

eosAC-LT/LO and eosMX/MX-P User Manual

Large Transparent/Opaque Auto-chambers,
Recirculating Multiplexers,
and Related Software



This guide is distributed by EOSENSE INC (“Eosense”) for users of the eosAC-LT/LO auto-chamber and eosMX(-P) multiplexer instruments, in conjunction with the eosLink-MX and eosAnalyze-AC software. Eosense is not liable for special, indirect, incidental, or consequential damages. Eosense’s obligation under this warranty is limited to repairing or replacing (at Eosense’s discretion) defective products within one (1) year from date of delivery to the customer. The customer shall assume all costs of removing, reinstalling, and shipping defective products to Eosense where applicable. Eosense will return said products by surface carrier prepaid. This warranty is in lieu of all other warranties, expressed or implied.

**WARNING: CRUSH HAZARD**

This symbol indicates that a crush hazard is present. Keep hands and all other objects clear of the bottom lip of the chamber during operation. Never attempt to prevent the chamber from opening or closing.

**WARNING: PINCH HAZARD**

This symbol indicates that a pinch hazard is present. Keep hands and all other objects clear of the chamber arm during operation. Never attempt to prevent the chamber from opening or closing.



These products comply with the following directives for CE Marking:

2006/42/EC (Machinery)
2011/65/EU (RoHS2)
2004/108/EC (Electromagnetic compatibility)

For more information, contact support@eosense.com

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1 Summary

This manual is intended to help end-users of the Eosense eosAC-LT/LO autochambers and eosMX(-P) multiplexer chamber system in conjunction with an external gas analyzer to measure a variety of soil flux and gas concentration data. The information provided is intended for first time users of the eosAC-LT/LO and eosMX(-P), and assumes a working knowledge of the gas analyzer in question. We highly recommend that you read the document thoroughly before using the eosAC-LT/LO or eosMX(-P), as each of the hardware and software features are explained in detail.

This manual is intended for users of the eosAC-LT/LO and eosMX(-P) with eosLink-MX v1.9.07 and eosAnalyze-AC 3.9.04 software. Please check the Eosense website for the most up-to-date manuals and software.

If you have any specific questions or require additional guidance or information, please contact Eosense Technical Support through our website, by phone or by email:

support@eosense.com

888.352.8313

<https://eosense.com/contact-support/>

- Make sure your system is ready to go: [Section 2 \(Quick Start Checklist\)](#) lists everything you need to get your system up and running. Make sure to read the relevant sections of the manual for more information on each step!
- Want to jump right into collecting flux measurements? [Section 6 \(eosLink-MX Scheduling Software\)](#) tells you all you need to know to start out. For best results, we do recommend you read this complete user manual for both the eosAC-LT/LO and the eosMX(-P) multiplexer!
- Ready to start viewing and analyzing your flux data? [Section 7 \(eosAnalyze-AC Analysis Software\)](#) explains how the software allows you to import, view and quality check your measurements, before exporting the data.
- Please visit the [Resources](#) section of our website to review the Application Notes relevant to your system's setup.



2 Quick Start Checklist

- ❑ **Review Documentation**
 - ❑ User Manual for user specific analyzer
 - ❑ eosAC-LT/LO / eosMX(-P) User Manual
 - ❑ Relevant Application Notes for your study, found here: <https://eosense.com/resources/>
- ❑ **Analyzer Setup**
 - ❑ Install the Virtual COM Port (VCP) [USB-Serial driver](#) for your operating system
 - ❑ Download and extract the software folder for eosLink-MX and eosAnalyze-AC onto the analyzer desktop
 - ❑ Contact support@eosense.com for assistance installing the eosLink-MX software onto your ABB-LGR analyzers
- ❑ **eosAC-LT/LO / eosMX(-P) Hardware Setup**
 - ❑ Review the relevant Application Note - [Picarro](#), ABB-LGR ([U-GGA-915](#) or [M-GGA-918](#)) or [Gasmet](#) - for details on how to connect power, data and gas tubing in your system
 - ❑ Insert the collars and install the eosAC-LT/LOs using the provided bolts
 - ❑ Connect the eosMX(-P) Multiplexer to power using the supplied power cable
 - ❑ Connect gas tubing between the eosMX(-P) and your analyzer
 - ❑ Connect the two USB cables from the eosMX(-P) to your analyzer
 - ❑ Connect each eosAC-LT/LO to the eosMX(-P) using the combined power/data cable
 - ❑ Connect gas tubing between each eosAC-LT/LO and the eosMX(-P)



3 eosAC-LT/LO Large Transparent/Opaque Automated Chambers

3.1 Hardware Overview

The eosAC-LT/LO soil gas flux chamber's large footprint, proven design and automated measurement capabilities allow researchers to capture accurate measurements of Net Ecosystem Exchange and trace gases. The eosAC-LT/LO has several main components that are outlined below in **Figure 1**. The eosAC-LT/LO is built of aluminum with a transparent acrylic dome. The acrylic dome should be handled with care as it can be damaged or may shatter with blunt impact. Do not use any cleaning products that will dissolve or damage acrylic (e.g. acetone, isopropyl). The feet can be adjusted to ensure the chamber is stable. The fan arm can be moved to allow sufficient mixing of chamber headspace.

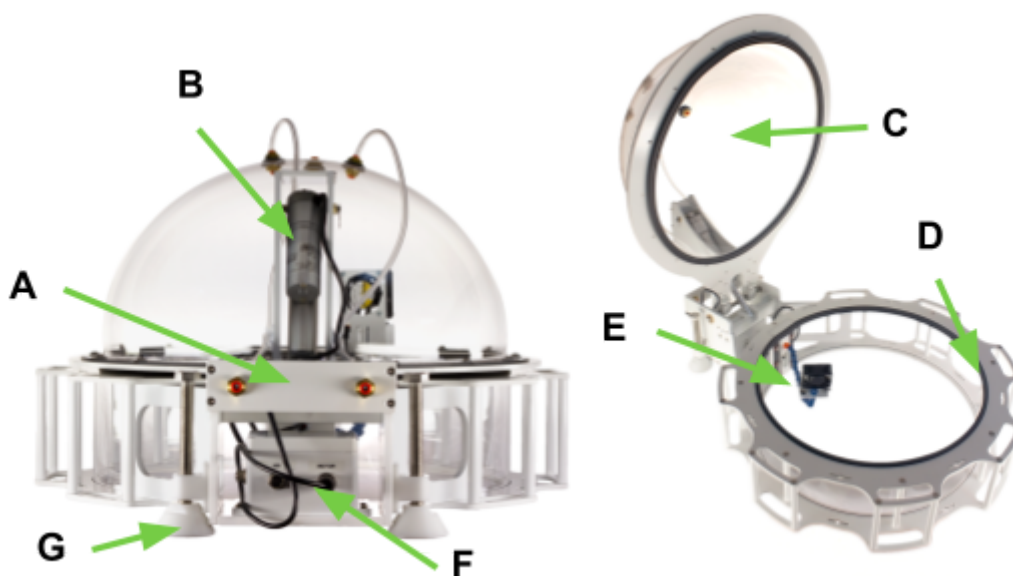


Figure 1. eosAC-LT/LO main components: (A) handle with push-connect gas tubing connections, (B) chamber actuator, (C) transparent acrylic dome, (D) chamber lip with gasket seal, (E) adjustable fan arm with temperature sensor, (F) main control box, including COMM port for power/data cable, and (G) height-adjustable feet.

3.2 eosAC-LT/LO Sensors and Auxiliary Ports

The eosAC-LT/LO is equipped with temperature and pressure sensors, as well as two AUX connection ports for one interior and one exterior sensor (see **Figure 2**). The eosAC-LT/LO will read data from these two auxiliary ports whenever a flux measurement is made. The data can be analog (voltage or converted current) or digital (SDI-12). To transform the recorded data into true sensor measurements (e.g. soil temperature or soil volumetric water content), choose the **Options** menu at the top of the eosAnalyze-AC software window, then choose **Equipment**, and then **Auxiliary Sensors**.

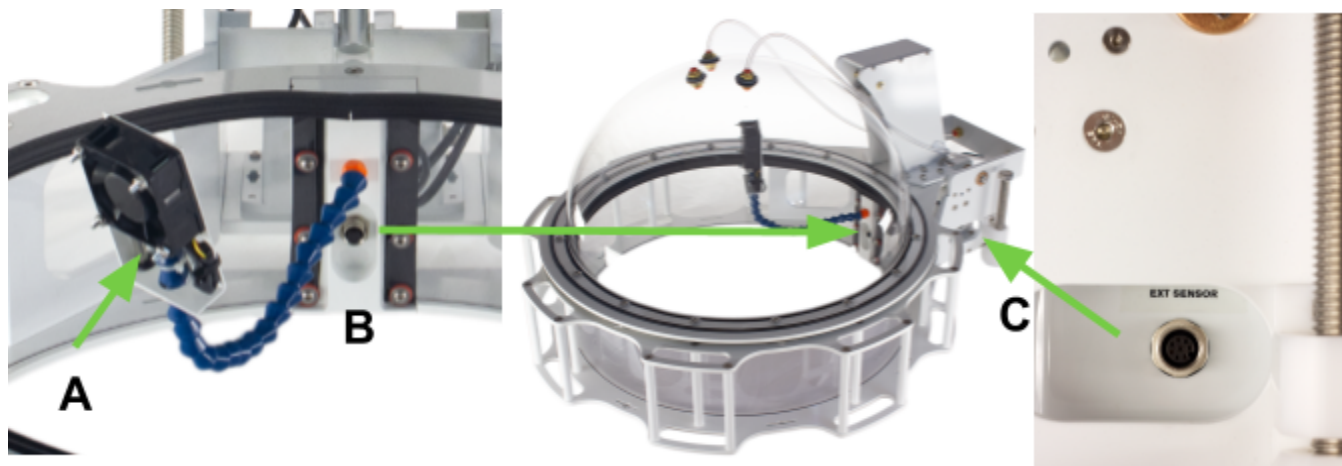


Figure 2. eosAC-LT/LO sensors: (A) Temperature sensor, (B) Interior auxiliary port, and (C) Exterior auxiliary port. A pressure sensor, located in the external chamber control box, measures ambient pressure.

3.3 Deploying eosAC-LT/LO in the Field

Before deployment, the two lengths of provided tubing should be connected between the push-connects on the dome to the push-connects on the chamber's handle. Also note that approximately 60 cm of vent tubing comes pre-installed on the back wall's outer push-connect.

The chamber's collar (standard 10 cm height) can be found installed upside down on the inside of the chamber upon arrival. The collar should be removed by unscrewing the eight bolts using a 1/4" or 6mm hex key (see Figure 3a). Re-install the bolts on the collar to ensure they are not lost. The provided collar seal should be applied by the user before deploying the collars in the field (see Figure 3b).

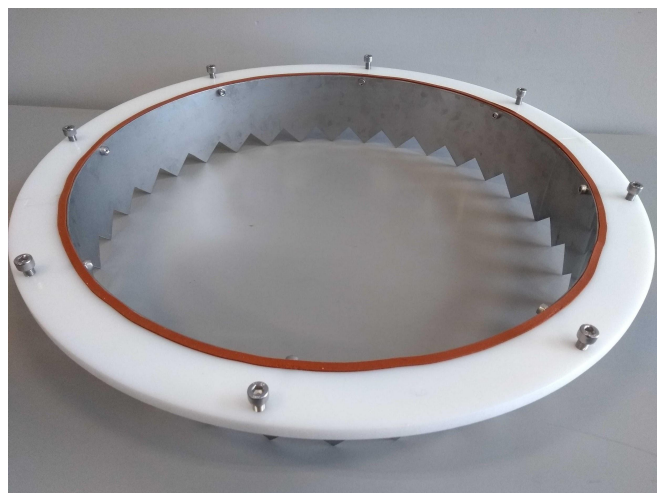


Figure 3. The collar (10 cm) comes installed inside the chamber. Green arrows point to 2 of 8 bolts that need to be removed upon receiving a new eosAC-LT/LO chamber (left). The provided collar seal should be installed by the user before deployment (right).

Before deploying the eosAC-LT/LO, first clear any large debris from the soil surface. Insert the collar into the soil before installing the chamber. Collar installation should happen at least 48 hours in advance, though 1-2 weeks is recommended. Depending on the density of the soil, you may need to pre-cut a circle for insertion (see Figure 4). Using the provided

bolts, secure the chamber to the collar. Avoid over tightening the bolts, as the plastic threads in the collar may strip. While the eosAC-LT/LO is water resistant, avoid situating the chamber in areas of standing water or hollows where flooding is a possibility. For best results choose a flat, clear soil surface to deploy the chamber.



Figure 4. Circle pre-cut into soil for collar, which is installed securely on chamber in the field.

The eosAC-LT/LO comes with a tube stem polypropylene gas muffler (see Figure 5). The muffler attachment should be installed inside the eosAC-LT/LO dome on the gas port being used as the Inlet. The muffler will help prevent any large particles or liquid water from entering the eosMX(-P).

When collecting the eosAC-LT/LO from your field site, ensure the chamber is in the closed position using the Close all eosAC-LTs button on the main window of the eosLink-MX software. Disconnect the power/data cable then remove the chamber from its collar by removing the bolts, disturbing the soil as little as possible.



Figure 5. Gas muffler installed on Inlet.

Note: Depending on the environment in which the analyzer and eosAC-LT/LO are deployed, steps to protect the power/data and gas tubing from rodents and other wildlife may be recommended.

