LOS GATOS RESEARCH

N_2O/CO Analyzer – Enhanced Performance User Manual

Models 913-0014 and 913-0015

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WARNING! This Analyzer contains a Class IIIB laser inside

There is a Class IIIB laser inside this analyzer that complies with 21CFR1040.10 and 21CFR1040.11.

Users should take appropriate precautions to ensure that the laser is off when the instrument cover is removed.

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1 System Overview

Standard Components

The analyzer includes the following components as part of the standard configuration. Before you begin installing the analyzer, verify each of the following items has arrived.

- N_2O/CO Analyzer
- Analyzer power cord
- User guide (this document)
- USB flash drive
- Serial port connection cable (null modem type)
- Exhaust muffler

Optional Components

The following component sets are optional and are used to change the default feature set or behavior of the analyzer.

Pump Kit

- External pump (Edwards XDS 35, KNF 920, and KNF 940)
- Pump connection kit
- Pump power cord

Multiport Inlet Unit (MIU)

- Multiport Inlet Unit
- Power cord
- 25-pin connection cable for control signal

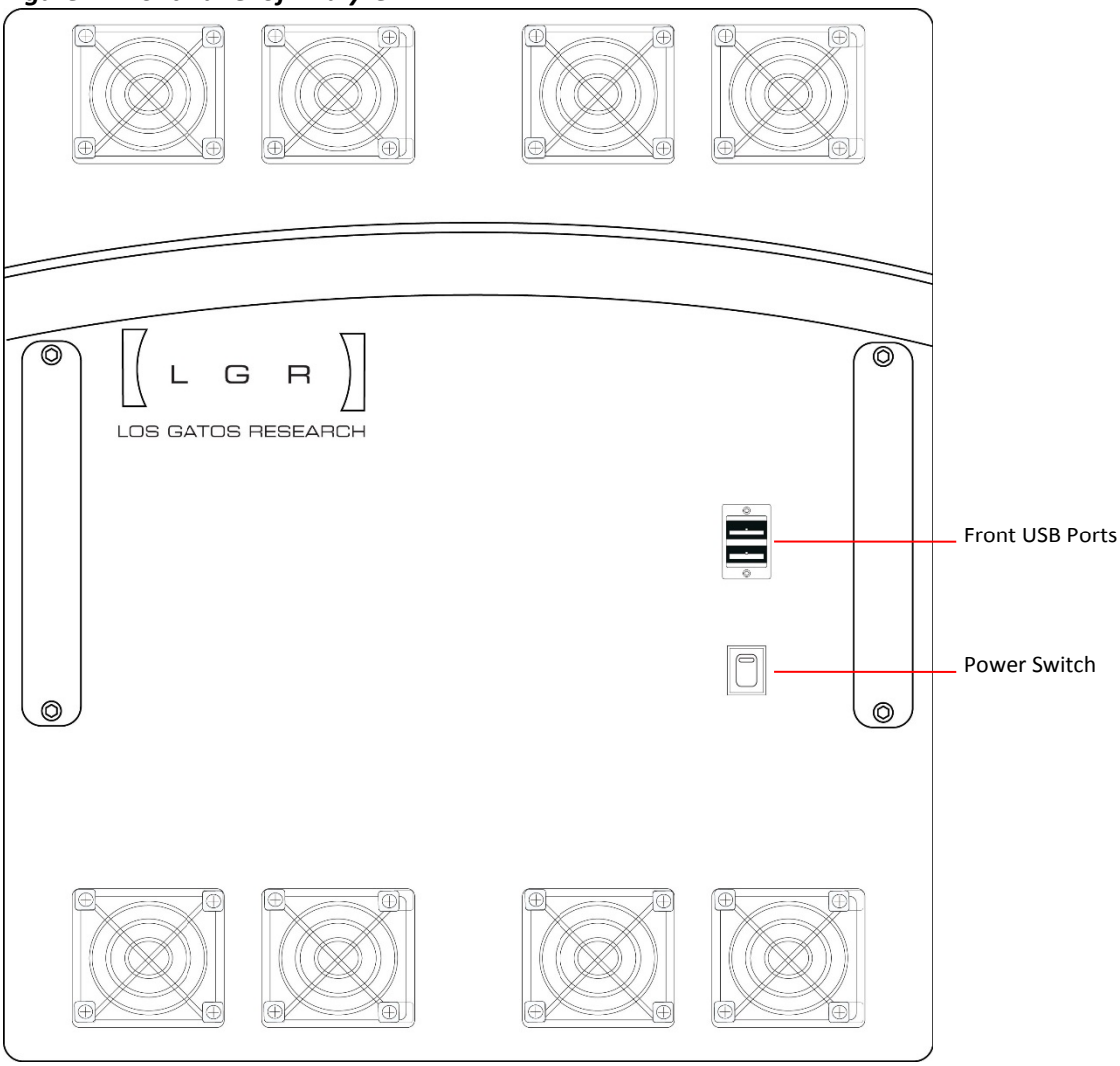
Batch Injection

- Syringe injection port
- 140 ml syringe

If you did not receive all of the components you ordered, contact LGR at +1 650-965-7772 or support@lgrinc.com.

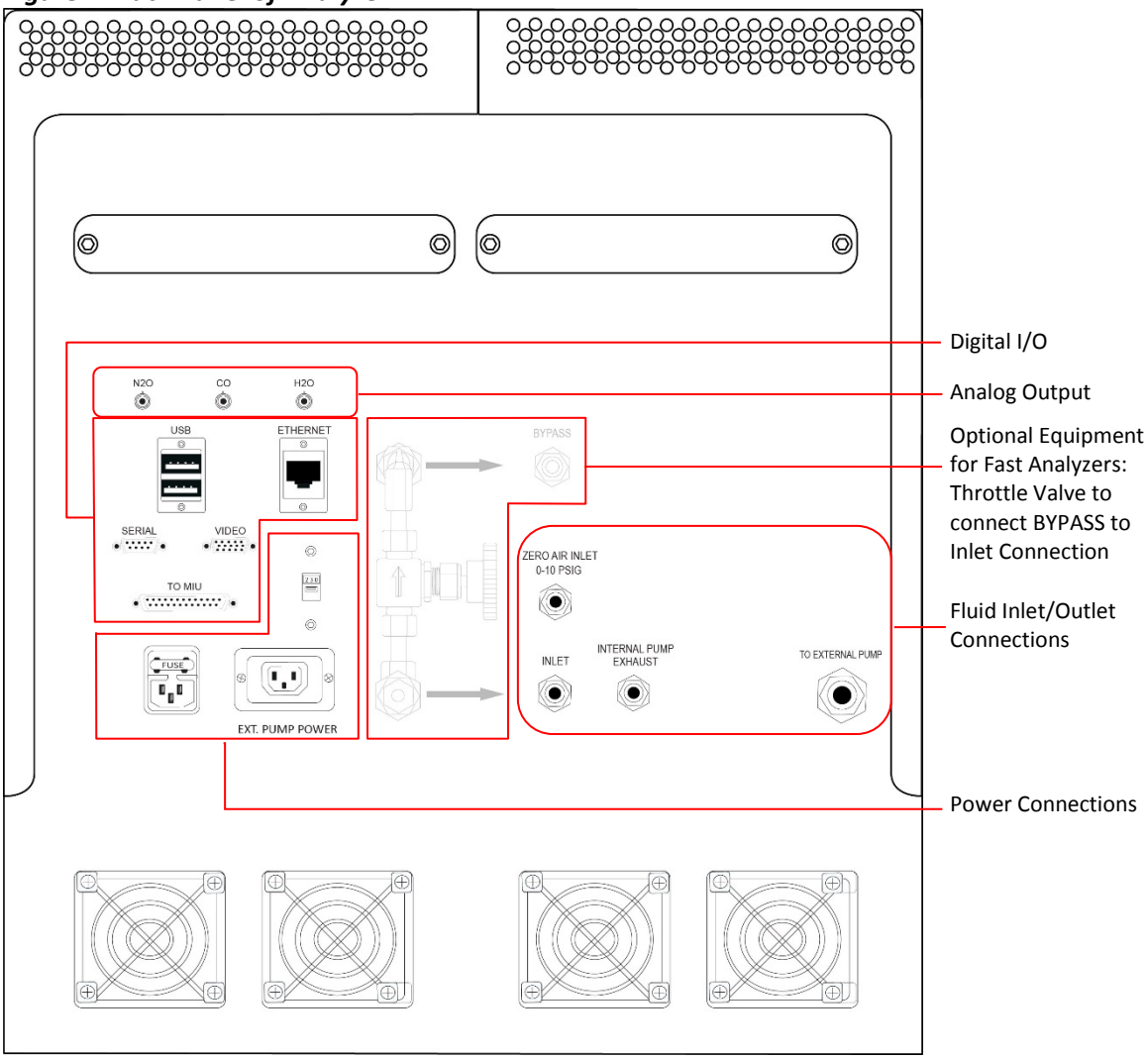
Front Panel

Figure 1. Front Panel of Analyzer



Back Panel

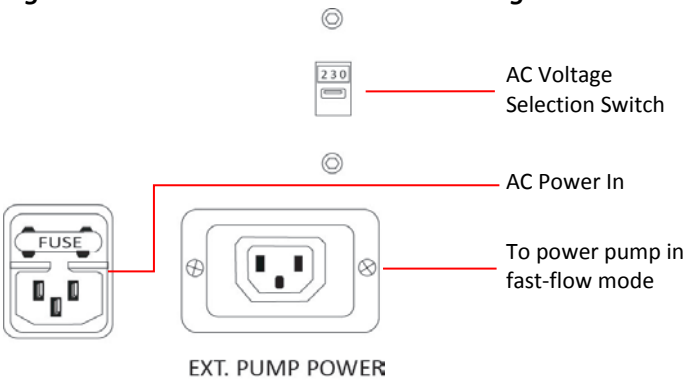
Figure 2. Back Panel of Analyzer



Power Connections

Figure 3 shows the analyzer's power connections and the AC Voltage Selection Switch.

Figure 3: Power Connections and AC voltage selection switch



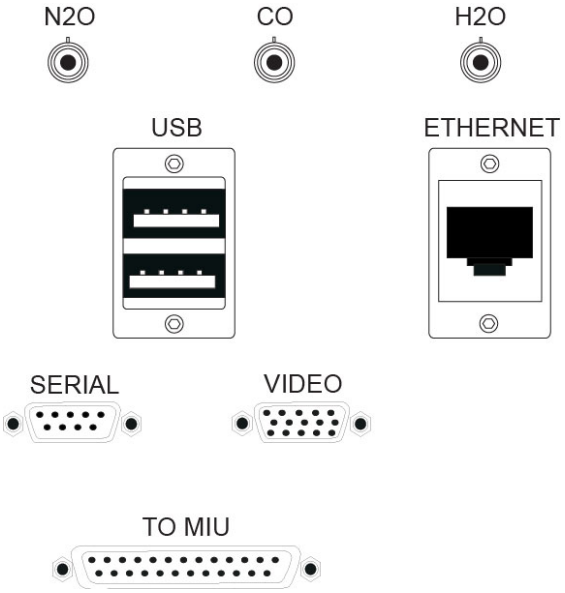
- **AC Power In** – Allows user to connect the analyzer to power supply.
- **AC Voltage Selection Switch** – Allows user to change the input voltage to the analyzer's power supply. User may select either 115 VAC or 230 VAC. The voltage is determined by the country where the analyzer will be used. When changing the supply voltage, verify that the AC voltage selection on the analyzer matches the AC voltage being supplied from your power supply. Be careful when changing the input voltage as setting an incorrect voltage may damage the analyzer.
- **EXT. Pump Power** – Allows user to power an external pump when operating the analyzer in fast-flow mode.

NOTE: If operation at any other voltage source or frequency is desired, please contact LGR.

Data Input/Output (I/O) Ports

The analyzer has several data I/O ports on the back panel. These ports and their quantity vary depending on the analyzer's configuration. Figure 4 shows a typical set of data I/O ports.

Figure 4: Data I/O ports



- **USB** – Allows user to connect supported devices to the analyzer. Supported devices include:
  - USB mouse and keyboard to control analyzer's setup and measurement software.
  - USB memory devices (flash or hard drives) to allow transfer of data files from the analyzer's internal drive.
- **ETHERNET** – Allows analyzer to connect to a local area network (LAN) via Ethernet. When connected, user may connect to the analyzer via FTP to access data stored on the analyzer.
- **SERIAL** – 9-pin serial port – Supplies real-time digital stream of measured data via serial interface.
- **N2O, CO, and H2O** – BNC connectors (Male) – Supply a DC voltage proportional to the measured nitrous oxide, carbon monoxide and water vapor concentrations. When connected to an external device, connections should be terminated using a moderate/high impedance (>1KΩ).
- **VIDEO** – 15-pin VGA port – Allows use of an external monitor with VGA adapter to setup analyzer and view collected data.
- **TO MIU** – 25-pin port – Allows analyzer to communicate with Multiport Input Unit (optional).

Gas Inlet/Outlet Connections

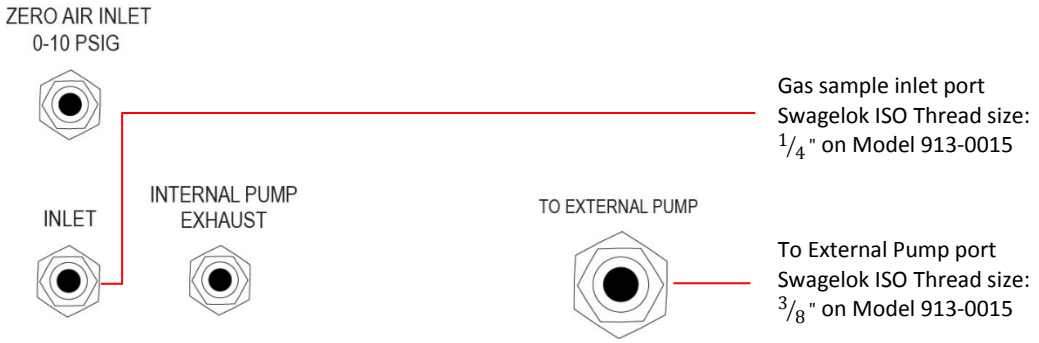
The gas inlet and outlet ports of the analyzer are located on the back panel. A detail view of these ports is shown in Figure 5. The unit ships with all inlets and outlets plugged for protection. Unless specified otherwise, all connections use Swagelok fittings ISO thread size ¼”.

Slow-Flow

During normal (slow-flow) operation, the internal pump draws a sample through the analyzer from the inlet. The inlet gas pressure range is 0 to 5 psig.

NOTE: Take care to not to over-pressurize the inlet port.

Figure 5: Gas Inlet/Outlet Connections for Model: 913-0015 (Standard)



Fast-Flow

During fast-flow mode the analyzer will utilize an external pump to increase the flow rate of the fluid during measurement. The external pump should be powered directly from the analyzer using the **EXT. PUMP POWER** plug on the back panel. Additionally, a user will also connect the external pump to the analyzer using ½" Teflon tubing and fittings from the **TO EXTERNAL PUMP** port on the back panel to the Swagelok fitting on the external pump.

Swagelok Connection Gap

Swagelok connections should be tightened between ¼ and ½ turn past finger tight. Leave a gap of at least 3.5 mm (see Figure 6).

Figure 6: Swagelok connection gap

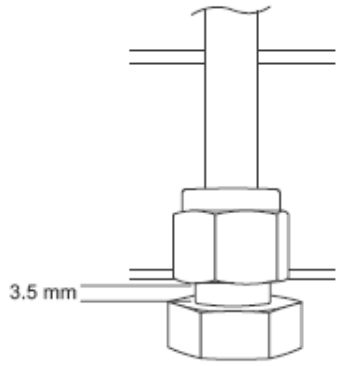


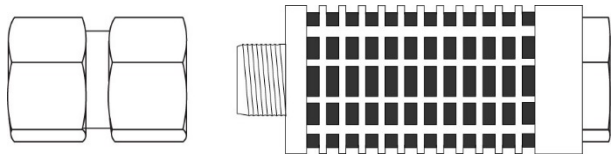
Table 1. Recommended Wrench Size for Swagelok Fittings

Swagelok Fitting Size	Recommended Wrench Size
$^{1}/_{4}$"	$^{9}/_{16}$"
$^{3}/_{8}$"	$^{11}/_{16}$"
$^{1}/_{2}$"	$^{7}/_{8}$"

Exhaust Muffler

User may either connect facility exhaust or exhaust muffler using included Swagelok adapter (see Figure 7) to the **INTERNAL PUMP EXHAUST** port. See Figure 5 for location of **INTERNAL PUMP EXHAUST** port.

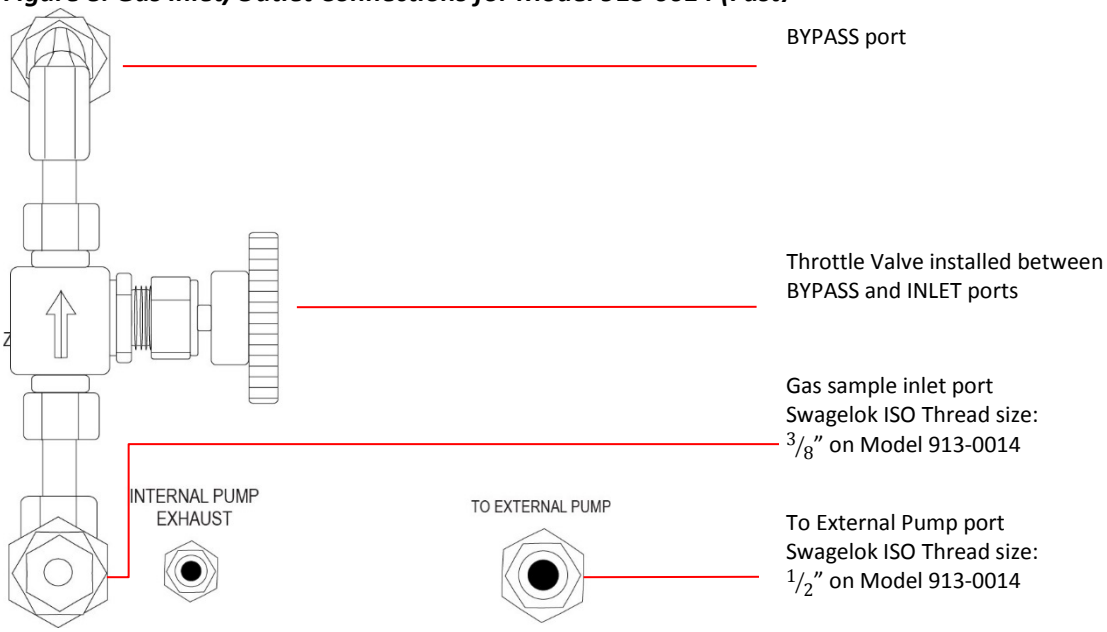
Figure 7: Exhaust muffler with 1/4" Swagelok adaptor



Fast Analyzers

Fast analyzers allow a user to measure data at a higher flow rate than a standard analyzer. A fast analyzer is equipped with a throttle valve (see Figure 8) 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. The procedure to adjust the throttle is in Appendix C: High Flow Throttle Valve Operation.

Figure 8. Gas Inlet/Outlet Connections for Model 913-0014 (Fast)



Internal Fluid Flow

For additional information regarding the analyzer's internal fluid flow, please review Appendix B: Analyzer Flow Schematic.

Fast and Slow Flow Pump Options

In fast-flow mode, user must connect a compatible external pump to the analyzer. The compatible pump options are listed below in Table 2.

Table 2: Pump Options

	Internal	N920	N940	XDS-35	Remarks
Model 913-0014 (Fast)	X	X	X	X	See Appendix C: High Flow Throttle Valve Operation
Model 913- 0015	X	X			

2 Running the Analyzer

Connecting the Analyzer and Components

1. Connect the analyzer's power cord from the AC power port on the back panel to a grounded outlet of your power supply or facility's power.
2. Make the appropriate gas inlet/outlet connections:

Slow-Flow Mode

- Connect the outlet for the fluid sample to the **INLET** port. Leave the **INTERNAL PUMP EXHAUST** port open. Do not connect anything to this port
- Cap **TO EXTERNAL PUMP** port using the provided plug.

