



# 146iQ Instruction Manual

## Multi-Gas Calibrator

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# Chapter 1

## Introduction

The Thermo Scientific™ 146iQ Multi-Gas Calibrator supplies precise levels of ozone, carbon monoxide, non-methane hydrocarbons, sulfur dioxide, nitric oxide and nitrogen dioxide or other gases that a user may require.

The gas levels are used to calibrate instruments that perform zero, precision and level 1 span checks, audits and multipoint measurements.

The design of the 146iQ Multi-Gas Calibrator meets or exceeds all published U.S. EPA requirements for multipoint calibration, audit, Level 1 and 2 span and precision checks. Options include Gas Phase Titration, UV Photometer, and a third Mass Flow Controller.

### **iQ Series Instrument Platform**

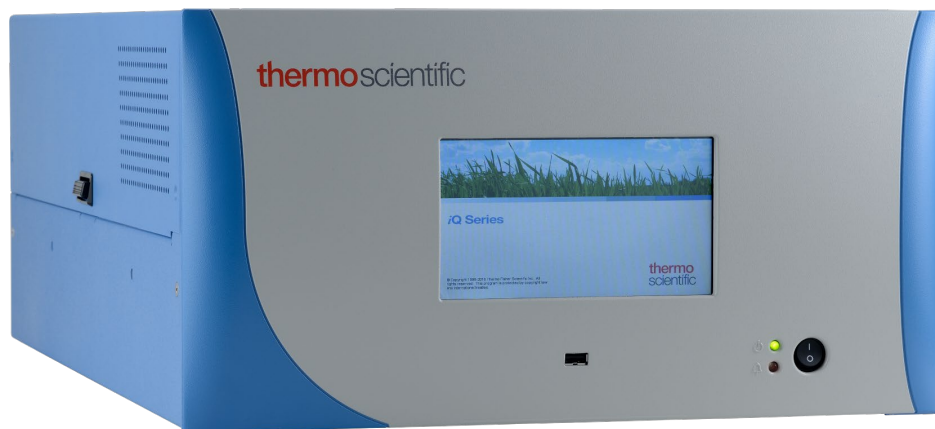
The iQ Series Instrument Platform is a smart environmental monitoring solution for ambient and source gas analysis that affords greater control over instrument performance and data availability.

- Distributed Measurement and Control (DMC) module design simplifies serviceability. Each DMC module contains its own microprocessor control enabling functional performance validation at the module level.
- Built-in predictive diagnostics and preventive maintenance schedules identify problems before they occur. The iQ Series platform sends email notifications directly to Thermo Fisher Scientific's world class service support team or locally identified addressees in order to proactively communicate analyzer performance conditions and identify spare parts needs before an operational concern arises.
- The iQ Series platform supports Modbus, streaming and VNC protocols over serial and Ethernet as well as analog and digital I/O for easy integration into most data management systems.
- Three standard USB ports afford convenient data download capability as well as the ability to connect additional hardware, such as a computer keyboard or mouse.
- The iQ Series GUI runs on a 7" color touchscreen display. The GUI is highly flexible and can be customized to enable a tailored experience to simplify daily operations. Custom designed ePort

## Introduction

### iQ Series Instrument Platform

software allows remote access to the analyzer with a PC. The ePort control mirrors the same GUI look and feel as the instrument touchscreen providing a speedy and familiar operational experience.



**Figure 1–1.** 146iQ Front



## Principle of Operation

All of the components used such as mass flow controllers, ozone generator, power supplies, solenoid valves, and photometer have been used previously for calibration purposes, and are known for their accuracy and reliability. In the 146iQ, these components are integrated into a single microprocessor-controlled unit. The instrument can be controlled locally via the front-panel interface or remotely, using a datalogger or computer.

## Dilution

The standard 146iQ hardware/plumbing configuration comprises gas and zero air flow controllers, as shown in [Figure 1–2](#). The basic unit can handle six gas standards, controlled by individual solenoids. The zero air flow and the gas flow are regulated by mass flow controllers. The zero air controller is high flow (typically 10 slm full scale). The primary gas flow controller is low flow (typically 100 sccm). An additional available gas flow controller option would allow the user to dilute gas standards over a wider range than allowable/achievable with a single span gas mass flow controller. When the two gas flow controllers are installed, they are connected in parallel to the same gas solenoid. The 146iQ turns on the gas flow controller with the lowest flow rate that can accommodate the requested/calculated flow and hence can provide the most accurate flow metering. When a flow is requested/calculated that is higher than the highest range of the flow controllers, but is lower than their combined maximum range, both gas flow controllers are utilized. A PTFE mixing chamber is used to achieve complete mixing of the two components at the desired concentration level. This hardware/plumbing configuration allows precision gas dilution.

## Ozone Generation

The 146iQ can be equipped with an optional internal ozone generator. The hardware/plumbing configuration of the standard instrument with the ozone generator is shown in [Figure 1–3](#). The generator produces ozone by exposing air to light at 185nm. The achievable ozone concentration is changed by varying the intensity of the lamp and varying the zero air flow. With all of the gas standard solenoids deactivated, the 146iQ can be used as a transfer standard ozone-generating source.

## Gas Phase Titration

Gas Phase Titration (GPT) is achieved by combining ozone with a known NO concentration, and measuring the loss of NO using the NO channel of a chemiluminescence analyzer. The amount of NO<sub>2</sub> formed is equal to the measured decrease in the NO level, as shown in the following equation:



In the 146iQ, GPT is accomplished by routing zero air, at approximately 150 cc per minute, through the internal ozone generator to create ozone and then precisely mixing this with NO from a gas cylinder connected to one of the gas inlets. From there, the NO/O<sub>3</sub> goes to the reaction chamber whose volume meets the dynamic parameter specification requirements of the U.S. EPA. The gas is then diluted with zero air to provide the desired NO<sub>2</sub> concentration out the manifold at the rear of the instrument.

## Photometer

The 146iQ photometer operates on the principle that ozone (O<sub>3</sub>) molecules absorb UV light at a wavelength of 254 nm. The degree to which the UV light is absorbed is directly related to the ozone concentration as described by the Beer-Lambert Law:

$$\frac{I}{I_o} = e^{-KLC}$$

where:

K = molecular absorption coefficient, 308 cm<sup>-1</sup> (at 0°C and 1 atmosphere)

L = length of cell, 38 cm

C = ozone concentration in parts per million (ppm)

I = UV light intensity of sample with ozone (sample gas)

I<sub>o</sub> = UV light intensity of sample without ozone (reference gas)

Zero air is supplied to the 146iQ through the *zero air* bulkhead and is split into two gas streams, as shown in [Figure 1–4](#). One gas stream flows through the zero air solenoid, then through the ozonator to the manifold and to the external/internal solenoid to become the sample gas (I). The other stream flows from the zero air bulkhead to the sample/reference solenoid in the photometer and is used as the reference gas (I<sub>o</sub>). Alternately, the sample gas may be pulled from an external source through the external/internal solenoid. The sample/reference solenoid valve alternates the reference and sample gas streams between the cell every 5 seconds. Ozone measured by the photometer is dumped out the exhaust bulkhead.

The UV light intensities of the zero and sample gases are measured by the detector. When the solenoid valves switch the reference and sample gas streams, the light intensity is ignored for several seconds to allow the cell to

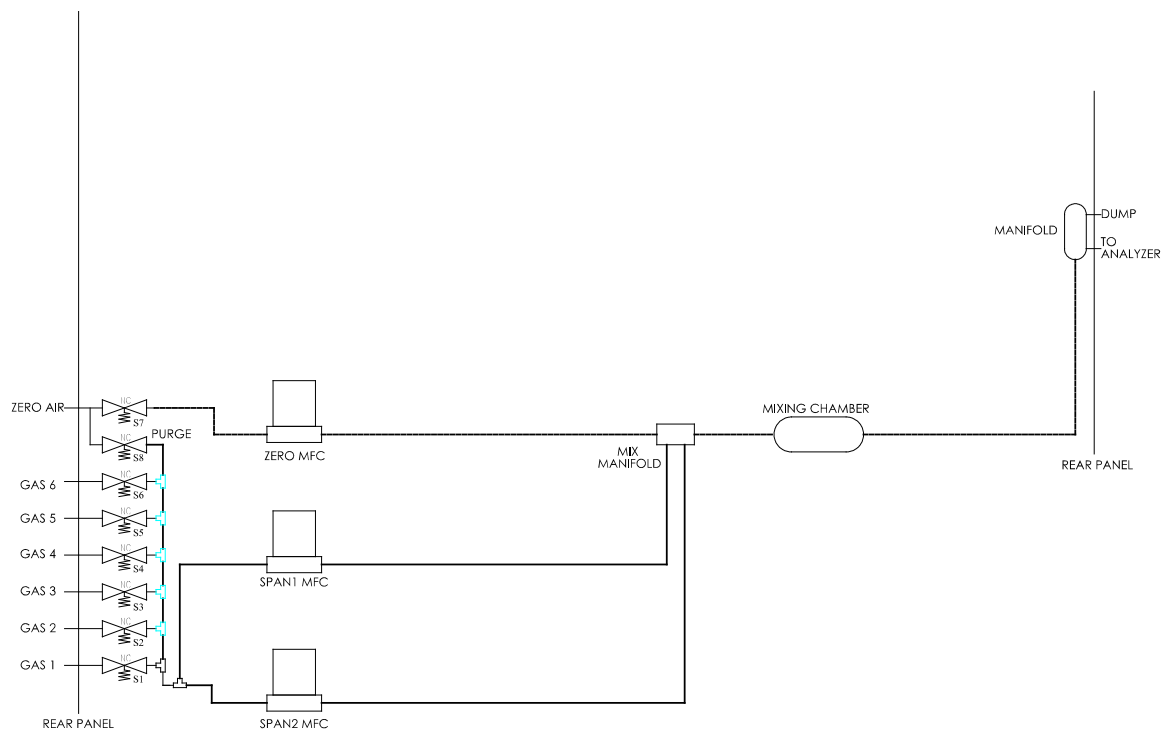
be flushed. The 146iQ calculates the ozone concentration from the ratio of zero and sample gas intensities and outputs the concentration to the front panel display, the analog outputs, and also makes the data available over the serial or Ethernet connection.

## **Permeation Oven**

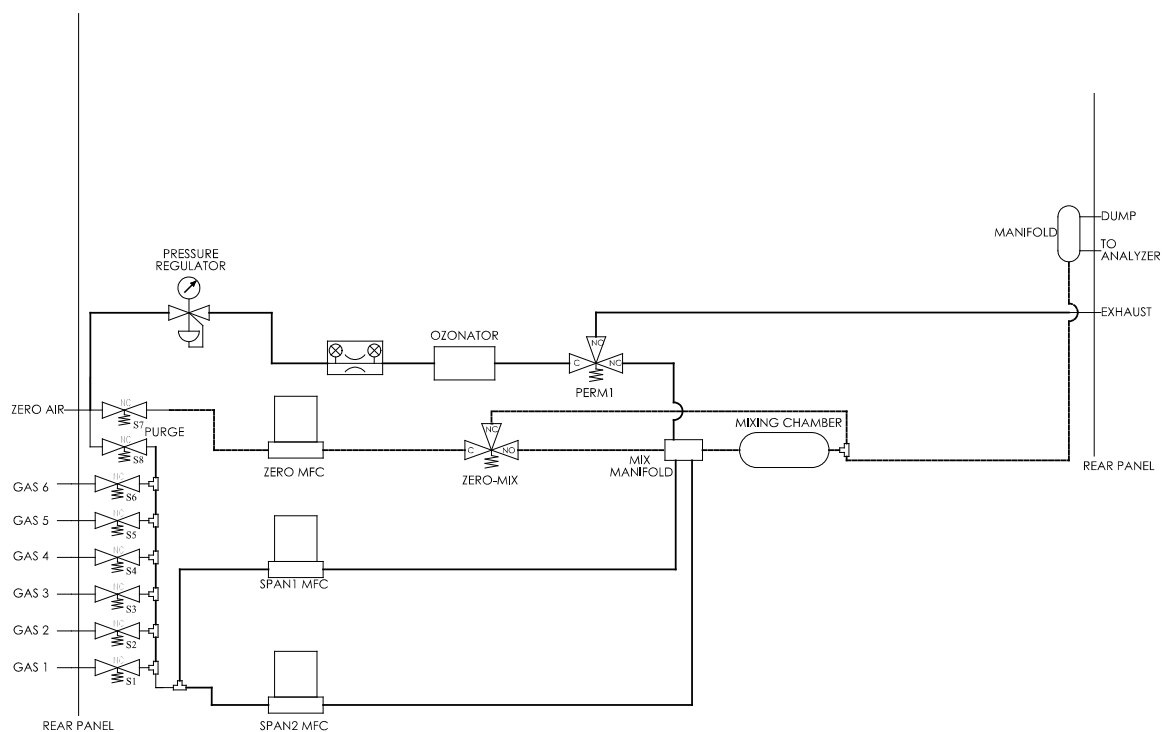
The 146iQ can also be used as a permeation gas source when equipped with an optional permeation tube oven, as shown in [Figure 1–5](#). Accuracy is achieved since both the release rate of the permeation tube gas and the flow of zero air through the zero-air mass flow controller are known, and the temperature of the permeation tube is stable. Temperature stability of the permeation tube is accomplished by allowing only a small amount of zero air to enter the permeation tube oven to be heated. The major portion of zero air bypasses the oven and is routed to the mixing chamber. The solenoids on either side of the permeation tube oven, under microprocessor control, are used to route the flow of gas going through the oven to either the main air stream or to exhaust. It should be noted that zero air must always flow through the permeation tube oven, regardless of the 146iQ output flow, so the oven may be kept at a stable temperature. To accomplish this, a flow of zero air set by a capillary at approximately 150 cc per minute is continuously fed through the permeation tube oven.

When the permeation oven is activated, up to six permeation dilution gas levels (ppm) can be set, in conjunction with the gas dilution system that controls the flow rate of zero air.

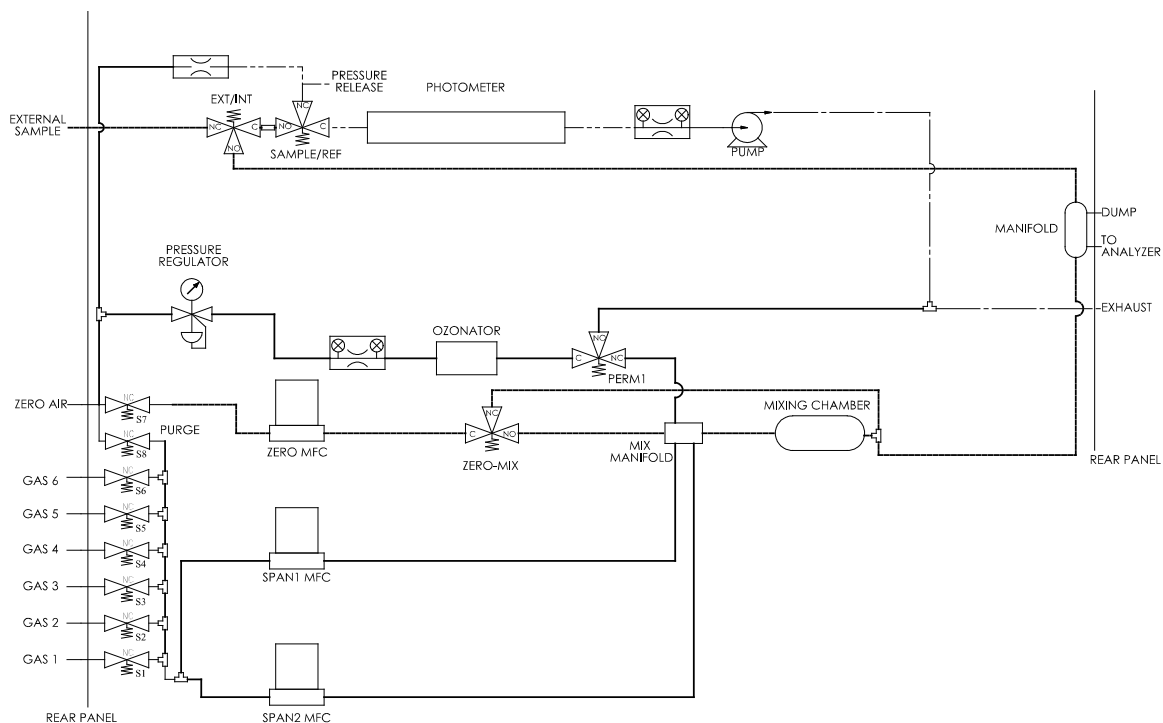
[Figure 1–6](#) shows the hardware/plumbing configuration with both the optional ozone generator and permeation oven installed.



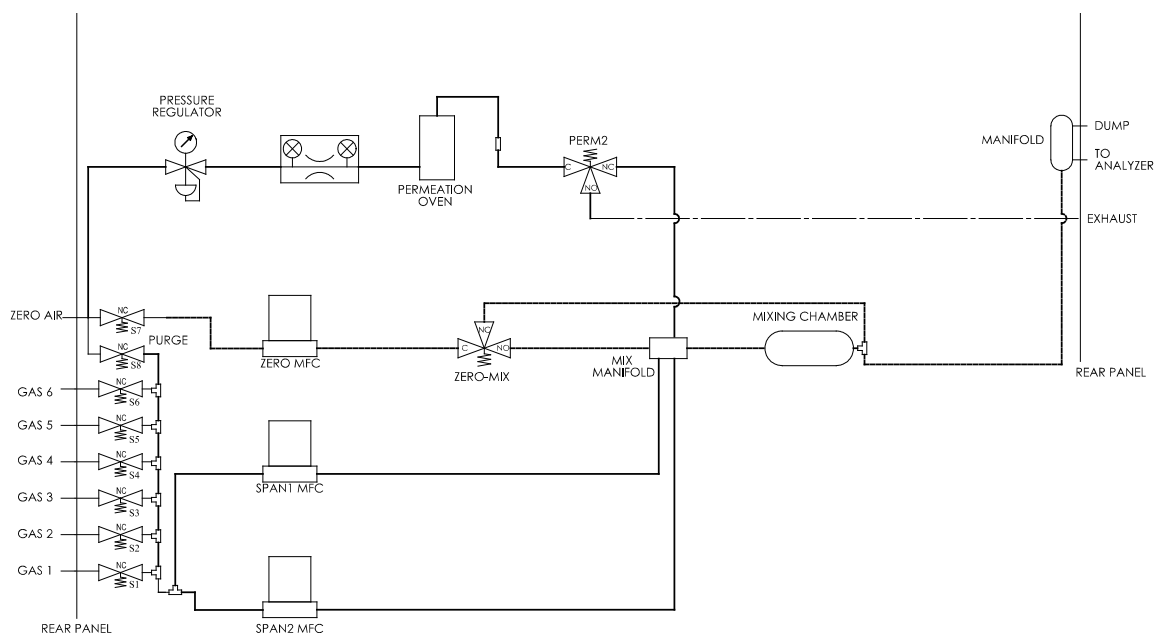
**Figure 1-2.** Standard Gas Dilution System



**Figure 1-3.** Standard Gas Dilution System with Gas Phase Titration (GPT)

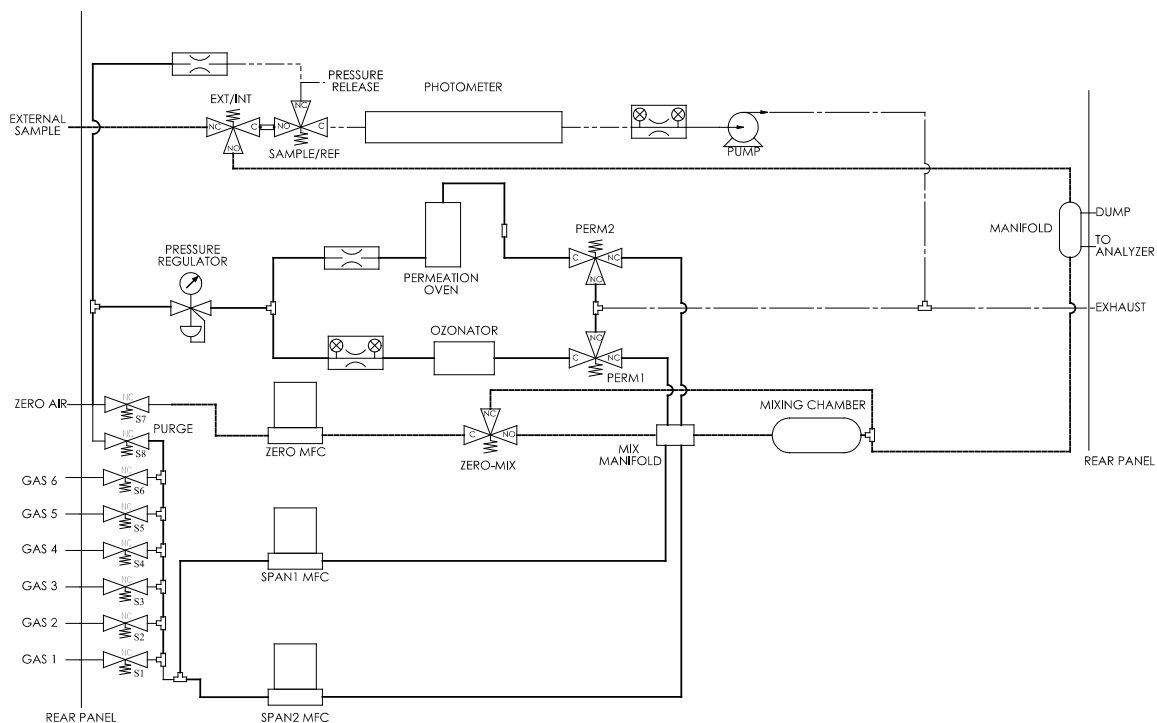


**Figure 1–4.** Standard Gas Dilution System with GPT and Photometer



**Figure 1–5.** Standard Gas Dilution System with Permeation Tube Oven

### Principle of Operation



**Figure 1–6.** Standard Gas Dilution System with GPT, Photometer, and Permeation Tube Oven



## Specifications

Table 1–1 lists the specifications for the 146iQ.

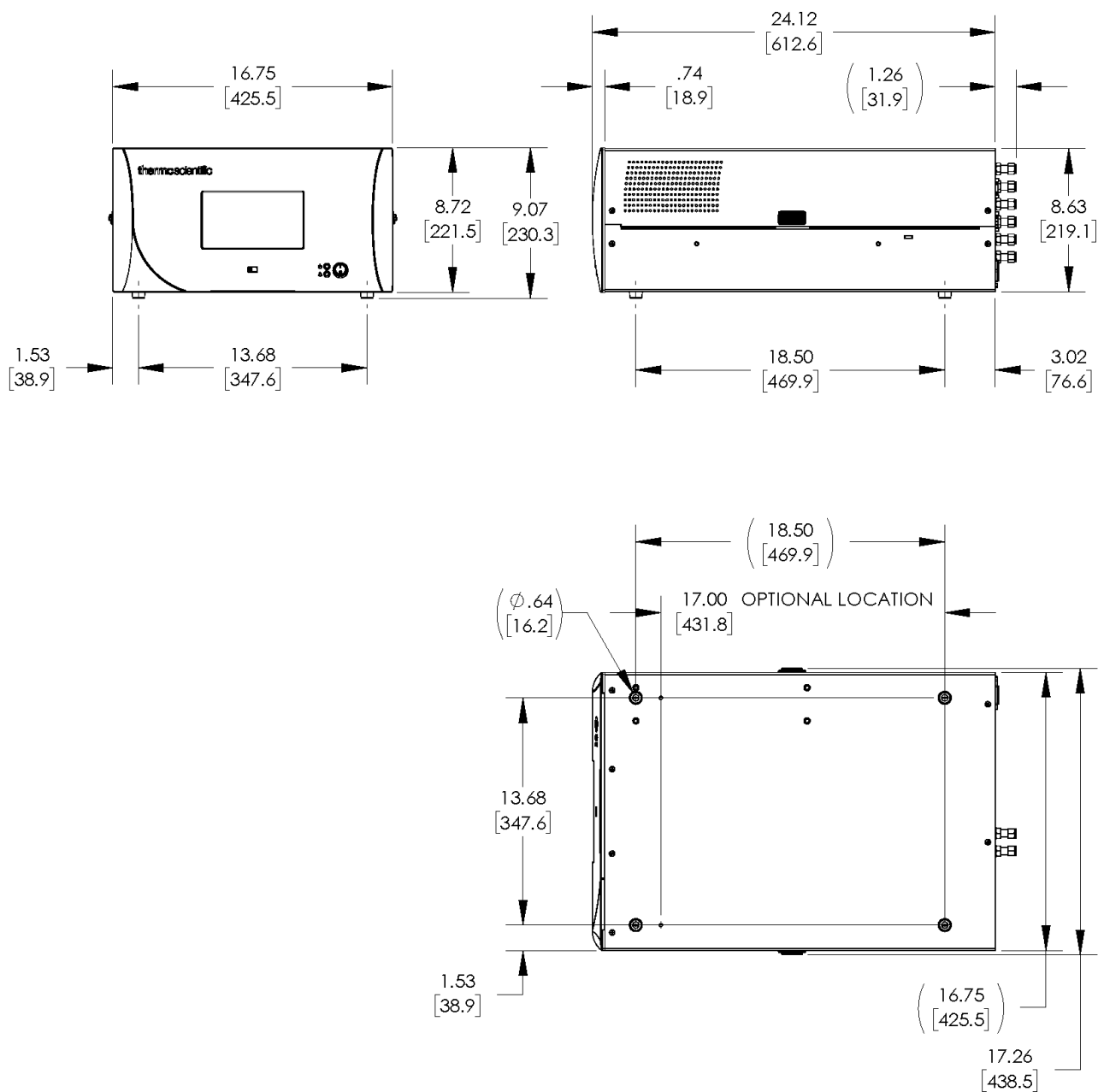
**Table 1–1.** 146iQ Specifications

Gas Dilution	
Flow Measurement Accuracy <sup>1</sup>	±(0.8% of reading + 0.2% of full-scale)
Linearity of Flow Measurement	0.25% of full-scale
Repeatability of Flow Control	±0.2% of full Scale
Typical MFC Warm-Up Time	<1 second
Available Zero Air MFC Ranges	0-5, 0-10, 0-20 SLPM
Available Span Gas MFC Ranges	0-50,0-100, 0-200 sccm
Available 2 <sup>nd</sup> Span Gas MFC Ranges (Optional)	0.05, 0-1, 0-2, 0-5, 0-10, 0-20, 0-50, 0-100, 0-200, 0-500 sccm 0-1, 0-2, 0-5 SLPM
Available Span Gas Ports	6
Purge Functionality	Standard
Response time as measured at output of manifold to 99% of final value	< 1 minute < 4 minutes for gas-phase titration (GPT) mode Meets or exceeds U.S. EPA Dynamic Parameters specification requirements for gas-phase titration
Physical Specifications	
Operating Temperature Range	0–45 °C
Power Requirements	100-240 VAC 50/60 Hz 275 watts
Physical Dimensions	24 in (D) x 16.75 in (W) x 8.72 in (H) [609 mm (D) 425.45 mm (W) x 221.48 mm (H)]
Weight	43 lbs (with 3 MFCs, Ozonator, and Photometer)
Ozonator	
Maximum Ozonator Output	6 ppm-LPM
Minimum Ozonator Output	10 ppb-LPM
Minimum O <sub>3</sub> Concentration	3 ppb
Carrier Gas Flow	150 cc/min nominal
Response Time	<180 seconds
Photometer	
Ranges	0–5.0 ppm (selectable)
Zero Noise	0.75 ppb RMS (60 sec. averaging)

Detection Limit	1.5 ppb (60 sec. averaging)
Precision	1 ppb
Zero Drift	<1.0 ppb (24 hours)
Span Drift	<1% of full scale (1 month)
Response Time	
Photometer	20 seconds (10 sec. averaging)
System	<180 seconds
Linearity	±1% full-scale
Flow Rate	0.8 LPM nominal
<b>Stability and Repeatability</b>	Meets or exceeds U.S. EPA requirements for a Transfer Standard
<b>Permeation Oven</b>	
Temperature Control	Three user selectable set points: 30, 35, 45 °C
Temperature Stability	± 0.1 °C
Warm-up Time	1 hour (permeation device can take 24 to 48 hours to stabilize)
Carrier Gas Flow	150 sccm nominal
Chamber size	Accepts permeation tubes up to 9 cm in total length; 1 cm in diameter
<b>Remote Operation</b>	
External Solenoid Outputs	Up to (8) 24 VDC external solenoids can be controlled by 146iQ
Analog I/O	4 Isolated Voltage Inputs 0–10 V 6 Isolated Analog Voltages Outputs, with 4 selectable ranges 6 Isolated Analog Current Outputs, with 2 selectable ranges
Digital I/O	16 Digital Inputs (TTL) 8 Solenoid Driver Outputs 10 Digital Reed Relay Contact Outputs
Serial Ports	1 RS-232/485 port 1 RS-485 External Accessory port
Other Ports	3 Full Speed USB ports (one in front, two in rear) 1 Gigabit Ethernet port
Communication Protocols	MODBUS, Streaming
Approvals and Certifications	CE, TUV-SUD Safety, UKCA

<sup>1</sup>Gas Composition of span gas (as defined by user) is incorporated by the MFCs to generate precise Calibration gases for CO, CO<sub>2</sub>, NO, NO<sub>2</sub>, SO<sub>2</sub>, and others.