4 eosMX(-P) Recirculating Gas Multiplexers

4.1 Hardware Overview

The eosMX and eosMX-P are recirculating multiplexers for gas analyzers that schedule chamber flux measurements using eosAC-LT/LOs autochambers. Although both models are functionally the same, there are a few key differences (see **Figure 6**). The eosMX is constructed of light weight aluminum, and is designed for stacking alongside gas analyzers, with the external pump (often) resting on top of the eosMX. The eosMX-P comes equipped with a portable hard case, but should be closed and locked when not in use. Although the outer case is weather resistant, the inside panel and interior components can be damaged if left exposed to the elements.



Figure 6. eosMX-P hard portable case (left) and an eosMX stacked on top of a Picarro analyzer (right).

The eosMX(-P) comes equipped with ports for two USB cables, the power cord, and analyzer inlet/outlet tubing. The eosMX(-P) power cable should be connected to stable 100-240 VAC power (43-67 Hz), and draws a maximum of 430 W (eosMX) or 60 W (eosMX-P). The eosMX-P can be powered directly by a 12 VDC power source, but also comes with a wall adapter. The power connector on the eosMX-P is compatible with some ABB-LGR power supplies for convenience (contact Eosense for more information). The two USB cables should be connected to the computer that will be operating the chamber scheduling software and storing measurement logs (typically the gas analyzer itself).

On the eosMX, the chamber tubing inlet/outlets and COMM ports are located on the front; the gas analyzer Inlet and Outlets, the On/Off switch, power cable port, and USB ports are located on the back (see **Figure 7**). All ports are located on the top face of the eosMX-P and the On/Off switch is labeled Power, with a green LED indicating that the multiplexer is powered (see **Figure 8**).



Figure 7. The front of the eosMX, showing chamber tubing inlet/outlet ports and COMM ports (top). The rear face of the eosMX, showing the eosMX power cable port, On/Off switch, gas analyzer Inlet and Outlet fittings, and the two USB communication cables (bottom).



Figure 8. The eosMX-P face, showing chamber tubing inlet/outlets and COMM ports (top), the gas analyzer Inlet and Outlet ports (bottom-left), the power cable port and On/Off switch (middle), and the USB ports (bottom-right).

4.2 Connecting eosAC-LT/LO Automated Chambers to the eosMX(-P)

The eosMX(-P) has connections for up to twelve Eosense eosAC-LT/LO autochambers, which include a combined power/data port and two Swagelok gas fittings for transporting gases to and from the analyzer. Each connected eosAC-LT/LO will require a power/data cable and two lengths of tubing (Swagelok fitting on one end only), with a maximum length of 30 m.

Attach one length of tubing to the port being used as the inlet by pushing the tubing into the **push-connect** port on the back of the eosAC-LT/LO until held securely. Connect the other end of the tubing to an Inlet port on the eosMX(-P) using the Swagelok fitting. Repeat this process with the other length of tubing and the port being used as the outlet on the

eosAC-LT/LO and corresponding Outlet port on the eosMX(-P). Please note, either port on the eosAC-LT/LO can be used as the inlet or outlet, but the tube stem polypropylene gas muffler should be installed on the inlet port (see **Figure 9**).

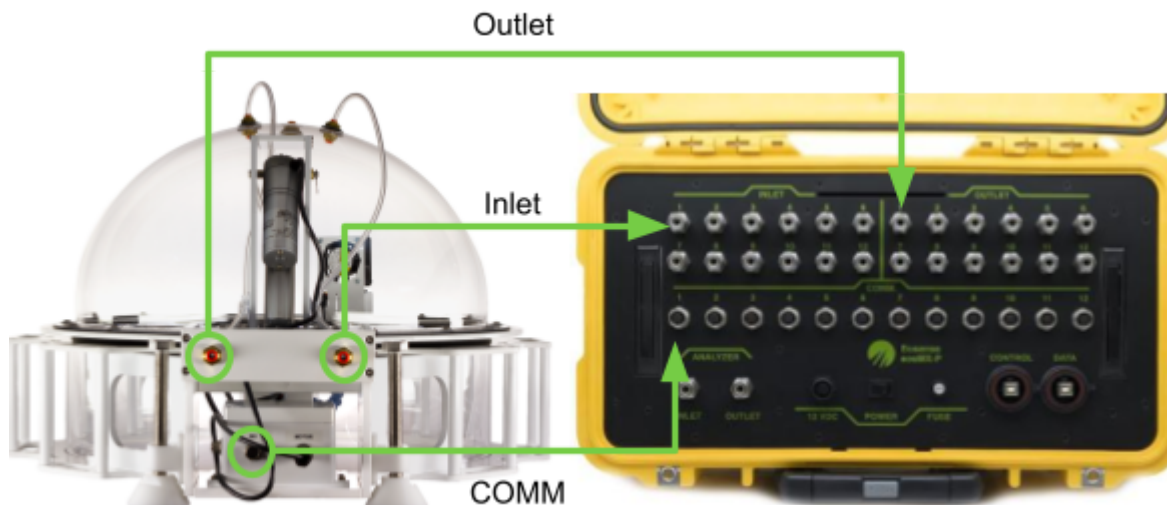


Figure 9. eosAC-LT/LO gas outlet (left) connects to the outlet on eosMX(-P); eosAC-LT/LO gas inlet (right) connects to inlet on eosMX(-P); and the combined power/data cable from the eosAC-LT/LO control box connects to the COMM port on eosMX(-P).

Attach the eosAC-LT/LO power/data cable to the control box of the eosAC-LT/LO, ensuring that it is connected to the left electrical port, **labelled COMM**. Connect the other end of the cable to one of the power/data ports on the eosMX(-P).

Each eosAC-LT/LO must be connected to a power/data port and the matching Inlet/Outlet fittings (see **Figure 10**). For example, the first eosAC-LT/LO would connect to COMM 1, Inlet 1 and Outlet 1, while the next would connect to COMM 2, Inlet 2, Outlet 2 and so on. Connecting the power/data cable or tubing to the wrong ports will result in failed measurements and other issues.

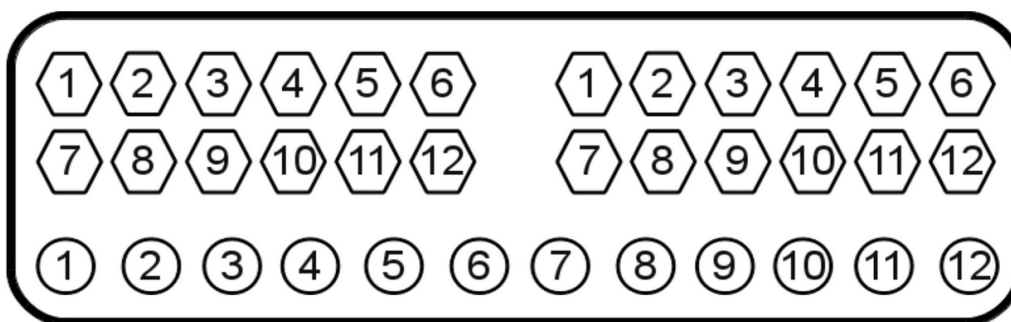


Figure 10. Diagram of the eosMX(-P) showing the correct pairing between power/data, inlet and outlet ports.

4.3 Relief Valve - Port 12

When not drawing from an active port, the eosMX(-P) defaults to directing the Inlet/Outlet lines of port 12 to the analyzer Input/Exhaust lines. As a result, systems with less than 12 chambers often draw in small portions of air from right beside the eosMX(-P) in between chamber measurements.

Depending on the layout of equipment and people, this can result in noticeably different CO₂ concentration and moisture data during these periods, which often manifests as “spikes” in the real-time data displayed by the analyzer. To remove this bias, we recommend running a length of tube from the 12th eosMX(-P) Inlet to a distance of 10 m from the eosMX(-P) to an area of “fresh air” (away from other equipment and people). Use of a filter on the end of this tubing length is also recommended.

Port 12 is also sampled during an "Idle/Delay" step (see [Section 6: eosLink-MX Scheduling Software for more details](#)). Additionally, anytime the eosMX(-P) is powered on but not running a cycle (e.g. after a non-looped cycle finishes), Port 12 remains open to act as a relief valve for the entire system.

4.4 Internal Volume of the eosMX(-P)

The eosMX internal volume is approximately 26 mL and the eosMX-P internal volume is about 24.3 mL. **Table 1** and **Figure 11** below outline the average lengths of tubing within the eosMX(-P) housing and the corresponding volume (using standard tubing with an inner diameter of 1/8").

Table 1 Internal eosMX(-P) tubing lengths and volumes.

Letter	eosMX		eosMX-P	
	Length	Volume	Length	Volume
A	21 cm	1.7 mL	15 cm	1.2 mL
B	n/a	9.3 mL	n/a	9.3 mL
C	21 cm	1.7 mL	23 cm	1.8 mL
D	30 cm	2.4 mL	19 cm	1.5 mL
E	n/a	9.3 mL	n/a	9.3 mL
F	20 cm	1.6 mL	15 cm	1.2 mL

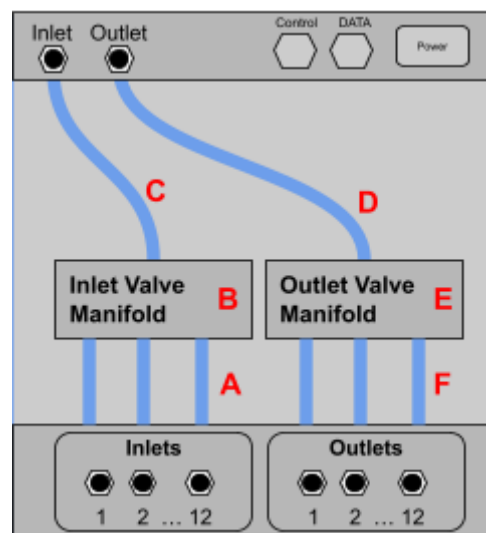


Figure 11. Internal eosMX(-P) diagram.

5 Connecting Gas Analyzers

The following sections will outline how to connect your eosMX(-P) to three common analyzer brands. Please review the analyzer manual and the relevant Eosense Application Note found on our website (Picarro [G2508](#), ABB-LGR [U-GGA-915](#), ABB-LGR [M-GGA-918](#), or Gaset [DX4015/4040](#)) for details on how to connect power, data and gas tubing in your system.

5.1 Connecting Picarro Gas Analyzers to the eosMX(-P)

The eosMX(-P) allows the user to coordinate Picarro gas analyzer samples from up to twelve eosAC-LT/LO autochambers (sequentially). The three instruments should be connected in a continuous loop, as shown in **Figure 12**.



Figure 12. Gas tubing connections between the eosMX-P (top-left), external pump (top-right), and Picarro analyzer (bottom).

In order to create this loop, a number of components are required (see **Figure 13**):

- Picarro Analyzer (e.g. G2508)
- Recirculation Pump (A0702)
- Eosense eosMX(-P) Multiplexer
- (A) Convoluted Metal Hose (VCR)
- (B) VCR Coupling (SS-4-VCR-CG)
- (C) VCR → Swagelok Fitting (SS-4-VCR-6-400)
- (D) 1/4 Ferrule x2 (SS-403-1, SS-404-1)
- (E) 1/4 Swagelok Nut x2 (SS-402-1)
- (F) Vacuum VCR Connection
- (G) VCR Metal Gasket x3 (SS-4-VCR-2)

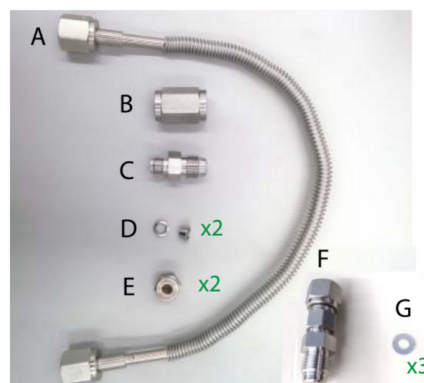


Figure 13. Components A-G (left).

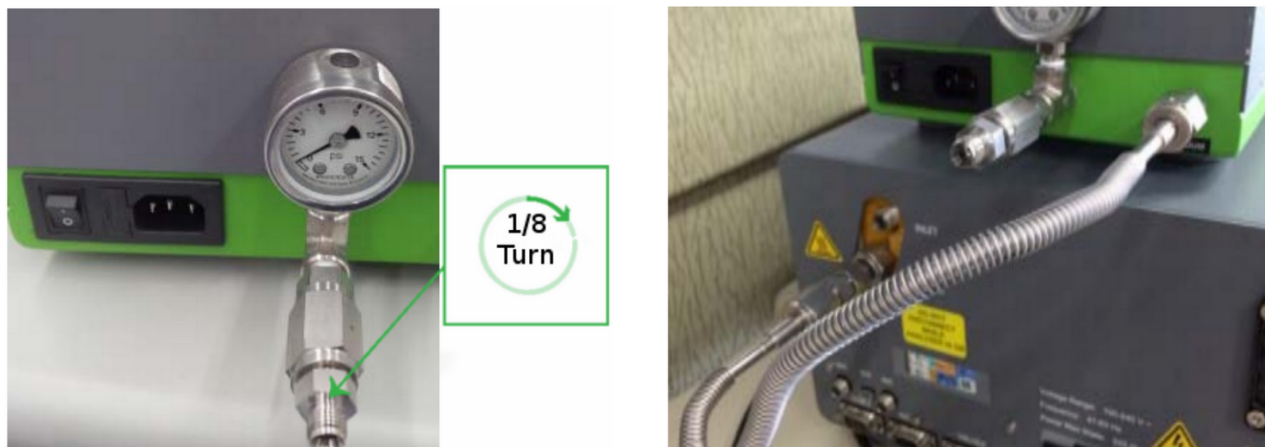


Figure 14. External recirculating pump with VCR coupling and Swagelok fitting attached.