Fast-Flow Mode

- Connect the outlet for the fluid sample to the **INLET** port.
- Connect the external pump outlet to the analyzer's **TO EXTERNAL PUMP** port using the provided tubing and fittings in the pump connection kit supplied by LGR
- Connect the external pump's power cord to the **EXT. PUMP POWER** port on the analyzer.

3. Make the appropriate data interface connections.

Starting the Analyzer

Start the Analyzer by toggling the power switch on the front panel. Power switch light should illuminate.

NOTE: If running the Analyzer in Fast-flow mode, verify the external pump is powered on.

When the Analyzer is powered on, the internal computer will boot and the system will begin initialization automatically. Initialization takes 90 seconds. The initialization screen is blue with the following message: **Please Wait**.

Thermal Stabilization

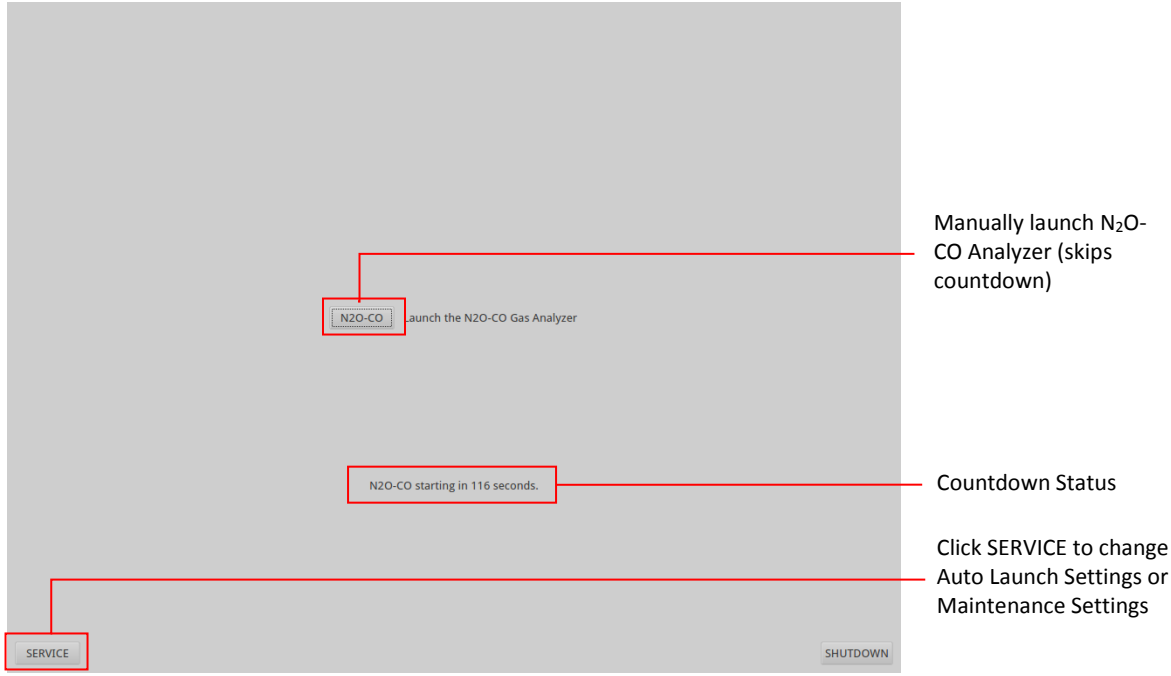
To allow the components to thermally stabilize, LGR recommends running the analyzer for four hours prior to starting work.

Launch Service Screen

The Launch Service screen is shown following initialization. From this interface a user may

- Bypass the auto launch countdown to manually start measurement by clicking **N2O-CO**.
- Open the Auto Launch window by clicking **Service**.
- Turn off the analyzer by clicking **Shutdown**.

Figure 9: Launch Service Screen

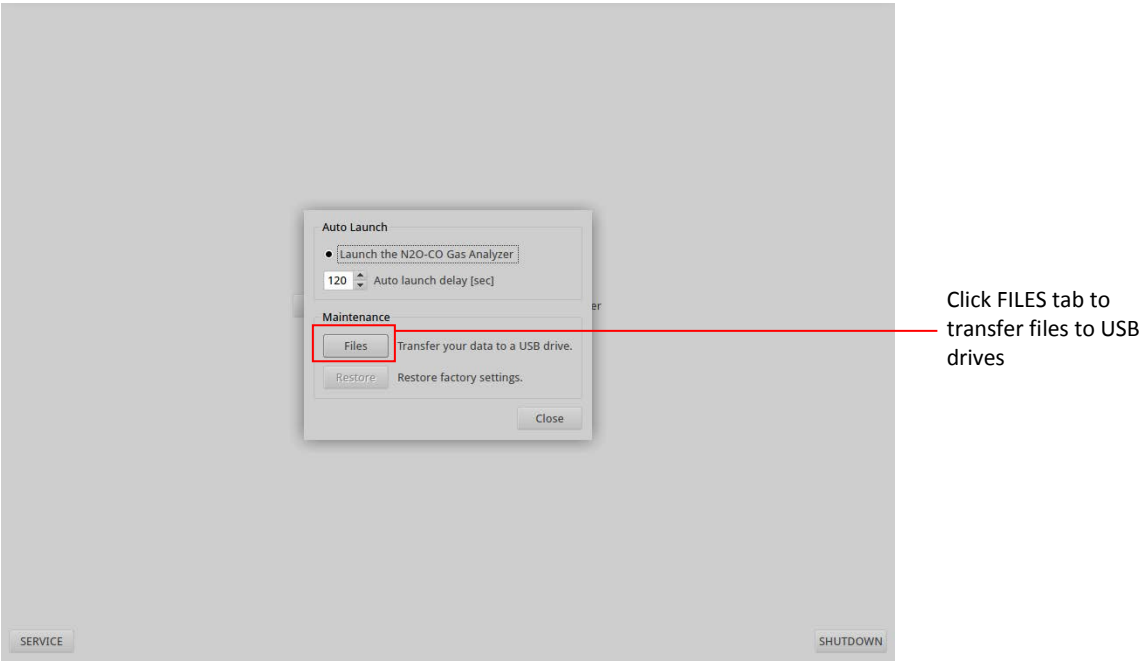


Auto Launch Window

The Auto Launch and Maintenance settings (see Figure 10) are available when a user clicks **Service** from the Launch Service screen. From this interface a user may:

- Change the auto launch delay from the default
- 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 10: Auto Launch Window

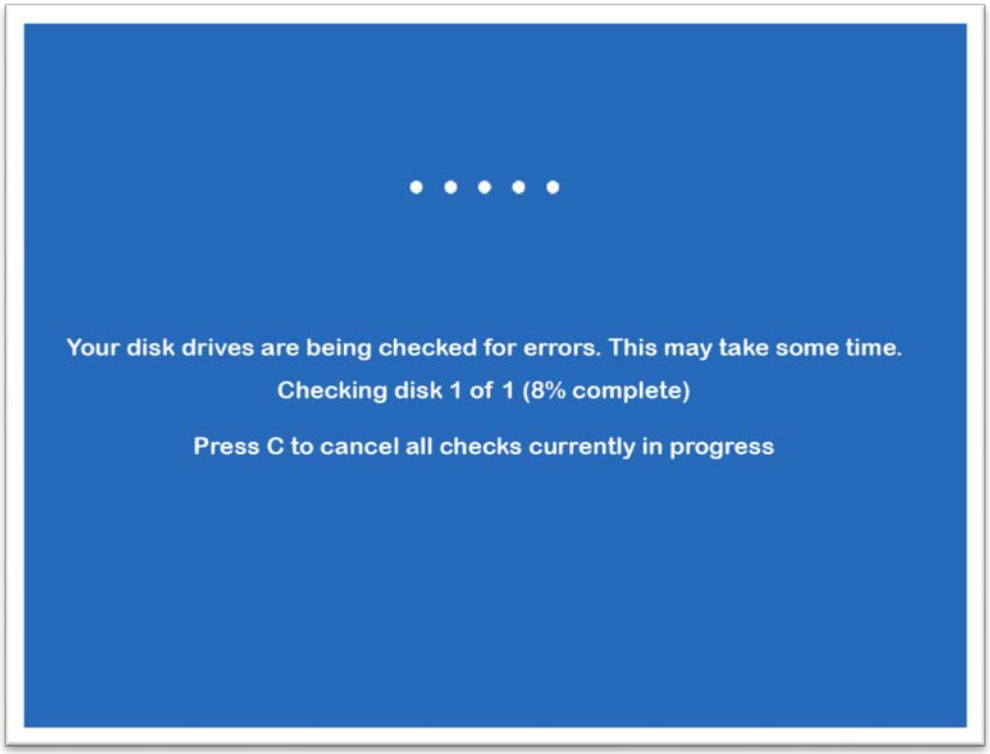


File System Integrity Check

Once a month, the analyzer will automatically perform a file system integrity check following initialization after startup. Figure 11 shows the screen users will see while the integrity check runs. The integrity check will run for one to two minutes then load the analyzer's software.

IMPORTANT! Do not turn off the computer during this maintenance.

Figure 11: Routine Maintenance Screen (checking disk for errors...)



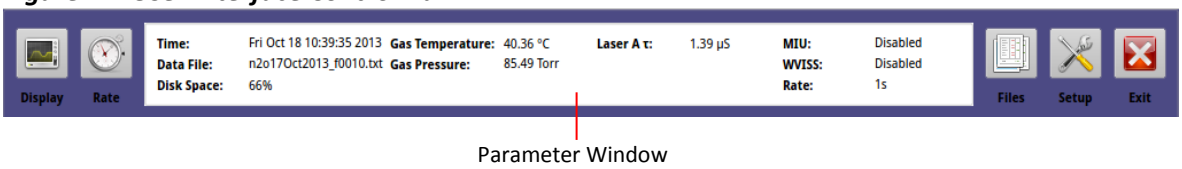
Main Panel

After launch, the Analyzer software will display the Main Panel containing the Numeric Display (see Figure 13 default display) and the User Interface Control Bar (see Figure 12). The analyzer will begin to draw in gas and show live measurements.

User Interface Control Bar

The User Interface Control Bar is displayed at the bottom of the screen (see Figure 12) below the main data display and enables a user to control the operation of the analyzer through the functions described below.

Figure 12: User Interface Control Bar



- **Display** – Toggles the how data is displayed in the Main Panel. Data is displayed in the Main Panel in one of the three ways described below. Click on the **Display** button to change how the data is displayed.
  - **Numeric Display** – Displays the numeric readout of the last measurement (see Figure 13). This is the default display that appears when the analyzer is powered on or rebooted.
  - **Spectrum Display** – Displays the raw and fitted spectral scans (see Figure 14).
  - **Time Chart Display** – Displays the concentration over time (see Figure 15).
- **Rate** – Allows the user to adjust the rate at which data is written to the log file.
- **Parameter Window** – Displays the following values:
  - **Time** – Current time
  - **Data File** – current filename to log data
  - **Gas Temperature** – Gas temperature in Cell (Celsius - °C)
  - **Gas Pressure** – Gas pressure in Cell (Torr)
  - **Laser A τ** – Cell ring-down time (micro-seconds - µs).
  - **MIU** – MIU Channel
  - **WVISS** – WVISS Step (Not active for this analyzer)
  - **Rate** – Data rate
  - **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.

Displays

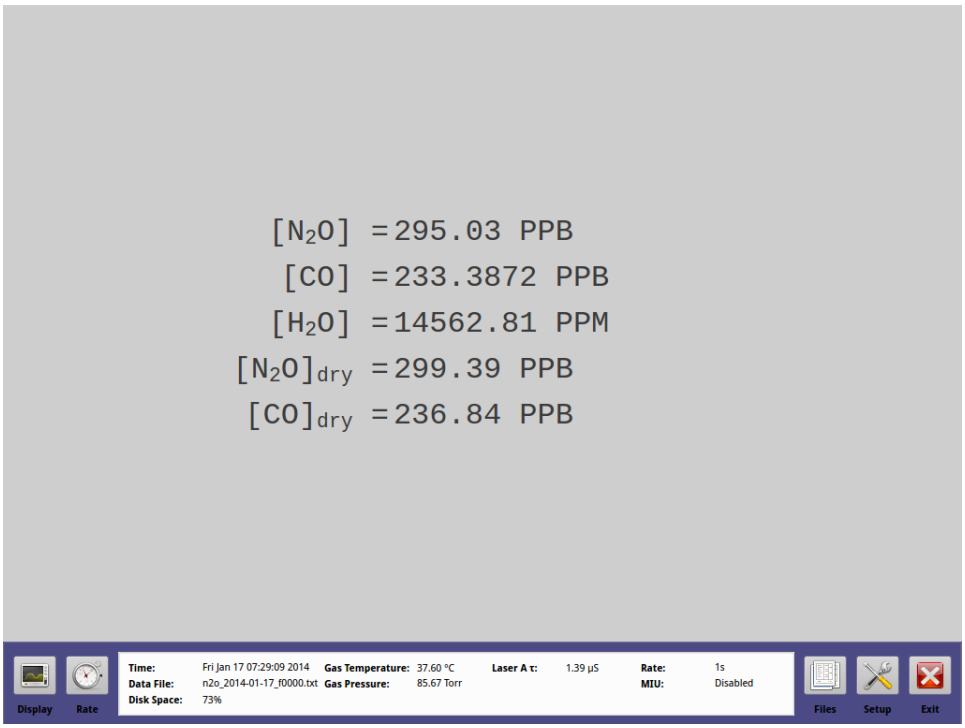
The **Display** button toggles the data display in the Main Panel. Data can be displayed in three ways: Numeric, Spectrum, and Time Chart displays. Each display is described in more detail below.

Numeric Display

This is the default display (see Figure 13) and appears when the analyzer is first powered on or rebooted.

Figure* 13*. Numeric Display

Shows numeric readout of the last measurement



Spectrum Display

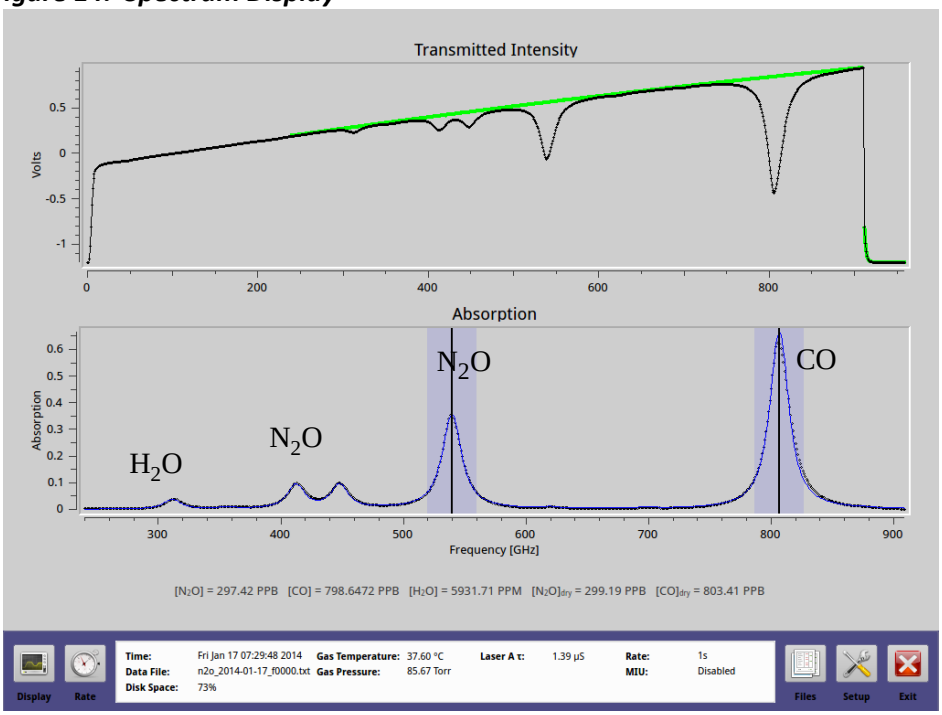
Click the **Display** button on the User Interface Control Bar to switch to Spectrum display.

The Spectrum display consists of two plots: the top plot shows the voltage from the photo detector as the laser scans across the N_2O and CO absorption features; the bottom plot shows the measured fractional optical absorption in black. The peak at ~ -12 GHz is due to CO and the peak at ~ -2 GHz is due to N_2O.

The measured N_2O and CO concentrations are shown in parts-per-billion (ppb).

Spectrum display shows the laser transmission through the ICOS measurement cell (see Figure 14, top plot) recorded as the laser is tuned across the selected wavelength region near 4.60 microns. The N_2O and CO absorption line-shapes that result from a detailed analysis of the measured transmission signal (see Figure 14, bottom plot).

Figure 14: Spectrum Display



Top Plot
shows photo detector voltage

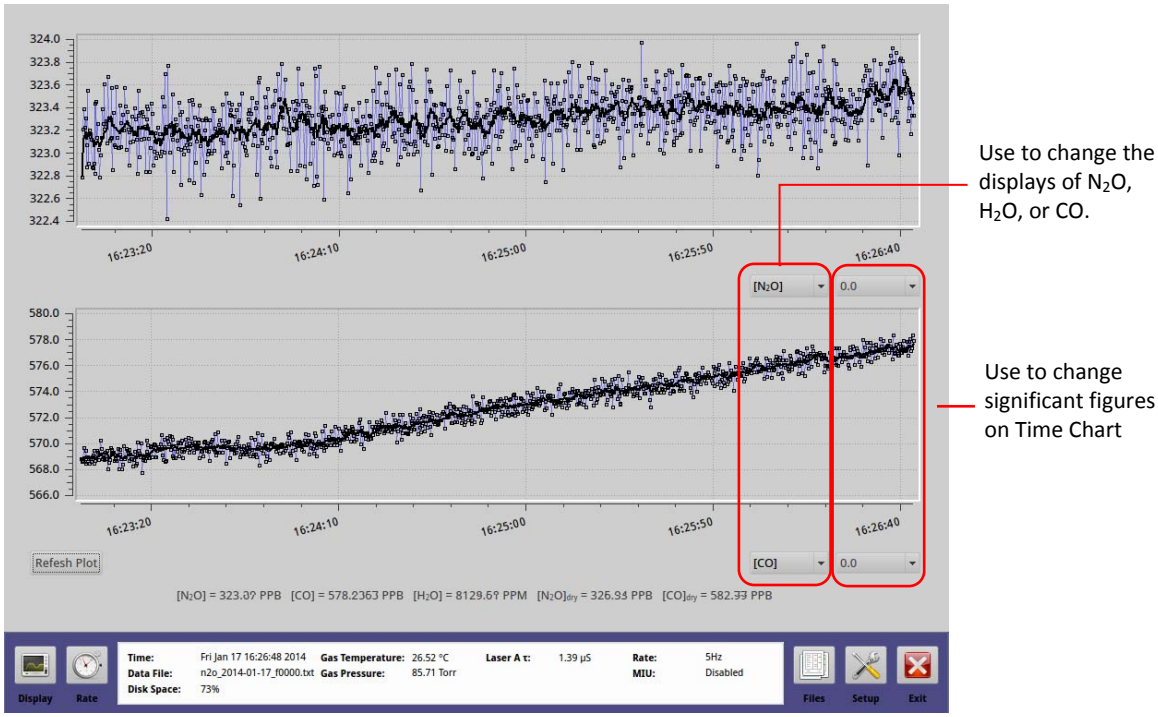
Bottom Plot
Shows optical absorption

Time Chart Display

The Time Chart display shows two plots that allow a user to view a continuous record of N_2O, CO or H_2O concentrations and compare the concentrations over time (see Figure 15). A 10-point moving average (shown in black) overlays the raw data (shown in color).

To view data for a different gas or change number significant figures used to display data, use the drop-down menus in the lower-right corner of a plot.

Figure 15: Time Chart Display



Rate control

Click on **Rate** in the User Interface Control Bar to view or change analyzer data rate. Fast-flow and slow-flow refer to the rate at which data is averaged and which pump is active. A longer averaging interval (slower data logging rate) will yield better measurement precision than shorter averaging interval.