## Dimensions



**Figure 1–7.** Bench Mount Assembly (dimensions in inches [mm])

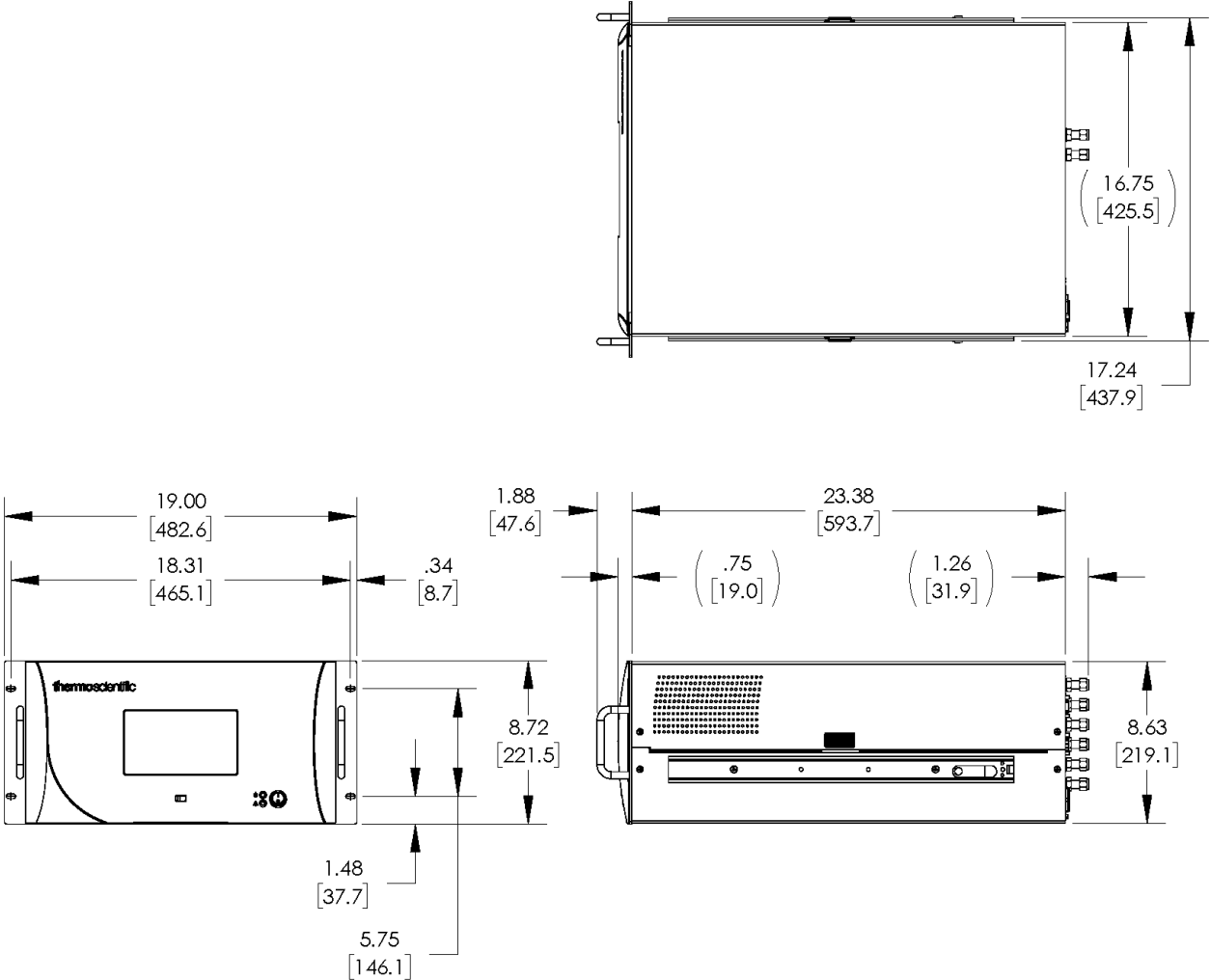
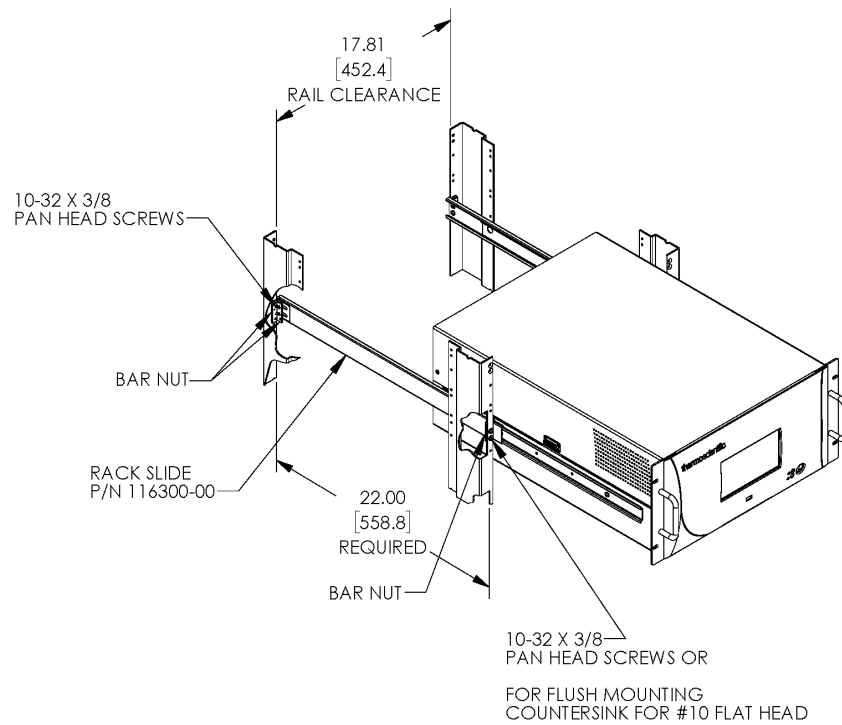
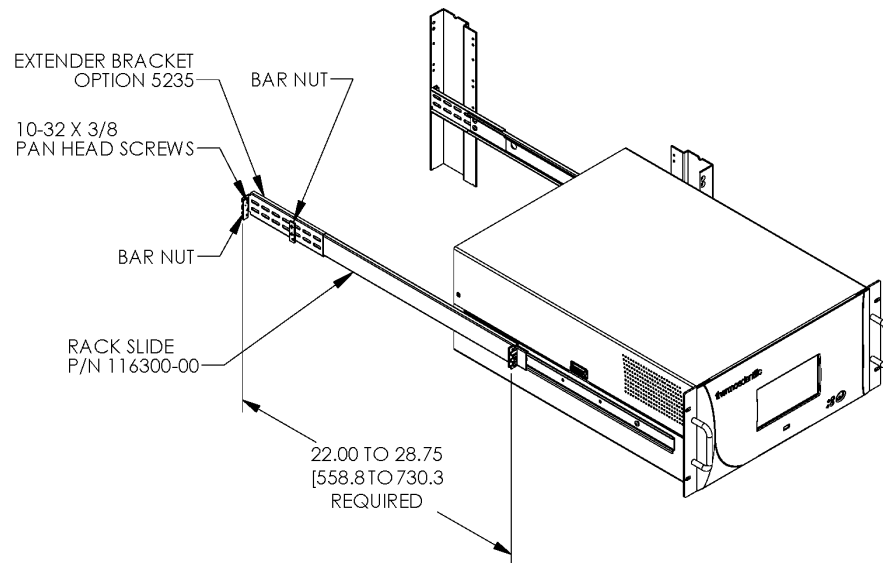


Figure 1–8. Rack Mount Assembly (dimensions in inches [mm])



**Figure 1-9.** Rack Mount Requirements



**Figure 1-10.** Rack Requirements Part 2





## Chapter 2

# Installation and Setup

Installation and Setup describes how to unpack, setup, and start-up the instrument. The installation should always be followed by instrument calibration as described in the “[Calibration](#)” chapter of this manual.



**Equipment Damage** Do not attempt to lift the instrument by the cover or other external fittings. ▲

### Unpacking and Inspection

The 146iQ is shipped complete in one container. If there is obvious damage to the shipping container when you receive the instrument, notify the carrier immediately and hold for inspection. The carrier is responsible for any damage incurred during shipment.

Use the following procedure to unpack and inspect the instrument.

1. Remove the instrument from the shipping container and set it on a table or bench that allows easy access to both the front and rear.
2. Remove the cover to expose the internal components. (See “[Figure 2–1](#)” on page [2-2](#).)
3. Check for possible damage during shipment.
4. Check that all connectors and circuit boards are firmly attached.
5. Re-install the cover.
6. Remove any protective plastic material from the case exterior.

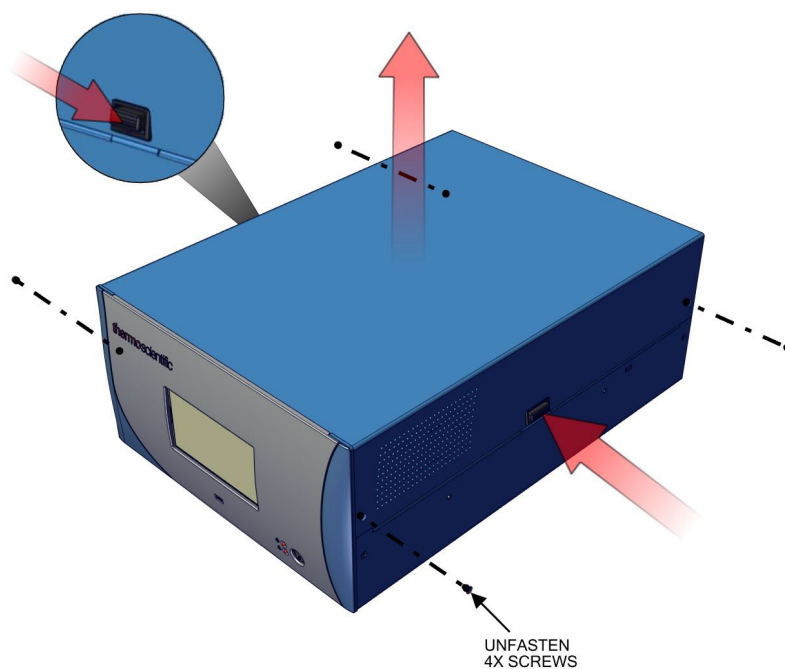
## Cover Removing and Replacing

Use the following procedure to remove and replace the cover.

Equipment required:

Phillips screwdriver, #2

1. Unfasten the four 8-32 screws securing the cover (shipping screws).
2. Press in both latches located on top cover and hold while pulling up to remove. Set upright.



**Figure 2–1.** Removing the Cover

3. To replace, align cover and drop in. Latches will automatically snap in place.

## Mounting Options

The instrument can be installed in the following configurations:

- Bench Mount
- Rack Mount

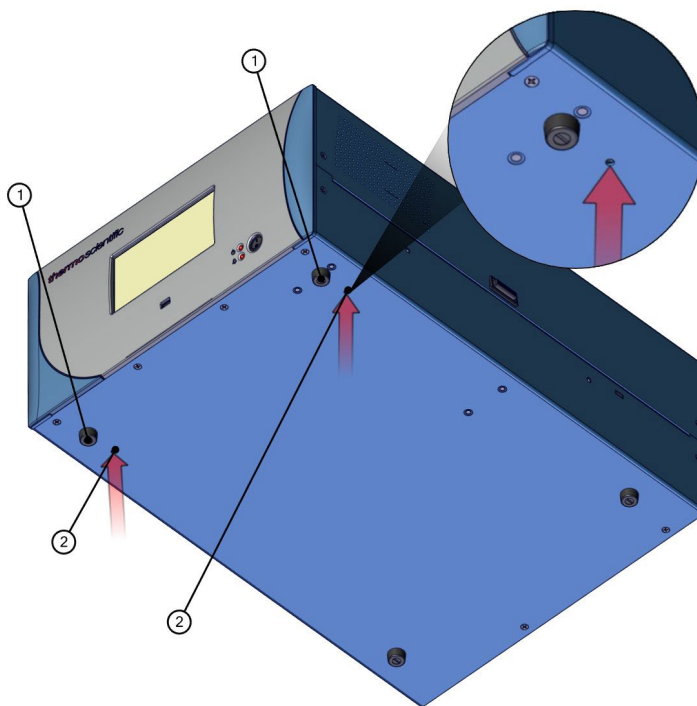
### Bench Mount

Positioned on bench, includes installing feet. See [Figure 2–2](#).

Equipment required:

Slot drive, 5/16-inch

1. Fasten feet in position 1 or 2 to fit to the desired depth.



**Figure 2–2.** Installing Feet

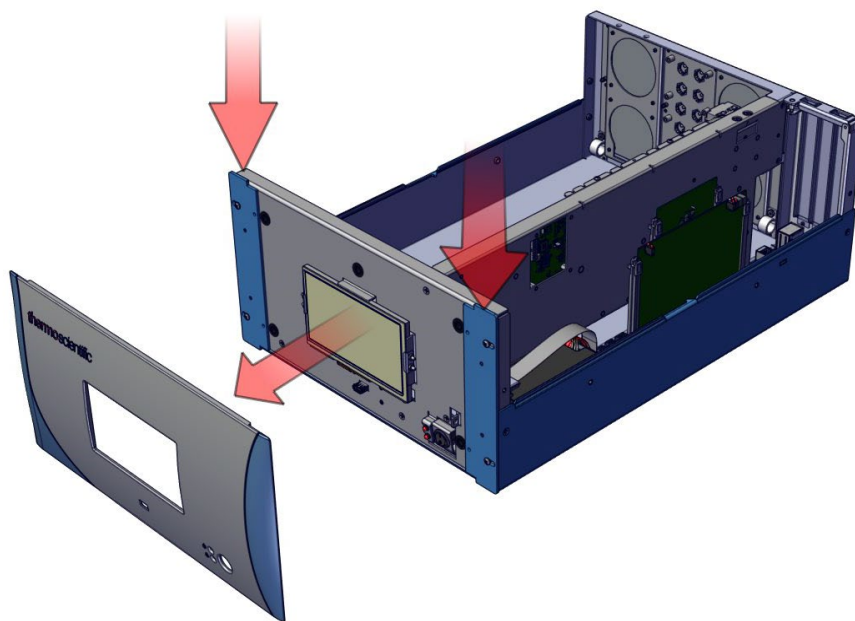
## Rack Mount

Mounting in a rack includes removing the front panel and installing ears and handles.

Equipment required:

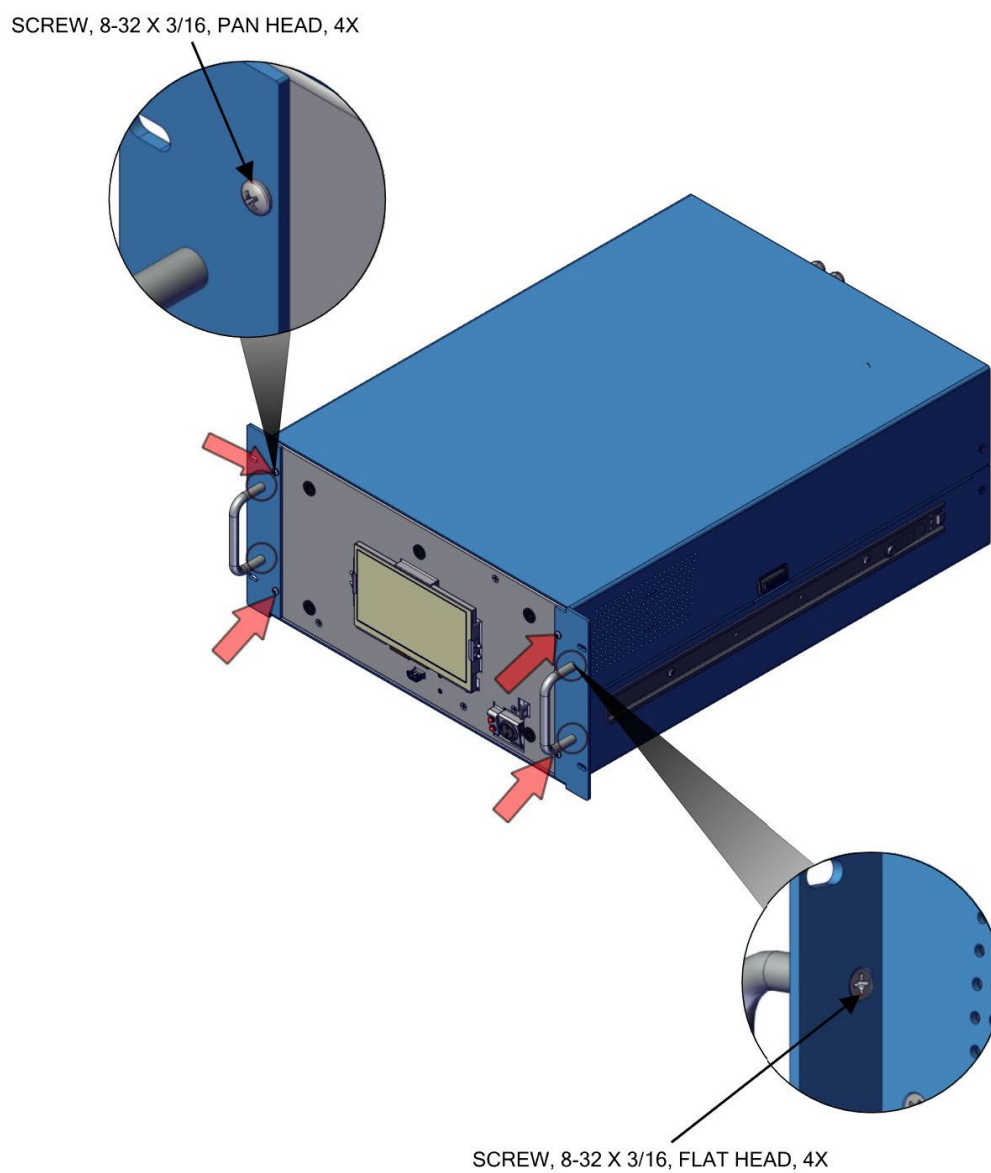
Phillips drive, #2

1. Start by gripping from the top corners of the front panel and pull outwards.



**Figure 2–3.** Removing the Front Panel

2. Unfasten the four 8-32 pan head screws.
3. Slide ears outwards.
4. Use the same four 8-32 pan head screws to secure it.
5. Install the handles with the four 8-32 flat head screws that came with the handle kit on the backside as shown.



**Figure 2–4.** Installing Ears and Handles

## Setup Procedure

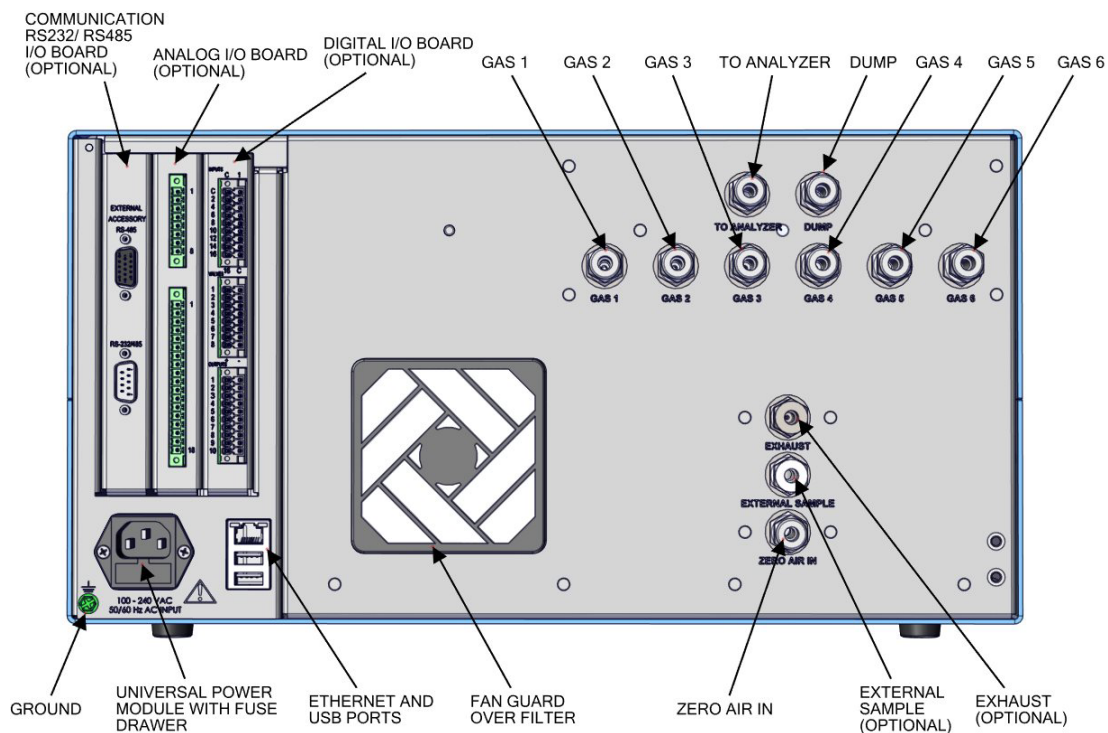
Use the following procedure to setup the instrument:

1. Connect a source of zero-air to the inlet port labeled ZERO AIR IN. The zero-air source should be capable of supplying the full-scale flows of the zero-air controller at a pressure between 10 and 40 psi.
2. Connect the standard gas cylinders to the ports labeled GAS1–GAS6.
3. Connect the EXHAUST bulkhead to a suitable vent. The exhaust line should be 1/4-inch OD with a minimum ID of 1/8-inch. The length of the exhaust line should be less than 10 feet. Verify that there is no restriction in this line.
4. Connect a suitable recording device to the rear panel connector. For detailed information about connecting to the instrument, refer to:  
    “[Connecting External Devices](#)” on page 9-1  
    Communications > “[Analog I/O](#)” on page 3-59, and “[Digital I/O](#)” on page 3-61.
5. Plug the instrument into an outlet of the appropriate voltage and frequency.

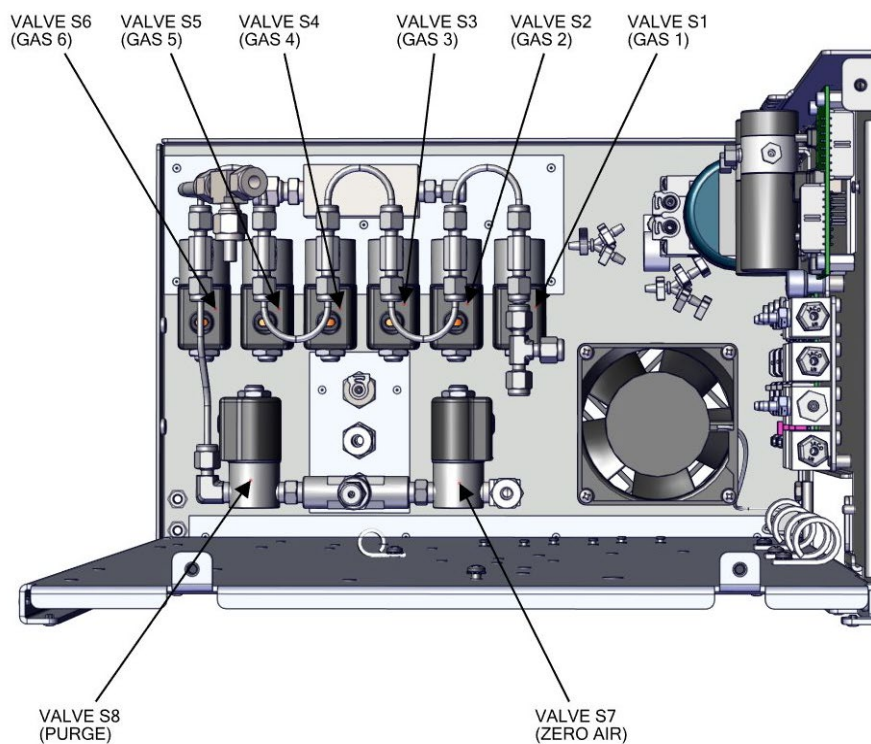


The 146iQ is supplied with a three-wire grounding cord. Under no circumstances should this grounding system be defeated. ▲





**Figure 2–5.** 146iQ Rear Panel

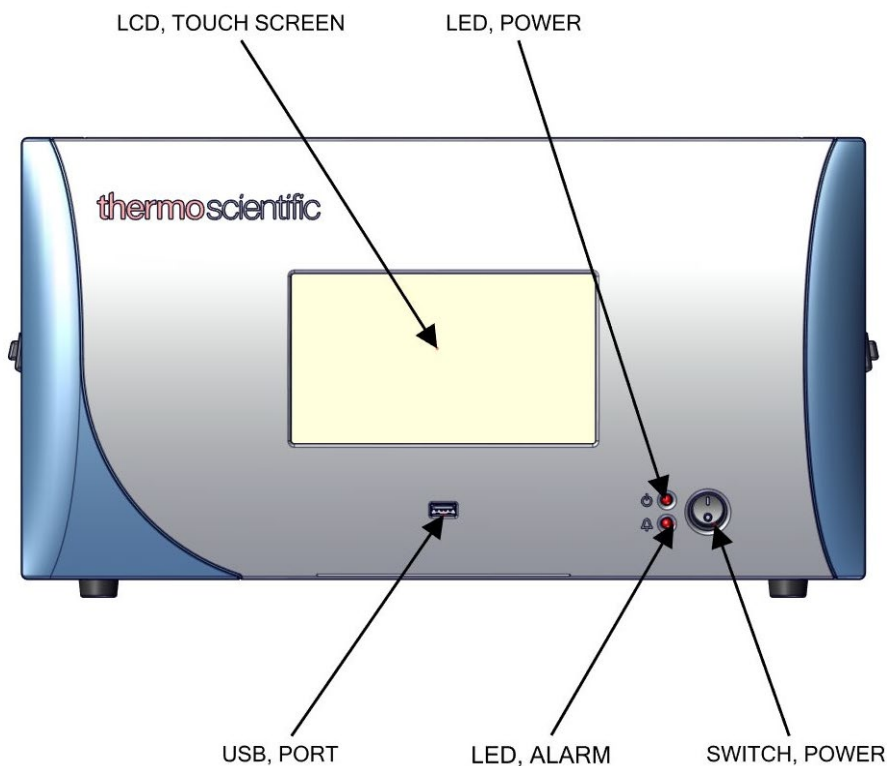


**Figure 2–6.** 146iQ Rear Panel Valves

## Startup

Use the following procedure when starting the instrument.

1. Turn the power ON.
2. Allow 90–120 minutes for the instrument to stabilize. During the time that the instrument is warming up, the mode “warm up” is displayed on the gas mode button in the title bar, and the concentration calculation is turned off. To disable warm up, go to Settings>**Configuration**.
3. Allow 90 minutes for the instrument to stabilize (if the ozonator/photometer options are installed).
4. Set instrument parameters such as cylinder setup, gas setup, and operation modes to their appropriate settings. For more information about instrument parameters, see the “[Operation](#)” chapter.



**Figure 2–7.** Front Panel and Touchscreen Display

## Chapter 3

# Operation

This chapter describes the functionality of the touchscreen user interface.

### Instrument Display

The Instrument Display consists of a Title Bar, a User Interface, and a Status Bar. The Title Bar, located at the top, includes the Home button, instrument name, instrument gas mode, and Help button. The User Interface, located in the middle, is where the Home Screen and all other screens are accessed. The Home screen has three Main Menu buttons, located on the left side, which include Calibration, Data, and Settings, while the user interface to the right of the buttons displays the chemical name, concentration value and unit. The Status Bar, located at the bottom, includes the Back button, Access Levels, Health Check, Favorites, Date and Time, and Contact Information. If a particular option is not installed or not being used, it is removed from the display. The example below shows the 146iQ Home Screen with gas dilution, photometer and ozonator installed.

#### Home Screen



The Instrument Display contains the following information:

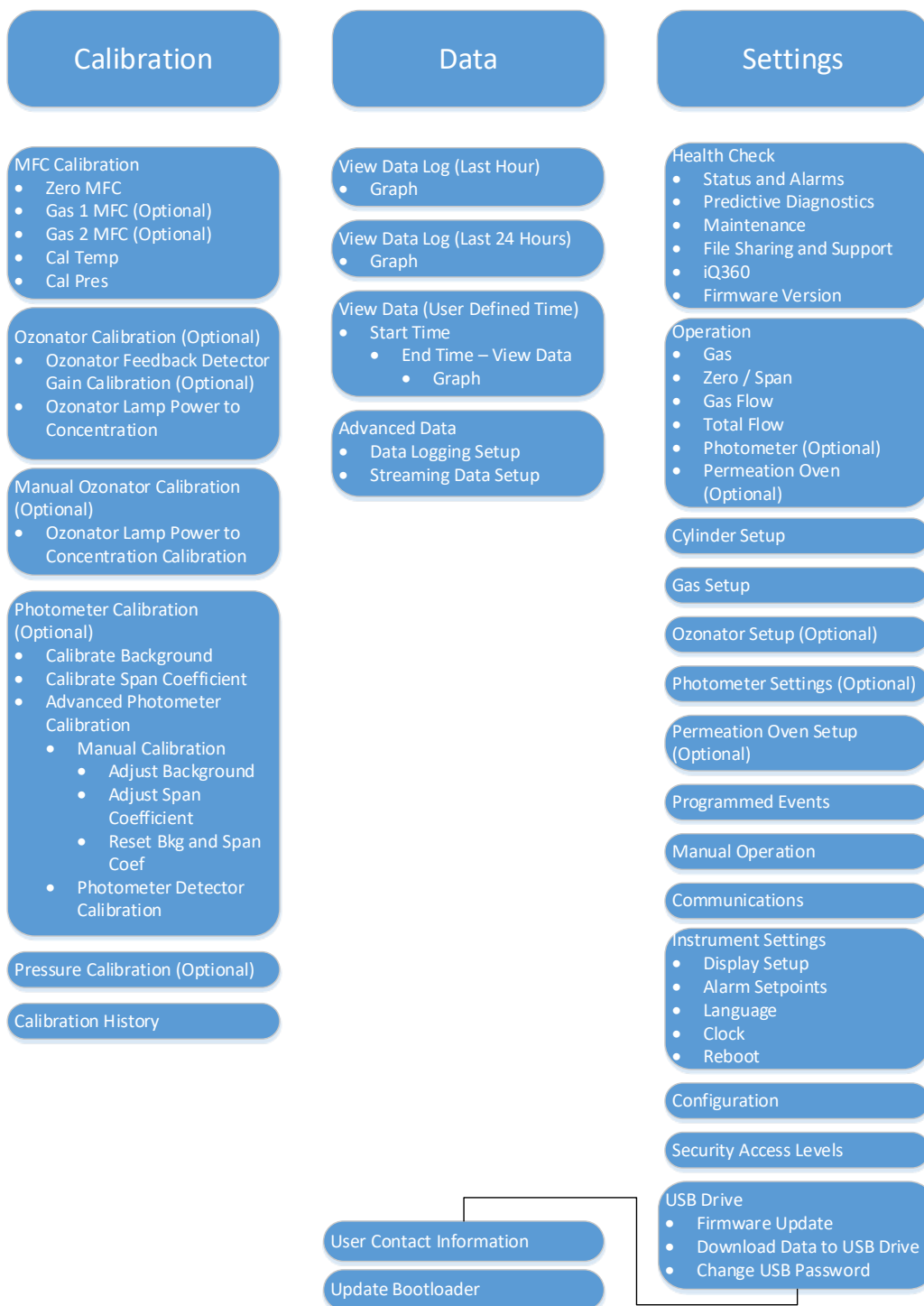
- **Title Bar:**
  - *Home button:* When pressed, it brings you to the Home Screen.
  - *Title Text:* Displays instrument name when in the Home Screen. Displays the total flow being output when in all other screens.
  - *Operation button:* Displays operation mode (“Operation” or “Manual Operation”). Displays “Program” when a program is active.
  - *Help button:* When pressed, it brings you to the help screens.
- **User Interface:**
  - *Calibration button:* Allows the user to calibrate various components of the instrument, and view calibration data.
  - *Data button:* Allows the user to view, graph, stream, and analyze data.
  - *Settings button:* Shows real-time status and alarms, also predictive diagnostics and maintenance history. Contains controls for operating the instrument, communications, and sets instrument options.
  - *Total Flow:* Displays total flow in sccm, as measured by the zero and gas flow controllers.
  - *GasX:* Displays diluted concentration of gas (from selected solenoid), diluted O<sub>3</sub> (from ozonator), or diluted NO<sub>2</sub> (from GPT), in ppm.
  - *Phot O3:* Displays concentration of ozone measured by photometer.
- **Status Bar:**
  - *Back button:* When pressed, it displays the previous screen.
  - *Access Levels button:* Allows the user to set security access levels, and allows/restricts access to functionality depending on the selected access level.
  - *Health Check button:* Brings the user to the Health Check screen.
  - *Favorites button:* Allows user-selectable favorite buttons. To add to the favorites screen, user presses the desired screen button for 2 seconds. The user will be directed to the favorites screen where the user chooses the button position. To remove a favorite button from

the favorites screen, press and hold the corresponding button on the favorites screen for 2 seconds.

- *Clock*: Displays current date and time.
- *Thermo Scientific Information button*: Shows contact information.

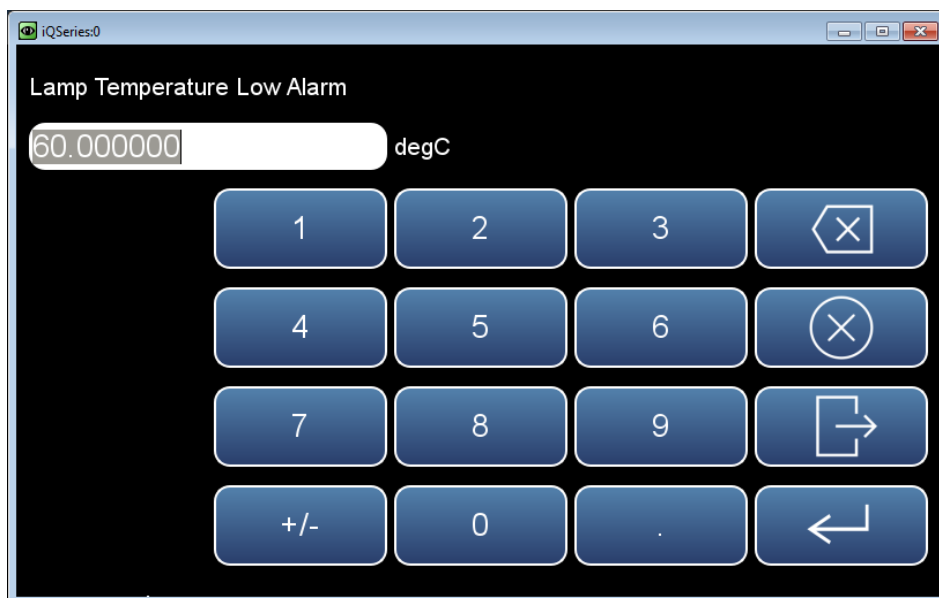
## Main Menus and Keypads

The Main Menu buttons, located on the Home Screen, contains three submenus. Each submenu contains related instrument settings. This chapter describes each submenu and screen in detail. Refer to the appropriate sections for more information.



