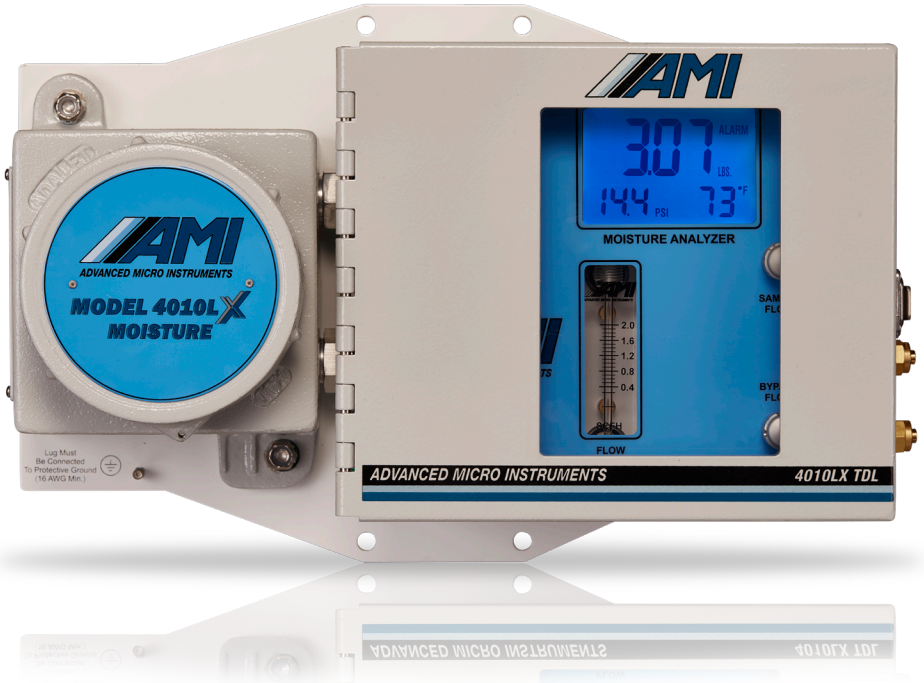
ADVANCED MICRO INSTRUMENTS

An ENPRO Company

THE BARRACUDA MODEL 4010LX

Tunable Diode Laser Adsorption Spectrometer



Operator Manual

Special Message from Advanced Micro Instruments® (AMI):

Thank you for purchasing this **BARRACUDA MODEL 4010LX** for your trace moisture measurement needs. It has a state-of-the-art design and is the industry's most advanced TDL Moisture Analyzer. You will find that this Analyzer will set a new bar for high performance, reliability, and intuitive design.

Note: Read this manual carefully prior to installation. Please take extra precautions against any potential leaks when installing and operating your the **BARRACUDA MODEL 4010LX.**

If you have any questions, contact AMI at 1.714.848.5533 or www.amio2.com

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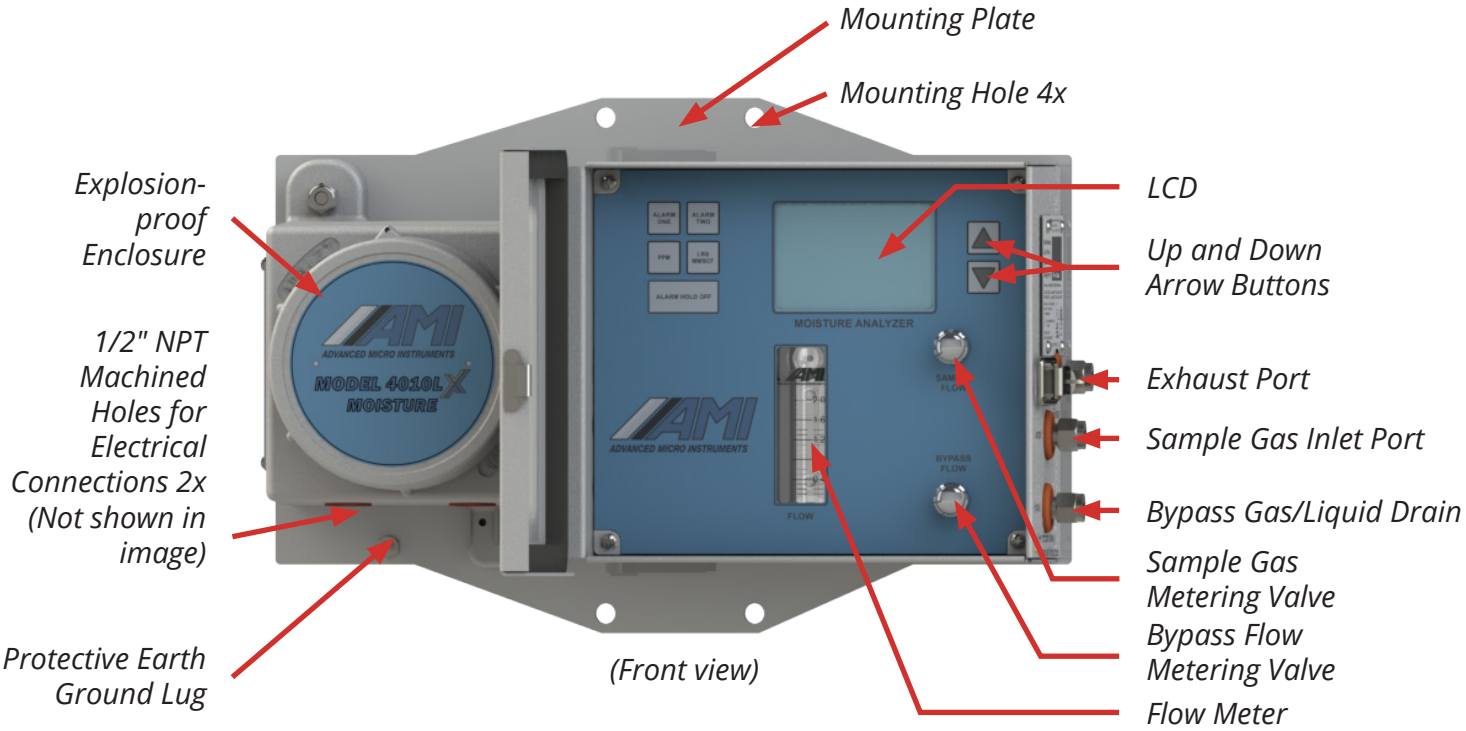
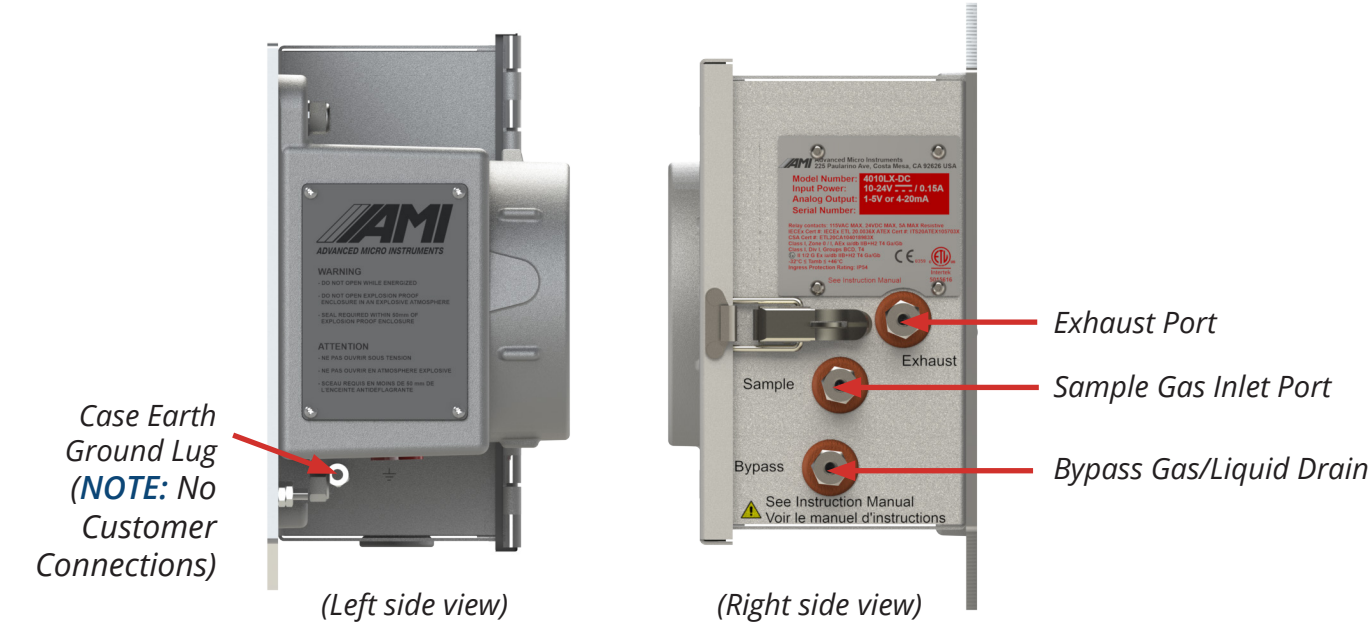
ANALYZER OVERVIEW



(Front view)



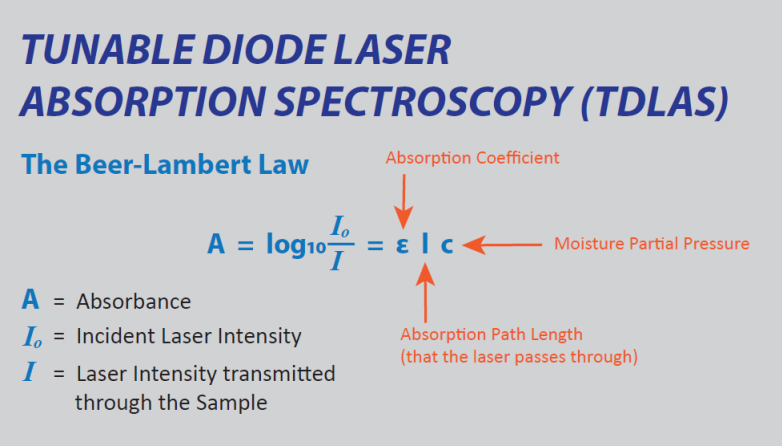
(Left side view) (Right side view)

The Advanced Micro Instruments **MODEL 4010LX** TDL gas analyzer products are protected by one or more patents in the US and elsewhere. The specific patents are:
10,508,976
10,739,255
11,898,946
Other pending U.S. and non-U.S. applications may apply.

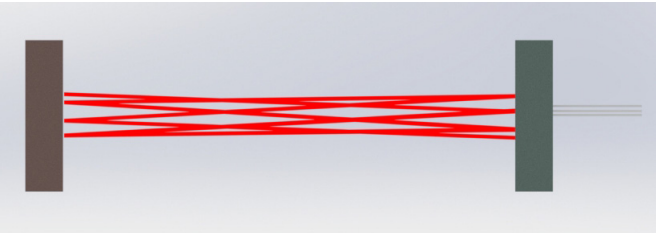
END OF ANALYZER OVERVIEW

METHOD OF MEASUREMENT: WAVELENGTH MODULATED TUNABLE DIODE LASER SPECTROSCOPY (WMTDL)

The **BARRACUDA MODEL 4010LX** utilizes a state-of-the-art, next generation technology called Wavelength-Modulated Tunable Diode Laser Spectroscopy (WMTDL) for fast, accurate, and highly reliable moisture measurements. This proven technology is based on the Beer-Lambert Law.



The Beer-Lambert Law states that the amount of light absorbed by the natural gas sample is proportional to the amount of water vapor in the path of the laser. Hence, by measuring the amount of absorbed light and the total pressure, the concentration of moisture in a particular sample can be accurately determined.



The measurement in a **MODEL 4010LX** is made by tuning the laser wavelength rapidly two (2) times per second, back and forth, across the narrow absorption line for a single vibrational/rotational mode of a water molecule. The number of water vapor molecules in the path of the laser is determined by the ratio of the detected signal when the laser wavelength is on the absorption line to the signal when it is off the absorption line. Any variances in the laser intensity, laser detector gain, obstructions in the optical path or other changes are the same on and off the absorption line and will cancel out when the ratio is taken – thus, keeping the measurement stable (in calibration) if variances occur.

Over longer periods of time, the laser wavelength potentially can drift. A standard feature of the **MODEL 4010LX** Moisture Analyzer is that it tracks the original location of the background methane absorption. Using AMI's ***COMMAND CENTER*** software, the customers can easily check for any drift in the laser wavelength. If you believe there is drift in the laser wavelength, please contact AMI for details how to re-align the wavelengths.

AMI Factory Configuration and Calibration

Every **MODEL 4010LX** Moisture Analyzer is rigorously tested and calibrated at the factory over the entire measurement, temperature, and pressure ranges, using NIST traceable gases and sophisticated mass flow controllers within a temperature chamber. The performance of the Analyzer during the 30+ hours of testing and calibration is validated, using NIST traceable master analyzers, which are further validated using chilled mirrors. The master calibration variables, which are specific to each analyzer, are permanently loaded into the Analyzer's firmware. During the validation, performance testing of all results across all temperatures must meet a 1% or better accuracy specification prior to passing.

Field Performance Validation

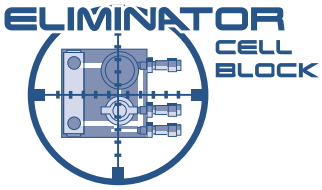
The factory calibration performed by AMI and the inherent stability of the ratiometric WMTDL measurement result in an Analyzer that will hold its calibration for many years. A customer may want to periodically verify the accuracy of the **MODEL 4010LX** using their own NIST traceable calibration gas, but it is important to follow AMI's specific steps so that errors are not introduced. You can read AMI's recommendations for field performance validation of a **MODEL 4010LX** in the **MAINTENANCE, TROUBLESHOOTING & REPAIRS** section.

END OF METHOD OF MEASUREMENT

KEY INNOVATIONS

Advanced Micro Instruments has developed and patented key technologies that enable our devices to deliver the highest levels of **PERFORMANCE, RELIABILITY** and **EASE-OF-USE.** These technologies are included in the **BARRACUDA MODEL 4010LX** and cannot be replicated by any other company.

Eliminator Cell Block

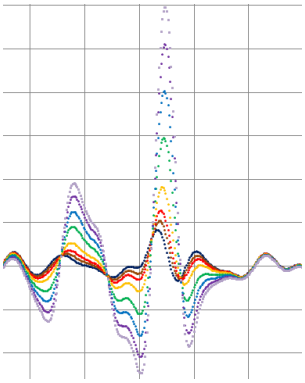


Our patented Cell Block Technology provides the next generation of innovation for a complete, very compact sample system that virtually eliminates all potential leak paths while optimizing flow efficiencies. The volume and distance the sample gas travels prior to entering the laser chamber has been dramatically reduced.

All sample handling components, including the Herriott Cell, have been machined from a series of solid compact blocks with precision-drilled intersecting passages in place of long lengths of tubing and compression fittings. Additionally, metering valves, pressure sensor, and flow-meter are all directly integrated into the machined blocks.

Finally, the **ELIMINATOR CELL BLOCK** features a unique liquid rejection/ particulate membrane that is sealed between cell blocks. As a result, all liquids and particulates are effectively exhausted through the bypass without ever reaching the optical components.

Measurement Algorithm



The **BARRACUDA MODEL 4010LX** is programmed with a proprietary measurement algorithm to carry out trace moisture measurements. Not only will the **BARRACUDA** complete multiple scans every second for the signature H_2O peak and CH_4 (methane) peak, its algorithm contains a compensation function to account for pressure and temperature. This ensures maximum stability and accuracy regardless of the methane levels.

A wavelength realignment feature is also enabled on the **BARRACUDA.** Over time, laser-based Moisture Analyzers potentially may see a gradual movement of their signature peaks on the x-axis of the measurement waveform. The **BARRACUDA MODEL 4010LX** can realign the laser to the critical H_2O peak and CH_4 peak. If you believe there is drift in the laser wavelength, please contact AMI for details how to re-align the wavelengths.

COMMAND CENTER Interface Software

This powerful software platform comes standard with every **MODEL 4010LX** purchase and provides users with access to a full suite of advanced features, including:

- Settings & logic adjustments for two (2) fully independent Alarm Relay Contacts
- Security settings to prevent unauthorized adjustments to the Analyzer via the front panel
- Changing the analog outputs from 4–20 mA to 1–5 VDC or vice versa
- Datalogger that records measurement readings, temperature of the Cell Block, gas pressure, brown-outs, and power voltage over a period of 15 days at 1–minute intervals (data can be displayed on a graph or in tabular format)
- Error Status Display that alerts users to any error(s) detected by the Analyzer
- Communication with the Analyzer via USB Virtual COMport and Modbus bi-directional RS485 Communication

END OF KEY INNOVATIONS

SYMBOL TABLE

	Warning - Risk of Danger or Harm to the User or Risk of Damage to the Product. Consult the operator manual.
	Relay
	Earth Ground
	DC (Direct Current)
	Frame Chassis Terminal

	Risk of Shock (DC)
	Risk of Shock (AC)
	Protective Ground
	AC (Alternating Current)

END OF SYMBOL TABLE

SAFETY, WARNING & CAUTIONS

A **WARNING** identifies conditions or procedures that can be dangerous to the user.

A **CAUTION** identifies conditions or procedures that can cause damage to the Product.

⚠ WARNING

Make sure no hazardous gas is present in the area before and during installation.

Violation of the National Electrical Code requirements (especially Article 500 that deals with hazardous areas) may cause a fire or explosion with the potential for serious injury or loss of life.

⚠ WARNING

Drilling any holes in the enclosure will violate the safety approval and may create risk of harm.

⚠ WARNING

Due to non-conductive surfaces, there exists a **POTENTIAL ELECTROSTATIC CHARGING HAZARD.**

EN RAISON DE SURFACES NON CONDUCTRICES, IL EXISTE UN RISQUE POTENTIEL DE CHARGE ELECTROSTATIQUE.

⚠ WARNING

You must follow the National Electrical Code (NEC) in your installation. Consult the NEC Handbook for the correct guidelines and standards.

Class I, Div 1 areas must use rigid conduit with seal-offs.
Class I, Div. 2 areas can use flexible conduit with seal-offs.

The Analyzer has approval for Class I, Division 1, Groups B,C,D. To comply with these requirements, you need to ensure the following:

- The Protective Earth Ground Lug on the front lower left of the Analyzer mounting bracket must be connected to the High–Quality Protective Earth Ground using a16-gauge wire. Please refer to the Front View of the Analyzer in the **ANALYZER OVERVIEW** section for the location of the Protective Earth Ground Lug.
- The mains wiring must be no smaller than a 16-gauge wire.

⚠ WARNING

The following power requirements must be met by the installer of the DC/AC power connections to the Analyzer:

– You must include an electrical disconnect means and a current limiting device, such as a switch and fuse. The disconnect device must be marked as a 'disconnect device' and readily accessible to shut off power to the Analyzer. This will allow the Analyzer to be quickly shut-off in case of an emergency. The disconnect and current limiting device must be housed in an enclosure rated for the area classification. Conduit seals may be required on the enclosure, depending on the area classification.

DC-powered version
Use a 1.0–Amp fuse disconnect.

AC-powered version
Use a 0.50–Amp fuse disconnect.

The voltage rating for the AC Analyzer is 100 to 240 VAC at 50/60Hz ± 10%. AC voltages outside this may cause the Analyzer to malfunction.

⚠ WARNING

Enclosure materials contain a light metal content of over 10% Aluminum and pose a potential impact spark ignition hazard. The end user shall carry out a risk assessment prior to installation in an EPL Ga environment and shall only install the equipment where the risk of impact has been considered to be negligible.

Les matériaux de boîtier contiennent une teneur en métaux légers de plus de 10% d'aluminium et constituent un risque potentiel d'inflammation. L'utilisateur final doit procéder à une évaluation des risques avant de l'installer dans un environnement EPL Ga et ne doit installer le matériel que dans les cas où le risque d'impact a été considéré comme négligeable.

⚠ WARNING

A SEAL SHALL BE INSTALLED WITHIN 50 mm OF THE ENCLOSURE.

UN SCELLEMENT DOIT ETRE INSTALLE A MOINS DE 50 mm DU BOITIER.

⚠ WARNING

SUBSTITUTION OF COMPONENTS MAY IMPAIR INTRINSIC SAFETY.

LE REMPLACEMENT DE COMPOSANTS PEUT COMPROMETTRE LA SECURITE INTRINSEQUE.

⚠ CAUTION

The voltage rating of the DC Analyzer is 10–24 V.

- DC input has to be an approved Class 2 or limited energy circuit for DC power
- Voltages outside this range may cause the Analyzer to malfunction

The voltage rating of the AC Analyzer is 100 to 240 VAC at 50/60Hz ± 10%.

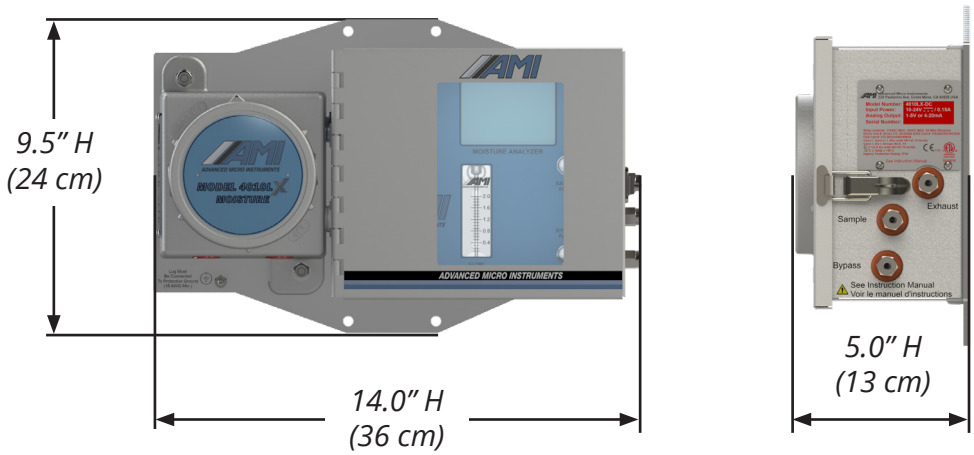
- Any AC voltages outside this range may cause the Analyzer to malfunction

Any use of this equipment in a manner not specified in this manual or approved AMI documentation may impair the protection provided by the equipment.