Switching between Slow-flow and Fast-flow modes

To switch between flow modes, a user selects an interval from either the fast or the slow list. When a user selects a rate from the **Fast** list, the analyzer changes to fast-flow mode, powering off the internal pump and powering on the external pump. Likewise when a user selects a rate from the **Slow** list, the analyzer changes to slow-flow mode, powering off the external pump and powering on the external pump.

Averaging Intervals

For a standard (non-fast) analyzers in both slow-flow and fast-flow modes, the interval is between 1 and 100 seconds (see Figure 16).

For fast analyzers, the slow-mode interval is between 1 and 100 seconds. The fast-mode interval is between 1 and 10 Hz (see Figure 17).

Figure 16. Rate Control Window (Standard Analyzer)

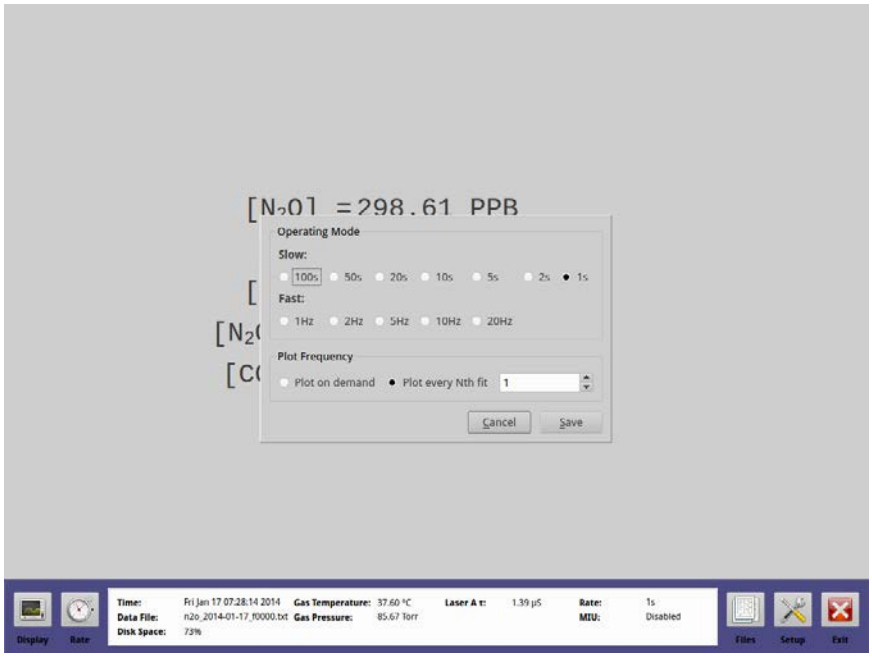
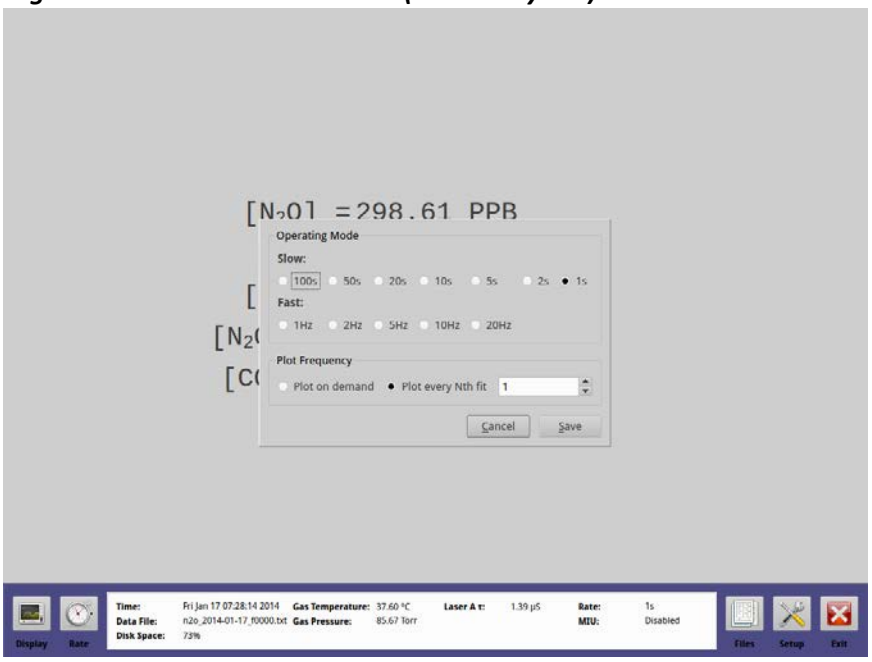


Figure 17: Rate Control Window (Fast Analyzers)



Files - File Transfer Menu

Click on the **Files** button in the User Interface Control Bar (see Figure 12) to access the File Transfer menu. This menu is used to access data collected by the analyzer.

Each time the analyzer is restarted, a new data file is created with a file name of the form: **`n2oDDMMMYYYY_fxxxx.txt`**. This filename has a timestamp consisting of day (**`DD`**), month (**`MMM`**), and year (**`YYYY`**) and is followed by a 4-digit serial number **`(xxxx`**); For example, the 10th file on April 27th 2009 would be named: **`n2o27Apr2009_f0010.txt`**. The serial number counts upward to provide up to 10000 unique file names each day.

NOTE: If the analyzer is left in continuous operation, a new data file will be automatically created every 24 hours in order to keep data file sizes manageable.

Figure 18: Typical Data File

Shows a few of the data columns.

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,

The Time column reports the time stamp of each recorded measurement; its format is set in the Startup Menu. Also reported are:

- [CO] (ppm)
- [CO] d (ppm)
- [N2O] (ppm)
- [N2O]d (ppm)
- [H2O] (ppm)
- Cell pressure (Torr)
- Cell temperature (Celsius)
- Ambient Temperature (Celsius)
- …and further analyzer parameters

NOTE: In the listed variables above [N2O]d(ppm) and [CO]d(ppm), the "d" stands for "Dry Mole".

Standard Deviation Logging

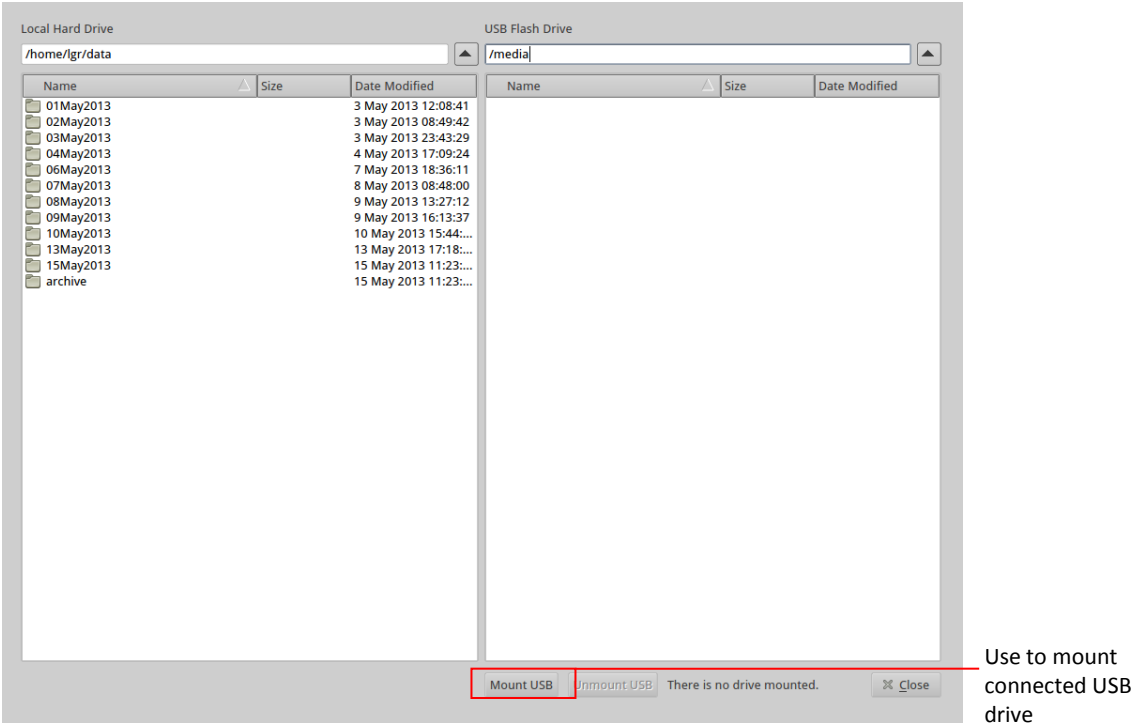
For each measurement, the adjacent column contains the standard deviation of the measurement (its heading is designated with **_sd** tag). The standard deviation is zero when the analyzer is running at 1 Hz, as the data is not averaged. At speeds slower than 1 Hz, the standard deviation of the average is reported.

At the end of each data file, an encoded list of the analyzer's settings is recorded for diagnostic or troubleshooting purposes.

Transfer Data Files

The user may transfer data files from the analyzer hard disk to a USB storage device by dragging and dropping the files from hard disk pane to the USB device pane (see Figure 19). The directory windows default to the local drive on the left screen and the USB memory device on the right. The user may navigate through folders, create directories, and delete files and directories. The user may also use the left mouse button to highlight one or multiple files in the windows and drag and drop to copy the files between the directories.

Figure 19: Typical daily directory and archive of data files.



The internal drive directory (see Figure 19, left pane) is composed of two types of directories: the archive directory and daily directories.

The archive directory (see Figure 20), contains compressed files that the analyzer generates daily. Each file is a single zip archive that contains all the data files recorded on a given day named using the following convention: **`ddMonYYYY.zip`**.

The daily directories are created every day that the analyzer operates.

Figure 20: Archive directory.

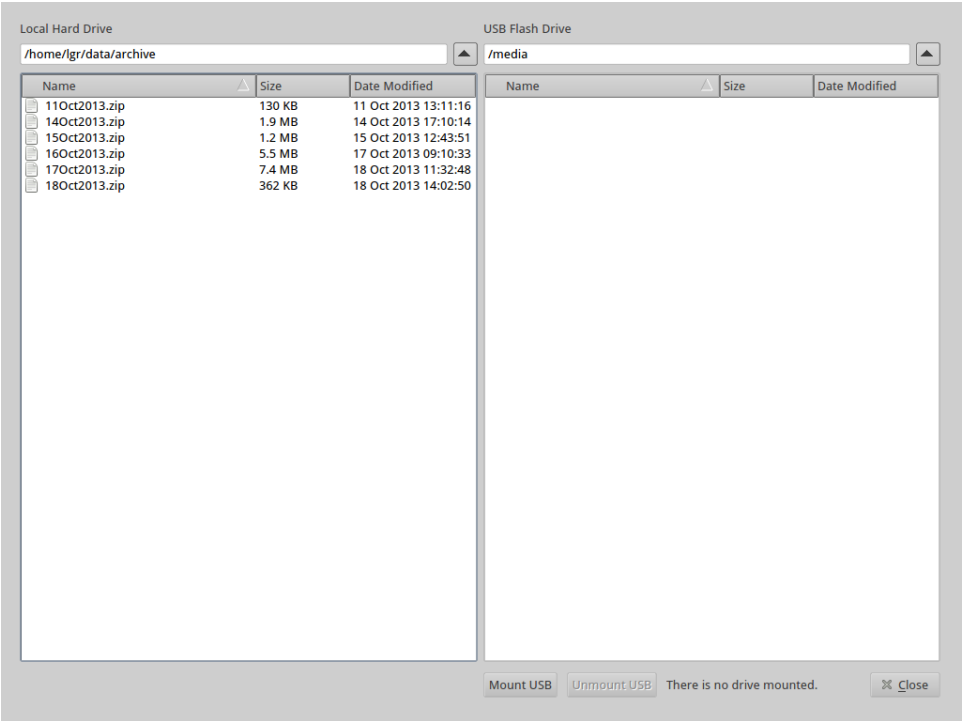


Figure 21: Archive of data files taken during day.

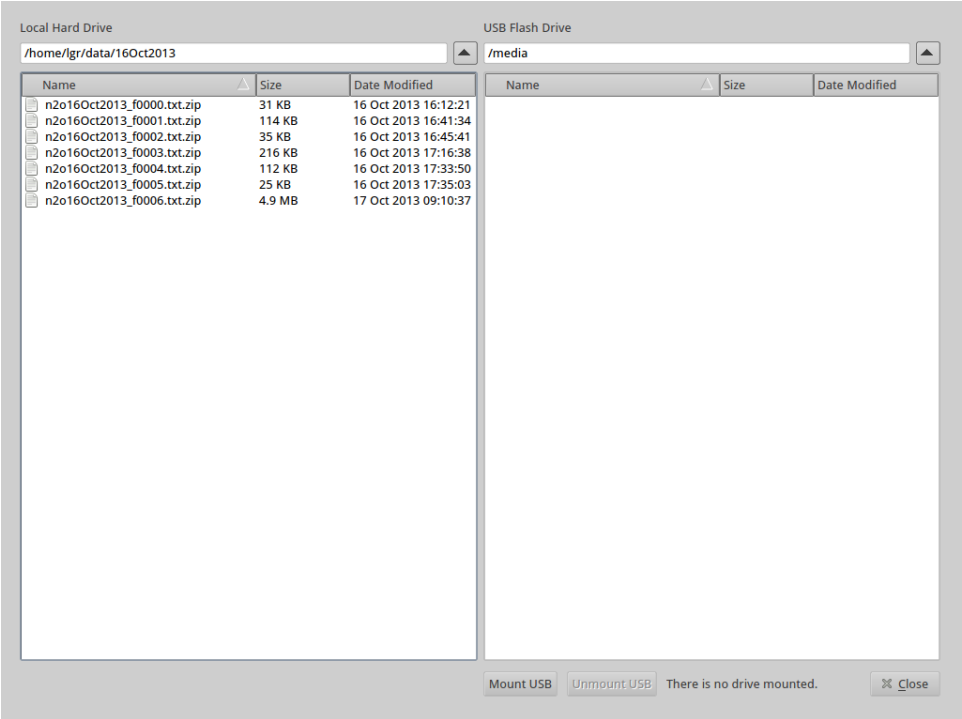
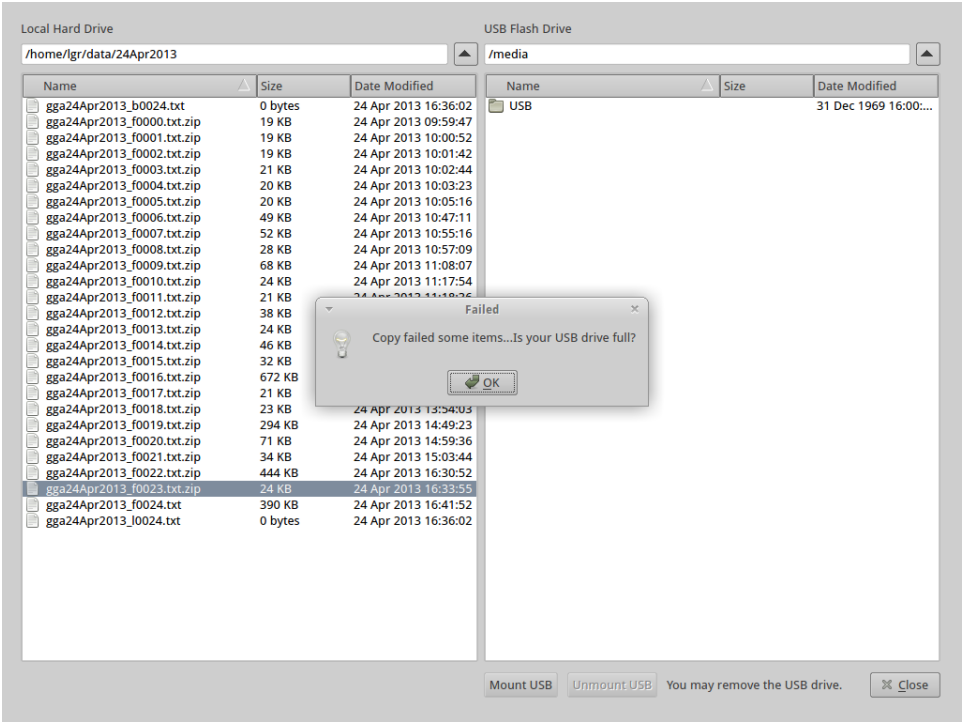


Figure 22. File Transfer Error

User forgot to insert a USB device or the device was not recognized. Please try again with a USB device correctly inserted or with a different USB device.



Setup Panel

The Setup panel allows access to additional configuration and service menus. To enter Setup, click the **Setup** button on the User Interface Control Bar (see Figure 12).

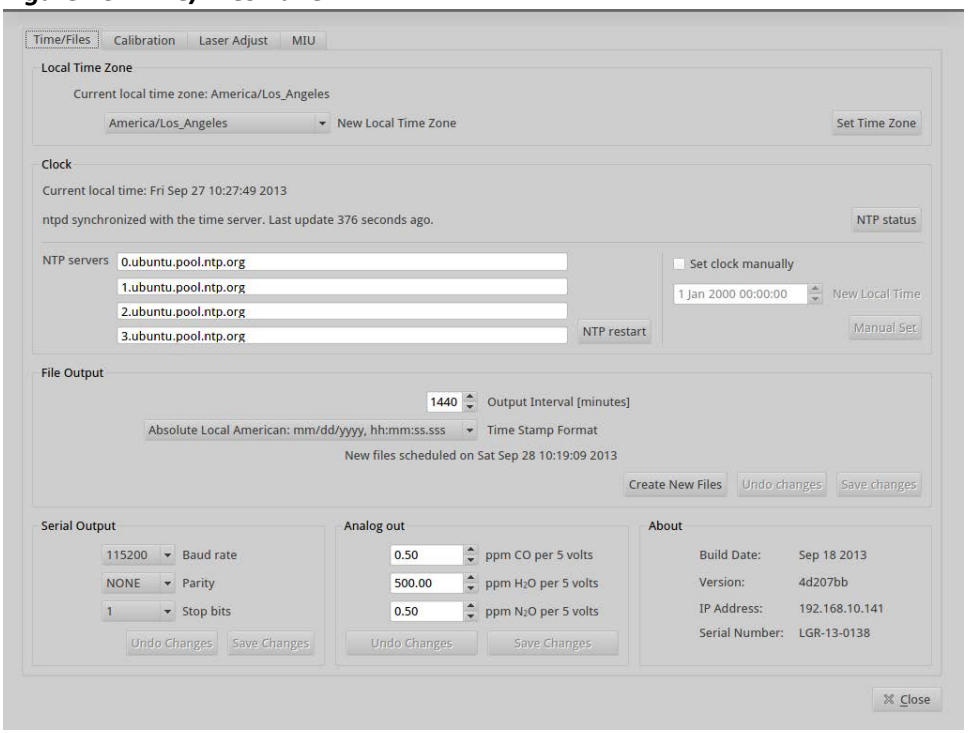
The Setup Menu has tabs at the top that allow the user to switch between four configuration panels:

- **Time/Files**
  - Adjust the current time/date settings
  - Manage file saving settings
  - Configure the serial output
  - Configure analog output
- **Calibration** – Calibrate the analyzer to a local gas standard
- **Laser Adjust** – Adjust laser offset
- **MIU** – Configure Multi-port Inlet Unit

Time/Files

The **Time/File** panel (see Figure *23*) has the following sections: **Local Time Zone**, **Clock**, **File Output**, **Serial Output**, **Analog out**, and **About**.

Figure* 23. *Time/Files Panel



Local Time Zone

This section allows a user to set current time zone for the analyzer.

Clock

This section allows a user to view the current time, view current status of the NTP Servers, change the NTP server addresses, and to set the time manually.

File Output

This section allows a user to adjust both the new file creation interval (when running continuously) and the timestamp format of the data files. The available timestamp formats are shown below in Table 3.

Table 3. Available Timestamp Formats

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

This section allows the user to change the serial communication settings for the analyzer. Standard settings for Baud Rate, Parity, and Stop Bits are provided. Note that the actual rate of serial output is equal to the rate that data is logged (i.e. 1 Hz) divided by the Serial Baud Rate a user specifies.