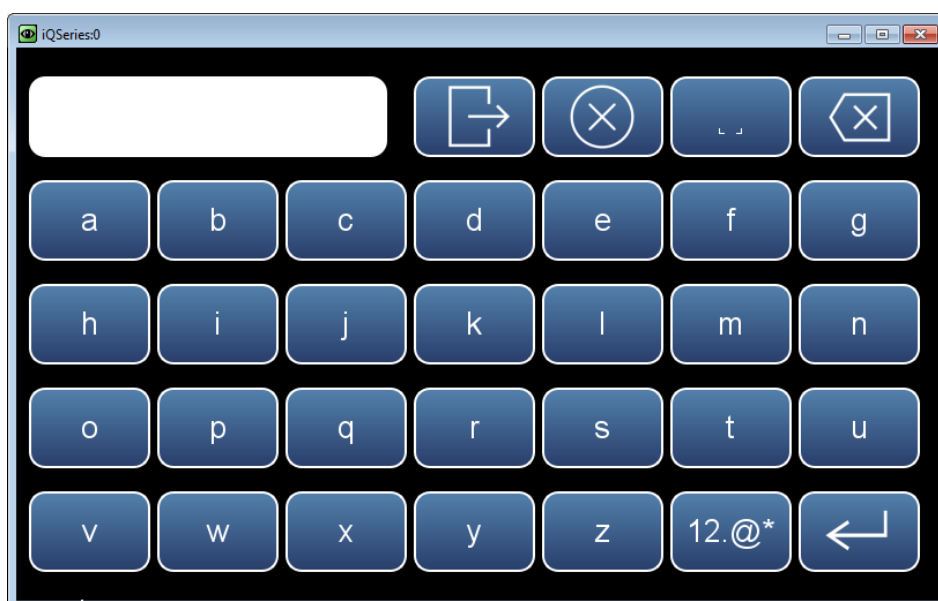
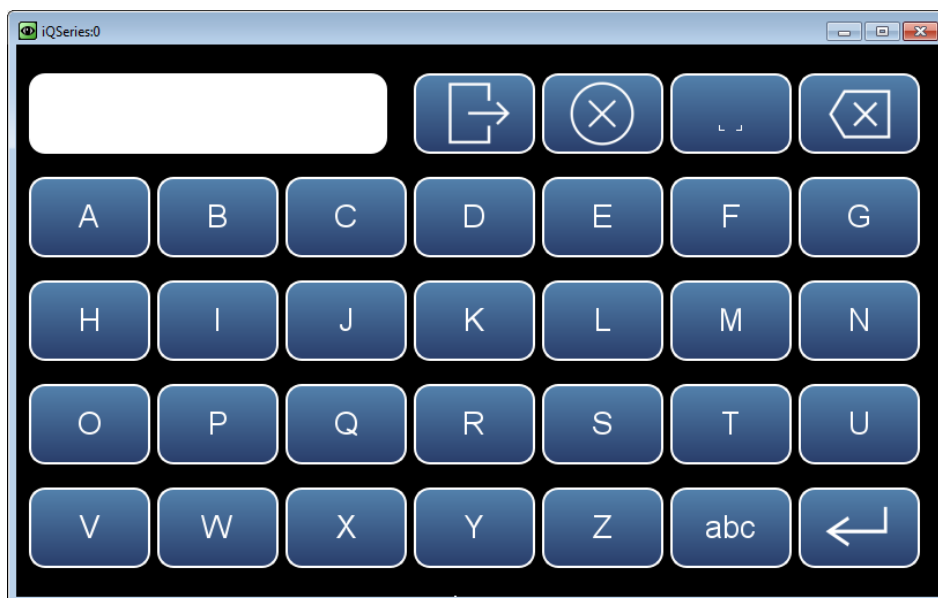
## Numeric Keypad

User enters a value into the box using the number keypad. When the user needs to change a value, such as for flow rates, temperatures or pressures, the keypad screen will automatically display. Initially, the box above the keypad will display the current value. Enter a new value using the keypad, and then select the **Enter** button to set the new value or press the **Cancel** button to exit the keypad screen and return to the previous screen without saving the value.

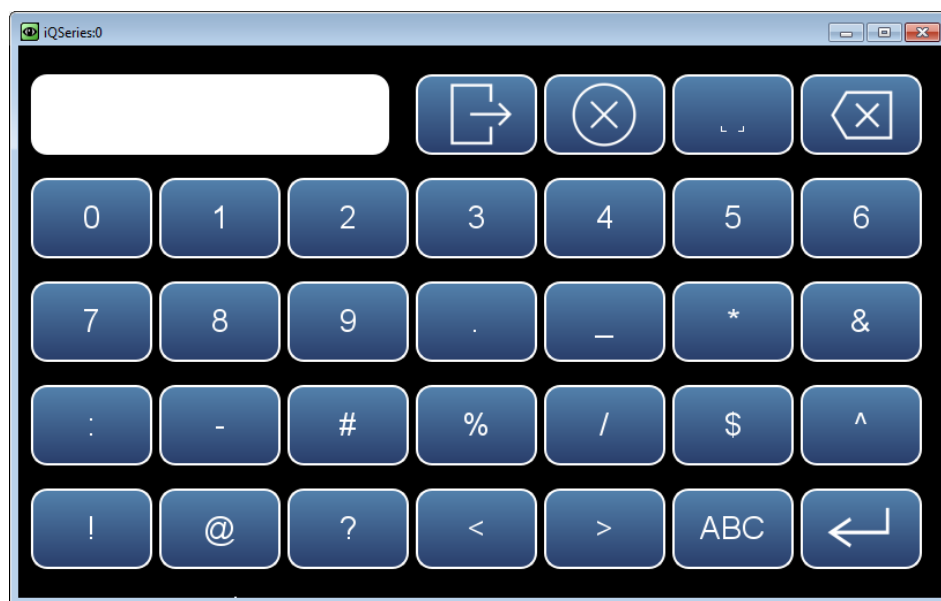


## Alphanumeric Keypad

User enters a value into the box using the keypad. When the user needs to change an alphanumeric value, this keypad will automatically display. Initially, the box above the keypad will display the current value. Enter a new value using the keypad, and then select the **Enter** button to set the new value or press the **Cancel** button to exit the keypad screen and return to the previous screen without saving the value. The alphanumeric keypad is only available when the user needs to enter alphabet characters.



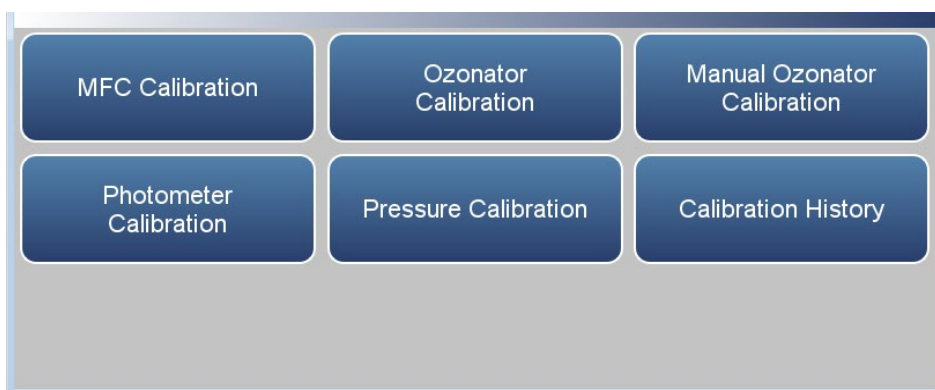




## Calibration

The Calibration screen allows the user to calibrate instrument hardware and view calibration history. See Chapter 4 “[Calibration](#)” for further instructions on how to run a calibration. If a particular option is not installed or not being used, it is removed from the display.

### Home Screen>Calibration



The Calibration screen contains the following information:

- *MFC Calibration:* The user calibrates MFCs. The calibration temperature and calibration pressure should be chosen prior to MFC calibration to tell the calibration algorithm whether standard or volumetric flows are being entered by the user.
- *Ozonator Calibration:* The user calibrates the ozonator automatically. (Visible if ozonator, photometer options are enabled.)
- *Manual Ozonator Calibration:* The user manually calibrates ozonator with an external calibrated photometer. (Visible if ozonator option is enabled.)
- *Photometer Calibration:* The user can calibrate the photometer. (Visible if photometer option is enabled.)
- *Pressure Calibration:* Calibrates pressure. (Visible if ozonator and/or photometer option(s) is/are enabled.)
- *Calibration History:* Lists all calibrations performed and calibration checks.

## MFC Calibration

The MFC Calibration screen allows the user to calibrate the MFC's, and change calibration temperature and pressure.

Use the ▲ and ▼ buttons to move up and down and the ◀ and ▶ buttons to move left and right.

**Note** Display automatically reflects the amount and type of MFC's installed. ▲

### Home Screen>Calibration>MFC Calibration

	Full Scale (sccm)	Calibration	Cal Status	Reset Coefficients	
Zero MFC	10000.0	Zero MFC Points	Ok	Reset Zero MFC	▲
Gas 1 MFC	100.0	Gas 1 MFC Points	Ok	Reset Gas 1 MFC	▼
Gas 2 MFC	1000.0	Gas 2 MFC Points	Ok	Reset Gas 2 MFC	◀
					▶
Cal Temp (C)	25.0				
Cal Pres (mmHg)	760.0				

The MFC Calibration screen contains the following information:

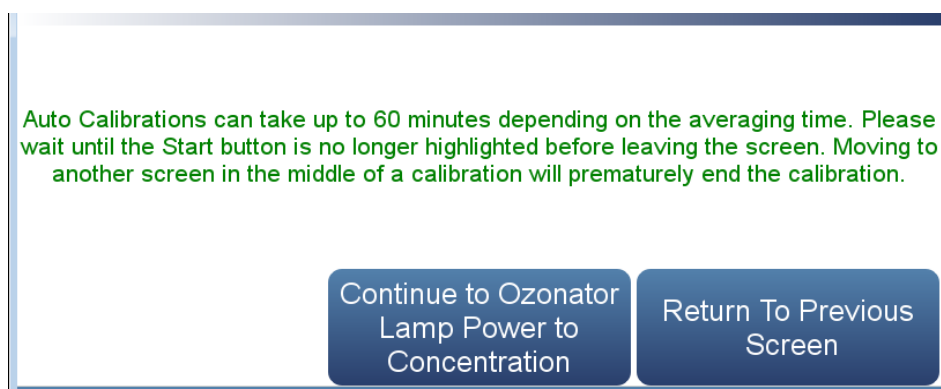
- Across:
  - *Full Scale (sccm)*: Shows the full-scale range of the MFC.
  - *Calibration*: Allows the user to run a 2–7-point calibration for each of the MFC's.
  - *Cal Status*: Displays Ok/Fail based on latest MFC calibration attempt.
  - *Reset Coefficients*: Resets MFC coefficients to factory default.
- Down:
  - *Zero MFC*: Calibration of zero MFC.
  - *Gas 1 MFC*: Calibration of gas 1 MFC (if installed).
  - *Gas 2 MFC*: Calibration of gas 2 MFC (if installed).
  - *Cal Temp (C)*: User sets calibration temperature.
  - *Cal Pres (mmHg)*: User sets calibration pressure.

## Ozonator Calibration

The Ozonator Calibration screen allows the user to run automated calibrations for the ozonator. The automated calibration can only be performed if the photometer option is enabled. It is recommended to calibrate the photometer prior to proceeding to the ozonator calibration.

Use the ▲ and ▼ buttons to move up and down and the ◀ and ▶ buttons to move left and right.

### Home Screen>Calibration>Ozonator Calibration



### Home Screen>Calibration>MFC Calibration>Continue to Ozonator Lamp Power to Concentration

Description	Lamp Power to Concentration			
Auto Cal	Start			▲
End Cal	Stop			▼
				◀
				▶

The Continue to Ozonator Lamp Power to Concentration screen contains the following information:

- Across:
  - *Description*: Lists items in table.
  - *Lamp Power to Concentration*: User can initiate calibration by pressing Start, and end calibration prematurely by pressing Stop.

- Down:
  - *Auto Cal*: User initiates auto calibration by pressing Start.
  - *End Cal*: User ends auto calibration by pressing Stop. If calibration is ended prematurely, the calibration is terminated.

## Manual Ozonator Calibration

The Manual Ozonator Calibration screen allows the user to manually calibrate ozonator drive power to O<sub>3</sub> concentration.

Use the ▲ and ▼ buttons to move up and down and the ◀ and ▶ buttons to move left and right.

**Home Screen>Calibration>Manual Ozonator Calibration**

Ensure the external calibrated Photometer has been connected to the bulkhead labeled "To Analyzer" before performing this calibration. Press the Start button for the desired ozonator lamp power. Next, wait at least 45 seconds for the photometer reading to stabilize before entering the concentration in the same row, otherwise the concentration value will not be accepted.

Continue to Ozonator Lamp Power to Concentration Screen      Return to Previous Screen

**Home Screen>Calibration>MFC Calibration>Continue to Ozonator Lamp Power to Concentration Screen**

	Ozonator Drive %	Select Drive	Enter O3 Concentration (ppb)
1	28	Start	14.31
2	32	Start	38.69
3	34	Start	85.29
4	36	Start	178.37
5	38	Start	288.28
6	40	Start	408.09

Navigation buttons: ▲, ▼, ◀, ▶

The Ozonator Lamp Power to Concentration Screen contains the following information:

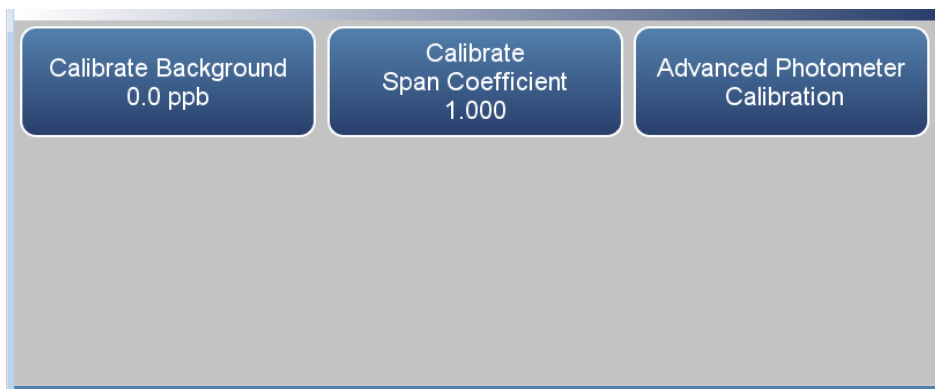
- Across:
  - *Ozonator Drive %*: Output power of the ozonator.
  - *Select Drive*: User initiates ozonator output power setting by pressing Start for the corresponding ozonator drive %.
  - *Enter O3 Concentration (ppb)*: Allows user to enter calibrated external photometer reading for the corresponding ozonator drive % setting.

- Down:
  - 1–10: Lists ozonator output power calibration points.

## Photometer Calibration

The Photometer Calibration screen, visible if the photometer is installed, allows the user to calibrate the ozone background, span coefficient, and photometer detector, if installed.

**Home Screen>Calibration>Photometer Calibration**



The Photometer Calibration screen contains the following information:

- *Calibrate Background:* User can automatically calibrate O<sub>3</sub> background.
- *Calibrate Span Coefficient:* User can automatically calibrate O<sub>3</sub> span coefficient.
- *Advanced Photometer Calibration:* User can manually calibrate ozone background, span coefficient, and photometer detector.



## Calibrate Background

The Calibrate Background screen is used to set the O<sub>3</sub> zero background. Before making an adjustment, be sure the analyzer samples zero air for at least 5 minutes.

It is important to note the averaging time when calibrating. The longer the averaging time the more precise the calibration results. To achieve maximum precision, allow the instrument to stabilize each time input gas is changed and set the averaging time to 300-second averaging.

### Home Screen>Calibration>Photometer Calibration>Calibrate Background



The screenshot shows a digital interface for calibrating the background. It features four rectangular boxes with rounded corners and a blue button. The boxes are arranged in two rows: the top row contains 'Target Concentration 0 ppb', 'Current Concentration 5.0 ppb', and 'Current Background 0.0 ppb'; the bottom row contains 'Calculated Background 0.0 ppb' and a large blue 'Calibrate' button. The background is a light gray with a thin blue border.

The Calibrate Background screen contains the following information:

- *Target Concentration:* Read only. Displays what the concentration value will become when the calibrate button is pressed.
- *Current Concentration:* Read only. Displays current concentration.
- *Current Background:* Read only. Displays current background.
- *Calculated Background:* Read only. Displays what the background will become when the calibrate button is pressed.
- *Calibrate:* When pressed, updates the background value, making the concentration go to zero.

## Calibrate Span Coefficient

The Calibrate Span Coefficient screen is used to enter the span concentration and calibrate the O<sub>3</sub> coefficient. The O<sub>3</sub> span coefficient is calculated, stored, and used to correct the current reading.

It is important to note the averaging time when calibrating. The longer the averaging time the more precise the calibration results. To achieve maximum precision, allow the instrument to stabilize each time input gas is changed and set the averaging time to 300-second averaging.

**Home Screen>Calibration>Photometer Calibration>Calibrate Span Coefficient**

Edit Span Concentration 5 ppb	Current Concentration 5.0 ppb	Current Span Coefficient 1.000
Calculated Span Coefficient 1.000	Calibrate	

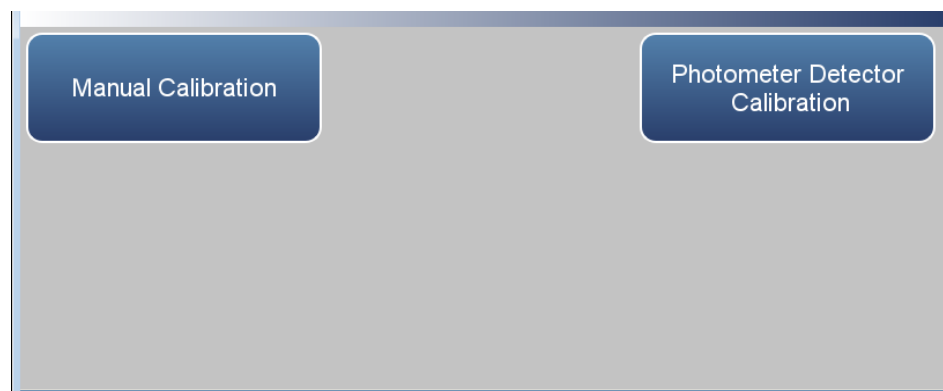
The Calibrate Span Coefficient screen contains the following information:

- *Edit Span Concentration:* User enters the span concentration.
- *Current Concentration:* Read only. Displays current concentration.
- *Current Span Coefficient:* Read only. Displays the current span coefficient.
- *Calculated Span Coefficient:* Read only. After the “Edit Span Concentration” value is entered, the new calculated span coefficient is displayed.
- *Calibrate:* When pressed, updates the coefficient and the current O<sub>3</sub> concentration should match the span concentration.

## Advanced Photometer Calibration

The Advanced Photometer Calibration screen provides a manual way to calibrate the photometer background and coefficient and photometer detector. See Chapter 4 “[Calibration](#)” for further instructions on how to run a calibration.

**Home Screen>Calibration>Photometer Calibration>Advanced Photometer Calibration**



The Advanced screen contains the following information:

- *Manual Calibration:* The user manually calibrates the background or span coefficient.
- *Photometer Detector Calibration:* User calibrates photometer detector.

## Manual Calibration

The Manual Calibration screen manually calibrates the O<sub>3</sub> zero background or span coefficient based on the current concentration reading. See Chapter 4, “[Calibration](#)” for instructions on how to run a Manual Calibration.

**Home Screen>Calibration>Photometer Calibration>Advanced Photometer Calibration>Manual Calibration**



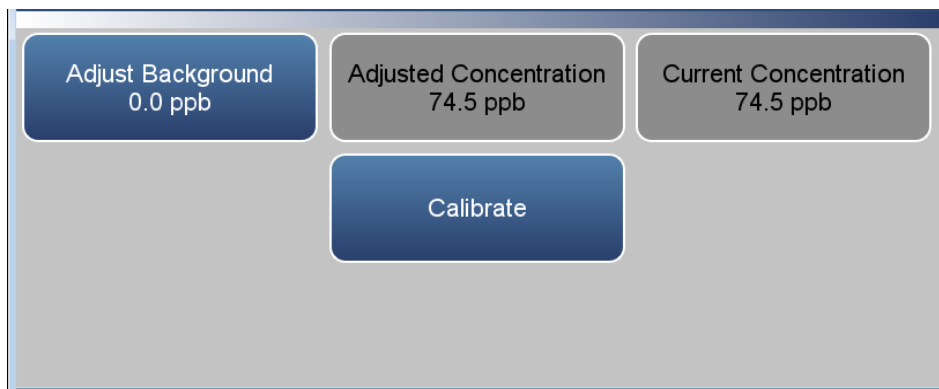
The Manual Calibration screen contains the following information:

- *Adjust Background:* Allows the user to manually adjust the zero background.
- *Adjust Span Coefficient:* Allows the user to manually adjust the span coefficient.
- *Reset Bkg to 0.000 and Span Coef to 1.000:* Resets all backgrounds and coefficients.

## Adjust Background

The Adjust Background screen is used to manually adjust the O<sub>3</sub> zero background.

**Home Screen>Calibration>Photometer Calibration>Advanced Photometer Calibration>Manual Calibration>Adjust Background**



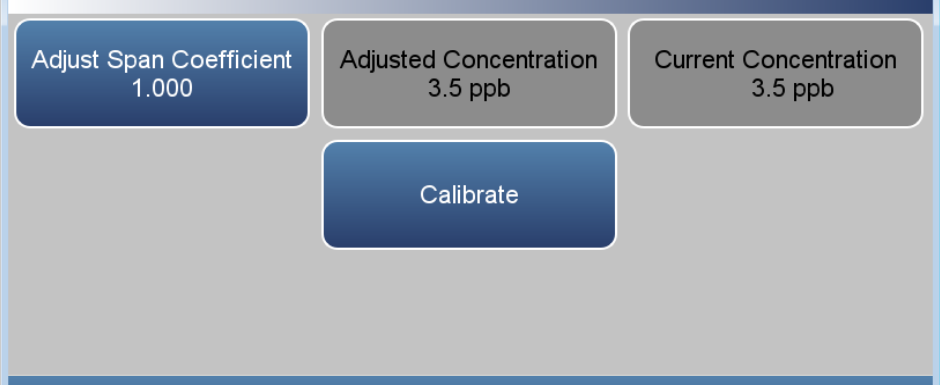
The Adjust Background screen contains the following information:

- *Adjust Background:* User manually adjusts zero background.
- *Adjusted Concentration:* Read only. Displays adjusted concentration based on adjusted zero background.
- *Current Concentration:* Read only. Displays current concentration.
- *Calibrate:* Calibrates zero background by saving the newly adjusted zero.

## Adjust Span Coefficient

The Adjust Span Coefficient screen is used to manually adjust the O<sub>3</sub> span coefficient.

**Home Screen>Calibration>Photometer Calibration>Advanced Photometer Calibration>Manual Calibration>Adjust Span Coefficient**



The screenshot shows a user interface for adjusting the span coefficient. It features three rectangular boxes at the top: a blue box on the left labeled 'Adjust Span Coefficient' with the value '1.000', a grey box in the middle labeled 'Adjusted Concentration' with the value '3.5 ppb', and a grey box on the right labeled 'Current Concentration' with the value '3.5 ppb'. Below these boxes is a large blue button labeled 'Calibrate'.

The Adjust Span Coefficient screen contains the following information:

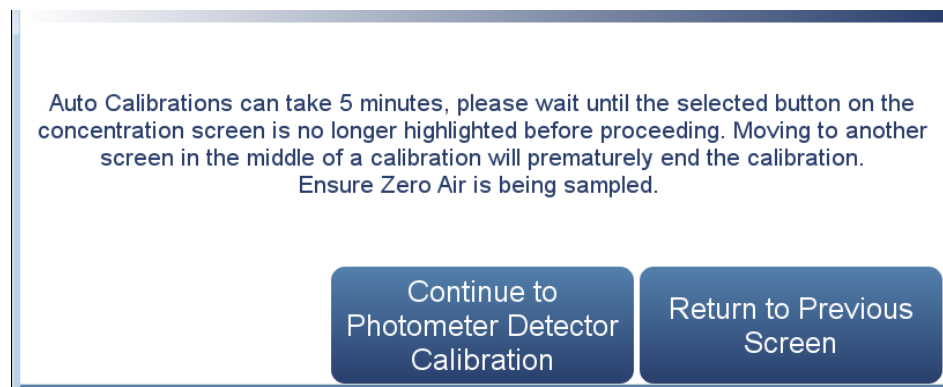
- *Adjust Span Coefficient*: User manually adjusts span coefficient.
- *Adjusted Concentration*: Read only. Displays adjusted concentration based on adjusted span coefficient.
- *Current Concentration*: Read only. Displays current concentration.
- *Calibrate*: Calibrates span coefficient by saving the newly adjusted span coefficient.

## Photometer Detector Calibration

The Photometer Detector Calibration screen allows the user to calibrate the photometer detector.

Use the ▲ and ▼ buttons to move up and down and the ◀ and ▶ buttons to move left and right.

**Home Screen>Calibration>Photometer Calibration>Advanced Photometer Calibration>Photometer Detector Calibration**



**Home Screen>Calibration>Photometer Calibration>Advanced Calibration>Continue to Photometer Detector Calibration**

Description	Detector Cal	Intensity (Hz)	
Detector Manual Entry	153	100486	▲
Auto Cal	Start		▼
End Cal	Stop		◀
Default Values	Default Detector Cal		▶

The Photometer Detector Calibration screen contains the following information:

- Across:
  - *Description:* Lists items in table.
  - *Detector Cal:* Allows the user to manually or automatically calibrate the photometer detector.
  - *Intensity:* Read only. Displays intensity.

- Down:
  - *Detector Manual Entry*: Allows user to manually calibrate the photometer detector.
  - *Auto Cal*: User initiates auto calibration by pressing Start.
  - *End Cal*: User ends auto calibration by pressing Stop. If calibration is ended prematurely, the calibration is terminated
  - *Default Values*: Restores default photometer detector calibration values.



## Pressure Calibration

The Pressure Calibration Screen is used to calibrate the pressure sensors on the Flow/Pressure DMC board to zero, span or factory default values. The Pressure Calibration screen is only visible when there is an ozonator and/or a photometer installed in the instrument.

Use the ▲ and ▼ buttons to move up and down and the ◀ and ▶ buttons to move left and right.

### Home Screen>Calibration>Pressure Calibration

Description	Reading	Calibration			
Sensor 1 Reading	374.1				▲
Sensor 2 Reading	159.0				▼
Sensor 3 Reading	763.3				◀
Atmospheric Sensor 1	780.0	Start			▶
Zero Sensor 1	200.0	Start			
Atmospheric Sensor 2	155.0	Start			

The Pressure Calibration screen contains the following information:

- Across:
  - *Description*: Lists items in table.
  - *Reading*: Displays reading of each pressure sensor.
  - *Calibration*: Starts calibration or resets default values.
- Down:
  - *Sensor 1–3 Reading*: Under the column labeled Reading, current reading of each pressure sensor. Sensor 1 is connected to the pump (vacuum) side of the photometer capillary, and in the 146iQ is the sensor on the bottom of the board. Sensor 2 is a differential pressure sensor that is connected to the 2 sides of the ozonator capillary. Sensor 3 is connected to the bench (pressure) side of the photometer capillary, and in the 146iQ is the sensor on the top of the board. The Sensor readings are only valid if their corresponding options are installed, and can otherwise be ignored.
  - *Atmospheric Sensor 1–3*: User should expose the sensor to atmospheric pressure by disconnecting the tube attached to the sensor. Under the column labeled Reading, the user enters the current atmospheric pressure in mm Hg units. Under the column

labeled Calibration, the user presses the Start button to calibrate the high point of Sensor 1.

- *Zero Sensor 1:* User should put the pressure sensor under a strong vacuum. Under the column labeled Reading, the user enters the measured pressure from the vacuum in mm Hg units. Under the column labeled Calibration, the user presses the Start button to calibrate the low point of Sensor 1.
- *High Point Sensor 2:* In order to calibrate the high point of the differential pressure sensor, adjust the pressure of the pressure gauge in line with the capillary to 3 psi (~155 mm Hg). Under the column labeled Reading, the user enters the measured pressure in mm Hg units. Under the column labeled Calibration, the user presses the Start button to calibrate the high point of Sensor 2.
- *Low Point Sensor 2:* In order to calibrate the low point of the differential pressure sensor, disconnect the two tubes to the differential pressure sensor so that both sides of the sensor are exposed to atmospheric pressure. In this condition, the measured differential pressure should be 0 mm Hg. Under the column labeled Reading, the user enters this pressure in mm Hg units. Under the column labeled Calibration, the user presses the Start button to calibrate the low point of Sensor 2.
- *Atmospheric Sensor 3:* User should expose the sensor to atmospheric pressure by disconnecting the tube attached to the sensor. Under the column labeled Reading, the user enters the current atmospheric pressure in mm Hg units. Under the column labeled Calibration, the user presses the Start button to calibrate the high point of Sensor 3.
- *Zero Sensor 3:* User should put the pressure sensor under a strong vacuum. Under the column labeled Reading, the user enters the measured pressure from the vacuum in mm Hg units. Under the column labeled Calibration, the user presses the Start button to calibrate the low point of Sensor 3.
- *Reset all values:* Under the column labeled Calibration, the user presses Reset to reset all the calibration pressures to their defaults.

## Calibration History

The Calibration History screen shows the log of calibrations and calibration checks performed.

Use the ▲ and ▼ buttons to move up and down and the ◀ and ▶ buttons to move left and right.

**Home Screen>Calibration>Advanced Calibration>Calibration History**

**Note** Pressing the Calibration History button responds with Retrieving calibration log data, it may take a few seconds... ▲

						Tabular Data
Time Stamp	Cal Event	Cal Result	Cal Target	Cal Units	Cal Avg Time	
01/23/2024 06:11:48	MFC 0 Cal	-7.803e...	-1.5474...	sccm	0	▲
01/22/2024 15:46:51	MFC 0 Cal	-7.803e...	-1.5474...	sccm	0	
01/22/2024 15:02:34	MFC 0 Cal	-6.1689...	-6.1688...	sccm	0	▼
12/18/2023 05:52:29	MFC 0 Cal	0	-1.4114...	sccm	0	
12/18/2023 04:39:18	MFC 0 Cal	0	-1.4114...	sccm	0	
12/18/2023 04:09:01	MFC 0 Cal	0	-1.4114...	sccm	0	
12/16/2023 05:02:14	MFC 0 Cal	0	-1.4114...	sccm	0	◀
12/16/2023 04:12:38	MFC 0 Cal	0	-1.4114...	sccm	0	
12/15/2023 09:02:01	MFC 0 Cal	0	-1.4114...	sccm	0	
12/11/2023 08:06:17	MFC 0 Cal	0	-1.4114...	sccm	0	▶

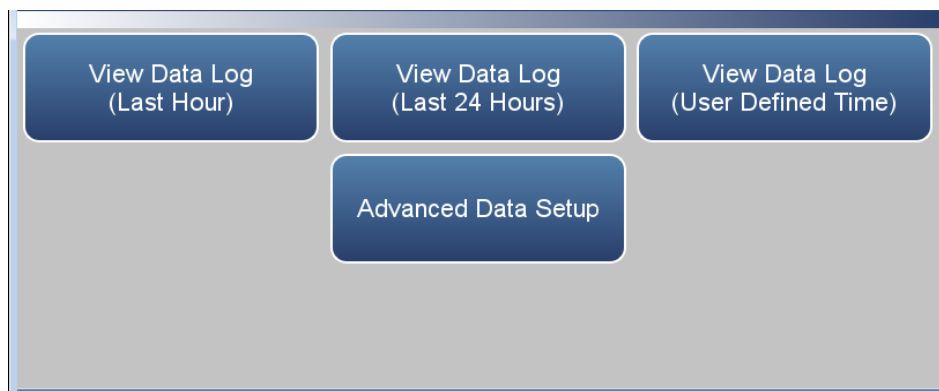
The Calibration History screen contains the following information:

- *Time Stamp*: Time of calibration or calibration check.
- *Cal Event*: Lists the type of calibration event.
- *Cal Result*: Concentration result.
- *Cal Target*: Concentration setpoint value.
- *Cal Units*: Displays units for each item.
- *Cal Avg Time*: Averaging time used during the calibration or calibration check.
- *Serial No*: Displays the module serial number.

## Data

The Data screen is used to view and record concentrations and instrument data. Users can view both tabular data and graphed data.