Toute utilisation de cet équipement d'une manière non spécifiée dans ce manuel ou dans la documen tation AMI approuvée peut altérer la protection fournie par l'équipement.

END OF SAFETY, WARNING & CAUTIONS

ANALYZER INSTALLATION
Mounting the Analyzer



NOTE: *Analyzer weighs 17.0 lbs (7.7 kg)*

Key Points

- The Analyzer can be mounted either indoors or outdoors, where the ambient temperature remains between 20°F (-6.7°C) and 149°F (65°C)
- For installation, where temperature drops down to 10°F (-12°C), order a **MODEL 4010LX** with the factory-installed **EXTREME WEATHER ENCLOSURE**
- When using a solar panel to power the Analyzer, we recommend mounting the solar panel just above the Analyzer, using the same mast, to serve as a sunshield

⚠ WARNING

For both DC and AC models, do not use above 10,500 ft (3,200 m).

⚠ WARNING

The Analyzer weighs 17.0 lbs (7.7 kg) and can pose a risk to the user if dropped.

Steps

1. Determine a convenient location to place the analyzer. The location should ideally be eye-level.

2. Mount the Analyzer to a wall or bulkhead using the four (4) mounting holes or to a 2–inch (5 cm) pipe using 1/4" x 2" U–brackets with 1/4" nuts.

NOTE: *Equipment shall only be installed and operated in the upright orientation with the mounting plate vertical.*

Electrical Connections for the Analyzer

Key Points

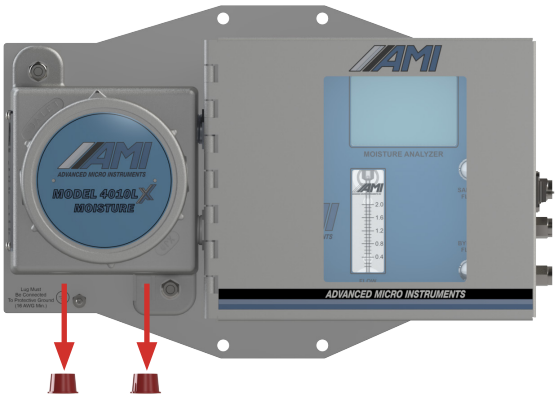
- Verify your rated power supply matches the operating voltage of your Analyzer before you begin
- The **MODEL 4010LX** is available with either AC or DC Power (you must request your desired power at the time of your purchase)

  DC power requirements are 10–24 VDC, 1.00 A max.
  AC power requirements are 100–240 VAC, 500 mA max.

NOTE: *Both alarm relays are rated for 5 A @115 VAC or 24 VDC*

- Your Analyzer has an isolated active analog output that can be configured as either a 1–5 VDC or 4–20 mA output. It has been setup at the factory per your analog output requirements at the time of purchase. However, this can be easily changed in the field by following the instructions CHANGING ANALOG OUTPUT on page 29.

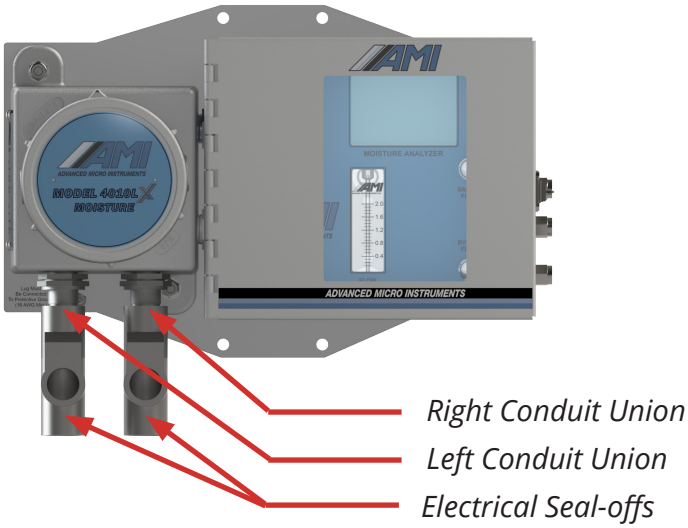
Steps



1. Remove the two (2) red plastic protective caps from the 1/2” NPT conduit holes on the explosion-proof side of the Analyzer. These plastic caps protect the threads of the unit during shipping.

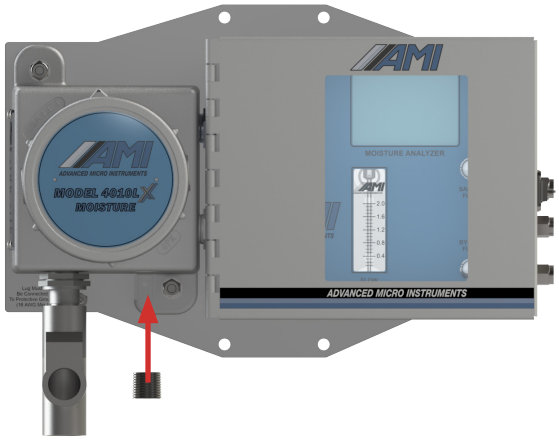
- We provide two (2) separate 1/2” NPT conduit holes to accommodate all electrical connections. The first conduit opening should be used for power and alarm relay connections. The second is for analog output and RS485 connections.

NOTE: *AC Power and the opening and closing of alarm relays produce both electrical noise and large inductive spikes that can have an undesirable effect on the measurement readings. This is why we provide two (2) conduit openings and strongly recommend separating the sensitive analog signal wiring from the power and relay wiring.*



2. Install the conduit unions between the explosion–proof housing of the Analyzer and the electrical seal-off. DO NOT fill the electrical seal-offs yet.

- In order to meet electrical codes for Class 1, Div 1 and Class 1, Div 2, Groups B,C,D, you must use electrical seal-offs in your installation
- We recommend that you install conduit unions between the explosion-proof housing of the Analyzer and the seal-offs. This will prove very useful in the event that you have to remove the Analyzer for servicing, without cutting wires.

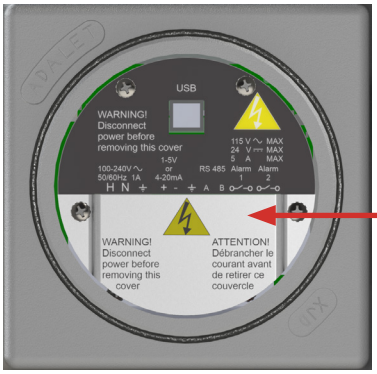


⚠ WARNING

If you are using DC Power and intend on using the analog output only feature (which is the same as using 'NO RELAYS'), you can safely run both DC Power and Analog Output Signal in a single conduit. However, you must install an approved 1/2" NPT plug for hazardous locations in the unused 1/2" NPT port. ***FAILURE TO DO SO WILL VIOLATE ALL SAFETY REQUIREMENTS AND POTENTIALLY RESULT IN AN EXPLOSION.***

Terminal Cover

DC Version with Terminal Cover and white information panel



AC Version with Terminal Cover and black information panel

Terminal Cover

3. Remove the explosion-proof cover by rotating it counterclockwise.
   Note: A white sheet metal panel inside the explosion-proof housing indicates the Analyzer has been built for use with DC power, while a black sheet metal panel indicates AC power.

4. Then remove the Terminal Cover to access the electrical connections.

5. Verify the operating voltage of your Analyzer and the correct power requirements before you continue.

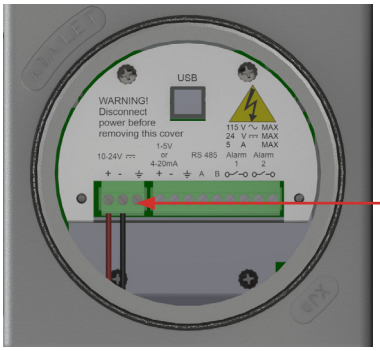
6. Make sure the power source has been turned-off before you begin installing wiring.

– The green terminal block connectors are combination connectors, which allows you to unplug the connector during the wiring process. Combination connectors can accommodate 12–24 AWG wire sizes for your electrical connections.

IMPORTANT: *When attaching wiring to the green terminal connectors, use either solid wire or stranded wire with wire ferrule(s) attached. Verify no loose strands are visible after installation of wire ferrule(s).*

1st Conduit (Power & Alarms):

FOR DC POWER

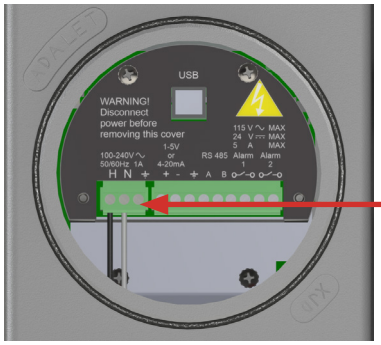


Shield Earth Ground Terminal Connection

7. Connect the DC power wires to the appropriate terminals on the left.

   – The + positive and - negative are clearly marked on the sheet metal cover
   – If you decide to use a 2-wire cable with shield for the power supply connection, AMI provides quality Shield Earth Ground Terminal Connection next to the + positive and - negative terminals

FOR AC POWER:



AC Power Ground Terminal Connection (A)

7. Connect the AC power wires to the appropriate terminals on the left. The wire designations are clearly marked on the black metal cover.

   – H is for the Hot Wire
   – N is for the Neutral Wire
   – Position (A), as shown above, is for the AC Power Ground

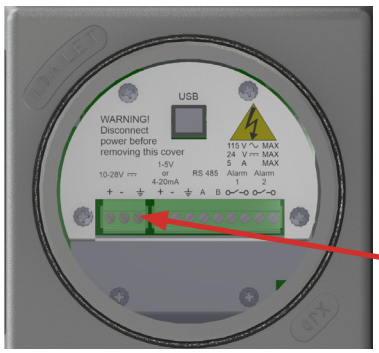
Protective Earth Ground Lug
(Must connect to a quality ground)

⚠ WARNING

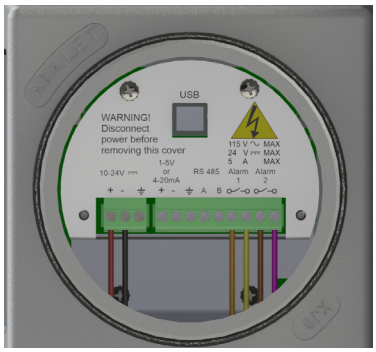
Analyzer must be connected to a Quality Protective Earth Ground for safety and the highest level of RFI protection. This is accomplished by connecting a 16-gauge wire from the Analyzer's Protective Earth Grounding Lug to an 8-foot ground rod or equivalent quality ground. (The Protective Grounding Lug is located just below the explosion-proof housing as seen in the image above.)

⚠ WARNING

When using AC power, never rely on the AC Power Ground as a source for Analyzer safety or ground protection. Always connect the Protective Earth Ground Lug, shown previous page, to a high quality ground, such as an 8-foot ground rod or equivalent.



RECOMMENDED: *When using DC Power, use a shielded-twisted pair cable and connect the cable shield to the shield earth ground terminal shown in position "A" of the illustration to the left. Do not connect the other end of the shield wire as it will cause undesirable loops!*

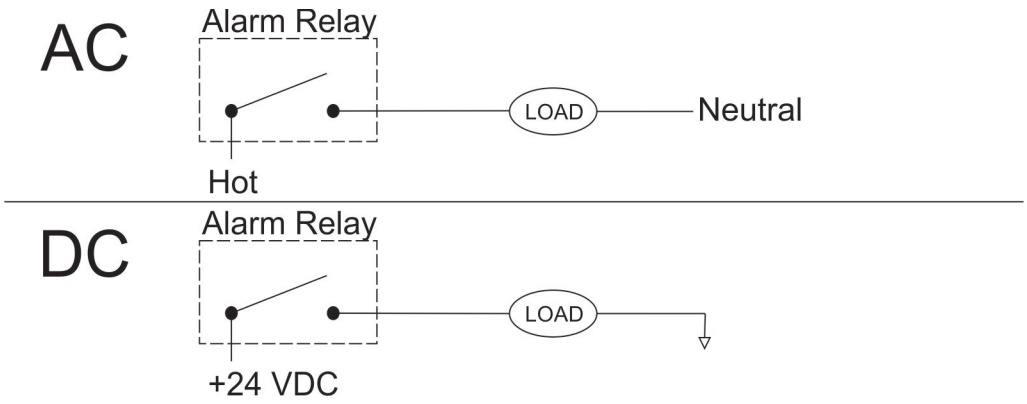


(DC Power Version is shown for ALARM wiring. The AC version will be identical for ALARMs, analog output and RS–485 connections.)

8. Connect the wires for the two (2) fully adjustable alarm contact relays to their proper terminals.

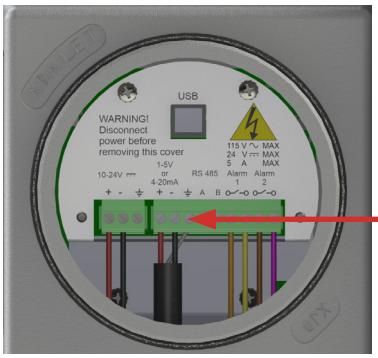
NOTE: *Both alarm relays are rated for 5 A @115 VAC or 24 VDC.*

IMPORTANT: *If you desire to use the alarm contact relays, the alarm wires must be pulled through the same conduit as the supply power.*



IMPORTANT: *The relay contacts act like a simple switch breaking only a single leg of the circuit. In keeping with good electrical practices while wiring the* ALARM *contacts, we suggest* ***SWITCH/BREAK THE HOT LEG ONLY, NOT THE GROUND LEG OF YOUR CIRCUIT.***

2nd Conduit (Analog outputs & RS485 Communication)



(DC Power Version is shown. Instructions are the same for the AC Power Version)

Analog Output is self-powered (Active) and is connected using a twisted 2–conductor wire with shield

NOTE: *Always use a twisted 2–conductor cable with shield.* ***NEVER CONNECT BOTH ENDS OF THE SHIELD TO BOTH DEVICES (ANALYZER AND OTHER DEVICE) AS IT WILL CAUSE GROUND LOOPS.*** *Connect the analog output shield to the shield earth ground shown above.*

Never apply external power to the analog output connections, the analyzer sources power to the analog output and is a self–powered (Active) type. The analyzer may be damaged if any other equipment provides power to any of the three (3) terminals on the analog output. Any attached equipment or devices are to be setup and configured as passive resistive loads such that ONLY the AMI analyzer is providing power to the analog output.

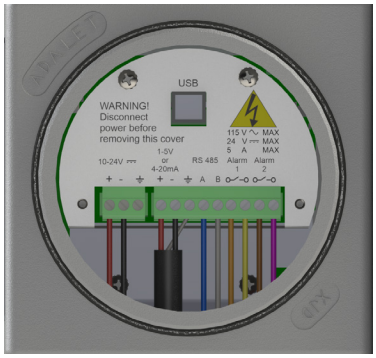
A load of the proper range is required. The load attached to the analog output must be within the allowed load range. The load allowed is different for 1–5 V and 4–20 mA. If the load is out of range the analog output may partially or fully shutdown and typically results in a lower signal or measurement than expected. When overloaded, output calibration may be difficult or impossible to calibrate. To reset an overloaded analog output, the load must be corrected to the proper range. The isolated analog output driver will typically self-reset when the load is corrected but in extreme cases the analyzer will need to be reset (power cycled).

THE ATTACHED LOAD MUST ACCOUNT FOR ALL COMPONENTS, NOT JUST A TERMINATING RESISTOR. The total attached load (resistance) is the combined load of the wiring, the internal load of the external device, and any additional load attached to the external device.

Best performance is achieved when the analyzer analog output is calibrated to the load — see CHANGING ANALOG OUTPUT page 29.

4–20 mA: Verify total load resistance is between 0.5 to 600 ohm. When configured as a current output, common loads used are 100 to 250 ohm, where a 250 ohm load is useful for converting a 4–20 mA signal to 1–5 V for troubleshooting. A load resistance of 0.5 ohm is supported so the output can be verified with a handheld current meter. The analyzer powers the current loop with a maximum of 15–16 V depending on temperature and load.

1–5 V: Verify total load resistance is between 10 kohm to >1 Mohm. When configured as a voltage output, common loads are in the 100 kohm to 1 Mohm range. The output can be verified with a handhold multimeter. Loads with a resistance less than 10 kohm are not supported and the analyzer output may be overloaded delivering up to 8 mA for a short time and **then partially or completely shut the output down to protect the analog output.**



(DC Power Version is shown. Instructions are the same for the AC Power Version)

9. Last, connect the wires for RS485 communication to their proper terminals, marked A and B under the RS 485 heading.

10. Verify all electrical connections and then turn on the source of power. The Analyzer will power-up and the LCD will blink for a few seconds during power–up. You may see some LEDs blinking within the explosion-proof housing and IP 65 box as this is normal during operation.

11. Once you have tested all electrical functions, pour approved potting compound into the electrical seal–offs.

Gas Connections

Key Points:

- All gas connections will require using the supplied ferrule set, 1/4" stainless–steel compression fittings, and customer-supplied 1/4" stainless–steel tubing
- Sample Gas Inlet Pressure to the Analyzer should be regulated down to the range of 1.0 to 20.0 psig (0.07–1.4 bar), depending on the line pressure
- The **BARRACUDA MODEL 4010LX** comes internally equipped with a complete Sample System, including a Liquid Separator that effectively removes liquids and particulates
- However, it is highly recommended that you install a regulated Insertion Gas Probe with Filter Feature into the pipeline at the Sample Point. An Insertion Probe dramatically reduces pipeline liquids, condensation, and particulates from reaching both the Sample Gas Line and Moisture Analyzer.
- **We recommend the Genie® 755 Direct Drive Probe™ (offered by A+ Corporation) or equivalent product**

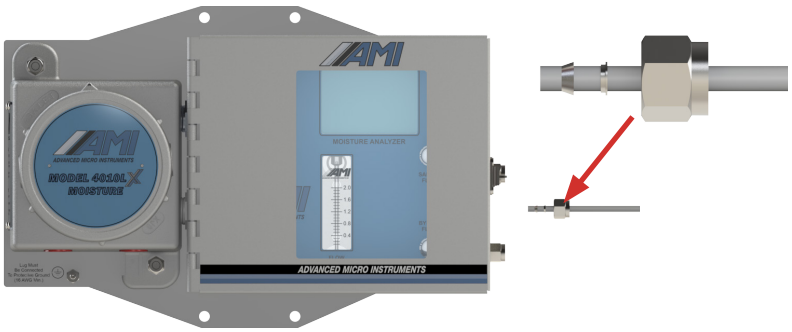
Steps

The **BARRACUDA MODEL 4010LX** has three (3) gas connections on its right side.

Exhaust Port

Sample Gas Inlet Port

Bypass Gas/Liquid Drain

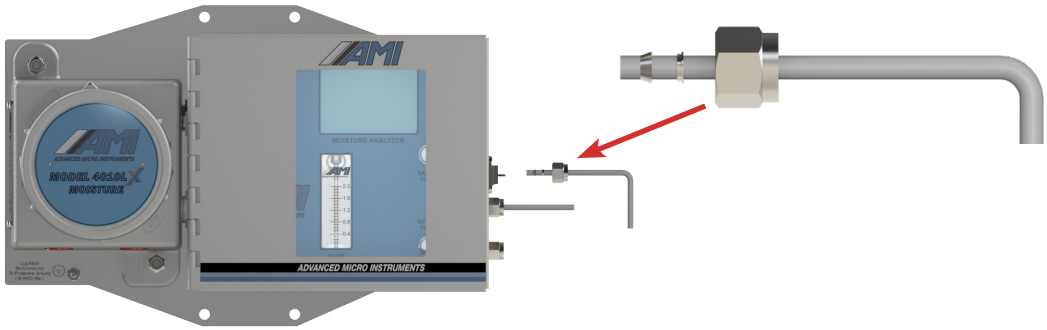


Sample Gas Connection

1. Take a deburred length of 1/4" stainless–steel tubing and slip it through the supplied compression nut and ferrule set. Confirm that the ferrule is properly orientated at one end and connect it to the SAMPLE GAS INLET PORT.

   Make sure the 1/4" stainless–steel tubing slips all the way into the compression fitting until it bottoms out. Tighten the compression nut with 1 & 1/4 turns.

2. Connect the other end to the pipeline gas tap or pressure reducing regulator.



Exhaust Gas Connection

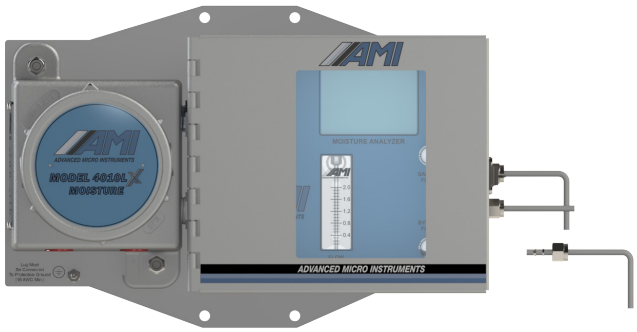
3. Take another deburred length of 1/4" stainless–steel tubing and slip it through the supplied compression nut and ferrule set. Confirm that the ferrule set is properly oriented and then connect to the EXHAUST PORT.

   Make sure the 1/4" stainless–steel tubing slips all the way into the compression fitting until it bottoms out. Tighten the compression nut with 1 & 1/4 turns.

4. Run the other open end of the 1/4" stainless–steel tubing to a safe vented area outside of the meter building.

⚠ CAUTION

The EXHAUST LINE must run slightly downhill the entire way to a safe area to allow any condensate to drain outside and not back into the Analyzer. If you must run the EXHAUST LINE vertically through the ceiling, install a 'knock-out' pot to capture the liquid condensate just prior to going vertical. This will prevent condensate from running back into the Analyzer.



Bypass Gas Connection

5. Take the final deburred length of 1/4" stainless–steel tubing and slip it through the supplied compression nut and ferrule set. Confirm that the ferrule set is properly oriented and then connect to the BYPASS/DRAIN PORT.

   Make sure the 1/4" stainless–steel tubing slips all the way into the compression fitting until it bottoms out. Tighten the compression nut with 1 & 1/4 turns.