NOTE: When connecting the serial port of the analyzer to an external computer, a null modem type serial cable should be used.

Analog Output

This section allows a user to define the maximum scale value for each gas detected during measurement. The analog ports have a 16-bit voltage range from 0 to 5 volts. Generally to capture the full range of data, users will wish to select the value based on the maximum concentration that a user expects to see throughout the duration of measurement. For example, a user may expect that a typical measurement will be around 2 ppm with occasional bursts up to 10 ppm, in this case they may wish to set the maximum scale value to 10 ppm to adequately capture the burst data.

Alternatively, a user may wish to ignore occasional bursts of 10 ppm to achieve greater resolution within the typical data range. In this case, a user may set maximum scale value at 5 ppm for twice the resolution or even closer to the nominal data range to maximize the resolution.

NOTE: If the measured concentration goes above the selected maximum scale value, the analog output voltage will saturate until the concentration drops below maximum scale value. However, the on-screen displays and data files will continue to record the correct measured concentration.

Calibration

The **Calibration** Panel shows a reference plot, the **Reference Gas Settings** pane that displays the most recent calibration date and reference gas concentrations last used to calibrate, and the **Calibrate** pane that displays calibration status and user instructions.

To calibrate the analyzer

1. Setup analyzer to run into slow-flow mode.
2. Connect reference gas supply to inlet on back of analyzer.
3. From the Setup Menu, select the Calibration tab.
4. In the Reference Gas Settings section, select the checkbox next to the gas you wish to calibrate.
5. Enter the known concentration for the local gas standard.
6. Repeat steps 4 and 5 for each gas you wish to calibrate.
7. Click **Start** in the Calibrate pane to initiate the calibration process.
8. Figure 25 shows the sequence of screen shots for calibration.
9. Click **Close** to return to the Main Panel.

The time of the latest calibration is stored in the analyzer configuration files for future reference.

Figure 24. Calibration Panel

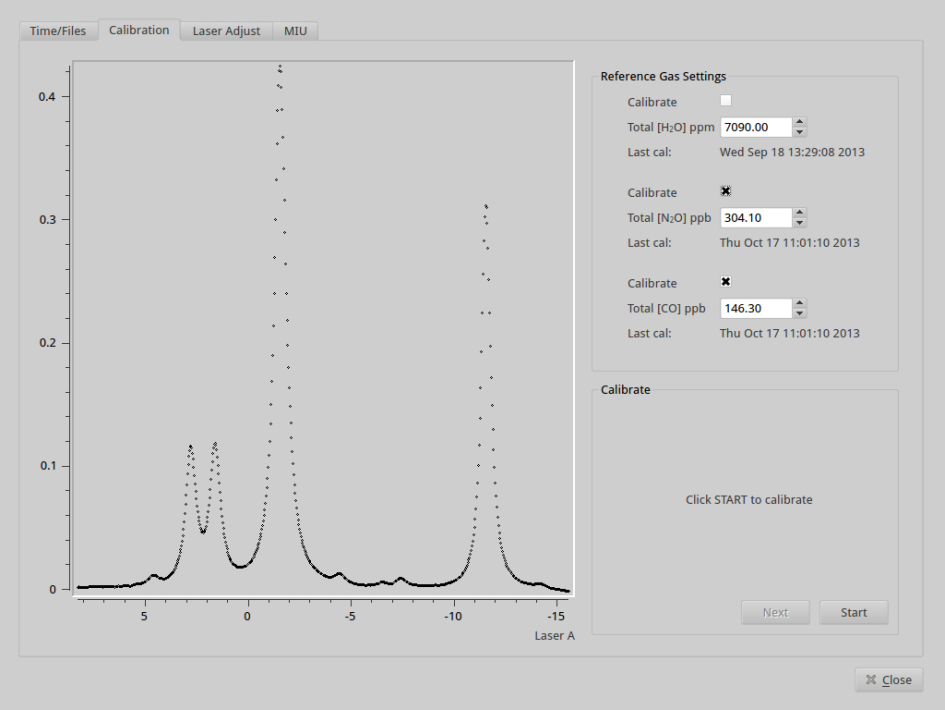


Figure 25. Calibration Process

Sequence of Status Messages

Laser Adjust

The **Laser Adjust** panel allows a user to manually adjust the laser's voltage to correct an offset between the peaks of gas absorption features and their target values.

An offset may occur for the following reasons:

- The laser's wavelength has drifted beyond the automatic control range of the analyzer (see Figure 26).
- The analyzer is operated outside the recommended temperature range.

To manually adjust the laser offset

1. From the Setup Menu, select the Laser Adjust tab.
2. Select the **Disable Laser Frequency Lock** to allow manual control of the laser.
3. Adjust the laser's voltage using the arrow buttons to shift the peaks of CO and N_2O absorption features until they are centered on their respective target lines.
4. Deselect **Disable Laser Frequency Lock**. The software will resume automatic tracking and control of the laser wavelength.
5. Click **Close** to exit the menu and return to the Main Panel.

Figure 26. Laser Adjust Spectrum Display

Spectrum display showing offset between absorption peaks and target lines and with manual control of laser offset enabled.

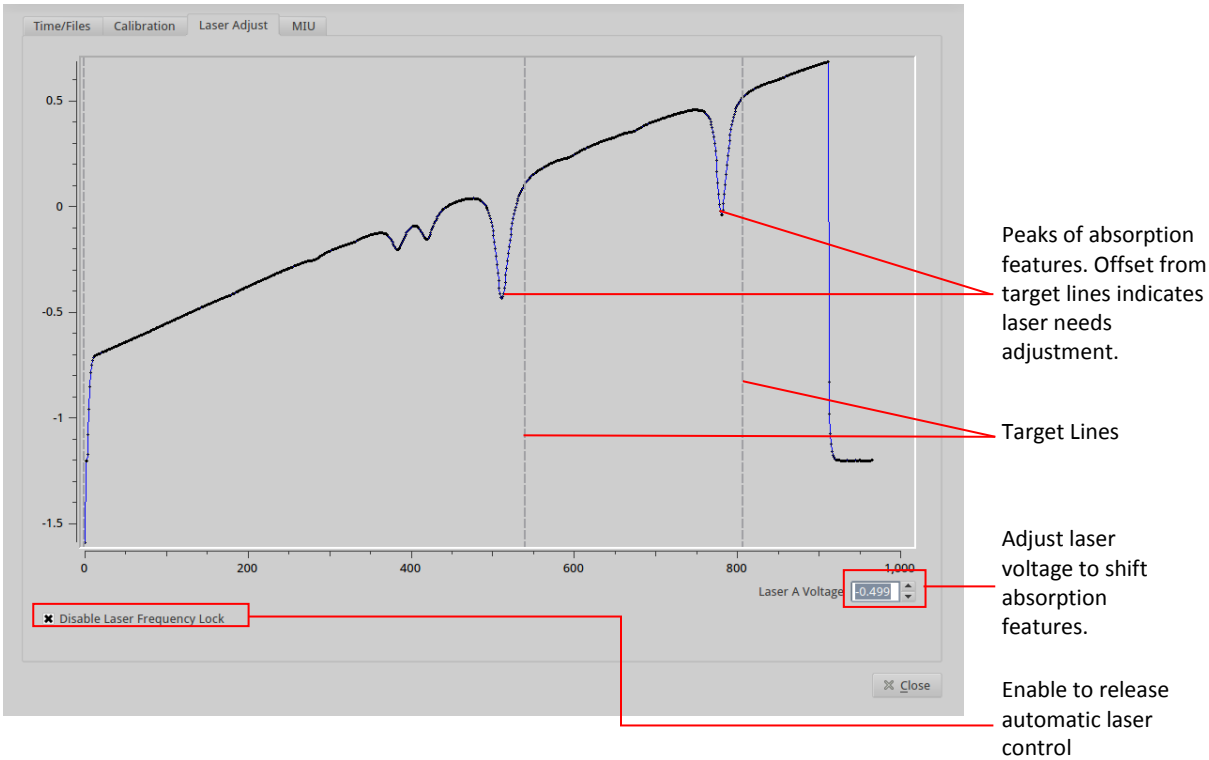
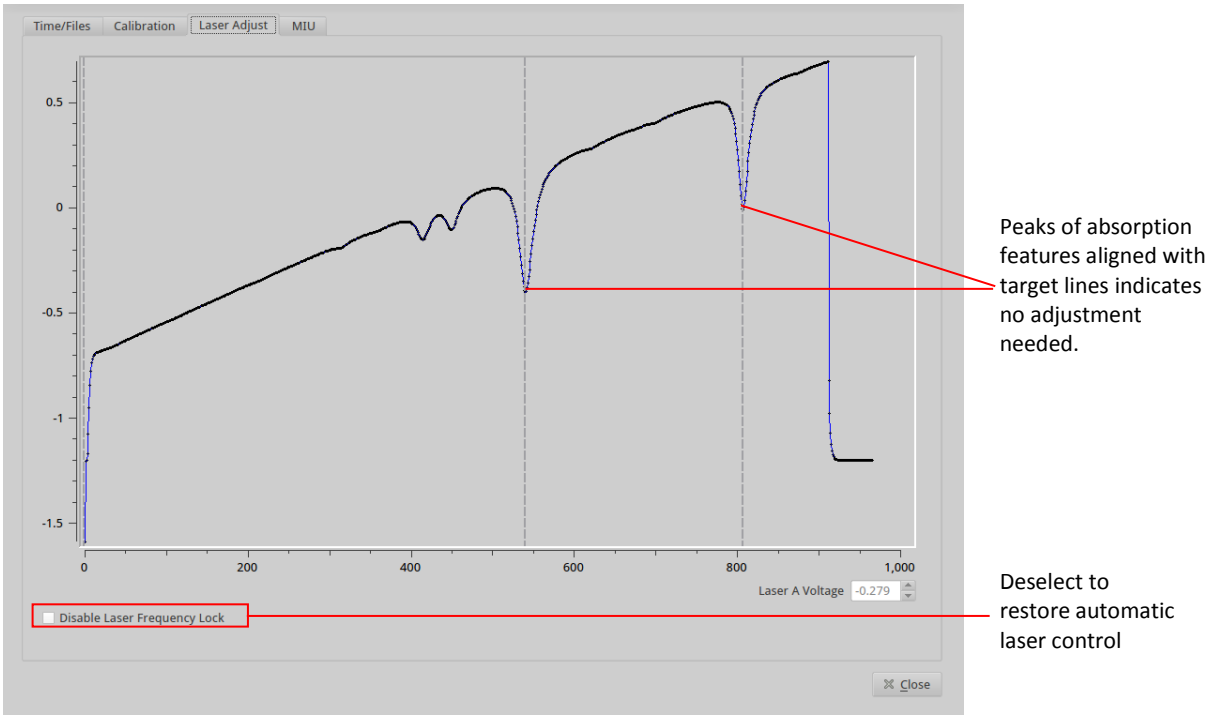


Figure 27. Laser offset corrected

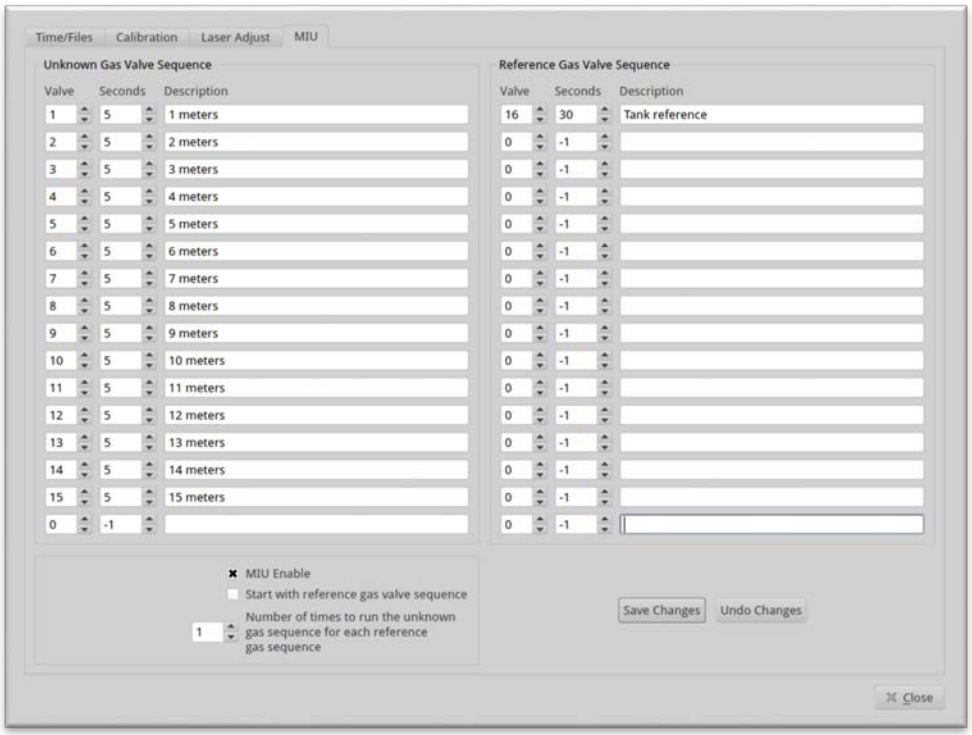
The laser voltage has been adjusted so the N_2O and CO absorption features are centered on the target lines



MIU

The MIU panel allows a user to configure the control of the optional Multi-port Inlet Unit (MIU). Please refer to Appendix G: Controlling the MIU Using the Gas Manifold Control Screen for further instruction about its setup and operation. If the MIU is not connected to the analyzer, its menu tab will be disabled.

Figure 28. Multi-Port Inlet Unit Valve Sequence Control Panel



Shutting Down the Analyzer

1. Click the **Exit** button on the User Interface Control Bar (see Figure 12).
2. In the Shutdown prompt, verify that you want to shut down the analyzer by clicking **OK** (see Figure 29). When you click **OK**, the analyzer will halt data acquisition, close the current data file, and display the final shutdown screen (see Figure 30).
3. After the **You may turn off the instrument** message displays, the user can safely turn off the analyzer by toggling power switch on the front panel of the analyzer.

NOTE: Failure to wait for the final "You may turn off the instrument" command to display before shutting off power to the analyzer may result in file system instability.

Figure 29. Shutdown Prompt

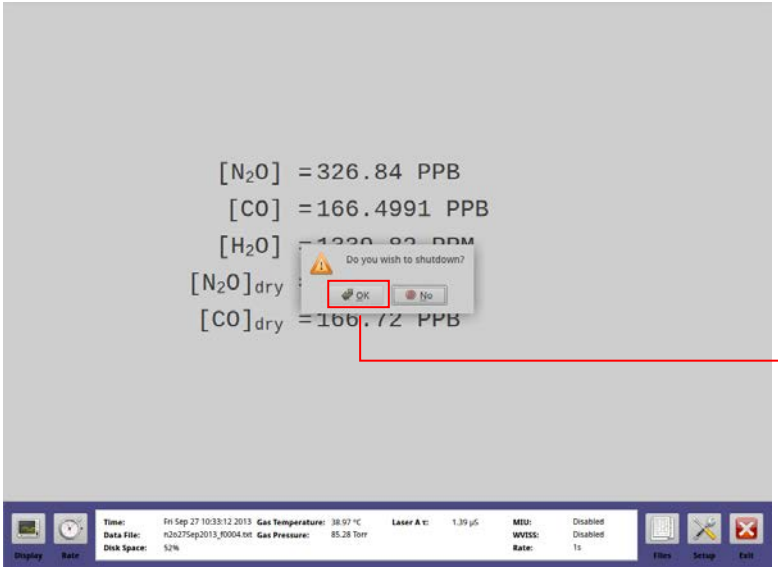
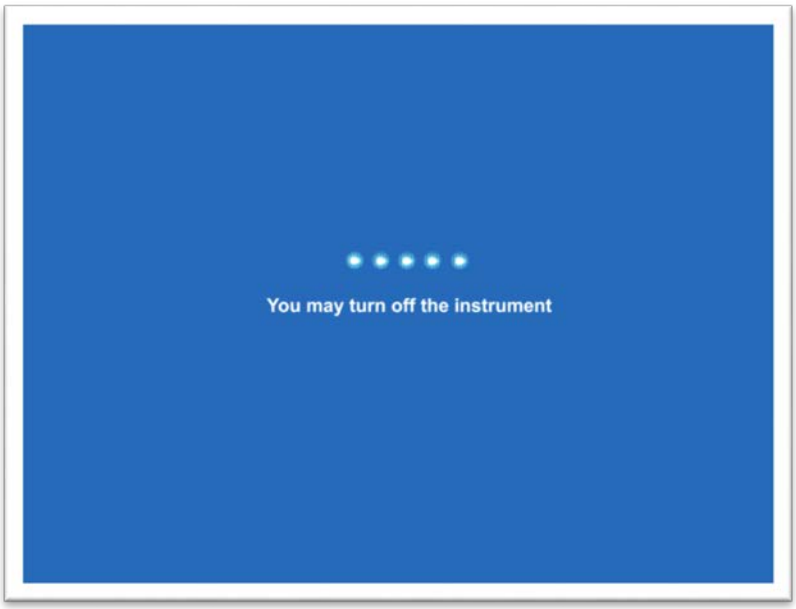


Figure 30. Final Shutdown Screen



3 Maintenance

Daily Operation Checklist

Perform the periodic maintenance tasks shown in Table 4 to keep the Analyzer operating smoothly.

Table 4: Maintenance Checklist

Frequency	Task
Every 1 – 2 days	• View the Spectrum Display Screen and verify the spectrum is correct. The spectrum should appear as shown in Figure 14. You should become familiar with the normal appearance of this characteristic spectrum. It is the best diagnostic of analyzer performance. Any deviation from the normal appearance could indicate a problem with the analyzer. • Review transmitted intensity in the data log (upper plot in Figure 14) If the transmitted intensity has decreased since your last review, the mirrors may be dirty. • Review the analyzer pressure values in the data log. If the transmitted intensity has decreased since your last review, there may be an obstruction in the flow system.
Every 3 – 6 days	• Check the Laser Offset, if the peaks of the Absorption features do not align with the target lines adjust the laser as described in the Laser Adjust section. • Measure a reference cylinder. Any substantial decrease in measured values could indicate that the cell needs to be cleaned. Contact LGR if the cell needs to be cleaned.

Mirror Ring-Down Time and Maintenance

The mirrors of the measurement cell 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 that is employed in the N_2O/CO analyzer, the ring-down is too short to actively measure.

If a significant change occurs in the mirror ring-down time, the precision of the analyzer may be reduced. Degradation in the mirror reflectivity will result in a decrease in the measured concentration of a known reference gas. Monitor the measured value of the reference standards and take note of any decrease. If the measured value of a known reference cylinder has changed more than 20%, clean the mirrors then measure the reference cylinder again. If the analyzer is still not accurate, contact LGR.

NOTE: LGR recommends only opening the analyzer case (external enclosure) when the analyzer is powered off and unplugged from a power source. If running the analyzer without a portion of its external enclosure, pay special attention to moving parts like fans and bare wiring.

