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WARNING!

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

WARNING!

Service to the analyzer must be performed only by certified service personnel trained on servicing this analyzer. User adjustments inside the analyzer are not necessary or recommended by the manufacturer.

WARNING!

Only authorized persons may open the analyzer cover or perform internal maintenance. Contact ABB 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.

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 if you find any error in this document, so we can make appropriate corrections.
Cybersecurity

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

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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:

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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.
Be prepared to provide the serial number or sales order number of the analyzer.
1 Introduction

This manual contains basic information on using the *LGR-ICOS™* GLA131 Series Microportable Analyzers, and analyzer operational and safety information.

This manual describes the analyzer menu and data screens. It also provides instructions to calibrate the analyzer to its traceable certified bottle gases, adjust data sampling rates, and data transfer through WiFi on the device that has established and secured a link with the analyzer.

Even though this user manual provides additional information on the hardware components and their particular functions, it is recommended to have qualified ABB service personnel resolve any issues with the analyzer.
2  Safety

The following pages provide important safety precautions.

Class of Laser Equipment

The analyzer is a Class 1 laser analyzer 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: Analyzer Safety Certifications

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Standards Tested &amp; Met</th>
</tr>
</thead>
<tbody>
<tr>
<td>![CE]</td>
<td>2004/108/EU (EMC), EN61326-1</td>
</tr>
<tr>
<td>![FDA]</td>
<td>Title 21 Code of Federal Regulations, chapter 1, sub-chapter J</td>
</tr>
</tbody>
</table>

WEEE Directive

The analyzer is not subject to WEEE Directive 2002/96/EC (Waste Electrical and Electronic Equipment) or relevant national laws (for example, 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. Proper disposal prevents negative effects on people and the environment, and supports the reuse of valuable raw materials.

Labels

The following labels are at specific locations on or in the analyzer to identify hazardous areas.
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 \( \leq 6.8 \) V DC.

Laser Hazards

NOTE

This analyzer is a Class 1 laser product.
There are one or two lasers (depending on your configuration) used in the analyzer. During normal operation, with the analyzer case cover closed and the lock installed, the analyzer spectroscopy instrument is a Class 1 Laser Product in accordance with Title 21 Code of Federal Regulations, chapter 1, sub chapter J.

The laser(s) in the analyzer are rated Class 3B, > 5 mW. The laser is enclosed and not accessible, unless the lock is removed, and the case cover is opened for servicing. Laser warning labels are on the enclosure covering the laser.

Figure 2: Laser Radiation Labels and Magnetic Interlock Switch

The analyzer laser is not field serviceable. Should a laser fail in the field, the analyzer must be shipped back to ABB for service repair.

The analyzer laser is equipped with a magnetic interlock switch. Whenever the case cover is open, the magnetic switch breaks contact from the magnetically encoded counterpart, and power is interrupted from the Laser Controller PCB in the analyzer, thus, disabling the laser.
Safety Provisions

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.

Lithium-Ion Battery Hazard

---

CAUTION!

For analyzer functionality and user safety, only use batteries provided by ABB.

---

Rechargeable lithium-ion batteries are potentially hazardous and may present a serious fire hazard if damaged, defective, or improperly used. A fire may potentially occur in the following circumstances:

- The battery has been fully discharged and is not recharged shortly afterwards.
- Charging is attempted at temperatures below 0 °C (32 °F).
- The battery is exposed to liquids, especially salt water.
- Operating or charging a battery damaged from dropping or from shipping damage.
- Using a charger other than specifically designated for the particular battery.

Charging recommendation:

- Perform charging in a fire-safe area away from children or pets.
- Perform charging at a temperature between 0 °C to 45 °C (32 °F to 113 °F).
- Do not attempt to charge a battery that is bulging. Use only supplied charging cables and connections.
- A battery in good condition should only get slightly warm during charging. Any other conditions immediately terminate charging.

Disposal: Dispose the battery at a recycling center that processes lithium-ion batteries.
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 to emphasize the names of screens or text fields.
- **Bold** text is used to show text that you type in fields and button choices that you enter.

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

*Table 2: Warning Icon Descriptions*

<table>
<thead>
<tr>
<th>Icon</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image" alt="Note or Important Icon" /></td>
<td>Emphasizes facts and conditions important to analyzer operation.</td>
</tr>
<tr>
<td><img src="image" alt="Warning or Caution Icon" /></td>
<td><strong>WARNING</strong>: Failure to comply may result in serious injury. <strong>CAUTION</strong>: Follow instructions carefully to avoid equipment damage or personal injury.</td>
</tr>
<tr>
<td><img src="image" alt="Warning Icon" /></td>
<td><strong>Electrical Warning Icon</strong>: warns of potential electrical shock hazard.</td>
</tr>
<tr>
<td><img src="image" alt="Warning Icon" /></td>
<td><strong>Laser Warning Icon</strong>: warns of potential laser hazard.</td>
</tr>
</tbody>
</table>
3 Product Specification

Table 3 lists analyzer product specifications. Figure 3 illustrates the overall dimensions of the analyzer. Figure 4 illustrates attached external components.

*Table 3: Product Specification*

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical Dimensions</td>
<td>Length: 34.7 cm (13.37 in) x Width: 29.5 cm (11.6 in) x Height: 14.8 cm (5.8 in) (see Figure 3)</td>
</tr>
<tr>
<td>Physical Weight</td>
<td>6.1 kg (13.5 lb) with internal battery</td>
</tr>
<tr>
<td>Power Source</td>
<td>Internal battery (see Figure 5)</td>
</tr>
<tr>
<td></td>
<td>External power supply (battery charging)</td>
</tr>
<tr>
<td>Power Input</td>
<td>10-30 V DC or 110/240 V AC</td>
</tr>
<tr>
<td></td>
<td>35 watts: GLA131-GGA</td>
</tr>
<tr>
<td></td>
<td>27 watts: GLA131-GPC, GLA131-MEA, GLA131-CH4</td>
</tr>
<tr>
<td></td>
<td>120 W power supply/charger included</td>
</tr>
<tr>
<td></td>
<td>99.9 watt-hour internal battery included, &gt; 3 hours autonomy</td>
</tr>
<tr>
<td>Operating Current</td>
<td>9 A (max.)</td>
</tr>
</tbody>
</table>
Figure 3: Analyzer Dimensions

Figure 4: Analyzer Case Component Identification
Figure 5: Analyzer Replaceable Lithium-Ion Polymer Battery
Environmental Requirements

Table 4 defines the environment requirements of the analyzer during operational and non-operational conditions. Operation outside of these requirements may cause damage to the analyzer.

Table 4: Environment Requirements

<table>
<thead>
<tr>
<th>Requirements</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operational Ambient Temperature</td>
<td>5 °C to 45 °C (41 °F to 113 °F)</td>
</tr>
<tr>
<td>Non-Operational Temperature¹</td>
<td>4 °C to 50 °C (40 °F to 122 °F)</td>
</tr>
<tr>
<td>Relative Humidity</td>
<td>Below the dew point for the area, avoiding condensation on surfaces</td>
</tr>
</tbody>
</table>

WARNING!

To prevent damage to the analyzer, do not expose the analyzer to, or use the analyzer in, rain or snow.

CAUTION!

ABB does not endorse operation of any analyzer (including MicroGuard™) not certified for operation in hazardous locations continuously in air that contains methane levels higher than the lower flammability limit (LFL), where LFL for methane in air is 4.4% or 44,000 ppm.

¹ For maximum lithium-ion battery life and safety, the recommended storage temperature is between 4 °C to 25 °C (40 °F to 77 °F).
4 Features and Measurement Theory

The analyzer is a cavity-based spectroscopy instrument. The analyzer’s cavity design enhances the absorption of laser light by the target gas molecule. This enhancement improves the signal-to-noise ratio over conventional laser sensors enabling trace gas measurement and sensitive monitoring. The type of gas the analyzer can measure is based upon the laser wavelength used. There are various models, each targeting gases that various industries monitor. All measurements are real-time.

