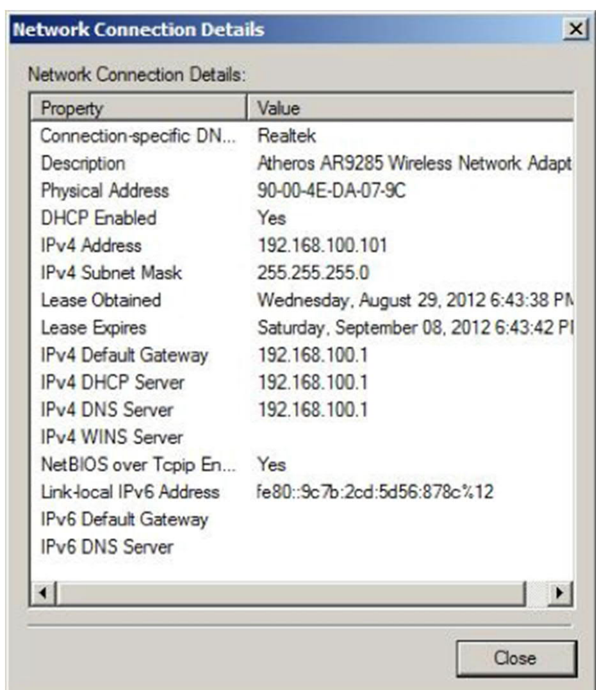

Figure 87: Network Connection Details Window

12. Verify the *Ipv4 Address* of the Windows device, which should be either 192.168.100.100 or 192.168.100.101. For example, the Windows device IP address is 192.168.100.101. (Figure 87)

13. Install the VNC software by going to the *RealVNC* website and downloading the RealVNC Viewer "EXE" file from http://www.realvnc.com/download/.

NOTE

Detailed instructions for installing Real VNC Viewer for Windows can be found online at: http://www.realvnc.com/products/vnc/documentation/5.0/guides/user/Chapter1.html

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14. Open the program by clicking the Connect button. (Figure 88)

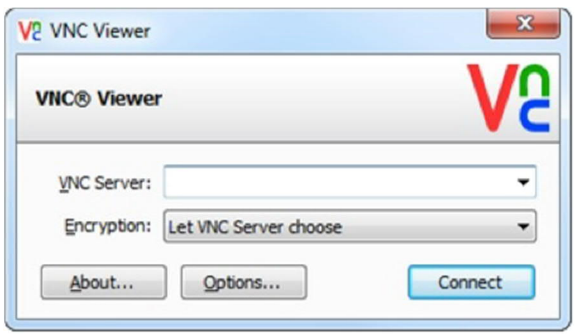

Figure 88: Real VNC Viewer Installation Screen

15. Enter the analyzer's address in the VNC server address field (192.168.100.100 or 192.168.100.101), from Figure 87.

    The IP address of the analyzer will be whichever address the Windows device is not. For example, if the IP address of the Windows device that was displayed in Step 12 is 192.168.100.101, then the IP address of the analyzer will be 192.168.100.100.

    Wireless devices can compete for dynamic addresses. If the 192.168.100.100 address does not connect, then use 192.168.100.101.

Appendix E: Multi-Port Inlet Unit (Optional)

The *Multiport Inlet Unit* (MIU) directs samples of multiple unknown gases and multiple reference gases through a series of inlet ports and digitally controlled valves directly into the inlet port of the analyzer. The gas manifold control screen (Figure 89) controls which gases are introduced into the inlet port of the analyzer in what order and for how long.

NOTE

For the GLA351-CCIA3, the Zero Air Sequence must not be removed. Refer to the *MIU* section on page 66 for more details.

By sampling references periodically during an ongoing data run, you can post-correct the data for long-term drift when active calibration cannot be done.

ABB-LGR offers two versions of the MIU:

- 8 port
- 16 port

Figure 89 shows the front panel of a 16 port MIU.

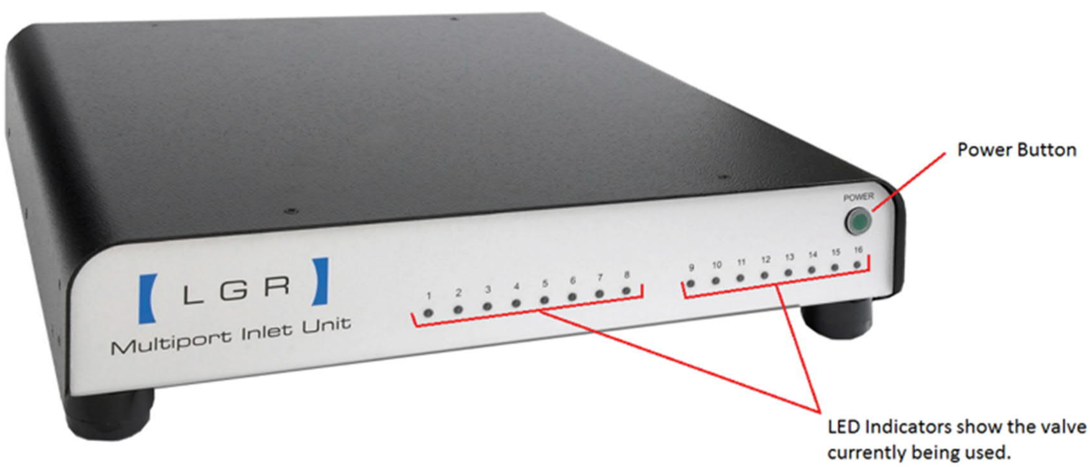

Figure 89: 16 Port MIU Front Panel

NOTE

Control of the MIU is unidirectional. The analyzer does not receive feedback on the MIU state. If the MIU is enabled in the analyzer *Setup Panel*, the data file is tagged with MIU valve descriptions whether or not the MIU is properly connected. The data file simply logs the condition of the control signal to the MIU.

Figure 90 shows the back panel of a 16 port MIU. The MIU inlet ports are labeled numerically on the back panel of the MIU. The outlet port connects to the gas inlet on the analyzer. The MIU is shipped with these accessories:

- A 25-pin control cable (connects the analyzer to the MIU)
- A power cable (Powers the MIU)
- A 1/4" x 6' Teflon tube (connects the outlet port of the MIU to the inlet port of the analyzer)

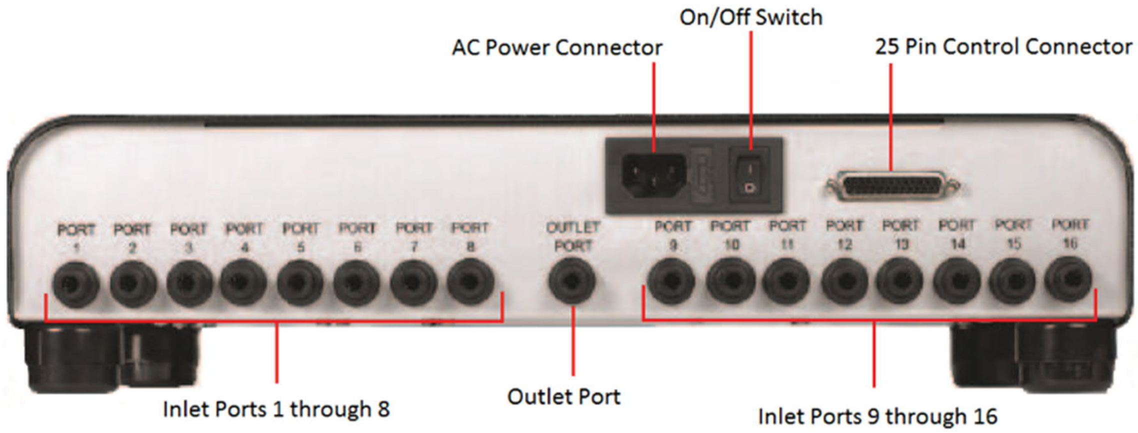

Figure 90: MIU Back Panel

Set Up the MIU

Connect the Components

1. Connect the provided power cable into the fused power-entry module on the back panel.
2. Connect the 25-pin control cable from the MIU to the TO MIU port on the back panel of the analyzer.
3. Connect a 1/4" Teflon tube from your gas source into one of the numbered inlet ports. Repeat for multiple gases.
4. When connecting the tubing, push the tube into the port until you feel a click in order to avoid leaks in the seal.
5. Connect the provided 1/4" x 6' Teflon tube from the MIU outlet port to the Inlet port of the analyzer.
6. Turn on the power switch on the back panel of the MIU.

Disconnect the MIU

1. Push the outer ring around the inlet and outlet connectors on the MIU to release the 1/4" tubing.

Control the MIU Using the Analyzer Setup Panel

1. Click Setup on the *User Interface Control Bar.* (Figure 93)
2. Click on the MIU tab at the top of the *Setup* menu selection bar. (Figure 91)
    a. The *MIU setup* menu becomes active. Use the menu to specify what ports are sampled and for how long.

Figure 91 shows the *Gas Manifold Control* Screen for the MIU not yet enabled.

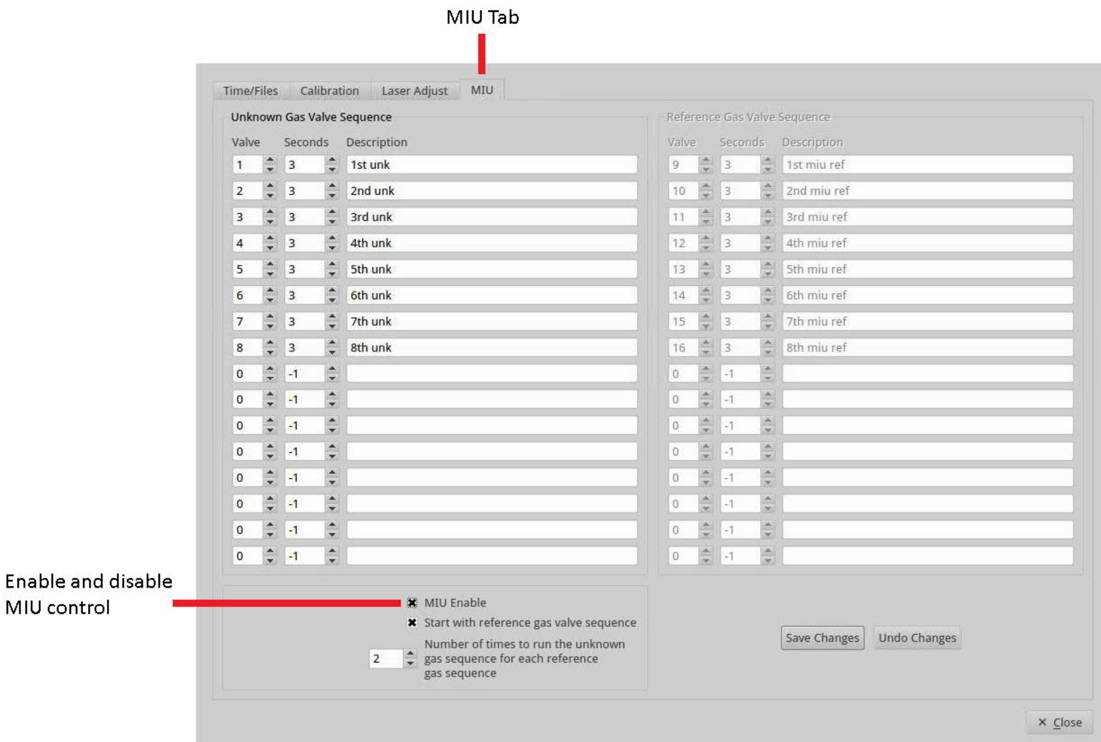

Figure 91: Gas Manifold Control Screen for the MIU, not yet enabled

3. Populate the unknown gas valve sequence:
    a. Valve - The current valve being sampled (corresponds to the port number on the MIU).
    b. Seconds - How long the analyzer should sample the gas (in seconds).
    c. Description - Input a short text description associated with the gas connected to that valve.