6. Run the other open end of the 1/4" stainless–steel tubing to a safe vented area outside of the meter building.

⚠ CAUTION

Run the Bypass Line to the outside of the Meter Building in a downhill direction all the way to a safe location. This will prevent water traps from forming and later freezing in cold weather, creating a back pressure. A 24" H_2O column will create 1 lb of back pressure and cause readings to fluctuate. A 48" H_2O column will create 2 lbs of back pressure and cause readings to fluctuate even more.

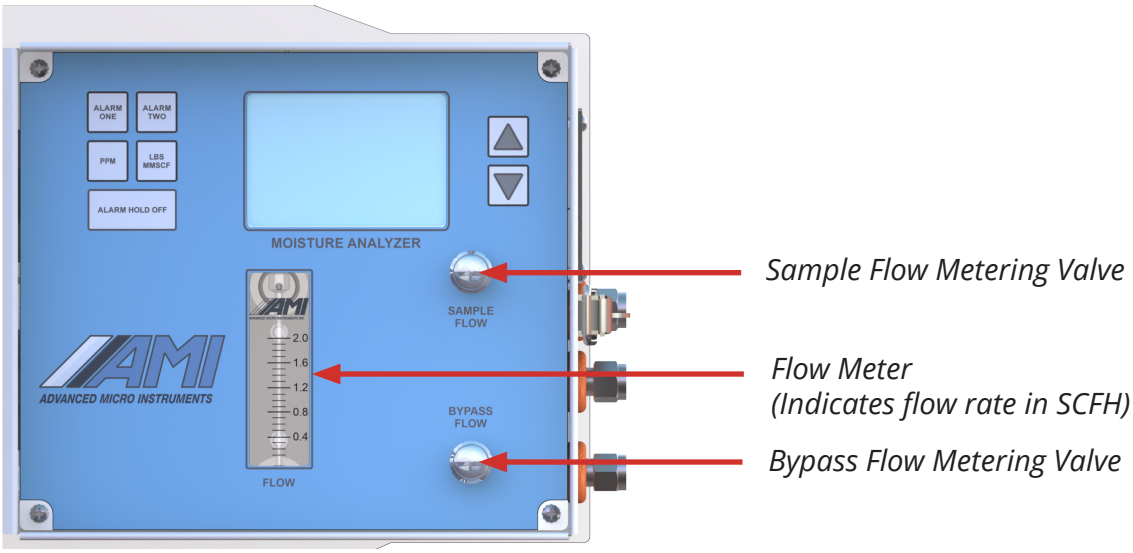
Initiation of Sample Flow to the Analyzer

⚠ WARNING

DO NOT OVERTIGHTEN THE METERING VALVES or you will damage them. They are not ON/OFF VALVES!

Sample Gas Flow Rate

This can be adjusted using the SAMPLE FLOW METERING VALVE KNOB. To increase the Flow Rate, turn the Knob counterclockwise. To decrease, turn clockwise.



Bypass Gas Flow Rate

This can be adjusted using the BYPASS FLOW METERING VALVE KNOB. To increase the Flow Rate, turn the Knob counterclockwise. To decrease, turn clockwise.

Steps

NOTE: *SCFH = standard cubic feet per hour*

1. Turn the SAMPLE FLOW METERING VALVE to the full clockwise position to the Off Position. Do not overtighten it! Turn until finger tight only.

2. Turn the BYPASS FLOW METERING VALVE to the full clockwise position to the Off Position. Do not overtighten it! Turn until finger tight only.

3. Apply a gas pressure of approximately 20 psig (1.4 bar) and leak test check all fittings back to the Sample Tap while looking for tiny bubbles (We recommend using SNOOP®). DO NOT USE the spray bottle as this technique produces bubbles and does not achieve the best results.

4. Once the installation has passed the Leak Test, slowly turn the SAMPLE FLOW METERING VALVE KNOB counterclockwise until the Flow Meter reads approximately 1.0 SCFH (0.5 Lpm).

5. Now open the BYPASS FLOW METERING VALVE by turning the Knob counterclockwise 1/2 a turn or temporarily using an external flow meter, adjust the bypass flow for 1.0 SCFH. Then, remove the flow meter and reattach the bypass tubing.

NOTE: *AMI has chosen this technique since all bypass flow meters have a tendency to plug quickly due to the volume of liquids and particulates going through the bypass path.*

END OF ANALYZER INSTALLATION

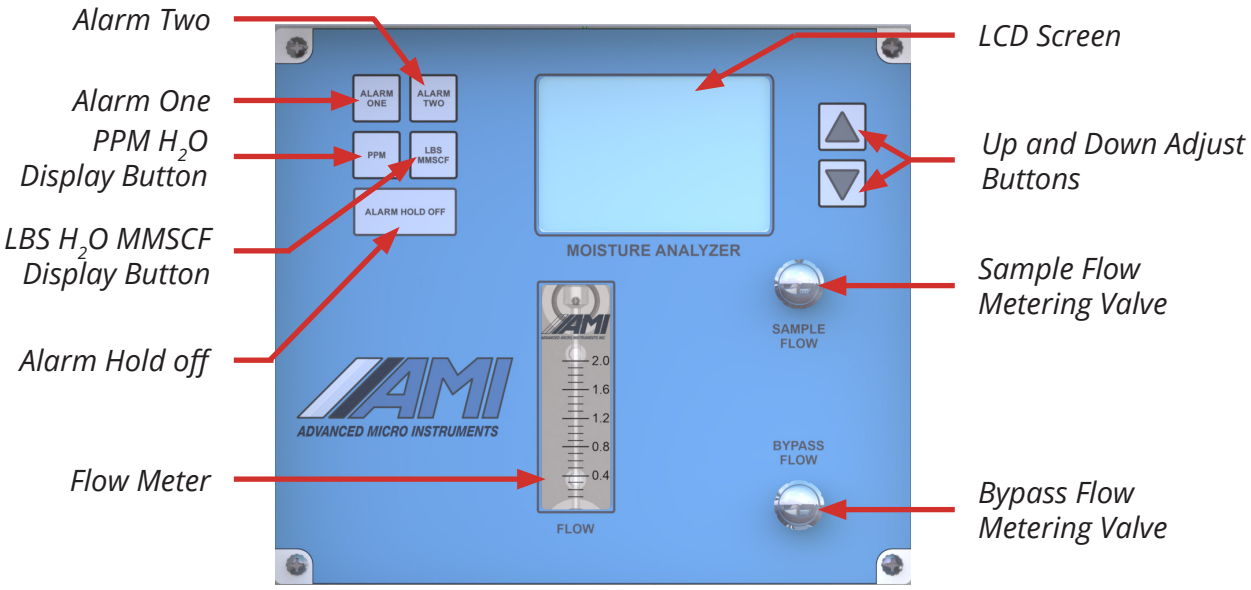
CALIBRATION

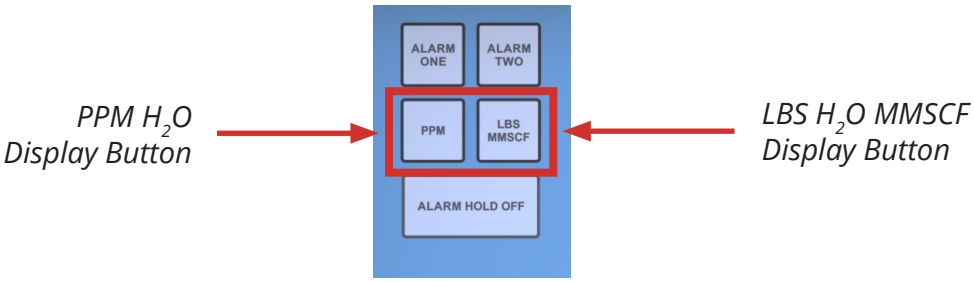
Unlike most gas sensing technologies, **MODEL 4010LX** moisture analyzer does not require periodic calibrations. By design, there is no required method for field-calibrating a **4010LX**. Wavelength tunable diode laser (WMTDL) spectroscopy-based instruments, like the **4010LX**, are extremely stable and reliable.

END OF CALIBRATION

ANALYZER OPERATION

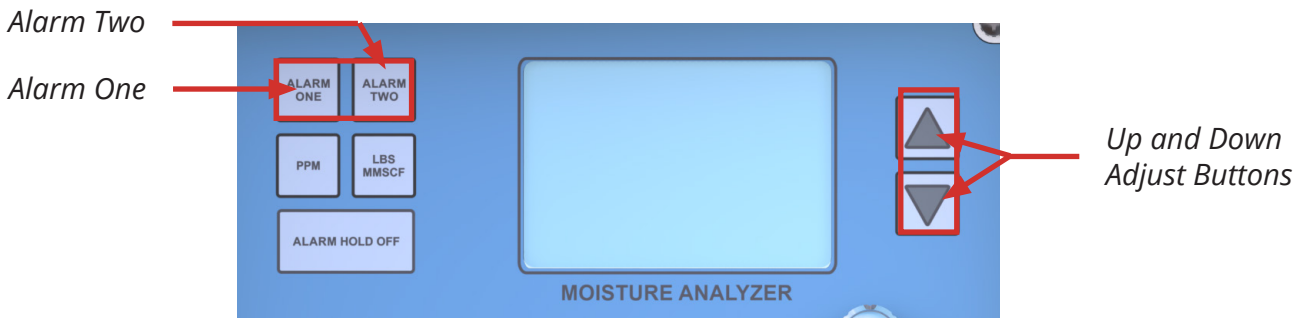
Front Panel Interface





Moisture readings on the **BARRACUDA MODEL 4010LX** are shown in units of pounds per million standard cubic feet (lbs/mmscf) by default. To display in parts per million (ppm) by volume, press the PPM H_2O Display Button. To display the moisture readings in lbs/mmscf, simply press the LBS H_2O MMSCF Display Button.

How to Set the Alarms



The **BARRACUDA MODEL 4010LX** comes standard with two (2) fully adjustable independent Alarms (ALARM 1 and ALARM 2) that can be adjusted over the **BARRACUDA'S** entire moisture measurement range.

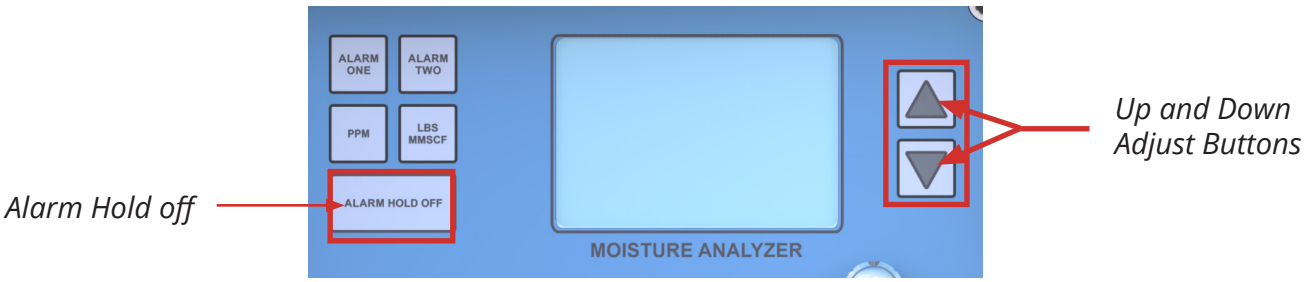
To set ALARM 1, press the ALARM ONE Button and quickly release. The LCD Alarm flag will blink, and within 3 seconds, press either the UP or DOWN Buttons to set your Alarm setpoint. Once pressed, just hold the button until you reach your desired Alarm setpoint. The longer you hold, the faster the Alarm setpoint adjusts. If no buttons are pressed within 3 seconds, the Analyzer will revert to measurement mode.

If you make a mistake at any time, simply let go of the button for 3–4 seconds, and the LCD will return to measurement mode. Then try again.

To set ALARM 2, repeat the same steps as used in ALARM 1.

***NOTE:** If you want to adjust any other ALARM settings, you must do so through the **COMMAND CENTER**.*

How to Set the Alarm Hold Off



Press the ALARM HOLD OFF Button, and the ALARM HOLD NUMBER will appear. And within 3–4 seconds, push either the UP OR DOWN Button to adjust the duration of your Alarm Hold Off. The ALARM HOLD OFF can be engaged from 0 to 120 minutes.

After the time for setting the Alarm Hold Off expires, both Alarms and the Analog Output will revert to measurement mode.

ADDITIONAL NOTES: *If you need more time for the setup, simply push the* ***ALARM HOLD OFF*** *Button again, and it will automatically reset to the adjusted Hold Off Time.*

If you complete the calibration task quicker than expected and want the Alarms and Analog Output to become functional immediately, you can simply run the Hold Off Time to Zero by pushing the Hold Off Button until the LCD blinks and then pushing the Down Arrow until the LCD shows Zero.

Changing Display to Metric Units

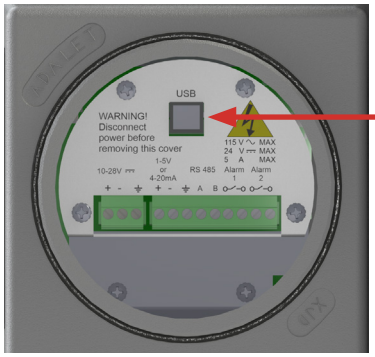
To change the units, see ***COMMAND CENTER*** Interface Software Set-up and Basic Operation section of this manual.

END OF ANALYZER OPERATION

COMMAND CENTER INTERFACE SOFTWARE SET-UP AND BASIC OPERATION

Interface with *COMMAND CENTER*

Step 1: Remove the explosion-proof cover to access the USB Port (Type B) of the Analyzer

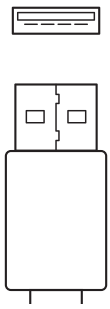


USB Port (Type B)

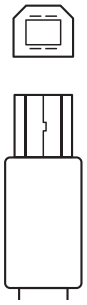
(DC Power Version is shown. Instructions are the same for the AC Power Version)

Step 2: Establish a Communication Link between your laptop and the Analyzer

A. Power up your laptop and open the current version of the ***COMMAND CENTER*** User Interface Software.

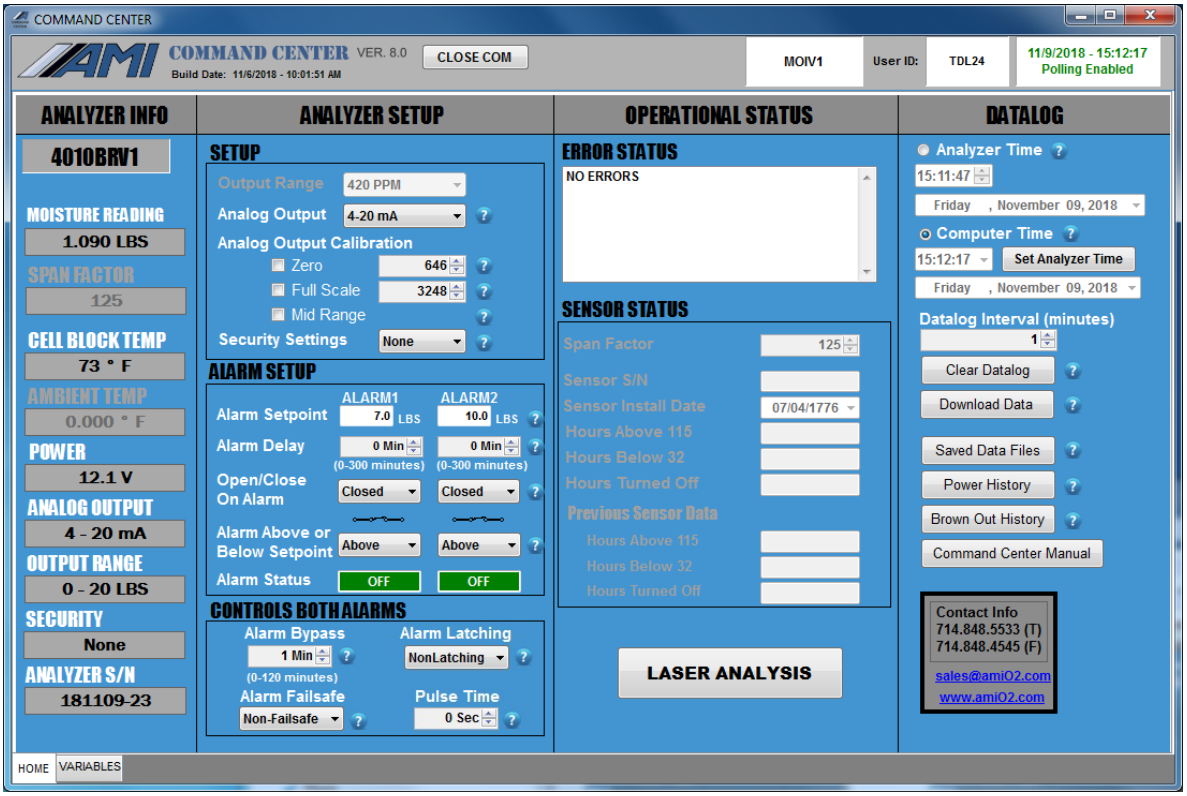


USB Type A Connector



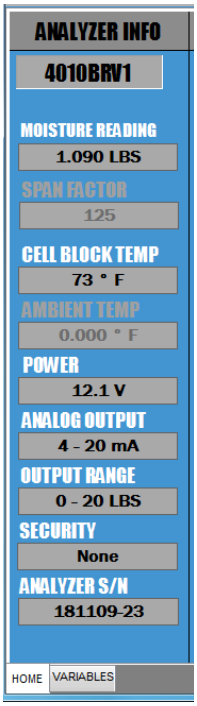
USB Type B Connector

B. Using a USB cable with a Type A Connector on one end and a Type B Connector on the other, insert the Type A Connector into the USB port of your laptop and the Type B Connector into the USB port of the Analyzer on the Explosion-proof side.



Above: ***COMMAND CENTER*** Software window shown with settings for **MODEL 4010LX**

C. Once the link is established, the software will automatically recognize the Analyzer and populate the Analyzer Info Column with information specific to your Analyzer.

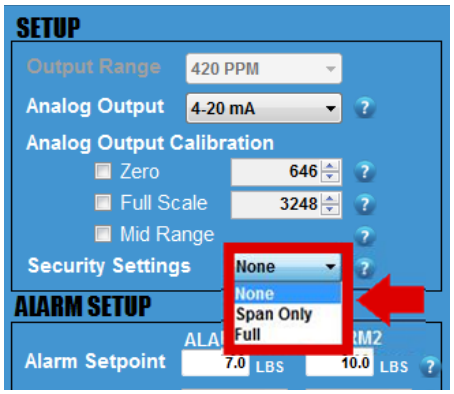


View of the Left Status Column of the User Interface

D. The Analyzer Info Column will display the following information about your Analyzer:

- Analyzer Model Number
- Moisture Reading in either lbs or ppm, depending on your selection
- Cell Block Temperature
- Input Power, either AC or DC
- Analog Output Setting (4–20 mA or 1–5 VDC)
- Output Range Selection
- Security Selection
- Analyzer Serial Number

Step 3: Selection of Options in Analyzer Setup Area & Syncing with Electronic Flow Meter (EFM)

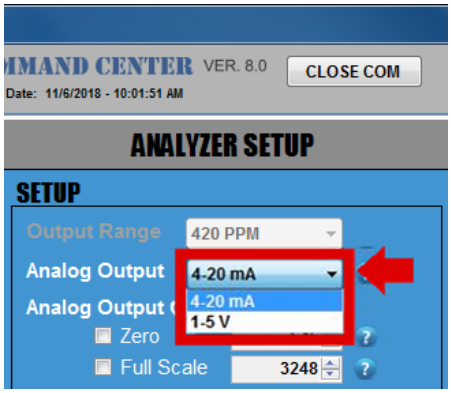


A. Set your desired SECURITY SETTINGS. You have two (2) options available to select from:

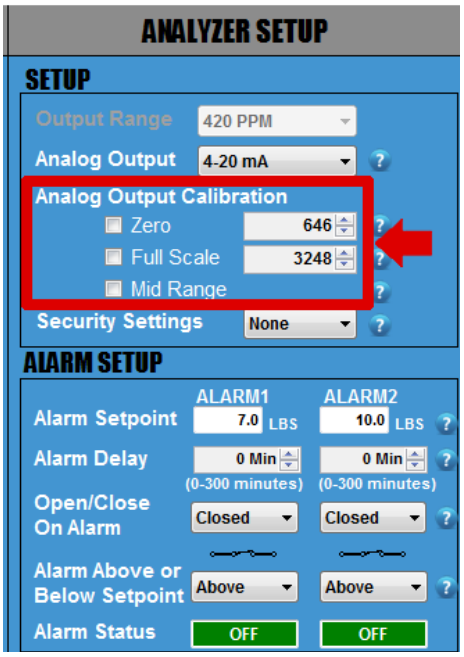
– NONE allows anyone to make changes to the Analyzer's settings using the front panel

– FULL prevents anyone from changing the Analyzer's settings using the front panel. However, you can still use the front panel to check the Analyzer's status values by pushing any of the buttons (i.e., pressing the ALARM ONE Button displays the setpoint for ALARM 1, pressing the ALARM TWO Button displays the setpoint for ALARM 2, and so on). While in the full security setting, once any front panel button is pushed, the LCD will flash FSEC as an indication of the security setting and then display status.

***NOTE:** To make setting adjustment in the **COMMAND CENTER**, the 'NONE' Security Setting must be selected.*



B. View ANALOG OUTPUT Setting.
This is set and calibrated at the factory per your order requirements prior to shipping. If you wish to change the analog output from 4–20 mA or 1–5 VDC or vice versa, refer to the instructions CHANGING ANALOG OUTPUT shown on page 29.



C. Sync your EFM or similar device to your Analyzer. If this is the first time making the analog output connection to the analyzer or there are any issues with your connection, first complete the more detailed procedure in the next step CHANGING ANALOG OUTPUT.

NOTE: the ZERO and FULL SCALE calibration limits described next.

The following steps are critical because they will ensure that both devices display the same measurement readings and, thereby, prevent unnecessary confusion in the future.

1. By now, you have already wired your EFM or similar device to the Analyzer using the Analyzer's analog output terminals, ANALYZER INSTALLATION - ELECTRICAL CONNECTIONS FOR THE ANALYZER section in the manual.