Appendix A: About Gas Analyzers and Laser Absorption Spectroscopy

Conventional Laser Absorption Spectroscopy

For gas measurements based on conventional laser-absorption spectroscopy (see Figure 31), 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:

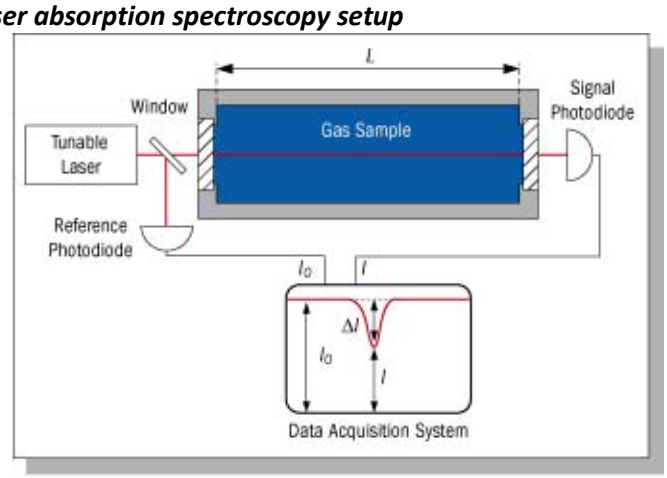
$$\frac{I_0}{I_v} = e^{-SL\chi P\phi_v}$$

where I_v is the transmitted intensity through the sample at frequency v, I_0 is the (reference) laser intensity prior to entering the cell, P is the gas pressure, S is the absorption line strength of the probed transition, L is the optical path length, c is the mixing ratio and f_n is the lineshape function of the transition at frequency n. 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 31: Typical laser absorption spectroscopy setup



Subsequent integration of the measured spectra together with measured values of gas temperature, pressure, path length and the line strength of the probed transition allow determination of the mixing ratio directly from the relation:

$$\chi = \frac{1}{SLP}\int_v \ln\left(\frac{I_0}{I_v}\right)dv$$

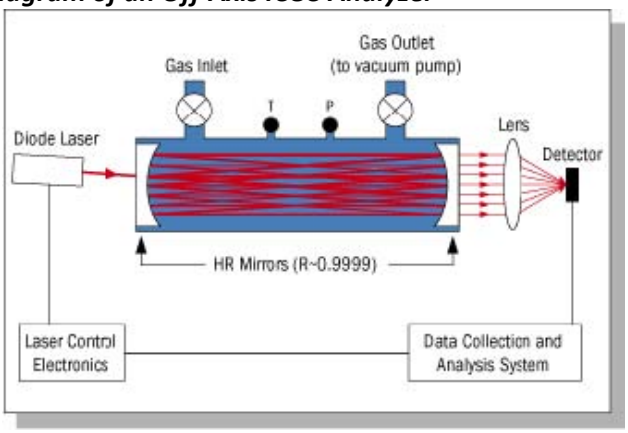
This strategy has been proven successful in determining gas concentrations in mixtures containing several species, in flows at elevated temperatures and pressures, and in hostile environment, without using calibration gases or reference standards.

Until recently, high-sensitivity trace-gas measurements have been possible only by using expensive lasers (e.g., lead-salt or quantum-cascade) or broadband lamps that operate in the mid-infrared region where absorption features are strong. LGR's advances in cavity-enhanced absorption-spectroscopy techniques provide dramatic increases in the optical path length (as described below) and as a result, enable ultrasensitive trace-gas measurements using robust, reliable, room-temperature diode lasers that operate in the near infrared.

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

Off-Axis ICOS utilizes a high-finesse optical cavity as an absorption cell as shown in Figure 8. Unlike conventional multi-pass arrangements, which are typically limited to path lengths 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 32: 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 multipass 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 combined with measured gas temperature and pressure in the cell, effective path length, and known line strength, used to determine a quantitative measurement of mixing ration directly and without external calibration.

Appendix B: Analyzer Flow Schematic

The internal flow of gas through the analyzer is shown schematically in Figure 33 on the next page.

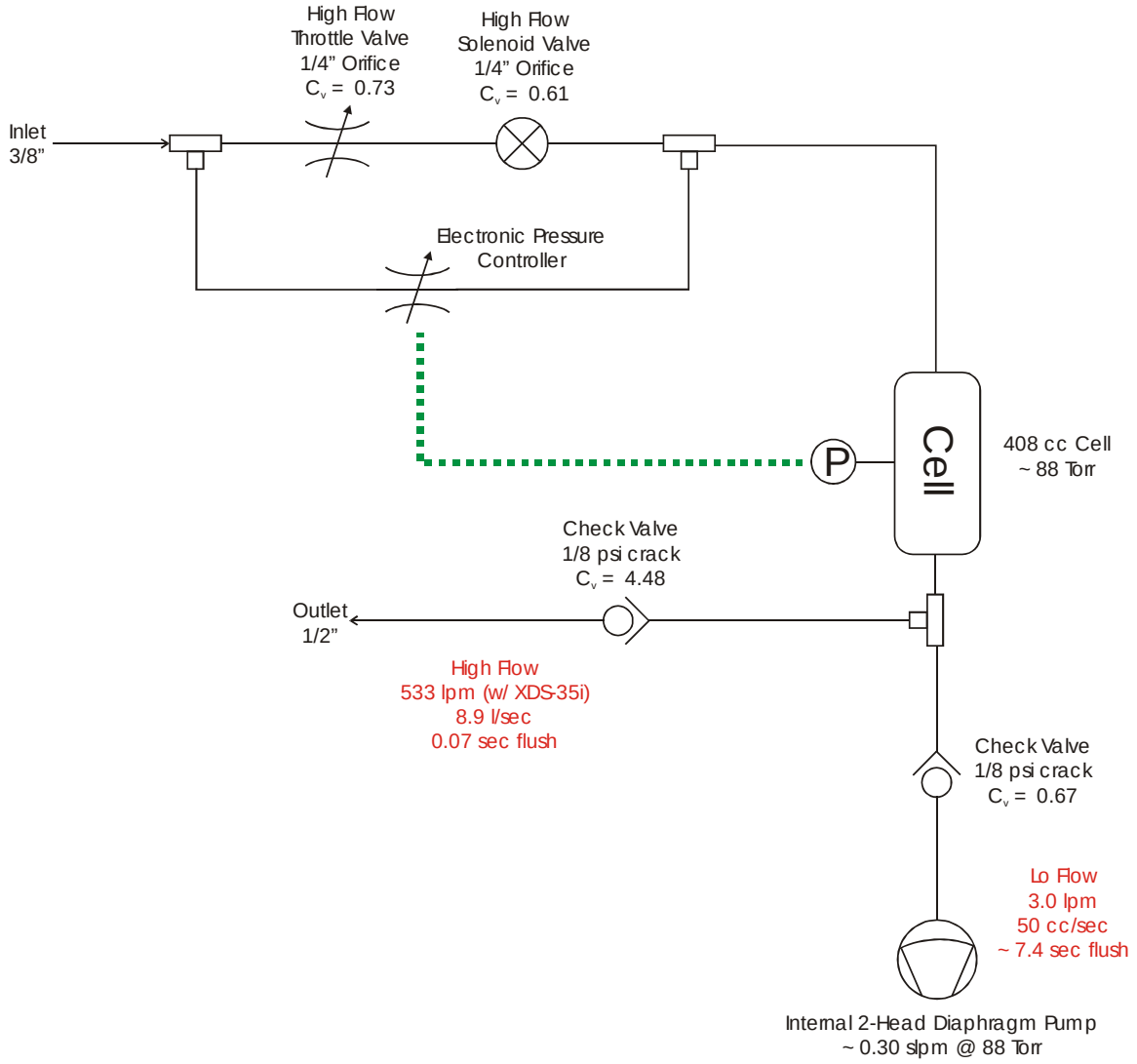
Gas from the analyzer inlet flows through one or both of the inlet paths shown, depending on whether the analyzer is in normal flow mode or fast-flow (flux) mode.

In normal-flow mode, the high flow solenoid valve is closed and all of the inlet gas flows through the electronic pressure controller. This controller throttles the flow to maintain the cell at its target pressure (~85 Torr) under variable ambient inlet pressure and any variations in the pumping speed.

In high flow (flux) mode, the high flow solenoid valve opens, and the inlet gas flows through both of the inlet paths. The high flow throttle valve (see Appendix C: High Flow Throttle Valve Operation) provides coarse manual control of the flow to adjust for various external inlet configurations, and the electronic pressure control provides trim control to again maintain the target cell pressure under variable conditions.

The gas exiting the cell flows through either the internal pump (in normal flow mode) or through the external pump connection if using the external pump. Both of these outlet flow paths are isolated by check valves to prevent leakage from the flow path that is not in use. The cell “flush” time (cell volume/flow rate) is approximately 7.4 seconds while operating with the internal pump, and approximately 0.042 seconds while operating with an external BOC Edwards XDS-35i scroll pump.

Figure 33: Internal Flow Schematic



Appendix C: High Flow Throttle Valve Operation

The function of the high flow throttle valve is to provide coarse manual control of the flow to compensate for various external inlet configurations.

Depending on the pressure drop of the customer inlet system that is coupled to the analyzer, this valve might have to be adjusted to allow the internal pressure controller to function properly. If the analyzer is not operating at the target set point (~85 Torr) during high flow operation, the high flow throttle valve might need to be adjusted.

For the location of the High Flow Throttle Valve, please see section: Gas Inlet/Outlet Connections

The operation and adjustment of the high flow throttle valve is shown schematically in Figure 34.

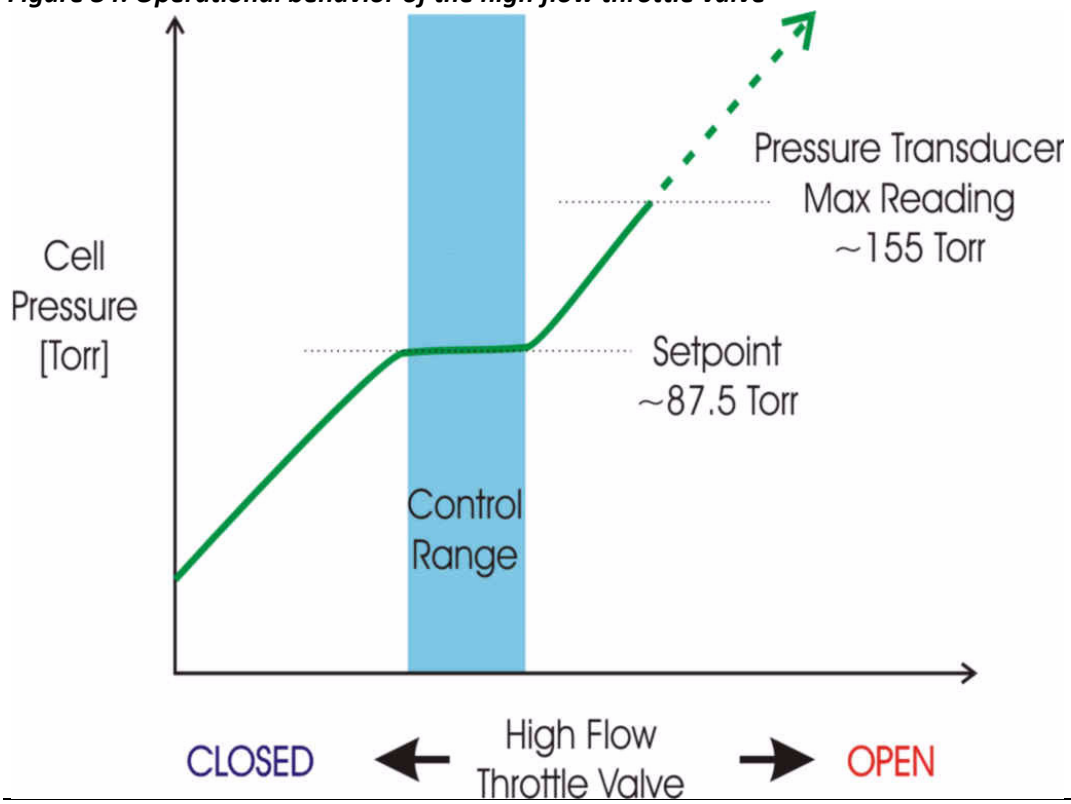
With the analyzer operating in fast-flow mode, and the high flow throttle valve nearly closed, the flow is routed primarily through the electronic pressure controller (see Figure 33). In this condition, the electronic pressure controller is fully open but not able to pass sufficient flow to the cell at its target pressure.

As the high flow throttle valve is opened, a point is reached where the flow through the valve combined with the flow through the fully open 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. As the high flow throttle valve is opened even further, the electronic pressure controller is now fully closed and unable to control the cell pressure.

The ideal operating point is for the high flow throttle valve to be set in the middle of the electronic pressure control range. This midpoint can be found by slowly opening and closing the high flow throttle valve while observing the reported cell pressure (5 Hz mode works well for this) 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.

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.

Figure 34: Operational behavior of the high flow throttle valve



NOTE: The cell pressure should be the same in both flow modes. Each N_2O/CO analyzer has a unique pressure set point between 80-90 Torr. If the cell pressure is 85 Torr in slow mode, then the pressure reading should be 85 Torr in high flow mode as well. Adjust the High flow throttle valve until this is achieved.

Appendix D: Accessing Data Using an Ethernet Connection

This procedure describes how to access the analyzer data directory as a Windows Share by 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 via Local Area Network (LAN) Ethernet connection. The following prerequisites are necessary for this function to operate:

- The analyzer must be connected to a Local Area Network (LAN) via the RJ-45 Ethernet connection on the rear panel.
- The analyzer must receive a response to a DHCP (Dynamic Host Configuration Protocol) request when the analyzer is booted. If the analyzer does not receive a reply, it will disable the Ethernet port and not attempt another DHCP request until the analyzer is restarted.

When these parameters are met, the data directory may be accessed via a Window computer on the same LAN as follows:

1. Click **Start > Run**, and type the following into the **Open** field:
   \\LGR-XX-XXXX (where XX-XXXX is the serial number of the analyzer.)
2. Click **OK**.
   In a short time (usually between 10 and 60 seconds for the first access), a Windows share directory window will open displaying a subdirectory named **lgrdata**.
3. Double-click on the **lgrdata** directory.
   You will see a listing of the data files stored on the internal hard disk 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 may or may not be visible by browsing for it in Windows Network Neighborhood. If it is, it will be in the workgroup called LGR. The computer name will be **LGR-XX-XXXX**, where **XX-XXXX** is the analyzer serial number.
- You can open the data file that is currently being written into by the analyzer without interrupting the analyzer operation (you will see a snapshot of the file as it was when you opened it). You will notice that the current data file is only updated occasionally (every four KB of data), so a new data file will appear empty until enough data is collected and written to the disk.
- If a LAN is not available, you can plug the analyzer into a simple standalone broadband router (such as, NetGear Model RP614) to enable the analyzer to obtain a DHCP address from the router when the analyzer is started. You can then plug any Windows computer into the same broadband router and access the data directory.
- A crossover Ethernet cable will NOT allow an external computer to access the shared data directory, as the analyzer will not obtain a DHCP address upon booting up and will shut down its Ethernet interface.
- You might be able to access the shared analyzer data directory from computers running operating systems other than Windows, The analyzer uses a Samba server to share the data directory, which might be accessed by any appropriate Samba client application.

Appendix E: Wireless Router Setup

The analyzer can be ordered with an optional wireless router, the ZyXEL Portable Wireless Router. If you ordered the wireless router option, it will already be installed on the back of the analyzer.

This section provides instructions for configuring the wireless router so it can connect other devices to the analyzer.

Router Modes

There are three ways or modes in which the Wireless Router can be set up:

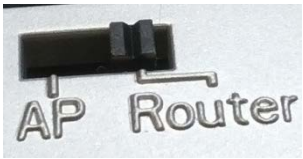
- **Wireless Router Mode**– This is the default mode of the Wireless Router. Use this mode to connect devices wirelessly to the analyzer, thereby creating your own network. The router will issue IP addresses for the analyzer and the wireless device(s) (see Figure 36).
- **Access Point Mode**– Use this mode to connect the analyzer to an existing network via a LAN connection. This mode does not issue IP addresses but will allow wired and wireless devices on an existing network to access the analyzer via a LAN connection (see Figure 38).
- **Client Bridge Mode** – Use this mode to connect the analyzer wirelessly to an existing network. This mode does not issues IP addresses but will allow wired or wireless devices on an existing network to connect wirelessly to the analyzer (see Figure 40).

Once you have configured the router according to one of the three methods above, the analyzer will be wirelessly accessible. For wireless control of the analyzer via a remote device, you must then install the appropriate VNC (virtual network client) software on your remote device. Instructions to do this are in section, Appendix F: Setting up Devices for Remote Access Using VNC Software.

Configuration for Wireless Router Mode

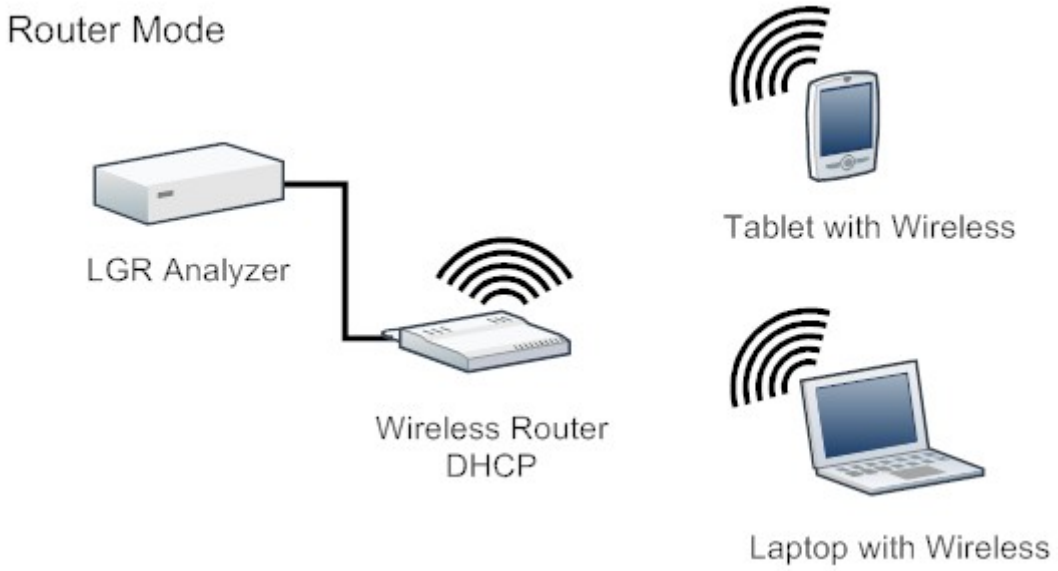
To configure the wireless router for wireless router mode, slide the mode switch on the router to the "Router" position (see Figure 35).

Figure 35: Switch on Wireless Router set to Wireless Router mode



The diagram below shows how the wireless router connects wireless devices to the analyzer. In this "Wireless Router Mode," the wireless router forms its own network, and issues IP addresses to the analyzer and client devices via DHCP (Dynamic Host Configuration Protocol). This mode is primarily intended for standalone operation of the analyzer in the field.

Figure 36: Wireless Connection Diagram in Router Mode



In order for your wireless devices to access and control the analyzer, you must first install VNC (virtual network client) software on your wireless device, and join the wireless router network. For instructions about how to do this, see section, Appendix F: Setting up Devices for Remote Access Using VNC Software.

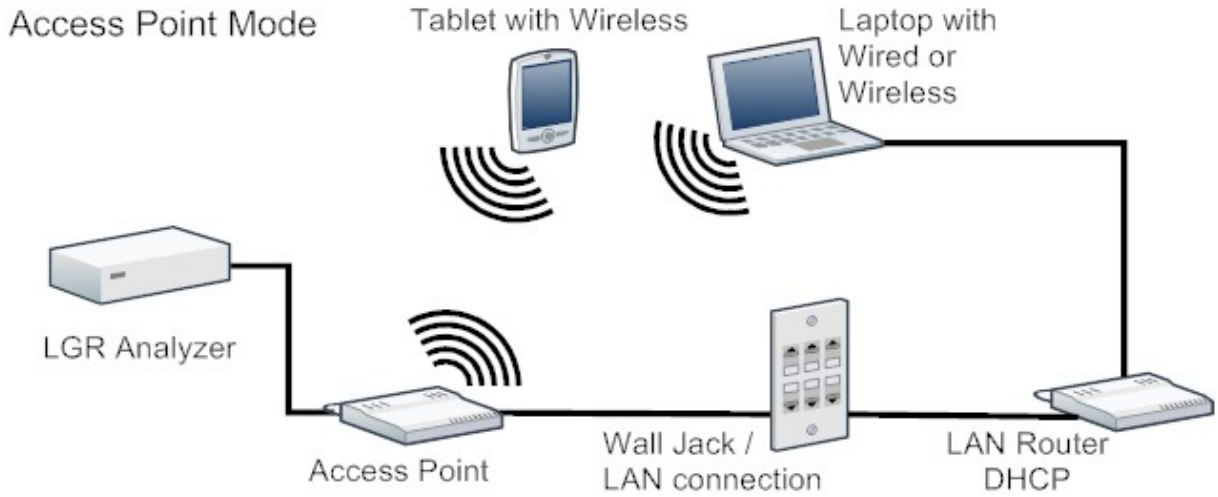
Configuration for Access Point Mode

To configure the wireless router for Access Point mode, on the router, slide the mode switch on the router to the AP position (see Figure 37).