Carefully set the analyzer, eosMX(-P) and external pump on a flat surface and remove the caps from the analyzer (Vacuum and Input) and pump (Vacuum and Exhaust), if still present. There are two ports on the back of the recirculating pump: one provides vacuum to the Picarro analyzer, which is necessary for its operation, while the other port acts as the gas exhaust for the system. To connect the external recirculating pump into the gas sampling loop (see **Figures 13** and **14**):

1. Attach the VCR coupling (B) to the outlet port of the pump;
2. Insert the VCR Metal Gasket (G) into the coupling and attach the VCR to Swagelok fitting (C);
3. Once the VCR to Swagelok fitting (C) is finger tight, turn the fitting an additional 1/8th turn to compress the gasket;
4. Attach the Vacuum VCR Connection (F) to the Vacuum port of the gas analyzer;
5. Connect the pump and analyzer vacuum ports using the convoluted metal hose (A); and
6. Ensure that each connection receives a VCR Metal Gasket (G) and is tightened 1/8th of a turn past finger tight.

Before attaching the tubing between the analyzer and the eosMX(-P), ensure that the unit's main power is turned on so that the pressure relief valve is active. Depending on application, the tubing lengths for the eosMX(-P) setup may vary. Two lengths of pre-Swagelok fitted tubing approximately 60 cm long are included with your eosMX(-P) equipment. Using one of these pieces, attach one end to the **gas analyzer Inlet** on the Picarro, hand tightening and then turning an extra 1/4 turn with a wrench, and the other to the **Analyzer Inlet** port on the eosMX(-P). Using the other piece, repeat this process between the **external pump** Swagelok fitting (C) and the eosMX(-P) **Analyzer Outlet** port.

Note: The **Inlet** port is required in order for the gas analyzer to draw chamber samples, however the **Outlet** port need only be connected if you are interested in recirculating the sampled gas back to the chamber. Recirculation is recommended, as this minimizes the impact on the soil system and thus allows for unbiased flux measurements.

5.2 Connecting ABB-LGR Gas Analyzers to the eosMX(-P)

Up to twelve eosAC-LT/LO autochambers can be linked to an ABB-LGR analyzer (such as the U-GGA-915) through the eosMX(-P). Connecting the U-GGA to the eosMX(-P) is accomplished through two pieces of tubing (pre-Swagelok fitted on one end) and the two USB cables.

With the U-GGA powered off and using one piece of the provided tubing, connect the Swagelok end to the Analyzer Inlet port on the eosMX(-P) and insert the bare end into the Inlet push-connect port on the U-GGA, making sure it is firmly seated. Using the other piece of tubing, connect the Swagelok end to the Analyzer Outlet port on the eosMX(-P), and plug the other end into the Waste push-connect port on the UGGA, making sure it is firmly seated (see Figure 15). If using a microportable greenhouse gas analyzer (M-GGA-918), use its quick-connect fittings to secure the tubing into the appropriate ports.



Figure 15. Left: Inlet and Waste push-connect ports on the U-GGA. Right: Inlet (left) and outlet (right) ports on the eosMX-P.

Connect the two USBs from the eosMX(-P), DATA and CONTROL, to the ABB-LGR analyzer. To access the eosLink-MX software when connected to the U-GGA-915 or M-GGA-918, switch to the second Desktop (default shortcut: <Ctrl> + <Alt> + <Right Arrow>) and launch the software from the shortcut. After a short warm up period, custom measurement cycles can be created and started.

Note: The **Inlet** port must be connected in order for the gas analyzer to draw chamber samples, however the **Waste** port need only be connected if you are interested in recirculating the sampled gas back to the chamber. Recirculation is recommended, as this minimizes the impact on the soil system and thus allows for unbiased flux measurements.

5.3 Connecting Gasmet Gas Analyzers to the eosMX(-P)

Up to twelve eosAC-LT/LO automated chambers can be linked to a Gasmet analyzer (such as the DX4015) through the eosMX(-P). Two lengths of pre-Swagelok fitted ¼" outer diameter (OD) tubing are included with your eosMX(-P) equipment. The bare ends of this tubing are fitted with ¼" to 6 mm tubing adapters. Two lengths of 6 mm OD tubing should be connected to the provided adapters. Gasmet ports are most often metric (though some analyzers can be special-ordered with imperial ¼" push-connect ports). Please note the 6 mm OD tubing (and Swagelok fittings for the DX4015) are not included and should be provided by the customer.

With the Gasmet analyzer powered off, connect the Swagelok ends of the provided tubing to the **Analyzer Inlet and Outlet** ports on the eosMX(-P). Connect the other 6 mm lengths of tubing to the **Sample** port of the DX4015 (**Sample In** port in the DX4040) and the **Out** port of the DX4015 (**Sample Out** port in the DX4040), respectively. When using the DX4015, hand tighten the Swagelok nuts and then turn a further 1/4" turn to secure using a wrench (see **Figure 16**). If connecting to a DX4040, use its quick-connect fittings and snap into the corresponding front panel port.



Figure 16. Left: Out, Zero In and Sample ports on the DX4015. Right: Inlet (left) and outlet (right) ports on the eosMX-P.

Connect the two USBs from the eosMX(-P), DATA and CONTROL, to the desktop PC that will be running the Calcmeter Pro software and check the following (see [AN0016](#) for more information):

1. Check that the chemical formula (e.g. CO₂ for carbon dioxide) is present in the species name.
2. For the best balance of data density and analytical accuracy, navigate to Options > Measuring Times and set the Measuring interval to 20 s and the Sampling time to 18 s.
3. Ensure the Calcmeter software is logging data in a format expected by the eosAnalyze-AC software. Under Options > Autosave Results, Create Result Files by Date, and Save residuals to results file should be checked. Change the default Save To File (.TXT) filename to "DATA".

Note: The **Sample** port is required in order for the gas analyzer to draw chamber samples, however the Out port need only be connected if you are interested in recirculating the sampled gas back to the chamber. Recirculation is recommended, as this minimizes the impact on the soil system and thus allows for unbiased flux measurements.

6 eosLink-MX Scheduling Software

6.1 Overview

The eosLink-MX software logs temperature, pressure and peripheral data from up to twelve connected eosAC-LT/LOs, while also serving as the control panel for the eosMX(-P) multiplexer. The eosLink-MX software comes as part of the "eosAnalyze-AC.zip" folder and can run immediately after it is uncompressed.

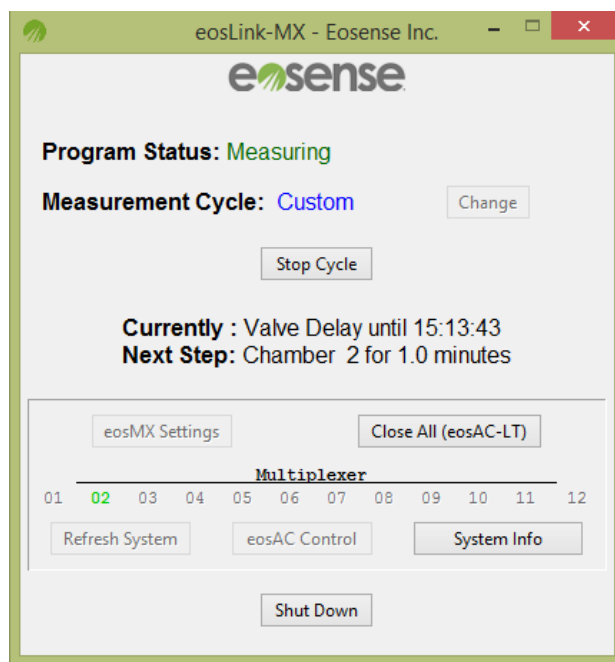


Figure 17. eosLink-MX main window.

The main software window shows the current connection status (Idle, Searching, or Measuring), the type of Measurement Cycle (Default or Custom), the current and next steps in the cycle, and the eosMX(-P) ports with detected eosAC-LT/LOs (see **Figure 17**). Once a Measurement Cycle is configured, clicking the **Start** button will begin the cycle, with a new option appearing to stop the cycle.

As each step in the cycle completes, the main window will be updated to show the new current step (with time remaining) and the next step in the cycle (with duration). The numbers underneath the "Multiplexer" heading will also update, with unused multiplexer ports grayed out, and currently closed chambers in bolded **green text**. If the cycle is set to loop, it will continue until manually stopped, otherwise the program will return to an idle status when the cycle is complete.

The current cycle should always be stopped using the **Stop Cycle** button and the software should be closed using the **Shut Down** button. In older versions of the software, if eosLink-MX is closed by clicking the “X” at the top-right of the screen, the software will minimize and continue to run in the computer’s System Tray.

The **eosMX Settings** button is not available at this time. The **Close All (AC-LT)** button can be used to control all connected eosAC-LT/LOs when collecting the chambers from the field. The **Refresh System** button will scan all 12 eosMX(-P) ports again, updating the chamber IDs associated with each port. The **System Info** button will be covered in [Section 6.3](#). Finally, the **eosAC Control** allows you to send Close and Open commands to the eosAC-LT/LOs connected to the eosMX(-P). The two checkboxes (“Lock eosAC motor after opening?” and “Override Open Limit Switch”) are for eosACs only, so will not be covered in this manual.

6.2 Measurement Cycle

From the main eosLink-MX window, the measurement cycle can be configured by clicking the **Change** button. This brings up the **Create Measurement Cycle** window that allows the user to choose the number and type of measurement steps, as well as **Save** or **Load** custom cycles (see [Figure 18](#)). Checking the **Use Default** box will reset the measurement cycle to a loop through each detected eosAC-LT/LO using 10 minute measurements.

As the **Number of Measurements** is increased, steps will be added to the scrolling window, to a maximum of 50. To access the **Edit Measurement** window, click on one of the steps in the default measurement cycle. The **Measurement Type** can be set to one of 12 eosMX(-P) ports (Chambers 1-12) or an Idle/Delay period (see [Figure 19](#)). The duration of either choice is displayed in seconds. The Idle/Delay option can also be set to wait until the next hour according to the current system time.

Checking **Loop Cycle** will cause the specified measurement cycle to begin from the first step each time the cycle completes. Checking **Randomize Chamber Measurements** instructs the software to randomly sample from each step in the measurement cycle.

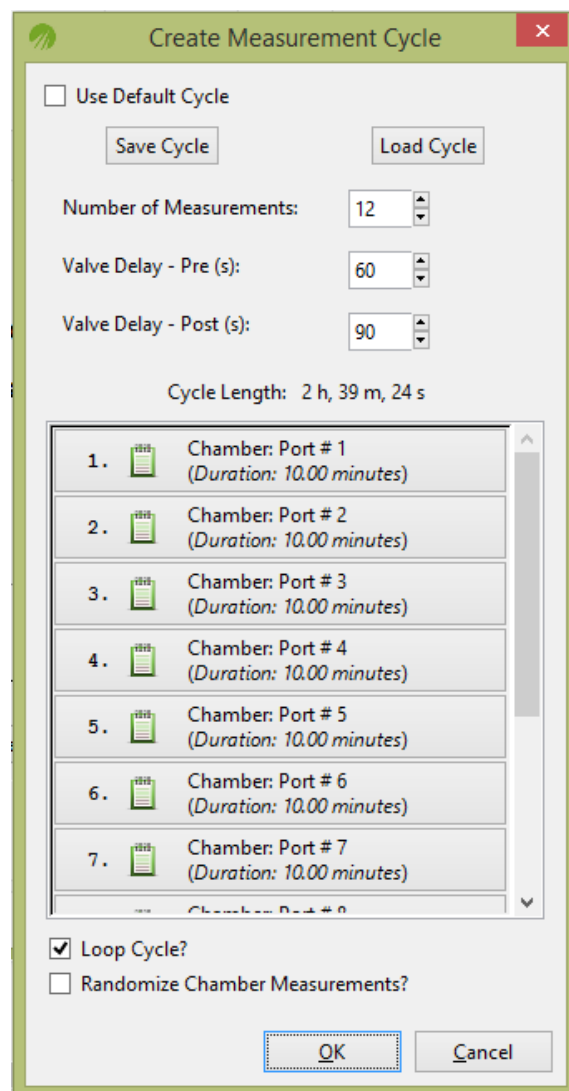


Figure 18. The Create Measurement Cycle window.

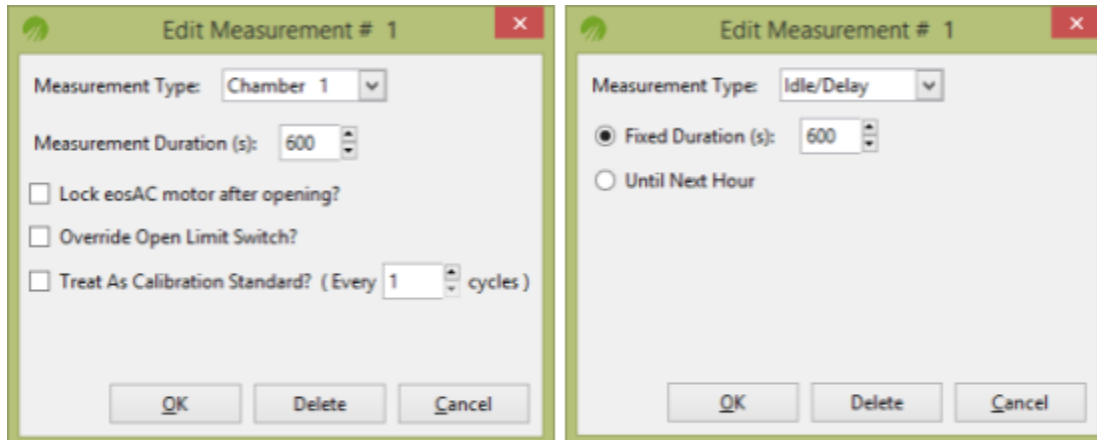


Figure 19. Edit Measurement window - the Measurement Type can be set to Chamber 1 - Chamber 12 (left) or an Idle/Delay period (right). The first two checkboxes are for eosACs only and are not applicable to eosAC-LT/LOs.