Main Features

The analyzer’s main features are:

- Measurement and processing time up to 10 Hz
- Reduced data cross-interference
- Sensitivity up to ppb

Connection Ports

This section describes the connections shown in Figure 6. These connections vary from analyzer to analyzer depending on the ordered configuration.

Figure 6: Connection Ports
Gas Inlet and Outlet
Gas to be measured is connected to the ¼ inch push-connect IN port.
The acceptable inlet gas-pressure range is 0 to 15 psig.
The ¼ inch push-connect OUT port may:

• Remain open, expelling non-hazardous gas into the air,
• Be routed to a different location or system, or
• Be recirculated through an enclosed gas-flux chamber.

Power
The analyzer is operational for up to 3 hours when using the internal battery only.
The battery may be recharged using the AC/DC power supply to the DC power inlet. This power supply contains a 10 A 32 V DC automotive fuse inside the external power-input harness.
There is also an optional battery charger (ACC-MICRO-BC) when extra batteries need to be charged outside the analyzer.

---

WARNING!
Do not use a battery other than the battery provided by ABB.

---

Data Interface

• USB ports – Used to transfer data to a USB memory device or connect a USB keyboard and mouse.
• 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.
• MIU port (9 pin D-sub) – For connecting to a Multiport Inlet Unit (optional). Provided with cable for connection to an MIU data port.
• Ethernet port – Connects the analyzer to a local area network (LAN) and allows access to the data directory using an external computer.
• Modbus TCP - For reading analyzer process variables and health status via a Modbus master using the Modbus TCP version of the protocol.
Plumbing Diagram

The internal flow of gas through the analyzer is shown in Figure 7.

![Plumbing Diagram](image)

Figure 7: Plumbing Diagram

The gas enters the sample inlet (IN) and is initially filtered through a 5 µm screen filter. It then enters the optional pressure controller, which regulates the pressure to maintain a specific set point. Before the gas travels through the optical cell to the pump, it passes through an additional filter that is greater than 95% efficient at removing particles that are 0.01 µm diameter or larger. Finally, the gas passes through a second 5 µm screen filter before the pump as it exits through the waste (OUT) port.

Services and Ports

Table 5 lists the ports, services, and software which supports the ICOS software.
### Table 5: Ports and Services

<table>
<thead>
<tr>
<th>Port</th>
<th>Service</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>22/tcp</td>
<td>Secure Shell (SSH)</td>
<td>Remote shell login</td>
</tr>
<tr>
<td>445/tcp</td>
<td>SMB Version 2 or higher</td>
<td>File sharing</td>
</tr>
<tr>
<td>2222/tcp</td>
<td>Modbus/TCP</td>
<td>Data streaming (option)</td>
</tr>
<tr>
<td>5900/tcp</td>
<td>TCP/VNC</td>
<td>Remote login</td>
</tr>
<tr>
<td>20002/tcp</td>
<td>WebSocket</td>
<td>WebSocket (option) (full-duplex over single TCP)</td>
</tr>
</tbody>
</table>
5 User Interface Operation

WARNING!
To maximize cybersecurity, users are advised to change all passwords from their default value.

Malware Protection
The analyzer’s operating system runs Xubuntu 18.04LTS. ABB runs an anti-virus scanner on each disk image at the factory to ensure no malware is inadvertently included.

Set Up Communication
To establish communication and operate the analyzer, the following options are available:

- SSH: For remote shell login. Use your preferred SSH client (for example, Putty) and log in using the IP address and SSH password.
- Samba: For sharing the data directory on the network. Using the explorer, navigate to: \\<IP-ADDRESS>\grdata, then log in with the Samba password.
- VNC Viewer: For remote login. Data transfer via VNC is not encrypted, however, authentication credentials are. By default, VNC is not activated on the analyzer. To enable VNC, navigate to Setup > Security. Refer to VNC Viewer User Interface for setup instructions.
WiFi Setup

1. Power on the analyzer by pressing the Power button on the case right side.
2. On the tablet, cell phone, or laptop, go to the WiFi symbol to access all available networks your device can see.
3. From the available network list, select the network (SSID) marked on the analyzer label. It should read: GL-MT300N-V2-XXX, where XXX is the variable. Once selected, enter the corresponding password (key) from the same label on the analyzer for access. (See Figure 8.)

![Figure 8: Access WiFi](image)

4. Log in:
   a. Open a Web browser (Chrome/Firefox is recommended).
   c. Enter the default password, **123456789**.
5. Change the Web-interface admin password for the router:
   a. On the left side of the screen, navigate to **MORE SETTINGS > Admin Password**. (See Figure 9).
b. Input your default password, 123456789, in the **Old Password** field.

c. Input your new password in the **New Password** field. The new password must be at least five characters long.

d. Click **Apply**.

6. Change the Wireless Key (WiFi password):
   a. On the left side of the screen, click **WIRELESS** (see Figure 10).

b. Input the new WiFi password in the **WiFi Key** field. The new password must be at least six characters long.

c. Click **Modify**.

d. Click **Apply** to save the changes (see Figure 11).
VNC Viewer User Interface

The VNC Viewer® application must be installed on a tablet, cell phone, or laptop PC, to allow a wireless remote-control connection between the analyzer and the interface.

The analyzer uses VNC Viewer® by RealVNC Limited for communication between the user and the analyzer. VNC Viewer, shown in Figure 12, can be downloaded from Play Store for Android devices, App Store Apple OS devices, or directly from the RealVNC Internet site for PC or Mac installation.

Once VNC Viewer is downloaded and installed on the tablet, cell phone, or laptop, power on the analyzer, then select the VNC icon shown in Figure 13.
The following procedure is for an Android device with a newly installed VNC application to establish communication with the analyzer using VNC.

1. Tap or click on the VNC application to execute it: The screen shown in Figure 14 appears.

2. Tap or click **GOT IT**.

3. When VNC cannot determine the source server from its database, it displays a *No connections* message, as shown in Figure 15: Tap or click the + symbol.
4. The *New connection* screen appears. Enter the *Address* parameter of the *New connection: Wireless IP* on the analyzer label, as shown in Figure 16.

5. Enter the name of the device to be connected under *Name*. The *Name* parameter shown in Figure 16 is only an example.
6. Tap or click **CREATE** to create the VNC communication network.
7. Enter the password for the VNC Viewer to the analyzer: `lgrvnc` (see Figure 17).

---

**NOTE**

This is the default password for VNC and can be changed by the user.
8. Select **CONNECT**: The VNC application displays an informational message indicating the VNC attempt at connection (see Figure 18).

![Figure 18: VNC Attempting Connection Screen](image-url)
Log In

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

1. Click the Security button on the Control Bar (see Figure 19).

   ![Click to log in]

   Figure 19: Control Bar Security Button

2. For initial login, use the default Linux credentials for the username and password (see Figure 20), as follows:

   User: lgr
   Password: 3456789

   ![WARNING!]

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

   ![NOTE]

   There is only one Linux account.

3. Click Login.

Security Button

Once logged in, the Security button also lets you do the following:

- Change a user password
- Add a new user
- Log out of the system
Change User Password

Upon commissioning of the analyzer, all passwords should be changed. Table 6 lists the default passwords.

**Table 6: Default Passwords**

<table>
<thead>
<tr>
<th>Password</th>
<th>Password</th>
</tr>
</thead>
<tbody>
<tr>
<td>lgr</td>
<td>3456789</td>
</tr>
<tr>
<td>ssh</td>
<td>3456789</td>
</tr>
<tr>
<td>samba</td>
<td>lgrsmb</td>
</tr>
<tr>
<td>vnc</td>
<td>lgrvnc</td>
</tr>
<tr>
<td>Wireless Key</td>
<td>goodlife</td>
</tr>
<tr>
<td>Wireless Router</td>
<td></td>
</tr>
<tr>
<td>Admin Password</td>
<td>123456789</td>
</tr>
</tbody>
</table>

To change a user password, perform the following:

1. Click the **Security** button: The dialog box shown in Figure 21 appears.

   ![Security Dialog Box After Login](image)

   *Figure 21: Security Dialog Box After Login*

2. Click **Change Password**: The *Change Password* dialog-box appears.
3. Enter the new password in the **New Password** field.
4. Re-enter the new password in the **Confirm New Password** field.
5. Click **Change Password**.