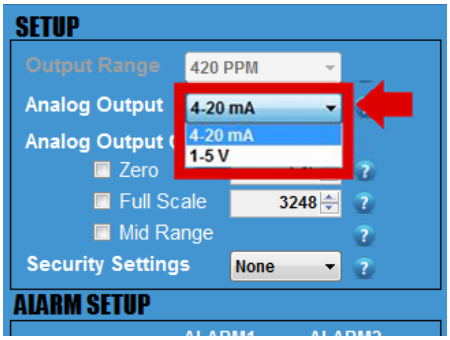
2. Click on the small square box next to ZERO and the reading, and this will drive the analog output to exactly 4.00 mA or 1.00 VDC, depending on your selected output! Confirm that the reading on your EFM or similar device reads 0.00. If it does not, use the UP and DOWN ARROWS to the right of 'ZERO' to adjust until the EFM or similar device now reads 0.00.

3. Once this is done, click on the square next to FULL SCALE, and this will drive the analog output to exactly 20.00 mA or 5.00 VDC, depending on your selected output.

   Confirm that the reading on your EFM or similar device reads FULL SCALE. If it does not, use the UP and DOWN ARROWS to right of 'FULL SCALE' to adjust until the reading of the EFM or similar device reads FULL SCALE.

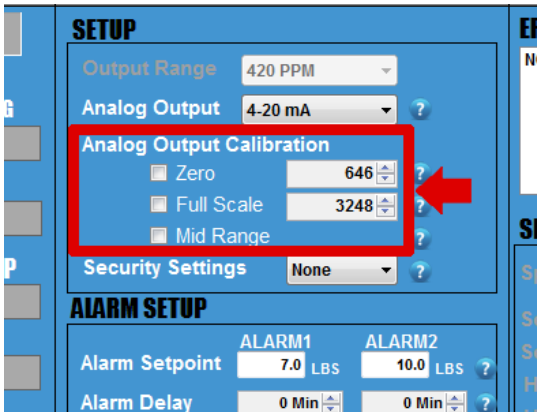
4. Repeat Step 2 (ZERO) and Step 3 (FULL SCALE) once more to confirm that both your EFM or similar device and the Analyzer are displaying the same readings.

5. Last, click on MID RANGE. This will check the linearity. There are no values to adjust as this is just a midpoint validation.



D. CHANGING ANALOG OUTPUT from 4–20 mA to 1–5 VDC or vice versa. (Skip this step if you DO NOT want to change your ANALOG OUTPUT.)

   Click on the drop down menu of ANALOG OUTPUT and select the output option that you wish to change to.



IMPORTANT: *Whenever you change the Analog Output from 4–20 mA to 1–5 VDC or vice versa, or significantly change the load, you will need to complete the following steps to verify your Analog Output. Remove any analog output wires from the Analyzer connection point!*

1. Attach a multimeter to the Green Analog Out Terminal Connector of your Analyzer. Make sure your multimeter is set appropriately, either current for 4–20 mA or voltage for 1–5 VDC.

2. Click on the square box next to ZERO to confirm that your multimeter is displaying either 4.00 mA or 1.000 VDC (the number of digits displayed on the screen will depend on the multimeter that you use). If the reading of the multimeter does not match the reading of the Analyzer, use the UP and DOWN ARROWS to the right of ZERO to adjust the values until the reading of the multimeter is either 4.00 mA or 1.000 VDC.

3. Once this is completed, click on the square box next to FULL SCALE to confirm that your multimeter is displaying either 20.00 mA or 5.00 VDC. If the reading of the multimeter does not match the reading of the Analyzer, use the UP and DOWN ARROWS to the right of FULL SCALE to adjust the values until the reading of the multimeter is now either 20.00 mA or 5.00 VDC.

4. Repeat Step 2 (ZERO) and Step 3 (FULL SCALE) again until you can confirm that your multimeter is displaying 4.00 mA or 1.000 VDC for ZERO and 20.00 mA or 5 VDC for FULL SCALE.

5. Click on MID RANGE. This will check the linearity. There are no values to adjust as this is just a midpoint validation.

6. Disconnect the multimeter from the analyzer and measure the wiring you are attaching to analog (+) and analog (-) and verify the load is supported. First, verify there is no voltage on these lines with your multimeter. Then, for a 4–20 mA analog output, verify load is in the range 0.5–600 ohms. For 1–5 VDC analog output, verify load is in the range 10 kohm to >1 Mohm.

7. Connect both the load and the multimeter to the analog (+) and analog (-) terminals as follows: For 1–5 VDC the multimeter is connected and measures voltage across the terminals parallel to the load. For 4–20 mA the multimeter is connected to measure current in series with the load. In ***COMMAND CENTER***, click on the square box next to ZERO and then FULL SCALE to verify the output into the load as shown on the multimeter. If there is an offset, repeat steps 2–4 to calibrate the analog output with the load attached.

8. Disconnect the multimeter from the system leaving the wiring attached to the analog output. Verify the reading in your attached device and if additional tuning is required continue calibrating any offset. This procedure is detailed in previous step SYNC YOUR EFM.

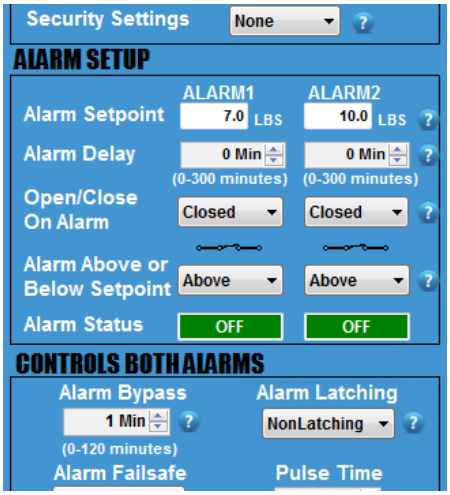
⚠ CAUTION

The values of the analog output SPAN (FULL SCALE) and ZERO values must be set so that the analog output reflects the 1–5 V or 4–20 mA output during calibration.

ZERO value for 4 mA or 1 V output must be set between 500 to 700.

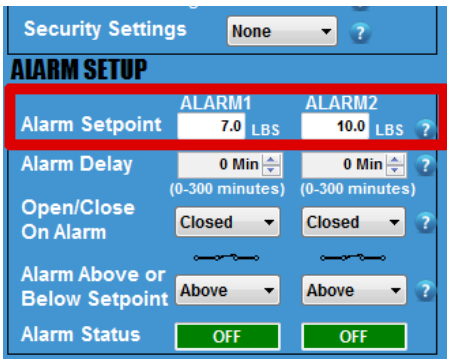
SPAN (FULL SCALE) value for 20 mA or 5 V output must be set between 3000 to 3500.
If these values are not set correctly, the analog output will not behave correctly.

Step 4: Alarm Logic & Setup



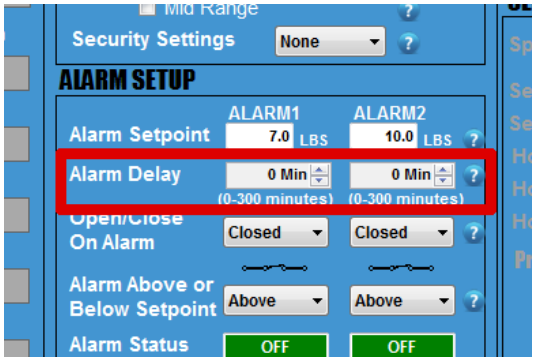
The Analyzer features two (2) independent Moisture Concentration ALARMS – one for ALARM 1 and one for ALARM 2. The settings for these ALARMS, including setpoints, relay contacts, close/open logic and ALARM delays, are adjusted through the ***COMMAND CENTER***.

It is important that you plan out how you want your ALARM LOGIC to work for each ALARM before you start adjusting the settings discussed in this step.



A. Set the ALARM SETPOINTS.
Enter your desired value for each setpoint and then press the ENTER key on your laptop. Keep in mind that your values cannot exceed the limit of the selected analog Output Range that you previously selected.

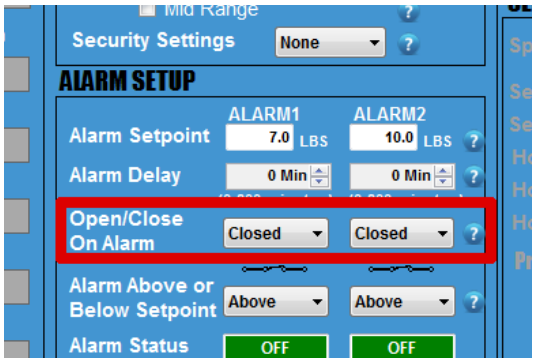
Both Alarms have a 1% hysteresis band that correlates with the measurement range.



B. Set the ALARM DELAYS.
There are two (2) ALARM DELAYS. Each ALARM DELAY setting is located beneath the corresponding ALARM that it controls.

Enter your desired time duration for each ALARM DELAY and press the ENTER key on your laptop. You can also adjust using the UP AND DOWN ARROWS. The range is from 0 to 300 minutes.

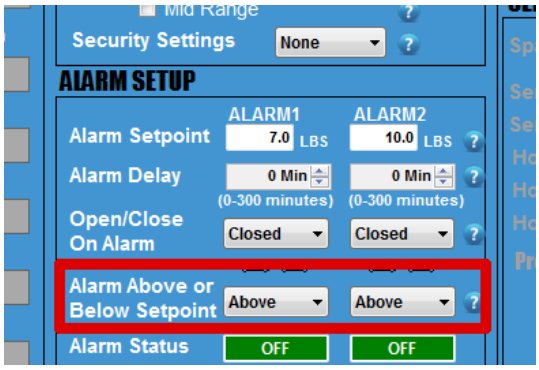
*This feature is especially helpful at custody transfer points when customers are allowed to exceed contractual limits for a predetermined amount of time.



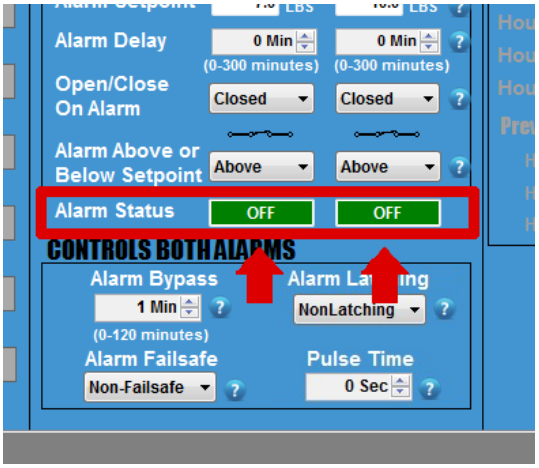
C. Click on the drop-down menu OPEN/CLOSE ON ALARM and set the ALARM relay contact of each individual ALARM to OPEN or CLOSE when its respective ALARM is triggered.

Each ALARM will be triggered above or below setpoint as you select in Step (D).

The schematic symbol under the drop-down menu represents the ALARM logic that has been selected. If you select OPEN, the schematic will show an 'open' alarm relay contact. If you select CLOSED, the schematic will show a 'closed' alarm relay contact.



D. Click on the drop-down menu ALARM ABOVE OR BELOW SETPOINT and set the ALARM to trigger ABOVE or BELOW setpoint. This causes the alarm flag located on the LCD to illuminate in accordance with your desired setting and the alarm relay contact to open or close as configured in the next step.



E. View the ALARM STATUS.
Both independent ALARMS have their own ALARM STATUS.

If an ALARM is not triggered, the ALARM STATUS will display 'OFF' in green.

If an ALARM is triggered, its ALARM STATUS will display 'ON' in red.

*For an ALARM to be triggered, it will take into account the complete logic of how the ALARM was set up. This includes ALARM SETPOINT, ALARM DELAY, OPEN/CLOSE ON ALARM, and ALARM ABOVE OR BELOW SETPOINT.

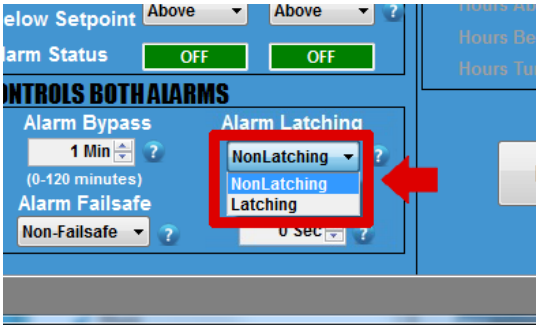
Step 5: Setup of the Controls for Both Alarms

IMPORTANT: *For this step, the adjustments discussed below will affect both and CANNOT be set independently for each ALARM.*

A. Set the ALARM BYPASS. Use the UP AND DOWN ARROWS to set the duration of your ALARM BYPASS (HOLDOFF).

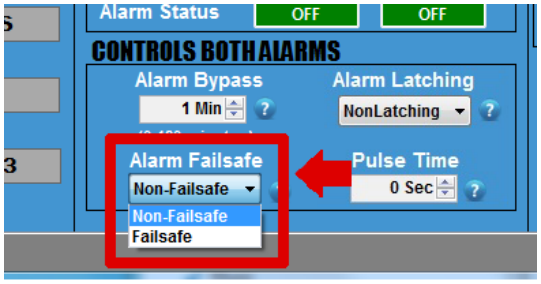
*This is a helpful feature during a routine calibration so that you do not set off alarm devices.

*This feature disables both ALARMS and ANALOG OUTPUTS for those of you using the analog output for control.



B. Click on the drop-down menu ALARM LATCHING and set the ALARM relay contacts to LATCHING or NONLATCHING.

- If set to NONLATCHING, the relay contacts will energize when the measurement readings exceeds the ALARM SETPOINTS and then de-energize when the measurement readings drop below the ALARM SETPOINTS
- If this is set to LATCHING, the relay contacts will energize when the measurement readings exceeds the ALARM SETPOINTS but also remain engaged when the reading drops below the ALARM SETPOINTS. A person will have to press the ALARM HOLDOFF Button for one (1) second on the front panel of the Analyzer to disengage the relay contacts.

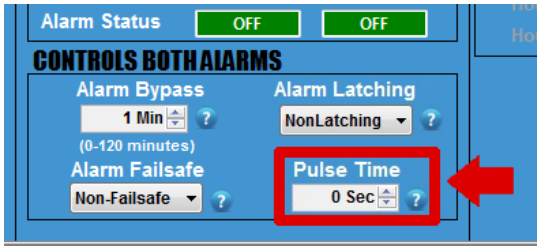


C. Click on the drop-down menu and set the Alarms to FAILSAFE or NON FAILSAFE.

- If set to FAILSAFE, the ALARMS will trigger if the power supplied to the Analyzer drops below 8.5V. However, the ALARMS will not clear until the power moves back up and exceeds 12V.
- If set to NON FAILSAFE, the ALARMS will not trigger if the power supplied to the Analyzer drops below 8.5 V.

⚠ CAUTION

DO NOT adjust this setting unless you are using a pulse-latch slam valve! Otherwise, you will override the relay logic for your ALARMS.

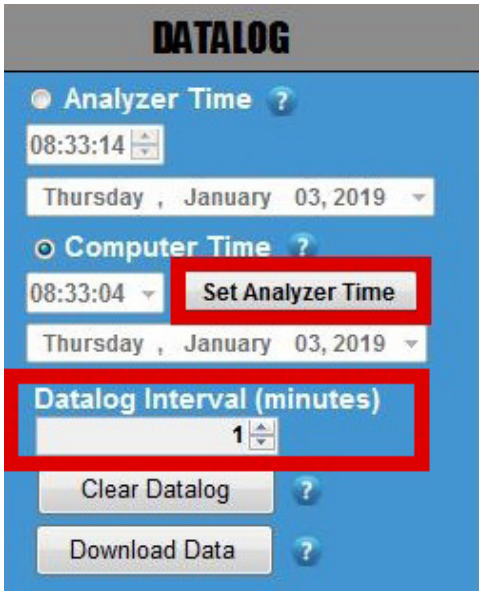


D. This feature is provided for powering a Pulse Latched Slam Valve. The valve manufacturer should indicate the time, in seconds, for the valve to Open or Close. Enter the time in seconds using the UP AND DOWN ARROWS.

This sets the duration of time that the Analyzer sends power to the relay contacts to open or close the valve when an ALARM is triggered. The ALARM 1 Contact will open the slam valve, while the ALARM 2 Contact will close the valve.

This features is helpful because it eliminates the need to continually draw power while the valve is closed.

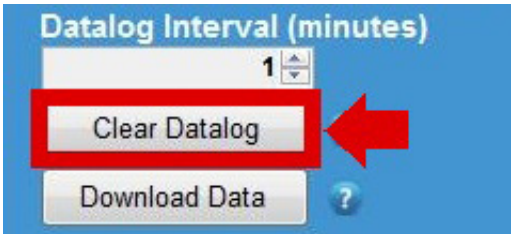
Step 6: Datalog Interval & Setup



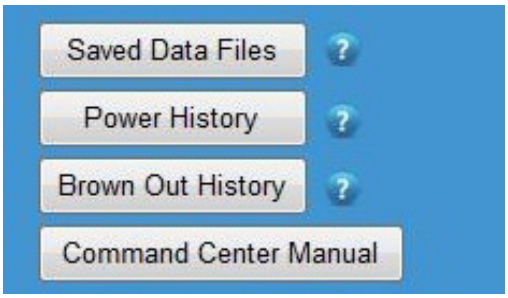
A. SET ANALYZER TIME
Select ANALYZER TIME and manually set the time. Or select COMPUTER TIME and then the SET ANALYZER TIME Button. The time should automatically adjust and closely match the time shown on your laptop.

B. DATA COLLECTION INTERVAL (minutes)
Then set your desired collection interval for the DATALOGGER by adjusting the time (in minutes). The DATALOGGER allows you to store a time-stamped recording of the measurement reading, inlet gas pressure, temperature of the cell block, power supply voltage, and minimum voltage supplied to the Analyzer.

NOTE: *The default setting has the DATALOGGER collecting data for 5 days in 1-minute intervals. If you increase the duration of the interval, the data collection period also increases proportionally. Therefore, if you increase the interval to 2 minutes, the data collection period adjusts to 10 days. Every 3 minutes will increase the collection period to 15 days and so forth.*



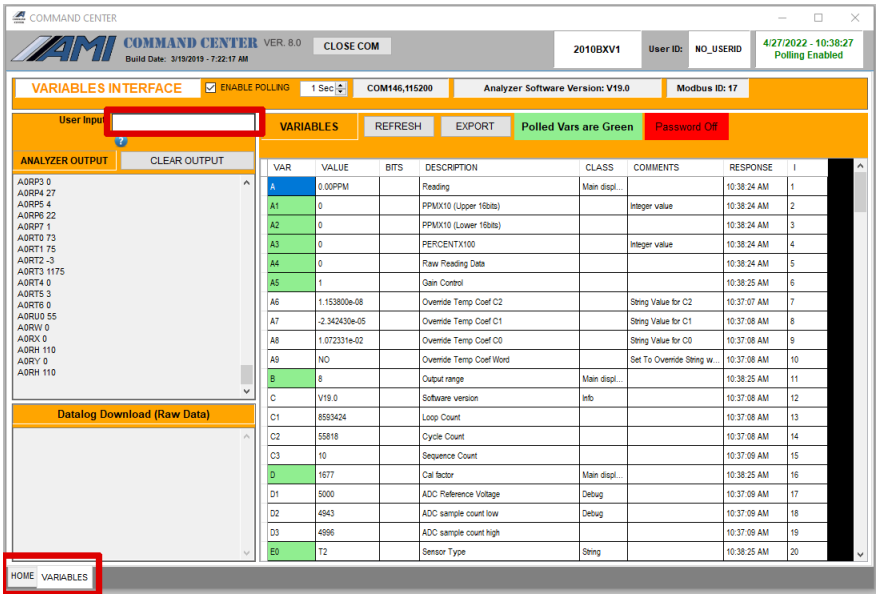
C. CLEAR DATALOG
Press the CLEAR DATALOG Button to clear any recorded data performed at the factory.



You can also view SAVED DATA FILES, POWER HISTORY, BROWN-OUT HISTORY, and ***COMMAND CENTER*** MANUAL by pressing their respective buttons in this column.

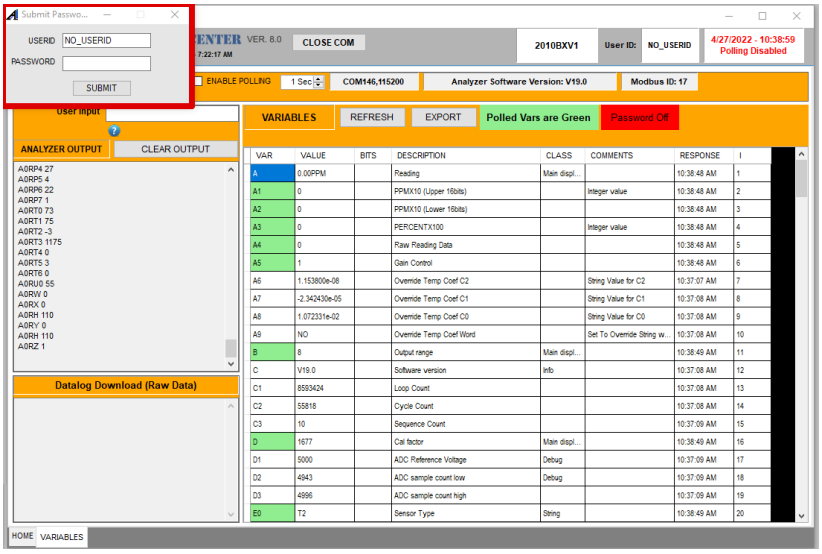
Step 7: Changing Display to Metric Units

This step will require a password. Contact AMI before proceeding with the instructions below.

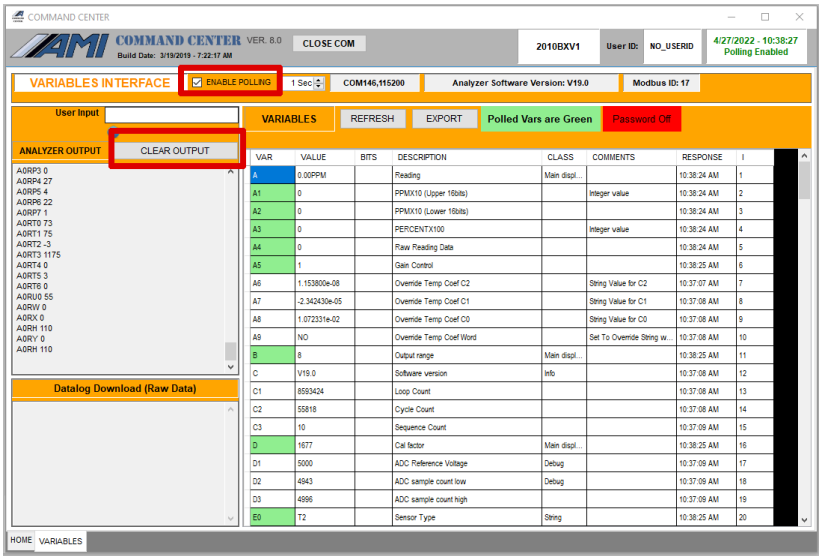


NOTE: ***MODEL 2010BX***
Screenshots shown . They are the same for the 4010LX for this step.