The **Valve Delay** options in the Create Measurement Cycle window specify the amount of time to wait between starting to draw gas from the chamber and the chamber closing (“**Pre**”) and the length of time to wait between the chamber opening and the end of gas being drawn from this chamber (“**Post**”). The optimal setting for these delays varies depending on a number of factors - increasing with tubing length and other factors that increase the total system volume, and decreasing with increased flow rate. We recommend setting these Pre and Post values to **at least 45 and 90 seconds, respectively**, but **strongly recommend you review these settings after collecting representative field measurements** in order to prevent data issues. Please see [AN0011](#) for more information about setting valve delays and data deadbands.

6.3 System Info and Chamber Settings

A number of chamber specific notifications can be viewed by clicking on the **System Info** button (see **Figure 20**). This window contains a tab for each of the twelve possible eosAC-LT/LOs, showing the most recently collected temperature and pressure data, as well as the current status of the chamber and any related warnings / errors. If eosAC-LT/LOs are experiencing issues, this is the first place to look for diagnostic and troubleshooting purposes.

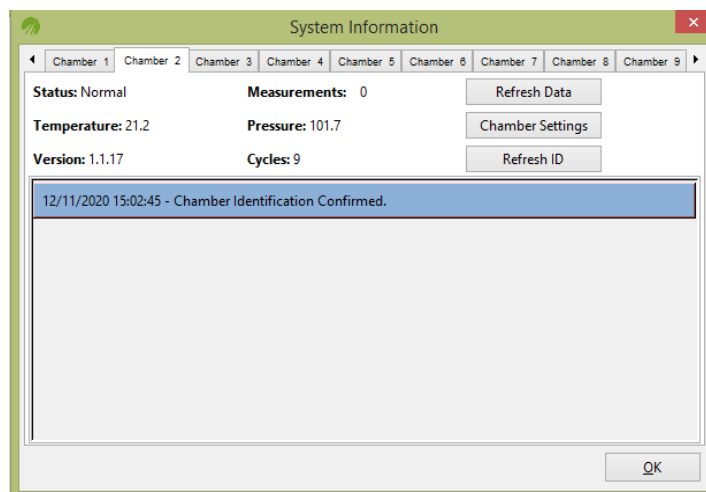


Figure 20. System Information window

The **Refresh Data** button will update the displayed chamber data and the **Refresh ID** will update the current chamber connected to that eosMX(-P) port. A number of chamber parameters can be accessed through the **Chamber Settings** button (see **Figure 21**), including several options to modify how the chamber opens or closes.

Note: Please do not change any settings until given instructions from Eosense Support.

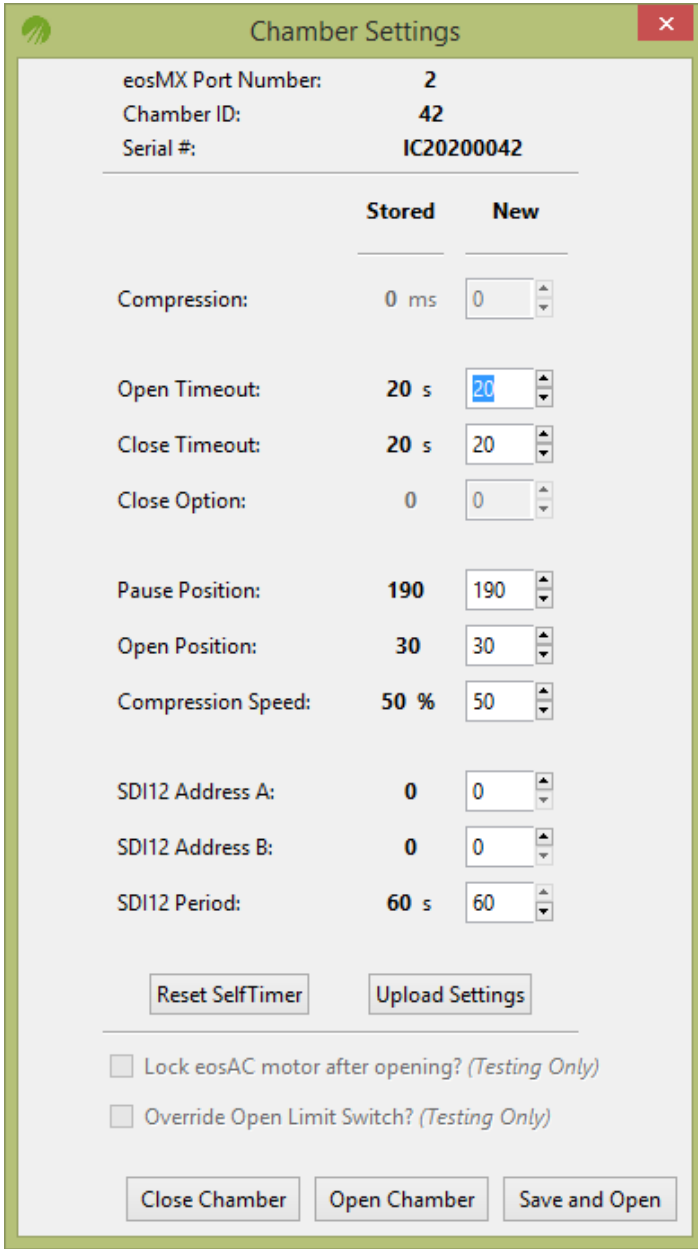
Note that the chamber will be instructed to open when this window is launched, and some settings may not be accessible depending on the type of chamber (eosAC-LT/LO or eosAC) and current firmware version of the chamber. The top of the screen shows the current eosMX(-P) port, Chamber ID and Serial Number of the connected chamber.

The **Open and Close Timeout** lengths govern how long the chamber will attempt to open or close (i.e. drive the actuator) before giving up and recording a timeout error.

The **Open Position** controls the angle at which the chamber will remain open between measurements. An Open Position of “0” is fully open; increasing this value will instruct the actuator to move the chamber dome down closer to the lip of the chamber.

The **Pause Position** controls where the chamber will pause when closing in order to minimize the induced pressure differential. The minimum setting of “180” will instruct the actuator to pause the chamber dome well above the chamber lip; as with the Open Position, increasing this value will tell the actuator to move the chamber dome closer to the bottom of the chamber.

The eosAC-LT/LO uses a dynamic closing speed to minimize pressure effects and reduce power consumption when closing the chamber. The chamber gradually decreases its speed from 95% to 30% of full speed when closing between the set Open and Pause Positions (see **Figure 22**).



	Stored	New
eosMX Port Number:	2	
Chamber ID:	42	
Serial #:	IC20200042	
Compression:	0 ms	0
Open Timeout:	20 s	20
Close Timeout:	20 s	20
Close Option:	0	0
Pause Position:	190	190
Open Position:	30	30
Compression Speed:	50 %	50
SDI12 Address A:	0	0
SDI12 Address B:	0	0
SDI12 Period:	60 s	60

☐ Lock eosAC motor after opening? (Testing Only)

☐ Override Open Limit Switch? (Testing Only)

Figure 21. The Chamber Settings window.

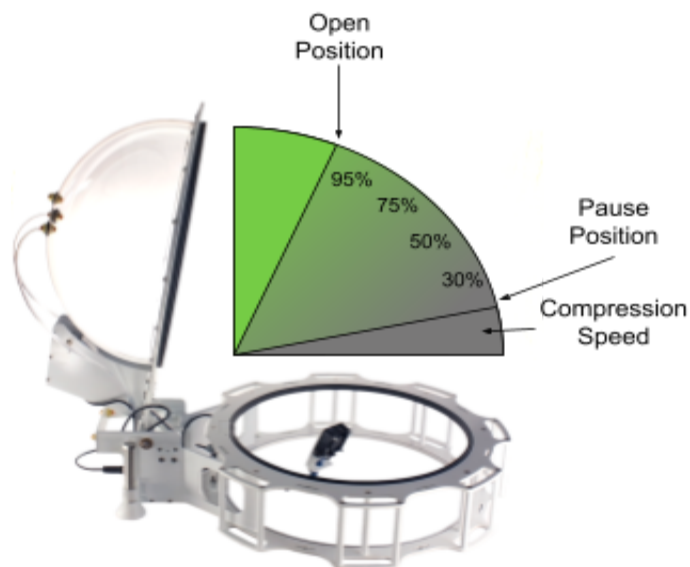


Figure 22. Dynamic closure of the eosAC-LT/LO.

The **Compression Speed** controls the speed of chamber movement between the set Pause Position and fully closed. **Figure 22** shows the location of the Open and Pause Positions, as well as where the Compression Speed set by the user in the Chamber Settings window will take effect. In cold or adverse weather conditions, users may need to increase Compression Speed if they find that they are getting Timeout Close errors; however, this setting should not be altered unless advised by Eosense Support.

The **SDI12 Address A & B**, and **SDI12 Period** should not be changed unless done so by Eosense Support. The default values for these settings should be 0, 0, and 60 seconds as shown in **Figure 21**.

All of the settings above are shown as Stored values (i.e. what the chamber is currently set to) and New values (the custom value that a user can upload). Once the desired New settings are chosen, click **Upload** to update the settings used by the chamber. You should then see the Stored settings change to reflect this update. The Close and Open Chamber buttons at the bottom of the screen can be used to test the new settings. Finally, the **Save and Open** button in the bottom right confirms any uploaded settings and returns to the main software window.

Note: The Compression setting at the top of the Chamber Settings window and the checkboxes at the bottom of the Chamber Settings window (“Lock eosAC motor after opening?” and “Override Open Limit Switch”) are for eosACs only, so will be greyed out and will not be covered in the manual. Additionally, the **Reset SelfTimer** button is not applicable at this time.

7 eosAnalyze-AC Analysis Software

7.1 Setup

The **eosAnalyze-AC** software requires no installation on the part of the user. Simply copy the zipped folder to a suitable directory on the PC in question, then unzip the file (which contains one folder titled “eosAnalyze-AC”). None of the files in this folder should be removed or changed in any way. If this occurs, simply delete the entire folder from your PC and re-extract from the zip file to recreate the folder.

The program executable is labeled “eosAnalyze-AC.exe”, and creating a shortcut to this file program on the Desktop is recommended. Double clicking this icon or a Desktop Shortcut will launch the software. Please note that the data collected by the companion program **eosLink-MX** is required in order to import flux measurements, as this data (in the form of .MXL or FRMonitor files) records chamber events and metadata. [Section 6](#) provides more information on how to use this program.

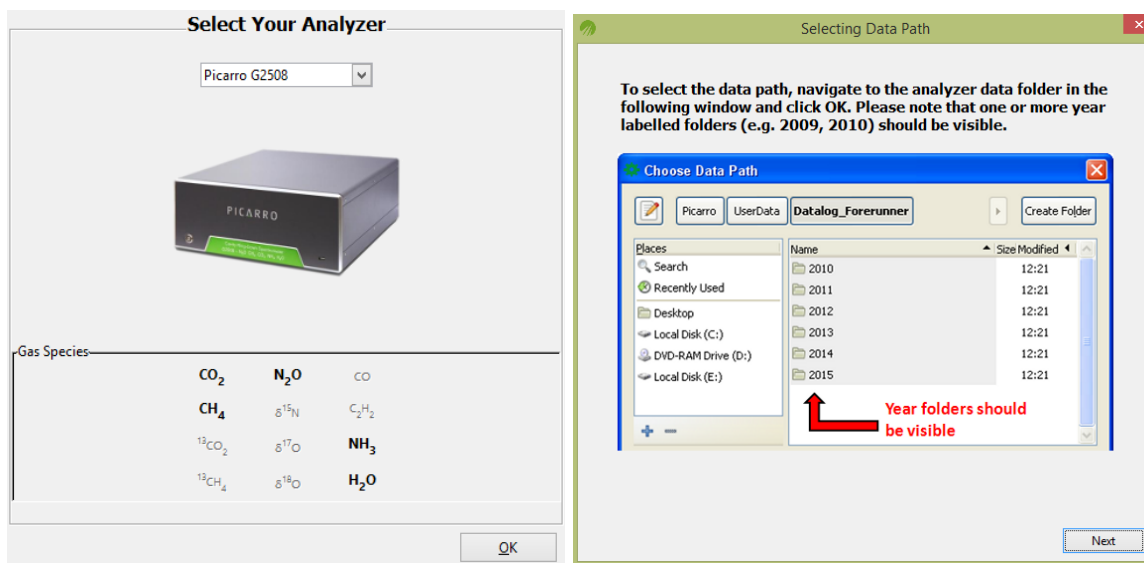


Figure 23. Select Analyzer (left) and Select Data Path (right).

The first time eosAnalyze-AC is run, the Analyzer Type, Analyzer Data Path, and Chamber Data Source need to be selected, and the user will be prompted to choose these options sequentially. The **Select Your Analyzer** window has a drop-down menu for selecting the gas analyzer used to collect data (see [Figure 23](#)). The **Choose Data Path** window will also pop-up and ask you to select the folder where the analyzer data is located. The **Chamber Data Source** window prompts users to choose one of four options. For most applications, this should be set to either eosLink Log Files (FRMonitor) or .MXL Log Files (.MXL) for newer software versions ([see section 7.3 for more details](#)).