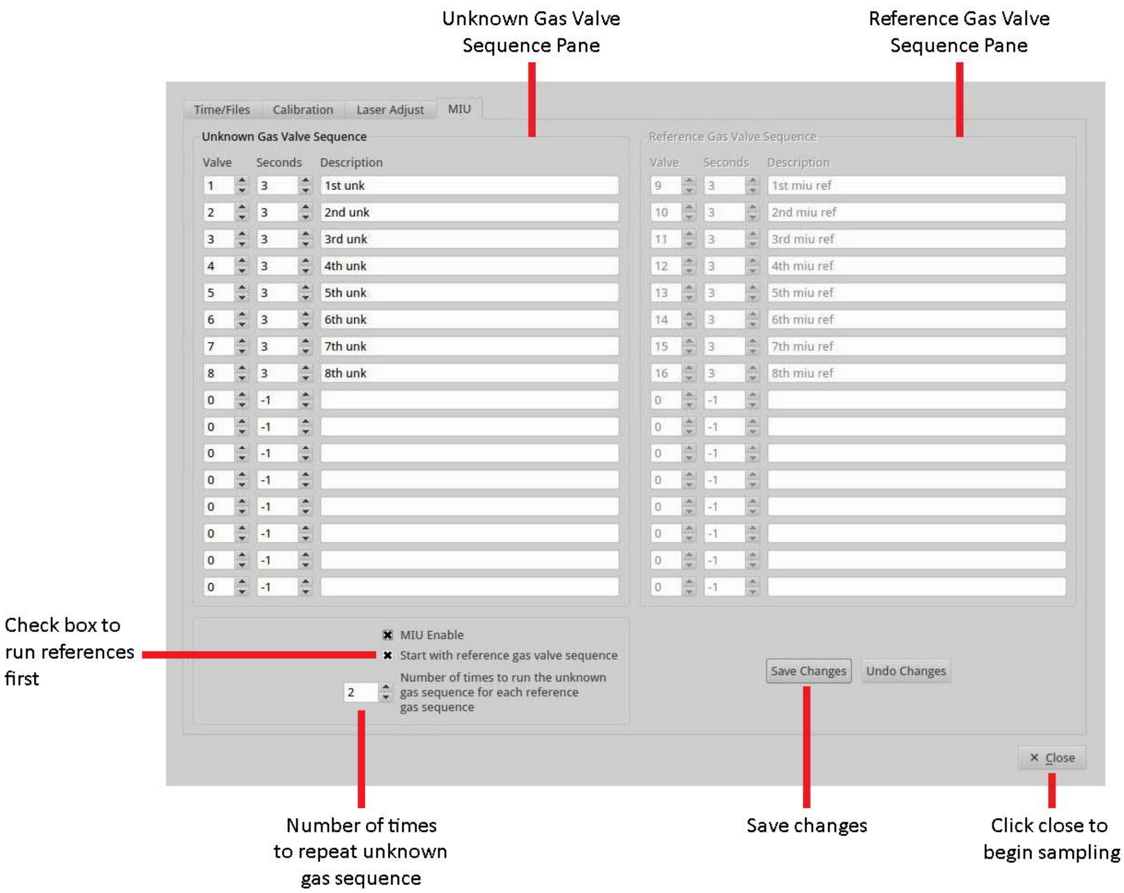

Figure 92: Gas Manifold Control Screen for the MIU, Enabled

NOTE

If a valve is set to 0, the entry is ignored. Each defined gas is sampled sequentially in its respective group (unknown or reference).

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4. Populate the reference gas valve sequence:
    a. Valve - The current valve being referenced. Corresponds to the port number on the MIU.
    b. Seconds - How long the analyzer should reference the gas (in seconds).
    c. Description- Input a short text description associated with the reference gas connected to that valve.

5. Click on the Start with reference gas valve sequence check box if you wish to run your reference gases first.
6. Use the arrow scroll bar to select the number of times to run the unknown gas sequence for each reference gas sequence. (Figure 92)
7. Select Save Changes to save your current configuration.
8. To begin sampling, click Close. (Figure 92)

The MIU outlet port is:

- Open when the MIU is powered on
- Open at initialization
- Open and closes as specified on the *MIU tab* when the analyzer software has properly initialized

While the MIU is operating, the current valve being sampled / referenced and its text description is shown in the parameter window of the *User Interface Control Bar.* (Figure 93)

The description is:

- Displayed on the parameter window of the *User Interface Control Bar* during analysis. (Figure 93)
- Saved to a data file

Figure 93: User Interface Control Bar (showing MIU information)

9. When sampling is complete, disable the MIU by returning to the *MIU screen*, and uncheck the MIU Enable check box. (Figure 92)

Appendix F: External Dynamic Dilution System (Optional)

The External Dynamic Dilution System (EDDS) is an optional accessory. This section describes the EDDS and explains setup and operation.

Figure 94: EDDS Front & Back Panel

The EDDS:

- Automatically dilutes the sample stream with zero-air whenever the concentration rises above the target (2, 5, or 10 ppm). It maintains the target concentration at that level.
- Has a response time constant of approximately 2 minutes, so a sudden rise in concentration will cause the concentration to over-range for up to 2 minutes while the DCS adjusts the concentration to target.

The sample and the zero-air flow in through the gas inlets and are mixed in the EDDS. Both the sample and the zero-air must:

- Be pressurized to between 15 and 50 PSIG
- Have a sample gas flow capability of 200 SCCM
- Have a zero-air flow capability of 2.2 SLPM

NOTE When transitioning from a large concentration to a lower concentration of gases, a memory effect may result from residual gas in the analyzer. Verify that the gas from the previous sample has had time to exit the system. Residual gas can also be removed by switching inlet lines, using shorter line lengths, or flushing lines with zero-air.

Connect the EDDS

This section describes the EDDS hardware and how to connect it. (Figure 95)

1. Control cable – Connect the BNC cable between:
    a. The CONTROL IN port on the EDDS
    b. The DCS port on the analyzer
2. Sample line – Use a 9/16” wrench to connect the 6’ x 1/4” Teflon tubing between:
    a. The OUTPUT TO ANALYZER INLET port on the EDDS
    b. The SAMPLE INLET port on the analyzer
3. Zero-air line - Use a 9/16” wrench to connect the 6’ x 1/4” Teflon tubing between:
    a. The ZERO AIR 15-50 psig port on the EDDS
    b. Your house air supply
4. Line to sample supply - Use a 9/16” wrench to connect the 6’ x 1/4” Teflon tubing between:
    a. The SAMPLE 15-50 psig port on the EDDS
    b. Your sample supply
5. Power cord – Connect the EDDS power cord from the port on the back panel to a grounded outlet of your power supply

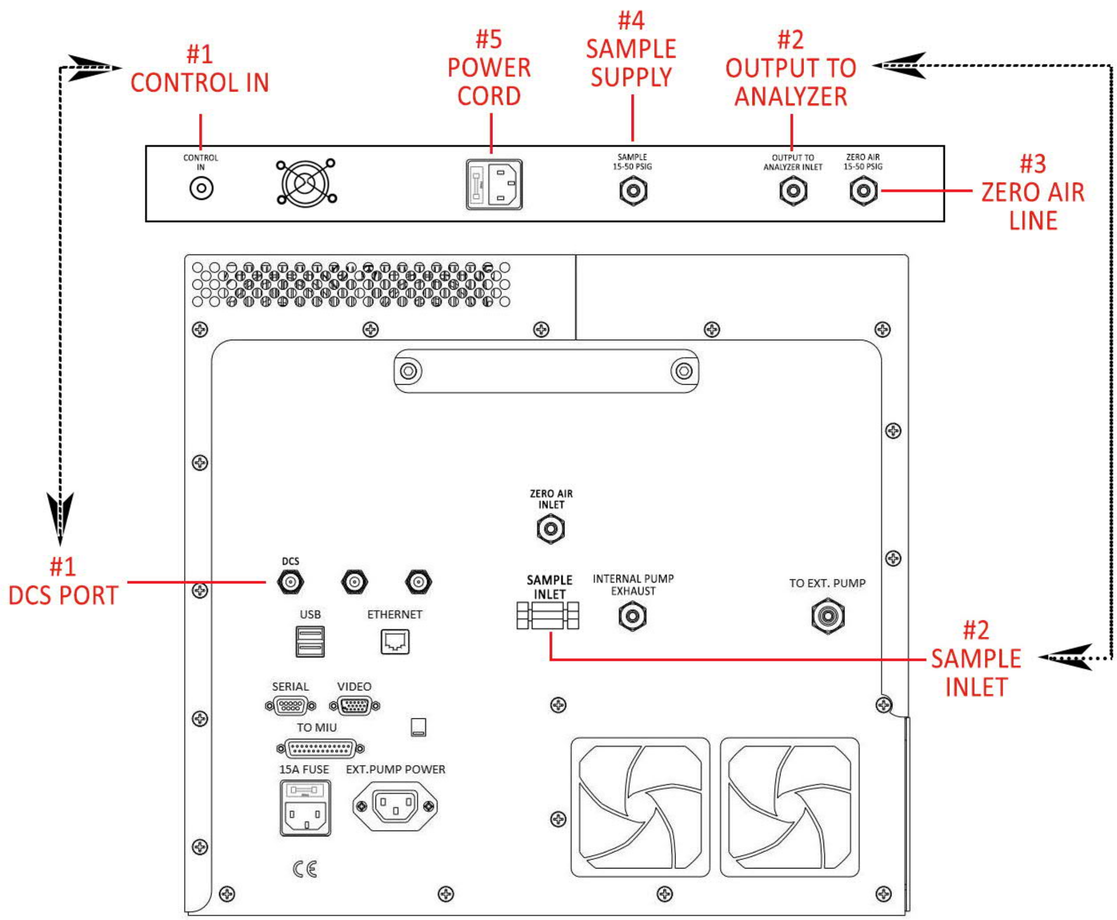


Figure 95: EDDS Connection System

Sample Inlet Tee Connector

The diluted gas flows into analyzer through a T-connector that allows for steady flow past the inlet to the analyzer. (Figure 96)