---

**WARNING!**

If you forget the new password, it is not recoverable.

---

**WARNING!**

The `lgr` password is the same for SSH. If you change the `lgr` password, the SSH password also changes.

---

**Add New User**

---

**NOTE**

Only users belonging to the Admin and Service groups can add new users.

---

To add a new user, perform the following:

1. Click the **Security** button: The dialog box shown in Figure 21 appears.
2. Click **Add User**: The *Add User* dialog box shown in Figure 23 appears.
3. Enter a username in the **User Name** field.
4. Enter a password in the **Password** field.
5. Re-enter the new password in the **Confirm Password** field.
6. Select a group from the **Group Name** drop-down menu: Admin, Service, or User.
7. Click **Add New User**.

If you try to add a user and are in the User group (instead of the Admin or Service group), the following dialog box appears, and you must cancel the action.

![Permission Denied](Figure24.png)

**Figure 24: Permission Denied**

**Log Out**

To log out of the system, click the **Security** button, then click **Log Out**.

**Control Bar**

The Control Bar (see Figure 25) lets you select the type of information to display: **Display, Rate, Files, Setup**. In addition, **Exit** to shut down the analyzer.

![Control Bar](Figure25.png)

**Figure 25: Control Bar**
Select an option by tapping the required button on the touchscreen tablet/phone. Adjust the screen size and zooming using the pinch-and-expand motion of your fingers on the tablet screen as you would on a regular tablet for zooming.

**Display**

In the Control Bar, the **Display** button (see Figure 25) lets you select the desired screen:

- **Numeric** (Figure 26)
- **Spectrum** (Figure 27)
- **Timechart** (Figure 29)
- **Alarm Status** (Figure 31)

**Numeric Display**

The **Numeric** display is the default display and one of the simplest screens for go/no-go decisions based strictly on gas concentration measurements. Sample gas is measured in parts per million (ppm). The resolution unit auto-adjusts. Figure 26 shows an example of a GLA131-GGA numeric readout of the last measurements of CH₄, H₂O, CO₂, CH₄ (Dry), and CO₂ (Dry) in parts per million (ppm). The displayed numeric readout may vary, depending on the analyzer type. In addition, the analyzer color-coded operational status is indicated (for details on color coding, refer to **Alarm Status Display**).

![Figure 26: Numeric Display Screen](image)

\[
\begin{align*}
[\text{CH}_4] &= 2.1072 \text{ PPM} \\
[\text{H}_2\text{O}] &= 15356.09 \text{ PPM} \\
[\text{CO}_2] &= 489.62 \text{ PPM} \\
[\text{CH}_4]\text{dry} &= 2.1401 \text{ PPM} \\
[\text{CO}_2]\text{dry} &= 497.25 \text{ PPM}
\end{align*}
\]

**Spectrum Display**

The sample **Spectrum** display provides additional information on the measured gas: the analyzer sensitivity level shown in the Transmitted Intensity diagram, absorption level, theoretical fit of the targeted gas, and ringdown time indicating the need to clean the high-reflectivity mirrors.
The analyzer may optionally be a dual-laser system. For example, the GLA131-GGA has a **drop-down selector** in the lower right portion of the *Spectrum display* which lets you toggle between the two lasers:

- Laser 1 (also referred to as laser A) displays CH\(_4\) and H\(_2\)O peaks. (Figure 27)
- Laser 2 (also referred to as laser B) displays the CO\(_2\) peak. (Figure 28)

The measured concentrations are shown in parts per million (ppm) on the bottom of the *Spectrum* display.

![Figure 27: Spectrum Display Screen for Laser 1](image1)

![Figure 28: Spectrum Display Screen for Laser 2](image2)
The transmitted intensity also provides important information about the analyzer measurement module light source. A drop in intensity may indicate an issue with the laser, detector, ICOS module mirrors, or supporting electronics board. This information is helpful when contacting ABB service about the issue.

**Timechart Display**

The *Timechart* display (see Figure 29) provides the absorption (in ppm or ppb) of the sample gas measured. The black line represents the trace of measured concentrations at a customizable interval rate.

*Figure 29: Timechart Display*

**Refresh** in the *Timechart* display (see Figure 30) refreshes the screen to display the sampling data with a new starting point.
Alarm Status Display

The Alarm Status display, shown in Figure 31 and Figure 32, indicates the real-time analyzer operational status. The status uses traffic-light color indication. **Green** indicates no problem. **Yellow** indicates the analyzer is out-of-spec or maintenance is soon required. **Red** indicates there is a problem, and maintenance is immediately required. Error messages for each alarm can be displayed by selecting the relevant alarm button: After the button is selected, a pop-up window appears displaying the messages.
Figure 31: Alarm Status Display – GLA131-GPC
Figure 32: Alarm Status Display – GLA131-GGA

Table 7 describes the analyzer alarm status.
### Table 7: Analyzer Alarm Status

<table>
<thead>
<tr>
<th>Warning / Alarm</th>
<th>UI Display</th>
<th>Detected Problem</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alarm</td>
<td>Data Health</td>
<td>Laser A and/or B goodness of fit is poor</td>
</tr>
<tr>
<td>Alarm</td>
<td>Pressure</td>
<td>Pressure is not in operating range</td>
</tr>
<tr>
<td>Alarm</td>
<td>HD Space</td>
<td>Disk space is low, deleting oldest files</td>
</tr>
<tr>
<td>Alarm</td>
<td>Mirror Health</td>
<td>Mirror health has degraded; clean mirrors</td>
</tr>
<tr>
<td>Alarm</td>
<td>Linelock</td>
<td>Laser A and/or B peak position is outside of control range, contact customer support</td>
</tr>
<tr>
<td>Alarm</td>
<td>Signal Power</td>
<td>Laser A and/or B power has degraded, contact customer support</td>
</tr>
<tr>
<td>Alarm</td>
<td>Maintenance</td>
<td>Maintenance is needed on system now</td>
</tr>
<tr>
<td>Warning</td>
<td>Data Health</td>
<td>Laser A and/or B goodness of fit is poor</td>
</tr>
<tr>
<td>Warning</td>
<td>Pressure</td>
<td>Pressure is noisy</td>
</tr>
<tr>
<td>Warning</td>
<td>HD Space</td>
<td>Disk space is low</td>
</tr>
<tr>
<td>Warning</td>
<td>Mirror Health</td>
<td>Mirror health is degrading; clean mirrors soon</td>
</tr>
<tr>
<td>Warning</td>
<td>Linelock</td>
<td>Laser A and/or B peak position is outside of control range, contact customer support</td>
</tr>
<tr>
<td>Warning</td>
<td>Signal Power</td>
<td>Laser A and/or B power has degraded, contact customer support</td>
</tr>
<tr>
<td>Warning</td>
<td>Maintenance</td>
<td>Maintenance is needed on system soon</td>
</tr>
<tr>
<td>No issue</td>
<td></td>
<td>No warning/alarm</td>
</tr>
</tbody>
</table>
Rate Button

The Rate button on the Control Bar changes the rate at which data are written to the log file. Figure 33 displays the Rate Control Adjustment pop-up box which appears when the Rate button is clicked.

![Figure 33: Rate Control Screen](image)

The Operating Mode radio buttons select the rate at which data are acquired. It is recommended to set the data acquisition rate between 1 Hz and 10 Hz. All data sampled are written into the data file and plotted on the time chart. Longer averaging periods (or equivalently, slower data acquisition rates) yield better measurement precision than shorter averaging periods.