These choices will be saved and loaded on each subsequent use of the eosAnalyze-AC software. If required, these settings can be changed from the **Options⇒Equipment** menu (Analyzer Type and Data Source) or **Data⇒Analyzer Data Path** or **Chamber Data Path**. Please note that incorrect measurement data or processing issues may occur if these options are set incorrectly. The currently selected Analyzer and Chamber Data Source will be displayed in the software's title bar.

7.2 User Interface

Once the program is running, the main viewing window will appear. This window consists of two main areas: the Plotting section and the Measurements section. Both sections will be empty until data has been imported (see [Figure 24](#)).

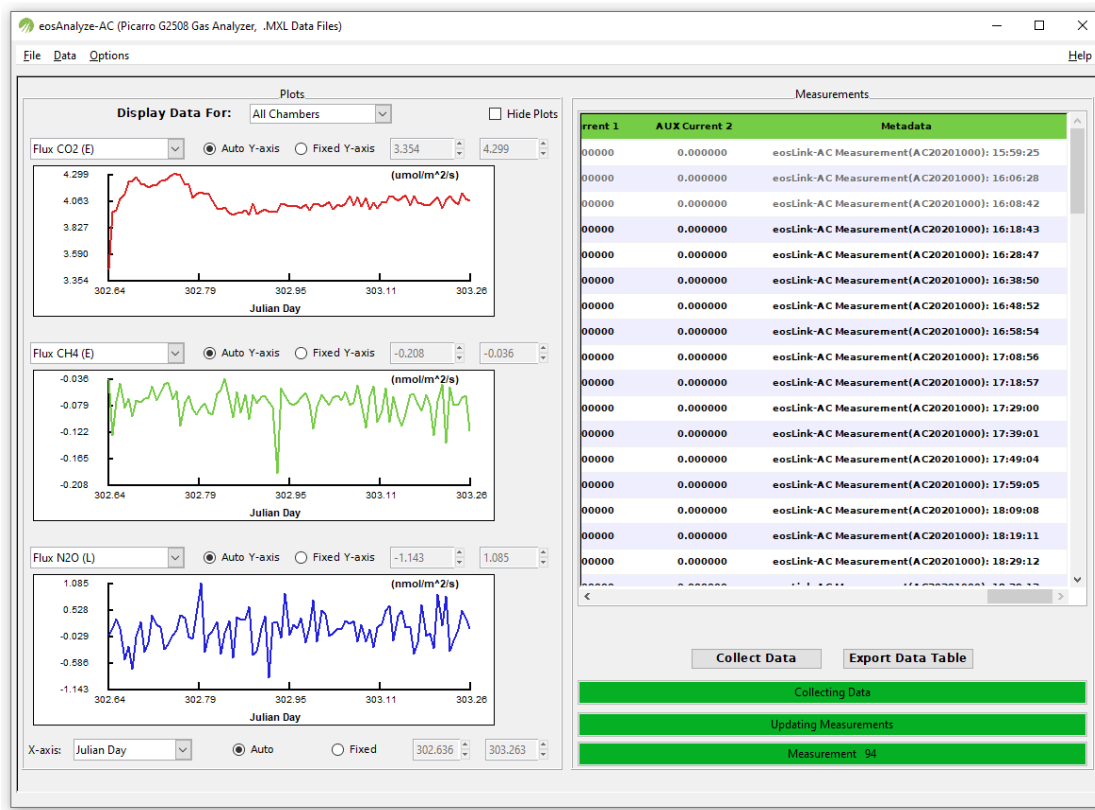


Figure 24. eosAnalyze main viewing window with Plotting section (left) and Measurements section (right).

The **Plotting** section on the left-hand side of the main window allows the user to quickly inspect up to three different time-series plots at a time from the chamber measurements collected. The **Display Data For** drop-down menu can be set to All Chambers or a specific Chamber number. Each of the three plots can be changed using the drop-down menus in the upper left of their areas, and the Y-axis behavior can be toggled between Automatic and Fixed scaling. The X-axis type and scaling for all three plots can be changed using the buttons at the bottom of the plotting area.

The two buttons underneath the **Measurements** section on the right-hand side of the main window allow the user to **Collect Data** and then **Export Data Table**. Chamber measurements detected by the program will populate a list in the Measurements area to the right of the main window. This scrolled window allows the user to view a customized table of data from the analyzer and chamber, as well as modify individual measurement parameters such as the deadband range or chamber offset. In addition to these two main sections, a number of options are available from the menu toolbar at the very top of the screen (**File**, **Data**, **Options**, **Help**).

7.3 Analyzer and Chamber Data Paths

The **Analyzer Data Path** corresponds to the location of stored analyzer data files on the computer. This option should be set after the first start-up of the eosAnalyze-AC software, but can always be changed by selecting **Analyzer Data Path** from the **Data** menu at the top of the screen. This will prompt the user to specify a data path using the **Choose Data Path** popup window. This screen will also provide instructions based on the analyzer selected at first setup or through the **Options**⇒**Equipment** menu at the top of the screen.

Note: The correct folder is selected by navigating to the root level of the data folder (see **Figure 25**). In the case of Picarro analyzers, this is the folder containing annual folders such as “2019”. For ABB-LGR analyzers, this can be any



folder of unzipped analyzer files. For Gasmet analyzers, this is typically the /CalcmResults folder. Once you have navigated to the correct location, click **OK** to set the path.

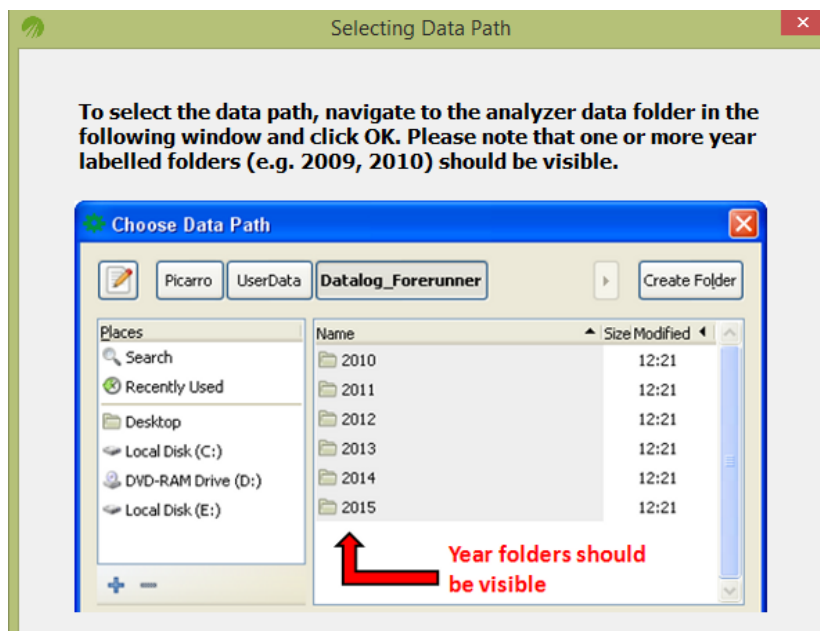


Figure 25. Analyzer Data Path location example for a Picarro analyzer.

The **Chamber Data Path** option specifies where the eosLink-MX chamber event log files are stored. This option should also be set after first start-up of the eosAnalyze-AC software, but can always be changed by selecting **Chamber Data Path** from the **Data** menu at the top of the screen. Most users will select “eosLink Log Files (FRMonitor)” for Chamber Data Source, so the Chamber Data Path should be set to the main Eosense software folder where these files are located (see **Figure 26**). If using “.MXL Log Files (.MXL)”, the Chamber Data Path should be set to the folder named for the multiplexer’s serial number within the main Eosense software folder. The **Chamber Data Source** can always be changed by navigating to **Options⇒Equipment**.

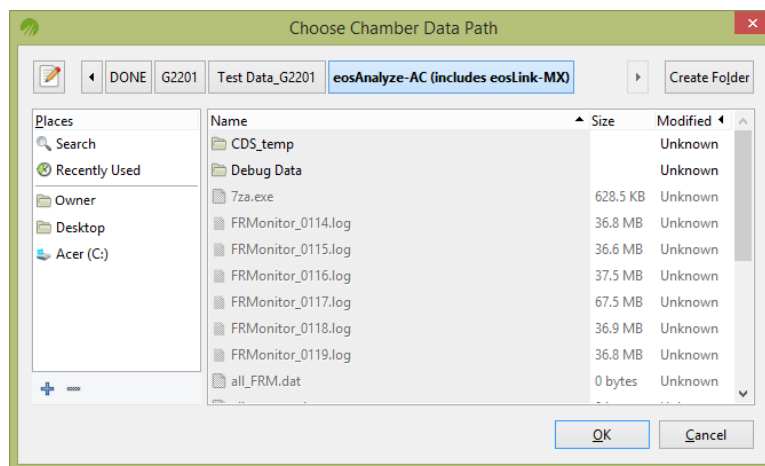
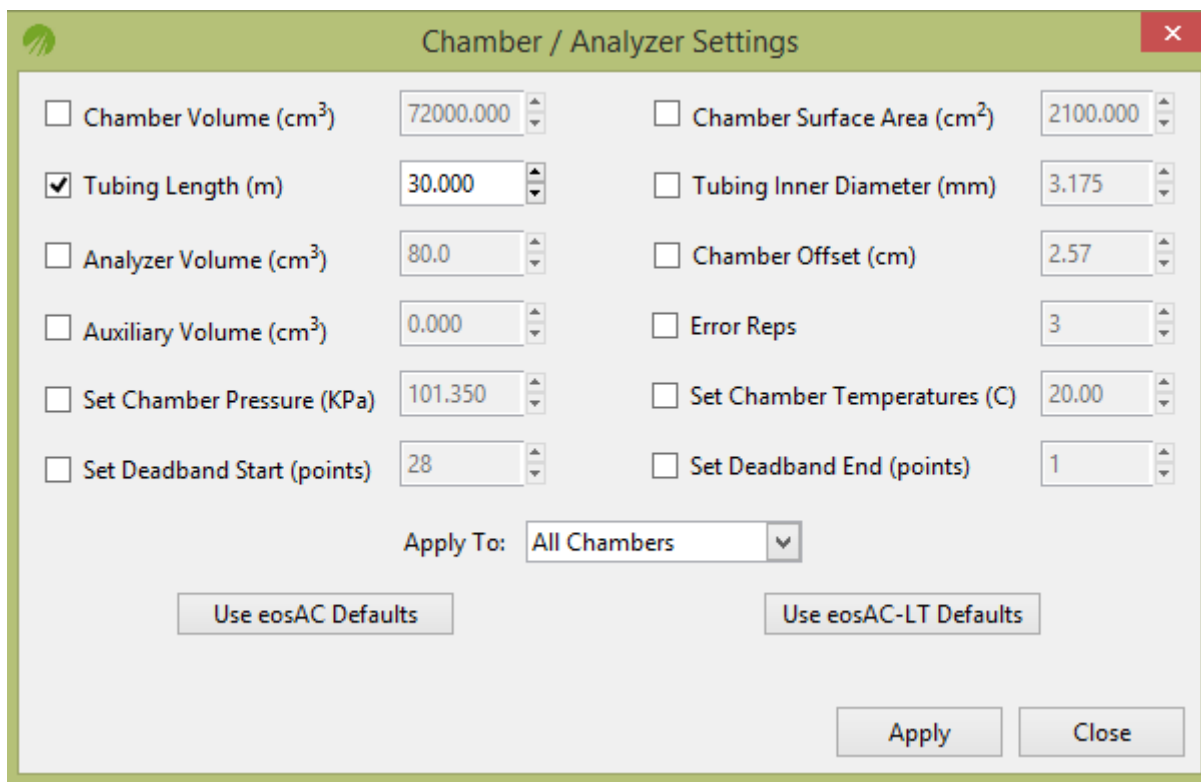


Figure 26. Chamber Data Path set to the main Eosense software folder where FRMonitor .log files are stored.

NOTE: Analyzer Data Path, Chamber Data Path, Chamber Data Source are viewable and changeable from the Choose Data Interval window (please see [Section 7.5.1](#) for more information).

7.4 Chamber and Analyzer Settings

The **Chamber and Analyzer Settings** window can be found under the **Options⇒Equipment** menu at the top of the screen, and allows the user to modify a number of chamber and analyzer specific settings (see **Figure 27**). The majority of these settings are related to the total volume occupied by the chamber, the analyzer cavity and the tubing connecting the two. These settings can be changed after data has been imported; however, this will require reprocessing of all of the flux data, so configuring these values before collecting data is recommended. The **Apply To** drop-down menu at the bottom of the window specifies which set of chamber measurements to modify.



Setting	Value
☐ Chamber Volume (cm ³)	72000.000
☒ Tubing Length (m)	30.000
☐ Analyzer Volume (cm ³)	80.0
☐ Auxiliary Volume (cm ³)	0.000
☐ Set Chamber Pressure (KPa)	101.350
☐ Set Deadband Start (points)	28
☐ Chamber Surface Area (cm ²)	2100.000
☐ Tubing Inner Diameter (mm)	3.175
☐ Chamber Offset (cm)	2.57
☐ Error Reps	3
☐ Set Chamber Temperatures (C)	20.00
☐ Set Deadband End (points)	1

Apply To: **All Chambers**

Buttons: Use eosAC Defaults, Use eosAC-LT Defaults, Apply, Close

Figure 27. Chamber and Analyzer Settings in eosAnalyze-AC.