ABB-LGR recommends these T-connectors:
1/4" inlet: Swagelok SS-400-3
3/8" inlet: Swagelok SS-600-3

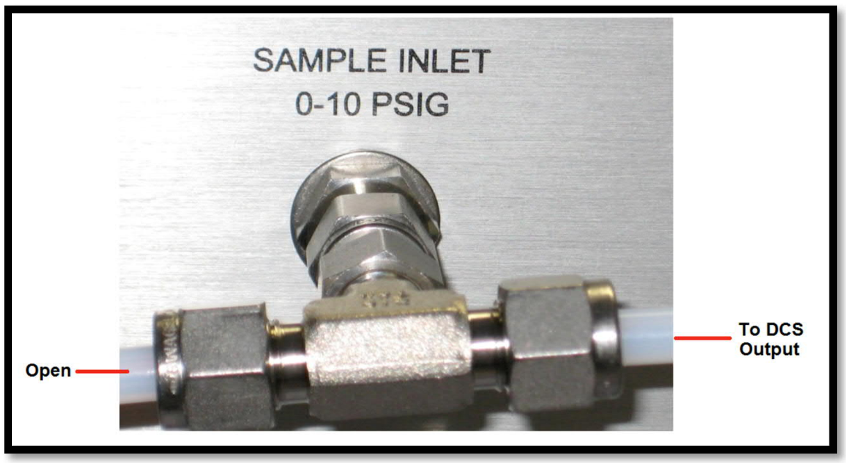


Figure 96: Inlet T-Configuration for the EDDS

If you do not use the inlet tee, and connect the gases directly to the analyzer, the mass flow controllers will not maintain proper dilution.

Depending on the sample concentration the mass flow controllers adjust the amount of dilution:

- Sample flow can vary from 0 to 200 SCCM
- Zero-air flow can vary from 0 to 2.2 SLPM

Flow through the measurement cell should remain steady at approximately 180 SCCM or less, with the excess flow vented out through the inlet tee.

Optional External Throttle Valve

An optional external throttle valve (Figure 97) lets you adjust the gas flow to the analyzer. Use the throttle valve to restrict the:

- Total flow into the analyzer to less than 200 SCCM
- Source gas to less than 180 SCCM for proper dynamic dilution control

The flow rate can be measured at the inlet if necessary.

Figure 97: External Throttle Valve

Enable the EDDS

1. Click Setup on the *User Interface Control Bar*. (Figure 98)

Figure 98: Setup button on the User Interface Control Bar

2. Click on the DCS tab at the top of the *Setup* menu selection bar. (Figure 99)
3. Use the radio buttons to Enable or Disable the EDDS.
4. Use the drop down selection box to set the dilution factor.
5. Click Save.
6. Click Close to begin the dilution.

Figure 99 shows the DCS Screen for the EDDS enabled.

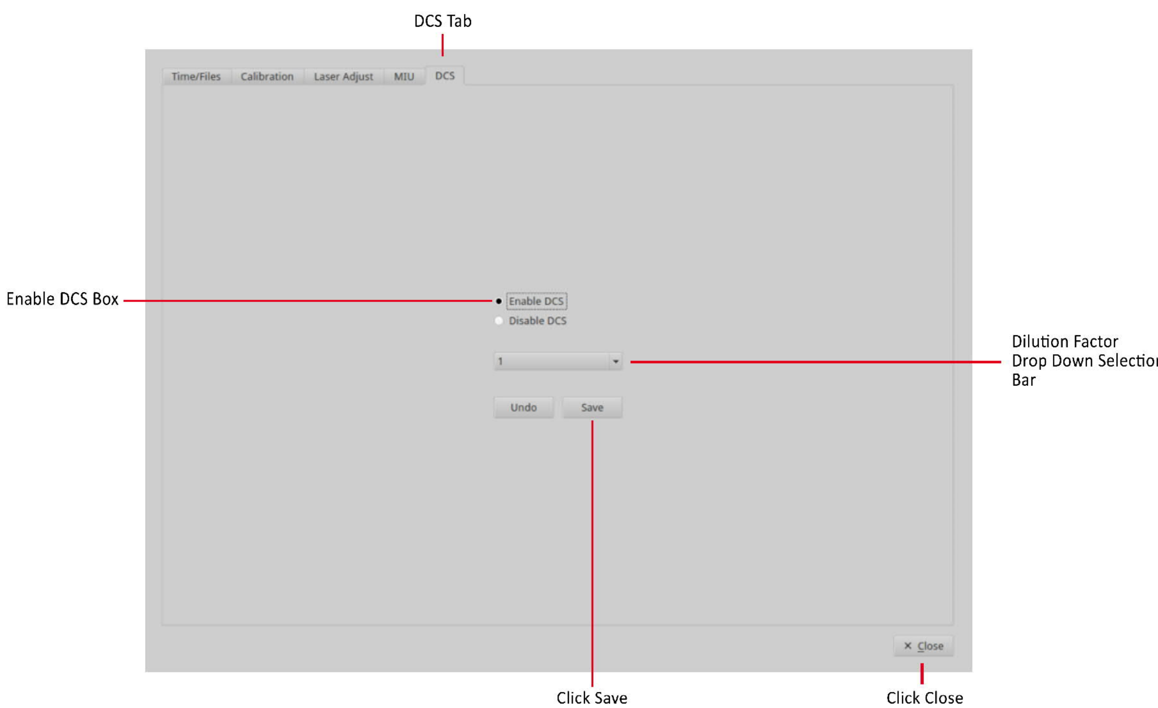


Figure 99: Enable EDDS

Appendix G: Fast-Flow Operation for the GLA351-N2OCM and GLA351-N2OM1

Analyzers with the Fast-flow feature:

- Measure data at a higher flow rate than a standard analyzer.
- Use an external pump to increase the flow rate of gas during measurement.
- Use a throttle valve to adjust the pressure inside the analyzer.

Figure 100 shows a plumbing diagram of an analyzer with the Fast-Flow option.

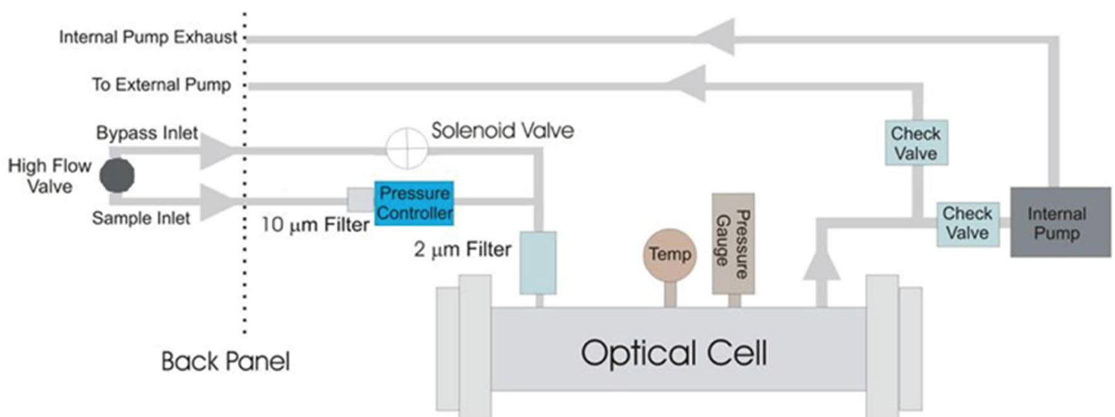


Figure 100: Plumbing Diagram for Fast-flow Mode

During high-flow mode, the External Pump is on and the Internal Pump is off. The high flow solenoid valve opens, and the inlet gas flows through both of the inlet paths. The External Throttle Valve (Figure 101) is used in conjunction with the electronic pressure controller to adjust the flow through the analyzer.

External Throttle Valve

The throttle valve reduces the pressure of the gas to the pressure controller, while the pressure controller regulates the fine adjustments to maintain cell pressure. If the analyzer is not operating at the target set point during high flow operation, the high flow throttle valve may need to be adjusted.

The high-flow throttle valve:

- Provides coarse manual control of the flow to compensate for various external inlet configurations.
- Optimizes the pressure at the target set point during high flow operation.

If the external throttle valve is closed, the flow is routed through the pressure controller. (Figure 100) However, the pressure controller is not able to pass sufficient flow to the cell at its target pressure in high flow mode. As the high-flow throttle valve is manually opened, a point is reached where the flow through the valve combined with the flow through the pressure controller is sufficient to maintain the target cell pressure. As the high-flow throttle valve is opened further (approximately ½ turn), the electronic pressure controller is within its control range and is able to throttle down its flow to compensate for the additional flow through the valve.

The ideal operating point is for the high-flow throttle valve to be set in the middle of the pressure control range. This midpoint can be set by slowly opening and closing the high-flow throttle valve while observing the reported cell pressure and noting the points at which the control range begins and ends. This control range typically spans approximately ½ turn of the high flow throttle valve. Once the range is found, set the valve position to the middle of this range.

Figure 93 shows the external throttle valve assembly.