### Home Screen>Data



The Data screen contains the following information:

- *View Data Log (Last Hour)*: User views last hour of historical data. Table shows most recent data on top.
- *View Data Log (Last 24 Hours)*: User views 24-hour of historical data. Table shows most recent data on top.
- *View Data Log (User Defined Time)*: User selects the start and end time for viewing the data. Table shows most recent data on top.
- *Advanced Data Setup*: Allows the user to set up the parameters of how the data is stored.

## View Data Log (Last Hour)

The View Data Log (Last Hour) screen allows the user to instantly view the last hour worth of data in real time.

Use the ▲ and ▼ buttons to move up and down and the ◀ and ▶ buttons to move left and right.

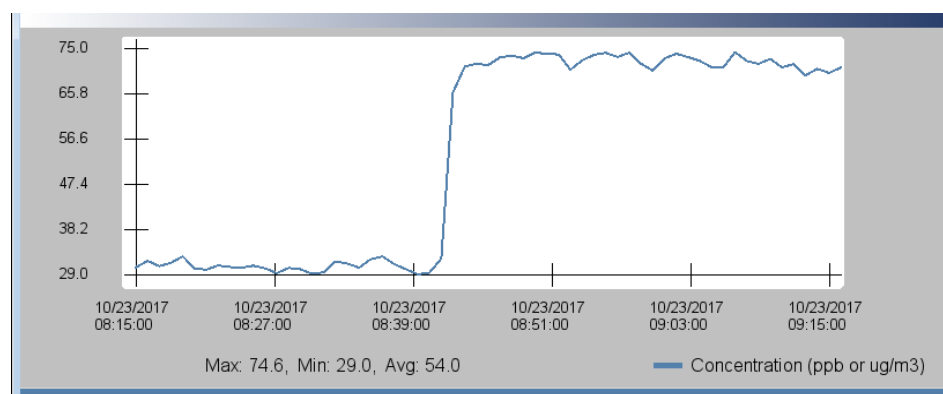
**Home Screen>Data>View Data Log (Last Hour)**

**Note** Pressing the View Data Log (Last Hour) responds with Retrieving user log data, it may take a few seconds... ▲

Time Stamp	Gas Concentration (PPM)	Total Flow (scm)	Concentration (ppb or ug/m3)	Ozonator Flow	Select
	Graph	Graph	Graph	Graph	Graph
10/23/2017 09:10:00	0	0.119949	71.5268	171.844	1
10/23/2017 09:09:00	0	0.082866	73.2435	171.837	1
10/23/2017 09:08:00	0	0.111315	72.2107	171.853	1
10/23/2017 09:07:00	0	-0.111409	72.8152	171.849	1
10/23/2017 09:06:00	0	0.132651	74.6095	171.843	1
10/23/2017 09:05:00	0	0.09674	71.4754	171.812	1
10/23/2017 09:04:00	0	-0.042996	71.5432	171.846	1
10/23/2017 09:03:00	0	0.075539	72.8399	171.841	1

The View Data Log (Last Hour) screen contains the following options:

- *Graph*: Displays data graph for the column selected. The graph time axis is defined by the data set in the table.



**View Data Log (Last 24 Hours)**

The View Data Log (Last 24 Hours) screen allows the user to instantly view the last 24 hours worth of data in real time.

Use the ▲ and ▼ buttons to move up and down and the ◀ and ▶ buttons to move left and right.

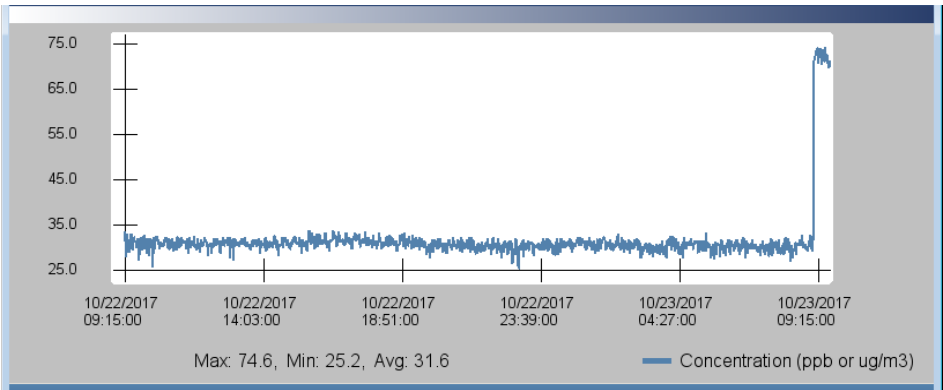
**Home Screen>Data>View Data Log (Last 24 Hours)**

**Note** Pressing the View Data Log (Last 24 Hours) responds with Retrieving user log data, it may take a few seconds... ▲

Time Stamp	Gas Concentration (PPM)	Total Flow (sccm)	Concentration (ppb or ug/m3)	Ozonator Flow	Select
	Graph	Graph	Graph	Graph	Graph
10/23/2017 09:12:00	0	-0.143602	69.8408	171.829	1
10/23/2017 09:11:00	0	0.007597	72.1732	171.845	1
10/23/2017 09:10:00	0	0.119949	71.5268	171.844	1
10/23/2017 09:09:00	0	0.082866	73.2435	171.837	1
10/23/2017 09:08:00	0	0.111315	72.2107	171.853	1
10/23/2017 09:07:00	0	-0.111409	72.8152	171.849	1
10/23/2017 09:06:00	0	0.132651	74.6095	171.843	1
10/23/2017 09:05:00	0	0.09674	71.4754	171.812	1

The View Data Log (Last 24 Hours) screen contains the following options:

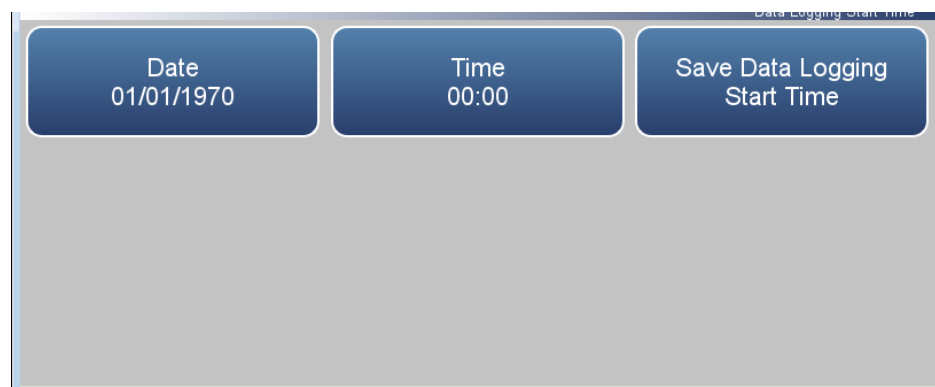
- *Graph*: Displays data graph for the column selected. The graph time axis is defined by the data set in the table.



## View Data Log (User Defined Time)

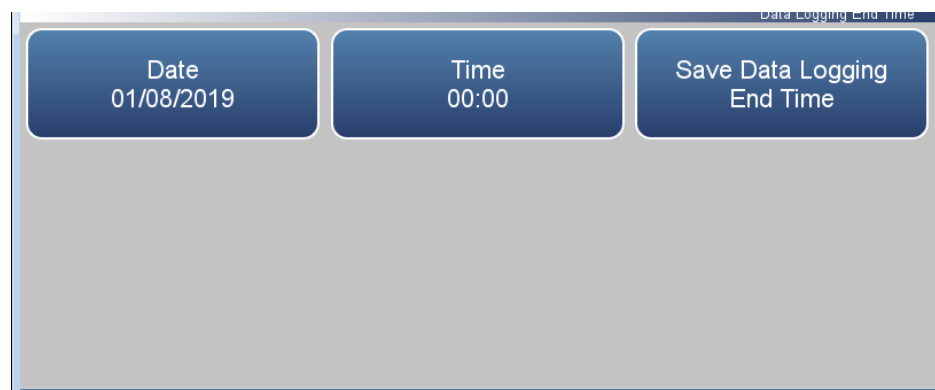
The View Data (User Defined Time) screen is used to specify the start and end time for viewing the data logging table.

**Home Screen>Data>View Data Log (User Defined Time)**



The screenshot shows a screen titled "Data Logging Start Time" at the top right. It contains three blue buttons with white text: "Date" with the value "01/01/1970", "Time" with the value "00:00", and "Save Data Logging Start Time". The background is a light gray.

**Home Screen>Data>View Data Log (User Defined Time)>Save Data Logging Start Time**



The screenshot shows a screen titled "Data Logging End Time" at the top right. It contains three blue buttons with white text: "Date" with the value "01/08/2019", "Time" with the value "00:00", and "Save Data Logging End Time". The background is a light gray.

The View Data Log (User Defined Time) screen contains the following information:

- *Date*: Sets date of data logging start time.
- *Time*: Sets time of data logging start time.
- *Save Data Logging Start Time*: Pressing this button saves the start time and follows directly to the end time selection for the data logging screen.

The View Data Log (User Defined Time) End Time screen contains the following information:

- *Date*: Sets date of data logging end time.
- *Time*: Sets time of data logging end time.
- *Save Data Logging End Time*: Pressing the Save Data Logging End Time button saves the end time and follows directly to the data logging table.

**Note** End time should not be greater than 1 year from start time . ▲

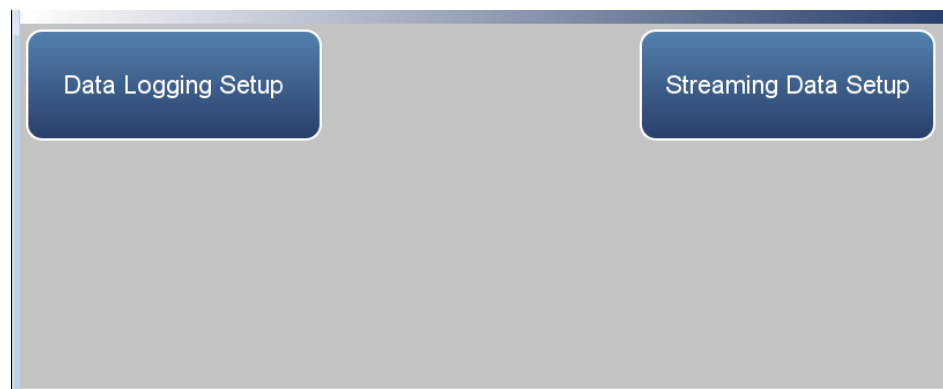
**Note** The datalogging table is limited to 10,000 points. ▲



## Advanced Data Setup

The Advanced Data Setup screen allows the user to select variables and set up parameters for data logging and streaming data.

**Home Screen>Data>Advanced Data Setup**



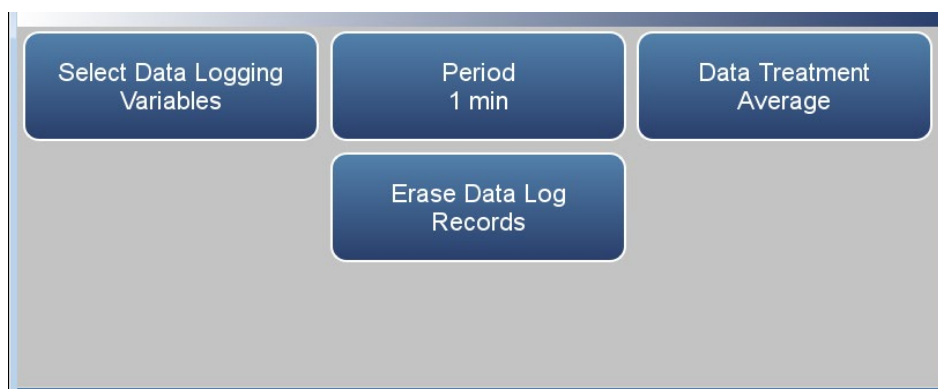
The Advanced Data Setup screen contains the following information:

- *Data Logging Setup*: User selects the parameters for collecting logged data.
- *Streaming Data Setup*: User selects the parameters for streaming data to a computer in real time.

## Data Logging Setup

The Data Logging Setup screen allows the user to select data to be stored and how it is stored.

**Home Screen>Data>Advanced>Data Logging Setup**



The Data Logging Setup screen contains the following information:

- *Select Data Logging Variables:* User selects instrument variables to log.
- *Period:* User selects how often data is collected by setting the duration between logged data.
- *Data Treatment:* Toggles between Average, Current, Minimum and Maximum. When set to average, the average value during the period will be recorded. When set to current, the latest data will be recorded. When set to minimum or maximum, the minimum or maximum value during the period will be recorded.
- *Erase Data Log Records:* Allows the user to erase all values in the data log and updates the data logging table.

**Note** The User Log stores up to 1 year or 525600 data points and the Service Log stores up to 10080 data points (1 week worth of 1-minute data). ▲

## Select Data Logging Variables

The Select Data Logging Variables screen allows the user to select which variables to store. Note: The Data logging and Streaming variable lists are **exclusive** from each other but contain the same variable selections. The list is based on the instrument's configuration.

Use the ▲ and ▼ buttons to scroll through the variables. Select the variables to log by pressing the corresponding cells. Next, press the **Commit Changes** button to save selections. Yellow buttons indicate that the variable is selected.

**Home Screen>Data>Advanced>Data Logging Setup>Select Data Logging Variables**

Table Selection			
Alerts	Analog Alarms	Analog Input 1	Analog Input 2
Analog Input 3	Analog Input 4	DF High Range Enable	DF Low Range Enable
Ethernet Configuration Alarm	Ethernet DNS Configuration Alarm	Ethernet Gateway Configuration Alarm	Ethernet IP Address Configuration Alarm
Ethernet Subnet			

▲

▼

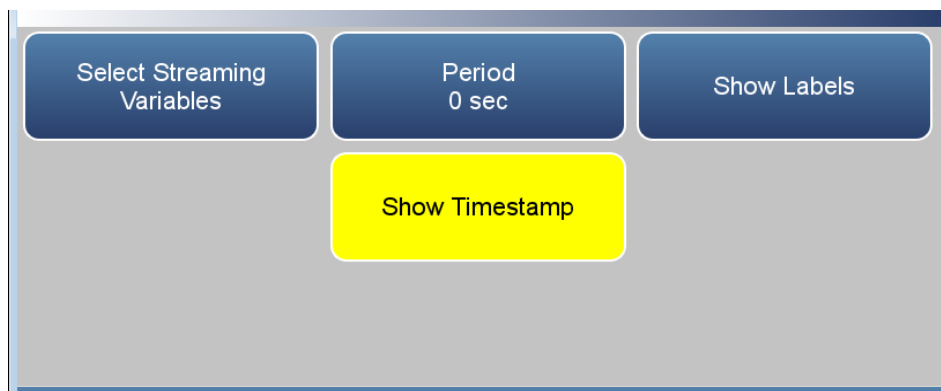
Select All

Commit Changes

## Streaming Data Setup

The Streaming Data Setup screen allows the user to stream data to a computer.

**Home Screen>Data>Advanced>Streaming Data Setup**



The Streaming Data Setup screen contains the following information:

- *Select Streaming Variables*: User selects which variables to stream.
- *Period*: Sets the time between streamed data.
- *Show Labels*: Toggles on/off. When on, shows variable labels to the left of the variable values.
- *Show Timestamp*: Toggles on/off. When on, shows timestamp at the beginning of each row of data.

## Select Streaming Variables

The Select Streaming Variables screen allows the user to select which variables to track. Note: The Data logging and Streaming variable lists are **exclusive** from each other but contain the same variable selections. The list is based on the instrument's configuration.

Use the ▲ and ▼ buttons to scroll through the variables. Select the variables to log by pressing the corresponding cells. Next, press the **Commit Changes** button to save selections. Yellow buttons indicate that the variable is selected.

**Home Screen>Data>Advanced>Streaming Data Setup>Select Streaming Variables**

Table Selection			
Alerts	Analog Alarms	Analog Input 1	Analog Input 2
Analog Input 3	Analog Input 4	DF High Range Enable	DF Low Range Enable
Ethernet Configuration Alarm	Ethernet DNS Configuration Alarm	Ethernet Gateway Configuration Alarm	Ethernet IP Address Configuration Alarm
Ethernet Subnet			

▲

▼

Select All

Commit Changes

## Settings

The Settings screen allows the user to view the status and alarms, operate the instrument, set up user preferences, communicate with outside devices and computers, download files to USB, and sets security protocol.

### Home Screen>Settings



### Home Screen>Settings>More




The Settings screen contains the following information:


- *Health Check:* View instrument status and alarms, predictive diagnostics, preventive maintenance alerts, maintenance history, email health check report files, and contact Thermo Fisher Scientific technical support.
- *Operation:* Allows the user to modify the calibrator's operational settings. This is a powerful screen that allows the user to select the gas span level, the permeation level, the ozonator level, and the photometer mode.
- *Cylinder Setup:* Allows the user to set up the gas cylinder information. Note: the cylinders need to be defined prior to MFC operation.

- *Gas Setup:* Allows the user to set span concentration and total flow values for solenoids.
- *Ozonator Setup:* Allows the user to set span concentration and total flow values for O<sub>3</sub> and NO<sub>2</sub> (GPT).
- *Photometer Settings:* Allows the user to set range, averaging time, and compensation settings for the photometer.
- *Permeation Oven Setup:* Allows the user to configure the permeation oven by setting gas name, permeation constant (K), permeation rate, temperature setpoint, zero mode flow, and span concentrations.
- *Programmed Events:* Allows the user to set up to 20 different programs each with up to 31 events.
- *Manual Operation:* Allows the user to enable/disable manual operation and access manual operation.
- *Communications:* Allows the user to communicate with outside devices.
- *Instrument Setting:* Allows the user to setup alarm setpoints and user preferences as related to the instrument setup.
- *Configuration:* User selects which options to enable.
- *Security Access Levels:* User selects security protocol. User can also change security passwords.
- *USB Drive:* User can update instrument firmware, download data, and change USB password.
- *User Contact Information:* User sets up their contact information.
- *Update Bootloader:* Used to update bootloader when an update to the Bootloader is available.

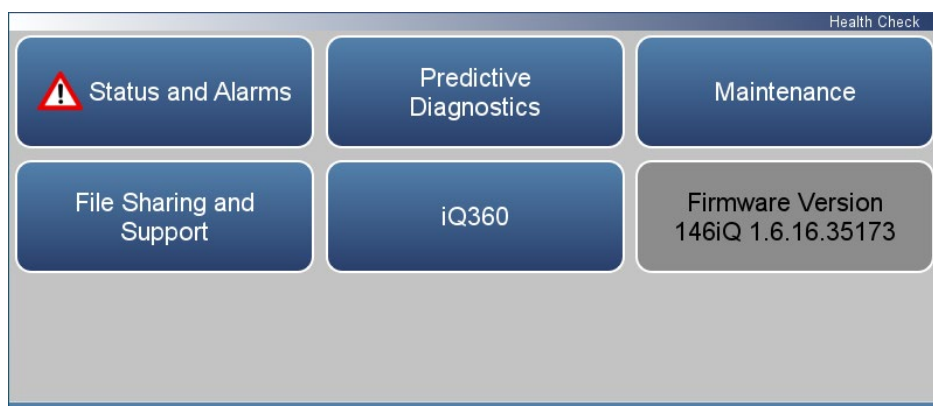
## Health Check

The Health Check screen is used for viewing instrument status and alarms, predictive diagnostics, preventive maintenance schedules, maintenance history, emailing files describing the health/status of the instrument, and viewing the instrument's firmware version.

**Note**  This symbol denotes there is an active alarm in the module. ▲

**Note**  This symbol denotes there is an active maintenance alarm in the module. ▲

### Home Screen>Settings>Health Check



The Health Check screen contains the following information:


- *Status and Alarms*: Allows the user to view the status and alarm menus. Menus are broken down according to modules where the user can view instrument readings, setpoints and alarms.
- *Predictive Diagnostics*: Smart module diagnostics, which shows possible future issues.
- *Maintenance History*: Allows the user to set up a maintenance schedule and track maintenance history.
- *File Sharing and Support*: File sharing via email. Support through Thermo Fisher Scientific technical support.
- *iQ360*: The iQ360 feature is a paid subscription enabling or disabling the instrument to send automated emails to technical support when an alarm or alert is triggered.
- *Firmware Version*: Shows the instrument's firmware version.



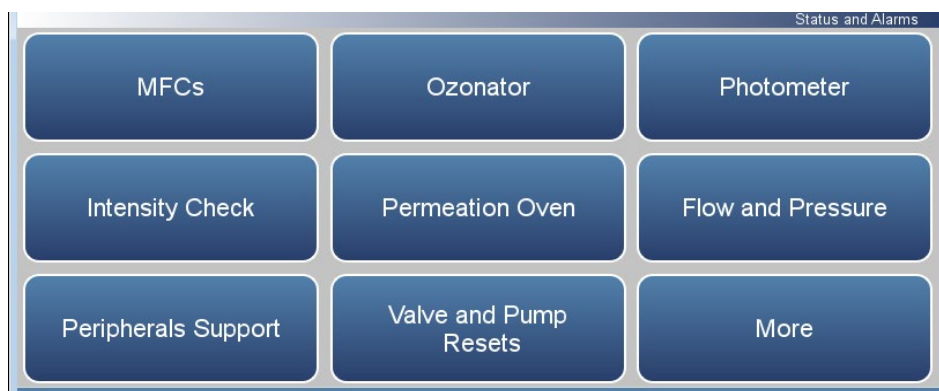


## Status and Alarms

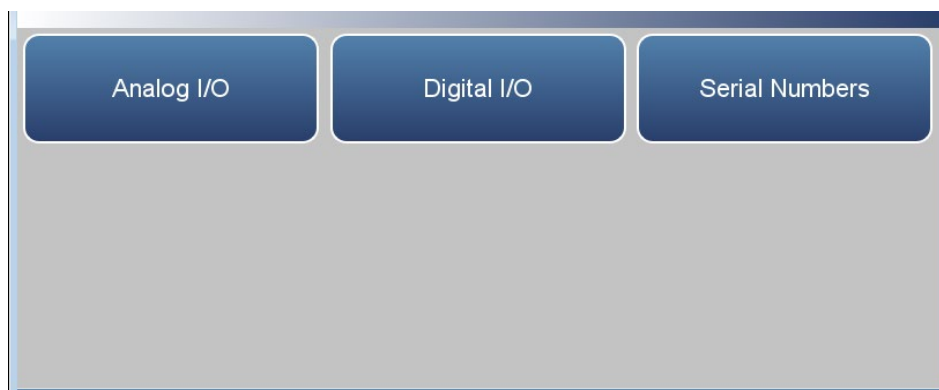
The Status and Alarms screen provides information with respect to module alarms. In each screen, instrument readings, setpoints, and low/high alarm values are displayed. If applicable, setpoints and alarms are also settable from the Settings>Instrument Settings screen.

**Note**  This symbol denotes there is an active alarm in the module. ▲

### Home Screen>Settings>Health Check>Status and Alarms



### Home Screen>Settings>Health Check>Status and Alarms>More



The Status and Alarms screen contains the following information:

- *MFCs*: Displays MFCs alarms and faults.
- *Ozonator*: Displays ozonator module alarms and faults.
- *Photometer*: Displays photometer module alarms and faults.
- *Intensity Check*: Displays reference and sample gas intensity and noise.
- *Permeation Oven*: Displays permeation oven module alarms and faults.
- *Flow and Pressure*: Displays flow and pressure alarms and faults.

- *Peripherals Support:* Displays peripherals support alarms and faults.
- *Valve and Pump Resets:* User can reset valve and pump power.
- *Analog I/O:* Displays analog input/output alarms and faults.
- *Digital I/O:* Displays digital input/output alarms and faults.
- *Serial Numbers:* Displays all the serial numbers for the instrument.

**MFCs** The MFCs (Mass Flow Controllers) screen provides status and alarms for up to three MFC's. If the item being monitored displays Fail, an alarm is activated.

Use the ▲ and ▼ buttons to move up and down and the ◀ and ▶ buttons to move left and right.

**Home Screen>Settings>Health Check>Status and Alarms>MFCs.**

MFCs	Zero MFC	Gas 1 MFC	Gas 2 MFC	
Temperature Overflow	OK	OK	OK	▲
Temperature Underflow	OK	OK	OK	▼
Volumetric Overflow	OK	OK	OK	◀
Volumetric Underflow	OK	OK	OK	▶
Mass Overflow	OK	OK	OK	
Mass Underflow	OK	OK	OK	

The MFCs screen contains the following information:

- Across:
  - *MFCs*: This column lists items associated with the MFC's.
  - *Zero MFC*: Zero mass flow controller. Controls zero air flow.
  - *Gas 1 MFC*: Gas 1 mass flow controller. Controls gas flow, if installed.
  - *Gas 2 MFC*: Gas 2 mass flow controller. Controls gas flow, if installed.
- Down:
  - *Temperature Overflow*: Displays status of temperature overflow condition in the MFC.
  - *Temperature Underflow*: Displays status of temperature underflow condition in the MFC.
  - *Volumetric Overflow*: Displays status of volumetric overflow condition in the MFC.
  - *Volumetric Underflow*: Displays status of volumetric underflow condition in the MFC.

- *Mass Overflow*: Displays status of mass flow overflow condition in the MFC.
- *Mass Underflow*: Displays status of mass flow underflow condition in the MFC.
- *Pressure Overflow*: Displays status of pressure overflow condition in the MFC.
- *Totalizer Overflow*: Displays status of totalizer overflow condition in the MFC.
- *PID Loop in Hold*: Displays status of PID loop in hold error condition in the MFC.
- *ADC Error*: Displays status of ADC error condition in the MFC.
- *PID Exhaust*: Displays status of PID exhaust error condition in the MFC.
- *Over Pressure Limit*: Displays status of over pressure limit reached/exceeded error condition in the MFC.
- *Flow Overflow during totalize*: Displays status of flow overflow during totalizing error condition in the MFC.
- *Measurement was aborted*: Displays status of the measurement being aborted error condition in the MFC.

## Permeation Oven

The Permeation Oven screen provides status and alarms for the permeation oven, if installed. If an item being monitored goes outside the lower or higher alarm limit, an alarm is activated.

Use the ▲ and ▼ buttons to move up and down and the ◀ and ▶ buttons to move left and right.

**Home Screen>Settings>Health Check>Status and Alarms>Perm Oven**

Perm Oven Status and Alarms					
Perm Oven	Value	Low Alarm	High Alarm	Units	
Perm Oven Temperature	29.98	29.90	30.10	°C	▲
Board Communication	OK				▼
Power Supply	OK				◀
2.5 V Diagnostic	2.50	2.25	2.75	V	
3.0 V Diagnostic	3.00	2.70	3.30	V	
3.3 V Diagnostic	3.31	2.97	3.63	V	▶

The Perm Oven screen contains the following information:

- Across:
  - *Perm Oven*: This column lists items associated with the perm oven.
  - *Value*: Displays the current value for each item.
  - *Low Alarm*: Displays low alarm for each item.
  - *High Alarm*: Displays high alarm for each item.
  - *Units*: Displays units for each item.
- Down:
  - *Perm Oven Temperature*: Displays the current perm oven temperature. User can adjust low and high alarm limits.
  - *Board Communication*: Displays OK/Fail for board communication status.
  - *Power Supply*: Displays OK/Fail of power supplies. Power supply goes red if any voltages are outside their limits. No voltage rows ever get highlighted.
  - *2.5 V Diagnostics*: Displays current voltage readings. Alarm limits are not changeable.

- *3.0 V Diagnostics*: Displays current voltage readings. Alarm limits are not changeable.
- *3.3 V Diagnostics*: Displays current voltage readings. Alarm limits are not changeable.
- *5.0 V Diagnostics*: Displays current voltage readings. Alarm limits are not changeable.
- *Heater Power Diagnostics*: Displays current heater voltage readings. Alarm limits are not changeable.

## Ozonator

The Ozonator screen provides status and alarms related to the ozonator module. If an item being monitored goes outside the lower or higher alarm limit, an alarm is activated.

Use the ▲ and ▼ buttons to move up and down and the ◀ and ▶ buttons to move left and right.

**Home Screen>Settings>Health Check>Status and Alarms>Ozonator**

Ozonator	Value	Low Alarm	High Alarm	Units
Lamp Temperature	67.05	60.0	80.0	°C
Lamp Temp Sensor Short	OK			
Lamp Temp Sensor Open	OK			
Lamp Current	0.30			mA
Lamp Connection	OK			
Lamp Short	OK			

The Ozonator screen contains the following information:

- Across:
  - *Ozonator*: This column lists items associated with the ozonator.
  - *Value*: Displays the current value for each item.
  - *Low Alarm*: Displays low alarm for each item.
  - *High Alarm*: Displays high alarm for each item.
  - *Units*: Displays units for each item.
- Down:
  - *Lamp Temperature*: Displays the current lamp temperature reading. User can adjust low and high alarm limits.
  - *Lamp Temp Sensor Short*: Displays the OK/Fail for lamp temperature sensor short status.
  - *Lamp Temp Sensor Open*: Displays the OK/Fail for lamp temperature sensor open status.
  - *Lamp Current*: Displays the current lamp Current reading.
  - *Lamp Connection*: Displays OK/Fail for lamp connection status.
  - *Lamp Short*: Displays OK/Fail for lamp short status.



- *Lamp Heater Current*: Displays the current lamp heater Current reading.
- *Board Communication Failure*: Displays OK/Fail for communication status.
- *Power Supply*: Displays OK/Fail of power supplies. Power supply goes red if any voltages are outside their limits. No voltage rows ever get highlighted.
  - *2.5 V Diagnostic*: Displays current voltage readings. Alarm limits are not changeable.
  - *2.5 V Ref. Diagnostic*: Displays current voltage readings. Alarm limits are not changeable.
  - *3.3 V Diagnostic*: Displays current voltage readings. Alarm limits are not changeable.
  - *5.0 V Diagnostic*: Displays current voltage readings. Alarm limits are not changeable.
  - *5-20 V Diagnostic*: Displays current voltage readings. Alarm limits are not changeable.
  - *15 V Diagnostic*: Displays current voltage readings. Alarm limits are not changeable.
  - *-15 V Diagnostic*: Displays current voltage readings. Alarm limits are not changeable.
  - *24 V Diagnostic*: Displays current voltage readings. Alarm limits are not changeable.

**Note** If both the low alarm and high alarms are set to zero, then no alarm will show. ▲

## Photometer

The Photometer screen provides status and alarms related to the photometer module. If an item being monitored goes outside the lower or higher alarm limit, an alarm is activated.

Use the ▲ and ▼ buttons to move up and down and the ◀ and ▶ buttons to move left and right.

**Home Screen>Settings>Health Check>Status and Alarms>Photometer**

Photometer	Value	Low Alarm	High Alarm	Units	
Pressure	761.52	200.000	1000.000	mmHg	▲
Bench Flow	0.36	0.400	1.600	L/min	▼
Bench Temperature	32.05	15.000	40.000	°C	◀
Concentration	0.00			ppb	▶
Cell Intensity	100036.00	4500.00	150000.00	Hz	
Lamp Temperature	59.86	55.00	65.00	°C	

The Photometer screen contains the following information:

- Across:
  - *Photometer*: This column lists items associated with the photometer.
  - *Value*: Displays the current value for each item.
  - *Low Alarm*: Displays low alarm for each item.
  - *High Alarm*: Displays high alarm for each item.
  - *Units*: Displays units for each item.
- Down:
  - *Pressure*: Displays the current bench pressure. User can adjust low and high alarm limits.
  - *Bench Flow*: Displays the current bench flow. User can adjust low and high alarm limits.
  - *Bench Temperature*: Displays the current bench temperature. User can adjust low and high alarm limits.
  - *Concentration*: Displays the current concentration.
  - *Cell Intensity*: Displays the current cell intensity. User can adjust low and high alarm limits.