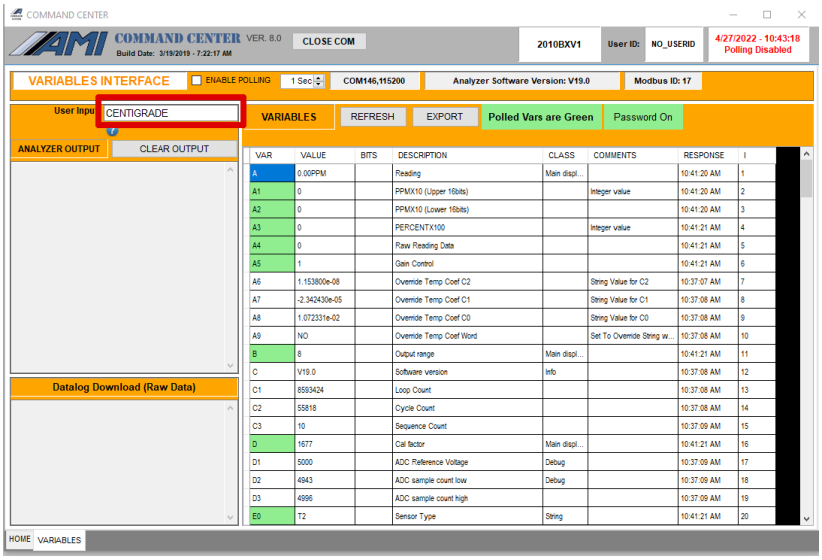
- Click on the 'VARIABLES' Tab at the bottom left-hand window.
- Click the 'USER INPUT' Cell at the upper left-hand area of the window.



- Once the small SUBMIT PASSWORD window opens, enter the password that you receive and press SUBMIT



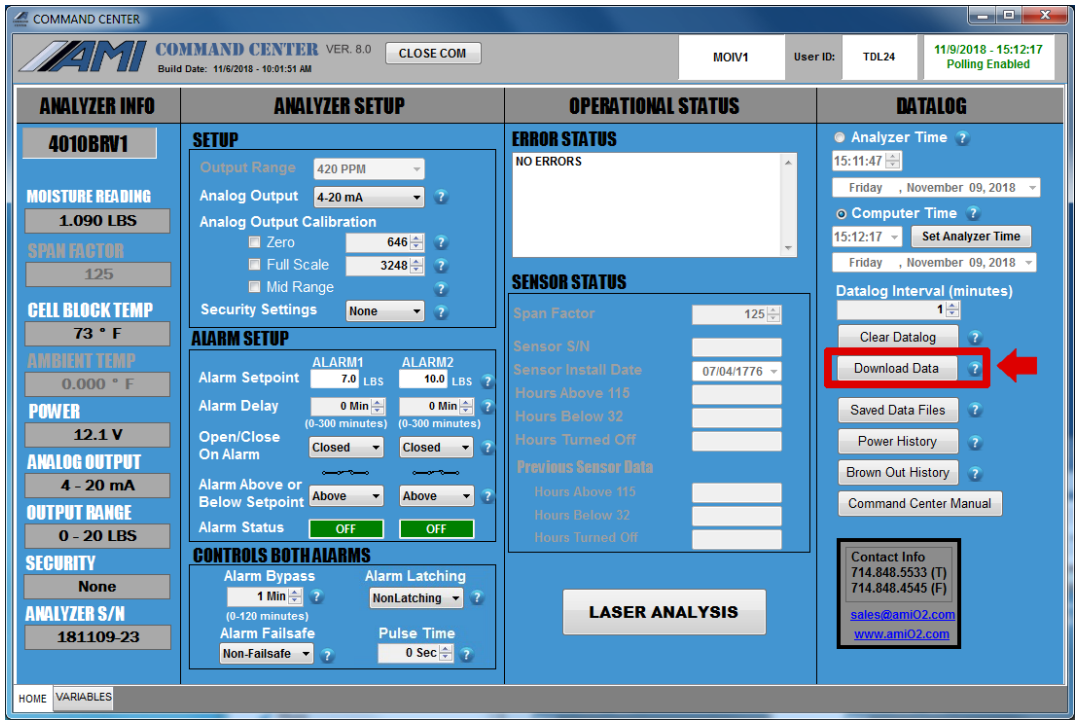
- Uncheck ENABLE POLLING
- Click CLEAR OUTPUT



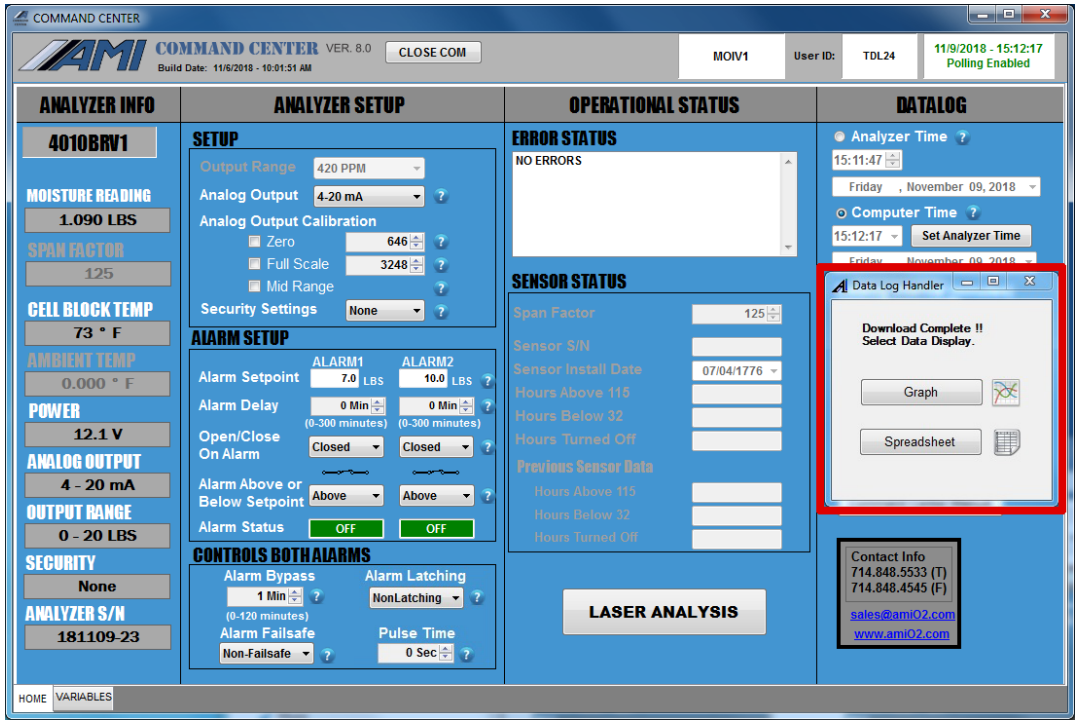
- Type ‘CENTIGRADE’ into the User Input area (shown above in the red box) and press RETURN. This will change BOTH Temperature to Celsius and Pressure to kPA.

NOTE: *To return to Imperial Units, enter ‘Fahrenheit’ and press Return.*

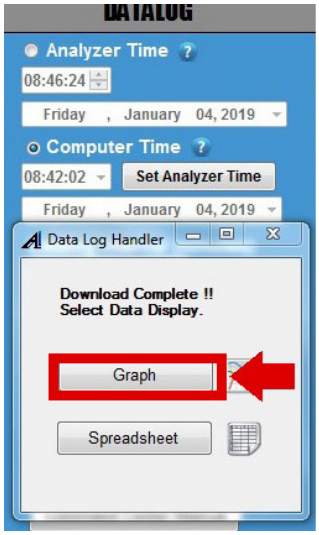
Download Data



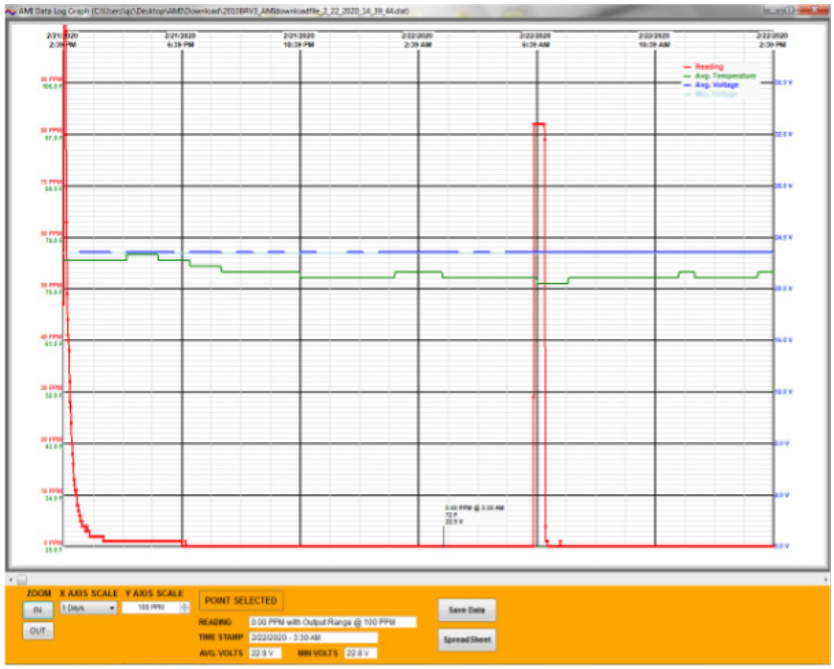
To begin, click the DOWNLOAD DATA Button located on the ***COMMAND CENTER*** Software.



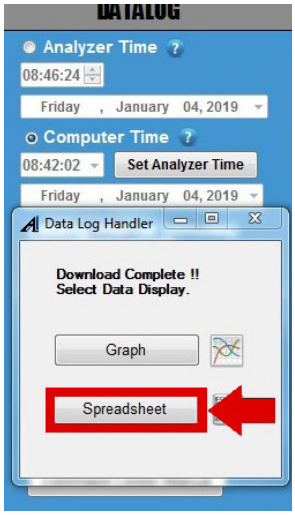
A. DATALOG HANDLER window will appear, giving you the options of seeing your downloaded data as either a graph or spreadsheet.



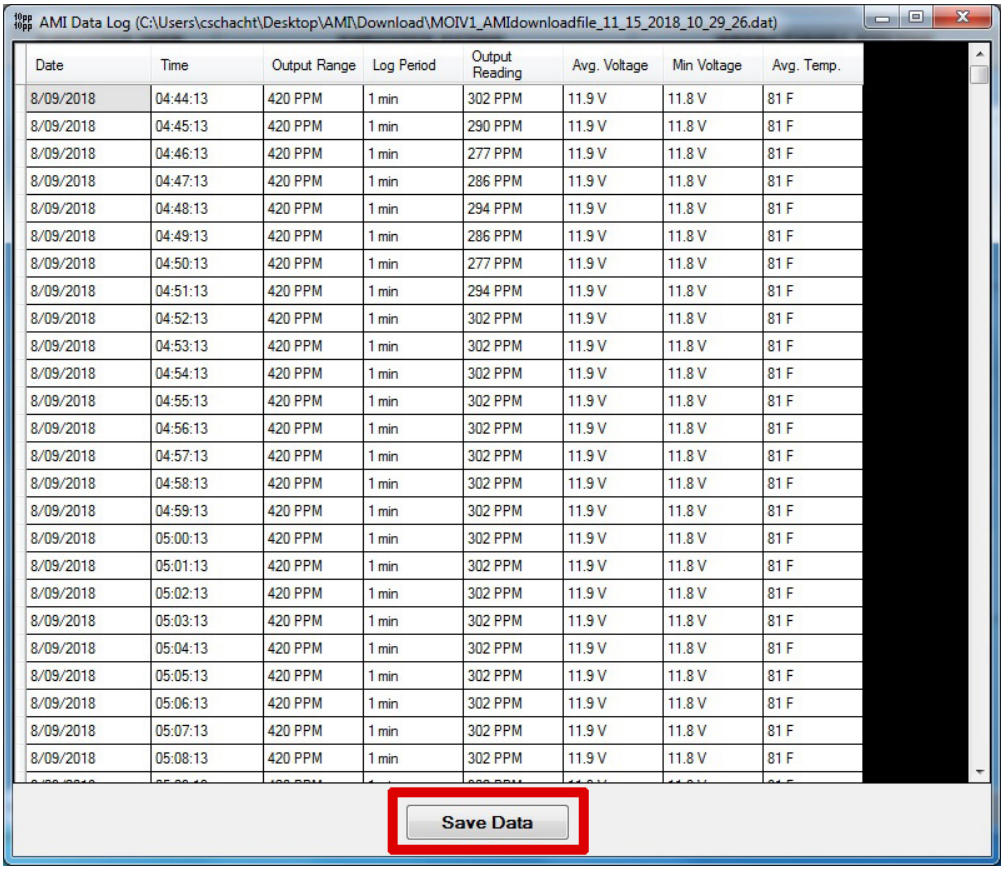
To see the graph, click the GRAPH Button.



(Sample Graph of Downloaded Data) You can save your graph to a file by clicking the SAVE DATA Button.



To see your downloaded data as a spreadsheet instead, click the SPREADSHEET Button on the DATALOG HANDLER Window.



Date	Time	Output Range	Log Period	Output Reading	Avg. Voltage	Min Voltage	Avg. Temp.
8/09/2018	04:44:13	420 PPM	1 min	302 PPM	11.9 V	11.8 V	81 F
8/09/2018	04:45:13	420 PPM	1 min	290 PPM	11.9 V	11.8 V	81 F
8/09/2018	04:46:13	420 PPM	1 min	277 PPM	11.9 V	11.8 V	81 F
8/09/2018	04:47:13	420 PPM	1 min	286 PPM	11.9 V	11.8 V	81 F
8/09/2018	04:48:13	420 PPM	1 min	294 PPM	11.9 V	11.8 V	81 F
8/09/2018	04:49:13	420 PPM	1 min	286 PPM	11.9 V	11.8 V	81 F
8/09/2018	04:50:13	420 PPM	1 min	277 PPM	11.9 V	11.8 V	81 F
8/09/2018	04:51:13	420 PPM	1 min	294 PPM	11.9 V	11.8 V	81 F
8/09/2018	04:52:13	420 PPM	1 min	302 PPM	11.9 V	11.8 V	81 F
8/09/2018	04:53:13	420 PPM	1 min	302 PPM	11.9 V	11.8 V	81 F
8/09/2018	04:54:13	420 PPM	1 min	302 PPM	11.9 V	11.8 V	81 F
8/09/2018	04:55:13	420 PPM	1 min	302 PPM	11.9 V	11.8 V	81 F
8/09/2018	04:56:13	420 PPM	1 min	302 PPM	11.9 V	11.8 V	81 F
8/09/2018	04:57:13	420 PPM	1 min	302 PPM	11.9 V	11.8 V	81 F
8/09/2018	04:58:13	420 PPM	1 min	302 PPM	11.9 V	11.8 V	81 F
8/09/2018	04:59:13	420 PPM	1 min	302 PPM	11.9 V	11.8 V	81 F
8/09/2018	05:00:13	420 PPM	1 min	302 PPM	11.9 V	11.8 V	81 F
8/09/2018	05:01:13	420 PPM	1 min	302 PPM	11.9 V	11.8 V	81 F
8/09/2018	05:02:13	420 PPM	1 min	302 PPM	11.9 V	11.8 V	81 F
8/09/2018	05:03:13	420 PPM	1 min	302 PPM	11.9 V	11.8 V	81 F
8/09/2018	05:04:13	420 PPM	1 min	302 PPM	11.9 V	11.8 V	81 F
8/09/2018	05:05:13	420 PPM	1 min	302 PPM	11.9 V	11.8 V	81 F
8/09/2018	05:06:13	420 PPM	1 min	302 PPM	11.9 V	11.8 V	81 F
8/09/2018	05:07:13	420 PPM	1 min	302 PPM	11.9 V	11.8 V	81 F
8/09/2018	05:08:13	420 PPM	1 min	302 PPM	11.9 V	11.8 V	81 F

(Sample Spreadsheet of Downloaded Data) You can save your spreadsheet to a file by clicking the SAVE DATA Button.

Modbus RTU Protocol over RS485 Communications

Interface Parameters
- Register format: 16 bit unsigned register
- Baud = 9600
- Data bits = 8
- Stop bits = 1
- Parity = None

The Modbus address is entered in variable N1 for the Analyzer. Directions for Writing to this Variable
- Open the ***COMMAND CENTER*** and initiate communication with the Analyzer
- When the ***COMMAND CENTER*** communicates with the Analyzer, go to the VARIABLES Page of the ***COMMAND CENTER***
- Go to the User Input of the VARIABLES tab. Click on the USER INPUT and enter 'AMI' for the password when prompted. Then, return to the USER INPUT
- In the USER INPUT, enter the following to change the address of the Modbus:

A0WN1<Address>, where <Address> is 1–255

NOTE: *By default, it is set to 17.*

Using the Modbus RTU command, you can read the Analyzer's Modbus register(s):
*(**NOTE:** There are a total of eight bytes to send)*
- Byte 0 = Address (Modbus Bus Slave addressed to be entered into variable N1)
- Byte 1 = 3
- Byte 2 = 0
- Byte 3 = Register (Register equals the Starting Register for the Modbus read)
- Byte 4 = 0
- Byte 5 = Count (Count equals the Number of Registers to be read)
- Byte 6 = CRC Bytes
- Byte 7 = CRC Bytes

Holding Registers for BARRACUDA MODEL 4010LX

Register	Number of Register Used	Variable Name	Description	Type	Comment
0	16	A0RA0	Reading String	String	
141	2	A0RZ2	PPM Value	Two 16-bit Unsigned Integers	v7.0 Firmware or Above
143	1	A0RZ3	LBS x 100 Value	16-bit Unsigned Integer	v7.0 Firmware or Above
16	1	A0RA1	2F Baseline	16-bit Unsigned Integer	
17	1	A0RA2	2F H Peak Value	16-bit Unsigned Integer	
18	1	A0RA3	2F H Peak Index	16-bit Unsigned Integer	
19	1	A0RA4	2F C Peak Value	16-bit Unsigned Integer	
20	1	A0RA5	2F C Peak Index	16-bit Unsigned Integer	
21	1	A0RA7	Output in Pounds Flag	16-bit Unsigned Integer	
22	1	A0RB0	Output Range	16-bit Unsigned Integer	
23	1	A0RB1	Frequency Code (1)	16-bit Unsigned Integer	
24	1	A0RB2	Phase Code (2)	16-bit Unsigned Integer	
25	1	A0RB3	Bandwidth Code (3)	16-bit Unsigned Integer	
26	1	A0RB4	Scan Period (4)	16-bit Unsigned Integer	
27	1	A0RB5	Laser Enable (5)	16-bit Unsigned Integer	
28	1	A0RB6	Two F Offset (7)	16-bit Unsigned Integer	
29	1	A0RB7	Amplitude (8)	16-bit Unsigned Integer	
30	1	A0RB8	Null Width Storage (11)	16-bit Unsigned Integer	
31	1	A0RB9	Ramp Coefficient 1 (12)	16-bit Unsigned Integer	
32	1	A0RB10	Ramp Coefficient 2 (13)	16-bit Unsigned Integer	
33	1	A0RB11	Ramp Coefficient 3 (14)	16-bit Unsigned Integer	
34	1	A0RB12	Low Pass Gain (MSW) (22)	16-bit Unsigned Integer	
35	1	A0RB13	Low Pass Gain (LSW) (23)	16-bit Unsigned Integer	
36	1	A0RB14	TEC Set Point (Disabled)	16-bit Unsigned Integer	
37	1	A0RB15	TEC Enable	16-bit Unsigned Integer	
38	8	A0RC0	Software Version	String	
46	1	A0RC2	Loop Count	16-bit Unsigned Integer	
47	1	A0RD0	Cal Factor	16-bit Unsigned Integer	
48	1	A0RD1	Samples Per Scan	16-bit Unsigned Integer	
49	1	A0RD8	ADC TEC Raw Value 4	16-bit Unsigned Integer	
50	1	A0RE3	Analog Zero Offset	16-bit Unsigned Integer	
51	1	A0RE4	Analog Full Scale	16-bit Unsigned Integer	
52	1	A0RE6	E6 Config Variable	16-bit Unsigned Integer	
53	1	A0RF0	Alarm 1 Setpoint	16-bit Unsigned Integer	
54	1	A0RG0	Alarm 2 Setpoint	16-bit Unsigned Integer	
55	1	A0RH0	Alarm Configuration	16-bit Unsigned Integer	
56	1	A0RH1	Unused	16-bit Unsigned Integer	
57	1	A0RI0	Error Register 0	16-bit Unsigned Integer	
58	1	A0RI1	Error Register 1	16-bit Unsigned Integer	

Holding Registers for BARRACUDA MODEL 4010LX (continued)

Register	Number of Register Used	Variable Name	Description	Type	Comment
59	1	A0RI2	Error Register 2	16-bit Unsigned Integer	
60	1	A0RI3	Error Register 3	16-bit Unsigned Integer	
61	8	A0RJ0	Analyzer Type	String	
69	1	A0RJ1	Analyzer Configuration	16-bit Unsigned Integer	
70	8	A0RL0	Analyzer Serial Number	String	
78	8	A0RL1	Analyzer Tracking Number	String	
86	8	A0RL2	Analyzer User ID	String	
94	8	A0RL3	Analyzer Laser S/N	String	
102	10	A0RM0	Latest Startup Info	String	
112	2	A0RN0	Write Com ID	String	
114	1	A0RN1	Modbus ID	16-bit Unsigned Integer	
115	10	A0RO0	Low Power Event	String	
125	1	A0RP0	RTC Seconds	16-bit Unsigned Integer	
126	1	A0RP1	RTC Minutes	16-bit Unsigned Integer	
127	1	A0RP2	RTC Hours	16-bit Unsigned Integer	
128	1	A0RP3	RTC DOW	16-bit Unsigned Integer	
129	1	A0RP4	RTC DOM	16-bit Unsigned Integer	
130	1	A0RP5	RTC Month	16-bit Unsigned Integer	
131	1	A0RP6	RTC Year	16-bit Unsigned Integer	
132	1	A0RP7	Log Interval	16-bit Unsigned Integer	
133	1	A0RT0	Block Temperature +26	16-bit Unsigned Integer	
134	1	A0RT2	Pressure x 10000 (bar)	16-bit Unsigned Integer	
135	1	A0RT3	Power Voltage x 100	16-bit Unsigned Integer	
136	1	A0RU0	Hours of Operations	16-bit Unsigned Integer	
137	1	A0RW0	Alarm Pulse Time	16-bit Unsigned Integer	
138	1	A0RX0	Delay on for Alarm 1	16-bit Unsigned Integer	
139	1	A0RY0	Delay on for Alarm 2	16-bit Unsigned Integer	
140	1	A0RZ0	Alarm Hold of Time	16-bit Unsigned Integer	

Modbus Error Register Descriptions

Analyzer error conditions can be read via Modbus RTU protocol. Error codes are stored as individual bits in four 16-bit registers. Please see **MODEL 4010LX** Registers and Error Codes Table for the full list of registers and error codes.