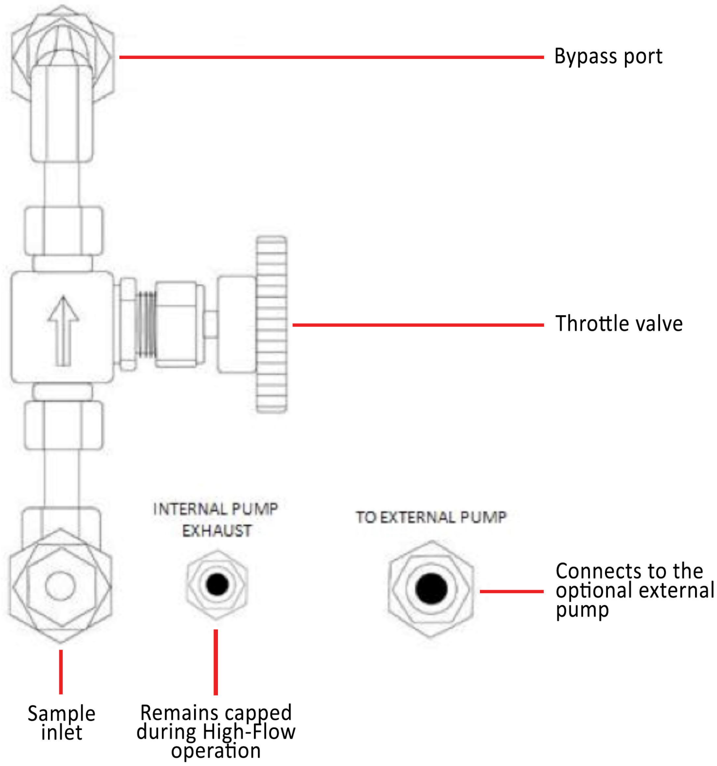


Figure 101: High-Flow Throttle Valve

Fast-Flow Setup and Operation

1. Connect the optional External Pump.
   a. Connect the External Pump's power cord from the pump to the EXT. PUMP POWER port on the back panel of the analyzer.
   b. Connect the provided 6' x 3/8" Teflon tubing with Swagelok fittings from the External Pump to the TO EXT PUMP port on the back panel of the analyzer.
   c. Press the Power switch on the front of the pump.
2. With the Internal Pump running (in standard mode), make note of the Gas Pressure reading within the *Parameter Window* of the *User Interface Control Bar*. (Figure 102)

Figure 102: User Interface Control Bar showing Pressure Reading and Rate Icon

3. Cap the Internal Pump Exhaust port with the provided ¼" Swagelok cap.
4. Click the Rate button (clock icon) on the *User Interface Control Bar* (Figure 102) to access the *Data Rate Control Adjustment Panel*. (Figure 103)
5. Click the Operating Mode radio buttons in the *FAST* row to select the rate at which data is acquired. Click Save.
    a. The Internal Pump will shut OFF, and the External Pump will power ON.
        i. Fast = External Pump on / Internal Pump off
        ii. Slow = External Pump off / Internal Pump on

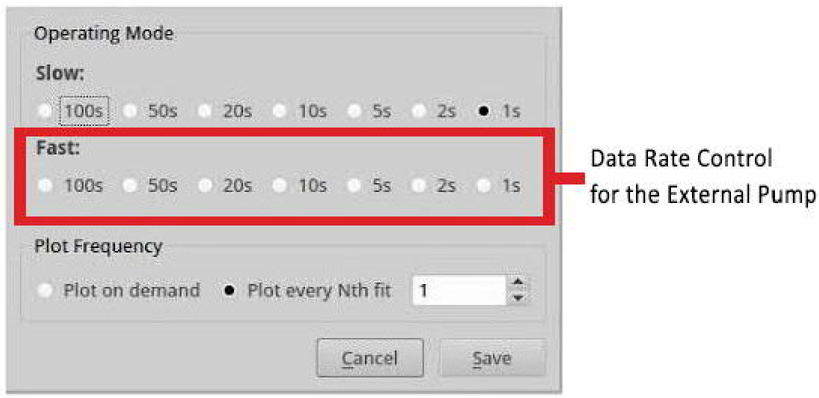


Figure 103: Data Rate Control Adjustment Panel

NOTE The analyzer restarts sampling at whatever rate was set last.

---

6. To begin adjustments to the external throttle valve, turn the valve clockwise until it is completely closed.
    a. The gas flow will be routed through the electronic pressure controller.
    b. The pressure controller is fully open but not able to pass sufficient flow to the cell at its target pressure.
7. Turn the throttle valve counter-clockwise to open, while watching the Gas Pressure reading in the *Parameter Window* of the *User Interface Control Bar*. (Figure 102)
    a. Find the midpoint control range by slowly opening and closing the high flow throttle valve while observing the reported cell pressure and noting the points at which the control range begins and ends.
        i. Each analyzer has a unique pressure set point. For example, if the cell pressure is 140 Torr in slow mode, then the pressure reading should be 140 Torr in high flow mode as well.
        ii. The gas pressure is reduced to the point that it is within the electronic pressure controller's range. The ideal setting for the high flow throttle valve is the middle of the electronic pressure controller's range.
    b. Set the valve position to the middle of this range.
        i. This control range typically spans approximately ½ turn of the high flow throttle valve.

Figure 104 shows a diagram of an analyzer's control range with the set point at 140 Torr.

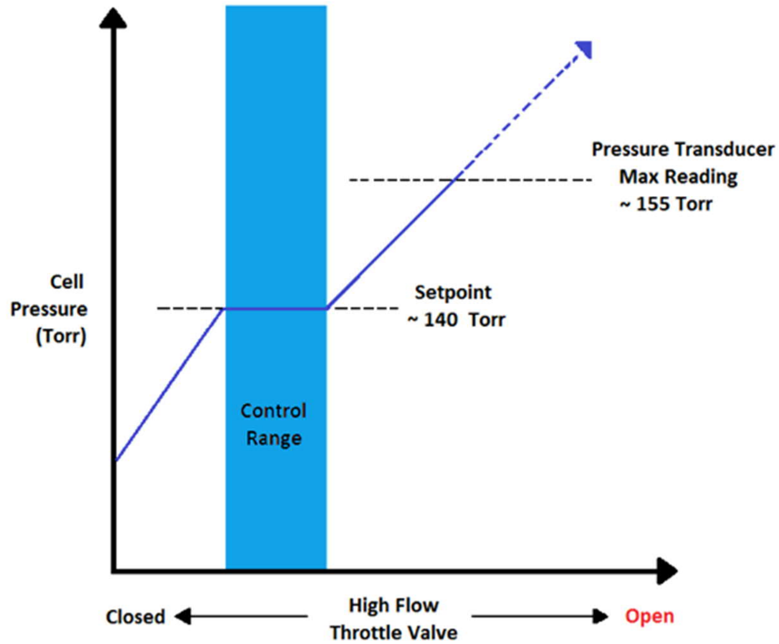


Figure 104: Control Range Diagram

8. Verify that the cell pressure is the same in both flow modes (with External Pump and Internal Pump)

NOTE The maximum range and reading display of the pressure transducer is approximately 155 Torr—any time the cell pressure is above 155 Torr the display will remain locked at 155 Torr.

To determine if your analyzer is capable of fast-flow mode, contact ABB-LGR at icos.support@ca.abb.com.

Appendix H: Batch Mode Operation

The analyzer can be factory equipped to include a batch injection system. The batch system allows the user to manually introduce individual samples to the analyzer, using syringe injection.

Figure 105 shows the plumbing configuration for the optional batch mode.

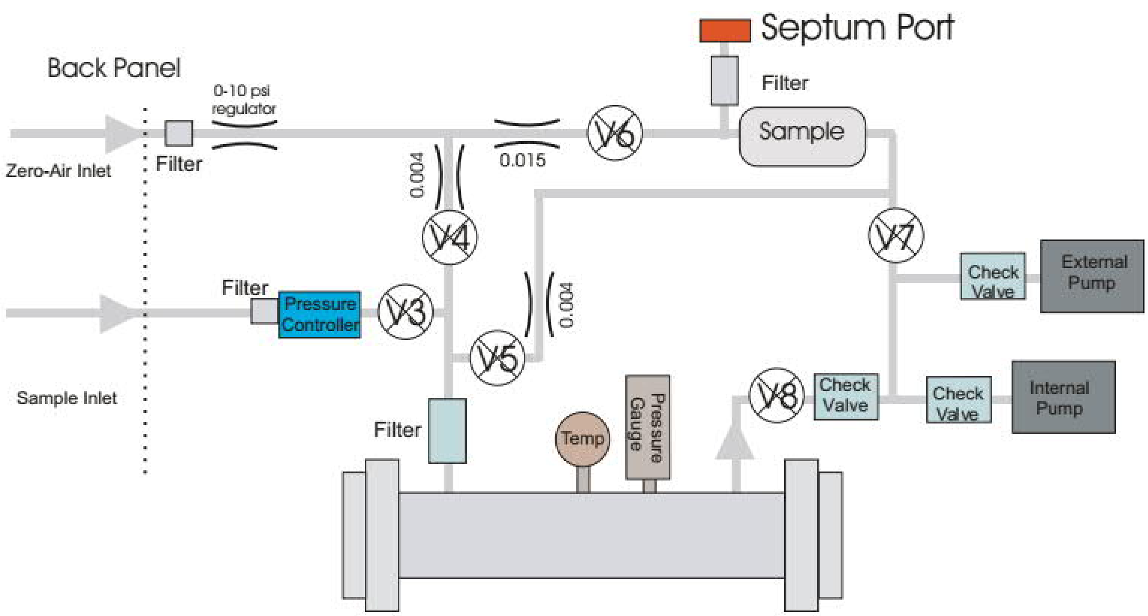


Figure 105: Batch Injection Plumbing Diagram

Accessories Required for Batch Injection

The necessary hardware and supplies for batch mode operation include:

- An external pump (ACC DP3H)
  - Pump slave power cord
  - Pump connection kit
- Additional ports on the front and back panels of the analyzer. (Figure 106)
  - Syringe injection port (front panel)
  - Zero-air inlet 1/4" Swagelok port (back panel)
- A 140mL Syringe with needle
- A 22-gauge centering needle
- Septa (Box of 50)
- A septum puller

Hardware Setup

Setup the External Connections:

1. Connect the External Pump:
    a. Connect the pump's power cord from the pump to the *EXT. PUMP POWER* port on the back panel of the analyzer.
    b. Connect the provided 6' x 3/8" Teflon tubing with Swagelok fittings from the external pump to the *TO EXT PUMP* port on the back panel of the analyzer.
    c. Connect the provided exhaust muffler to the exhaust port of the pump to exhaust into the room air, or route to your facility ventilation system.
2. Connect your Zero-Air source to the ¼" Swagelok Zero-Air Inlet port on the back panel of the analyzer. (Figure 106)
    a. Zero-Air flow should be set between 5 and 10 psig.