Figure 37: Switch on Wireless Router to AP mode

The diagram below shows how the router works in AP mode to connect wired and wireless devices to the analyzer via a LAN connection. In this "Access Point Mode" the wireless router is connected to an existing local area network (LAN) via a standard Ethernet jack, and the analyzer and wireless client devices are issued IP addresses via the DHCP server on that LAN. This mode is primarily intended for connecting wired and wireless devices to the analyzer on an existing network, such as in a laboratory or other large facility environment.

Figure 38: Wireless Connection Diagram in AP Mode



In order for your wired and wireless devices to access and control the analyzer, you must install VNC (virtual network client) software on the device. For instructions about how to do this, see section Appendix F: Setting up Devices for Remote Access Using VNC Software.

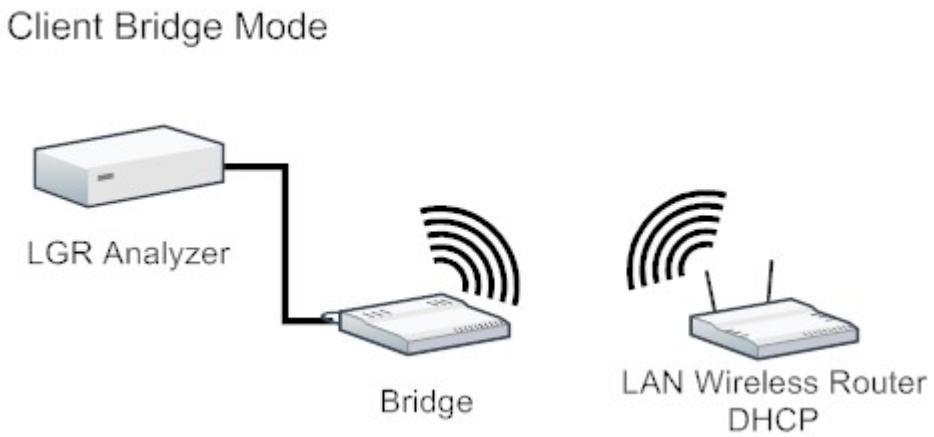
Configuration for Client Bridge Mode

To configure the wireless router for Client Bridge mode, slide the mode switch to the AP position (see Figure 39) then follow the instructions in the section below called, "Setting up the Client Bridge Mode Configuration."

Figure 39: Switch on Wireless Router to AP for Client Bridge mode

The diagram below shows how the router works in Client Bridge mode to wirelessly connect devices on an existing network to the analyzer. In this Client Bridge Mode, the wireless router is connected to an existing local area network (LAN) via a wireless link, and the analyzer and wireless devices are issued IP addresses via the DHCP server on that LAN. This mode is primarily intended for connecting the analyzer to an existing LAN in situations where a wired connection to the LAN is not available (e.g., on the roof of a facility, or in an outbuilding).

Figure 40: Wireless Connection Diagram in AP for Client Bridge mode



Setting up the Client Bridge Mode Configuration

1. In order to configure the router to operate in Client Bridge mode, you must first connect a computer to the wireless router via a standard Ethernet cable (wired) connection.
2. The computer then needs to be set with a Static IP address. This means that you need to manually set an IP address on your computer. To do this, follow the steps below for the appropriate computer system.

Windows XP

- Click on Start > Control Panel (set for Classic View) > Network Connections.
- Right click on Local Area Connections and click on Properties. In Properties, scroll down the list and highlight Internet Protocol (TCP/IP) and click Properties.
- Select Use the Following IP Address.
- Type in "192.168.100.10".
- Click on the Subnet Mask box and it will fill in automatically with "255.255.255.0".

- Click OK at the bottom then click on Close to close the Properties window.

Windows Vista and Windows 7

- Click on Start > Control Panel > Network and Internet> Network Sharing Center.
- On the left side of Network and Sharing Center, click on Manage Network Connections (in Vista) or Change Adapter Settings (in Windows 7).
- Right click on Local Area Connection and click on Properties.
- In this window, highlight Internet Protocol Version 4 and click Properties.
- Select Use the Following IP Address and type in "192.168.100.10".
- Click on the Subnet Mask box and it will fill in automatically with 255.255.255.0.
- Click OK and then Close on the Properties window.

Macintosh Apple Computer

- Click the **Apple Icon** in the top right corner.
- Select **System Preferences**.
- Click on **Network** then **Ethernet.**
- Click on the dropdown box next to **Configure IPv4** and select **manually**.
- For the **IP Address**, enter **"192.168.100.10"**.
- Click on the Subnet Mask box and enter **255.255.255.0**.
- Click on **Apply**.

3. Once your computer is set with a Static IP address, you should be able to open a browser and access the router interface by typing in "**192.168.100.1**" in the address bar.

Changing Your Computer Back

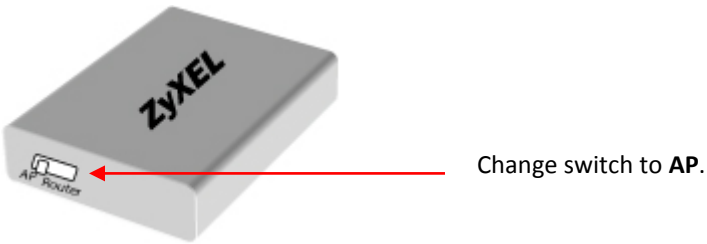
After setting up the Router, you will need to change your computer back to the way it was. Go through the appropriate steps listed above again and

- On Windows, change the setting to obtain an IP Address Automatically and Obtain a DNS Server Address Automatically.
- On Macintosh, change the Configure IPv4 setting to Use DHCP.

Setting up the Wireless Router

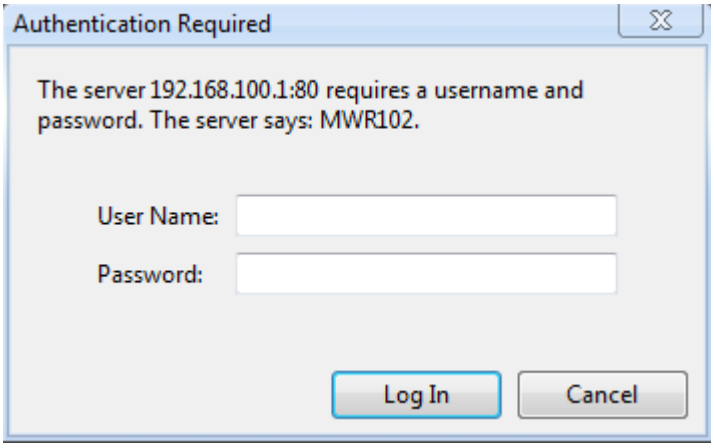
1. Flip the switch on the side of the Wireless Router from Router Mode to AP Mode (see Figure 41).

Figure 41: Set Switch on AP



2. Open a browser window and type in **"192.168.100.1"** and press **Enter** to display the Login Screen (see Figure 42).

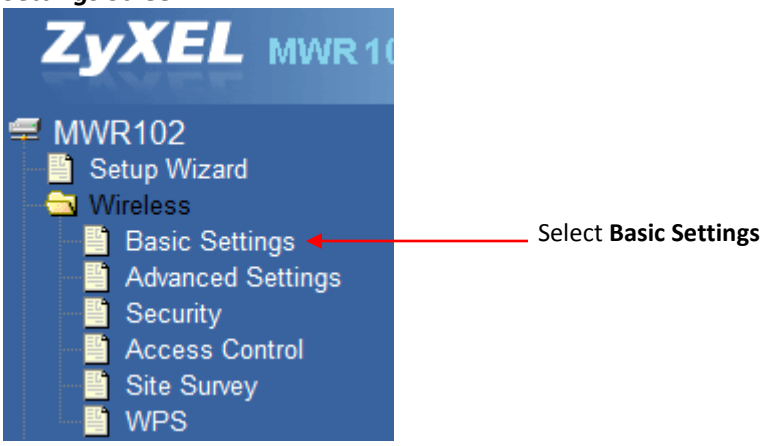
Figure 42: Authentication Screen



3. The login screen for the router will display. In the **User Name** field, enter **"admin"**; in the **Password** field, enter **"1234"**, and click **Login.**

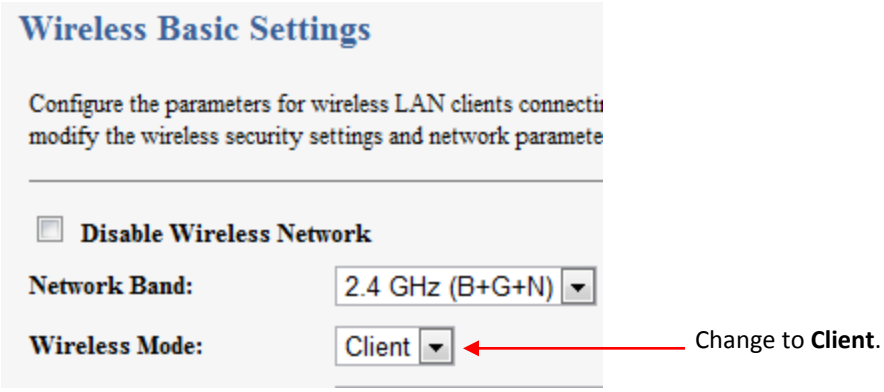
4. On the left side of the screen, click on **Wireless>Basic Settings**.

Figure 43: ZyXEL Wireless>Basic Settings Screen



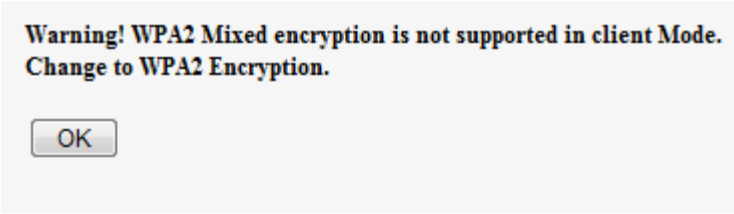
5. Change the **Wireless Mode** from **AP** to **Client**, then click **Apply** at the bottom of the page.

Figure 44: Wireless Basic Settings – Changing Wireless Mode to Client



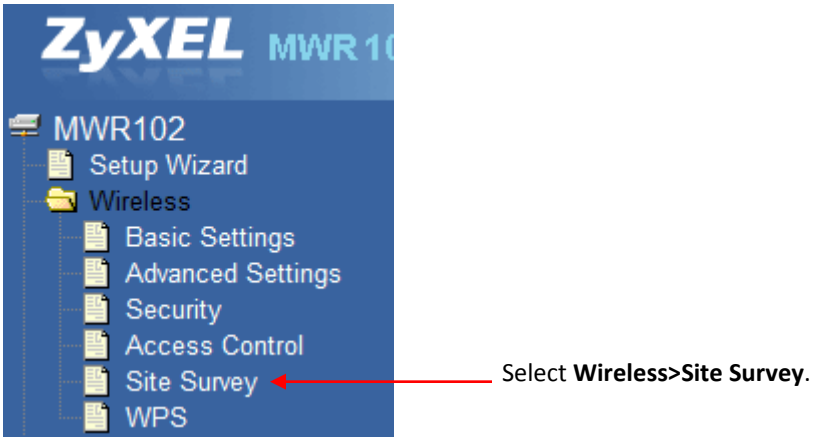
6. You will receive a message warning about using WPA/WPA2 mixed mode. This means that the wireless router you are connecting with must be strictly in WPA or WPA2 mode, but not both. Click on **OK**.

Figure 45: Warning Message



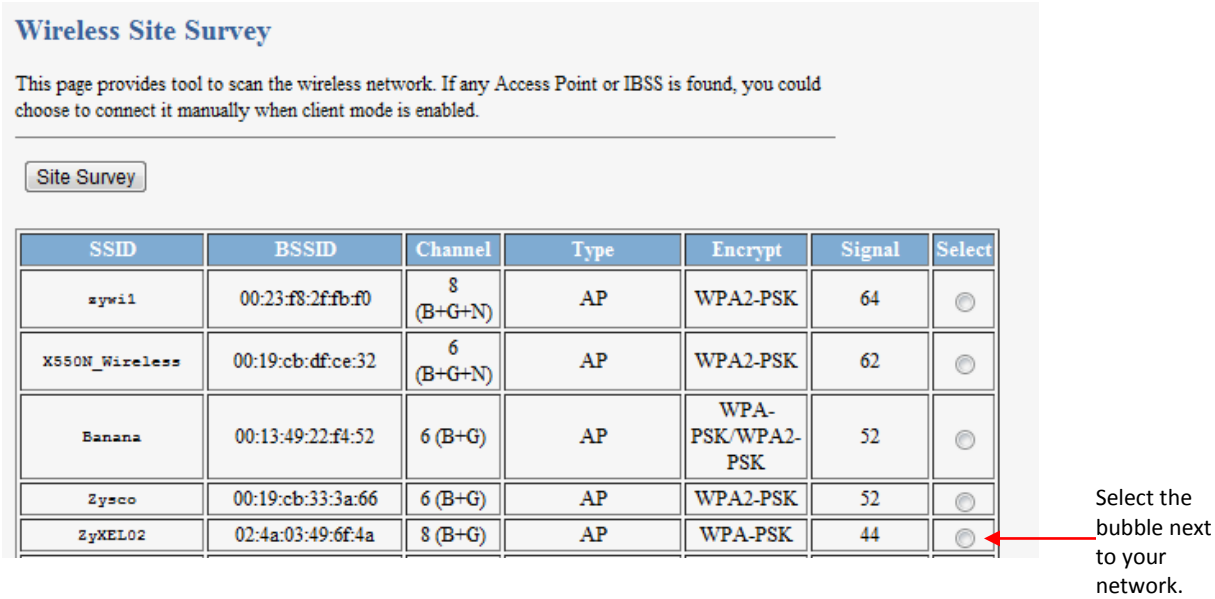
7. Next, click on **Wireless > Site Survey**.

Figure 46: Wireless > Site Survey Screen



8. Click on the **Site Survey** button to bring up a list of wireless networks that are close by in location. Select the bubble to the right of your network and click **Next** at the bottom of the page.

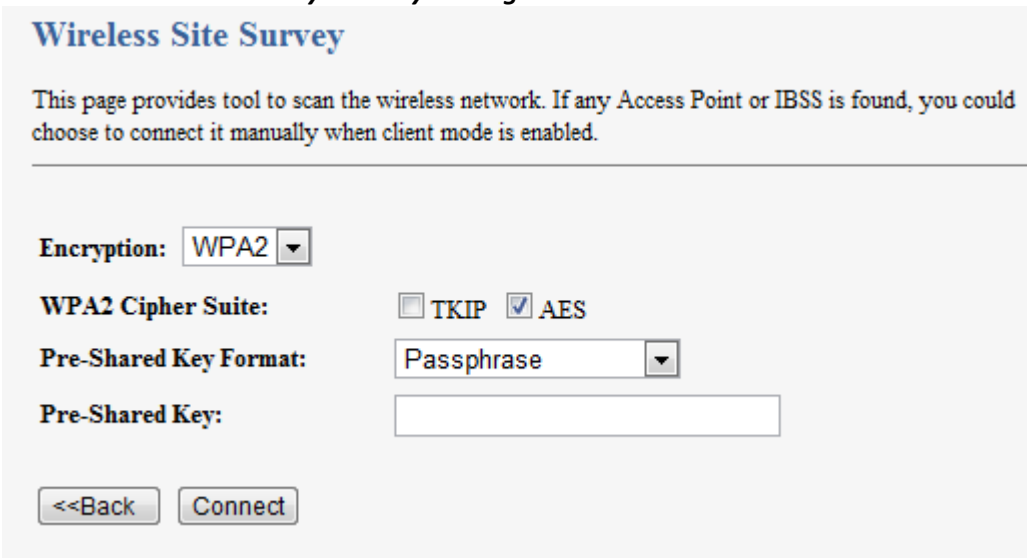
Figure 47: List of Wireless Networks that are Close



SSID	BSSID	Channel	Type	Encrypt	Signal	Select
zywi1	00:23:f8:2f:fb:f0	8 (B+G+N)	AP	WPA2-PSK	64	
X550N_Wireless	00:19:cb:df:ce:32	6 (B+G+N)	AP	WPA2-PSK	62	
Banana	00:13:49:22:f4:52	6 (B+G)	AP	WPA-PSK/WPA2-PSK	52	
Zysco	00:19:cb:33:3a:66	6 (B+G)	AP	WPA2-PSK	52	
ZyXEL02	02:4a:03:49:6f:4a	8 (B+G)	AP	WPA-PSK	44	

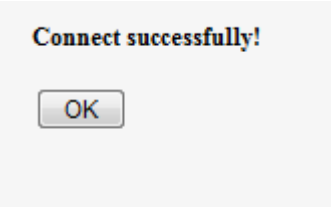
9. On the next screen you will need to input the security settings of your wireless router.

Figure 48: Wireless Site Survey Security Settings Screen



10. Once you have input the values for your network security, click **Connect**. If successfully connected you will get a message saying you were able to connect.

Figure 49: Successfully Connected Message Screen



Completing Setup

11. At this point, close your browser window and follow the instructions in the "Changing Your Computer Back" section on page 53 above.

Once this is done, you can connect the analyzer to the LAN port of the ZyXEL router and it will connect to your main wireless router through the bridge that was just created.

In order for your wired and wireless devices to control the analyzer, you must install VNC (virtual network client) software on the device. For instructions about how to do this, see section Appendix F: Setting up Devices for Remote Access Using VNC Software.

Appendix F: Setting up Devices for Remote Access Using VNC Software

There 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, tablet, etc.)
- iOS based devices (smart phones, tablets, laptops, etc.)
- Windows based devices (smart phones, tablets, laptops, etc.)

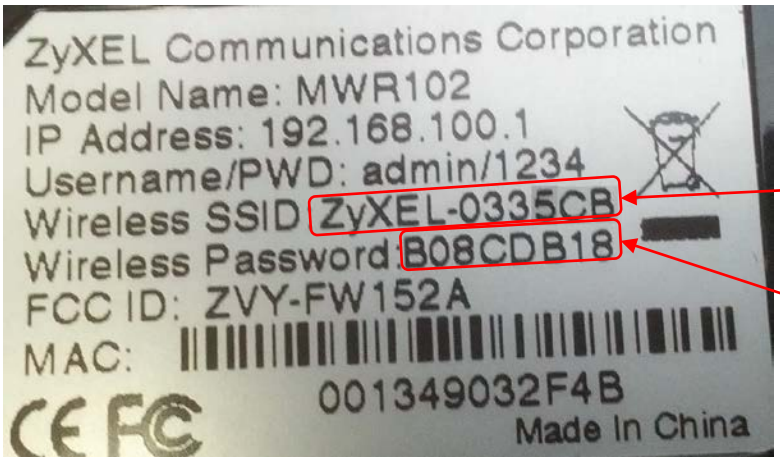
Each of these devices uses VNC (Virtual Network Client) software to access and control the analyzer through the router. Follow the instructions below to install and setup VNC software on the type of device you want to connect to the analyzer through the router.

Setting Up VNC Software on Android Devices

1. On the Android device, go to **Settings>Wi-Fi>Connect to Wireless Network**.

2. Connect to the wireless SSID network that matches the sticker on the ZyXEL Wireless Router, in this case, Z**yXEL-0335CB** (see Figure 50). The ZyXEL Wireless Router is installed inside the analyzer and may be accessed by opening the case.