Use the Plot every Nth fit radio button to automatically set the rate at which the data are updated on the Main panel display. For example, if you set the value to 5, a data point will be saved every 5 seconds.
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: mgga_2022-12-29_f0001.txt, where the:
  - First set of characters represent the analyzer model (mgga).
  - Next set of characters represent the date (yyyy-mm-dd).
  - Last set of characters 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 is automatically 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:

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

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

Figure 34 shows a typical data file.

```
<table>
<thead>
<tr>
<th>Time,</th>
<th>[CH4]_ppm,</th>
<th>[CH4]_ppm_sd,</th>
<th>[H2O]_ppm,</th>
<th>[H2O]_ppm_sd,</th>
<th>[CO2]_ppm,</th>
</tr>
</thead>
<tbody>
<tr>
<td>11/16/2017 14:32:17.025</td>
<td>1.8940e+00</td>
<td>6.000000e+00</td>
<td>3.925744e+00</td>
<td>0.000000e+00</td>
<td>3.000000e+00</td>
</tr>
<tr>
<td>11/16/2017 14:32:22.026</td>
<td>1.8623e+00</td>
<td>6.000000e+00</td>
<td>3.750830e+00</td>
<td>0.000000e+00</td>
<td>3.495215e+00</td>
</tr>
<tr>
<td>11/16/2017 14:32:10.024</td>
<td>1.997474e+00</td>
<td>6.000000e+00</td>
<td>2.705034e+00</td>
<td>0.000000e+00</td>
<td>3.915712e+00</td>
</tr>
<tr>
<td>11/16/2017 14:32:19.189</td>
<td>1.898177e+00</td>
<td>6.000000e+00</td>
<td>4.005718e+00</td>
<td>0.000000e+00</td>
<td>3.908394e+00</td>
</tr>
<tr>
<td>11/16/2017 14:32:20.186</td>
<td>1.895076e+00</td>
<td>6.000000e+00</td>
<td>4.120824e+00</td>
<td>0.000000e+00</td>
<td>3.918602e+00</td>
</tr>
<tr>
<td>11/16/2017 14:32:21.135</td>
<td>1.894080e+00</td>
<td>6.000000e+00</td>
<td>4.269316e+00</td>
<td>0.000000e+00</td>
<td>3.905021e+00</td>
</tr>
<tr>
<td>11/16/2017 14:32:22.111</td>
<td>1.997651e+00</td>
<td>6.000000e+00</td>
<td>3.992456e+00</td>
<td>0.000000e+00</td>
<td>3.913911e+00</td>
</tr>
<tr>
<td>11/16/2017 14:32:23.085</td>
<td>1.896896e+00</td>
<td>6.000000e+00</td>
<td>3.853035e+00</td>
<td>0.000000e+00</td>
<td>3.911902e+00</td>
</tr>
<tr>
<td>11/16/2017 14:32:24.086</td>
<td>1.899493e+00</td>
<td>6.000000e+00</td>
<td>3.902836e+00</td>
<td>0.000000e+00</td>
<td>3.910128e+00</td>
</tr>
<tr>
<td>11/16/2017 14:32:25.041</td>
<td>1.894080e+00</td>
<td>6.000000e+00</td>
<td>3.128625e+00</td>
<td>0.000000e+00</td>
<td>3.918638e+00</td>
</tr>
<tr>
<td>11/16/2017 14:32:26.018</td>
<td>1.998146e+00</td>
<td>6.000000e+00</td>
<td>3.426563e+00</td>
<td>0.000000e+00</td>
<td>3.915020e+00</td>
</tr>
<tr>
<td>11/16/2017 14:32:26.996</td>
<td>1.996125e+00</td>
<td>6.000000e+00</td>
<td>4.100226e+00</td>
<td>0.000000e+00</td>
<td>3.912913e+00</td>
</tr>
<tr>
<td>11/16/2017 14:32:27.971</td>
<td>1.895566e+00</td>
<td>6.000000e+00</td>
<td>2.666021e+00</td>
<td>0.000000e+00</td>
<td>3.909358e+00</td>
</tr>
<tr>
<td>11/16/2017 14:32:28.983</td>
<td>1.896708e+00</td>
<td>6.000000e+00</td>
<td>3.195251e+00</td>
<td>0.000000e+00</td>
<td>3.905767e+00</td>
</tr>
</tbody>
</table>
```

Figure 34: Beginning of a Typical Data File for a GLA131-GGA

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, because no averaging of data has occurred.
- 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 solid-state drive (SSD) to a USB storage device:

1. Click the Files button on the Control Bar (Figure 25) to access the File Transfer menu. (Figure 35)
2. Insert a USB storage device into the USB port on the side panel of the analyzer.
3. Click the Mount USB button. (Figure 35)

4. Transfer data files from the analyzer SSD 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.
USB drives should be no larger than 8 GB. They must be FAT32.

When you have finished transferring files:

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

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

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

**Directory Types in Local Hard Drive**

The analyzer SSD contains two types of directories:

- Daily
- Archive

**Daily Directory**

The local hard drive (Figure 35) 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 36)

Each file is a single zipped .txt file, using the following convention:

`mgga_YYYY-MM-DD_f0000.txt.zip`

Examples of files in the daily directory are shown in Figure 36.
Figure 36: Daily Directory

Archive Directory

The local hard drive (Figure 35) creates an archived folder containing zipped files organized by date. (Figure 37)

To access the archived files, double-click the Archive folder. (Figure 35)

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 37.
The File Transfer Error screen (Figure 38) displays when:

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

Try again with a correctly inserted USB device.
Setup Button

Click Setup on the Control Bar to access the Setup screen, which provides additional configuration and service menus: The Time/Files tab is displayed by default (see Figure 39).

![Setup Menu Tabs]

**Figure 39: Setup Screen**

Setup screen menu tabs are:

- **Time/Files**: Set time and file format.
- **Calibration**: Single-point calibration using a known reference standard.
- **Laser Adjust**: Manually fine-tune laser wavelength for goodness of fit (GOF) if necessary.
- **MIU**: Configure the optional Multi-Port Inlet Unit.
- **Service**: Technicians can check on the analyzer status.
- **Serial Logger**: Change how data reported at the RS-232 port are configured. Refer to the Serial Logger section.
- **Modbus Logger**: View the Modbus data stream and analyzer alarm status, and change certain Modbus settings from the default configuration. Refer to the Modbus TCP section.
• **Security**: Change security settings including changing passwords; adding, deleting, and assigning users; and returning the system to default settings. Refer to the Security section.

**Time/Files**

Click the **Time/Files** tab to access the **Time/Files** menu. This screen lets you adjust the time zone, manually set the clock, and adjust the format of data files. Contents may vary, depending on analyzer types.

![Time/Files Menu](image-link)

**Figure 40: 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 listed in Table 8.

New file creation intervals (when running continuously) can be set by adjusting the value in the **Output Interval [minutes]** spinner control box.
### Table 8: Timestamp Formats

<table>
<thead>
<tr>
<th>Timestamp Name</th>
<th>Format</th>
</tr>
</thead>
<tbody>
<tr>
<td>Absolute Local American</td>
<td>mm/dd/yyyy, hh:mm:ss.sss</td>
</tr>
<tr>
<td>Absolute Local European</td>
<td>dd/mm/yyyy, hh:mm:ss.sss</td>
</tr>
<tr>
<td>Absolute GMT American</td>
<td>mm/dd/yyyy, hh:mm:ss.sss</td>
</tr>
<tr>
<td>Absolute GMT European</td>
<td>dd/mm/yyyy, hh:mm:ss.sss</td>
</tr>
<tr>
<td>Relative Seconds After Power On</td>
<td>ssdddd.dd</td>
</tr>
<tr>
<td>Relative Seconds in Hours, Minutes, Seconds</td>
<td>hh:mm:ss.sss</td>
</tr>
</tbody>
</table>

### About

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

- Current software build date
- Code version
- IP address
- Analyzer serial number

### Calibration

---

**WARNING!**

It is not recommended for inexperienced users to perform a calibration without first contacting technical support.

---

Click the *Calibration* tab to access the *Calibration* screen. This screen provides the tools to calibrate the analyzer without shipping it back to the factory. Before performing a calibration on the analyzer, have the following information available:

- Traceable regulated gas type
- Traceable regulated gas type concentration
To perform a gas calibration, connect the traceable, regulated bottle gas to the analyzer gas-inlet line (see Figure 41 for parameters referred to in the procedure):

1. Click **Setup**, then the **Calibration** tab.
2. Check the **Calibrate** box in the *Reference Gas Settings* pane.
3. Enter the gas concentration for the gas type using the arrow keys in the traceable certified bottle gas menu (below the **Calibrate** box).
4. Click **Start** to start the calibration.
5. Repeat Step 2 through 4 for all gases measured by the analyzer.
6. After the calibration is complete, click **OK**. The analyzer then resumes its normal measurement mode.
7. Click **Close** to exit the *Calibration* screen.