A value of “1” in each bit position indicates that error is active, while a value of “0” indicates that error is inactive. Multiple error conditions can be active at once.

The registers can be read in either decimal or binary format, however they are simpler to decode in binary format.

Model 4010LX Registers and Error Codes Table

Register Number	Variable Name	Register Description	Binary Bit Position	Integer Equivalent	Message
57	A0RI0	Error Register 0	0	1	No 2F Trigger
			1	2	No DC Trigger
			2	4	TEC Setpoint Low
			3	8	TEC Setpoint High
			4	16	DC Average Value Low
			5	32	2F Average Value Low
			6	64	Power Supply Low
			7	128	PPM Overrange
			8	256	LBS Overrange
			9	512	2F Min-to-Max Low
			10	1,024	2F H2O Peak Out of Index
			11	2,048	2F CH4 Peak Out of Index
			12	4,096	Over / Under Pressure
			13	8,192	H2O DC Peak Too Large
			14	16,384	Over /Under Temperature
			15	32,768	2F Value Unstable
58	A0RI1	Error Register 1	0	1	FPGA Read Error
			1	2	Memory Read Error
			2	4	Memory Write Error
			3	8	Analytical Timeout
			4	16	Analyzer Warmup
			5	32	-
			6	64	-
			7	128	-
			8	256	-
			9	512	-
			10	1,024	-
			11	2,048	-
			12	4,096	-
			13	8,192	-
			14	16,384	-
			15	32,768	-

Model 4010LX Registers and Error Codes Table (continued)

Register Number	Variable Name	Register Description	Binary Bit Position	Integer Equivalent	Message
59	A0RI2	Error Register 2	0	1	ADC Sample High
			1	2	ADC Sample Low
			2	4	ADC Conversion Timeout
			3	8	DC Sample Too Low
			4	16	-
			5	32	-
			6	64	-
			7	128	-
			8	256	-
			9	512	-
			10	1,024	-
			11	2,048	-
			12	4,096	-
			13	8,192	-
			14	16,384	-
			15	32,768	-
60	A0R13	Error Register 3	0	1	-
			1	2	-
			2	4	-
			3	8	-
			4	16	-
			5	32	-
			6	64	-
			7	128	-
			8	256	-
			9	512	-
			10	1,024	-
			11	2,048	-
			12	4,096	-
			13	8,192	-
			14	16,384	-
			15	32,768	-

Modbus Error Register Example:

Reading Modbus registers 57 thru 60 on a **4010LX** results in the following:

Register Number	Variable Name	Register Value
57	A0RI0	2192
58	A0RI1	0
59	A0RI2	0
60	A0RI3	0

Since registers 58 thru 60 read “0” there are no active errors reported in these registers. Register 58 reports multiple active errors. To determine which errors are active, convert 2192 from decimal to binary.

2192 (decimal) = 0000 1000 1001 0000 (binary)

Since bits 4, 7, and 11 read “1” the following errors are active:

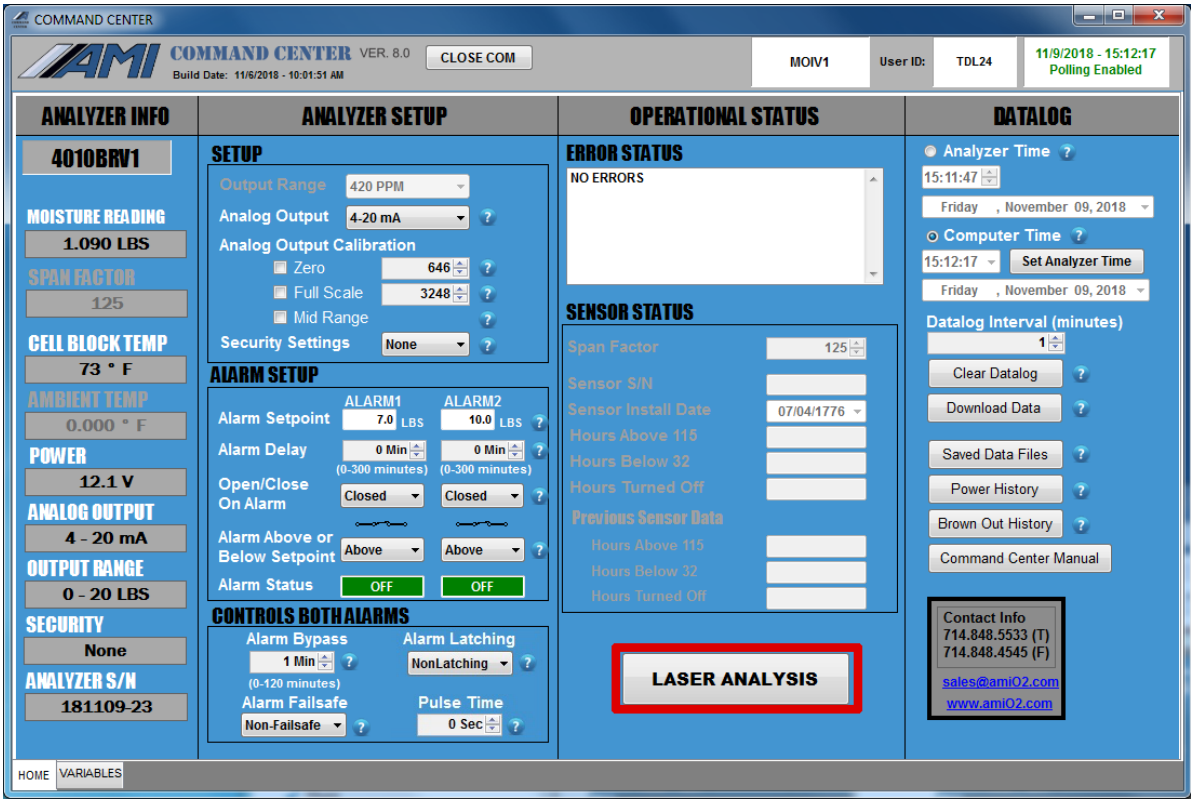
- Error 4: DC Average Value Low
- Error 7: PPM Overrange
- Error 11: 2F CH4 Peak Out of Index

END OF COMMEND CENTER INTERFACE SOFTWARE SET-UP AND BASIC OPERATION

MAINTENANCE, TROUBLESHOOTING & REPAIRS

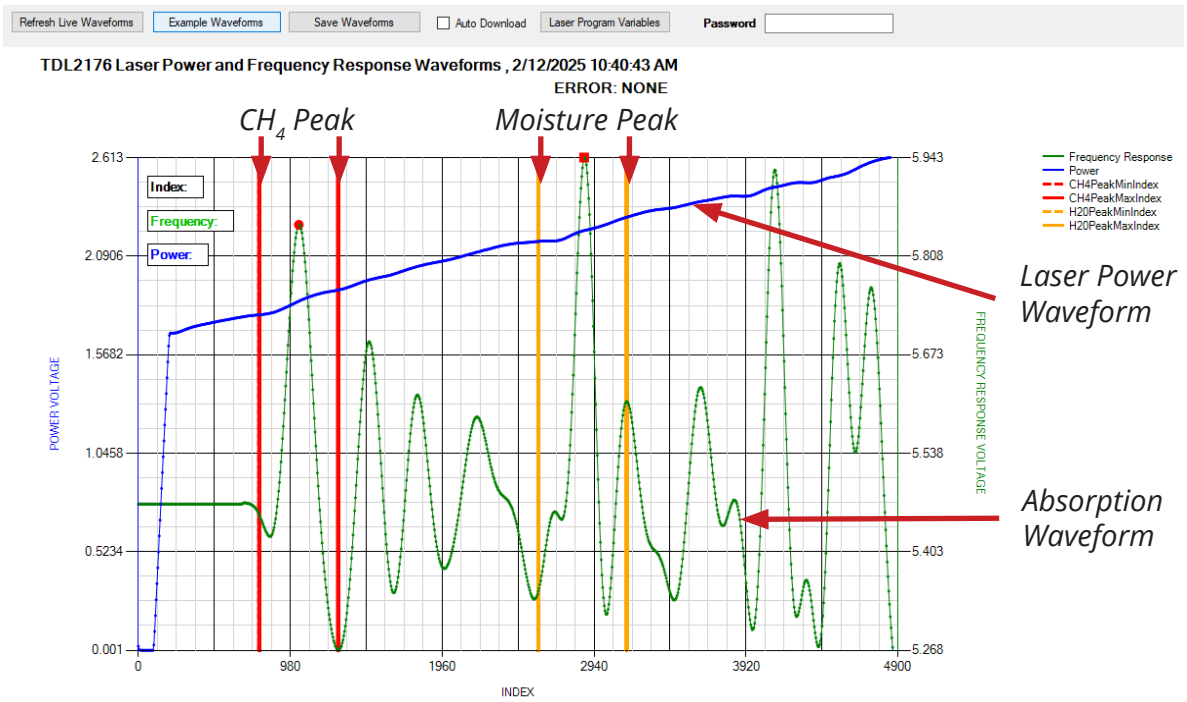
Viewing the Moisture Readings Waveform

To view the waveform of your measurement readings, click the LASER ANALYSIS Button located on the bottom of the Operational Status Column of the ***COMMAND CENTER***.



A separate Laser Graph Window will appear and display the waveform of the current moisture measurement.

Sample Waveform Displayed in the Laser Graph Window

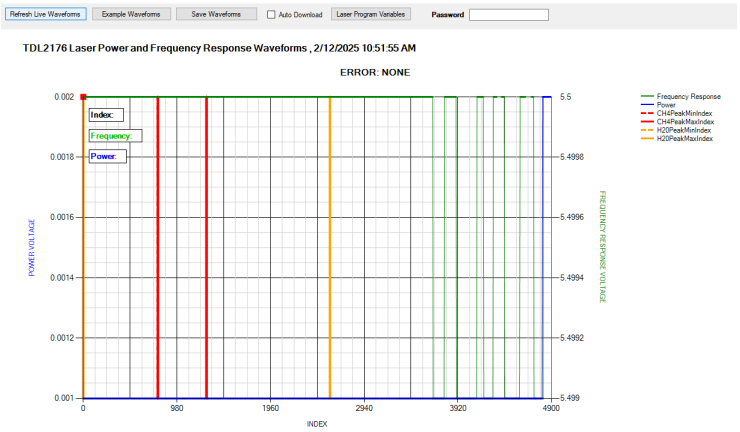


The graph above shows a typical waveform that a user should see when the **BARRACUDA** is measuring the concentration of H_2O in a sample.

- The size of the Moisture Peak will vary, depending on the concentration of H_2O vapor in the sample. The greater the concentration of H_2O vapor in the gas sample, the larger the height and size of the peak.
- The vertical dashed yellow line and solid yellow line represent the acceptable range for your signature water peak
- The CH_4 (methane) peak is a signature portion of the Laser Frequency Absorption Waveform and should always appear in every moisture reading. Its amplitude will be consistent from reading to reading unless there are changes in pressure. If the CH_4 peak is missing, it is an indication that something is likely wrong with your Analyzer.
- The vertical dashed red line and solid red line represent the acceptable range for your signature methane peak
- The Laser Power Waveform shows that the laser is working and functional
- The Absorption Waveform shows the absorption that is occurring while the moisture measurement is being performed

The following section identifies potential system issues and provides possible resolutions. The waveforms on the graph of each moisture measurement can indicate whether an issue needs to be addressed. If you are unable to resolve an issue after following the suggestion shown in this section, contact AMI for further support.

Graph with No Discernible Peaks or Waveforms



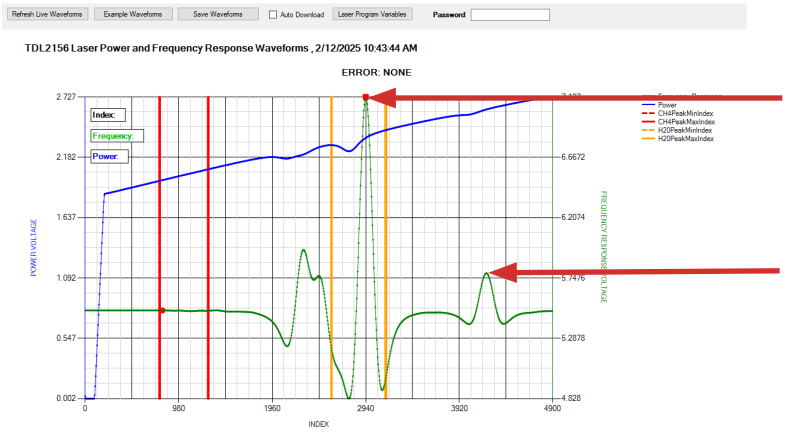
Potential Issue:

A graph with no visible waveforms and having no signature H_2O and CH_4 peaks is indicative of either **Laser Failure, Detector Failure** or **Detector Misalignment**.

Resolution:

Stop using the **BARRACUDA MODEL 4010LX** for trace moisture measurements and contact AMI for support.

Waveform with Signature Moisture Peak but No Signature CH4 (Methane) Peak



Moisture Peak
is present

Absorption Waveform
is normal

Potential Issue:

Whenever a waveform appears with the signature moisture peak but is missing the signature CH_4 peak, it may indicate an issue with the **Laser Power** or **the Gas Sample entering the Analyzer**.

Resolution:
First, check to verify that the laser power is present. The blue waveform represents the laser power of the **BARRACUDA MODEL 4010LX**. If its pattern appears, as shown above, it means that the laser is functioning properly.

Then check your Sample Inlet from the pipeline to the **BARRACUDA**, making sure that all connections are secured and have no leaks. Also, purge the Sample Line for a few minutes before resuming taking moisture measurements.

If the signature CH_4 peak does not reappear, stop using the **BARRACUDA MODEL 4010LX** for trace moisture measurements and contact AMI for support.

Graph with Shifted Waveforms Out of Tuning Range

Moisture Peak has also moved from the frequency range that the Analyzer targets

CH_4 Peak has slightly moved from the frequency range that **THE BARRACUDA** targets

Potential Issue:
Over time, laser-based Moisture Analyzers eventually see a gradual movement of their signature peaks on the x-axis of the measurement waveform. This shift can potentially affect the moisture measurement.

Resolution:
Stop using the **BARRACUDA MODEL 4010LX** and contact AMI for support.

Cleaning the Mirrors

NOTE: *AMI has taken many precautions for keeping the critical laser path clean during use in harsh gas pipeline conditions. Our compact patented cell block/sample system incorporates unique features; including a membrane that blocks liquids and particulates found in the gas stream and bypassing them prior to reaching the critical Herriott Measurement Cell.*

It is important to remember that the analyzers bypass valve must be partially open, allowing approx. 1 SCFH of gas to be bypassed, for liquids and particulates to properly drain. Failure to do so will force the liquids through the membrane and contaminate the mirrors.

We highly recommend purchasing AMI's complete optical Cleaning Kit prior to disassembly and cleaning the optical mirrors. Two cleaning kits are available.

AMI'S Cleaning Kit with Alcohol, part number 4KIT12, includes: a miniature ratchet, hex bits, 99% Isopropyl alcohol with squeeze bottle, optical lens wipes, three (3) 16" swabs, 10L can of compressed nitrogen and two (2) new replacement o-rings.

AMI's Cleaning Kit without Chemicals, part number 4KIT20, includes: a miniature ratchet, hex bits, optical lens wipes, three (3) 16" swabs, and two (2) new replacement o-rings.

If you purchase the Cleaning Kit without Chemicals, you will need to supply 99% pure isopropyl alcohol to clean the mirrors and 99.999% compressed pure nitrogen (or other clean, dry compressed inert gas) to blow off debris and evaporate alcohol.

If liquid and debris from the pipeline do enter the analyzer, there are different actions that should be taken depending on the severity of contamination.

Situations Requiring Cleaning

Situation #1 – Heavy flooding contamination of analyzers due to water slug or other upset condition.

Heavy contaminate loading in the analyzer can happen if the analyzer is not isolated during pigging operations or other significant upset conditions. One sign of this is visible liquids or debris in the flow meter of the analyzer. When this happens, the small passages of the entire cell block have also been saturated with liquids and they have been carried into the Herriott laser cell. A simple mirror cleaning will not resolve this issue. If the unit is put back into service in this condition after a mirror cleaning, it is very likely more trapped contaminates will be forced onto the mirrors. If the analyzer has been heavily flooded, it should be returned to the factory for cleaning.

Situation #2 – Condensate and light oil build up on mirrors.

It is possible for a thin film or layer of oily residue to accumulate on mirrors as the result of ambient heating and cooling of the gas as well as long term use. This condition would present itself as slight signal loss over time. It is appropriate to utilize the mirror cleaning procedure to try to resolve this condition.

Safety, Warnings and Cautions

This procedure describes the method for field servicing and cleaning of the **MODEL 4010LX**'s Herriott cell mirrors.

⚠ WARNING

All power must be turned off and disconnected from the Analyzer before performing the mirror cleaning procedure.

⚠ WARNING

The Herriott cell mirrors are a key component of our precision optics. Any damage to the surface of the mirrors can result in degradation of analyzer performance.

⚠ WARNING

Be careful not to damage the two (2) alignment dowel pins of Herriott cell when removing either endcap. Proper alignment of the laser during reassembly is dependent on these precision dowel pins.

⚠ WARNING

Fiber Optic Cables are extremely fragile and can be damaged by excessive flexing, bending, or impact to the cables. Care must be taken when using tools around the fiber optic cables and when setting mirror end cap down.

⚠ WARNING

Fiber optic cable has a minimum bend radius of 1" (25 mm). A smaller bend than 1" (25 mm) in will result in permanent loss of signal.

Steps:

1. Turn off mains power supply to the analyzer.

2. Turn off sample gas supply line.

⚠ WARNING

All power must be turned off and disconnected from the Analyzer. The 'Lock out and tag out' method is preferred.

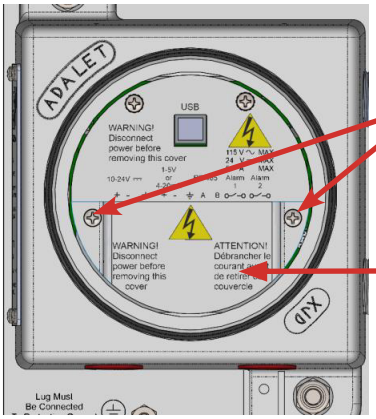
⚠ WARNING

Do not service while energized.

3. Remove the cap of explosion proof housing by unscrewing counterclockwise.

⚠ WARNING

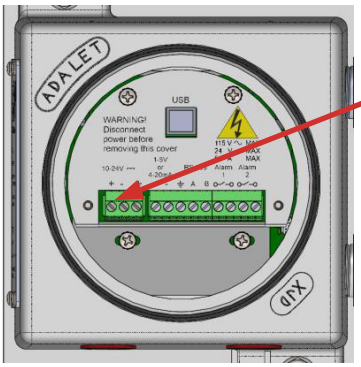
Do not open the enclosure while in an explosive atmosphere.



Philips Screws

Connector Cover

4. Remove the two (2) Philips screws and connector cover to access the electrical connections.

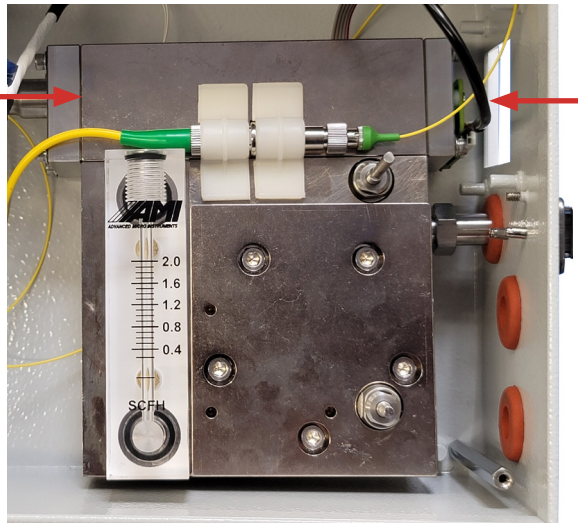


Mains Power Supply

5. Disconnect mains power supply from analyzer by removing the green Phoenix connector from the terminal strip.

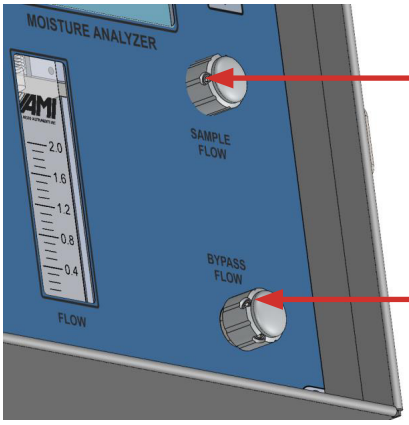
Far Mirror Disassembly and Inspection — Detector End

Near Side End Cap

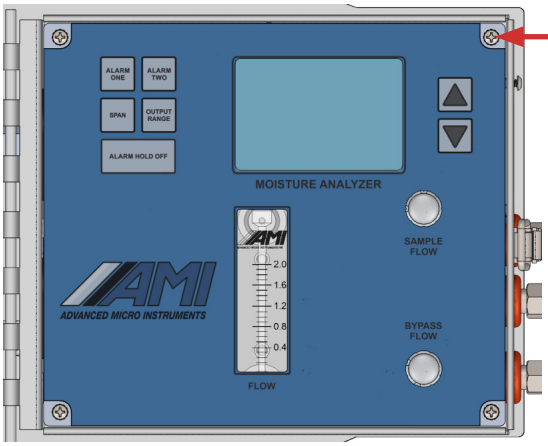


Far Side End Cap

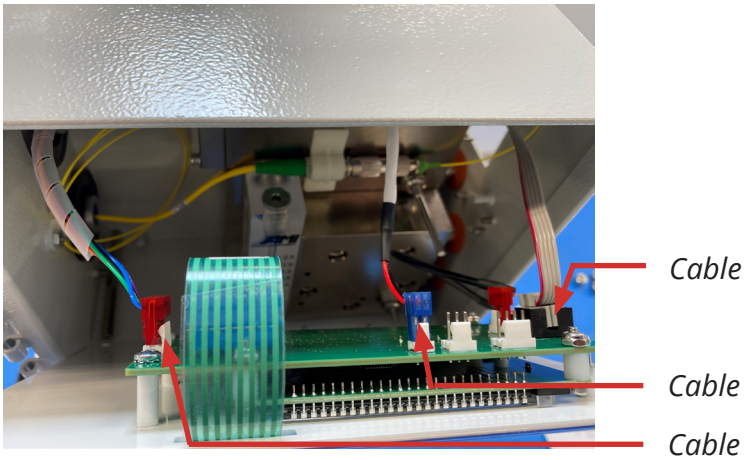
The Far Mirror – Detector End (right hand side of block) is the most likely to have a light layer of residue coating the mirror. By removing the far mirror, it can be inspected, and the operator will have the ability to visually inspect the Herriott cell bore and the near mirror – laser end (located on the left hand side of the cell block).