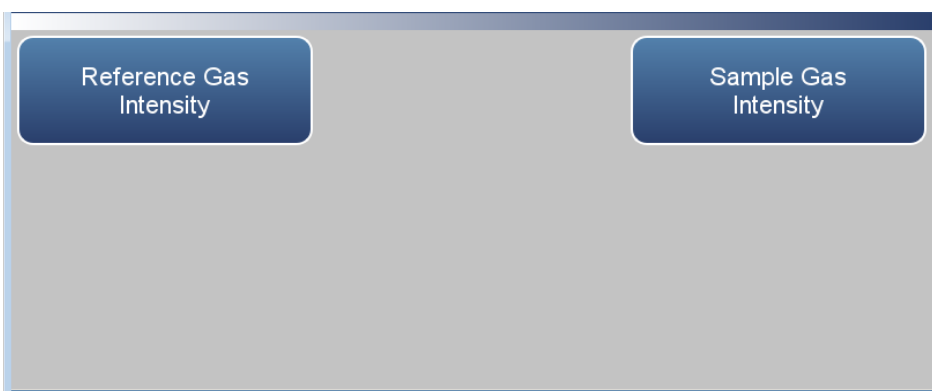
- *Lamp Temperature*: Displays the current lamp temperature reading. User can adjust low and high alarm limits.
- *Lamp Temp Sensor Short*: Displays OK/Fail for lamp temperature sensor short status.
- *Lamp Temp Sensor Open*: Displays OK/Fail for lamp temperature sensor open status.
- *Lamp Current*: Displays the current lamp Current reading.
- *Lamp Connection*: Displays OK/Fail for lamp connection status.
- *Lamp Short*: Displays OK/Fail for lamp short status.
- *Lamp Heater Current*: Displays the current lamp heater Current reading.
- *Bench Temp Sensor Short*: Displays the OK/Fail for bench temperature sensor short status.
- *Bench Temp Sensor Open*: Displays the OK/Fail for bench temperature sensor open status.
- *Board Communication Failure*: Displays OK/Fail for communication status.
- *Power Supply*: Displays OK/Fail of power supplies. Power supply goes red if any voltages are outside their limits. No voltage rows ever get highlighted.
- *2.5 V Diagnostic*: Displays current voltage readings. Alarm limits are not changeable.
- *2.5 V Ref. Diagnostic*: Displays current voltage readings. Alarm limits are not changeable.
- *3.3 V Diagnostic*: Displays current voltage readings. Alarm limits are not changeable.
- *5.0 V Diagnostic*: Displays current voltage readings. Alarm limits are not changeable.
- *5-18 V Diagnostic*: Displays current voltage readings. Alarm limits are not changeable.
- *15 V Diagnostic*: Displays current voltage readings. Alarm limits are not changeable.
- *-15 V Diagnostic*: Displays current voltage readings. Alarm limits are not changeable.
- *24 V Diagnostic*: Displays current voltage readings. Alarm limits are not changeable.

## Intensity Check

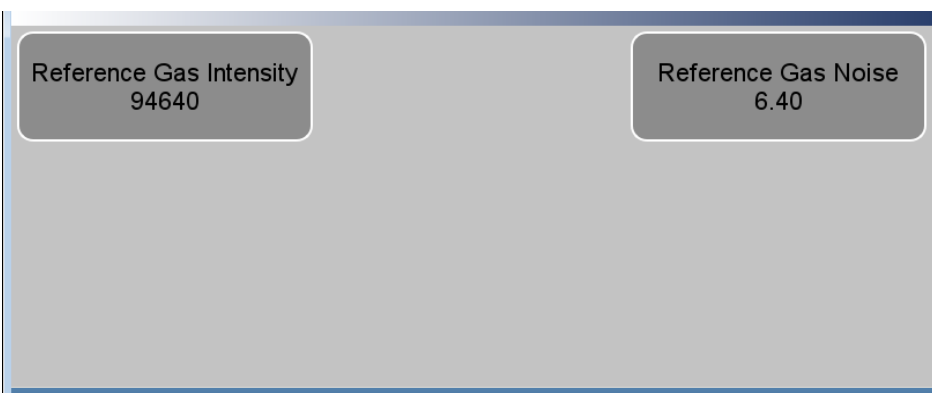
The Intensity Check screen is used to determine the intensity and noise reading of the photometer detector with either reference or sample gas flow. This is accomplished by adjusting photometer valve operation to receive only reference or sample gas while in the respective screens. Selecting any of these screens will disturb the analog outputs. The intensity check is visible only if the photometer option is installed.

Both intensity screens function the same way. Therefore, the following example of the Reference Gas Intensity screen applies to the Sample Gas Intensity screen as well.

**Home Screen>Settings>Health Check>Status and Alarms>Intensity Check**



**Home Screen>Settings>Health Check>Status and Alarms>Intensity Check>Reference Gas Intensity**



The Intensity Check screen contains the following information:

- *Reference Gas Intensity*: Displays reference gas intensity and noise check.
- *Sample Gas Intensity*: Displays sample gas intensity and noise check.

- *Reference Gas Intensity*: Read only. Displays the detector intensity on reference gas.
- *Reference Gas Noise*: Read only. Displays the calculated detector noise on reference gas.

## Flow and Pressure

The Flow and Pressure screen provides status and alarms related to the flow and pressure module. If an item being monitored goes outside the lower or higher alarm limit, an alarm is activated.

Use the ▲ and ▼ buttons to move up and down and the ◀ and ▶ buttons to move left and right.

**Home Screen>Settings>Health Check>Status and Alarms>Flow and Pressure**

Flow and Pressure	Value	Low Alarm	High Alarm	Units	
Photometer Flow	0.80	0.400	1.600	L/min	▲
Ozonator Flow	0.18			L/min	▼
Ozonator Diff Pressure	162.40			mmHg	◀
Photometer Pressure	760.31	200.000	1000.000	mmHg	▶
Pump Pressure	349.41			mmHg	
Module Temperature	25.30			°C	

The Flow and Pressure screen contains the following information:

- Across:
  - *Flow and Pressure*: This column lists items associated with the flow and pressure module.
  - *Value*: Displays the current value for each item.
  - *Low Alarm*: Displays low alarm status for each item.
  - *High Alarm*: Displays high alarm status for each item.
  - *Units*: Displays units for each item.
- Down:
  - *Photometer Flow*: Displays the flow reading through photometer. User can adjust low and high alarm limits.
  - *Ozonator Flow*: Displays the flow reading through ozonator.
  - *Ozonator Diff Pressure*: Displays differential pressure across the capillary restricting flow to the ozonator.
  - *Photometer Pressure*: Displays photometer bench pressure. User can adjust low and high alarm limit.
  - *Pump Pressure*: Displays the current pump pressure reading.

- *Module Temperature*: Displays module temperature reading.
- *Board Communication*: Displays pass/fail for communication status.
- *Power Supply*: Displays pass/fail of power supplies. Power supply goes red if any voltages are outside their limits. No voltage rows ever get highlighted.
  - *2.5V Diagnostic*: Displays current voltage readings. Alarm limits are not changeable.
  - *3.3V Diagnostic*: Displays current voltage readings. Alarm limits are not changeable.
  - *5.0V Diagnostic*: Displays current voltage readings. Alarm limits are not changeable.
  - *24V Diagnostic*: Displays current voltage readings. Alarm limits are not changeable.

**Note** Depending on instrument model and the presence or absence of optional components, not all pressure sensor and flow readings rows will be applicable, and should be disregarded. ▲

## Peripherals Support

The Peripherals Support screen provides status and alarms related to the peripheral module. If an item being monitored goes outside the lower or higher alarm limit, an alarm is activated.

Use the ▲ and ▼ buttons to move up and down and the ◀ and ▶ buttons to move left and right.

**Home Screen>Settings>Health Check>Status and Alarms> Peripherals Support**

PSB	Value	Low Alarm	High Alarm	Units	
Instrument Temperature	27.4	8.0	45.0	°C	▲
Zero Solenoid	0.000			mA	▼
Zero Mix Solenoid	0.000			mA	
Gas Solenoid 1	0.000			mA	◀
Gas Solenoid 2	0.000			mA	
Gas Solenoid 3	0.000			mA	▶

The Peripherals Support screen contains the following information:

- Across:
  - *PSB*: This column lists items associated with the peripherals support.
  - *Value*: Displays the current value for each item.
  - *Low Alarm*: Displays low alarm for each item.
  - *High Alarm*: Displays high alarm for each item.
  - *Units*: Displays units for each item.
- Down:
  - *Instrument Temperature*: Temperature of the peripherals module, used as a surrogate for the instrument temperature. User can adjust low and high alarm limits.
  - *Zero Solenoid*: Displays whether or not the zero solenoid is activated. Displays electrical Current value.
  - *Zero Mix Solenoid*: Displays whether or not the zero mix solenoid is activated. Displays electrical Current value.




- *Gas Solenoid 1–6*: Displays whether or not the Gas solenoid 1–6 is activated. Displays electrical Current value.
- *Purge Solenoid*: Displays whether or not the purge solenoid is activated. Displays electrical Current value.
- *Pump*: Displays whether or not the pump solenoid is activated. Displays electrical Current value.
- *Ext/Int Solenoid*: Displays whether or not the external/internal solenoid is activated. Displays electrical Current value.
- *Sample Reference Solenoid*: Displays whether or not the sample reference solenoid is activated. Displays electrical Current value.
- *Permeation Solenoid 1–2*: Displays whether or not the permeation solenoid 1–2 is activated. Displays electrical Current value.
- *Board Communication*: Displays pass/fail for communication status.
- *Power Supply*: Displays pass/fail of power supplies. Power supply goes red if any voltages are outside their limits. No voltage rows ever get highlighted.
- *2.5V Diagnostic*: Displays current voltage readings. Alarm limits are not changeable.
- *3.3V Diagnostic*: Displays current voltage readings. Alarm limits are not changeable.
- *5V Diagnostic*: Displays current voltage readings. Alarm limits are not changeable.
- *24V Diagnostic*: Displays current voltage readings. Alarm limits are not changeable.
- *5V Step Board 1*: Displays current voltage readings. Alarm limits are not changeable.
- *24V Step Board 1*: Displays current voltage readings. Alarm limits are not changeable.
- *5V Step Board 2*: Displays current voltage readings. Alarm limits are not changeable.
- *24V Step Board 2*: Displays current voltage readings. Alarm limits are not changeable.
- *5V Step Board 3*: Displays current voltage readings. Alarm limits are not changeable.
- *24V Step Board 3*: Displays current voltage readings. Alarm limits are not changeable.

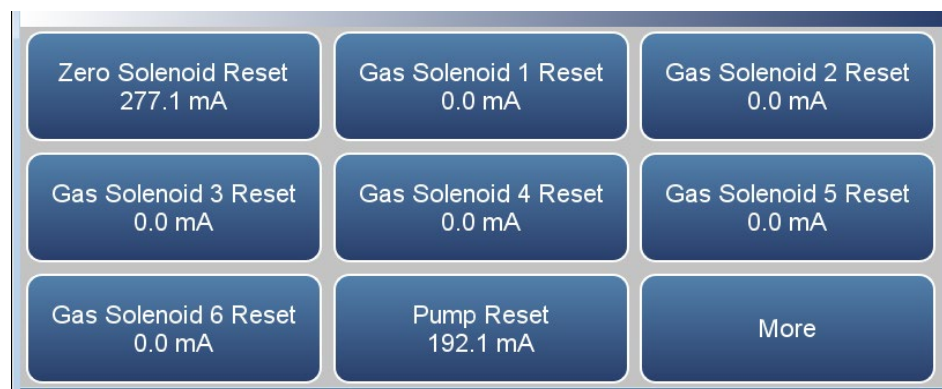
- *5V Step Board 4:* Displays current voltage readings. Alarm limits are not changeable.
- *24V Step Board 4:* Displays current voltage readings. Alarm limits are not changeable.

## Valve and Pump Resets

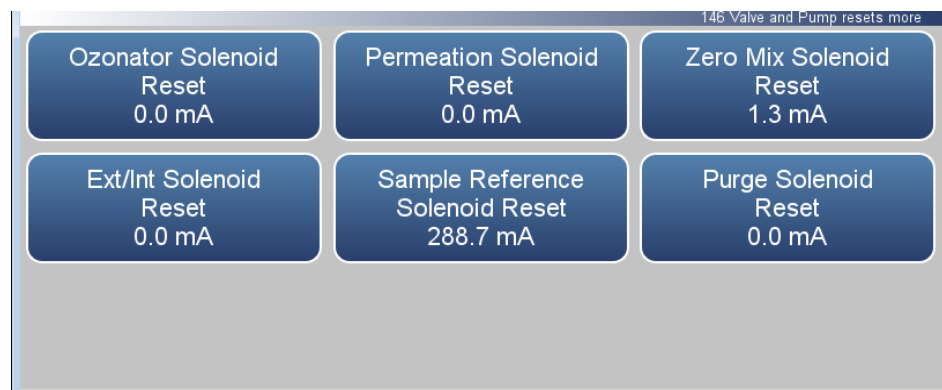
The Valve and Pump Resets screen allows the user to reset a valve or pump after a failure due to excessive amperage.

**Note**  This symbol denotes that the device needs to be reset. ▲

**Home Screen>Settings>Health Check>Status and Alarms> Valve and Pump Resets**



**Home Screen>Settings>Health Check>Status and Alarms> Valve and Pump Resets>More**



The Valve and Pump Resets screen contains the following information:

- *Zero Solenoid Reset:* Resets zero solenoid.
- *Gas Solenoid 1–6 Reset:* Resets gas solenoid 1–6.
- *Pump Reset:* Resets pump.
- *Ozonator Solenoid Reset:* Resets ozonator solenoid.
- *Permeation Solenoid Reset:* Resets permeation solenoid.
- *Zero Mix Solenoid Reset:* Resets zero mix solenoid.

- *Ext/Int Solenoid Reset:* Resets external/internal solenoid.
- *Sample Reference Solenoid Reset:* Resets sample reference solenoid.
- *Purge Solenoid Reset:* Resets purge solenoid.

**Note** Solenoids and the pump are distributed among the various step boards. Resetting a valve or pump will reset all the other components on the same board as the valve or pump. ▲

## Analog I/O

The Analog I/O screen provides status and alarms related to the analog input/output module. If an item being monitored goes outside the lower or higher alarm limit, an alarm is activated.

Use the ▲ and ▼ buttons to move up and down and the ◀ and ▶ buttons to move left and right.

**Home Screen>Settings>Health Check>Status and Alarms>More>Analog I/O**

Analog IO	Value	Low Alarm	High Alarm	Units
Voltage Output Channel 1	OK			
Voltage Output Channel 2	OK			
Voltage Output Channel 3	OK			
Voltage Output Channel 4	OK			
Voltage Output Channel 5	OK			
Voltage Output Channel 6	OK			

The Analog I/O screen contains the following information:

- Across:
  - *Analog IO*: This column lists items associated with the analog I/O.
  - *Value*: Displays the current value for each item.
  - *Low Alarm*: Displays low alarm status for each item.
  - *High Alarm*: Displays high alarm status for each item.
  - *Units*: Displays units for each item.
- Down:
  - *Voltage Output Channel 1–6*: Displays real-time voltage output for each channel.
  - *Current Output Channel 1–6*: Displays real-time current output for each channel.
  - *Chip Temperatures*: Displays OK/Fail for chip temperatures.
  - *Chip 1–3 Communication*: Displays OK/Fail for each chip communication.
  - *Test Mode*: Displays test mode on or off.

- *Board Communication:* Displays OK/Fail for board communication status.
- *Power Supply:* Displays OK/Fail of power supplies. Power supply goes red if any voltages are outside their limits. No voltage rows ever get highlighted.
  - *3.3V Diagnostic:* Displays current voltage readings. Alarm limits are not changeable.
  - *5.0V Diagnostic:* Displays current voltage readings. Alarm limits are not changeable.
  - *5.0V Ref Diagnostic:* Displays current voltage readings. Alarm limits are not changeable.
  - *15V Diagnostic:* Displays current voltage readings. Alarm limits are not changeable.
  - *-15V Diagnostic:* Displays current voltage readings. Alarm limits are not changeable.

## Digital I/O

The Digital I/O screen provides status and alarms related to the digital input/output module. If an item being monitored goes outside the lower or higher alarm limit, an alarm is activated.

Use the ▲ and ▼ buttons to move up and down and the ◀ and ▶ buttons to move left and right.

**Home Screen>Settings>Health Check>Status and Alarms>More>Digital I/O**

Digital IO	Value	Reset	Low Alarm	High Alarm	Units	
Solenoid 1	0.0	Reset	OK	OK	mA	▲
Solenoid 2	0.0	Reset	OK	OK	mA	▼
Solenoid 3	0.0	Reset	OK	OK	mA	◀
Solenoid 4	0.0	Reset	OK	OK	mA	▶
Solenoid 5	0.0	Reset	OK	OK	mA	
Solenoid 6	0.0	Reset	OK	OK	mA	

The Digital I/O screen contains the following information:

- Across:
  - *Digital IO*: This column lists items associated with the digital I/O.
  - *Value*: Displays the current value for each item.
  - *Reset*: Resets item.
  - *Low Alarm*: Displays low alarm status for each item.
  - *High Alarm*: Displays high alarm status for each item.
  - *Units*: Displays units for each item.
- Down:
  - *Solenoid 1–8*: Displays whether or not the solenoid is activated by showing the current in mA.
  - *External Alarm 1–3*: Displays OK/Fail for external alarms.
  - *Relay Test Mode*: Displays relay test mode on or off.
  - *Solenoid Test Mode*: Displays solenoid test mode on or off.
  - *Board Communication*: Displays OK/Fail for communication status.

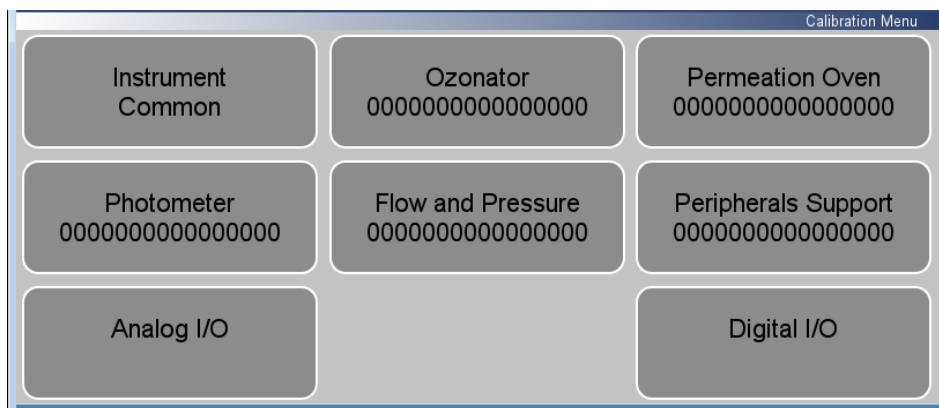
- *Power Supply:* Displays OK/Fail of power supplies. Power supply goes red if any voltages are outside their limits. No voltage rows ever get highlighted.
  - *3.3V Diagnostic:* Displays current voltage readings. Alarm limits are not changeable.
  - *5.0V Diagnostic:* Displays current voltage readings. Alarm limits are not changeable.
  - *24V Diagnostic:* Displays current voltage readings. Alarm limits are not changeable.



## Serial Numbers

The Serial Numbers screen displays the serial number for each module.

**Home Screen>Settings>Health Check>Status and Alarms>More>Serial Numbers**




The Serial Numbers screen contains the following information:

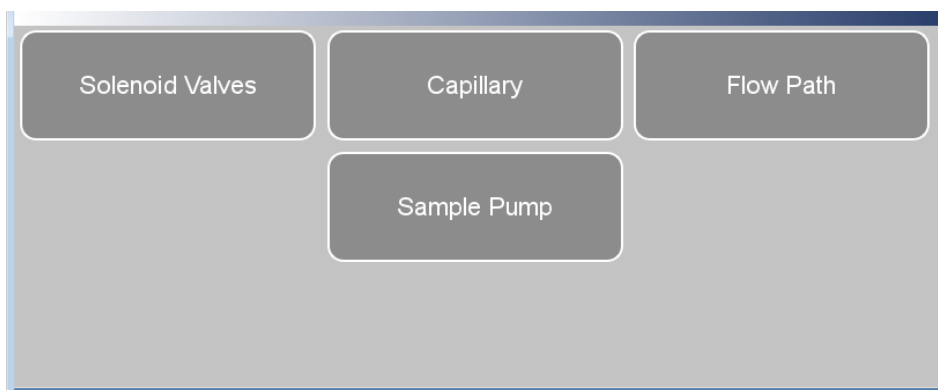
- *Instrument*: Instrument serial number.
- *Ozonator*: Ozonator serial number.
- *Permeation Oven*: Permeation oven serial number.
- *Photometer*: Photometer serial number.
- *Flow and Pressure*: Flow and pressure serial number.
- *Peripherals Support*: Peripherals support serial number.
- *Analog I/O*: Analog I/O serial number.
- *Digital I/O*: Digital I/O serial number.

## Predictive Diagnostics

The Predictive Diagnostics screen is a feature for instruments to anticipate maintenance needs, reduce downtime, and reduce troubleshooting time. If button is greyed out, no maintenance is needed. If button is blue, maintenance is suggested.

**Note**  This symbol denotes there is an active maintenance related warning in the module. ▲


### Home Screen>Settings>Health Check>Predictive Diagnostics



The Predictive Diagnostics screen contains the following information:

- Solenoid Valves
- Capillary
- Flow Path
- Sample Pump

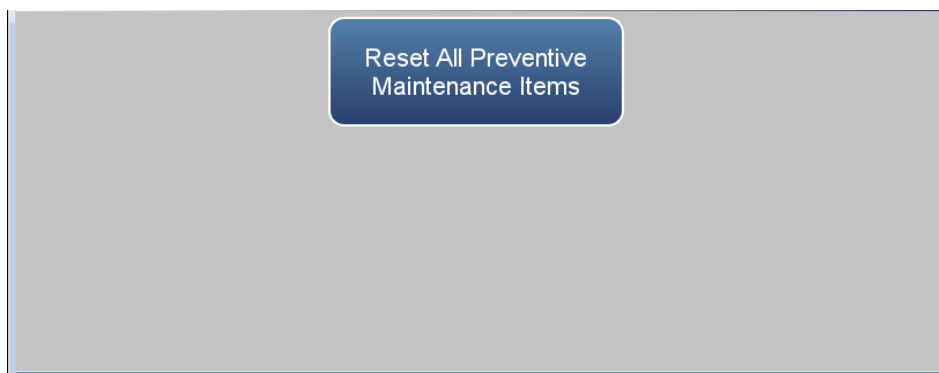
**Maintenance** The Maintenance screen reminds the user when certain instrument components need to be serviced/replaced.

**Note**  This symbol denotes there is an active maintenance related warning in the module. ▲

#### Home Screen>Settings>Health Check>Maintenance



#### Home Screen>Settings>Health Check>Maintenance>Advanced Maintenance



The Maintenance screen contains the following information:

- *Preventive Maintenance*: Shows suggested service interval and time left for component replacement.
- *Change Part*: User logs component fix.
- *Maintenance History*: Shows the log of all recorded component fixes.
- *Service Tips*: Provides video and procedural service tips.
- *Advanced Maintenance*: Resets all preventive maintenance items.

## Preventive Maintenance

The Preventive Maintenance screen reminds the user when certain instrument components need to be serviced/replaced. When the “Months Left” has decreased to 2, the row is highlighted yellow. If the “Months Left” is 1 or less, the row is highlighted red and the maintenance icon (gears) will appear in the status bar located at the bottom of the screen.

Use the ▲ and ▼ buttons to move up and down and the ◀ and ▶ buttons to move left and right.

**Home Screen>Settings>Health Check>Maintenance>Preventive Maintenance**

Component	Interval in Months	Months Left	Reset	Alert	
Photometer DMC	60	60	Reset	Enabled	▲
Lamp	60	60	Reset	Enabled	▼
Lamp Heater	60	60	Reset	Enabled	◀
Detector	60	60	Reset	Enabled	▶
Ozonator	60	60	Reset	Enabled	
Lamp	60	60	Reset	Enabled	

The Preventive Maintenance screen contains the following information:

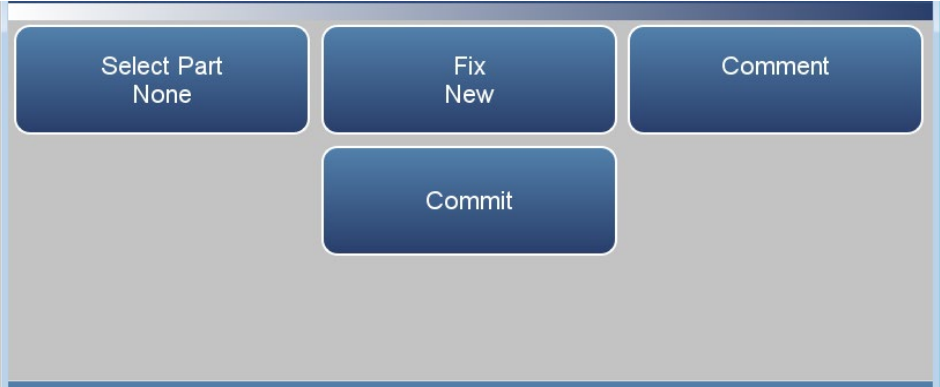
- Across:
  - *Component*: Device to be routinely serviced or replaced.
  - *Interval in Months*: Expected period of time before a component needs to be checked and/or serviced.
  - *Months Left*: Count down timer in months. Remaining time since the beginning of the service interval. When the value is 1 or less, the row will be highlighted and it is suggested that the component should be checked and/or serviced.
  - *Reset*: Once the component is serviced/replaced, the user presses the Reset button and the “Months Left” value resets to the “Interval in Months” value.
  - *Alert*: Allows the user to opt out of receiving preventive maintenance alerts. Displays Enabled/Disabled for each component.

- Down:
  - *Photometer DMC*: Service interval for photometer module components.
    - *Lamp*: Service interval for photometer lamp.
    - *Lamp Heater*: Service interval for photometer lamp heater.
    - *Detector*: Service interval for detector.
  - *Ozonator*: Service interval for ozonator module.
    - *Lamp*: Service interval for ozonator lamp.
    - *Lamp Heater*: Service interval for ozonator lamp heater.
  - *Permeation Tube*: Service interval for permeation tube.
  - *Flow System*: Service interval for the flow system components.
    - *Pump*: Service interval for pump.
    - *Capillary (Pump)*: Service interval for pump capillary.
    - *Capillary (Reference)*: Service interval for reference capillary.
    - *Capillary (Ozonator)*: Service interval for ozonator capillary.
  - *DC Power Supply*: Service interval for DC power supply.
  - *Fan Filter*: Service interval for fan filter.
  - *System Components*: Service interval for system components.
    - *Purafil*: Service interval for purafil.
    - *Charcoal*: Service interval for charcoal.
    - *Dri-Rite*: Service interval for dri-rite.

## Change Part

The Change Part screen allows the user to enter the component being serviced and the type of fix. Pressing commit will update the preventive maintenance table and predictive diagnostics screen when applicable.

**Home Screen>Settings>Health Check>Maintenance>Change Part**

A screenshot of the 'Change Part' screen. It features a light gray background with a dark blue header bar at the top. Below the header, there are four dark blue buttons with white text. The buttons are arranged in two rows: the top row contains 'Select Part None', 'Fix New', and 'Comment'; the bottom row contains a single 'Commit' button centered horizontally. The buttons have rounded corners and a slight shadow effect.

The Change Part screen contains the following information:

- *Select Part:* User selects part to service from the selection table.
- *Fix:* User chooses from new, rebuilt, cleaned, and unknown.
- *Comment:* User can write a brief comment, which will be saved to the preventive maintenance history table.
- *Commit:* User commits and saves the selected part fix.

## Maintenance History

The Maintenance History screen allows the user to view when components are replaced, rebuilt, or cleaned. When a user changes a part in the change part screen, the new row will be automatically created at the top in the maintenance history table.

Use the ▲ and ▼ buttons to move up and down and the ◀ and ▶ buttons to move left and right.

**Home Screen>Settings>Health Check>Maintenance>Maintenance History**

**Note** Retrieving maintenance history data, it may take a few seconds... ▲

Part	Fix	Date	Service Months	Comments	
All	Unknown	07/17/2017	0	Reset All	▲
					▼
					◀
					▶

The Maintenance History screen contains the following information:

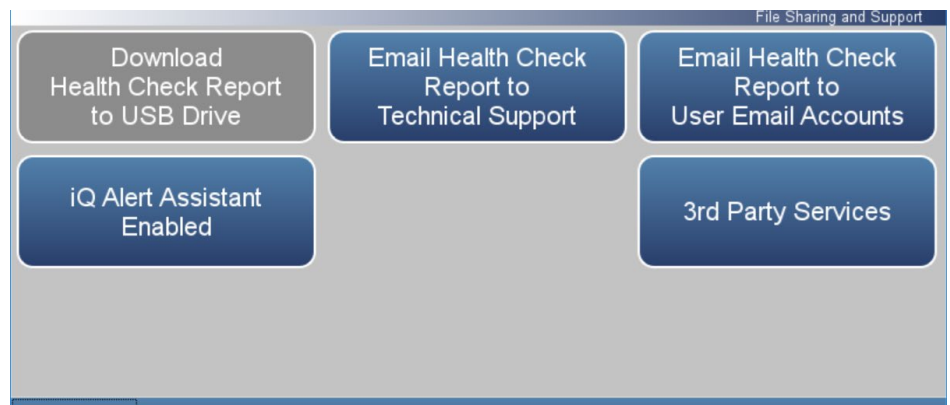
- *Part*: Component that has been fixed.
- *Fix*: The type of maintenance.
- *Date*: Shows date/time when service was logged.
- *Service Months*: Amount of time in months since last service.
- *Comments*: Shows comments entered from time of change.

## File Sharing and Support

The File Sharing and Support screen allows the user to send health check report files to Thermo Fisher Scientific technical support or user emails. The Health Report file includes: Status and Alarms, PM Alerts, Activity Log, Service Database, Cal History, and Data Log (last 24 hours).

**Note** To create email list, go to Settings>User Contact Information. To configure email, go to Settings>Communications>Email Server (SMTP). ▲

### Home Screen>Settings>Health Check>File Sharing and Support



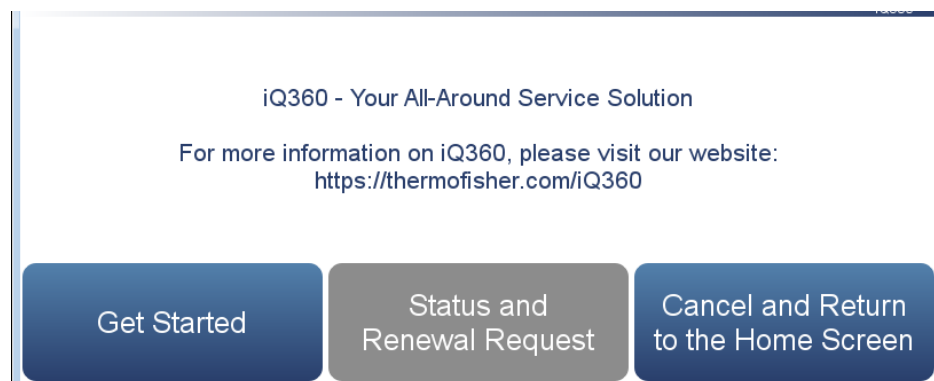
The File Sharing and Support screen contains the following information:

- *Download Health Check Report to USB Drive:* Sends the health report to USB drive.
- *Email Health Check Report File to Technical Support:* Sends the health report file to technical support and the customer email addresses via email.
- *Email Health Check Report to Personal Account:* Sends the health report file to a personal account via email.
- *iQ Alert Assistant:* With the iQ Alert Assistant enabled, the instrument will email Thermo Scientific Technical Support the health check report after each event. After each maintenance alert or predictive diagnostic alert, Customer Service will produce a quote for the components that require service. This quote will get emailed to the email addresses that have been entered into the “User Contact Information” menu.
- *3<sup>rd</sup> Party Services:* The 3<sup>rd</sup> party services feature is a paid subscription, which allows a service provider to enable or disable automated email notifications when an alarm or alert is triggered.

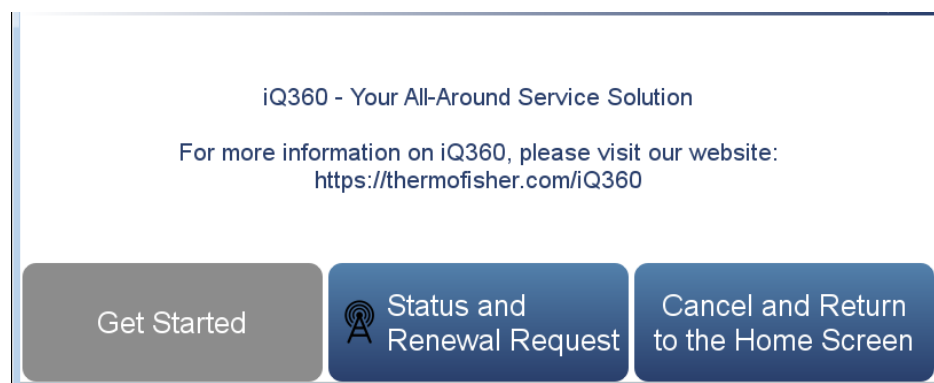


**iQ360** The iQ360 is a paid subscription enabling or disabling the instrument to send automated emails to technical support when an alarm or alert is triggered.