**Figure 41: Calibration Tab**

**Laser Adjust**

Click the **Laser Adjust** tab to access the *Laser Adjust* screen. Use the *Laser Adjust* screen to manually adjust the laser’s wavelength, to compensate for any cumulative drift. (Figure 42)
Laser adjustment may be required if the analyzer has not been operated for a long time, and the laser's wavelength has drifted beyond the target range of the analyzer.

**WARNING!**
Do not operate the analyzer outside the recommended temperature range because this will result in unexpected behavior or failures.

Figure 42 shows an example of a GLA131-GGA with an offset between absorption peaks and target lines for laser A (top plot) and laser B (bottom plot). Both lasers require adjustment.

To manually adjust the laser wavelength:

1. Click the **Setup** button on the Control Bar. (Figure 25)
2. Select the **Laser Adjust** tab at the top of the screen. (Figure 42)
3. Select the **Disable Laser Frequency Lock** checkbox 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: **Up Arrow** - peaks adjust to the right; **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.
lines: **Up Arrow** - peaks adjust to the right; **Down Arrow** - peaks adjust to the left.

6. De-select the **Disable Laser Frequency Lock** checkbox. 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 43 shows the laser voltage adjusted so that the absorption peak is centered on the target line.

![Figure 43: Absorption Peaks Centered Correctly on Target Lines](image)

**MIU**

The (optional) Multi-Port Inlet Unit (MIU-8) is an ABB accessory that allows automated control of 8 inlet ports.

The MIU-8 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 **MIU** menu (Figure 44) controls which gases are introduced into the inlet port of the analyzer, in what order, and for how long.

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.
Figure 44: Control Menu for MIU

Figure 45 shows the front panel of the eight-port MIU.

Figure 45: MIU Front Panel
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 46 shows the back panel of the eight-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 one each of these accessories:

- Control cable (connects the analyzer to the MIU)
- Power cable (powers the MIU)
- ¼ inch x 6 foot Teflon tube (connects the outlet port of the MIU to the inlet port of the analyzer)

**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 control cable from the MIU to the TO MIU port on the back panel of the analyzer. Figure 47 illustrates the pin numbers on the analyzer DB9 male MIU output connector. Refer to Table 9 for pin numbers and corresponding MIU port numbers.
3. Connect a ¼ inch 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 to avoid leaks in the seal.

5. Connect the provided ¼ inch x 6 foot 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**

Push the outer ring around the inlet and outlet connectors on the MIU to release the ¼ inch tubing.

**Control MIU Using Analyzer Setup Panel**

1. Click **Setup** on the Control Bar. (Figure 25)
2. Click the **MIU** tab at the top of the **Setup** menu selection bar. (Figure 44)

Figure 48 shows the *Gas Manifold Control* screen for the MIU not yet enabled.

![MIU Tab](image)

**Figure 48: Gas Manifold Control Screen for MIU, Disabled**

3. Check the **MIU Enable** box to activate the **MIU** setup menu.
4. 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.
If a valve is set to 0, the entry is ignored. Each defined gas is sampled sequentially in its respective group (unknown or reference).

5. 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.

6. If you wish to run your reference gases first, check the **Start with reference gas valve sequence** box.

7. Use the arrow scroll bar to select the number of times to run the unknown gas sequence for each reference gas sequence. (Figure 49)

8. Click **Save Changes** to save your current configuration.
9. To begin sampling, click **Close**. (Figure 49)

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, are shown in the parameter window of the Control Bar. (Figure 50)

The description is:
- Displayed on the parameter window of the Control Bar during analysis. (Figure 50)
- Saved to a data file.

![Figure 50: Control Bar (Showing MIU Information)](image)

10. When sampling is complete, disable the MIU by returning to the **MIU** screen, then uncheck the **MIU Enable** box. (Figure 48)

**Service**

ABB-trained field service engineers monitor the performance of the analyzer via the **Service** screen. (Figure 51)

- 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 51: Service Screen**

**Data Output Logging**

**Serial Logger**

Click the **Serial Logger** tab to access the **Serial Logger** menu, in which you can change how data reported at the RS-232 port are configured.
NOTE

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

Active Listeners (OPT-DATALOG Option)

Select which serial port(s) are available to stream data: **ICOS**, **ANEMOMETER**, or **MAVLINK**. Check the adjacent box to activate the port; uncheck to de-activate.

Serial Port Settings

Use the **MAVLINK**, **ANEMOMETER**, and **OUTPUT** tabs to configure the selected serial port(s) that stream data. Figure 52 shows the **Serial Logger** menu with the **OUTPUT** tab selected.

NOTE

The **OUTPUT** tab corresponds to the **Active Listeners ICOS** tab.
Standard settings are provided for:

- Baud rate
- Parity
- Stop bits
- Data bits
- Timeout

The actual rate of the serial output is equal to the Logged File Rate (that is, 1 Hz) divided by the Rate specified in the *Rate Control Adjustment* panel.

You can also name the port.

Additional settings on the **OUTPUT** tab:

- Active – check this box to activate the port for data output. If unchecked, no data are output from the port.
- Append checksum – check this box to include serial port data columns in the output file.

Additional setting and display on the **ANEMOMETER** tab:

- Parser Settings – select the method to parse raw serial data into the correct format for data output.
- Raw data – displays the raw data output from the device on the selected serial port.

**Parsed Debug**

This panel displays the serial data stream.

- Enable live debug – check this box to enable the data stream from the port. If unchecked, no data appear in the table.
- Clean debug – click to clear the table of data.
- Go to the table bottom – check this box to scroll to the bottom of the table.

**Save or Restore Configuration**

To save the configuration, click **Save** (at the bottom of the screen), or **Restore** to return the configuration to the default setting.

**Modbus TCP**

The analyzer process variables and health status may be read by a Modbus master using the Modbus TCP version of the protocol.

---

**WARNING!**

The Modbus protocol is an unsecured protocol, as such, the intended application should be assessed to ensure that these protocols are suitable before implementation.
Modbus Logger

Click the Modbus Logger tab to access the Modbus Logger menu.

Use this menu to view the Modbus data stream and analyzer alarm status.

You can also change certain Modbus settings from the default configuration including:

- Port name and server address
- Whether to display analyzer alarms and measurement:
  - Show alarms – check this box to display alarms. If unchecked, alarms are not displayed.
  - Show measurements – check this box to display Modbus measurements. If unchecked, measurements are not displayed.
- Click **Save** (at the bottom of the screen) or **Restore** to return the configuration to the default setting.

Register Ordering

The following describes the data order in the Modbus registers for the GLA131-GGA.

Analyzer Process Variables

The Modbus data ordering is structured to mirror the data in the analyzer’s local data file and output over the analyzer’s RS-232 serial stream: Each of these streams
contain the same data and are interchangeable to provide the greatest flexibility for recording data.

The analyzer process variables and their order can be found in the local data file as a header or as listed in Table 10. These columns of data are mapped directly into the Modbus holding register starting at 040000. Except for the timestamp (*Epoch Time*), each process variable occupies two holding registers to represent a floating-point value. Both registers must be read to properly return the process variable of interest. Table 10 lists analyzer process variables, registers, and bit assignments.