6. Open the enclosure door. Remove both flow control knobs by loosening the two (2) set screws with 1/16” Hex wrench until the knobs slip off the valve stem.



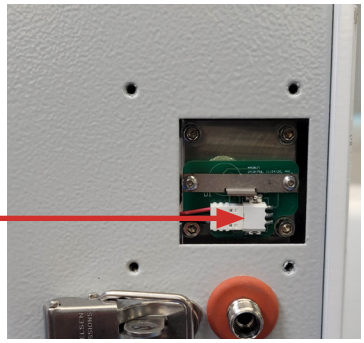
7. Remove the four (4) Philips screws holding the front panel. Lift the front panel carefully off of the analyzer while monitoring the internal cabling.



8. When accessible, disconnect the three (3) cables from the front panel and set front panel aside.

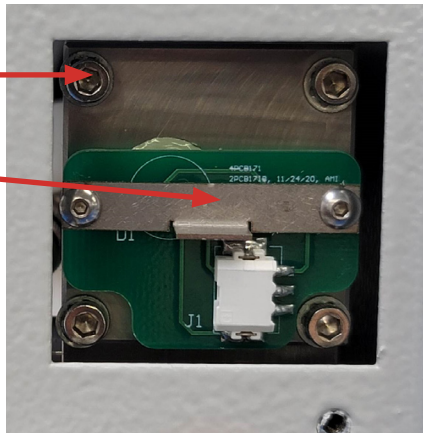
9. Remove the nameplate by removing the four (4) x pan head screws with a 5/64” hex wrench.

10. Disconnect the detector cable from the detector PCB. Tuck away the cable so it is out of the way.



⚠ WARNING

Be careful not to damage dowel pins of Herriott cell when removing end caps. Proper alignment of the laser during reassembly is dependent on the dowel pins.

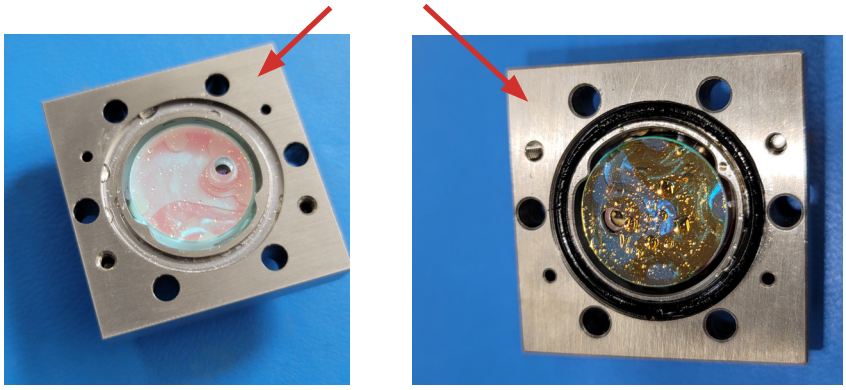


11. Remove the four (4) socket head cap screws of the Herriott cell far end cap with a 7/64" hex wrench. Utilizing the pull bracket, pull the end cap directly away from the Herriott cell block. Set the endcap down with the mirror facing up, protecting the mirror with supplied lens wipe. Discard the endcap o–ring and prepare to clean the mirrors.

Mirrors and Herriott Cell Inspection

12. Inspect far side mirror – detector end for visible signs of contamination. Small levels contamination (see image to the right) can be removed using the cleaning steps outlined in the mirror cleaning procedure below.

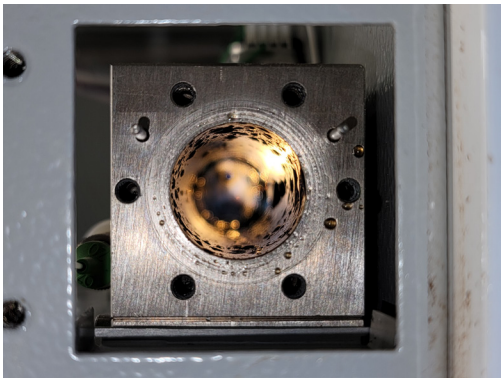
Far Side Mirror Examples



Light Contamination

Contamination Behind Mirror

13. If contamination is visible behind the far side mirror (right image above), the analyzer has been heavily flooded and will require cleaning at the factory



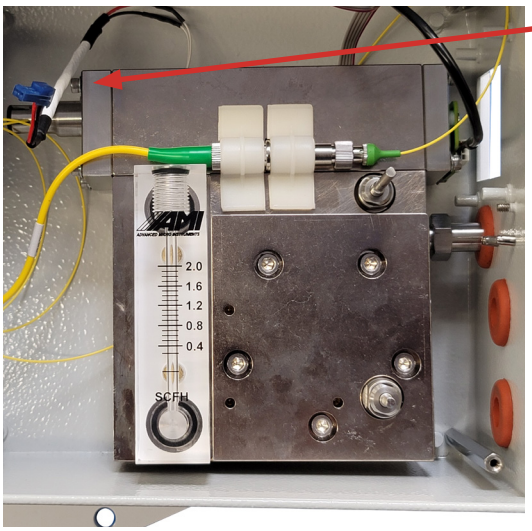
14. Look inside the Herriott cell for signs of moisture.

    If there is a small level of contamination on the near end (laser end) mirror, proceed to step 15 to remove the mirror from the Herriott cell block.

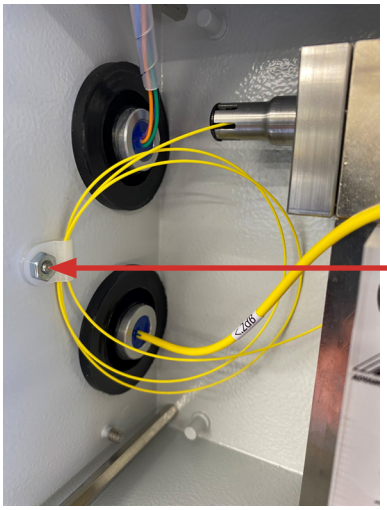
    If there is significant contamination on the Herriott cell walls (image to left), the analyzer will need to be sent back to the AMI factory for service.

    Re-assemble the analyzer prior to return to AMI.

Near Mirror Disassembly and Inspection — Laser End



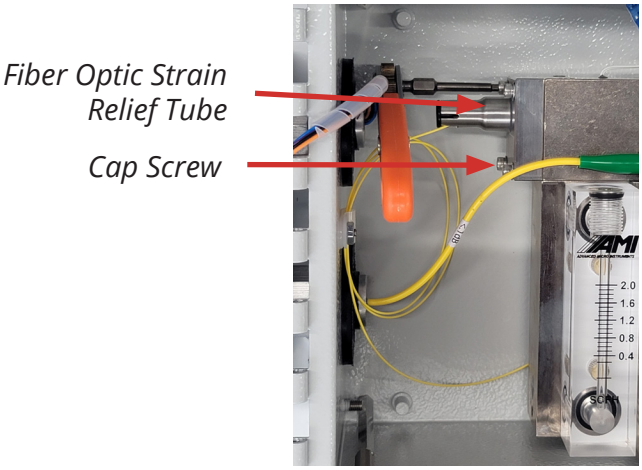
Near Side End Cap



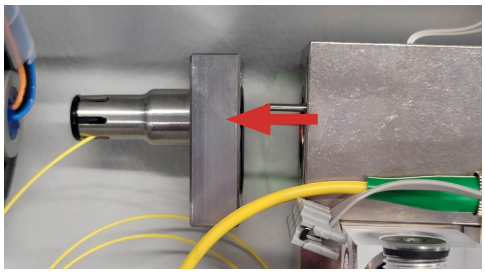
Head Cap Screw

15. Remove the white fiber optic loop hanger by unscrewing the 6–32 nut and carefully removing the hanger from the left side of the case.

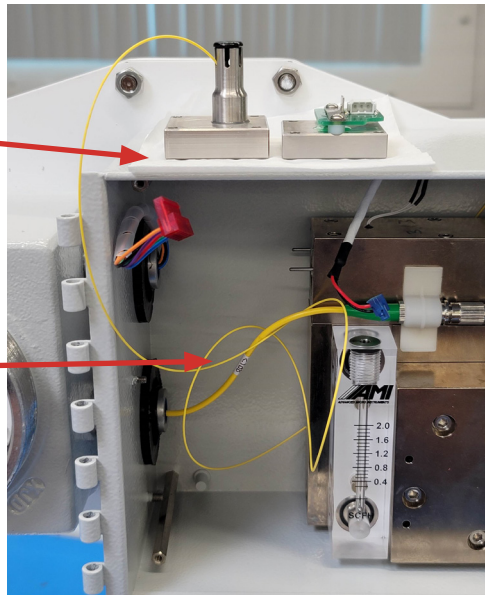
16. Remove the four (4) socket head cap screws holding the near end cap in place with a miniature ratchet and 7/64” hex wrench. Start by loosening all four (4) cap screws 1/4 turn before completely removing any of the screws.



17. Utilizing laser fiber optic strain relief tube, very carefully pull the near end cap directly away from the Herriott cell block, making sure to clear both alignment dowel pins before lifting from the enclosure. The dowel pins stick out roughly 3/8” from the Herriott cell block.



18. Set end cap on top of the case, with an optical wipe underneath it and do not damage this yellow fiber optic laser hoop during the cleaning process.



⚠ CAUTION

The Herriott cell mirrors are precision optics. Any damage to the surface of the mirrors can result in degradation of analyzer performance.

⚠ CAUTION

Be careful not to damage dowel pins of Herriott cell when removing endcaps. Proper alignment of the laser of the laser during reassembly is dependent on the dowel pins.

⚠ CAUTION

Fiber Optic Cables are extremely fragile and can be damaged by excessive flexing, bending or impacting the cables. Pay attention where tools are and when setting mirror end cap down.

Mirror Cleaning Process

⚠ WARNING

The Herriott cell mirrors are precision optics. Any damage to the surface of the mirrors can result in degradation of analyzer performance. Please use the following steps for cleaning the mirror surfaces.

19. Remove and discard o-rings from removed endcaps.

20. Using the AMI supplied optical wipes, apply a few drops of 99% pure isopropyl alcohol onto the wipe and then lightly rub one of the mirror surfaces. Use light pressure only and small circular motion.

21. Repeat this process with a new wipe and additional alcohol drops until all contamination is removed. Carefully blow dry with the can of dry nitrogen or other clean, dry, compressed inert gas.

22. Make sure the mirrors surface is free of any streaks. If not repeat steps 20 and 21.

23. After both mirrors are clean, carefully install the new, pre–lubricated o-rings into the endcaps.

24. Wet a swab with alcohol and carefully run it through the full length of the Herriott Cell block until clean. Then blow dry with the can of nitrogen or other clean, dry, compressed inert gas.

Analyzer Re-assembly

⚠ WARNING

When re-installing the Ends Caps, be careful not to hit the mirrors on the dowel pins. This can cause scratches on the mirror and any damage to the surface of the mirrors can result in degradation of analyzer performance.

25. Begin the reassemble by carefully reinstalling the near side mirror – laser end cap. Holding the strain relief, make sure the dowel pins are aligned and slip the near end cap into place.

26. Make sure the fiber optic loop is still intact with its approximately 1” (25 mm) radius and secure with the 6–32 nut (figure on next page).

27. Place the four (4) socket head screws in place and begin tightening in a star pattern. When assembling near mirror endcap torque screws to 12 in-lb.

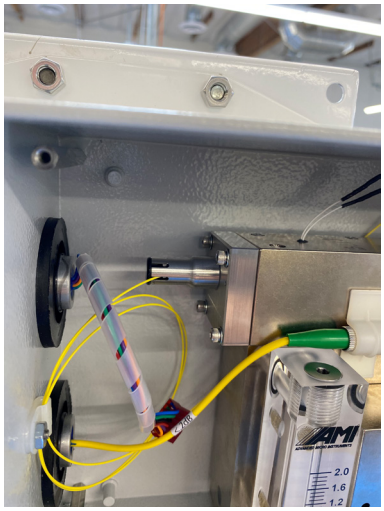
28. Reinstall the far end mirror assembly (right detector end) by carefully aligning the dowel pins with the end cap and slip into place.

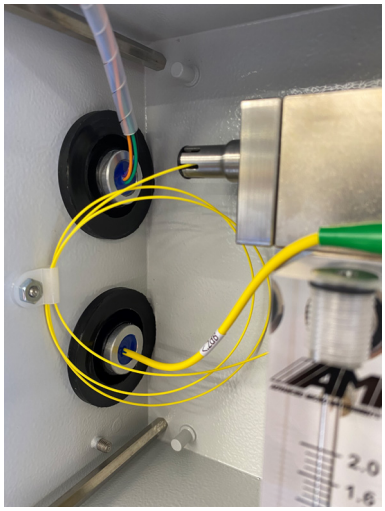
29. Slip screws into place and tighten in a star pattern. Torque to 12 in-lb.

30. Reattach white detector connector.

31. Replace the side cover and screws.

32. Reattach front panel by carefully reconnecting the three (3) cables and then front panel screws.





33. Place both flow meter knobs back in place and tighten with 1/16” hex key.

34. Reconnect power plug, protective cover and explosion proof lid.

35. Reapply power to the Analyzer.

Membrane Maintenance Procedure

NOTE: *AMI has taken many precautions for keeping the critical laser path clean during use in harsh gas pipeline conditions. Our compact patented cellblock/sample system incorporates unique features; including a membrane that blocks liquids and particulates found in the gas stream and bypassing them prior to reaching the critical Herriott Measurement Cell.*

AMI recommends using a Genie® 755 Direct Drive Probe™ (offered by A+ Corporation) or equivalent product in front of the analyzer for the gas connection into the pipeline for additional protection.

It is important to remember that the analyzers, bypass valve must be partially open, allowing approx. 1 SCFH of gas to be bypassed, for liquids and particulates to properly drain. Failure to do so will force the liquids through the membrane and contaminate the mirrors.

We highly recommend purchasing AMI’s complete Membrane Maintenance Kit prior to disassembly and replacement of the membrane.

AMI’S Membrane Maintenance Kit, part number 4KIT13, includes: one (1) membrane, two (2) new replacement o-rings, one (1) perforated disc, one (1) solid disc, and o-ring lubricant (Dow 55).

If liquid and debris from the pipeline do enter the analyzer, there are different actions that should be taken depending on the severity of contamination.

There is a video, Replacing the Internal Guardian Membrane for a ***4010LX*** *TDL Moisture Analyzer, available in the Video Library at www.amio2.com. For the best results, please watch this video prior to replacing the membrane.*

Safety, Warnings, and Cautions

This procedure describes the method for field servicing the **4010LX** Membrane in the sample cell block assembly.

⚠ WARNING

All power must be turned off and disconnected from the analyzer before performing the Membrane Maintenance Procedure.

⚠ WARNING

Fiber Optic Cables are extremely fragile and can be damaged by excessive flexing, bending or impact to the cables. Care must be taken when using tools around the fiber optic cables and when moving components with the cables attached.

⚠ WARNING

Fiber optic cable has a minimum bend radius of 1” (25 mm). A smaller bend than 1” (25 mm) in will result in permanent loss of signal.

Safety Measures

1. Turn off mains power supply to the analyzer. If energized, disconnect power to alarm relays.

⚠ WARNING

All power must be turned off and disconnected from analyzer. Lock out and tag out method is preferred.

⚠ WARNING

Do not service while energized.

2. Turn off sample gas supply line. In the following steps, the lines will be disconnected.

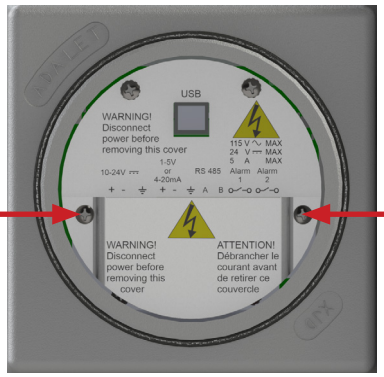
3. Remove the cap of explosion proof housing by unscrewing counterclockwise.

⚠ WARNING

Do not open enclosure in an explosive atmosphere.

4. Remove two (2) Philips screws and connector cover to access electrical connections.

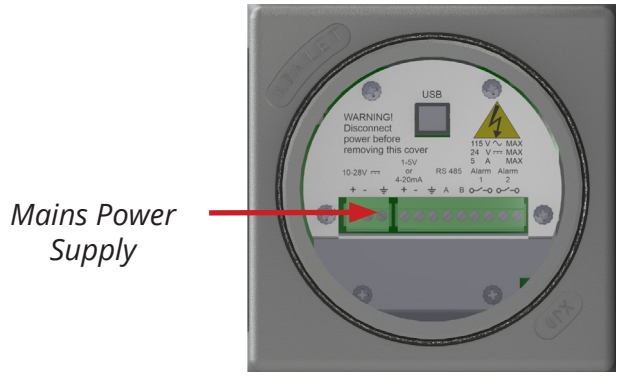
Connector Cover



Philips Screw *Philips Screw*

Removal of electrical access cover

5. To prevent any form of sparks, arcs, or any other form of electrical ignition in an explosive environment, disconnect mains power supply from analyzer by removing the green Phoenix connector from the terminal strip. Disconnect Analog Output/ RS485 Connector. Disconnect alarm relay connector. Disconnect USB cable if attached.



Mains Power Supply

Mains power connector

6. Disconnect Exhaust, Sample, and Bypass lines.

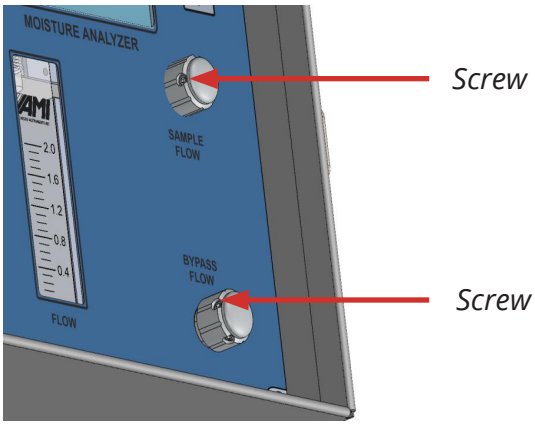
Exhaust Port

Sample Gas Inlet Port

Bypass Gas/Liquid Drain

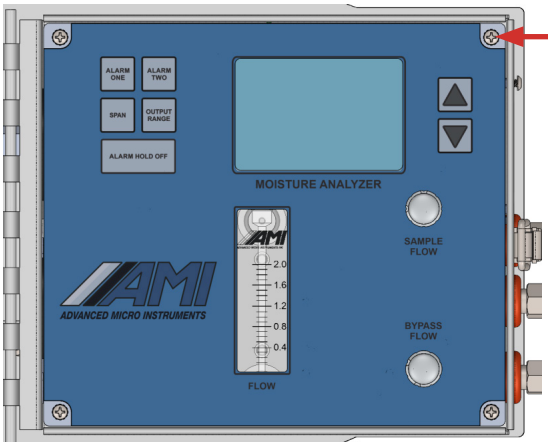
(Right side view)

Disassembly



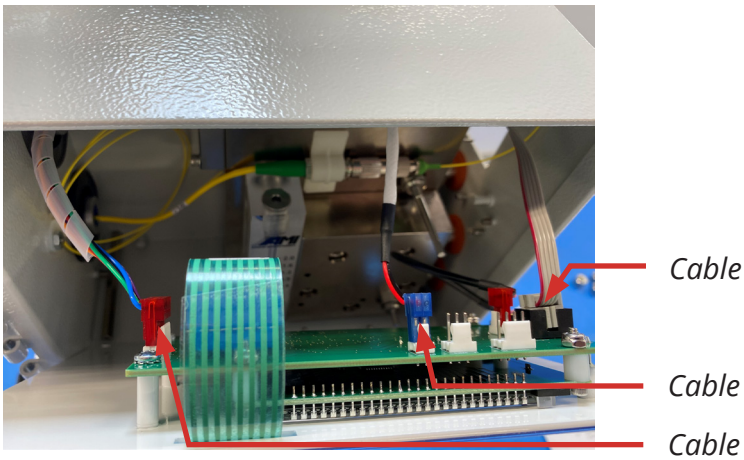
Flow control knobs and set screws

7. Open the enclosure door. Remove both flow control knobs by loosening the two (2) set screws with 1/16” Hex wrench until the knobs slip off the valve stem.