The tubing volume is expressed via the length (m) and inner diameter (mm) for convenience. The chamber and analyzer volumes should remain unchanged under normal operation, as the **Auxiliary Volume** and **Chamber Surface Area** options allow the user to include any aftermarket modifications they may have made to the system (with the latter corresponding to the total surface area exposed to the soil). The final volume-related setting is **Chamber Offset**. This value represents the distance between the top of the soil collar and the soil surface, with the minimum value being 2.57 cm. This offset is then transformed into an additional volume by assuming that the soil surface area within the collar is equal to the chamber's surface area.

The **Error Reps** setting dictates how many fitting iterations will be used to estimate the parameter error for the linear and exponential flux/Keeling intercept values. For demonstration purposes, this value defaults to 3. Note that changing this value can dramatically increase processing time, depending on the amount of data collected. A more in-depth explanation of this error estimation is available upon request. Finally, a global temperature and pressure can be applied to all chamber measurements using the **Set Chamber Pressure** and **Set Chamber Temperature** options. These temperature and pressure values will override those reported by the eosAC-LT/LO chambers, and should only be applied in the event of chamber data loss or malfunction.

7.5 Chamber Measurements

7.5.1 Importing Data

Analyzer data can be imported by clicking the **Collect Data** button below the Measurements window. This will prompt the user to select a time and date range in which to search for chamber measurements (see **Figure 28**). This data interval does not need to be exact; however, only chamber measurements falling within this range will be processed. The **Analyzer Local Time** option at the bottom is used to correct for any UTC offsets that may exist: this value should be set to correspond with the analyzer's local clock *at the time the chamber data was measured*.

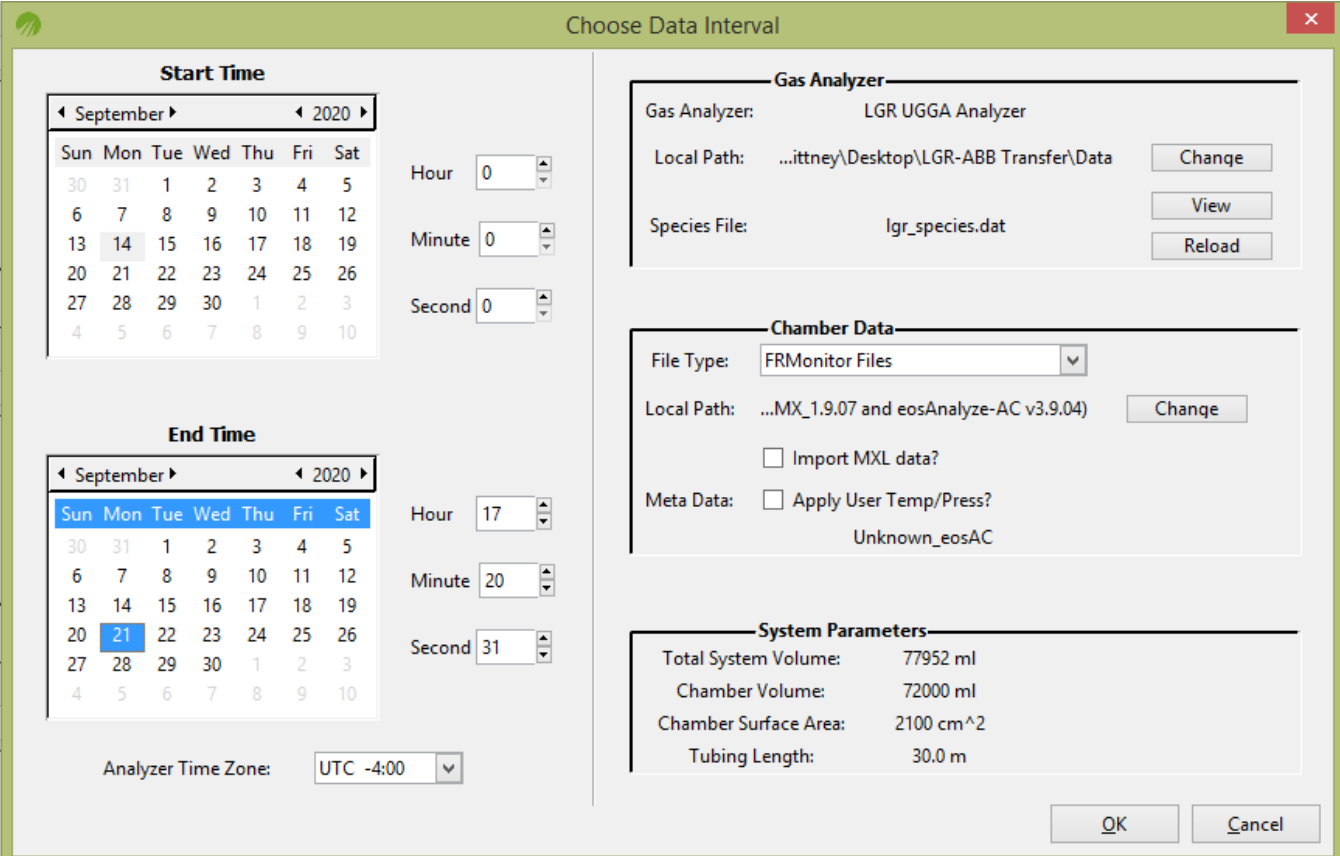


Figure 28. The Choose Data Interval window. Note the Analyzer Time Zone drop-down menu at the bottom of the window.

The right-hand side of the **Choose Data Interval** window displays the current settings for the software, including information about the Gas Analyzer (Analyzer Type and the Analyzer Data Path, the Chamber Data (File Type and Chamber Data Path), and some common System Parameters. The Analyzer Data Path and Chamber Data Paths can be changed from this window by clicking the **Change** button next to **Local Path** under the Gas Analyzer or Chamber Data sections, respectively. The Chamber Data File Type can also be changed using the corresponding drop-down menu.

Note: The Analyzer Type (under Gas Analyzer section) and the System Parameters (i.e. Chamber and Analyzer Settings) section can only be changed by navigating to the **Options⇒Equipment** menu.

Once the data interval has been set by clicking **OK**, the program will begin searching through the chamber data (FRMontior .log or .MXL files) or to find chamber events, and will then match these events to the corresponding analyzer data files to produce a set of flux estimates. During this process many Graphic User Interface (GUI) elements will be

disabled as the Measurement and Plotting sections are updated. Progress bars indicating the status of the data search and measurement processing can be found in the area directly below the **Collect Data** and **Export Data Table** buttons (see **Figure 29**).

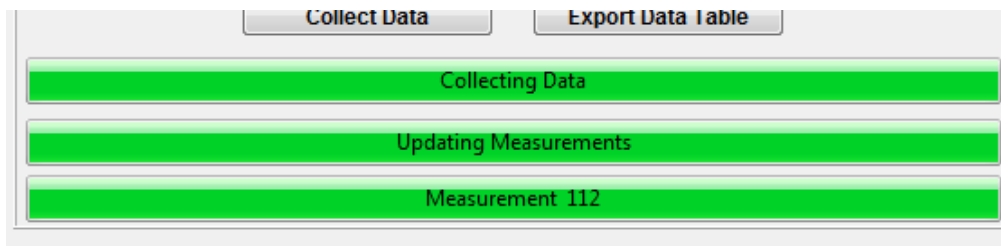


Figure 29. Progress bars indicating status of data search and measurement processing.

As new measurements are found, they will be used to populate the Measurement and Plotting sections of the main window. Once the entire data interval has been searched and all fitting is complete, normal GUI interaction will be restored. Additional measurements can be added to the same data table by clicking the **Collect Data** button again, and by specifying a new data interval. Any measurements that have already been added to the Data Table will be ignored on subsequent searches.

7.5.2 Data Table Fields

Once analyzer data has been parsed for the eosAC-LT/LO measurements, a number of data fields will be displayed in the Data Table (see **Figure 30**). These default parameters are analyzer specific, but generally include gas flux, gas concentration, and analyzer diagnostics information. Fields that are not currently displayed can be added by clicking on the Data Table header (or from **Data⇒Customize Data Table**), and customizing the table using the pop-up window (see **Figure 31**). From this window the number of columns can be adjusted, as well as what parameter will be displayed in each column.

Measurements						
#	Chamber	Julian Day	Duration	Mean CO2	Mean CH4 (HP)	Mean CH4 (HR)
1	12	138.99	0:21:51	437.953483	1.921688	1.884723
2	1	139.01	0:21:56	437.499731	1.927777	1.891095
3	2	139.03	0:21:53	437.810043	1.931128	1.894530
4	3	139.05	0:21:55	435.524115	1.944864	1.910288
5	4	139.07	0:21:52	447.609674	1.920039	1.886054
6	5	139.10	0:22:18	436.970618	1.948540	1.914508
7	6	139.12	0:22:04	439.525089	1.945779	1.908958

Figure 30. Examples of parameters included in the Data Table and chamber errors flagged by red numbers on measurements 3 and 6.

If any chamber errors are detected while importing data, the software will flag this with a “Chamber Errors Detected” warning. Chambers with errors are identified with a **red** measurement number (please see **Figure 30**). Mousing over the red number will indicate the type of error. Please contact Eosense Support for more information about these errors.

In addition, the timestamp used for each line of the Data Table can be changed to one of three options:

- **Julian Day** - Fractional days elapsed since January 1 of respective year
- **Date/Time** - Timestamp using MM/DD/YYYY HH:MM:SS format
- **Hours Elapsed** - Hours elapsed since start of first measurement

Note: The number/order of columns and the chosen timestamp will be reflected in any exported data. You may need to scroll the Data Table in order to view all columns.

The flux estimates for each chamber measurement will default to a unit generally appropriate for the gas in question ($\mu\text{mol}/\text{m}^2/\text{s}$ for CO_2 and NH_3 , $\text{nmol}/\text{m}^2/\text{s}$ for CH_4 and N_2O). These can be changed from the Data menu under Flux Units, either prior to or after data collection. This window allows the flux units to be specified arbitrarily from various mass, area and measurement time settings, such as $\text{kg}/\text{km}^2/\text{year}$ or $\text{nmol}/\text{ha}/\text{hour}$ (see **Figure 32**).

Note: Some combinations of units may be rejected if they would typically produce extremely large (e.g. $\text{nmol}/\text{km}^2/\text{yr}$ for CO_2 flux) or extremely small values (e.g. $\text{kg}/\text{m}^2/\text{s}$ for CH_4 flux).

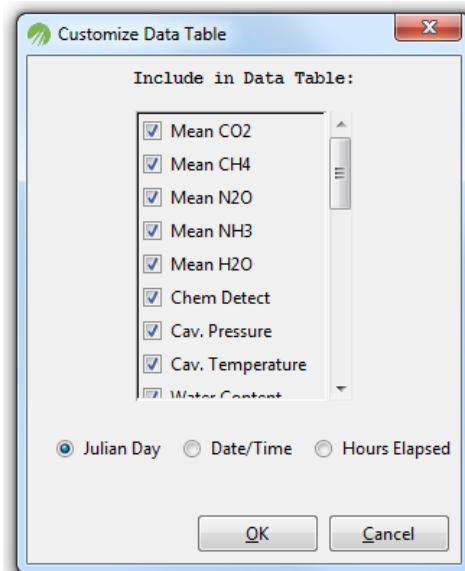


Figure 31. Customize Data Table window.

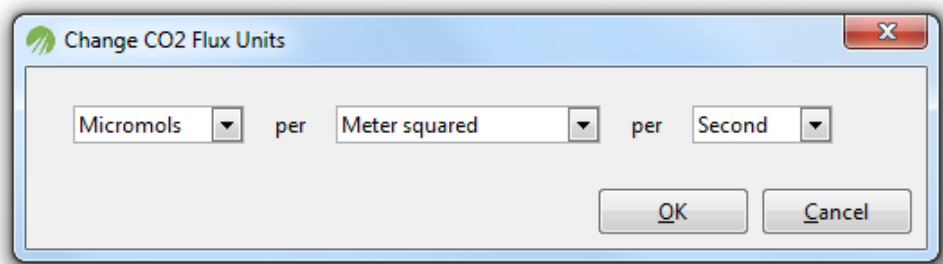


Figure 32. Change flux Unite Window.

7.5.3 Filtering Data

Chamber data can be filtered in order to automatically disable any measurements which qualify as outliers. The outlier range is a field-specific setting, accessed from **Outlier Filters** in the **Data** menu (see **Figure 33**). The **Data Field** drop-down menu selects which measurement value to set the filter for, with all ranges defaulting to **No Filter**. Selecting a filter will cause measurements outside the allowable range to be disabled (grayed out), meaning that they will not appear in the main window's plots or any exported data files. Please note that this feature is not intended as a replacement for robust statistical post-processing, but as a means to quickly remove outliers.

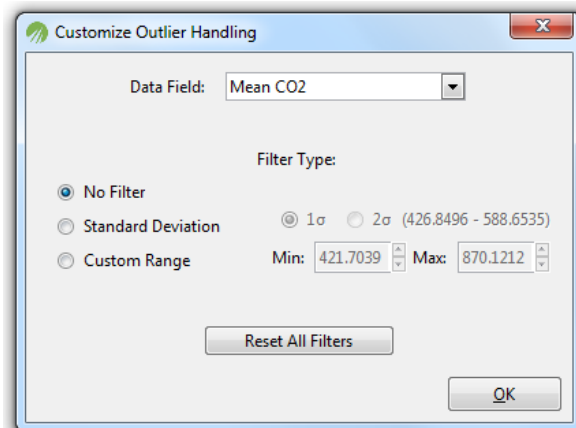


Figure 33. Customize Outlier Handling window

Choosing **Standard Deviation** allows the user to choose the distance from the mean value a measurement can be before it is considered an outlier. The user can choose between 1 or 2 for the allowable range, with the corresponding minimum and maximum values shown in parentheses. For normally distributed data, this represents inclusion ranges of 68 and 95% of the total range, respectively.