**Table 10: Analyzer Process Variables**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Register</th>
<th>Data Format</th>
</tr>
</thead>
<tbody>
<tr>
<td>Epoch Time (ms)</td>
<td>040000</td>
<td>Lease Significant Bit (LSB)</td>
</tr>
<tr>
<td></td>
<td>040001</td>
<td></td>
</tr>
<tr>
<td></td>
<td>040002</td>
<td></td>
</tr>
<tr>
<td></td>
<td>040003</td>
<td>Most Significant Bit (MSB)</td>
</tr>
<tr>
<td>[CH4]_ppm</td>
<td>040004</td>
<td>LSB</td>
</tr>
<tr>
<td></td>
<td>040005</td>
<td>MSB</td>
</tr>
<tr>
<td>[CH4]_ppm_sd</td>
<td>040006</td>
<td>LSB</td>
</tr>
<tr>
<td></td>
<td>040007</td>
<td>MSB</td>
</tr>
<tr>
<td>[CO2]_ppm</td>
<td>040008</td>
<td>LSB</td>
</tr>
<tr>
<td></td>
<td>040009</td>
<td>MSB</td>
</tr>
<tr>
<td>[CO2]_ppm_sd</td>
<td>040010</td>
<td>LSB</td>
</tr>
<tr>
<td></td>
<td>040011</td>
<td>MSB</td>
</tr>
<tr>
<td>[H2O]_ppm</td>
<td>040012</td>
<td>LSB</td>
</tr>
<tr>
<td></td>
<td>040013</td>
<td>MSB</td>
</tr>
<tr>
<td>[H2O]_ppm_sd</td>
<td>040014</td>
<td>LSB</td>
</tr>
<tr>
<td></td>
<td>040015</td>
<td>MSB</td>
</tr>
<tr>
<td>[CH4]d_ppm</td>
<td>040016</td>
<td>LSB</td>
</tr>
<tr>
<td>Variable</td>
<td>Register</td>
<td>Data Format</td>
</tr>
<tr>
<td>--------------------------</td>
<td>----------</td>
<td>-------------</td>
</tr>
<tr>
<td>[CH4]d_ppm_sd</td>
<td>040017</td>
<td>MSB</td>
</tr>
<tr>
<td></td>
<td>040018</td>
<td>LSB</td>
</tr>
<tr>
<td></td>
<td>040019</td>
<td>MSB</td>
</tr>
<tr>
<td>[CO2]d_ppm</td>
<td>040020</td>
<td>LSB</td>
</tr>
<tr>
<td></td>
<td>040021</td>
<td>MSB</td>
</tr>
<tr>
<td>[CO2]d_ppm_sd</td>
<td>040022</td>
<td>LSB</td>
</tr>
<tr>
<td></td>
<td>040023</td>
<td>MSB</td>
</tr>
<tr>
<td>GasP_torr</td>
<td>040024</td>
<td>LSB</td>
</tr>
<tr>
<td></td>
<td>040025</td>
<td>MSB</td>
</tr>
<tr>
<td>GasP_torr_sd</td>
<td>040026</td>
<td>LSB</td>
</tr>
<tr>
<td></td>
<td>040027</td>
<td>MSB</td>
</tr>
<tr>
<td>GasT_C</td>
<td>040028</td>
<td>LSB</td>
</tr>
<tr>
<td></td>
<td>040029</td>
<td>MSB</td>
</tr>
<tr>
<td>GasT_C_sd</td>
<td>040030</td>
<td>LSB</td>
</tr>
<tr>
<td></td>
<td>040031</td>
<td>MSB</td>
</tr>
<tr>
<td>AmbT_C</td>
<td>040032</td>
<td>LSB</td>
</tr>
<tr>
<td></td>
<td>040033</td>
<td>MSB</td>
</tr>
<tr>
<td>AmbT_C_sd</td>
<td>040034</td>
<td>LSB</td>
</tr>
<tr>
<td></td>
<td>040035</td>
<td>MSB</td>
</tr>
<tr>
<td>RD0_us</td>
<td>040036</td>
<td>LSB</td>
</tr>
<tr>
<td></td>
<td>040037</td>
<td>MSB</td>
</tr>
<tr>
<td>RD0_us_sd</td>
<td>040038</td>
<td>LSB</td>
</tr>
<tr>
<td></td>
<td>040039</td>
<td>MSB</td>
</tr>
<tr>
<td>Variable</td>
<td>Register</td>
<td>Data Format</td>
</tr>
<tr>
<td>------------------</td>
<td>----------</td>
<td>-------------</td>
</tr>
<tr>
<td>RD1_us</td>
<td>040040</td>
<td>LSB</td>
</tr>
<tr>
<td></td>
<td>040041</td>
<td>MSB</td>
</tr>
<tr>
<td>RD1_us_sd</td>
<td>040042</td>
<td>LSB</td>
</tr>
<tr>
<td></td>
<td>040043</td>
<td>MSB</td>
</tr>
<tr>
<td>Gnd</td>
<td>040044</td>
<td>LSB</td>
</tr>
<tr>
<td></td>
<td>040045</td>
<td>MSB</td>
</tr>
<tr>
<td>Gnd_sd</td>
<td>040046</td>
<td>LSB</td>
</tr>
<tr>
<td></td>
<td>040047</td>
<td>MSB</td>
</tr>
<tr>
<td>LTC0_v</td>
<td>040048</td>
<td>LSB</td>
</tr>
<tr>
<td></td>
<td>040049</td>
<td>MSB</td>
</tr>
<tr>
<td>LTC0_v_sd</td>
<td>040050</td>
<td>LSB</td>
</tr>
<tr>
<td></td>
<td>040051</td>
<td>MSB</td>
</tr>
<tr>
<td>LTC1_v</td>
<td>040052</td>
<td>LSB</td>
</tr>
<tr>
<td></td>
<td>040053</td>
<td>MSB</td>
</tr>
<tr>
<td>LTC1_v_sd</td>
<td>040054</td>
<td>LSB</td>
</tr>
<tr>
<td></td>
<td>040055</td>
<td>MSB</td>
</tr>
<tr>
<td>Batt_v</td>
<td>040056</td>
<td>LSB</td>
</tr>
<tr>
<td></td>
<td>040057</td>
<td>MSB</td>
</tr>
<tr>
<td>Batt_v_sd</td>
<td>040058</td>
<td>LSB</td>
</tr>
<tr>
<td></td>
<td>040059</td>
<td>MSB</td>
</tr>
<tr>
<td>BATT_PERCENT</td>
<td>040060</td>
<td>LSB</td>
</tr>
<tr>
<td></td>
<td>040061</td>
<td>MSB</td>
</tr>
<tr>
<td>BATT_PERCENT_sd</td>
<td>040062</td>
<td>LSB</td>
</tr>
</tbody>
</table>
Table 11: System Warning and Alarm Coil Register Configuration

<table>
<thead>
<tr>
<th>Health Event</th>
<th>Warning Register</th>
<th>Alarm Register</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reserved</td>
<td>000000</td>
<td>000001</td>
<td>Reserved for future use</td>
</tr>
<tr>
<td>Maintenance</td>
<td>000002</td>
<td>000003</td>
<td>System maintenance is required</td>
</tr>
<tr>
<td>Pressure</td>
<td>000004</td>
<td>000005</td>
<td>Pressure is not in operating range</td>
</tr>
<tr>
<td>HD Space</td>
<td>000006</td>
<td>000007</td>
<td>System data storage space is low</td>
</tr>
</tbody>
</table>

Analyzer Warning and Alarm States

The analyzer health alarms are stored in the coil registers and follow the standard ABB system health ordering. Each alarm type consists of two coil registers: the first for a warning state and the second for an alarm state. The order for alarms is shown in Table 11.
### Health Event

<table>
<thead>
<tr>
<th>Health Event</th>
<th>Warning Register</th>
<th>Alarm Register</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data Health A</td>
<td>00008</td>
<td>00009</td>
<td>Laser A goodness of fit</td>
</tr>
<tr>
<td>Data Health B</td>
<td>00010</td>
<td>00011</td>
<td>Laser B goodness of fit</td>
</tr>
<tr>
<td>Mirror Health A</td>
<td>00012</td>
<td>00013</td>
<td>Mirror health has degraded for Laser A</td>
</tr>
<tr>
<td>Mirror Health B</td>
<td>00014</td>
<td>00015</td>
<td>Mirror health has degraded for Laser B</td>
</tr>
<tr>
<td>Linelock A</td>
<td>00016</td>
<td>00017</td>
<td>Laser A peak position is outside of control range</td>
</tr>
<tr>
<td>Linelock B</td>
<td>00018</td>
<td>00019</td>
<td>Laser B peak position is outside of control range</td>
</tr>
<tr>
<td>Signal Power A</td>
<td>00020</td>
<td>00021</td>
<td>Laser A power has degraded</td>
</tr>
<tr>
<td>Signal Power B</td>
<td>00022</td>
<td>00023</td>
<td>Laser B power has degraded</td>
</tr>
</tbody>
</table>

### Cyclic Redundancy Check

No cyclic redundancy check (CRC) is included in the returned data frame because error-checking functionality is provided by the TCP/IP encapsulation.