Figure 50: Wireless Router Sticker



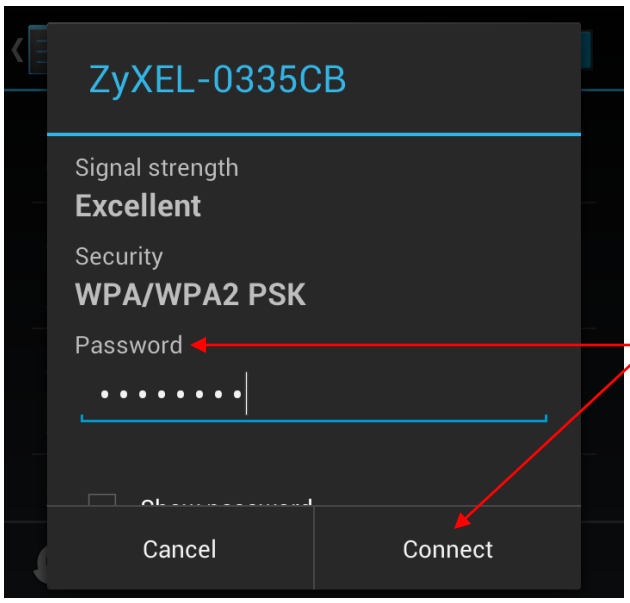
SSID Network: in this case, **ZyXEL-0335CB**

Wireless Password: in this case, **B08CDB18**

3. Select **SSID** and type in the Wireless Password that matches the sticker on the router, in this case, **B08CDB18**, and click **Connect** (see Figure 50 and Figure 51).

NOTE: Every router will have a different, unique SSID number and Wireless Password.

Figure 51: Password Connection Screen



Enter the Password that appears on the sticker on the router, and then tap the **Connect** button.

4. The following screen will display showing that the Android device is connected to the router.

Figure 52: Connectivity Confirmation Screen

Hold your finger on the network connection icon to display the IP address of the Android device.

5. Ensure that the IP address of the Android device is correct by holding your finger down on the network connection icon (see Figure 52). The IP address of the Android device will either be **192.168.100.100** or **192.168.100.101**.

NOTE: Remember the IP Address of the Android device because it will be necessary to refer to it in Step 9, below.

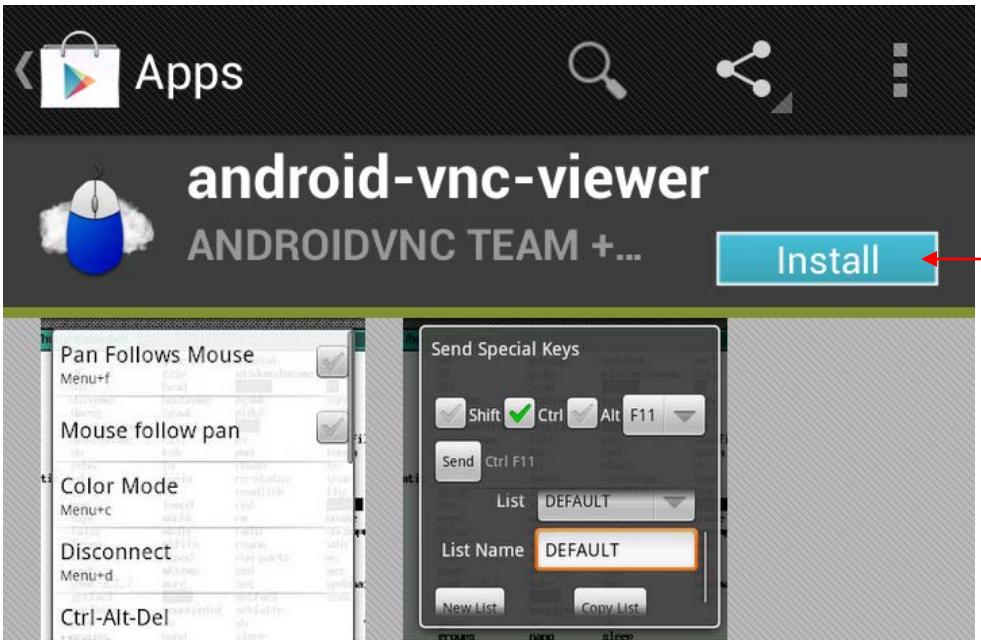
6. Install VNC software/connect with VNC software by searching and installing from the store: in the Google Play store, search for "Android-vnc-viewer" and install the application by tapping on the **Install** button (see Figure 53).

NOTE: 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

Figure 53: "Android-vnc-viewer" Install Screen



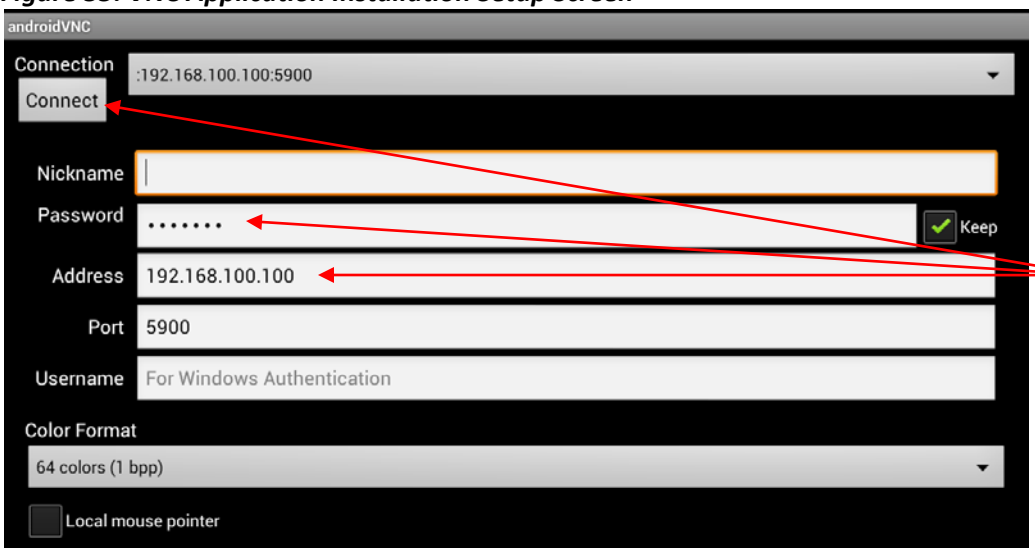
Tap on the **Install** button to install the application.

7. Open the VNC application on the Android device by tapping on the icon pictured below:

Figure 54: VNC Application Icon

8. The following screen will appear:

Figure 55: VNC Application Installation Setup Screen



In the **Address** field, enter the IP address of the ***analyzer***.

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

Tap the **Connect** button.

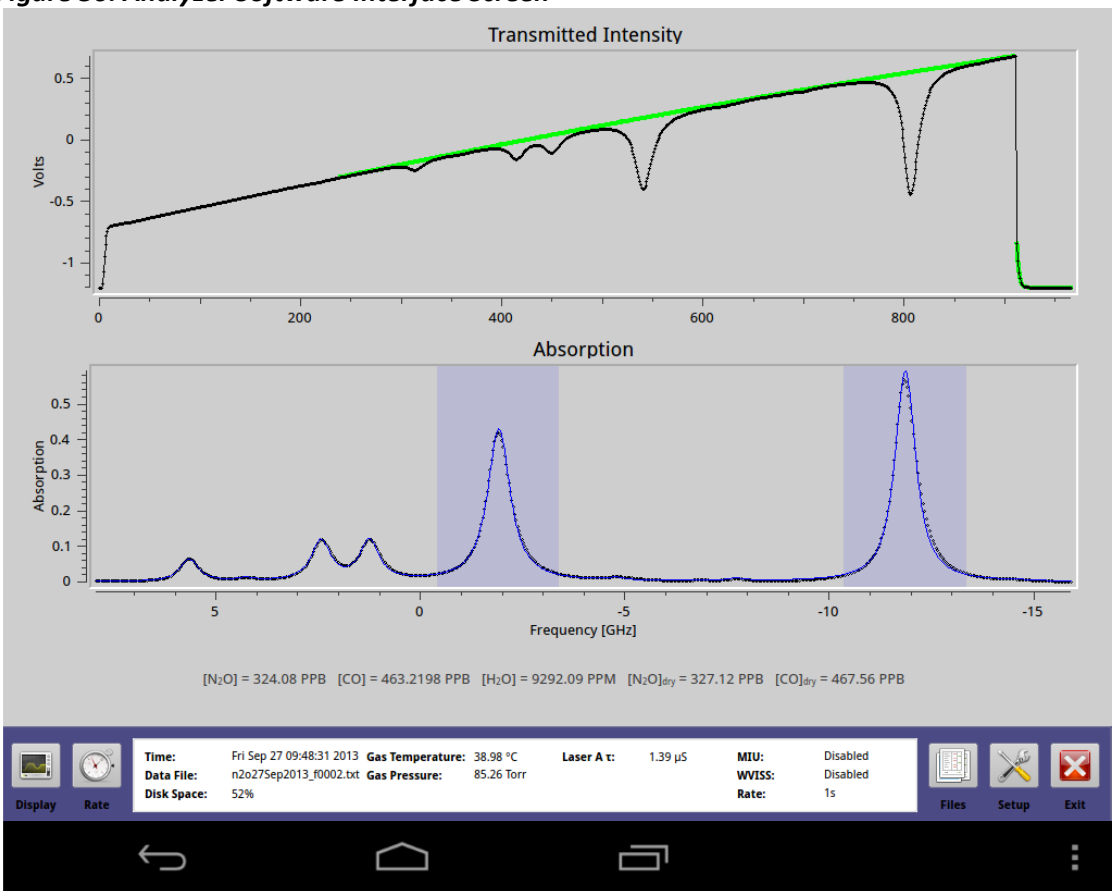
9. In the **Address** field, type in the correct address of the ***analyzer***, which will either be **192.168.100.100** or **192.168.100.101**, depending on the IP address of the Android device that was displayed in Step 5 above; the IP Address of the ***analyzer*** will be whichever address the Android device is ***not***.

For example, if the IP address of the Android ***device*** that was displayed in Step 5 is 192.168.100.10**1**, then the IP address of the ***analyzer*** will be 192.168.100.10**0** (and vice-versa).and therefore, **192.168.100.100** must be entered into the Address field in the screen above, as displayed in this example.

10. In the **Password** field, type **lgrvnc**.

11. Tap the **Connect** button to connect the Android device to the analyzer. The analyzer software interface screen will display on the device; the screen size is adjustable to fit the screen of the device.

Figure 56: Analyzer Software Interface Screen

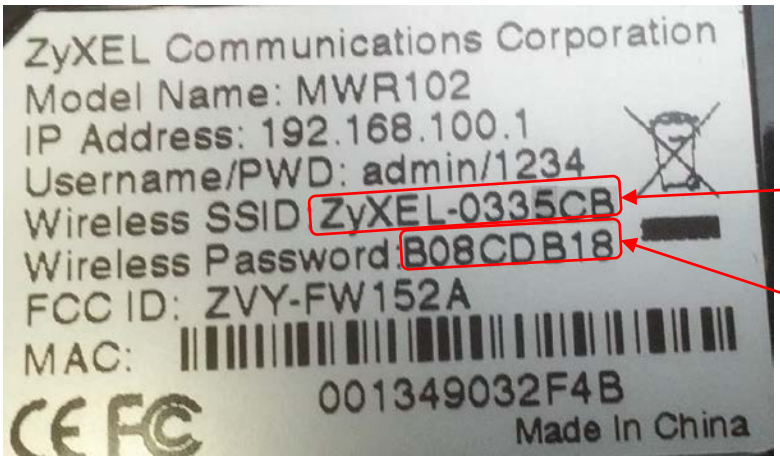


Setting Up VNC Software on iOS Devices

1. On the iOS device (iPad, iPhone, etc.), go to **Settings>Wi-Fi>Connect to Wireless Network**.

2. Connect to the wireless SSID network that matches the sticker on the router, in this case, **ZyXEL-0335CB** (see Figure 57). The ZyXEL Wireless Router is installed inside the analyzer and may be accessed by opening the case.

Figure 57: Wireless Router Sticker

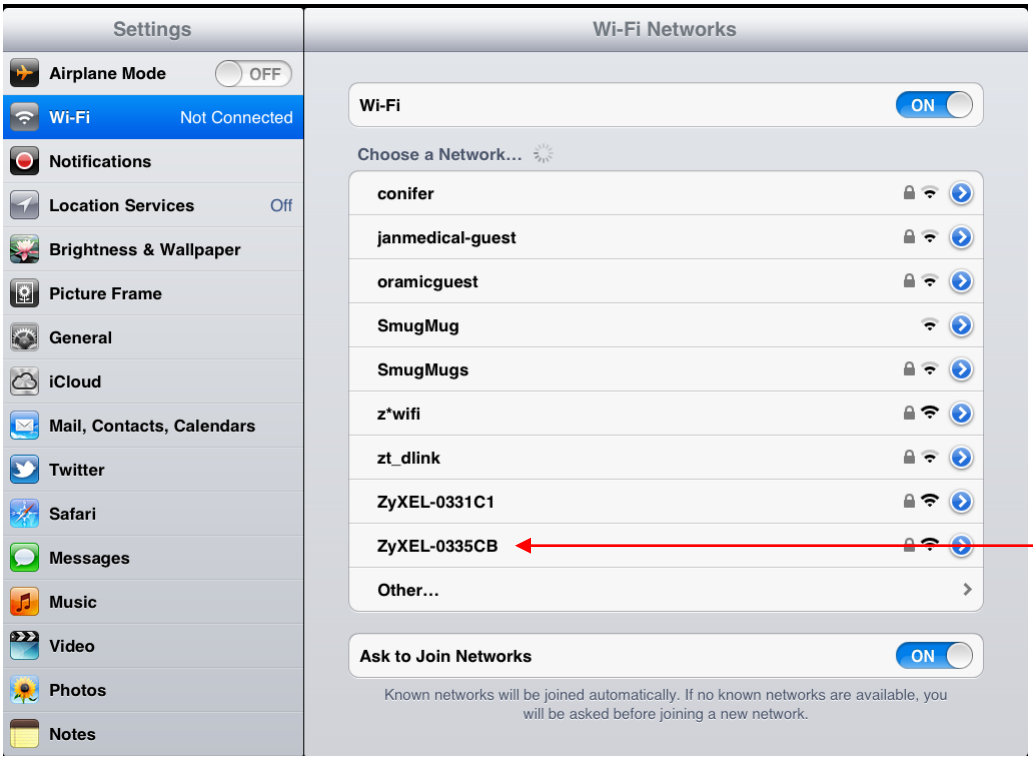


SSID Network: in this case,**ZyXEL-**

Wireless Password: in this case, **B08CDB18**

3. Select the appropriate SSID network, in this case **ZyXEL-0335CB** (see Figure).

Figure 58: Network Connections Screen



Select the correct Network.

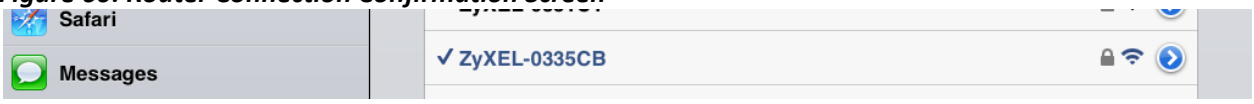
4. Once selected, the following screen will appear (see Figure 59, below). In the **Password** field, type in the Wireless Password on the sticker on the router, in this case, **B08CDB18,** and tap **Join**.

NOTE: Every router will have a different, unique SSID number and Wireless Password.

Figure 59: Router Connection Screen

5. The following screen will display, confirming that the iOS device is connected to the router.

Figure 60: Router Connection Confirmation Screen



6. Select the Network to check the IP address of the device (see Figure 61), which should be **192.168.100.100** or **192.168.100.101**.

NOTE: Remember the IP Address of the device because it will be necessary to refer to it in Step 10, below.

Figure 61: Device IP Address Confirmation Screen

The IP Address of the ***device*** shown here is **192.168.100.101**

7. Install VNC software/connect with VNC software by searching and installing it from the App store. Mocha VNC Lite for iOS is the software used in this example.

NOTE: Internet connection is required for this step.

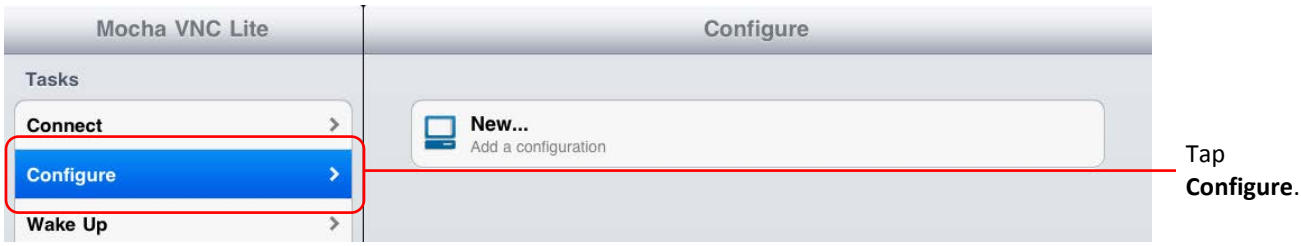
NOTE: Complete instructions for installing Mocha VNC Lite for iOS can be found online at:

http://www.mochasoft.dk/iphone_vnc_help2/help.htm

Figure 62: VNC Selection Screen – Mocha VNC Lite is selected in this example

Mocha VNC Lite is the software selected.

8. Once installed, open the application and tap **Configure**.



9. The screen below will display (see Figure 63).

Figure 63: Mocha VNC Lite Configure Screen

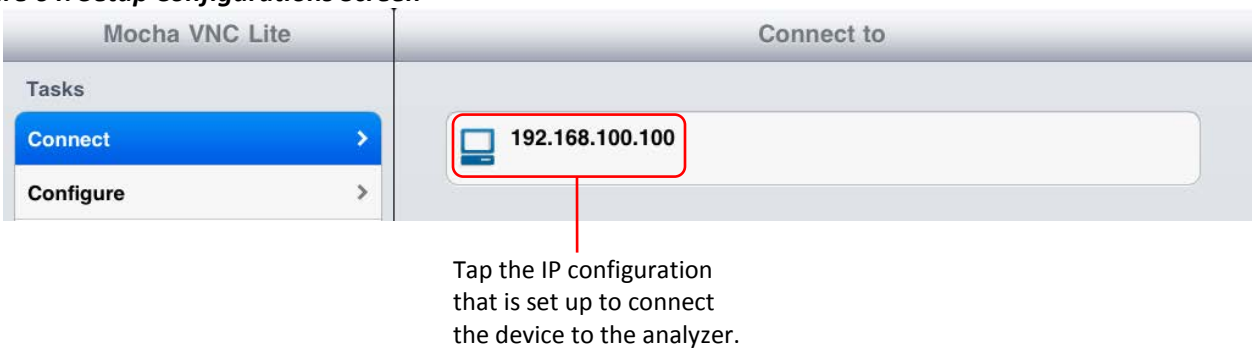
10. In the **VNC server address** field type in the correct address of the ***analyzer***, which will either be **192.168.100.100** or **192.168.100.101**, depending on the IP address of the device that was displayed in Step 6, above; the IP address of the ***analyzer*** will be whichever address the device is ***not***.

For example, if the IP address of the ***device*** that was displayed in Step 6 is 192.168.100.10**1**, then the IP address of the ***analyzer*** will be 192.168.100.10**0** (and vice-versa) and therefore, 192.168.100.100 must be entered into the **VNC server address** field in the screen above, as shown in this example.