By choosing **Custom Range**, the inclusion range can be set arbitrarily, within the limits of the value's global minimum and maximum. This can be used to select only certain parts of the dataset, or to avoid problematic measurements (e.g. high Water Content or ChemDetect). Finally, clicking **Reset All Filters** will select **No Filter** for each data field. Please note that this will enable **all** chamber measurements, including those manually disabled by the user through the Measurement Settings window.

7.5.4 Hiding Data Files

In the event that any of the default data fields are unlikely to be useful for your application, they can be hidden ("ignored") from all eosAnalyze-AC options. To ignore a data field, select **Ignored Data Fields** from the **Data** menu, choose a field from the drop-down menu and then click **Add**. To remove an ignored field, simply click the corresponding name in the scrolling list to the right (see **Figure 34**). Ignored data fields will not show up as options in the Plotting selection or data table customization menus until they are removed from this list.

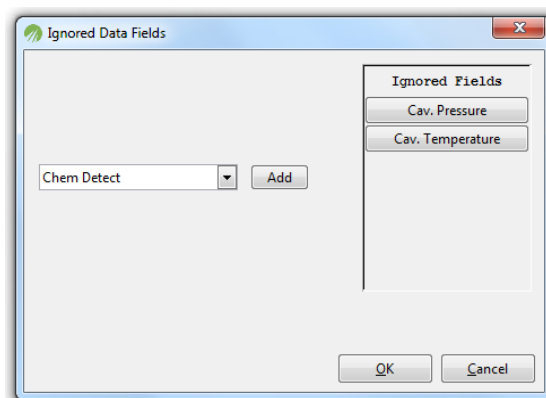


Figure 34. Ignored Data Fields window.

7.6 Data Processing

Individual measurements can be viewed in greater detail by clicking on them in either the Data Table or one of the main plots, which brings up the **Measurement Settings** window (see **Figure 35**).

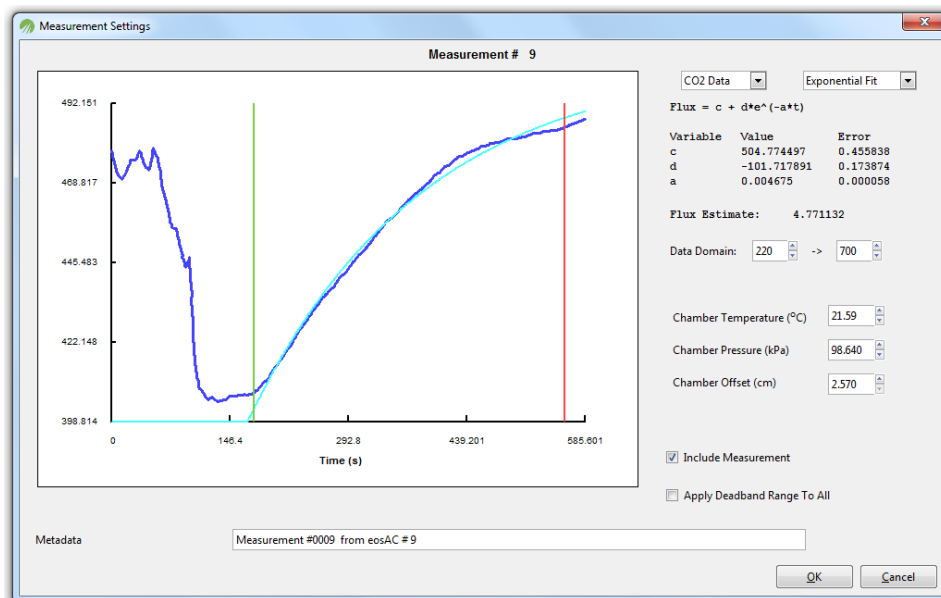


Figure 35. Measurement Settings window.

The flux fits and Keeling plot intercepts (isotopic analyzers only) for any relevant gases can be viewed using the drop down menus in the top-right of the window. Directly below these buttons are the specific parameter estimates for the shown fit, followed by the current deadband settings. Data from the beginning or end of the timeseries can be omitted by changing these settings using the **Data Domain** spin buttons. Note that changing these options will result in a brief updating period while the fits are recalculated once the Measurement Settings window is closed. The **Apply Deadband Range To All** check box can be checked to apply the deadband setting to all current data table measurements. Please see [AN0011](#) for more information about adjusting data deadbands.

The chamber temperature, chamber pressure and chamber offset (distance between bottom of chamber and soil due to collar) can be modified from their default values as well. The **Use Measurement** check box can be unchecked to exclude the displayed measurement from both the (exported) data table and the main window plots. **Note:** Adjust deadbands before deciding to exclude any measurements, as the Apply Deadband Range To All button will re-select all measurements.

The user can enter a metadata string directly below the Measurement Settings plot. This string can be up to 200 characters long, and is used to make any notes about the measurement/environment or other important details. Holding shift while clicking the plot provides an option to export the current data as a PNG or JPEG image.

7.6.1 Saving and Loading Data

To save a eosAnalyze-AC session, select **Save** from the **File** menu, then choose a filename and path. This creates a .cds settings file and archives all analyzer data for the collected chamber measurements. In the event that this file is transferred to a different PC, the settings file can be used to reload the Data Table and chamber, analyzer, and measurement settings; however, the data can not be re-processed without also transferring the archived folder of analyzer data (see **Figure 36**).

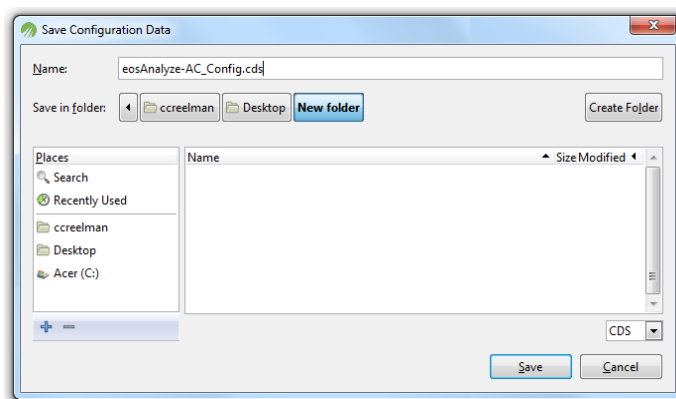


Figure 36. Saving Configuration Data window

To load a eosAnalyze-AC session, select **Load** from the **File** menu, then browse to a .cds save file. Clicking **Open** will repopulate the Data Table as well as load all previously selected plotting, measurement, chamber and analyzer settings. As long as the settings file is loaded on the same PC that created it, measurements can be reprocessed and modified exactly as if they had been newly imported (see **Figure 37**).

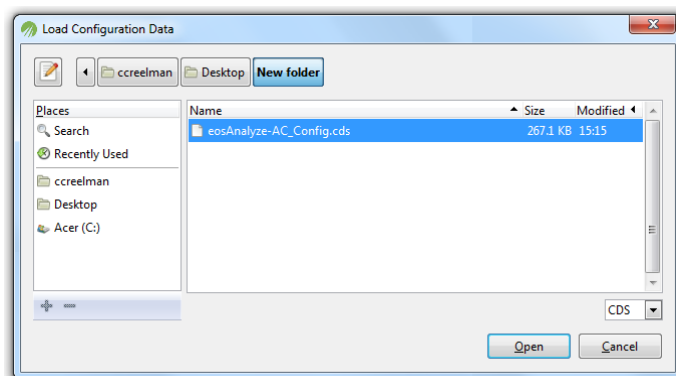


Figure 37. Loading Configuration Data window.

7.6.2 Viewing Data

Along with the Data Table, chamber data can be viewed via three plots on the left of the main window (see **Figure 38**). Each plot can be customized using the drop down data selector, the Y-axis settings and the X-axis settings, and all three can be hidden using the **Hide Plots** checkbox. The style of all three plots can also be modified from the **Plotting Options** window (see **Figure 39**), found under the **Options** menu. Note that if both Lines and Symbols are turned off, nothing will be shown in the plots.

The Y-axis is automatically scaled by default. As long as this option is left unchanged, the (unused) Fixed Y-axis settings will be updated to reflect the current plot zoom. Once **Fixed Y-axis** is selected for the first time, this relationship will be broken, in order to prevent loss of user-specified axis settings.

The X-axis type can be selected at the bottom of the Plotting section, and can be set to Julian Day (since January 1 of that year), Hours Elapsed (since start time) and Measurements (sequential numbering). Unlike the Y-axis settings, switching back to Automatic X-axis scaling will always result in the Fixed X-axis settings being changed along with the plot, to allow for the inclusion of new data. Mousing over a plot will display the X/Y coordinates at that location and holding shift while clicking will save the current plot as an image.

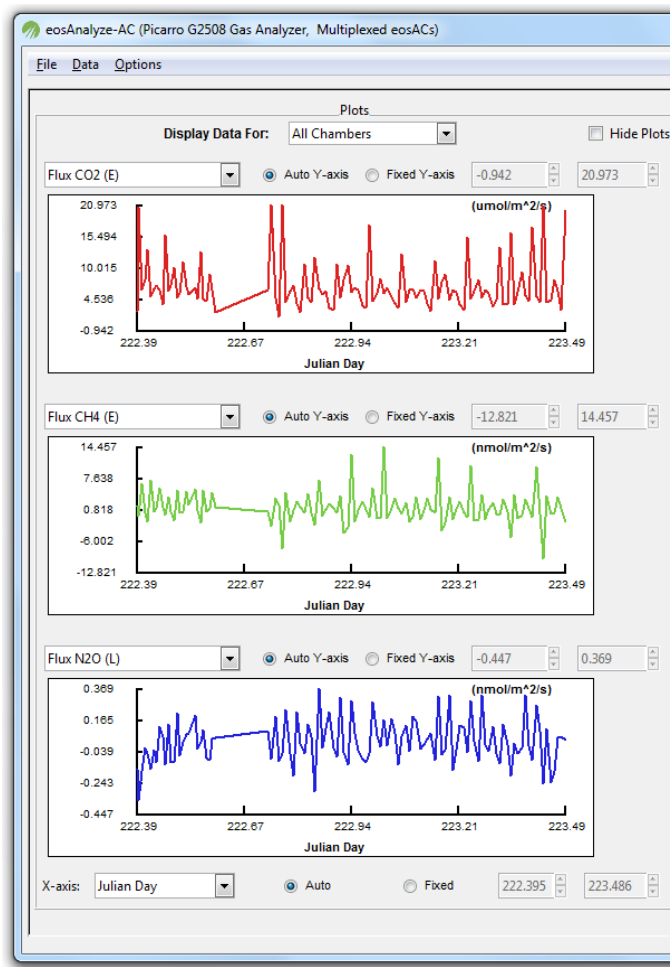


Figure 38. Plotting windows in eosAnalyze-AC.

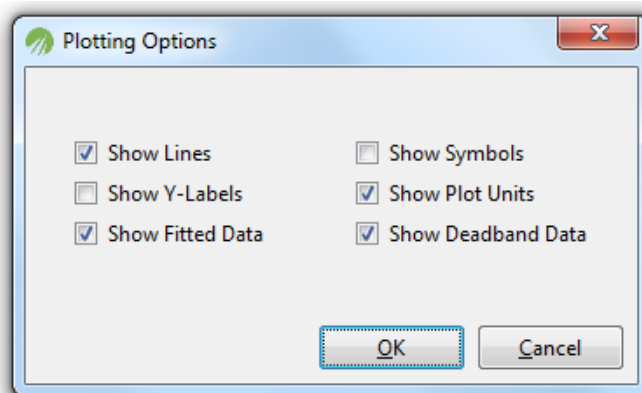


Figure 39. Plotting Options window.

7.6.3 Exporting Data

Once all the chamber data has been collected and fine-tuned, the user can export the Data table as either a .csv or .dat file using the **Export Data Table** button at the bottom left of the screen (see **Figure 40**). This prompts the user for a formatting type, followed by a pop-up window to choose the save location.

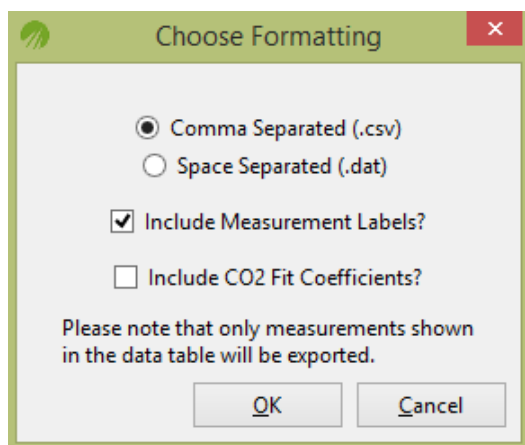
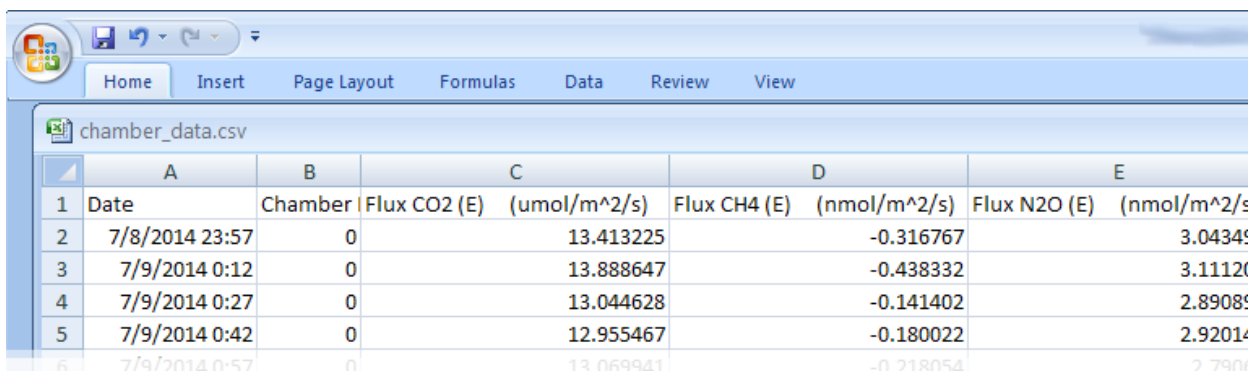


Figure 40. Choose format for exporting data.