**Home Screen>Settings>Health Check>iQ360 (Get Started)**



**Home Screen>Settings>Health Check>iQ360 (Status and Renewal Request)**



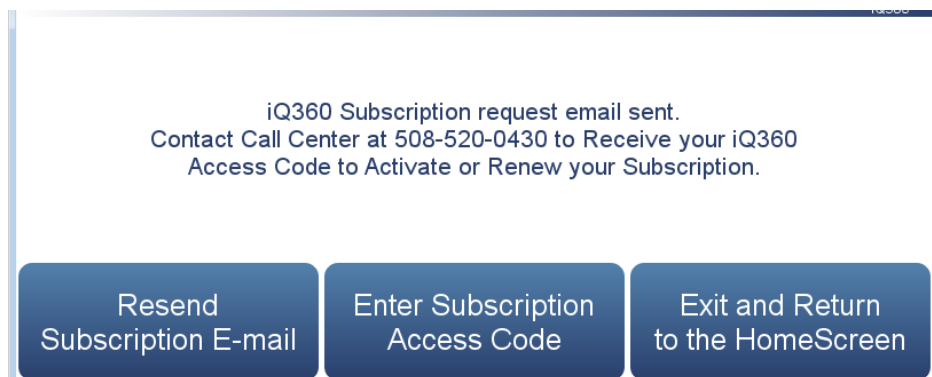
The iQ360 screen contains the following information:

- *Get Started*: Allows the user to access the menu where the subscription passcode is entered.
- *Status and Renewal Request*: Allows the user to access the iQ360 menu once the subscription has been enabled.
- *Cancel and Return to the Home Screen*: Exits screen and returns to the Home Screen.

## Get Started

The Get Started screen allows the user to access the menu where the subscription passcode is entered.

**Home Screen>Settings>Health Check>iQ360>Get Started**



The Get Started screen contains the following information:

- *Resend Subscription E-mail:* Allows the user to request another subscription passcode if the email was never received.
- *Enter Subscription Access Code:* Allows the user to enter the subscription passcode to enable an iQ360 subscription.
- *Exit and Return to the Home Screen:* Exits screen and returns to the Home Screen.

## Status and Renewal Request

The Status and Renewal Request screen allows the user to access the iQ360 menu once the subscription has been enabled.

**Home Screen>Settings>Health Check>iQ360>Status and Renewal Request**



The Status and Renewal Request screen contains the following information:

- *iQ360 Status*: Informs the user if the subscription is enabled.
- *iQ360 Subscription Expiration Date*: Informs the user when the subscription will expire.
- *iQ360 Test Connection*: Allows the user to verify the network connection is working.
- *iQ360 Subscription Renewal*: Allows the user to request a subscription renewal via email.

## Operation

The Operation screen is used to modify the calibrator's operational settings. This is a powerful screen that allows the user to select the gas span level, the ozonator level, and the photometer mode. Like the Home Screen, if any of these options are not installed, then their controls are not displayed on the operation screen.

### Home Screen>Settings>Operation

Operation	Setting	Set Value	Measured Value	Units	
Gas	Solenoid 1	CH4	--	--	▲
Zero / Span	Zero	0.000	-0.005	ppm	▼
Gas Flow	--	0.0	-0.0	sccm	◀
Total Flow	--	4000.0	3994.0	sccm	▶
Photometer	Internal	--	17.1	ppb	

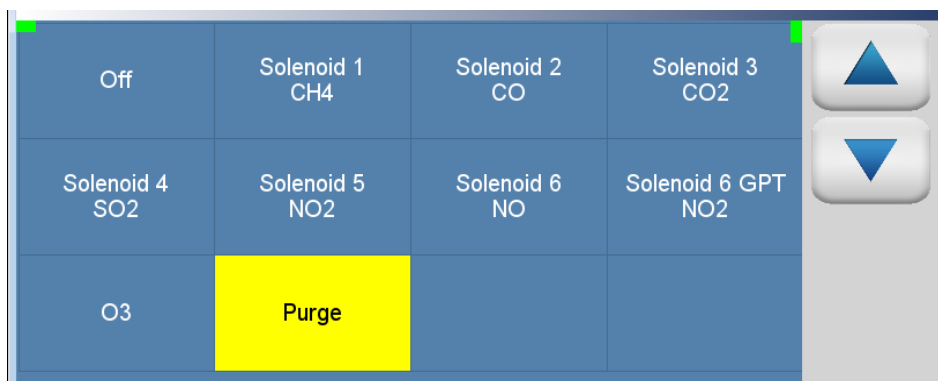
The Operation screen contains the following information:

- Across:
  - *Operation*: This column lists items associated with operation.
  - *Setting*: User modifies instrument operation.
  - *Set Value*: Displays concentration or flow setpoints.
  - *Measured Value*: Displays concentration or flow readings.
  - *Units*: Displays units for each item.
- Down:
  - *Gas*: Allows selection of the gas. Supports up to six external gases (Gas 1 through 6), GPT NO<sub>2</sub>, O<sub>3</sub> (if ozonator is installed), permeation gas, and Purge. The external gas names may be set up/changed by the user via the cylinder setup screen. Note: Defining the external gases is a prerequisite to the operation of the MFCs.
  - *Zero / Span*: Displays zero/span selection (zero, span 1–span 6). The instrument sets the flow parameters to meet the selected criteria. For zero, the gas mass flow controller is shut off and a previously determined zero air flow is output as set in the gas setup screen. For Span 1–span 6, the zero and gas flow controllers are set to provide the previously determined total flow and gas concentration.

- *Gas Flow:* Shows the gas flow set value (as set in the gas setup screen) and gas flow measured value. Note: For O<sub>3</sub>, this flow will be the flow through the ozonator. For NO<sub>2</sub>, this flow will be the NO flow through the gas MFCs. For permeation gas, this flow will be the flow through the permeation oven.
- *Total Flow:* Shows the total flow set value (as set in the gas, ozonator, or permeation oven setup screen).
- *Photometer:* Shows the photometer mode and reading, if installed. The allowable modes are Off, Internal, External, and Control. In Internal mode, the photometer is configured to take sample from the manifold and report the ozone concentration. In External mode, the photometer takes sample from the 'External Sample' rear-panel bulkhead fitting and reports the ozone concentration. In Control mode, the photometer is configured the same as Internal mode, and the ozonator drive signal is controlled to provide a pre-set ozone concentration. This concentration is maintained by constantly updating the drive signal to the ozonator lamp based on the measured photometer concentration.

**Note** The Purge function is utilized to clear residual span gases from the instrument's pneumatics with the available zero air. Initiating Purge through the Operation and Manual Operation screens or the Programmed Events option will open the Purge and Zero Air valves such that zero air goes through the Zero and Span Gas MFCs. The Zero air MFC is automatically set to 2.5 SLPM and the Span Gas MFCs are set to 75% of their full scale range such that there is highly responsive purging of the MFCs and downstream lines as well as the mixing chamber, when initiated through the Operation Screen. It is recommended to run the purge option frequently, and to add the purge event at the end of every programmed sequence. It should be noted that the purge event does not automatically shut off, and should be ended by the user. The following illustrates how to run the purge action through the Operation Screen. ▲

**Home Screen>Settings>Operation>Gas (under Setting)**



Choosing the Purge Action from the Manual Operation Screen will allow the user to set their own gas and zero flows, but will essentially function similar to what was described above.

### Home Screen>Settings>Operation

Operation	Setting	Set Value	Measured Value	Units
Gas	Purge	Purge	--	--
Zero / Span	Zero	0.000	0.000	ppm
Gas Flow	--	825.0	825.0	sccm
Total Flow	--	3325.0	3329.3	sccm
Photometer	Internal	--	29.8	ppb

**Note** Operation of the optional permeation oven is accomplished through the Operation, Manual Operation and Programmed Events screens similar to an external gas, O<sub>3</sub>, or NO<sub>2</sub>. The Permeation Oven Setup is described in a later sub-section, but generating a permeation gas output through the Operation screen is initiated by the following steps. ▲

### Home Screen>Settings>Operation>Gas (under Setting)

Gas O <sub>3</sub> Permeation Setup			
Off	Solenoid 1 CH <sub>4</sub>	Solenoid 2 CO	Solenoid 3 CO <sub>2</sub>
Solenoid 4 NO	Solenoid 5 NO <sub>2</sub>	Solenoid 6 SO <sub>2</sub>	Solenoid 6 GPT NO <sub>2</sub>
O <sub>3</sub>	Permeation SO <sub>2</sub>	Purge	

**Home Screen>Settings>Operation>Zero/Span (under Setting)**

Operation Permeation			
Zero	Span 1 0.025 ppm	Span 2 0.020 ppm	Span 3 0.015 ppm
Span 4 0.010 ppm	Span 5 0.007 ppm	Span 6 0.007 ppm	

**Home Screen>Settings>Operation**

Operation	Setting	Set Value	Measured Value	Units
Gas	Permeation	SO2	--	--
Zero / Span	Span 1	0.025	0.025	ppm
Gas Flow	--	167.7	167.7	sccm
Total Flow	--	2903.2	2895.7	sccm
Photometer	Internal	--	30.3	ppb

## Cylinder Setup

The Cylinder Setup screen allows the user to set up each solenoid based on the connected gas cylinder.

Use the ▲ and ▼ buttons to move up and down and the ◀ and ▶ buttons to move left and right.

**Home Screen>Settings>Cylinder Setup**

Gas Solenoid	Gas Name	Tank Conc. (ppm)	Tank Balance Gas	Tank Exp. Month	
1	CH4	1000.0	Air	January	▲
2	CO	100.0	N2	June	▼
3	CO2	100000.0	Air	January	◀
4	SO2	150.0	Air	March	▶
5	NO2	10.0	N2	November	
6	NO	40.0	N2	December	

The Cylinder Setup screen contains the following information:

- Across:
  - *Gas Solenoid*: This column lists items associated with the gas solenoid.
  - *Gas Name*: Displays gas name. The gas name can be selected from a list of commonly used gases or user-defined using an alphanumeric keypad.
  - *Tank Conc. (ppm)*: Displays cylinder concentration. User settable using numeric keypad.
  - *Tank Balance Gas*: Displays cylinder balance gas. The balance gas name can be selected from a list of commonly used balanced gases or user-defined using an alphanumeric keypad.
  - *Tank Exp. Month*: Displays month of expiration of the tank. User selectable.
  - *Tank Exp. Year*: Displays year of expiration of the tank. User settable using numeric keypad.
- Down:
  - 1–6: Up to 6 individual cylinder gases can be connected to the solenoids 1–6.





**Note** An important feature of the 146iQ is the incorporation of the cylinder composition in the information sent down to the gas mass flow controller(s) to better account for the variability in gas properties that may affect their mass flow. This feature also allows a user to not have to calibrate their gas mass flow controller(s) for a particular gas, and instead uniformly calibrate all their flow controllers with air/N<sub>2</sub> and allow the gas composition information to inform and compensate for differences in gas properties between air/N<sub>2</sub> and the actual gas flowing through the flow controller(s) at any given time. This feature will ensure accurate mass flow outputs at all times regardless of the gas flowing through the flow controller(s). In order for the cylinder composition to be utilized in mass flow control and metering, it is essential that the user accurately defines their cylinders in the Cylinder Setup screen

Additionally, in order to fully deploy the benefits of gas composition compensation, it is important that the cylinder gas and balance gas are chosen from the pre-populated list of gases in the Gas Name and Tank Balance Gas columns, respectively. If the user enters a custom name, the flow controllers will assume that the gas is Air. ▲



**Home Screen>Settings>Cylinder Setup>(Gas Solenoid X) Gas Name>Choose Solenoid X Gas Name From List**

CH <sub>4</sub>	CO	CO <sub>2</sub>	NO
NO <sub>2</sub>	SO <sub>2</sub>	None	

**Home Screen>Settings>Cylinder Setup>(Gas Solenoid X) Tank Balance Gas>Choose Solenoid X Balance Gas From List**

Air	N <sub>2</sub>	Ar	None

## Gas Setup

The Gas Setup screen, user selects gas solenoid to configure.

**Home Screen>Settings>Gas Setup**



The Gas Setup screen contains the following information:

- *Gas Solenoid 1–6*: Shows gas name based on cylinder setup screen. When pressed, goes to gas solenoid setup table.

## Gas Solenoid 1–6

The Gas Solenoid X screen allows the user to set up to 6 span concentration and total flow settings for each gas. The minimum and maximum allowable values are calculated based on setpoints, tank concentration, and acceptable MFC operation ranges.

All the gas solenoid screens function the same way. Therefore, the following example of the Gas Solenoid 1 screen applies to the other screens as well.

Use the ▲ and ▼ buttons to move up and down and the ◀ and ▶ buttons to move left and right.

### Home Screen>Settings>Gas Setup>Gas 1

Gas Solenoid 1	Setpoint	Minimum	Maximum	Units	
Zero Mode Flow	400.0	400.0	10000.0	sccm	▲
					▼
Span 1 Concentration	0.000	0.000	0.000	ppm	◀
Span 1 Total Flow	4.0	4.0	1100.0	sccm	▶
Span 2 Concentration	0.000	0.000	0.000	ppm	
Span 2 Total Flow	4.0	4.0	1100.0	sccm	

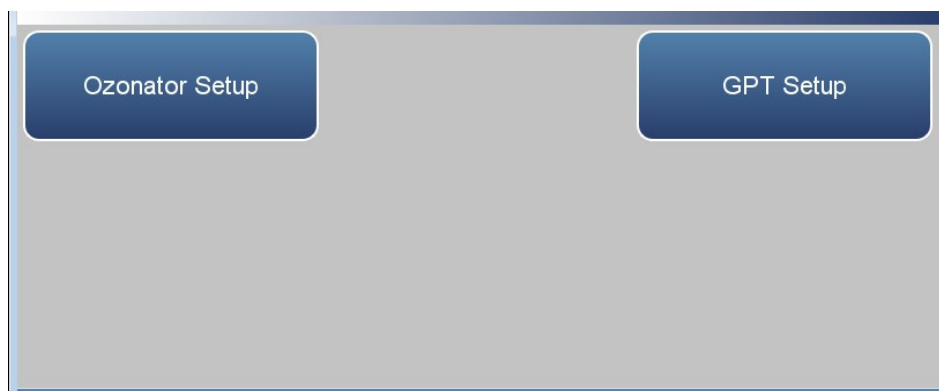
- Across:
  - *Gas Solenoid 1*: This column lists items associated with the gas solenoid 1.
  - *Setpoint*: User selects span concentration or total flow setpoint.
  - *Minimum*: Minimum allowable value.
  - *Maximum*: Maximum allowable value. Note: The span concentration, although limited by MFC ranges, can bet set up to run the tank concentration by entering it into the concentration setpoint field. This action will set the zero flow for that span level to 0.
  - *Units*: Displays units for each item.
- Down:
  - *Zero Mode Flow*: User sets flow for zero mode operation.
  - *Span 1–6 Concentration*: User sets span concentration for span operation.
  - *Span 1–6 Total Flow*: User sets total flow for span operation.

## Ozonator Setup

The Ozonator Setup screen allows the user to setup ozone and NO<sub>2</sub> span concentrations and total flows.

Use the ▲ and ▼ buttons to move up and down and the ◀ and ▶ buttons to move left and right.

**Home Screen>Settings>Ozonator Setup**



The Gas Setup screen contains the following information:

- *Ozonator Setup*: User sets up to six O<sub>3</sub> span concentrations and flows.
- *GPT Setup*: User sets up to six NO<sub>2</sub> span concentrations and flows.

**Ozonator Setup**

The Ozonator Setup screen allows the user to set up to 6 O<sub>3</sub> span concentration and total flow settings. The minimum and maximum allowable values are calculated based on setpoints, achievable ozonator output, and acceptable MFC operation ranges.

Use the ▲ and ▼ buttons to move up and down and the ◀ and ▶ buttons to move left and right.

**Home Screen>Settings>Ozonator Setup>Ozonator Setup**

Ozone Output	Setpoint	Minimum	Maximum	Units	
Zero Mode Flow	400.0	400.0	10000.0	sccm	▲
					▼
Ozone Span 1 Concentration	0.002	0.002	10.093	ppm	◀
Ozone Span 1 Total Flow	565.0	565.0	10135.0	sccm	▶
Ozone Span 2 Concentration	0.002	0.002	10.093	ppm	
Ozone Span 2 Total Flow	565.0	565.0	10135.0	sccm	

The Ozonator Setup screen contains the following information:

- Across:
  - *Ozone Output*: This column lists items associated with the ozone output.
  - *Setpoint*: User selects span concentration or total flow setpoint.
  - *Minimum*: Minimum allowable value.
  - *Maximum*: Maximum allowable value.
  - *Units*: Displays units for each item.
- Down:
  - *Zero Mode Flow*: User sets flow for zero mode operation.
  - *Ozone Span 1–6 Concentration*: User sets ozone span concentration for ozone span operation.
  - *Ozone Span 1–6 Total Flow*: User sets total flow for ozone span operation.

## GPT Setup

The GPT Setup screen allows the user to set up to 6 NO<sub>2</sub> span concentrations, the NO span concentration targets for each of the specified NO<sub>2</sub> span concentrations, and total flow. The minimum and maximum allowable values are calculated based on setpoints, NO tank concentration, achievable ozonator outputs, and acceptable MFC operation ranges.

**Note** The NO tank to be used for GPT should be connected to Solenoid 6. Additionally, NO has to be selected as the gas name in the Cylinder Setup screen (do not use user-defined names for this tank). ▲

### Home Screen>Settings>Ozonator Setup>GPT Setup

GPT Setup

Confirm that the NO tank to be used for GPT is connected to Solenoid 6.

Also, in the Cylinder Setup screen, ensure that NO is selected as the Gas Name.

Enabling the 'Auto Calculate NO target' button will automatically set the NO target for any specified NO<sub>2</sub> span concentration. This value can still be manually changed in the ensuing screen.

Auto Calculate NO target      Continue      Exit

### Home Screen>Settings>Ozonator Setup>GPT Setup>Continue

NO <sub>2</sub> Output	Setpoint	Minimum	Maximum	Units
Zero Mode Flow	400.0	400.0	10000.0	sccm
NO <sub>2</sub> Span 1 Concentration	0.020	0.002	6.607	ppm
NO <sub>2</sub> Span 1 Total Flow	5000.0	554.0	11250.0	sccm
NO <sub>2</sub> Span 1 NO Target	0.008	0.008	2.200	ppm
NO <sub>2</sub> Span 2 Concentration	0.020	0.002	6.607	ppm

The GPT Setup screen contains the following information:

- Across:
  - *NO<sub>2</sub> Output*: This column lists items associated with the NO<sub>2</sub> output.

- *Setpoint*: User selects span concentration (NO<sub>2</sub> and NO) or total flow setpoint.
- *Minimum*: Minimum allowable value.
- *Maximum*: Maximum allowable value.
- *Units*: Displays units for each item.
- Down:
  - *Zero Mode Flow*: User sets flow for zero mode operation.
  - *NO<sub>2</sub> Span 1–6 Concentration*: User sets NO<sub>2</sub> span concentration for NO<sub>2</sub> span operation.
  - *NO<sub>2</sub> Span 1–6 Total Flow*: User sets NO<sub>2</sub> total flow for NO<sub>2</sub> span operation.
  - *NO<sub>2</sub> Span 1–6 NO Target*: User sets required NO target concentration for the NO<sub>2</sub> GPT operation.

**Note** Choosing the ‘Auto Calculate NO target’ button automatically set the NO target for all the already specified NO<sub>2</sub> span concentrations. These auto calculated values can, however, still be manually changed in the GPT Setup screen. ▲

## Photometer Settings

The Photometer Settings screen is used to specify user preferences for photometer operation (if installed).

**Home Screen>Settings>Photometer Settings**



The Photometer Settings screen contains the following information:

- *Range:* Defines the concentration range for the analog outputs. For example, an O<sub>3</sub> range of 0–5,000 ppb sets the analog output to concentrations between 0 and 5,000 ppb. Pressing Range brings up a numeric keypad whereby the user can select a range.
- *Averaging Time:* Sets the averaging time for O<sub>3</sub> measurements.
- *Compensation:* Allows the user to compensate for the effect of changes in temperature and pressure on measured concentration.

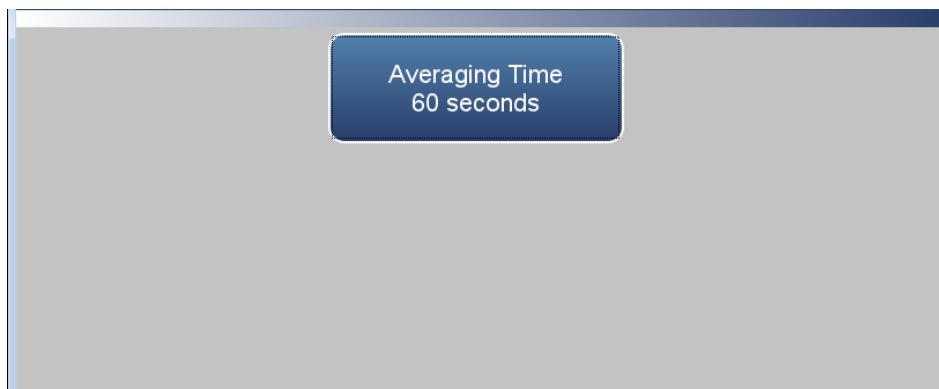


## Averaging Time

The Averaging Time screen allows the user to choose a manually selected (static) averaging time.

Averaging Time defines the time period (10 to 300 seconds) during which the O<sub>3</sub> measurement is taken and the average concentration of the reading for that time period is calculated. The front panel display and analog outputs are updated every 5 seconds for averaging times between 10 and 300 seconds. An averaging time of 10 seconds, for example, means that the average concentration of the last 10 seconds will be displayed at each update. An averaging time of 300 seconds means that the moving average concentration of the last 300 seconds will be the output at each update. Therefore, the lower the averaging time the faster the front panel display and analog outputs respond to concentration changes. Longer averaging times are typically used to smooth output data. Note: This 5 second update is only applicable to the photometer concentration. Other items on the front panel and elsewhere are updated every second.

**Home Screen>Settings>Photometer Settings>Averaging Time**



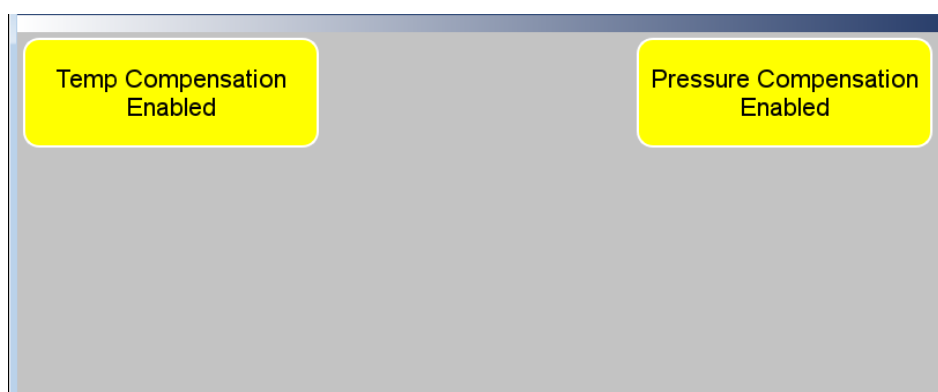
The Averaging Time screen contains the following information:

- *Averaging Time*: Sets averaging time period.

## Compensation

The Compensation screen provides compensation for any changes to the instrument's photometer output signal due to internal instrument temperature and pressure variations.

**Home Screen>Settings>Photometer Settings>Advanced Measurement Settings>Compensation**



The Compensation screen contains the following information:

- *Temp Compensation:* Toggles temperature compensation enabled or disabled and provides compensation for any changes to the instrument's photometer output signal due to internal instrument temperature variations. The effects of internal instrument temperature changes on the analyzer's subsystems and output have been empirically determined. This empirical data is used to compensate for any changes in temperature.
- *Pressure Compensation:* Toggles pressure compensation enabled or disabled and provides compensation for any changes to the instrument's photometer output signal due to bench pressure variations. The effects of bench pressure changes on the analyzer's subsystems and output have been empirically determined. This empirical data is used to compensate for any change in bench pressure.

## Permeation Oven Setup

The Permeation Oven Setup screen allows the user to define the permeation tube gas, enter the permeation constant (K, described in Chapter 9, “[Optional Equipment](#)”) and the relevant permeation rate of the permeation tube, set the permeation oven temperature setpoint, and set up the zero mode flows and up to 6 diluted span concentrations. The respective minimum and maximum allowable values are calculated based on setpoints and/or acceptable MFC operation ranges.

Use the ▲ and ▼ buttons to move up and down and the ◀ and ▶ buttons to move left and right.

### Home Screen>Settings>Permeation Oven Setup

Permeation Oven	Setting	Minimum	Maximum	Units	Permeation Setup
Permeation Gas Name	SO2				▲
Permeation K	0.382				▼
Permeation Rate	190.0			ng/min	◀
Temperature Setpoint	30			°C	▶
Undiluted Concentration	0.433			ppm	
Zero Mode Flow	4000.0	400.0	10000.0	sccm	

The Permeation Oven Setup screen contains the following information:

- Across:
  - *Permeation Oven*: This column lists items associated with the permeation oven setup.
  - *Setting*: User enters parameters relevant to the permeation oven operation.
  - *Minimum*: Minimum allowable value.
  - *Maximum*: Maximum allowable value.
  - *Units*: Displays units for each item.
  - *Total Flow (sccm)*: Displays the relevant measured/calculated total flows based on flow measurement/chosen setpoint.
- Down:
  - *Permeation Gas Name*: User enters permeation tube gas name through an alphanumeric keypad.

- *Permeation K*: User enters the permeation constant for the permeation gas. The permeation constant K is calculated as  $K = (24.45/\text{Molecular Weight of the gas})$ .
- *Permeation Rate*: User enters the permeation rate of the permeation tube at the operational temperature in ng/min.
- *Temperature Setpoint*: User chooses the temperature setpoint for the permeation oven. The temperature setpoint can be set to 30, 35, or 45 degrees C.
- *Undiluted Concentration*: Displays the calculated permeation oven concentration output based on the user entered parameters and measured flow through the permeation oven.
- *Zero Flow Mode*: User enters the zero mode air flow in sccm.
- *Span 1–6*: User sets the desired permeation oven diluted span concentrations for permeation oven span operation. The total flow is calculated based on the desired permeation oven concentration and acceptable zero MFC operation range, and is displayed in the “Total Flow (sccm)” column.

## Programmed Events

The Programmed Events screen sets the instrument's internal computer program to conduct a series of calibrator events at preset times and durations. There are up to 20 programs with up to 31 calibrator events that can be programmed. Each event can be assigned solenoid gas, span setting, ozonator span, GPT NO<sub>2</sub> span, permeation span, photometer mode, and event duration.

### Home Screen>Settings>Programmed Events



The Programmed Events screen contains the following information:

- *Current Program:* Shows the current running program number.
- *Current Event:* Shows the current running event number within the program.
- *View Programs:* User can view and edit programs.

## View Programs

The View Programs screen allows the user to enable/disable programs, select events within the programs, set program start times, set re-occurring period for programs, and displays the next start time for the programs.

Use the ▲ and ▼ buttons to move up and down and the ◀ and ▶ buttons to move left and right.

**Home Screen>Settings>Programmed Events>View Programs**

Program Number	Program	Select Events 1 to 15	Select Events 16 to 31	Set Initial Program Start Time	
1	Disabled	Select Events	Select Events	Not set yet	▲
2	Disabled	Select Events	Select Events	Not set yet	▼
3	Disabled	Select Events	Select Events	Not set yet	◀
4	Disabled	Select Events	Select Events	Not set yet	▶
5	Disabled	Select Events	Select Events	Not set yet	
6	Disabled	Select Events	Select Events	Not set yet	

The Programmed Events screen contains the following information:

- Across:
  - *Program Number*: This column lists the 20 programs.
  - *Program*: Allows the user to enable/disable individual programs.
  - *Select Events*: Allows the user to choose events to be performed for each program.
  - *Set Initial Program Start Time*: User sets the initial program start times.
  - *Period (hrs)*: Defines the period or interval between program runs.
  - *Next Program Start Time*: Read only. Displays next program start time based on initial program start time and period.
- Down:
  - *1–20*: Lists the 20 programs.

**Select Events** The Select Events 1–15 and 16–31 screens allow the user to select up to 31 events for each program.

Use the ▲ and ▼ buttons to move up and down and the ◀ and ▶ buttons to move left and right.

**Home Screen>Settings>Programmed Events>Select Events 1–15**

Program Events	Action	Duration (min)	Solenoid	Zero/Span	Photometer	User D.O.	
1	Disabled	0	Off	Zero	Off	No	▲
2	Disabled	0	Off	Zero	Off	No	▼
3	Disabled	0	Off	Zero	Off	No	
4	Disabled	0	Off	Zero	Off	No	◀
5	Disabled	0	Off	Zero	Off	No	
6	Disabled	0	Off	Zero	Off	No	▶

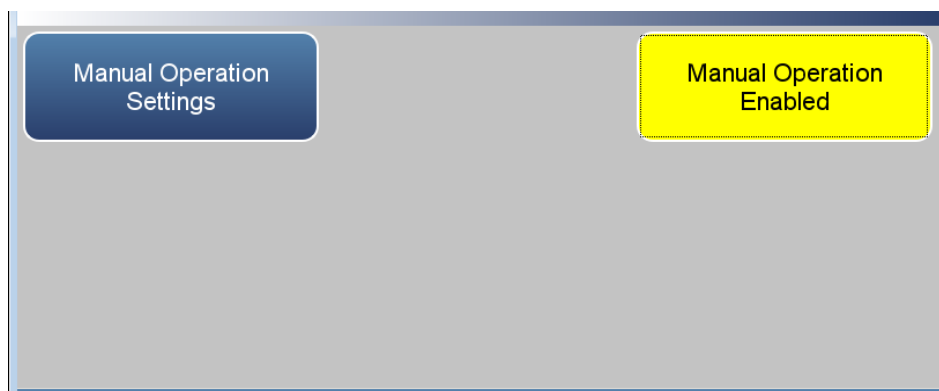
The Select Events screen contains the following information:

- Across:
  - *Program Events*: This column lists event numbers.
  - *Action*: User enables/disables event.
  - *Duration (min)*: Time duration for the event.
  - *Solenoid*: User chooses gas solenoid (includes GPT NO<sub>2</sub>, O<sub>3</sub>, and permeation “solenoids”) or off.
  - *Zero/Span*: User chooses zero or span 1–6.
  - *Photometer*: User chooses Internal, External, Control, or Off.
  - *User D.O. 01–16*: User chooses None, Off, or On for digital outputs.
- Down:
  - *1–15 and 16–31*: User can set up to 31 events for each program.

## Manual Operation

The Manual Operation screen is used to manually modify the calibrator's operational settings. This screen is similar to the Operation screen. When manual operation is enabled, user can manually set gas flow, zero flow, and ozone undiluted concentration. User will not be able to select preset span concentrations.

**Home Screen>Settings>More>Manual Operation**



The Manual Operation screen contains the following information:

- *Manual Operation Settings*: When pressed, goes to the Manual Operation screen.
- *Manual Operation*: Enables/disables manual operation. When manual operation is enabled, the user will have access to the manual operation screen but will not have access to the operation screen, and vice versa.



## Manual Operation Settings

The Manual Operation Settings screen allows the user to manually set the gas flow, zero flow, and ozone undiluted concentration (if installed). User will not be able to select preset span concentrations.

Use the ▲ and ▼ buttons to move up and down and the ◀ and ▶ buttons to move left and right.