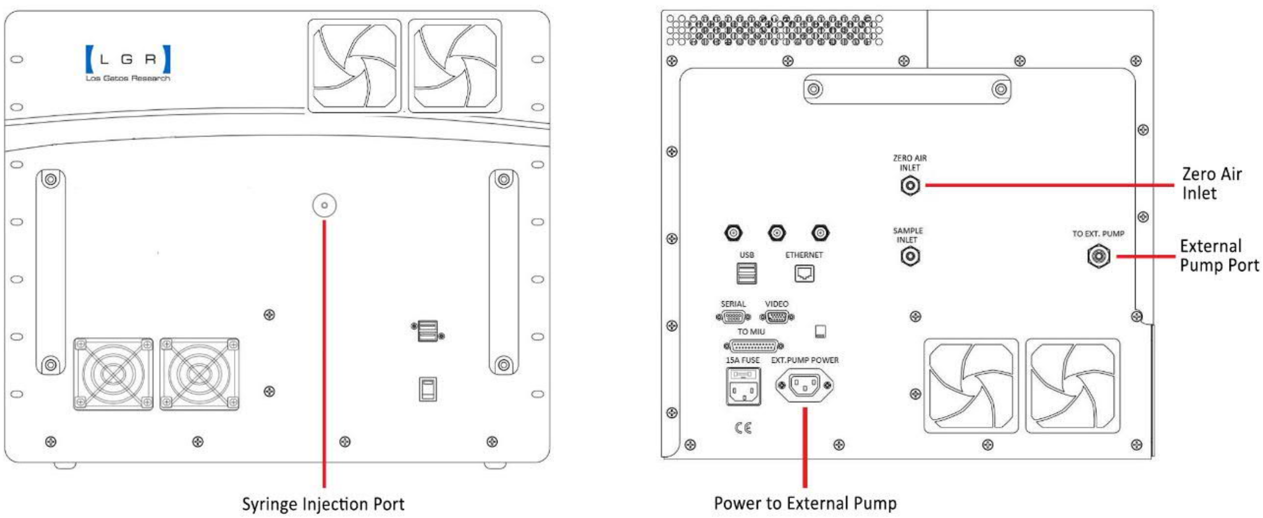


Figure 106: External Batch Connections for a 911 Series Analyzer

Software Setup

1. If applicable, in the parameter window of the *User Interface Control Bar*, verify that the optional MIU and WVISS accessories are not enabled. (Figure 107)
    a. Disable the *Multi-Port Inlet Unit (MIU)* if your analyzer is configured with this optional accessory. To disable the MIU:
        i. Click Setup on the *User Interface Control Bar*. (Figure 107)

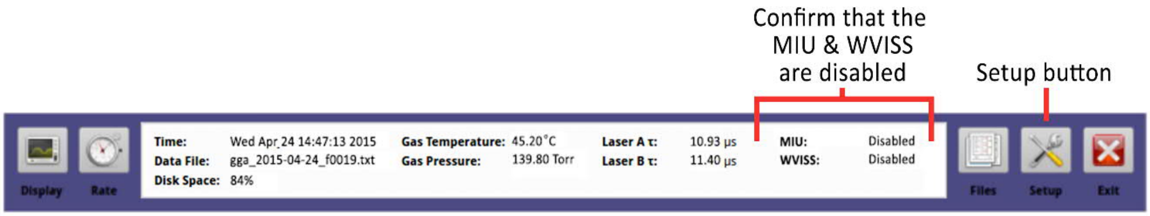


Figure 107: Setup Button on the User Interface Control Bar

        ii. Click on the MIU tab at the top of the *Setup* screen. (Figure 108)
        iii. Uncheck the checkbox at the bottom of the screen to disable the MIU. (Figure 108)
        iv. Click Save Changes. (Figure 108)
        v. Click Close to exit the *Setup* menu. (Figure 108)

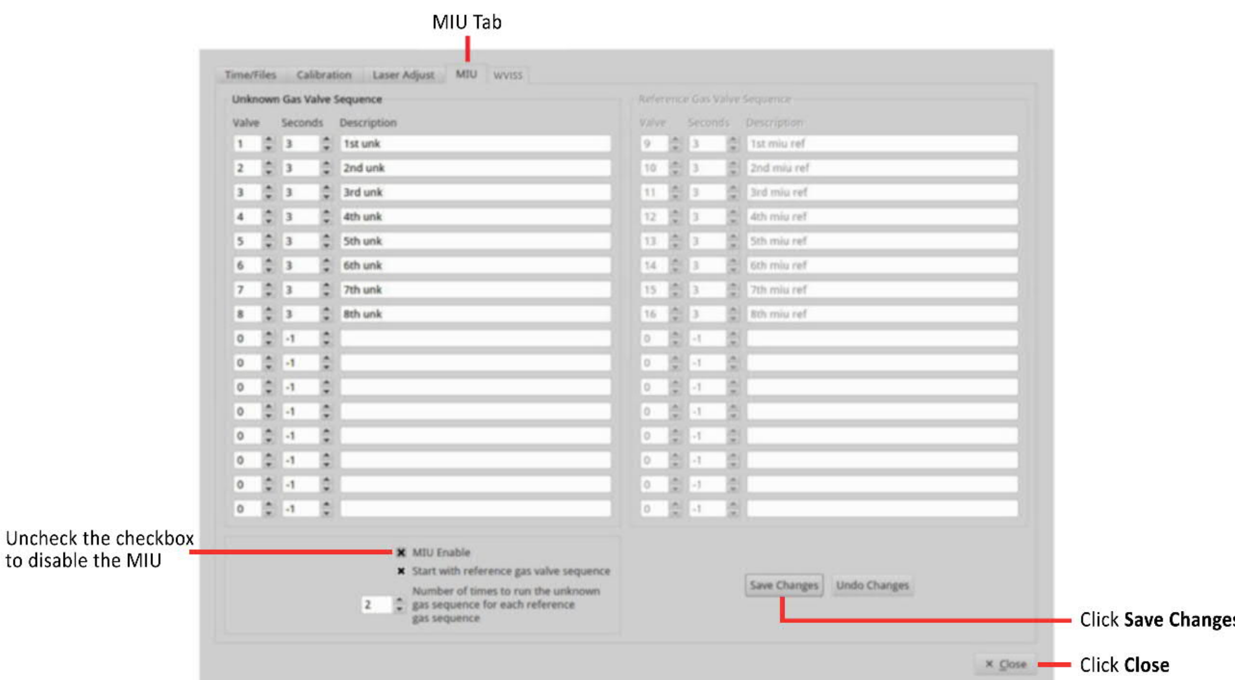


Figure 108: Control Menu for the (Optional) Multi-Port Inlet Unit (MIU)

b. Disable the *Water Vapor Isotope Standard Source (WVISS)* if your analyzer is configured with this optional accessory. To disable the WVISS:
   i. Click Setup on the *User Interface Control Bar*. (Figure 109)

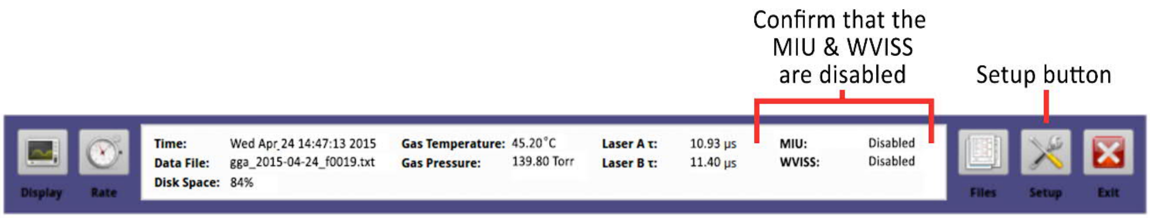


Figure 109: Setup button on the User Interface Control Bar

   ii. Click on the WVISS tab at the top of the *Setup* screen. (Figure 110)
   iii. Select Single Stage WVISS Disabled in the drop down menu in the WVISS mode section. (Figure 110)
   iv. Click Save Changes. (Figure 110)
   v. Click Close to exit the *Setup* menu. (Figure 110)

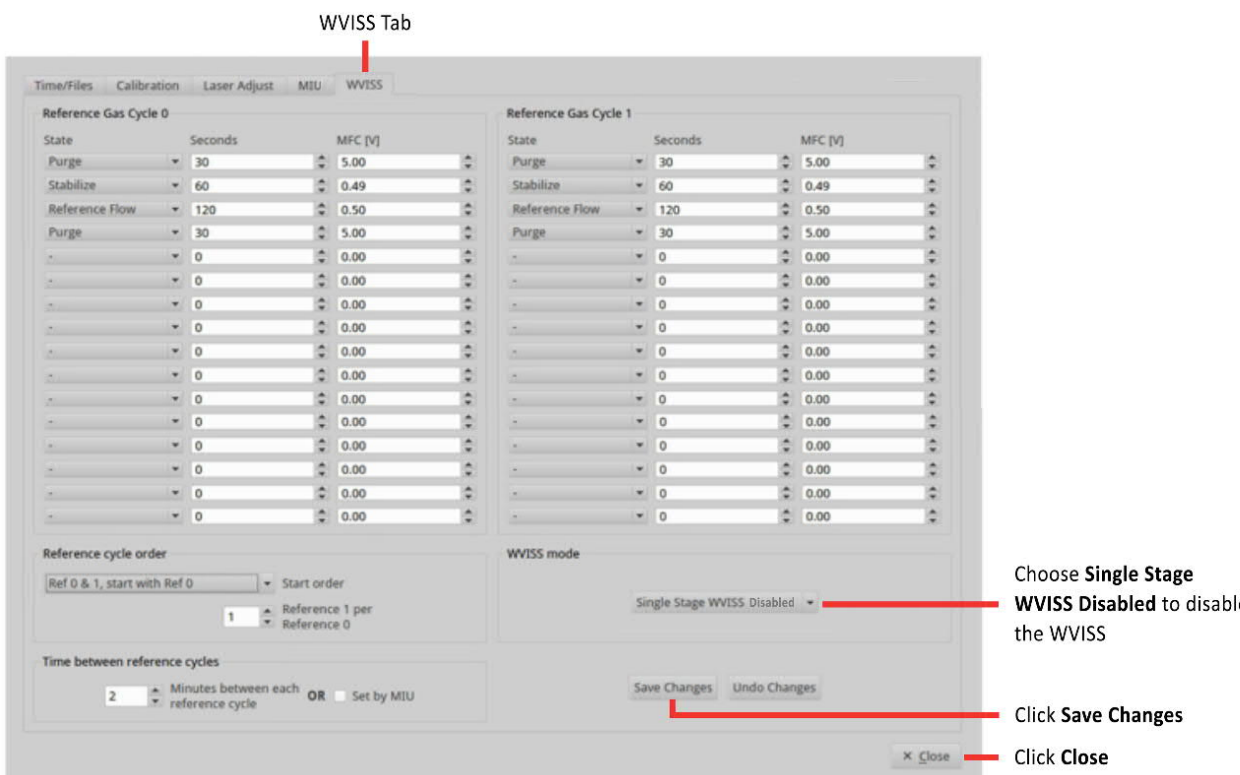


Figure 110: Control Menu for the (Optional) WVISS

2. Select *Batch Injection* mode in the analyzer software:
   a. Click the RATE button (clock icon) in the *User Interface Control Bar*. (Figure 111)

Figure 111: Click the Rate Button

3. The *Operating Mode* pop-up menu displays. (Figure 112)
   a. Select either:
      - Syringe Injection
      - Syringe Injection (Dilution x10), if applicable
        - o The sample will be diluted x10 by filling the cavity with zero air before measurement.