11. In the **VNC Password** field, type **lgrvnc**.

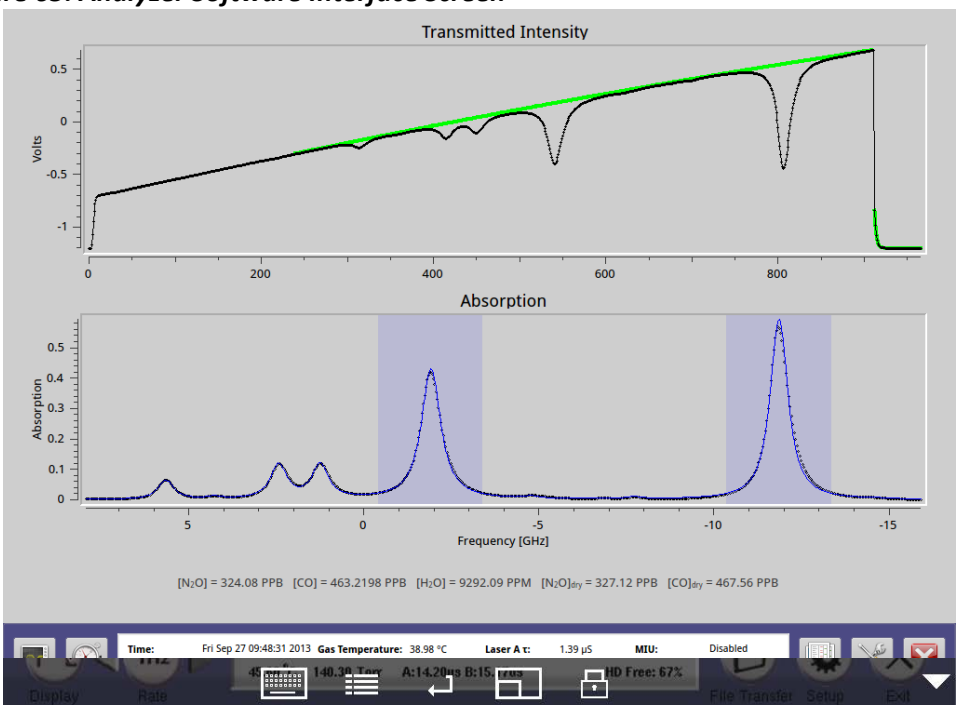
12. Tap **Connect**>, to display the screen below that shows the configurations that have been set up.

Figure 64: Setup Configurations Screen



13. .Tap the IP configuration that is setup, in this case, **192.168.100.100**, to connect the iOS device to the Analyzer. The analyzer software interface screen will display on the device; the screen size is adjustable to fit the screen of the device (see Figure 65).

Figure 65: Analyzer Software Interface Screen



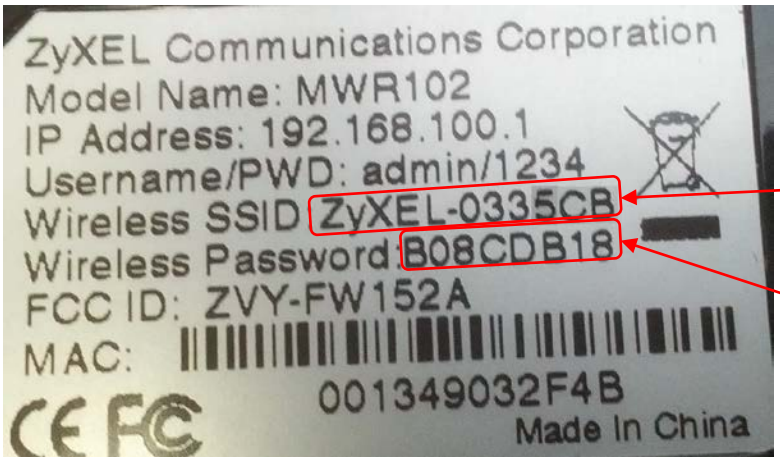
Setting Up VNC Software on Windows Devices

1. On your Windows device, open wireless router options.

2. Locate the sticker on the router as pictured below (see Figure 66).

NOTE: The ZyXEL Wireless Router is located on the back of the analyzer.

Figure 66: Wireless Router Sticker

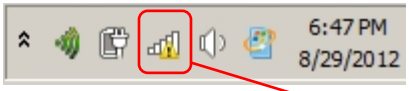


SSID Network: in this case,**ZyXEL-**

Wireless Password: in this case, **B08CDB18**

3. Click on the Wireless Connections icon in the bottom left part of the screen (see Figure 67) to open the Windows Wireless Networks window (see Figure 68).

Figure 67: Wireless Connections Icon



Click on the **Wireless Network Connections** icon.

Figure 68: Windows Wireless Networks

4. Select the SSID network that matches the SSID number on the router sticker, in this case **ZyXEL-0335CB** (seeFigure 66and Figure 68, above) to display the screen below.

Figure 69: Network Connections Security Screen

5. In the Connect to a Network box that appears, in the Security key field, type in the Wireless Password that matches the router sticker, in this case, **B08CDB18**, and click **OK**.

NOTE: Every router will have a different, unique SSID number and Wireless Password.

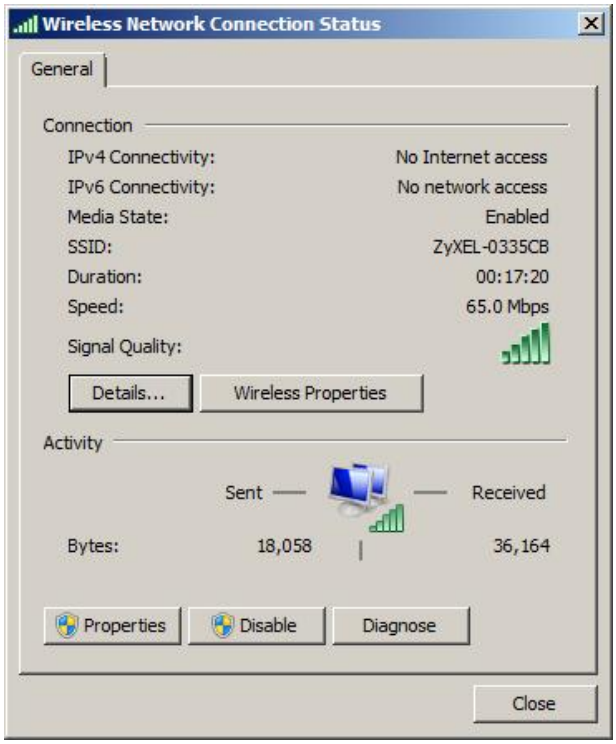
6. Check the connection to make sure the device is connected through the Wireless Router by selecting the router as shown in the screen below.

Figure 70: Wireless Network Connection Screen

7. Check the IP address of the Windows device by right clicking on the **ZyXEL-0335CB** Network Connection, then clicking on **Status** (see Figure 71) to display the Wireless Network Connection Status window (see Figure 72).

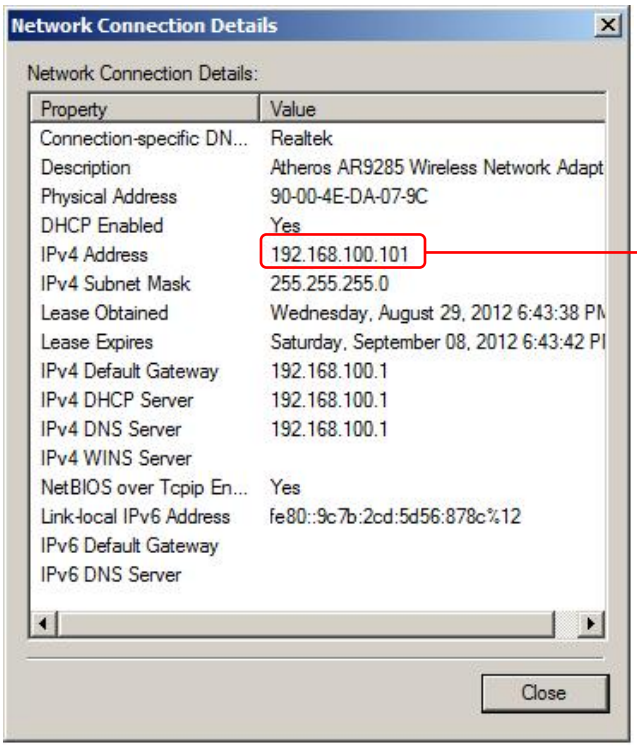
Figure 71: Current Connectivity Screen

Figure 72: Wireless Network Connection Status Window



8. Click on the **Details** box to display the Network Connection Details window (see Figure 73).

Figure 73: Network Connection Details Window



Check the IP Address of the Windows device, which in this case, is 192.168.100.101.

9. Check the **Ipv4 Address** of the Windows device, which should be either **192.168.100.100** or **192.168.100.101**; in this case, the Windows device IP address is 192.168.100.101 (see Figure 73).

NOTE: Remember the IP Address of the device because it will be necessary to refer to it in Step 12, below.

10. Install VNC software/connect with VNC software by going to the RealVNC Web site and downloading the RealVNC Viewer "EXE" file from http://www.realvnc.com/download/.

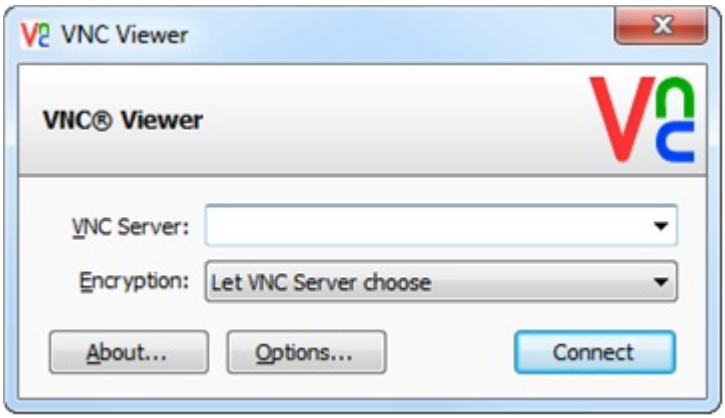
NOTE: Internet connection is required for this step.

NOTE: Complete 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

11. Open the program by clicking on the **Connect** button.

Figure 74: Real VNC Viewer Installation Screen



12. Type in the IP address of the ***analyzer***, which will either be **192.168.100.100** or **192.168.100.101**, depending on the IP address of the device that was displayed in Step 9, above; the IP address of the ***analyzer*** will be whichever address the device is ***not***.

In the example in Step 9 above, the IP address of the Windows ***device*** that was displayed is 192.168.100.10**1**, therefore, the IP address of the ***analyzer*** will be 192.168.100.10**0** and therefore, 192.168.100.100 must be entered into the **VNC server address** field (and vice-versa).

13. When prompted, type in the Password, which will be **lgrvnc.**

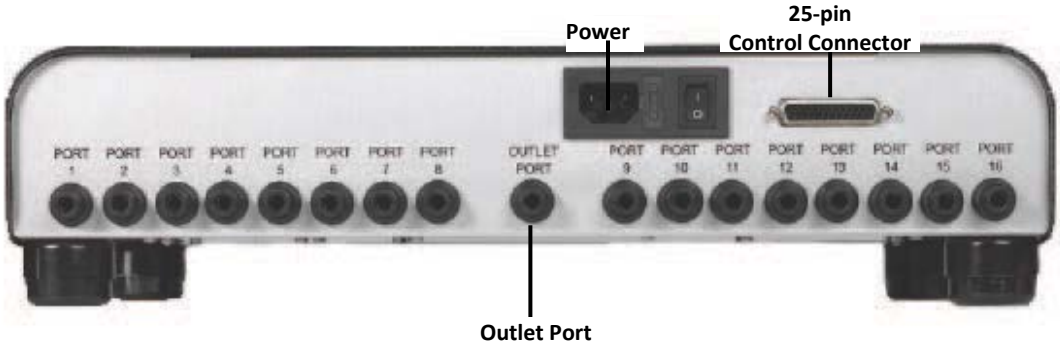
Appendix G: Multiport Inlet Unit

The Multiport Inlet Unit (MIU) is designed to allow the analyzer to switch automatically between various inlets giving you the opportunity to sample different unknowns in different locations as well as sampling different references. The unit contains a manifold of digitally controlled valves which are programmed to allow any one of the 16 input ports to be directed to the analyzer inlet port.

Figure 75: MIU Front Panel

The MIU supports up to 16 inlet ports labeled numerically. The outlet port connects to the gas inlet. The included 25-pin control cable connects the analyzer to the MIU. And additional power cable is included to power the MIU.

Figure 76: MIU Back Panel (ports, power and control connections)



Gas connections are made using ¼” Teflon tubing. Care should be taken to ensure that the tubing is inserted and pushed in entirely to avoid leaks in the seal. Pushing in the outer ring around the connector allows the tube to be released and then pulled free from the port.

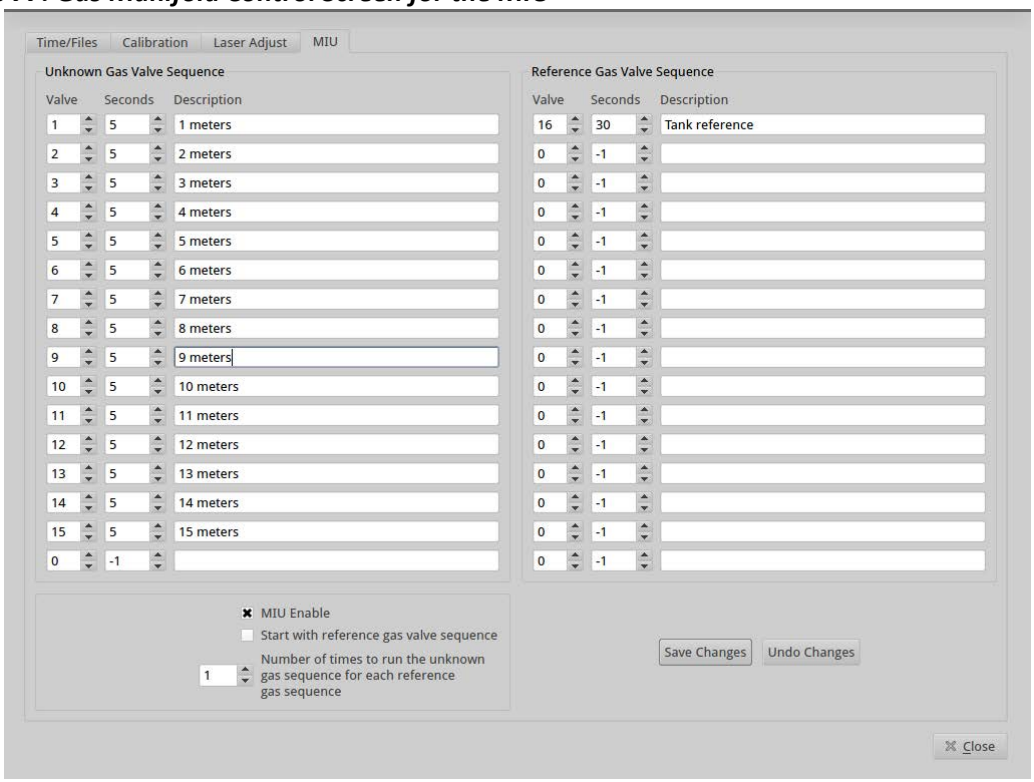
The Outlet port connects to the inlet port of the analyzer.

The user can configure which ports are sampled and for how long by opening the **Manifold Control Screen** by clicking on the **Setup** button on the User Interface Control Panel then clicking on the **Manifold** icon.

Controlling the MIU Using the Gas Manifold Control Screen

Figure 77 shows the Gas Manifold Control Screen for the MIU. The user can configure which inlet ports are being used and for how long the analyzer should sample each one (in seconds). The ports are identified by a valve number ranging from 1 to 16 (if a valve is set to 0, the entry is ignored). The user can also input a short text description which is associated with the valve, saved in the data file, and displayed on the parameter window during the analyzer run. The control allows two groupings of inlets: 'unknown' and 'reference'. All defined inlets are sampled sequentially in their respective group. The user decides how many cycles of the unknown group to sample before running a reference group. The user can also indicate whether to start with the reference group first.

Figure 77: Gas Manifold Control Screen for the MIU



The **Enable/Disable** toggle button allows you to specify whether the unit is being used. If it is enabled, the valve numbers and text descriptions are added to the data file to allow the user to identify which sections of the data run are associated with a particular valve (see Figure 78).

Figure 78: Selected columns from the data file showing the appended columns indicating active valve number and user description

2009 Nov 25 17:19:45

Time,	[12CO2]_ppm,	Fit_Flag,	N_Fits_Avg'd,	MIU
0000:00:01.358,	7.25378e+02,	3,	1,	1
0000:00:02.337,	7.42088e+02,	3,	1,	1
0000:00:03.327,	7.42150e+02,	3,	1,	1
0000:00:04.299,	7.42400e+02,	3,	1,	1
0000:00:05.292,	7.41892e+02,	3,	1,	1
0000:00:06.272,	7.42280e+02,	3,	1,	1
0000:00:07.252,	7.42361e+02,	3,	1,	1
0000:00:08.231,	7.41487e+02,	3,	1,	1
0000:00:09.212,	7.41683e+02,	3,	1,	1
0000:00:10.192,	7.42018e+02,	3,	1,	1
0000:00:11.171,	7.41707e+02,	3,	1,	1
0000:00:12.151,	7.41999e+02,	3,	1,	1
0000:00:13.130,	7.41936e+02,	3,	1,	1
0000:00:14.112,	7.42689e+02,	3,	1,	1
0000:00:15.090,	7.43418e+02,	3,	1,	1
0000:00:16.072,	7.43241e+02,	3,	1,	1
0000:00:17.055,	7.42719e+02,	3,	1,	1
0000:00:18.039,	7.42901e+02,	3,	1,	1
0000:00:19.025,	7.43302e+02,	3,	1,	1
0000:00:20.021,	7.42887e+02,	3,	1,	1
0000:00:21.020,	7.43548e+02,	3,	1,	1
0000:00:22.023,	7.42640e+02,	3,	1,	1
0000:00:23.019,	7.43071e+02,	3,	1,	1
0000:00:24.028,	7.42171e+02,	3,	1,	1
0000:00:25.040,	7.42686e+02,	3,	1,	1
0000:00:26.043,	7.42595e+02,	3,	1,	1
0000:00:27.060,	7.42798e+02,	3,	1,	1
0000:00:28.052,	7.42371e+02,	3,	1,	1

While the MIU is operating, the current valve being sampled is shown on the analyzer parameter window as shown in Figure 79.

Figure 79: Parameter window showing the MIU is enabled. The currently sampled valve number (1) is shown.

The MIU allows the user to sample multiple sources, including references, allowing for a more automated deployment. By sampling suitable references periodically during an ongoing data run, the user can post-correct the data for long-term drift when active calibration cannot be done.

NOTE: The control of the MIU is unidirectional. The analyzer does not receive feedback on the MIU state. If the MIU is enabled in the Setup panel, the data file will be tagged with MIU valve descriptions whether or not the MIU is properly connected, powered, etc; the data file simply logs the condition of the control signal to the MIU.

NOTE: The valves in the MIU are normally closed with power off. However, upon analyzer start-up, all the valves will receive an 'open' signal until the analyzer software has properly booted and initiated the data collection. If pressurized tanks are connected to the analyzer (such as reference tanks), there will be a short period of time (~one to two minutes) where the tanks will be exposed to other inlet ports during this start-up time.

Appendix H: Warranty

Warranty Details

Each Los Gatos Research Inc. (LGR) analyzer is warranted by LGR to be free from defects in material and workmanship; however, LGR's sole obligation under this warranty shall be to repair or replace any part of the analyzer which LGR's examination discloses to have been defective in material or workmanship without charge and only under the following conditions, which are:

1. The defects are called to the attention of 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 was not approved by 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 it is a distributor or direct customer of LGR or a distributor's customer, packs and ships or delivers the analyzer to LGR (at LGR's main office in Mountain View, CA) within 30 days after LGR has received written notice of the defect. Unless other arrangements have been made in writing, transportation to LGR is at customer expense.

5. No-charge repair parts may be sent at LGR's sole discretion to the purchaser for installation by purchaser.

6. LGR's liability is limited to repair or replace any part of the analyzer without charge if LGR's examination discloses that part to have been defective in material or workmanship.

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 date the analyzer shipped to a user who is a customer or eighteen months from the date of shipment to an LGR-authorized distributor, whichever is earlier.

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

LGR provides direct assistance in the use and application of all of its analyzers through email, telephone, and if necessary, in person. Training and installation services are available anywhere in the world.

Please contact us 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 one of our sales representatives at sales@lgrinc.com 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 (if applicable)
- 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, LGR will pay the shipping charges on the return of the merchandise to the customer.

Contact Information

For questions regarding the operation of this analyzer, please contact:

Los Gatos Research
67 East Evelyn Avenue, Suite 3
Mountain View, CA 94041

Phone: 650-965-7772

Fax: 650-965-7074

Sales: sales@lgrinc.com

Technical Support: support@lgrinc.com

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