Front panel and screws

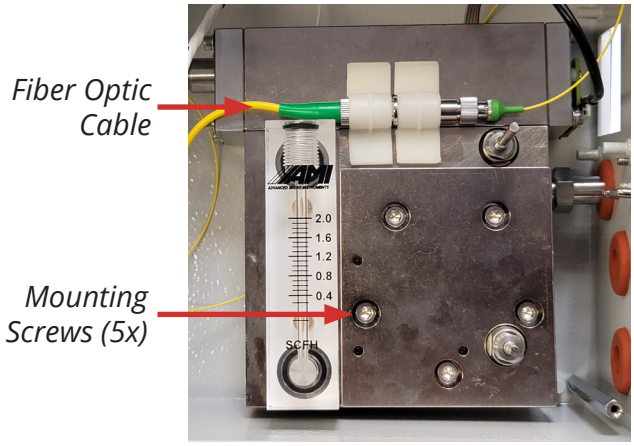
8. Remove the four (4) Philips screws holding the front panel. Lift the front panel carefully off of the analyzer while monitoring the internal cabling.



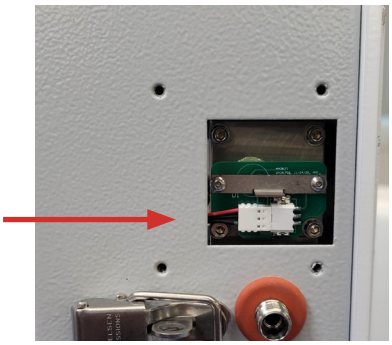
Front panel electrical connections

9. When accessible, disconnect the three (3) cables from the front panel and set front panel aside.

10. Remove five (5) mounting screws holding the sample cell blocks together and to the case with 5/32” hex. To prevent possible damage to the fiber optic cable, while removing the last screw, hold the cell blocks to prevent them from dropping and slamming on the bottom of the case.



11. Slide the sample cell block assembly to the left until the gas ports clear the orange grommets. Take care not to stretch or kink the fiber optic cable when moving the sample cell block.



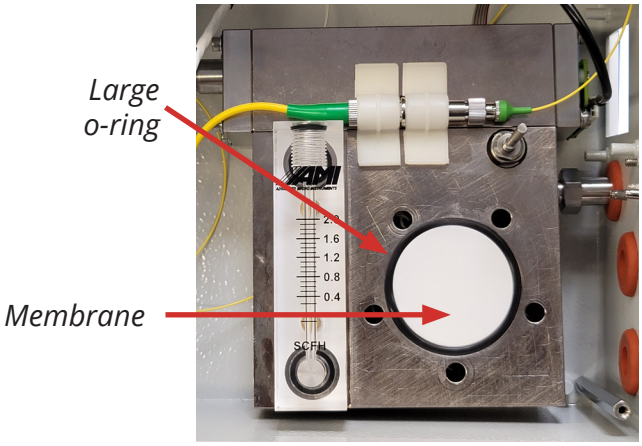
⚠ WARNING

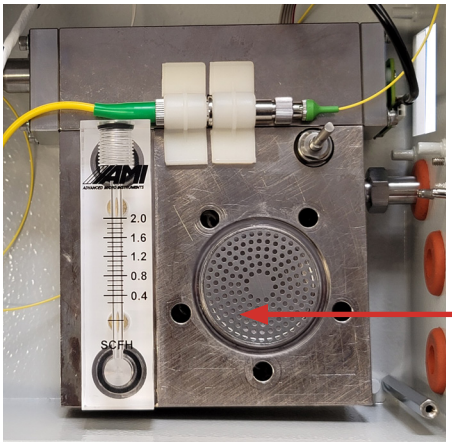
Make sure not to pinch or bend the fiber optic cables when manipulating the sample cell blocks. Any excess bends or pinch can result in loss of signal.

12. Remove the top block from the sample cell block assembly and set on top of the case.

13. Remove the three (3) orange grommets.

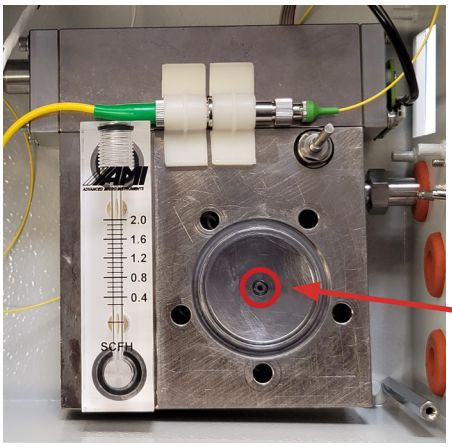
14. Remove large o-ring holding the membrane in place.





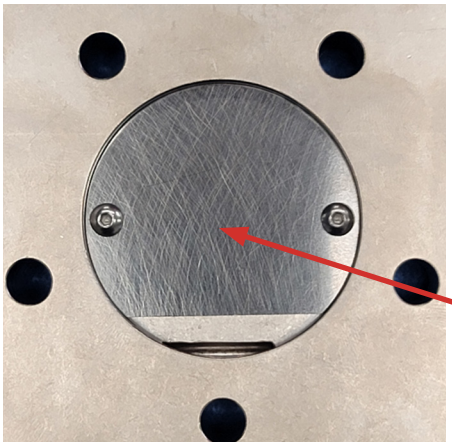
Perforated Disc

15. Remove the membrane to expose the perforated disc.



Small o-ring

16. Remove the perforated disc. Then remove the small o-ring.



Top block with vapor catch disc

17. Inspect the top block vapor catch disc. If the disc is corroded, remove disc and discard disc and replace with new disc.

Analyzer Re-assembly

18. With supplied o-ring lubricant, lube the two (2) o-rings and the inner id and the outer groove of the orange grommets.
19. Install the orange grommets into their respective holes.
20. Install the small o-ring into the o-ring groove.
21. Place the perforated disc in the cut out in the bottom sample cell block as shown in Perforated Disc image above.
22. Place the membrane over the perforated disc. Make the membrane concentric to the o-ring groove.

23. While holding the membrane in place, insert the large o-ring into the o-ring groove. Inspect the membrane to verify no holes or tears were created when installing the o-ring.
24. If vapor catch disc was removed, re-install. Place lock washers behind disc to elevate it from the block.
25. Place the top block on the bottom block. Slide the assembly so the gas ports go through the orange grommets and the holds line up with the standoffs in the case. Install the five (5) screws to lock the assembly in place.
26. Reattach front panel by carefully reconnecting the three (3) cables and then front panel screws.
27. Place both flow meter knobs back in place and tighten with 1/16" hex key.
28. Reconnect power plug, protective cover, and explosion proof lid.
29. Power up.

Field Validation Procedure

Every **MODEL 4010LX** unit undergoes rigorous internal quality tests prior to shipping. This includes a complete electronics and in–depth gas test. The factory calibrated ratiometric WMTDL measurement is inherently stable and will remain so for many years.

For a customer that wants to periodically verify the accuracy of their **MODEL 4010LX** using their own NIST traceable calibration gas, it is important to follow these specific steps so that errors are not introduced during the validation measurement.

For best results, use a calibration gas standard with 100 ppm moisture in a background of methane. (If your **MODEL 4010LX** is calibrated to measure moisture in nitrogen, calibration background gas should be nitrogen.)

Validation with Span Gas

REQUIRED COMPONENTS:

- Certified span gas with approximately 100 ppm oxygen in background of methane (or nitrogen for units measuring moisture in nitrogen)
- Stainless–steel body pressure-reducing regulator that is outfitted with inlet / outlet pressure gauges, with the outlet port being a compression fitting for 1/4" tube *(**NOTE:** the regulator must have a diaphragm made from stainless–steel).* It is recommended to dry-down the regulator prior to use.
- Length of stainless–steel tubing. It is recommended that the stainless–steel tubing is dried-down prior to use.
- Tank wrench

IMPORTANT:

- *Analyzer needs to be dry prior to validating with span gas. To dry unit, install Analyzer and flow dry sample gas or nitrogen through unit until unit reads <5 ppm moisture.*
- *It is recommended to dry down the pressure regulator and stainless–steel tubing prior to installation to minimize measurement stabilization time*
- *The Block and Bleed procedure is required only when a regulator has been connected to a gas cylinder for the first time or has not been used for an extended period of time*

NOTE: *Purging the regulator will not effectively evacuate moisture trapped in the regulator which can slowly leach into the calibration gas, introducing errors in your measurements.*

Block and Bleed Steps:

NOTE: *The AMI Oxygen Calibration video shows how to block and bleed the regulator. Video is available in the Video Library at* ***www.amio2.com****.*

1. Connect a pressure reducing regulator to the Span Gas Tank.

NOTE: *It is essential that all wetted components of the regulator is constructed out of stainless–steel, including the diaphragm. Failure to do so will invalidate the calibration.*

2. After the regulator has been attached to the Span Gas Tank and properly tightened, Block and Bleed the High-Pressure side of the Span Gas Regulator following this procedure:

   Open the valve of the Span Gas Tank approximately 1/2 turn. Confirm the inlet pressure gauge responds to 'full tank pressure'. Then, close the valve of the Span Gas Tank.

   Using the wrench, loosen the regulator nut that connects the regulator to the Span Gas Tank until gas starts to leak out at a high rate, approximately 1/2 turn. Watching the high-pressure gauge, wait until the needle reaches close to zero, and then quickly re-tighten the regulator nut. The goal is to keep a very small amount of pressure in the regulator, so air does not enter and saturate with moisture.

   Repeat the above procedure seven (7) times on high pressure side of the regulator.

3. Connect the stainless–steel tubing to the regulator outlet fitting.

NOTE: ***DO NOT*** *use Teflon® or another plastic tubing for this step as moisture will adhere to materials other than stainless–steel and invalidate your measurement.*

4. Now, Block and Bleed the Low Pressure side of the Regulator:

   Following standard operating procedures for working in hazardous environments, shut off flow in the sample gas connection tube line. Disconnect sample gas tubing from Sample Gas Inlet Port of analyzer.

   Connect the stainless–steel tubing from the regulator outlet fitting to the Sample Gas Inlet Port with a just a 1/2 turn or 1 thread, so gas can escape during the 'Block & Bleed' process.

   Open the valve of the Span Gas Tank approximately 1/2 turn. Confirm the high-pressure and low pressure gauges show to full pressure. Span gas should be venting through the sample gas connection off the analyzer and the span gas tubing. Adjust the pressure regulator to approximately 20 psig. Then, quickly close the valve of the Span Gas Tank. Watch the low-pressure gauge. When it approaches zero, open the valve on the tank. The goal is to keep a very small amount of pressure in the regulator.

   Repeat this procedure seven (7) times.

5. During the 7th Block and Bleed cycle of the Low Pressure side, tighten the gas fitting at the Sample Gas Inlet Port to complete the Block and Bleed process.

Validation Steps:

NOTE:*To avoid an alarm condition if you are utilizing the alarm feature on the Analyzer, press the ALARM HOLD OFF Button and adjust the UP/DOWN ARROWS for the desired Hold-Off/Bypass time in minutes. This will Hold-Off/Bypass the alarm relays and Analog output.*

1. Open the valve of the Span Gas Tank and adjust the regulator pressure to 20 psig.

2. Adjust the flow rate to approximately 1 SCFH.

3. Allow the measurement reading to stabilize. Measurement should be stable for at least 15 minutes before verifying analyzer reading.

4. Verify that the analyzer measurement reading matches the span gas concentration. The analyzer should read within the repeatability and accuracy range. If measured value does not match span gas concentration, **contact AMI at 1.714.848.5533 or at www.amio2.com for support**.

5. Close the valve on the Span Gas Tank. Disconnect span gas tubing from analyzer and reconnect sample gas tubing to Sample Gas Inlet Port.

Error Status Display: Error Reference Guide

The following section shows the existing error(s) that can be detected by the Analyzer and displayed on the Error Status Display. Each error has an assigned number and message.

Error Number	Message
0	No 2F Trigger
1	No DC Trigger
2	TEC Set Pt Low
3	TEC Set Pt High
4	DC Avg Value Low
5	2F Avg Value Low
6	Power Supply Low
7	PPM Over Range
8	LBS Over Range
9	2F MaxtoMin Too Low
10	2F H2O Peak Out of Index
11	2F CH4 Peak Out of Index
12	Over/Under Pressure
13	H20 DC Peak Too Large
14	Over/Under Temperature
15	2F CH4 Peak Error
16	No Peak Found
17	Memory Bad Read
18	Memory Bad Write
19	Analytical Timeout
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Error Number	Message
32	ADC Sample High
33	ADC Sample Low
34	ADC Conversion Time Out
35	DC SAMPLE TO LOW
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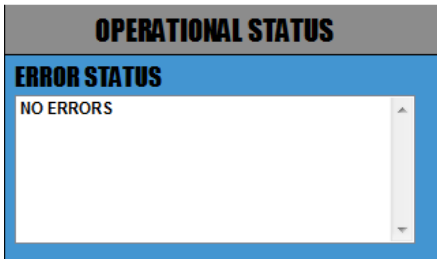

NOTE: *Once troubleshooting is completed and the error is resolved, the message will automatically be removed from the Error Status Display by the Analyzer.*

Important Messages Regarding Maintenance and Repairs

Sealing/Ingress Protection Maintenance

Whenever the Adalet Explosion–proof cap is opened, visually inspect the o-ring for any signs of damage or excessive wear.

Action:

– If the o–ring needs to be replaced, contact AMI

Important Message About Repairs

Where repair is possible:

⚠ WARNING

SUBSTITUTION OF COMPONENTS MAY IMPAIR INTRINSIC SAFETY.

LE REMPLACEMENT DE COMPOSANTS PEUT COMPROMETTRE LA SECURITE INTRINSEQUEZ.

IMPORTANT MESSAGE ABOUT CLEANING REQUIREMENTS:

The Analyzer is designed to function properly without cleaning requirements.

For any other issue not covered in this section, **contact AMI at 1.714.848.5533 or visit us at www.amio2.com for support.**

END OF MAINTENANCE, TROUBLESHOOTING & REPAIRS

SPECIFICATIONS

Usage	
Both indoor and outdoor use	
Altitude for Use	<10,500 ft (3,200 meters) for DC and AC models
Relative Humidity	<95%, non-condensing
Ingress Protection	IP65

Physical	
Dimensions	14.0”W x 9.5”H x 5.0”D (36 cm x 24 cm x 13 cm)
Weight	17.0 lbs (7.7 kg)
Digital Display	4–digit LCD
Mounting	Wall mount or 2.0” pipe
Gas Connections	1/4” 316 stainless–steel compression fittings
Wetted Parts	316 stainless–steel fittings, electroless nickel-plated cell block, acrylic flow meter & O–rings (Viton, kalrez, and Buna–N)
Materials	Cases (painted aluminum), Door Seal (urethane foam), Window (plastic), O–ring (neoprene)

Technology	
Principle of Measurement	Tunable Diode Laser Absorption Spectroscopy (TDLAS) *specific to moisture only
Key Technologies	Patented Wavelength and ***ELIMINATOR CELL BLOCK, MEASUREMENT ALGORITHM*** and ***SMART REALIGNMENT***, and ***COMMAND CENTER*** (which includes the following: Datalogger, Error Status Display, Brown-out History, Power-up History, USB Virtual Comport, and Modbus RS485 and Modbus RTU)

Performance	
Measurement Range	0.0–20.0 lbs of H_2O (0.0 – 420 ppm)
Low Minimum Detection Threshold	0.25 lbs (5.25 ppm) of H_2O
Response Time	90% < 2 sec, Incredibly fast upscale/downscale
Repeatability	±1% of range or ±0.25 lbs (±5.25 ppm) of H_2O, whichever is greater
Accuracy	±0.25 lbs (±5.25 ppm) of H_2O
Data Collection Capacity	5 days of data recording @1 data point per minute
Sample Cell Pressure Range	700–1100 mBarA
Inlet Gas Pressure	1.0–20.0 psig (0.07–1.4 bar)
Protection	RFI-protected

Specifications (continued)

Operation	
Ambient Operating Temperature Range	20°F to 149°F (–6.7°C to 65°C) **with Extreme Weather Enclosure:** 10°F to 149°F (–12°C to 65°C)
Recommended Sample Gas Flow Rate	1.0 to 2.0 SCFH* (0.5 to 1.0 Lpm) *SCFH = standard cubic feet/hour
Recommended Bypass Flow	Rate 0.5 SCFH* (0.25 Lpm) *SCFH = standard cubic feet/hour
Isolated Analog Output Signals (Active)	1–5 VDC and 4–20 mA

Alarms	
Number of Alarms	2 Fully, Adjustable Moisture Concentration Alarms
Alarm Delays	Programmable from 0–300 minutes
Alarm Hold-off / Bypass	Programmable from 0–120 minutes

Area Classification	
Area Classification	US / Canada: Class I, Division 1, Groups B–D, T4 Class I Zone 0/1, AEx ia op is/db IIB+H2 T4 Ga/Gb Ex ia op is/db IIB+H2 T4 Ga/Gb -20°C ≤ Tamb ≤ +65°C
	IECEx / NEPSI Ex ia op is IIB+H2 T4Ga/Ex db IIB+H2 T4 Gb -20°C ≤ Tamb ≤ +65°C
	ATEX / UKCA: Ⓔx II 1/2 G Ex ia op is/db IIB+H2 T4 Ga/Gb -20°C ≤ Tamb ≤ +65°C
	PESO: Ex ia op is/db IIB+H2 T4 Ga/Gb -20°C ≤ Tamb ≤ +65°C
Conforms/Certified to:	UL Std 61010-1 UL Std 1203 UL Std 60079-0 UL Std 60079-1 UL Std 60079-11 UL Std 60079-26 UL Std 60079-28 CSA Std C22.2#61010-1-12 CSA Std C22.2#30 CSA Std C22.2#60079-0 CSA Std C22.2#60079-1 CSA Std C22.2#60079-11 CSA Std C22.2#60079-26 CSA Std C22.2#60079-28
Environmental Conditions	OVII, PD2, Wet Location

Power	
Requirements	10–24 VDC, Um 24 VDC, 1.00 A max 100–240 VAC, 50/60Hz, Um 240 VAC, 500 mA max Use only approved Class 2 or limited energy circuits

AMI WARRANTY & SUPPORT

Limited Warranty/Disclaimer

The warranty period is TWO (2) YEARS for the Analyzer. Any failure of material or workmanship will be repaired free of charge for that specified period from the original purchase (shipping date) of the instrument. AMI will also pay for one–way ground shipment back to the customer.

The warranty period for the electrochemical oxygen sensor is six (6) months.

The warranty period for the electrochemical H2S sensor is six (6) months.

The warranty period for the zirconium oxide sensor is two (2) years.

Any indication of abuse or tampering of the instrument will void the warranty.

Receiving the Analyzer

When you receive the instrument, check the package for evidence of damage and if any is found contact the shipper. Although every effort has been made to assure that the Analyzer meets all performance specifications, AMI takes no responsibility for any losses incurred by reason of the failure of this analyzer or associated components. AMI's obligation is expressly limited to the Analyzer itself.

EXCEPT FOR THE FOREGOING LIMITED WARRANTY, AMI MAKES NO WARRANTIES, EXPRESS, IMPLIED OR STATUTORY, AS TO THE NON–INFRINGEMENT OF THIRD-PARTY RIGHTS, MERCHANTABILITY, OR FITNESS FOR A PARTICULAR PURPOSE. IF APPLICABLE LAW REQUIRES ANY WARRANTIES WITH RESPECT TO THE SYSTEM, ALL SUCH WARRANTIES ARE LIMITED IN DURATION TO TWO (2) YEARS FROM THE DATE OF DELIVERY.

Limitation of Liability

IN NO EVENT WILL AMI BE LIABLE TO YOU FOR ANY SPECIAL DAMAGES, INCLUDING ANY LOST PROFIT, LOST SAVINGS, OR OTHER INCIDENTAL OR CONSEQUENTIAL DAMAGES, EVEN IF THE COMPANY HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES, OR FOR ANY CLAIM BY ANY OTHER PARTY.

Limitation or Remedies

AMI's entire liability and your exclusive remedy under the Limited Warranty (see above) shall be the replacement of any Analyzer that is returned to the Company and does not meet the Company's Limited Warranty.

END OF AMI WARRANTY & SUPPORT

DECLARATIONS OF CONFORMITY

EU Declaration of Conformity

For the gas analyzers:

4010LX followed by -AC or -DC

In locations:

CE Ⓔx II 1/2 G Ex ia op is/db IIB+H2 T4 Ga/Gb -20°C ≤ T_{amb} ≤ +65°C

We, Advanced Micro Instruments (AMI) declare under sole responsibility that the above products, to which this declaration relates, is in conformity with the requirements of the following EU Directive(s):

- **ATEX DIRECTIVE 2014/34/EU**

Notified Body Name/number: Intertek Testing Services NA Ltd./ 2903
Issued the EU-Type examination certificate: ETL23ATEXQ0280

The Technical Documentation (TD), relevant to the product described above and which support this DoC is available from the contact address on this DoC.

The following harmonized standards and normative documents are those to which the product's conformance is declared, and by specific reference to the essential requirements of the reference Directive:

EN 60079-0:2018: Explosive Atmospheres - Part 0: Equipment - General Requirements
EN 60079-1:2014: Explosive Atmospheres - Part 1: Equipment Protection By Flameproof Enclosures "D"
EN 60079-11:2012: Explosive Atmospheres - Part 11: Equipment Protection By Intrinsic Safety "I"
EN 60079-28:2014: Explosive Atmospheres - Part 28: Protection of equipment and transmission systems using optical radiation

Kevin Bates
President

Signed for and on Behalf of
Advanced Micro Instruments
225 Paularino Ave
Costa Mesa, CA 92626
Tel: 714-848-5533
www.amiO2.com

UK Declaration of Conformity

For the gas analyzers:

4010LX followed by -AC or -DC

In locations:

CE Ex II 1/2 G Ex ia op is/db IIB+H2 T4 Ga/Gb -20°C ≤ T_{amb} ≤ +65°C

We, Advanced Micro Instruments (AMI) declare under sole responsibility that the above products, to which this declaration relates, is in conformity with the requirements of the following UK Directive(s):

- **UK DIRECTIVE UKSI 2016:1107**

Notified Body Name/number: Intertek Testing & Certification Limited, Cleeve Road, Leatherhead, Surrey, KT22 7SA (NB number 0359)
Issued the UK-Type examination certificate: ITS21UKQAN0067

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