4. Click Save.

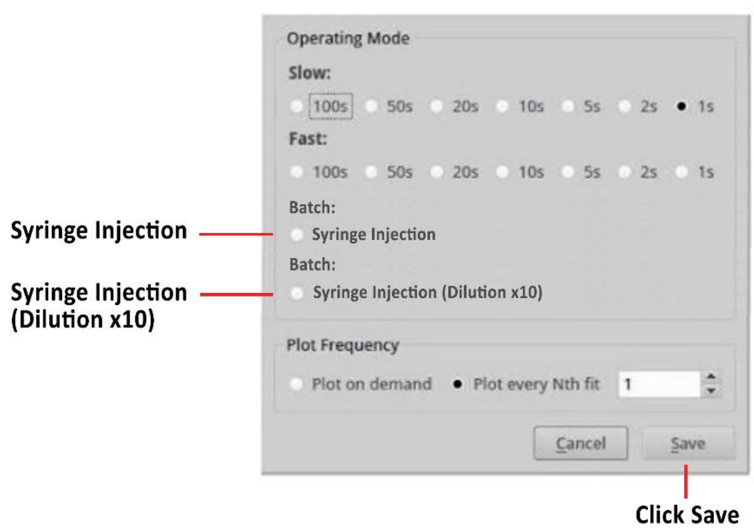


Figure 112: Rate Selection Menu

5. The *Batch Injection Measurement* screen displays. (Figure 113)
    a. This screen combines the three *Main Panel* display modes on one screen:
        - Numeric Display
        - Spectrum Display
        - TimeChart Display
    b. The *Batch Mode Status* display box in the lower right screen shows the status of the current injection. (Figure 113)

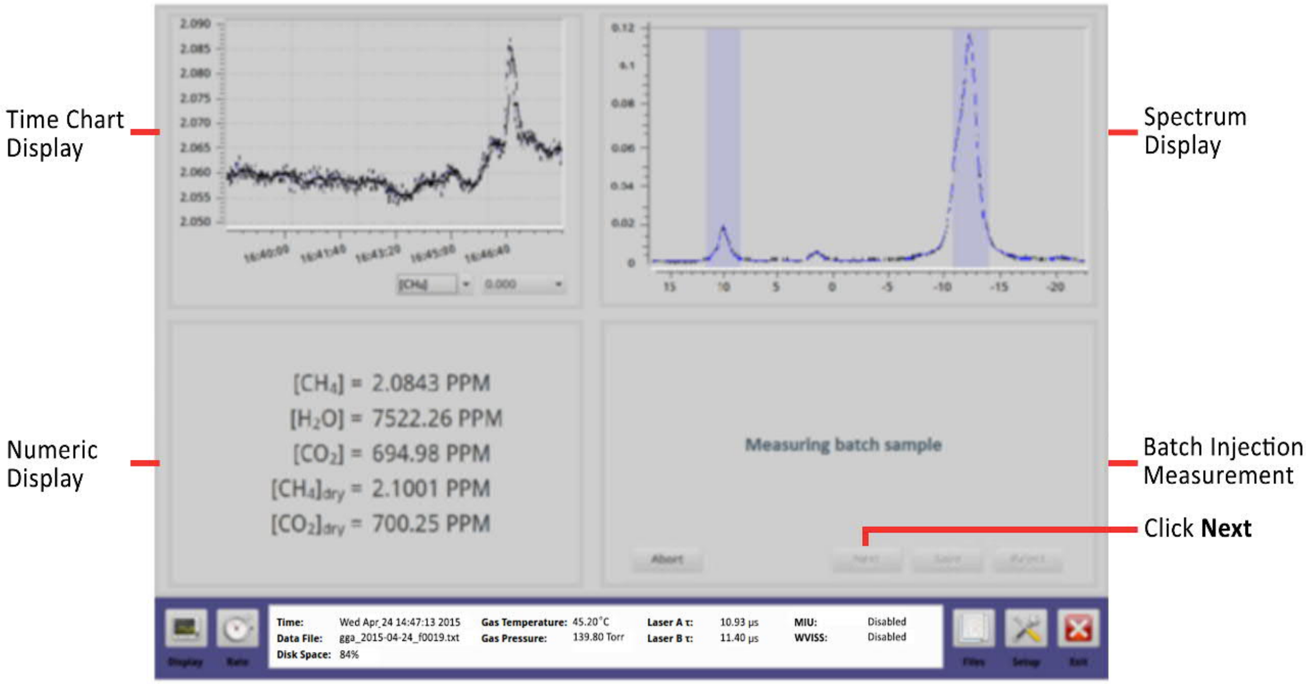


Figure 113: Batch Injection Measurement Screen

Batch Mode Processing

In *batch processing mode,* the analyzer:

1. Initiates the batch injection procedure.
2. Evacuates the cavity.
3. Flushes the cavity with zero air twice before requesting the sample.
4. Prompts you to inject sample (of >60 ml) gas into the syringe port.
    a. You have 120 seconds to inject the sample.

NOTE

If you take longer than 120 seconds to complete the injection, the *Failed Injection* message displays and instructs you to restart the injection process.

Figure 114 shows the batch measurement procedure.

Figure 114: Batch Injection Flow

To begin batch mode processing:

a. Click NEXT in the *Batch Mode Status* display box. (Figure 113)
    i. Each step is displayed in the lower-right panel of the screen as the analyzer prepares for the injection.
b. The ICOS cavity is pumped out.
c. The ICOS cavity is flushed with Zero Air twice before requesting the sample.
d. The analyzer Prompts you to inject >140mL of Sample Gas into the syringe port on the front panel of the analyzer.
e. Fill the 140mL syringe with your sample, and insert the needle into the syringe port on the front of the analyzer.
    ii. The suction from the cavity should automatically draw your sample into the cavity. Light pressure on the syringe will help to introduce the sample.
    iii. You have 120 seconds to inject the sample.

NOTE

If you take longer than 120 seconds to complete the injection, the *Failed Injection* message displays and instructs you to restart the injection process.

Changing the Septa on the Syringe Injection Port

The septum on the syringe injection port requires periodic replacement. Depending on use, a septum should last a minimum of 100 injections.

To replace the septum:

1. Click the Rate button on the *User Interface Control Bar*. (Figure 111)
2. The Operating Mode pop-up menu displays. (Figure 115)
3. Set the analyzer to *Slow* (Continuous Flow) mode by selecting one of the radio buttons under the *Slow* option. (Figure 115)

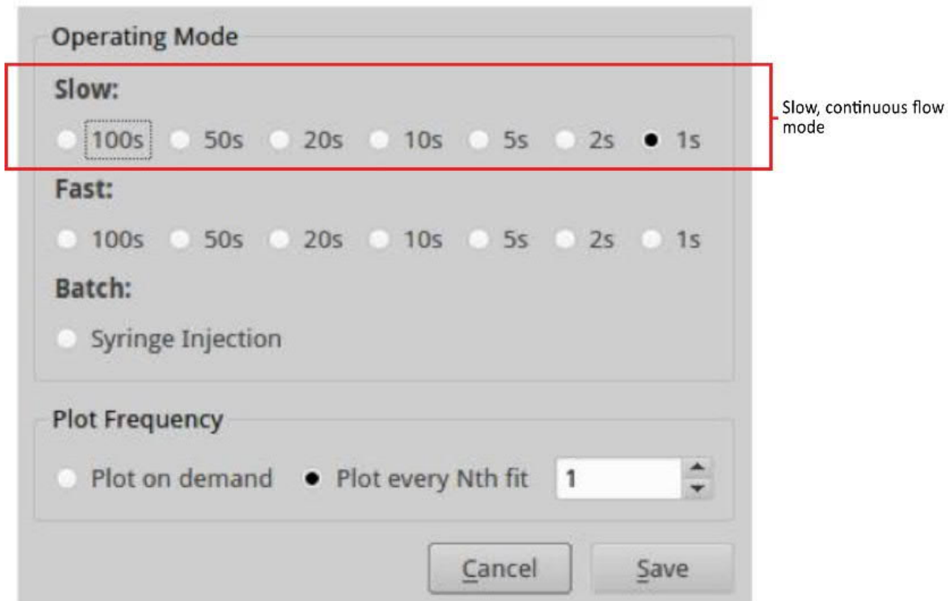


Figure 115: Rate Control Screen set to Slow Flow Mode

4. Unscrew the septum nut from the injection port as shown in Figure 116.

Figure 116: Septum Nut with used septum

5. Remove the red septum with white Teflon coating from the inside of the septum nut, using the provided septum puller. Discard the used septum.
6. Obtain a new septum from the provided package.

7. Slide the septum nut and new septum onto the provided blunt 22-gauge needle. The Teflon-coated side of the septum must face away from the septum nut. (Figure 117)

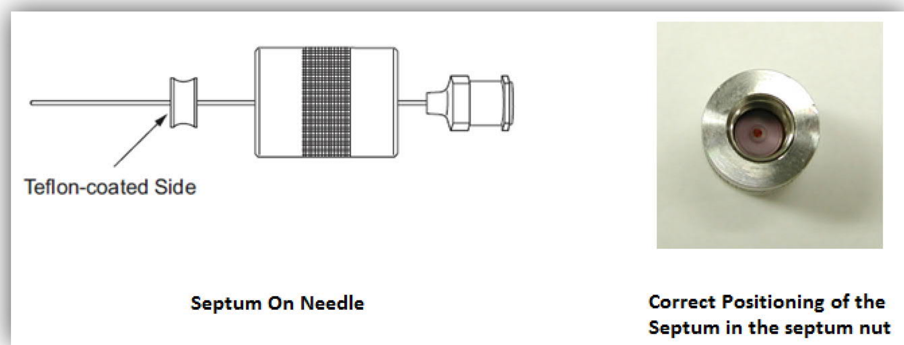


Figure 117: Septum inserted on needle with Teflon coating facing away from the septum nut

8. Slide the needle with septum assembly onto the injection port on the front panel of the analyzer. (Figure 118)

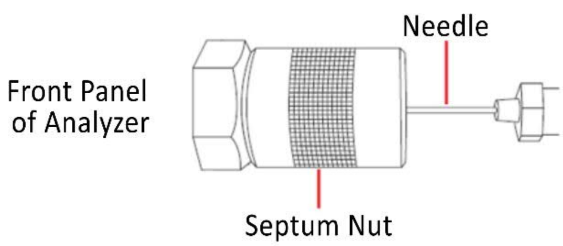


Figure 118: Needle and Septum assembly attached to the injection port

9. Hand-tighten the septum-nut firmly.
10. Manually actuate the needle five times to confirm that the septum is adequately pre-drilled.
11. Remove the needle from the septum nut.