### Security

Click **Setup** on the Control Bar, then click the **Security** tab to access the **Security** screen (see Figure 55). This screen lets you change security settings including changing passwords; adding, deleting, and assigning users; and returning the system to default settings. Returning to default settings restores default passwords, removes all users except `lgr`, and deletes all data.
User Management

The User Management area lets you do the following:

- Change the VNC server password
- Change the SSH password
- Change the Samba Share password
- Add and delete users, and assign to groups

Change VNC Server Password

To change the VNC server password, perform the following:

1. From the Setup screen, click the Security tab.
2. Click Remote Login (VNC): The dialog box shown in Figure 56 appears.

NOTE

The VNC server is disabled by default because transfer via VNC is not secured. However, authentication credentials are sent securely.
3. Click **Enable**: A message appears stating the connection to the VNC Server will not be encrypted.

4. To proceed, click **Yes**: The VNC server is enabled, and you can connect to the analyzer via the VNC interface. You can also disable the connection (see Figure 58).

5. Click **Change VNC Password**: The *Change VNC Password* dialog-box appears.
6. Enter the current VNC password in the **Current Password** field. (The default VNC password is *lgrvnc*.)

7. Enter the new password in the **New Password** field.

8. Re-enter the new password in the **Confirm New Password** field.

9. Click **Change Password**.

**Change SSH Password**

To change the SSH password, perform the following:

1. From the **Setup** screen, click the **Security** tab.

2. Click **Secure Shell Transfer (SSH)**: The **Change SSH Password** dialog-box appears.

3. Enter the current SSH password in the **Current Password** field. (The default SSH password is *3456789*.)

   **NOTE**

   The SSH password is the same as the lgr password. If you change the SSH password, the lgr password will also be changed.

4. Enter the new password in the **New Password** field.

5. Re-enter the new password in the **Confirm New Password** field.

6. Click **Change Password**.
Change Samba Share Password

To change the Samba Share password, perform the following:

1. From the Setup screen, click the Security tab.
2. Click Samba Share (data): The Change Samba Password dialog-box appears.

![Change Samba Password Dialog-Box](image)

3. Enter the Igr Password. (The default Igr password is 3456789.)
4. Enter the new password in the New Samba Password field.
5. Re-enter the new password in the Confirm New Password field.
6. Click Change Password.

Manage User Accounts

User Levels

The analyzer is shipped with one Admin user, Igr, which cannot be deleted. Refer to Table 12 for user level access.
### Table 12: User Level Access

<table>
<thead>
<tr>
<th>Category</th>
<th>Admin</th>
<th>Service</th>
<th>User</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Display Screens</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Numeric</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Spectrum</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Time Chart</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Alarm Status</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td><strong>Main Buttons</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rate</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>File Transfer</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Setup</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Exit</td>
<td>✔</td>
<td>✖</td>
<td>✖</td>
</tr>
<tr>
<td><strong>Setup Panels</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Time/Files</td>
<td>✔</td>
<td>✔</td>
<td>✏</td>
</tr>
<tr>
<td>Calibration</td>
<td>✔</td>
<td>✔</td>
<td>✏</td>
</tr>
<tr>
<td>Laser Adjust</td>
<td>✔</td>
<td>✔</td>
<td>✏</td>
</tr>
<tr>
<td>MIU</td>
<td>✔</td>
<td>✔</td>
<td>✏</td>
</tr>
<tr>
<td>Analog Output</td>
<td>✔</td>
<td>✔</td>
<td>✏</td>
</tr>
<tr>
<td>Serial Logger</td>
<td>✔</td>
<td>✔</td>
<td>✏</td>
</tr>
<tr>
<td>Service</td>
<td>✔</td>
<td>✔</td>
<td>✏</td>
</tr>
<tr>
<td>Bluetooth Daemon</td>
<td>✔</td>
<td>✔</td>
<td>✏</td>
</tr>
<tr>
<td>Security</td>
<td>✔</td>
<td>✔</td>
<td>✏</td>
</tr>
<tr>
<td><strong>Security Panel</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Change VNC password</td>
<td>✔</td>
<td>✏</td>
<td>✏</td>
</tr>
<tr>
<td>Change SSH password</td>
<td>✔</td>
<td>✏</td>
<td>✏</td>
</tr>
<tr>
<td>Change Samba password</td>
<td>✔</td>
<td>✏</td>
<td>✏</td>
</tr>
<tr>
<td>User account management</td>
<td>✔</td>
<td>✏</td>
<td>✏</td>
</tr>
<tr>
<td>Clean ICOS data (decommission)</td>
<td>✔</td>
<td>✏</td>
<td>✏</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Access Level</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>✔</td>
<td>Changeable</td>
</tr>
<tr>
<td>✏</td>
<td>Read Only</td>
</tr>
<tr>
<td>✖</td>
<td>Not Accessible</td>
</tr>
</tbody>
</table>

The lgr user and users belonging to the Admin and Service groups can add new users and delete users using the Group/User Account screen.
Add User

To add a user, perform the following:

1. From the Setup screen, click the Security tab.
2. Click Group/User Account: The Users dialog-box shown in Figure 62 appears.

   ![Figure 62: Group/User Dialog-Box]

   - Click Add User: The Add User dialog box shown in Figure 23 appears.
3. Enter a username in the User Name field.
4. Enter a password in the Password field.
5. Re-enter the new password in the Confirm Password field.
6. Select a group from the Group Name drop-down menu: Admin, Service, or User.
7. Click Add New User.
If you try to add a user and are in the User group (instead of the Admin or Service group), a dialog box (Figure 24) appears, and you must cancel the action.

Delete User

To delete a user, perform the following:

1. From the Setup screen, click the Security tab.
2. Click Group/User Account: The Users dialog-box shown in Figure 62 appears.
3. Click Delete next to the user you want to delete.

If you try to delete a user and are in the User group (instead of the Admin or Service group), a dialog box (Figure 24) appears, and you must cancel the action.

Set ICOS Default Data

The Set ICOS Default Data feature removes all measurement data and created users, and disables the VNC server. This feature may be applicable when the analyzer is decommissioned or released from active service.

This feature requires the Igr user Linux account and does the following:

- Sets default passwords in the user management group
- Removes all measurement data and created users
- Disables the VNC server

To set the ICOS default settings, perform the following:

1. From the Setup screen, click the Security tab.
2. Click Clean Icos Data: The Clear Icos Data dialog-box shown in Figure 63 appears.
3. Enter the lgr user Linux password in the **Igr Password** field. (The default lgr user Linux password is 3456789.)

4. Click **Clear Data**: The message shown in Figure 64 appears.

![Figure 64: Clear ICOS Data Message](image)

5. Click **Yes**.

**Analyzer Shutdown**

To properly shut down the analyzer, perform a soft shutdown by first selecting **Exit** on the Control Bar. When the dialog box appears with the question, “**Do you wish to shutdown?**” (see Figure 65), click **OK**.

![Figure 65: Shutdown Dialog-Box](image)
6 Service

WARNING! Use of controls or adjustments, or performance of procedures other than those specified, may result in hazardous radiation exposure.

The analyzer laser is not field serviceable. Should a laser fail in the field, the analyzer must be shipped back to ABB for service repair.

The analyzer laser is equipped with a magnetic interlock switch. Whenever the case cover is opened, the magnetic switch breaks contact from the magnetically encoded counterpart, and power is interrupted from the Laser Controller PCB in the analyzer, thus, disabling the laser.