Note: Data fields present in the table will be present in this exported file, and that measurements that have been deselected (appearing grayed out) will be excluded. This data can then either be used directly, or easily imported into a spreadsheet for further analysis (see **Figure 41**).



	A	B	C	D	E
1	Date	Chamber	Flux CO2 (E) (umol/m ² /s)	Flux CH4 (E) (nmol/m ² /s)	Flux N2O (E) (nmol/m ² /s)
2	7/8/2014 23:57	0	13.413225	-0.316767	3.04349
3	7/9/2014 0:12	0	13.888647	-0.438332	3.11120
4	7/9/2014 0:27	0	13.044628	-0.141402	2.89089
5	7/9/2014 0:42	0	12.955467	-0.180022	2.92014
6	7/9/2014 0:57	0	13.069941	-0.218054	2.79014

Figure 41. eosAnalyze-AC data exported to Microsoft Excel.

8 Troubleshooting for eosAC-LT/LO and eosMX(-P)

8.1 Coolterm Terminal Application

Typically chamber commands are handled through Eosense software. However, when troubleshooting it is sometimes useful to by-pass the software and communicate directly with the chambers. The use of a terminal program (such as [CoolTerm](#)) allows the user to communicate directly with a chamber. This is most conveniently done through command files - which are text files containing the hex characters that make up different chamber commands. For example, the “! AC - Chamber Close.txt” file, when sent to a listening eosAC-LT/LO chamber, instructs the chamber to close (see **Figure 42**).

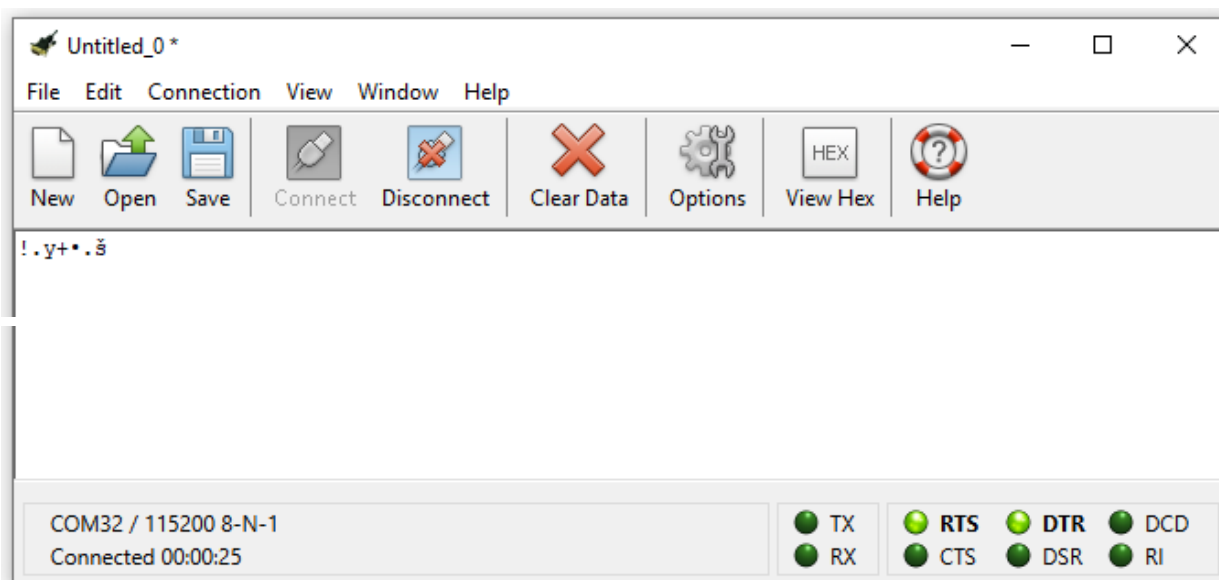


Figure 42. Example response from an eosAC-LT/LO. Responses always start with ‘!’ and are typically 6-9 characters in length.

Unless otherwise specified, all eosAC-LT/LO command files are addressed to **any** listening chambers. If used in conjunction with a modern eosMX(-P) multiplexer, specific addressing may be required to communicate to individual chambers. For ease of use, when using CoolTerm to communicate with eosAC-LT/LO chambers, **have only one chamber connected to the multiplexer at a time**.

Example: Closing an eosAC-LT/LO Chamber

This example walks through the process of using CoolTerm to send a command file to a connected eosAC-LT/LO that will instruct the chamber to close. This could be used to test chamber functionality outside of the typical eosLink-MX software.

1. Connect a single eosAC-LT/LO to an eosMX(-P) Multiplexer via the power/data cable, and connect the eosMX(-P) to your PC using only the **DATA** USB Cord. Ensure that the eosMX(-P) is plugged in and the power switch at the back is set to On.
2. Extract the downloaded .zip file containing the [CoolTerm](#) terminal program and the command files provided by Eosense Support. Be sure to save these files in an accessible folder (we recommend saving both to your computer's desktop).

- Click the Options button from the CoolTerm main window (also found under Connection in the top menu). Click the **Re-Scan Serial Ports** button at the bottom of the **Serial Port** tab, and ensure that the Baudrate is set to 115200, Data Bits are 8, Parity is none, and Stop Bits are 1 (see **Figure 43**).

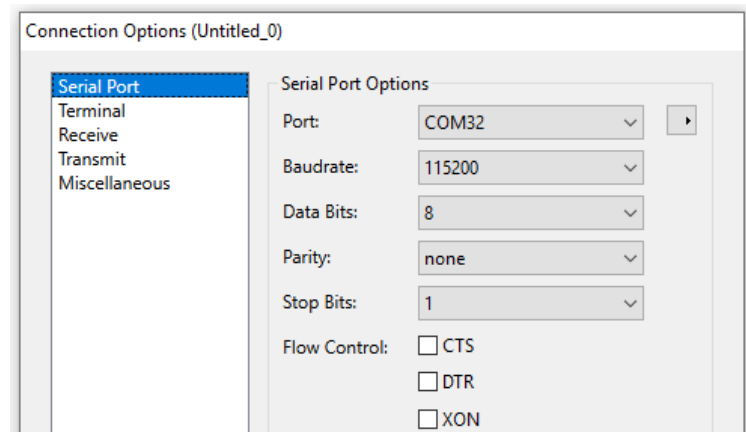


Figure 43. Serial Port Options in CoolTerm.

- Choose a port from the Port drop down menu ("COM32" is selected in the example above). What ports are available depends on your system - for example, some analyzers will have their own devices on COM1 and/or COM2, so try higher ports to start. The use of Windows Device Manager is recommended for determining the correct COM Port.
- Click **OK** to return to the main CoolTerm window, and then click the **Connect** button.
- If the port connects successfully, click the Connection menu and choose "**Send Textfile...**". Navigate to the folder created in step 1 and select the "**! AC - CloseChamber.txt**" file to send. The listening eosAC-LT/LO chamber should respond - this will appear as a series of ASCII characters in the CoolTerm window (see **Figure 42**), followed by the chamber closing.

Other command files can ask the chamber for temperature/pressure data, change the unit's serial number, or place the chamber in an automatic open/close loop.

8.2 Updating eosAC-LT/LO Firmware

eosAC-LT/LO users are able to perform firmware updates through any terminal program (e.g. CoolTerm) in just a few short steps. This requires the use of an eosMX / eosMX(-P) multiplexer and related cables OR a dedicated single-chamber communication cable (available from Eosense by request). Please note that this process differs from that used to update eosAC units. The steps below assume the use of an eosMX or eosMX(-P) for updating eosAC firmware:

- First **disconnect every other eosAC from the eosMX / eosMX(-P)** and then connect only the **DATA** USB cable (CONTROL is not required to update firmware).
- Use Coolterm and the DATA USB cable to open the COM Port corresponding to the eosMX / eosMX(-P) DATA connection (see [Section 8.1](#) for further details).
- Send the "**! AC - Enter Bootloader.txt**" command file (see **Figure 44**).



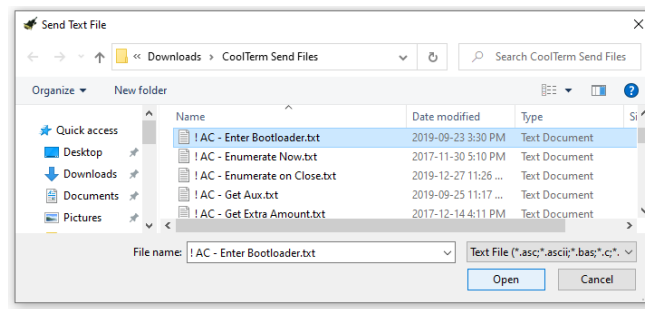


Figure 44. !AC - Enter Bootloader.txt” command file.

The eosAC-LT/LO should respond by displaying a warning, followed by a prompt to “Begin sending intel hex file now” (see Figure 45).

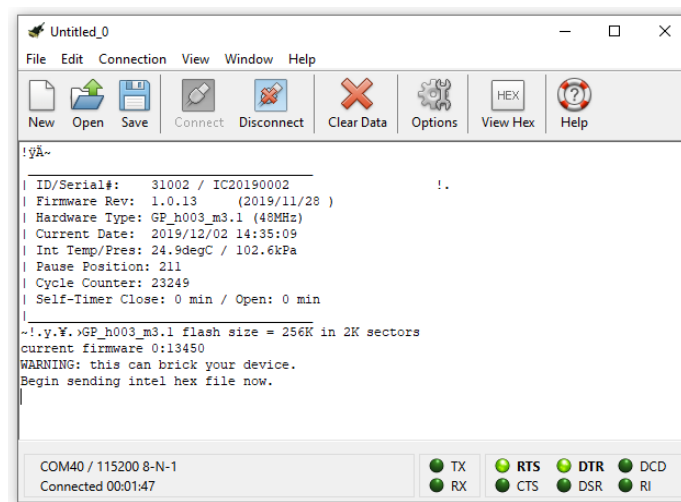


Figure 45. CoolTerm displaying the “Begin sending intel hex file now” message.

4. Click the **Connection > “Send Textfile...”** menu option, then navigate to the location of the firmware file (e.g. `ACLT_1_1_17-F.txt`) and open the relevant file.
5. CoolTerm will now upload the selected firmware file to the eosAC-LT/LO, filling a progress bar as it does so (see Figure 46a). This process may take up to a minute to complete. At no point in this process should you disconnect the eosAC-LT/LO from power or unplug the DATA USB cable from the PC or eosMX / eosMX(-P).
6. Once complete, CoolTerm will prompt the user to enter a string starting with `:flash`. Navigate to **Connection > “Send Textfile...”** and send the provided “!AC - Confirm_X.txt” file.
7. The eosAC-LT/LO will print a response to the `:flash` string and then restart, displaying “BL START” (see Figure 46b). The firmware update is now complete.



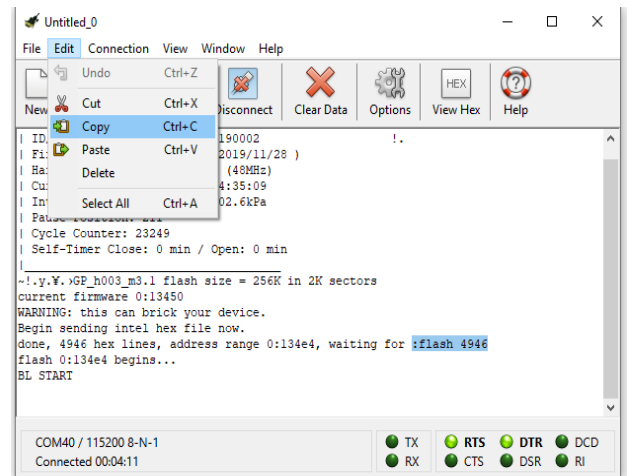
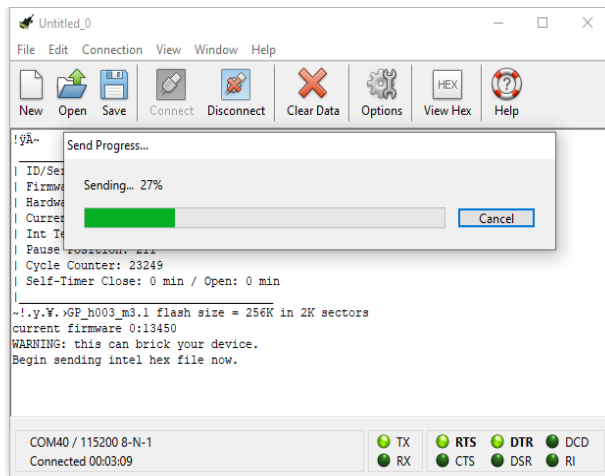


Figure 46. a) CoolTerm uploading selected firmware (left). b) Message displayed when firmware successfully uploaded (right).



WARNING:

Please use the provided “! AC - Confirm” send file to complete the firmware update. Entering the wrong value can brick your device, which requires returning the control box to Eosense for repairs.



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