**Home Screen>Settings>More>Manual Operation>Manual Operation Settings**

Manual Operation	Setting	Set Value	Measured Value	Units	
Gas	Solenoid 1	CH4	--	--	▲
Zero / Span	Manual	100.000	99.830	ppm	▼
Gas Flow	--	400.0	399.5	sccm	◀
Zero Flow	--	3600.0	3602.7	sccm	▶
Ozone undiluted	Disabled	0.000	0.000	ppm	
Ozone diluted		---	0.000	ppm	

The Manual Operation Settings screen contains the following information:

- Across:
  - *Manual Operation*: This column lists items associated with manual operation.
  - *Setting*: User sets up instrument operation.
  - *Set Value*: Displays concentration or flow setpoints.
  - *Measured Value*: Displays measured concentrations and flows. User sets gas flow, zero flow, and undiluted ozone concentration.
  - *Units*: Displays units for each item.
- Down:
  - *Gas*: Allows selection of the gas. Supports up to six external gases (Gas 1 through 6), GPT NO<sub>2</sub>, O<sub>3</sub> (if ozonator installed), Permeation, and Purge. The external gas names may be set up/changed by the user via the cylinder setup screen.
  - *Zero / Span*: Displays “Manual”. The set value is calculated by the manually entered gas flow and zero flow.

**Note** In the case of GPT NO<sub>2</sub>, the set value is the concentration of NO calculated by the manually entered NO gas flow and zero flow. ▲

- *Gas Flow:* The user sets the MFC gas flow under the Set Value column. Measured value displays to the right under the Measured Value column. The lowest allowable flow setting for the MFCs is 4%.

**Note** In the case of GPT NO<sub>2</sub>, the gas flow indicated is the flow of NO required for GPT. ▲

- *Zero Flow:* The user sets the MFC zero flow under the Set Value column. Measured value displays to the right under the Measured Value column. A lower limit of 4% of the lowest MFC range is enforced for zero flow. However, the zero MFC can be set to 0 sccm to be able to supply straight tank concentration.
- *Ozone Undiluted:* User sets the undiluted ozone concentration under the Set Value column, if installed. Measured value displays to the right under the Measured Value column. Undiluted ozone is the output from the ozonator prior to dilution by the zero air.
- *Ozone Diluted:* Displays diluted ozone concentration under the Set Value column, if installed. Measured value displays to the right under the Measured Value column. Diluted ozone is the ozone concentration at the output manifold.
- *Photometer:* User can choose either Off, Internal, External, or Control, if installed.

## Communications

The Communications screen allows the user to set TCP/DHCP parameters, Serial settings, Analog I/O and Digital I/O, Email Server, Instrument ID, and Ethernet Protocol Selection. Buttons are grayed out if not selected in Settings>**Configuration**.

### Home Screen>Settings>More>Communications



The Communications screen contains the following information:

- *Wired TCP/DHCP*: Settings for communicating with the instrument through wired Ethernet.
- *Serial RS-232/485*: Settings for communicating with the instrument through RS-232/485 protocol. This is only visible if selected in Settings>Configuration>Communications Board.
- *Analog I/O*: Settings for communicating with the instrument through analog I/O settings. This is only visible if selected in Settings>Configuration>Analog I/O.
- *Digital I/O*: Settings for communicating with the instrument through digital I/O settings. This is only visible if selected in Settings>Configuration>Digital I/O.
- *Email Server (SMTP)*: Settings for communication with email.
- *Instrument ID*: Allows the user to edit the instrument identification number (ID). The ID is used to identify the instrument when using protocols to control the instrument or collect data. It may be necessary to edit the ID number if two or more of instruments of the same model are connected to one computer. Valid instrument ID numbers are from 0 to 127. The 146iQ has a default instrument ID of 1.
- *Ethernet Protocol Selection*: Allows the user to enable VNC, Streaming, Modbus, or Bayern Hessen to utilize the mobile app and/or those communication protocols.

## Wired TCP/DHCP

The Wired TCP/DHCP screen allows the user to communicate with the instrument via wired TCP/IP settings.

**Note** When DHCP is enabled, the dynamic IP address is used. When DHCP is disabled, the static IP address is used. ▲

### Home Screen>Settings>More>Communications> Wired TCP/DHCP (with DHCP enabled)

The screenshot shows the 'Wired TCP/DHCP' screen with DHCP enabled. The 'DHCP Enabled' button is highlighted in yellow. The settings displayed are:

DHCP Enabled	Dynamic IP Address 10.175.248.56	Dynamic Netmask 255.255.255.0
Dynamic Gateway 10.175.248.1	Wired MAC Address 60:89:3C:7F:08:31	Host Name iQSeries

### Home Screen>Settings>More>Communications>Wired TCP/DHCP (with DHCP disabled)

The screenshot shows the 'Wired TCP/DHCP' screen with DHCP disabled. The 'DHCP Disabled' button is highlighted. The settings displayed are:

DHCP Disabled	Static IP Address 10.175.248.249	Static Netmask 255.255.255.0
Static Gateway 10.175.248.1	Static DNS Server 1 10.0.2.217	Static DNS Server 2 0.0.0.0
Wired MAC Address 70:B3:D5:F7:60:3D	Host Name iQSeries	Commit

The Wired TCP/DHCP screen contains the following information:

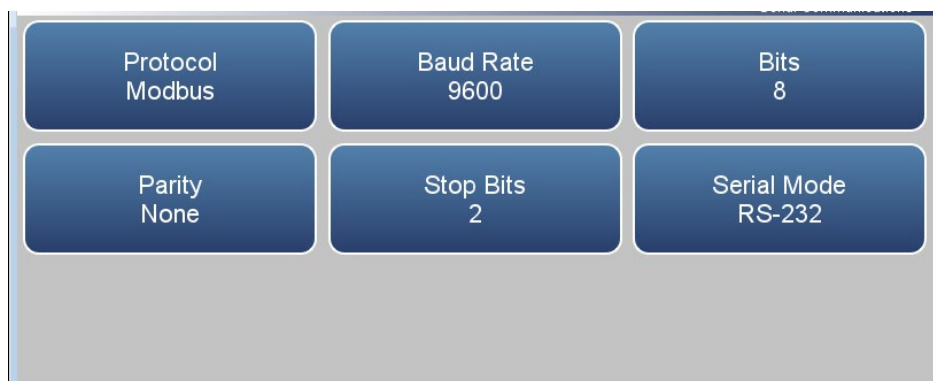
- *DHCP*: Toggles DHCP enabled/disabled.
- *Dynamic IP Address*: Dynamic IP address of the instrument.
- *Dynamic Netmask*: Dynamic Netmask of instrument.
- *Dynamic Gateway*: Dynamic Gateway of instrument.

- *Static IP Address:* Static IP address of the instrument. This is settable when DHCP is disabled.
- *Static Netmask:* Static Netmask of instrument. This is settable when DHCP is disabled.
- *Static Gateway:* Static Gateway of instrument. This is settable when DHCP is disabled.
- *Static DNS Server 1:* Static DNS server 1 of instrument. This is settable when DHCP is disabled.
- *Static DNS Server 2:* Static DNS server 2 of instrument. This is settable when DHCP is disabled.
- *Wired MAC Address:* Instrument MAC address.
- *Host Name:* Host name of instrument.
- *Commit:* Commits the new network configuration.

### Serial RS-232/485

The Serial RS-232/485 screen allows the user to setup serial communication. This is only visible if selected in Settings>Configuration>**Communications Board**.

**Home Screen>Settings>More>Communications>Serial RS-232/485**



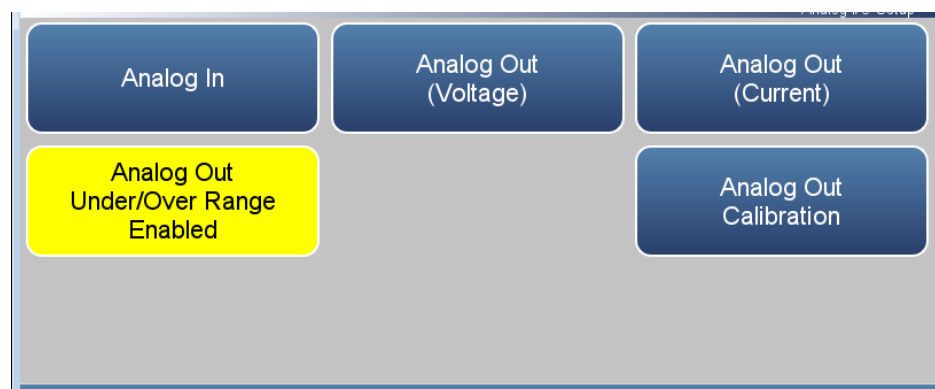
The Serial RS-232/485 screen contains the following information:

- *Protocol*: User selects Modbus or Streaming.
- *Baud Rate*: User selectable baud rates from 1200 to 115200.
- *Bits*: User selectable between 7 and 8.
- *Parity*: User selectable between None, Even, and Odd.
- *Stop Bits*: User selectable between 1 and 2.
- *RS 232/485*: User selectable between RS-232 and RS-485.

## Analog I/O

The Analog I/O screen allows for configuring the analog inputs/outputs. This is only visible if selected in Settings>Configuration>**Analog I/O**.

**Home Screen>Settings>More>Communications>Analog I/O**



The Analog I/O screen contains the following information:

- *Analog In*: Allows the user to view and calibrate voltage inputs from external devices.
- *Analog Out (Voltage)*: Allows the user to view voltage outputs.
- *Analog Out (Current)*: Allows the user to view current (mA) outputs.
- *Analog Out Under/Over Range Enabled/Disabled*: Allows the user to select whether or not the analog outputs are allowed to exceed the selected output range.
- *Analog Out Calibration*: Allows the user to calibrate the analog out voltage and current to account for varying loads attached to the terminals.

## Digital I/O

The Digital I/O screen allows for configuring the digital inputs/outputs. This is only visible if selected in Settings>Configuration>**Digital I/O**.

**Home Screen>Settings>Communications>Digital I/O**



The Digital I/O screen contains the following information:

- *Digital In*: Allows the user to view digital inputs from external devices.
- *Digital Out (Relays)*: Allows the user to view relay outputs.
- *Digital Out (Solenoids)*: Allows the user to view solenoid outputs.
- *Advanced Digital I/O*: Allows user to test the digital out relays and solenoids.



## Email Server (SMTP)

The Email Server (SMTP) screen allows the user to configure their email preferences.

**Home Screen>Settings>More>Communications>Email Server (SMTP)**

SMTP Server Address smtprelay1.therm...	From Email Address larry.ferreira@t...	SMTP Server Port 25
Email Password	Email UserName monil.jhaveri@th...	

The Email Server (SMTP) screen contains the following information:

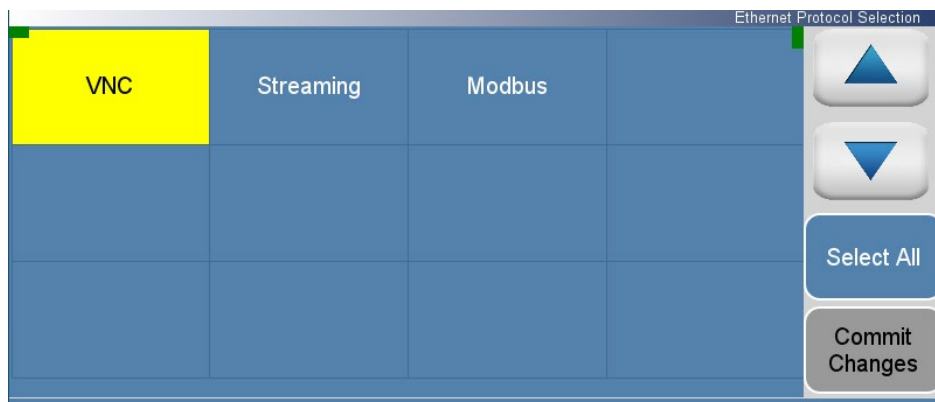
- *SMTP Server Address:* Address of the user's email server.
- *From Email Address:* The email address that goes in the From field in emails.
- *SMTP Server Port:* Server port of user's email server.
- *Email Password:* Password for SMTP server.
- *Email UserName:* User name that is authorized to send email through SMTP server.

## Ethernet Protocol Selection

The Ethernet Protocol Selection screen allows the user to select the enable VNC, Streaming or Modbus to utilize the mobile app and/or those communication protocols.

Press **Commit changes** button to save selections. Yellow buttons indicate that the selection is enabled. More than one can be chosen.

**Home Screen>Settings>Communications>Ethernet Protocol Selection**



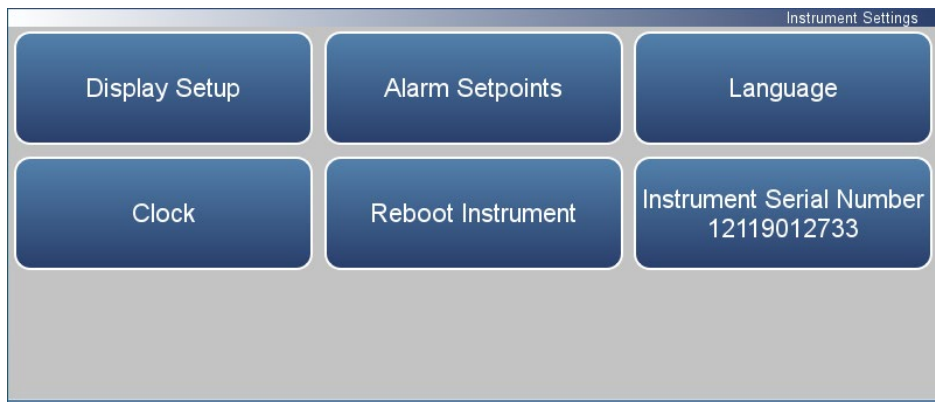
The Ethernet Protocol Selection screen contains the following information:

- VNC
- Streaming
- Modbus

## Instrument Settings

The Instrument Settings screen allows the user to configure various instrument settings.

**Home Screen>Settings>More>Instrument Settings**



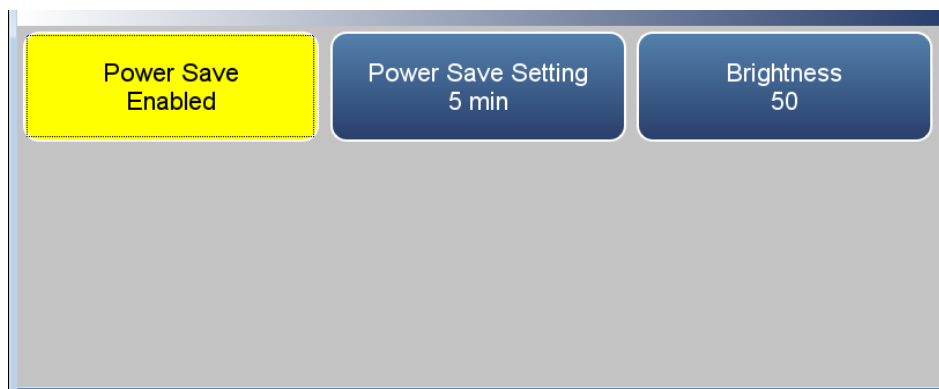
The Instrument Settings screen contains the following information:

- *Display Setup*: Sets touch screen display settings.
- *Alarm Setpoints*: View and set all available alarm minimum and maximum values.
- *Language*: Sets language.
- *Clock*: Sets date and time.
- *Reboot Instrument*: Reboots the instrument.
- *Instrument Serial Number*: Allows the user to change the instrument serial number.

## Display Setup

The Display Setup allows the user to change the brightness of the display and choose power save option.

**Home Screen>Settings>More>Instrument Settings>Display Setup**



The Display Setup screen contains the following information:

- *Power Save*: Minutes before screen times out. Toggles enable/disable.
- *Power Save Setting*: Option whereby the user can display a black screen after a set amount of inactivity.
- *Brightness*: Sets the brightness of the display.

## Alarm Set Points

The Alarm Setpoints screen allows the user to view and set all settable alarm minimum and maximum values. Alarm setpoints can also be set in Settings>Health Check>Status and Alarms screens.

**Note** User cannot set alarm limits outside of the acceptable range. The minimum and maximum alarm limit can also be set by pressing on the corresponding buttons located in the Settings>Health Check>Status and Alarms screen. See “[Status and Alarms](#)” on page 3-40. ▲

Use the ▲ and ▼ buttons to move up and down and the ◀ and ▶ buttons to move left and right.

**Home Screen>Settings>More>Instrument Settings>Alarm Setpoints**

Item	Value	Low Alarm	High Alarm	Units	
Photometer Bench Temperature	34.55	15.000	40.000	°C	▲
Photometer Flow	0.78	0.400	1.600	L/min	▼
Photometer Pressure	763.42	200.000	1000.000	mmHg	◀
Photometer Cell Intensity	96784.00	4500.00	150000.00	Hz	▶
Photometer Lamp Temperature	59.83	55.00	65.00	°C	
Photometer Lamp Current	7.38	6.00	8.00	mA	

The Alarm Setpoints screen contains the following information:

- Across:
  - *Item*: Lists the items that have settable alarm limits.
  - *Value*: Displays the current value for each item.
  - *Low Alarm*: User sets low alarm for item.
  - *High Alarm*: User sets high alarm for item.
  - *Units*: Units for each item (not settable).
- Down:
  - *Photometer Bench Temperature*: Photometer bench temperature.
  - *Photometer Flow*: Photometer flow alarm.
  - *Photometer Pressure*: Photometer pressure alarm.
  - *Photometer Cell Intensity*: Photometer cell intensity alarm.

- *Photometer Lamp Temp*: Photometer lamp temperature alarm.
- *Photometer Lamp Current*: Photometer lamp current alarm.
- *Ozonator Lamp Temperature*: Ozonator lamp temperature alarm
- *Perm Oven Temp Setpoint*: Permeation oven temperature setpoint alarm.
- *Instrument Temperature*: Instrument temperature alarm.

**Language** The Language screen allows the user to choose from the following languages.

**Home Screen>Settings>Instrument Settings>Language**

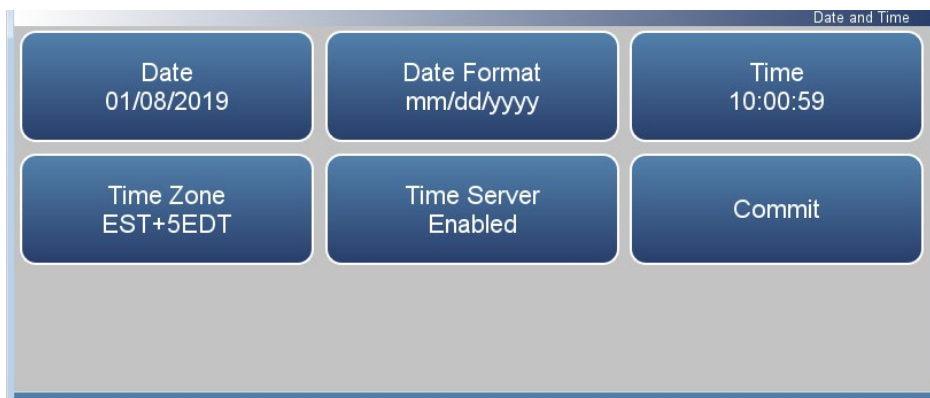


The Language screen contains the following information:

- English
- Chinese

**Clock** The Clock screen allows the user to set the instrument's date and time, choose date/time format, time zone, and time server.

**Home Screen>Settings>Instrument Settings>Clock**



Date and Time		
Date 01/08/2019	Date Format mm/dd/yyyy	Time 10:00:59
Time Zone EST+5EDT	Time Server Enabled	Commit

The Clock screen contains the following information:

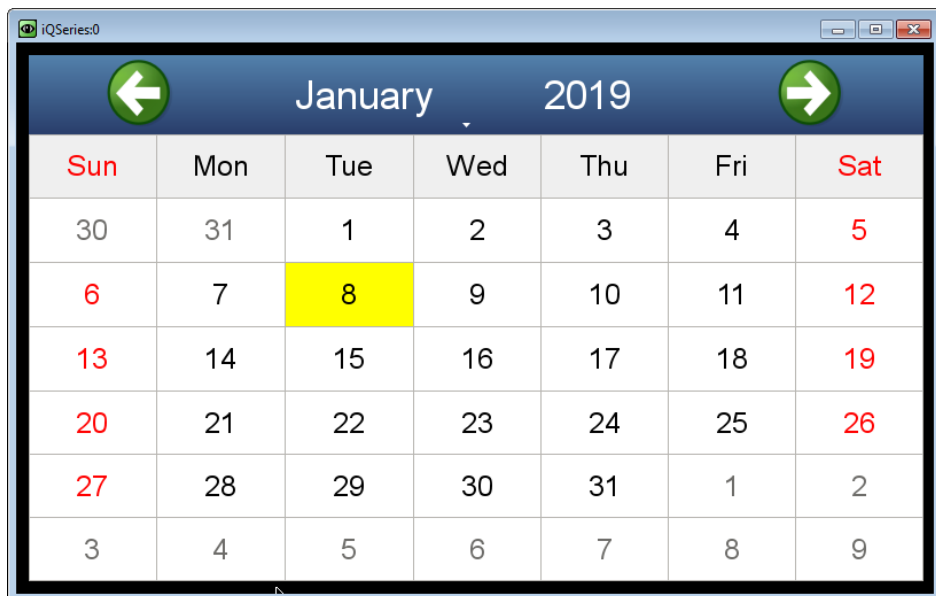
- *Date*: User sets date.
- *Date Format*: User selects date format.
- *Time*: User sets time.
- *Time Zone*: User chooses time zone.
- *Time Server*: User can enable/disable the time server to get periodic clock updates.
- *Commit*: When pressed, clock settings are saved.



**Date** The Date screen allows the user to choose date.

Use the ◀ and ▶ buttons to move left and right to select month and year.

**Home Screen>Settings>Instrument Settings>Clock>Date**

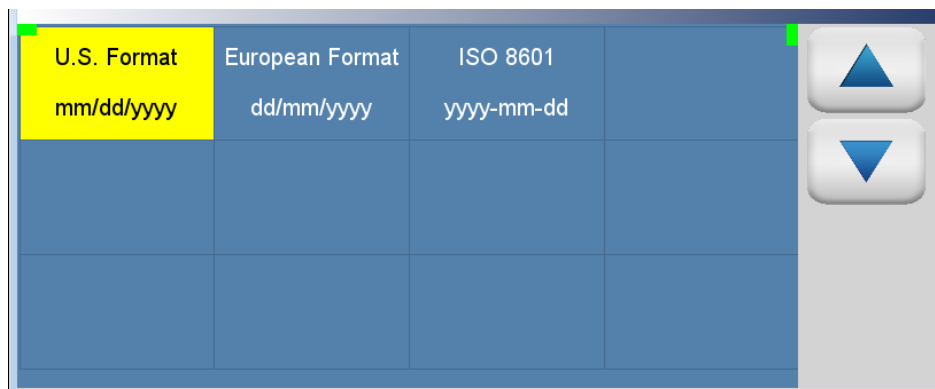


## Date Format

The Date Format screen allows the user to choose from the following formats: mm/dd/yyyy or dd/mm/yyyy.

Use the ▲ and ▼ buttons to select.

**Home Screen>Settings>Instrument Settings>Clock>Date Format**



The Date Format screen contains the following information:

- U.S. Format mm/dd/yyyy
- European Format dd/mm/yyyy
- ISO 8601 yyyy-mm-dd

**Time** The Time screen allows the user to choose from the following formats:  
mm/dd/yyyy or dd/mm/yyyy.

Use the ▲ and ▼ buttons to select.

**Home Screen>Settings>Instrument Settings>Clock>Time**



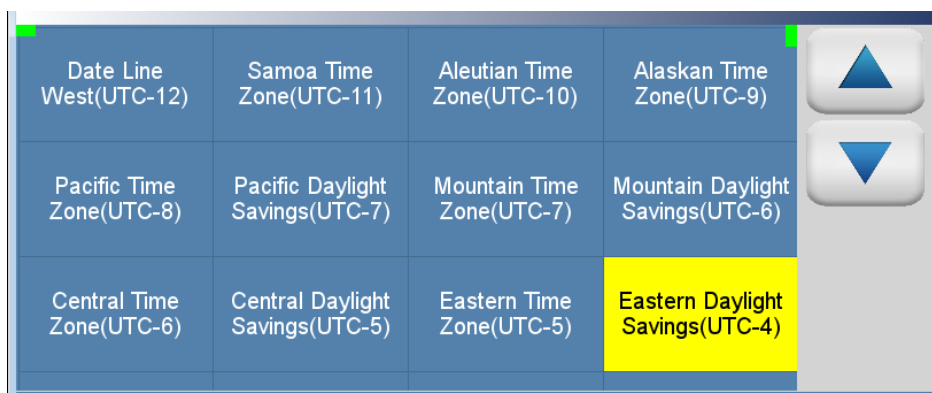
The Time screen contains the following information:

- Hours
- Minutes
- Seconds

**Time Zone** The Time Zone screen allows the user to set the time zone for the Network Time Protocol (NTP) server. This should be set to the time zone that the instrument is located in.

Use the ▲ and ▼ buttons to select.

**Home Screen>Settings>Instrument Settings>Clock>Time Zone**



The Time Zone screen contains the following information:

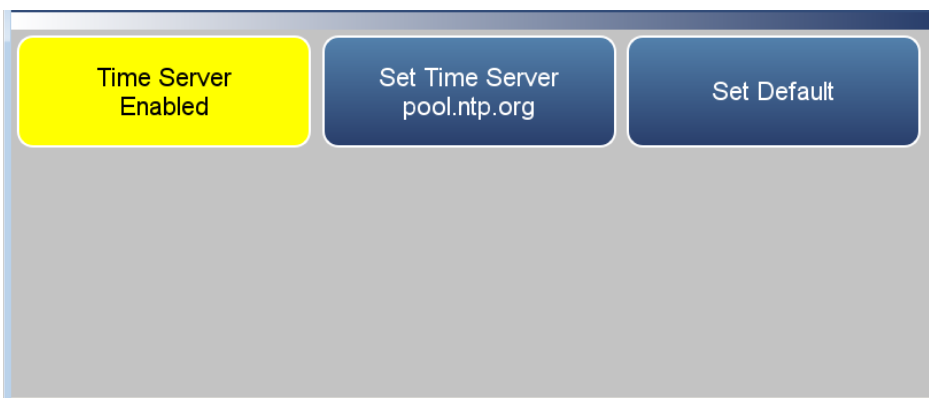
- Date Line West(UTC-12)
- Samoa Time Zone(UTC-11)
- Aleutian Time Zone(UTC-10)
- Alaskan Time Zone(UTC-9)
- Pacific Time Zone(UTC-8)
- Pacific Daylight Savings(UTC-7)
- Mountain Time Zone(UTC-7)
- Mountain Daylight Savings(UTC-6)
- Central Time Zone(UTC-6)
- Central Daylight Savings((UTC-5)
- Eastern Time Zone(UTC-5)
- Eastern Daylight Savings(UTC-4)
- Atlantic Time Zone(UTC-4)
- Mid-Atlantic(UTC-3)
- South Georgia(UTC-2)
- Cape Verde Time(UTC-1)

- Coordinated Universal Time(UTC-0)
- Central European Time(UTC+1)
- Eastern European Time(UTC+2)
- Further-Eastern European Time(UTC+3)
- Gulf Standard Time(UTC+4)
- Yekaterinburg Time(UTC+5)
- Omsk Time(UTC+6)
- Indochina Time(UTC+7)
- ASEAN Common Time(UTC+8)
- Japan Standard Time(UTC+9)
- Chamorro Time Zone(UTC+10)
- Sredmnekolymsk Time(UTC+11)
- New Zealand Standard Time(UTC+12)

## Time Server

The Time Server screen allows the user to enable/disable the time server to get periodic clock updates.

**Home Screen>Settings>Instrument Settings>Clock>Time Server**



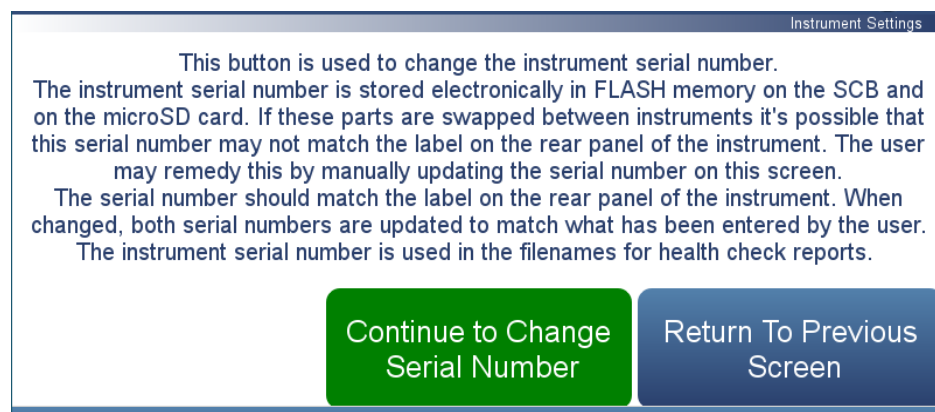
The Time Server screen contains the following information:

- *Time Server*: Enables/Disables periodic clock updates from an NTP (Network Time Protocol) source.
- *Set Time Server*: User can choose specific time server.
- *Set Default*: When pressed, default time server will be used.

## Instrument Serial Number

The Instrument Serial Number screen allows the user to change the instrument serial number.

**Home Screen>Settings>Instrument Settings>More>Instrument Serial Number**



The Instrument Serial Number screen contains the following information:

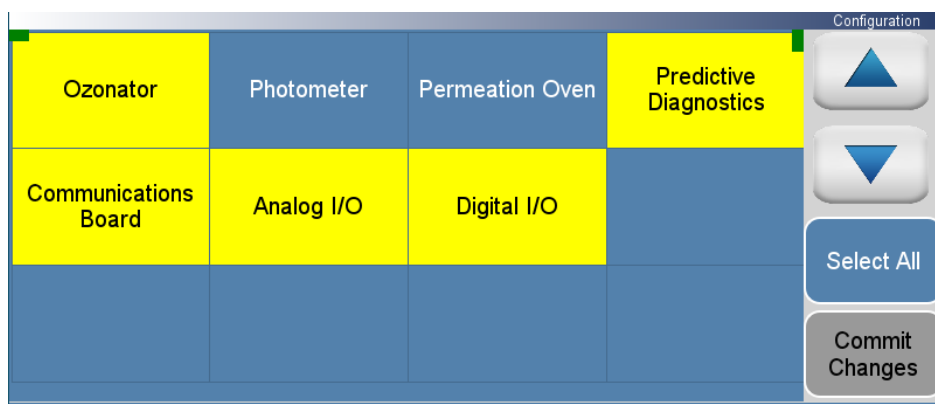
- *Continue to Change Serial Number*: Proceeds to the keypad to enter serial number.
- *Return to Previous Screen*: Returns to the previous screen.

## Configuration

The Configuration screen allows the user to enable optional features. If an option is disabled, the corresponding buttons will be grayed out and the screens will not be available.

Use the ▲ and ▼ buttons to scroll through the variables. Select the variables to log by pressing the corresponding cells. Next, press the **Commit Changes** button to save selections. Yellow buttons indicate that the variable is selected.

**Home Screen>Settings>More>Configuration**



The Configuration screen contains the following information:

- *Ozonator*: Enables ozonator option.
- *Photometer*: Enables photometer option.
- *Permeation Oven*: Enables permeation oven option.
- *Predictive Diagnostics*: Enables predictive diagnostics option.
- *Communications Board*: Enables RS-232 or RS-485 communication board option.
- *Analog I/O*: Enables analog I/O option.
- *Digital I/O*: Enables digital I/O option.



## Security Access Levels

The Access Levels screen allows the user to set the instrument to either View Only or Full Access. When in Full Access, the user will have access to all screens. When set to View Only, user will not be able to change any values.

### Home Screen>Settings>More>Security Access Levels (Full Access)



### Home Screen>Settings>More>Security Access Levels (View Only Access)



The Security Access Levels screen contains the following information:

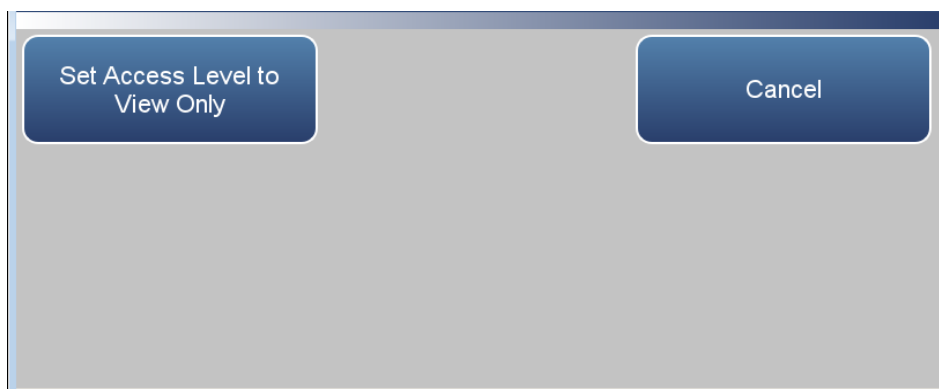
- *Current Security Access Full Access:* Read only. User will be able to change all values. Password is needed for full access.
- *Current Security Access View Only:* Read only. User won't be able to change any values. Password is not needed for view only.
- *Change Security Access to View Only:* User can switch to view only mode. Password not needed to change settings to view only access.
- *Change Security Access to Full Access:* User can switch to full access mode. Password is needed to change settings to full access.