Appendix I:Spectrum Displays

The following images show the *Spectrum Displays* for different analyzer types.

Table 13: Spectrum Displays for different analyzer types

Analyzer Type	Figure for Reference
GLA351-CCIA3	Figure 119
GLA351-N2OCM	Figure 120
GLA351-N2OM1	Figure 121

GLA351-CCIA3 Enhanced Performance QC Rackmount Carbon Dioxide Isotopic Analyzer

Figure 119 shows the *Spectrum Display* for the GLA351-CCIA3.

The CO_2 concentration is shown in parts per million (ppm) and δ13C, δ18O, δ17O in ‰ (permil) on the bottom of the *Spectrum Display*.

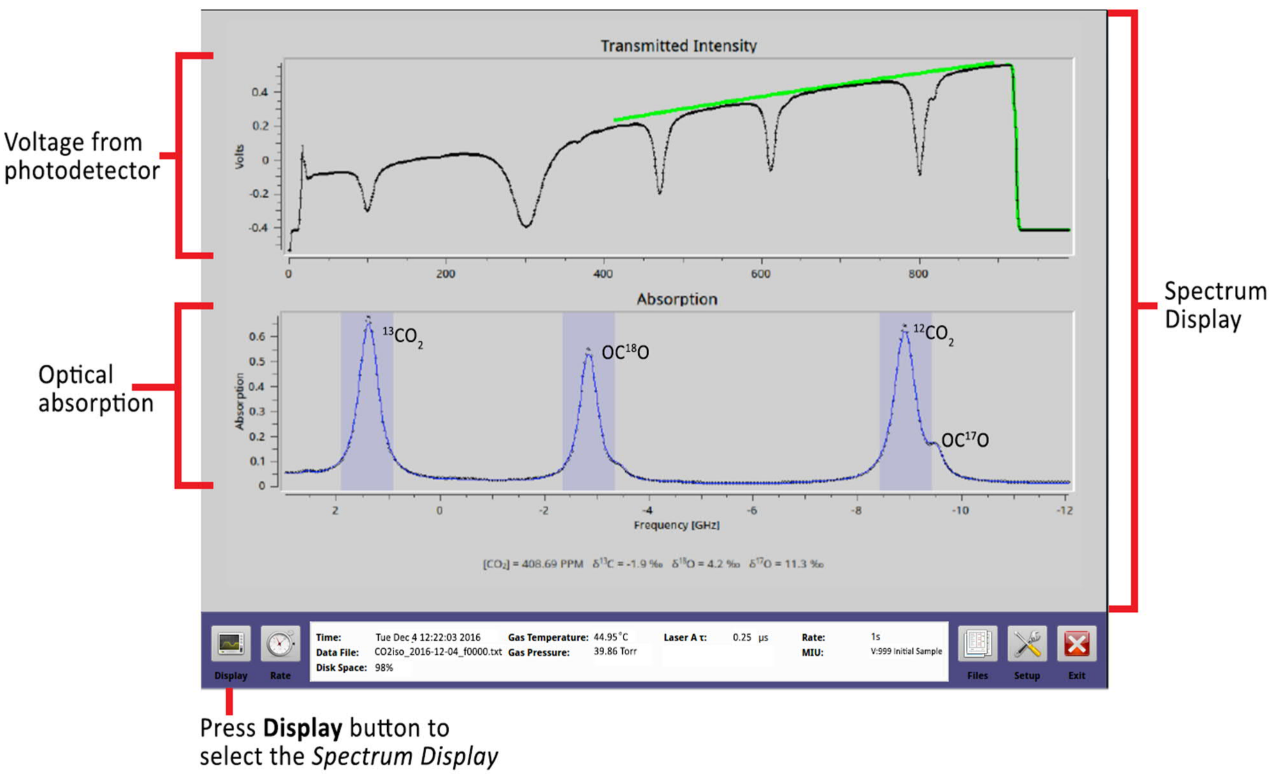


Figure 119: Spectrum Display (GLA351-CCIA3)

GLA351-N2OCM Enhanced Performance QC Rackmount Nitrous Oxide/Carbon Monoxide Analyzer

Figure 120 shows the *Spectrum Display* for the GLA351-N2OCM.

The measured N_2O and CO concentrations are shown in parts per billion (ppb) and H_2O in parts per million (ppm) on the bottom of the *Spectrum Display*.

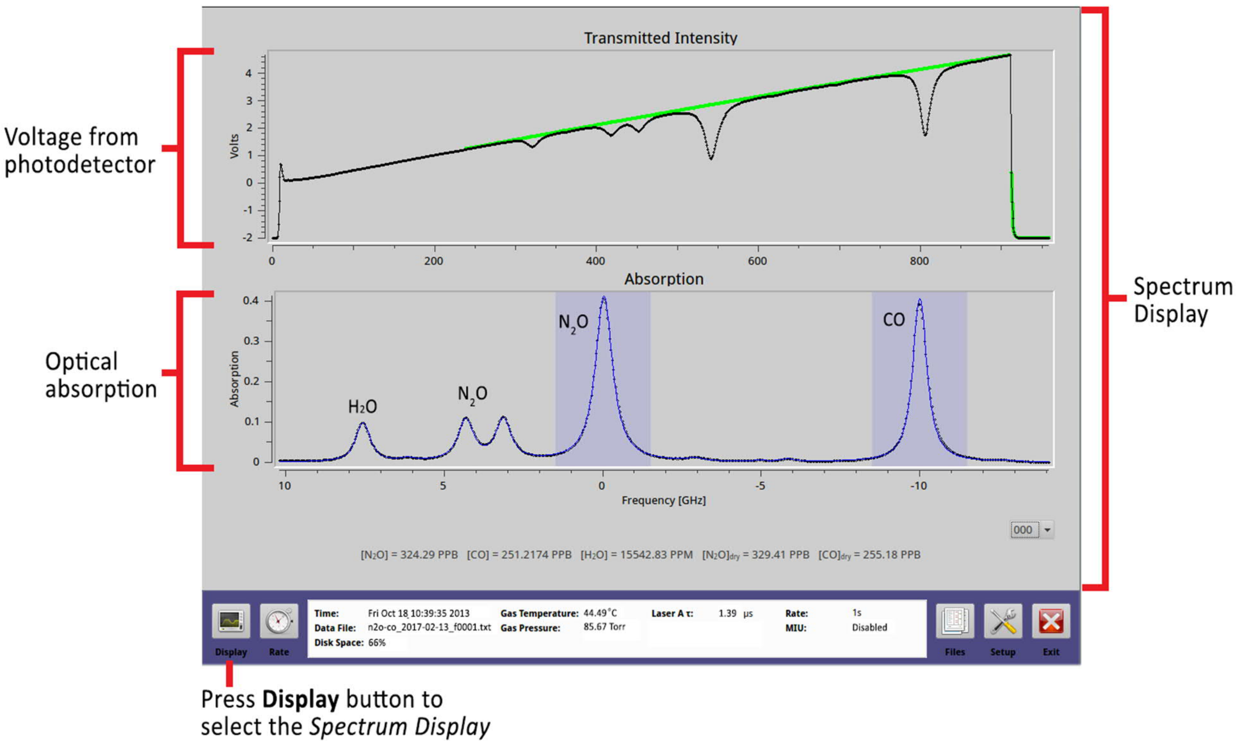


Figure 120: Spectrum Display (GLA351-N2OCM)

GLA351-N2OM1 Enhanced Performance QC Rackmount Methane / Nitrous Oxide Analyzer

Figure 121 shows the *Spectrum Display* for the GLA351-N2OM1.

The measured N_2O concentration is shown in parts per billion (ppb), and CH_4 and H_2O in parts per million (ppm) on the bottom of the *Spectrum Display*.

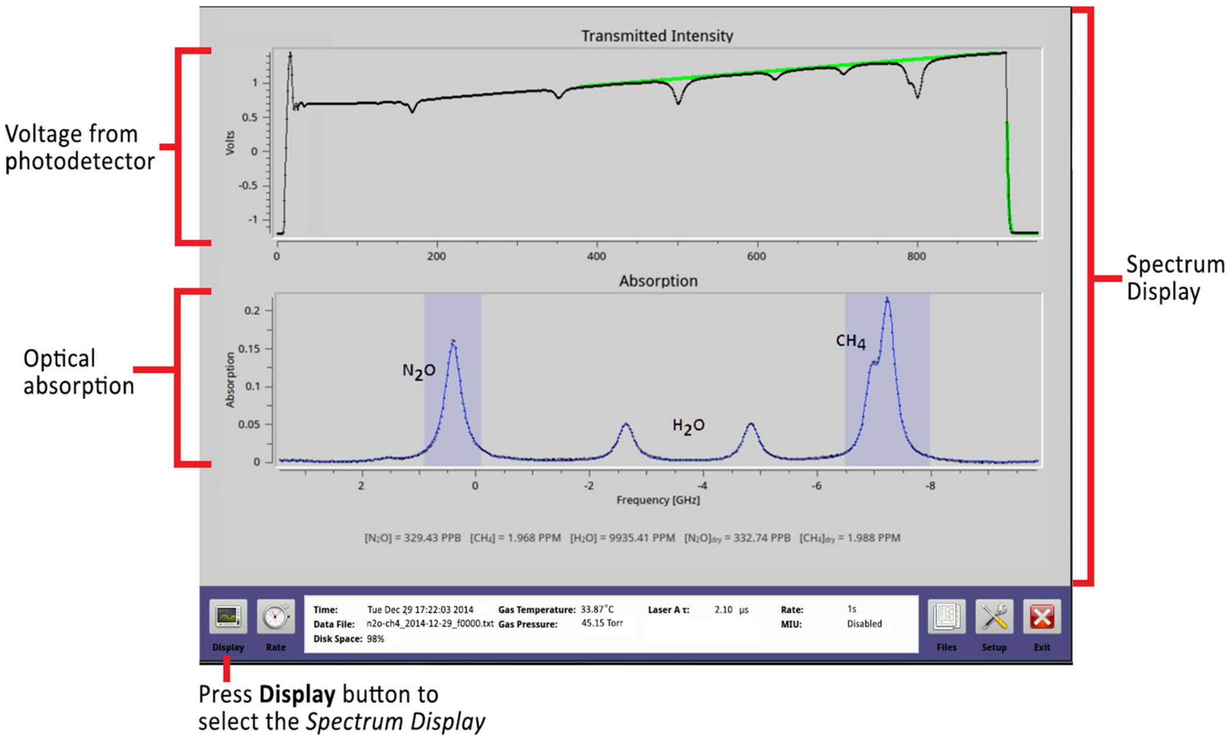


Figure 121: Spectrum Display (GLA351-N2OM1)

Appendix J: Isotope Definitions

The GLA351-CCIA3 measures the concentration of $^{12}CO_2$, $^{13}CO_2$, $OC^{18}O$, and $OC^{17}O$. These concentrations are used to calculate the total CO_2 and the isotope ratios that are reported on the display screens. The data file output includes the concentrations as well. The terms and their respective data file name are listed below:

CO_2	X_CO2__ppm
$\delta^{13}C$	D13C_VPDB_CO2
$\delta^{18}O$	D18O_VPDB_CO2
$\delta^{17}O$	D17O_VPDB_CO2
$[^{16}O^{12}C^{16}O]$	X_CO2_626__ppm
$[^{16}O^{13}C^{16}O]$	X_CO2_636__ppm
$[^{16}O^{12}C^{18}O]$	X_CO2_628__ppm
$[^{16}O^{12}C^{17}O]$	X_CO2_627__ppm

The isotope ratios are reported in ‰ relative to Vienna Pee Dee Belemnite converted to CO_2 (VPDB-CO2). The standards listed below were taken from IAEA-TECDOC-825.