Service to the analyzer itself must be performed only by certified service personnel trained on servicing this instrument. User adjustments inside the analyzer are not necessary or recommended by the manufacturer.

Basic Service Procedure

WARNING! Only ABB certified maintenance personnel may unlock and open the analyzer housing or perform internal maintenance.

Before servicing the analyzer, perform the following procedure:

1. Turn off the analyzer power via the software.
2. Unplug the power supply or the battery kit.
3. Wait 10 seconds for the power to dissipate.
4. Make sure the analyzer is on a stable surface and on the right side (main label facing up). Unlock the padlock and open the analyzer cover.
5. Make sure all LEDs are off.

Spare Parts, Maintenance, and Accessories

Mirror Cleaning Kit  
- Part number: MTN-CLEAN-1V

Spare Pump and Filters Kit  
- Part number: SPK-131V2-LITE
• Includes: replacement pump and 5 µm filters (2)

**Spare Parts Kit**
- Part number: SPK-131V2
- Includes: replacement pump, filters, and pressure controller

**Sampling Kit**
- Part number: ACC-MICRO-KIT
- Includes: wand and shoulder strap

**MicroGuard™ Accessory Kit**
- Part number: ACC-MICROGUARD
- Turns a Microportable into a MicroGuard™ Portable Gas Leak Detection System
- Contact factory

**Power Accessories**
- Battery, part number: ACC-MICRO-B
- Dockstation battery charger: ACC-MICRO-BC
- Microportable external battery charger, part number: ACC-MICRO-BC
- Power supply brick, part number: ACC-MICRO-AC
- External battery case, part number: ACC-DCMICRO

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**NOTE**

No battery is included with the ACC-DCMICRO - refer to your sales representative for dimensions and power requirements.
Preventive Maintenance

Daily Operation Checklist

Table 13 describes routine maintenance tasks that keep your analyzer operating smoothly.

Table 13: Maintenance Checklist

<table>
<thead>
<tr>
<th>Frequency</th>
<th>Task</th>
</tr>
</thead>
</table>
| Every 1-2 days     | • On the Spectrum display, verify that the spectrum is correct. The spectrum should appear as shown in Figure 27 and Figure 28. 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 42 and Figure 43)                                                          |

Recommended Maintenance

The recommended maintenance is:

- ICOS mirror cleaning
- Inline particulate filter
- Solid-state drive (SSD) maintenance
- Lithium-ion battery inspection

Mirror Ringdown 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.

If a significant change occurs in the mirror ringdown time (for example, greater than 20% reduction), the precision of the measurements may be reduced.

Periodically note the ringdown time. If a significant reduction in ringdown time occurs:
- Request a mirror cleaning kit from ABB or your local distributor.
- If further maintenance is required, contact ABB or your local distributor for service.
  - ABB call center: 1-800-858-3847 (North America) or +1 418-877-2944 (Worldwide)
  - ABB Technical Support: icos.support@ca.abb.com

Other Components

The inline particulate filter requires replacement once a year or when the measured data profile becomes thinner in the Spectrum display screen (GOF gets worse – refer to the Spectrum Display section for details), and/or when the gas pressure reading on the Control Bar increases.

Solid-state drive (SSD) maintenance: It is recommended to check the amount of memory space available on the 120 GB SSD. Prior to collecting measurement samples, verify there is sufficient SSD space available. In the Control Bar (see Figure 66), the current amount of available disk space is displayed.

![Figure 66: Current Disk Space Available](image)

Should the analyzer shut down without a soft shutdown, the operating software may get corrupted and make the analyzer non-functional. You can monitor the internal lithium-ion battery energy level by checking the Control Bar. The lithium-ion battery contains a protective PCB to prevent over-charging and over-discharge to prevent damage to the battery. The lithium-ion battery takes approximately 8 hours to recharge completely. Inspect the lithium-ion battery for any bulge in its package and protective PCB sealing. A bulge in the battery indicates internal damage. Should the battery have a bulge, remove the battery and dispose it at an organization that recycles lithium-ion batteries.

Battery Replacement

The analyzer battery may be replaced if it fails or is at end of life due to multiple charge/discharge cycles.

---

**CAUTION!**

Always replace the battery only at an ESD protected station with proper personal grounding. Any operation requiring opening the analyzer case must be performed in a controlled environment with proper ESD protection and the analyzer powered off. Never open the analyzer without ESD protection.
To replace the battery, perform the following (see Figure 67):

1. Ensure the analyzer power is OFF.
2. Open the case by unlatching two clamps next to the handle. (See Figure 4.)
3. Unplug the battery connector.
4. Holding the battery in place, unscrew the captive Phillips screw securing the battery faceplate.
5. Rotate the faceplate downward.
6. Remove the battery from the case ensuring not to damage other components.
7. Inspect the new battery for damage or bulging.
8. Place the new battery inside the faceplate and rotate the faceplate up.
9. Secure the faceplate to the battery with the captive screw.
10. Plug in the battery connector.
11. Close the case and fully lock the two clamps.
12. Power up the analyzer and verify proper installation.
NOTE

The battery automatically recharges when the analyzer power is on.

Fuse Replacement

If one of the fuses blows or is otherwise damaged, the analyzer automatically turns off. There are two fuses in the analyzer – one 5 A fuse for the battery input and one 10 A fuse for the power input. These fuses are available at auto parts stores.

- Battery input fuse, automotive, 5 A 32 V DC blade, ATO/ATC, color – tan (see Figure 68)
- Power input fuse, automotive, 10 A 32 V DC blade, ATO/ATC, color – red (see Figure 69)

To replace a fuse:

1. Power down the analyzer.
2. Disconnect the analyzer Swagelok inlet and outlet exhaust gas lines.
3. Disconnect the analyzer power plug.
4. Move the analyzer to a table where it can be worked on.
5. Open the case by unlatching two clamps next to the handle to expose its internal components.
6. Locate the fuse: See Figure 70 for locations (overall and close-up views).
7. Remove the fuse from the fuse fixture: Pull the cover off, then slide the fuse out. Figure 71 shows the fuses with the covers removed.
8. Insert the new fuse into the fuse fixture, then attach the fuse cover.
9. Close the analyzer case cover.
10. Move the analyzer back to the original location.
11. Re-connect the analyzer power plug.
12. Re-connect the inlet and outlet exhaust lines to the analyzer.
Appendix A  Theory of Operation

For gas measurements based on conventional laser-absorption spectroscopy, a laser beam is directed through a sample, and the mixing ratio (or mole fraction) of gas is determined from the measured absorption using Beer’s Law, which may be expressed with Equation 1.

\[ \frac{I_v}{I_o} = e^{-S_L x P} \]

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

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.

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

determines the mole fraction directly from the relation:

\[ x = \frac{-1}{S_L P} \int_v ln \left( \frac{I_v}{I_o} \right)dv \]

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

The values measured are:
- Mixtures containing several species
- Flows at elevated temperatures and pressures

Calibrated gases would normally be used to verify measurement accuracy, as a monitor to a fix process and for troubleshooting.
Appendix B  ABB OA-ICOS Technology

Off-axis integrated-cavity output spectroscopy (OA-ICOS) uses a high-finesse optical cavity as an absorption cell. Unlike multi-pass detectors typically limited to path lengths of less than 200 meters, an OA-ICOS absorption cell effectively traps the laser photon so that, on average, it makes thousands of passes before leaving the cell. As a result, the effective optical path length may be several thousand meters using high-reflectivity mirrors: Thus, the measured absorption of light after it passes through the optical cavity is significantly enhanced. For example, for a cell composed of two 99.99% reflectivity mirrors 25 cm (9.8 in) apart, the effective optical path length is 2,500 m (8,202 ft).

Because the path length depends only on optical losses in the cavity and not on a unique beam trajectory (such as conventional multi-pass cells or cavity-ringdown systems), the optical alignment is very robust to allow 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 several to tens of microseconds).

As with conventional tunable-laser absorption-spectroscopy methods:

- Laser wavelength selection is based on the selected absorption feature of the target gas to be measured.
- The measured absorption spectra are 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