(R_{13}) VPDP-CO_2	0.0112372
(R_{18}) VPDP-CO_2	0.002088349077
(R_{17}) VPDP-CO_2	0.000380803342

Total CO_2 is defined as the sum of all the isotopes:

$$CO_2 = [^{16}O^{12}C^{16}O] + [^{16}O^{13}C^{16}O] + [^{16}O^{12}C^{18}O] + [^{16}O^{12}C^{17}O]$$

The isotope ratios are defined according to:

$$\delta^{13C} = \left[\frac{(R_{13})_{Meas}}{(R_{13})_{VPDB-CO2}} - 1\right] \times 1000$$

$$\delta^{18O} = \left[\frac{(R_{18})_{Meas}}{(R_{18})_{VPDB-CO2}} - 1\right] \times 1000$$

$$\delta^{17O} = \left[\frac{(R_{17})_{Meas}}{(R_{17})_{VPDB-CO2}} - 1\right] \times 1000$$

Where the measured ratios are calculated from the measured concentrations:

$$(R_{13})_{Meas} = \frac{^{13}C}{^{12}C} = \frac{[^{16}O^{13}C^{16}O]}{[^{16}O^{12}C^{16}O]}$$

$$(R_{18})_{Meas} = \frac{^{18}O}{^{16}O} = \frac{[^{16}O^{12}C^{18}O]}{2[^{16}O^{12}C^{16}O] + [^{16}O^{12}C^{18}O] + [^{16}O^{12}C^{17}O]}$$

$$(R_{17})_{Meas} = \frac{^{17}O}{^{16}O} = \frac{[^{16}O^{12}C^{17}O]}{2[^{16}O^{12}C^{16}O] + [^{16}O^{12}C^{18}O] + [^{16}O^{12}C^{17}O]}$$

To convert the output oxygen isotope ratios from VPDB-CO2 to VSMOW use the follow formulas:

$$\delta^{18O-VSMOW} = \left[\frac{(R_{18})_{VPDB-CO2}}{(R_{18})_{VSMOW}}\left(\frac{\delta^{18O-VPDB}}{1000} + 1\right) - 1\right] \cdot 1000$$

$$\delta^{17O-VSMOW} = \left[\frac{(R_{17})_{VPDB-CO2}}{(R_{17})_{VSMOW}}\left(\frac{\delta^{17O-VPDB}}{1000} + 1\right) - 1\right] \cdot 1000$$

To use a calibration or reference gas where the oxygen isotope ratios are known relative to VSMOW, convert them to VPDB-CO2 using the following formulas:

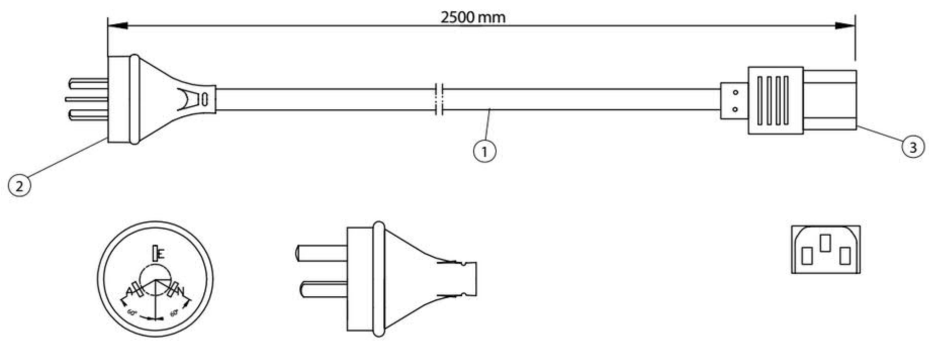
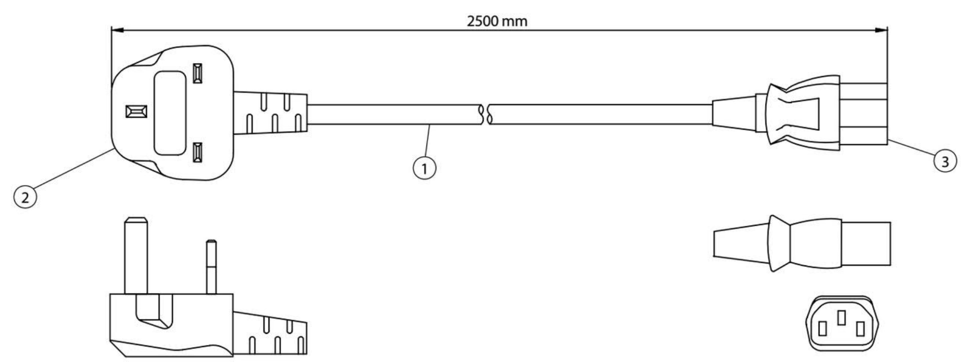
$$\delta^{18O-VPDB} = \left[\frac{(R_{18})_{VSMOW}}{(R_{18})_{VPDB-CO2}}\left(\frac{\delta^{18O-VSMOW}}{1000} + 1\right) - 1\right] \cdot 1000$$

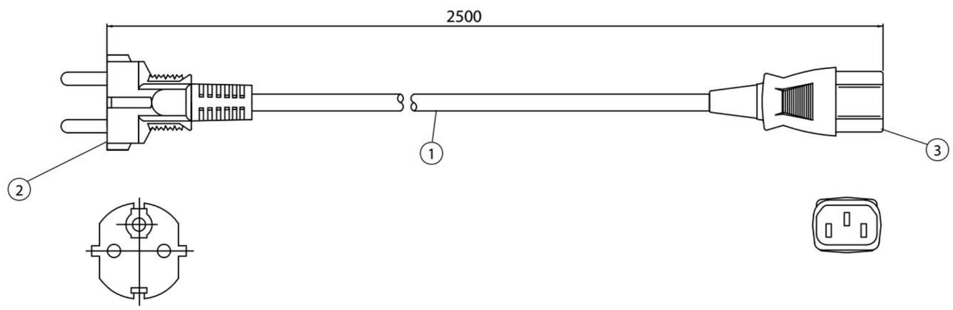
$$\delta^{17O-VPDB} = \left[\frac{(R_{17})_{VSMOW}}{(R_{17})_{VPDB-CO2}}\left(\frac{\delta^{17O-VSMOW}}{1000} + 1\right) - 1\right] \cdot 1000$$

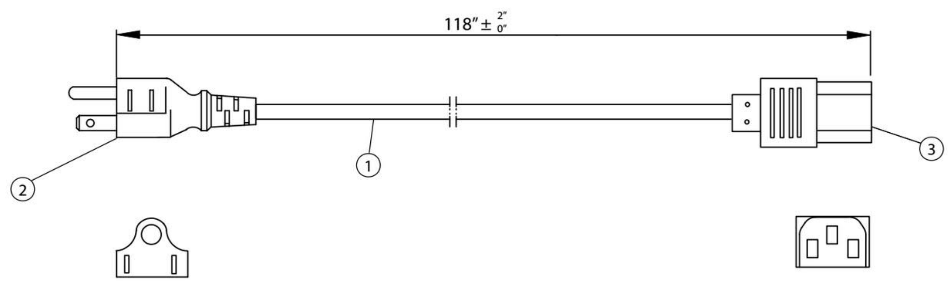
Appendix K: Cables

Table 14 describes the power cables shipped with your analyzer.

Table 14: Power Cables

Region	Cable Specifications
Australia and New Zealand	 1. CORDAGE: SAA, 3 x 1.0mm, UNSHIELDED, CEE COLOR CODE, TEMP. RATING 70°C, RATING: 250V 10A, JACKET COLOR: BLACK 2. PLUG: AS 3112/AUSTRALIAN 3. CONNECTOR: IEC 60320 C-13 APPROVALS: AUSTRALIA, NEW ZEALAND ROHS COMPLIANT
United Kingdom	 1. CORDAGE: HO5VV-F, 3x1.00mm, CEE COLOR CODE, TEMP. RATING: 70˚C, RATING: 250V, 10A, JACKET COLOR: BLACK 2. PLUG: UK PLUG BS1363A (SUPPLIED WITH 13A FUSE) 3. CONNECTOR: IEC 60320 C13 APPROVALS: UNITED KINGDOM, CE ROHS COMPLIANT

<table>
<tr>
<td>Europe</td>
<td>


1. CORDAGE: H05VV-F, 3 x 1.0mm, UNSHIELDED,
CEE COLOR CODE, TEMP. RATING 60°C,
RATING: 250V 10A, JACKET COLOR: BLACK
2. PLUG: IEC 884/CEE7-VII
3. CONNECTOR: IEC 60320 C13
APPROVALS: CB, GERMANY, DENMARK, NORWAY, FINLAND,
BELGIUM, NETHERLANDS, SWEDEN, AUSTRIA,
ROHS COMPLIANT
</td>
</tr>
<tr>
<td>United States</td>
<td>


1. CORDAGE: SJT, 16AWG / 3C, UNSHIELDED,
CEE COLOR CODE, TEMP. RATING 60°C,
RATING: 125V 13A, JACKET COLOR: BLACK
2. PLUG: NEMA 5-15P
3. CONNECTOR: IEC 60320 C-13
APPROVALS: UL, cUL
ROHS COMPLIANT
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</tr>
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ABB Measurement & Analytics

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

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

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 3KXG163002R4601

UM/ICOS-EN Rev. B2 12.2021