- *Change Full Access Security Password:* Full access password can have a blank value or user selected password.
- *Change Instrument Password:* User can change instrument password.
- *Reset Instrument Password:* User can reset the instrument password.

## Change Security to View Only Access

The Change Security to View Only Access screen allows the user to set the instrument to view only.

**Home Screen>Settings>More>Security Access Levels>Change Security Access to View Only Access**



The Change Security to View Only Access screen contains the following information:

- *Set Access Level to View Only*: Programs the instrument to be in the view only access level, where the user won't be able to change any values.
- *Cancel*: Exit screen.

**Note** To change security access from view only access to full access, a keypad will be displayed where the user can enter full access password. ▲

## Change Full Access Security Password

The Change Full Access Security Password screen allows the user to set a new password for allowing full access.

**Home Screen>Settings>More>Security Access Levels>Change Full Access Security Password**

To Change the Security Access Password perform the following steps using the graphical user interface only (do not use an external USB keyboard):

1. Enter the Current Security Access Password
2. Enter the New Security Access Password
3. Confirm the New Security Access Password
4. Commit the New Security Access Password Change

Note: To clear the Full Access Password, follow the steps above using blank values for the New Password.

**Continue** **Cancel and Return to the Home Screen**

**Home Screen>Settings>More>Security Access Levels>Change Full Access Security Password>Continue**

Security Access Levels

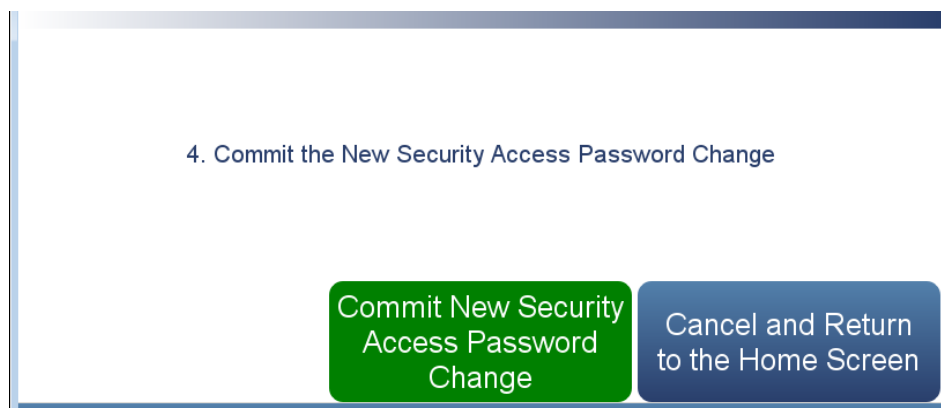
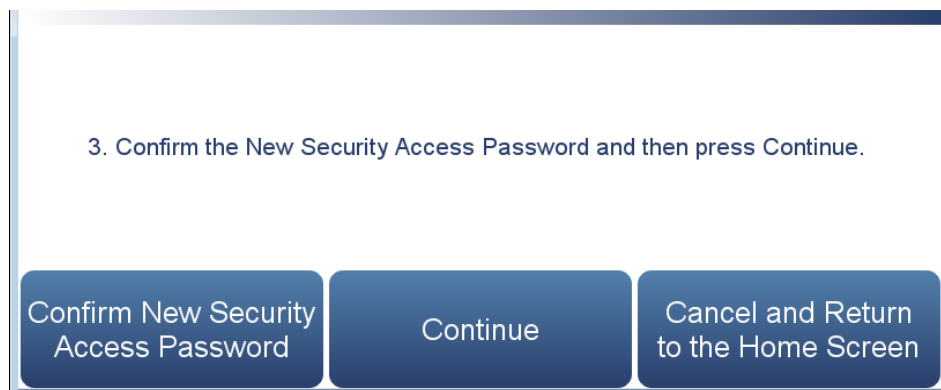
1. Enter the Current Security Access Password and then press Continue.  
If there is no Current Full Access Password then press Continue.

**Enter Current Security Access Password** **Continue** **Cancel and Return to the Home Screen**

Security Access Levels

2. Enter the New Security Access Password and then press Continue.

**Set New Security Access Password** **Continue** **Cancel and Return to the Home Screen**



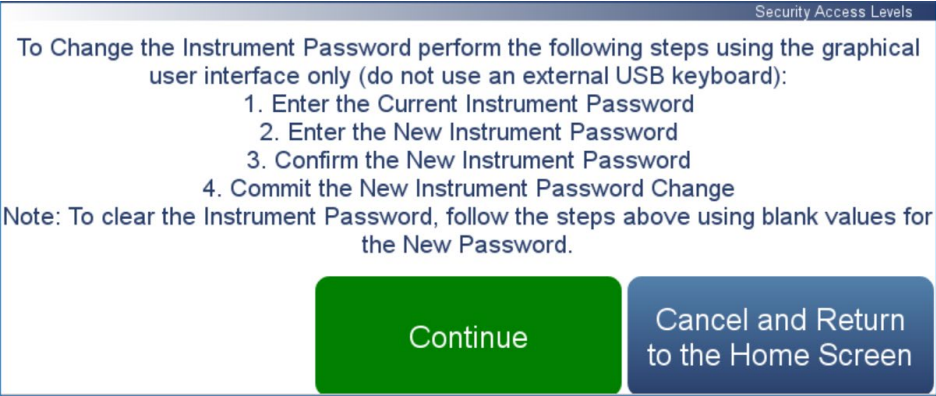
The Change Full Access Security Password screens contain the following information:

- *Enter Current Security Password:* User enters current security password.
- *Continue:* Proceeds to next screen.
- *Enter New Security Access Password:* User enters new security password.
- *Confirm New Security Access Password:* User confirms new security password for spelling confirmation.
- *Commit New Security Access Password Change:* Commits new security password.
- *Cancel and Return to the Home Screen:* Exits screen and returns to the Home Screen without changing password.

## Change Instrument Password

The Change Instrument Password screen allows the user to change the instrument password.

**Home Screen>Settings>More>Security Access Levels>Change Instrument Password**



Security Access Levels

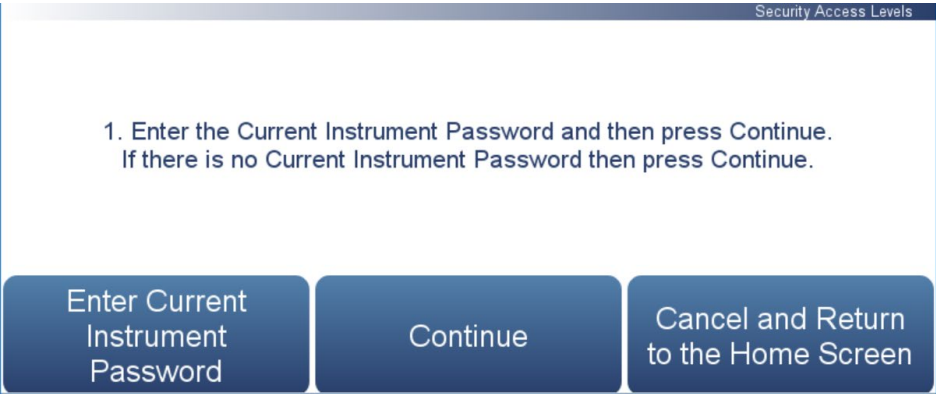
To Change the Instrument Password perform the following steps using the graphical user interface only (do not use an external USB keyboard):

1. Enter the Current Instrument Password
2. Enter the New Instrument Password
3. Confirm the New Instrument Password
4. Commit the New Instrument Password Change

Note: To clear the Instrument Password, follow the steps above using blank values for the New Password.

**Continue** **Cancel and Return to the Home Screen**

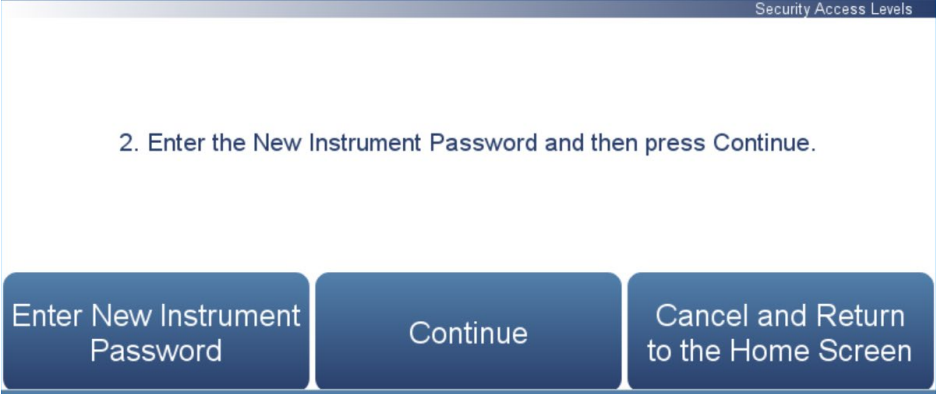
**Home Screen>Settings>More>Security Access Levels>Change Instrument Password>Continue**



Security Access Levels

1. Enter the Current Instrument Password and then press Continue.  
If there is no Current Instrument Password then press Continue.

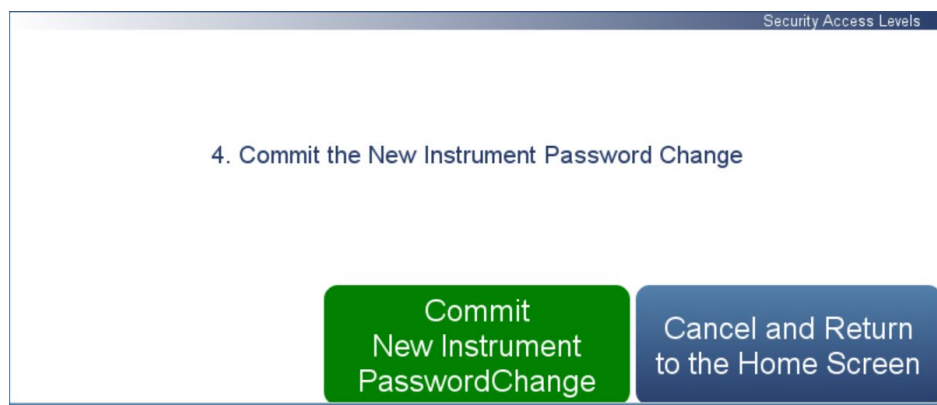
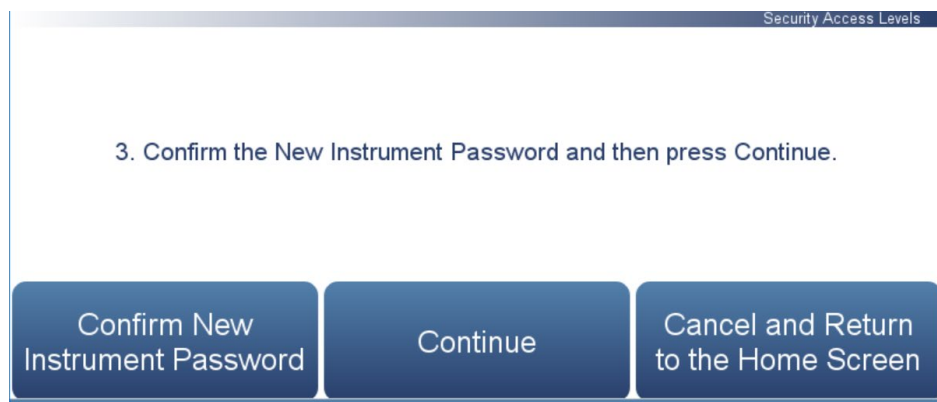
**Enter Current Instrument Password** **Continue** **Cancel and Return to the Home Screen**



Security Access Levels

2. Enter the New Instrument Password and then press Continue.

**Enter New Instrument Password** **Continue** **Cancel and Return to the Home Screen**



The Change Instrument Password screen contains the following information:

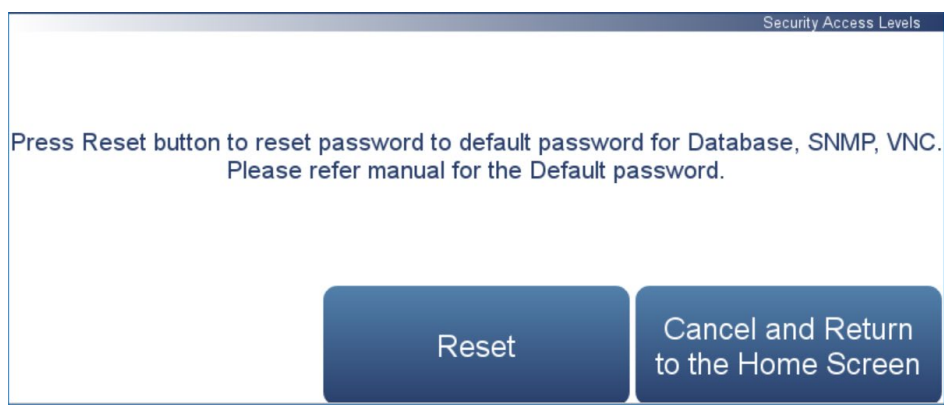
- *Enter Current Instrument Password:* User enters current instrument password.
- *Continue:* Proceeds to next screen.
- *Enter New Instrument Password:* User enters new instrument password.
- *Confirm New Instrument Password:* User confirms new instrument password for spelling confirmation.
- *Commit New Instrument Password Change:* Commits new instrument password.
- *Cancel and Return to the Home Screen:* Exits screen and returns to the Home Screen without changing password.

## Reset Instrument Password

The Reset Instrument Password screen allows the user to reset the instrument password for Database, SNMP, and VNC.

The default instrument password format is an alternating combination of instrument serial number and installed firmware build number. For example if your instrument serial number is 123456789 and the instrument firmware version is 1.6.8.ABCDE where the last five digits are the build number, then the default instrument password number will be 1A2B3C4D5E6789.

**Home Screen>Settings>More>Security Access Levels>Reset Instrument Password**



The Reset Instrument Password screen contains the following information:

- *Reset:* Allows the user to reset the instrument password.
- *Cancel and Return to the Home Screen:* Exits screen and returns to the Home Screen without changing password.



## USB Drive

The USB Drive screen allows the user to update firmware, download/upload information, change/reset the USB password, unmount USB drive, and restore configuration files.

**Note** The USB drive screen is only useable when a USB drive is inserted into the USB port. When a USB drive is inserted, the user is prompted to enter the password if a password has been set. Only one USB memory device can be connected to the instrument at a time. ▲

### Home Screen>Settings>USB Drive



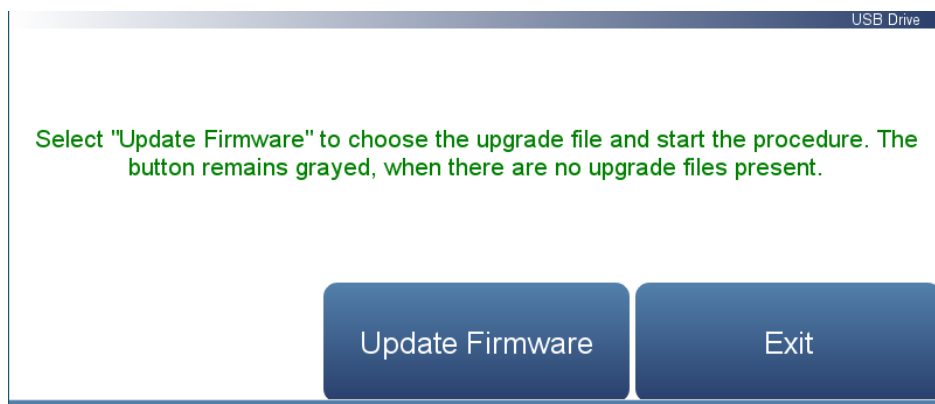
The USB Drive screen contains the following information:

- *Firmware Update Via USB Drive:* If USB is mounted, user can update instrument firmware.
- *Download Data To USB Drive:* User can download/upload information.
- *Change USB Password:* User can change the USB password.
- *Reset USB Password:* User can reset the USB password.
- *Unmount USB Drive:* User can safely unmount the USB drive.
- *Restore:* Allows the user to upload the configuration files from the USB to the instrument.

## Firmware Update Via USB Drive

The Firmware Update Via USB Drive screen allows the user to update instrument firmware from the USB drive.

**Home Screen>Settings>More>USB Drive>Firmware Update Via USB Drive**



The Firmware Update Via USB Drive screen contains the following information:

- *Update Firmware:* User chooses firmware file from USB and updates instrument firmware. Instrument reboots when update is finished.
- *Exit:* User exits without updating firmware.

Use the following procedure to update firmware using the USB connection.

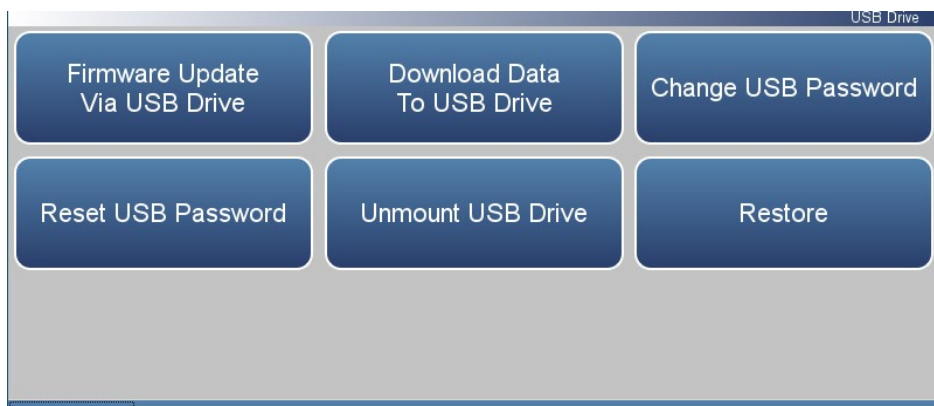
1. Copy the update\*.zip file onto the USB FLASH drive using Windows Explorer or another means. The file must be copied into the root directory of the USB stick's file system otherwise it won't be recognized. Also, make sure the USB stick is formatted using the FAT or FAT32 file system.
2. Plug a USB flash drive into the data port on the front panel of the unit or into one of the USB ports on the side near the power cable. A pop-up box will appear, acknowledging that a flash drive has been detected. If a USB password has been previously set, you will be prompted to enter the USB password to continue. Press **Enter** to continue.



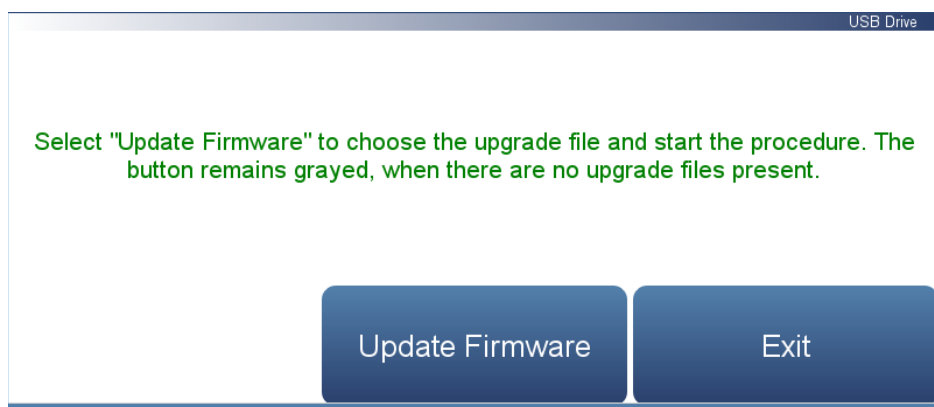
3. Press the OK button on the pop-up box to go to the Firmware Update Via USB Drive screen.



4. Press the **Firmware Update Via USB Drive** button to start the firmware update process.



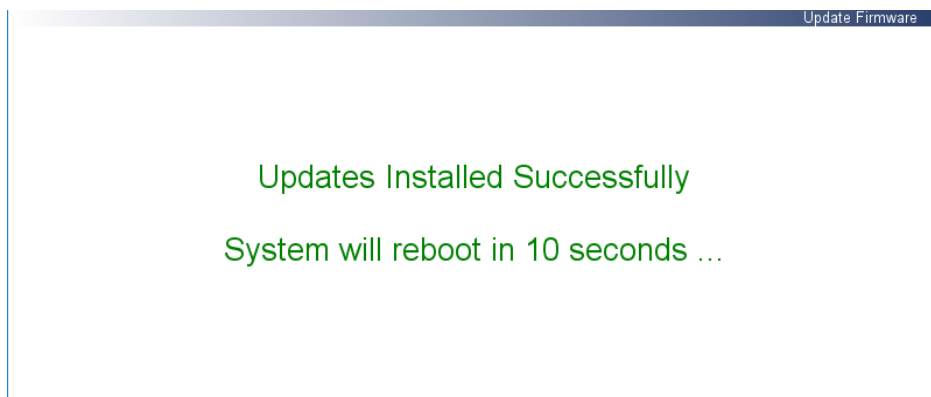
5. Press the **Update Firmware** button.



6. The on-screen instructions will prompt the user to select the firmware update file and display what it is doing at each step and some steps may take several minutes to complete.
7. Press **Yes** to confirm and proceed with the firmware upgrade.

**Note** Do not power off the instrument while the firmware update is in progress. ▲

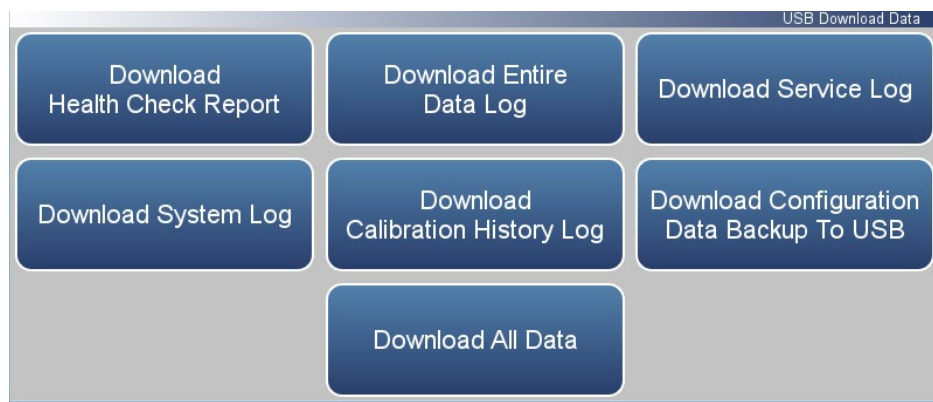
8. The instrument should reboot automatically and should have the new firmware installed. To check that the firmware was installed, go to the **Settings>Health Check** screen and view the Firmware Version button.



## Download Data To USB Drive

The Download Data To USB Drive screen allows the user to download/upload data to/from the USB drive.

**Home Screen>Settings>More>USB Drive>Download Data To USB Drive**



The Download Data to USB Drive screen contains the following information:

- *Download Health Check Report:* Includes status and alarms, preventive maintenance, and maintenance history.
- *Download Entire Data Log:* Includes the entire data log (from data logging).
- *Download Service Log:* Includes a complete listing of data for all variables. This is set at the factory.
- *Download System Log:* Consists of system log text files, which include a listing of system errors.
- *Download Calibration History:* Includes the data in the calibration history screen.
- *Download Configuration Data Backup to USB:* Allows the user to download the configuration file from the instrument to the USB.
- *Upload Configuration Data Restore from USB:* Allows the user to upload the configuration files from the USB to the instrument.
- *Download All Data:* Downloads all reports, logs, histories, and backup information.

Use the following procedure to download data using the USB connection.

1. Plug a USB flash drive into the USB connection on the front of the instrument. If a USB password has been previously set, you will be prompted to enter the USB password to continue. Press **Enter** to continue.



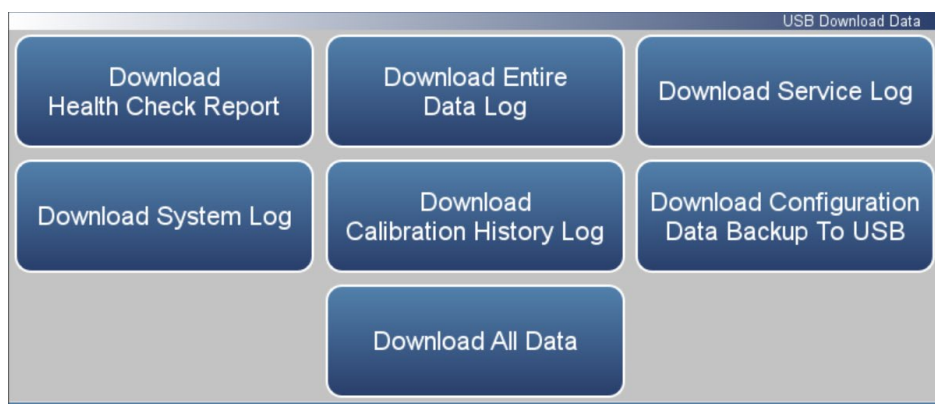
2. To continue, select the **OK** button.



3. The USB Drive will display. Select **Download Data To USB Drive**.



4. The Download Data to USB Drive screen will display. Select from various options to download.



5. The instrument will display a “downloading data” message and begin transferring data to the USB drive.

**Note** Do not remove the USB drive from the instrument while the data is downloading. ▲

6. When the data download is complete, the instrument will display a “Success!” message and display the file name as it is stored on the USB flash drive. (The file name format is the instrument serial number, name of download, followed by a date/time stamp.) Remove the USB flash drive and select the OK button to continue.



## Change USB Password

The Change USB Password screen allows the user to set a new password for accessing USB.

**Home Screen>Settings>More>USB Drive>Change USB Password**

To Change the USB Access Password perform the following steps using the graphical user interface only (do not use an external USB keyboard):

1. Enter the Current USB Access Password
2. Enter the New USB Access Password
3. Confirm the New USB Access Password
4. Commit the USB Access Password Change

Note: To clear the USB Password, follow the steps above using blank values for the New Password.

Continue

Cancel and Return to the Home Screen

**Home Screen>Settings>More>USB Drive>Change USB Password>Continue**

1. Enter the Current USB Access Password and then press Continue.  
If there is no Current USB Password then press Continue.

Enter Current USB Password

Continue

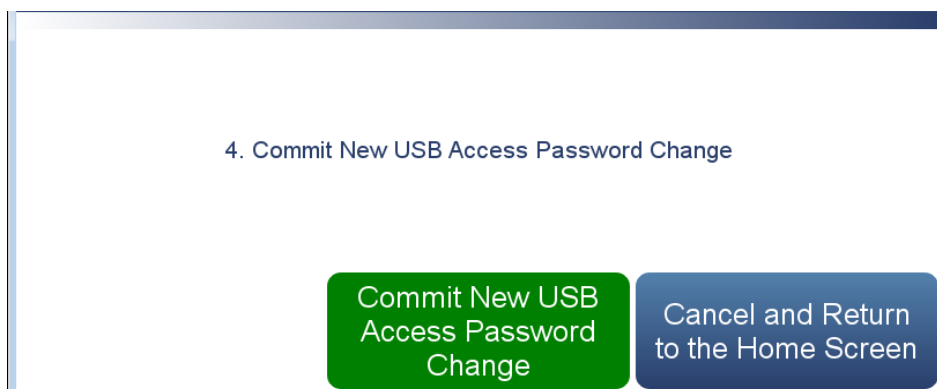
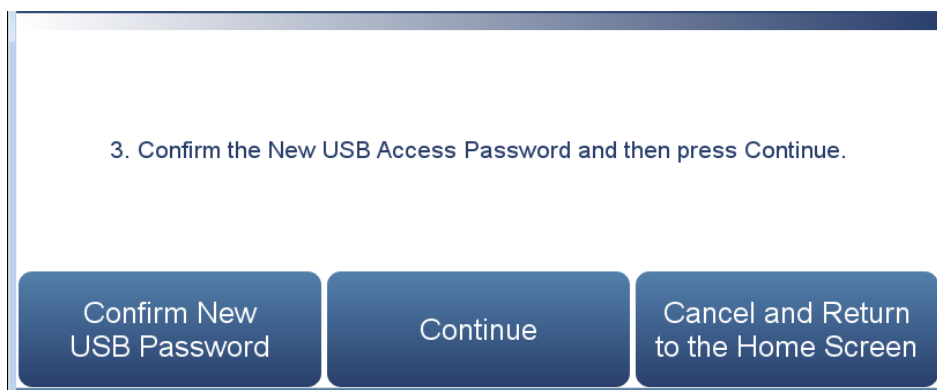
Cancel and Return to the Home Screen

2. Enter the New USB Access Password and then press Continue.

Enter New USB Password

Continue

Cancel and Return to the Home Screen



The Change USB Password screens contain the following information:

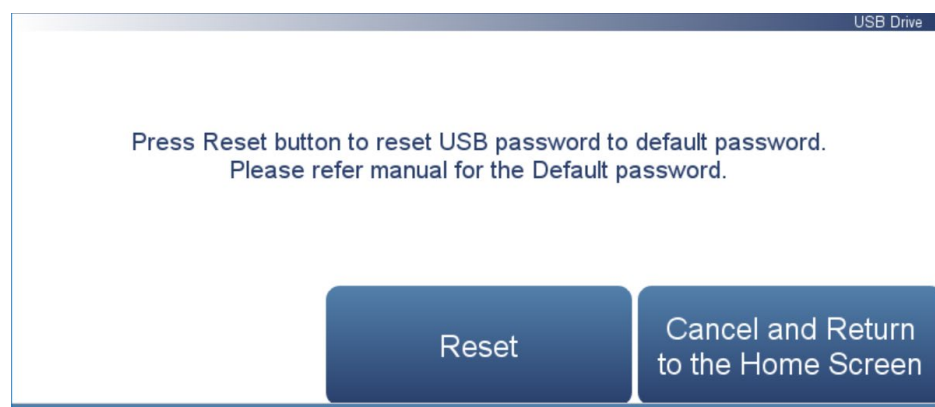
- *Enter Current USB Password:* User enters current USB password.
- *Continue:* Proceeds to next screen.
- *Enter New USB Password:* User enters new USB password.
- *Confirm New Security Access Password:* User confirms new security password for spelling confirmation.
- *Commit New USB Password Change:* Commits new USB password.
- *Cancel and Return to the Home Screen:* Exits screen and returns to the Home Screen without changing password.

## Reset USB Password

The Reset USB Password screen allows the user to reset the USB password.

The default USB password format is an alternating combination of instrument serial number and installed firmware build number. For example if your instrument serial number is 123456789 and the instrument firmware version is 1.6.8.ABCDE where the last five digits are the build number, then the default USB password number will be 1A2B3C4D5E6789.

**Home Screen>Settings>More>Security Access Levels>Reset USB Password**



The Reset USB Password screen contains the following information:

- *Reset*: Allows the user to reset the USB password.
- *Cancel and Return to the Home Screen*: Exits screen and returns to the Home Screen without changing password.

**Restore** The Restore screen gives the user the option to upload configuration, calibration history and maintenance history files from the USB to the instrument.

**Home Screen>Settings>Security Access Levels>Restore**



The Restore screen contains the following information:

- *Restore Configuration Data:* Allows the user to restore the instrument configuration.
- *Restore Calibration History Data:* Allows the user to restore calibration history.
- *Restore Maintenance History From Health Check Data:* Allows the user to restore maintenance history.

## User Contact Information

The User Contact Information screen allows the user to enter their contact information. This is useful when contacting technical support through emails found at the screen Health Check>File Sharing and Support.

**Home Screen>Settings>More>User Contact Information**

Description	User Information	
Business Name		▲
User Name		▼
Alternate User Name		◀
User ID		▶
Business Address		
Business Shipping Address		

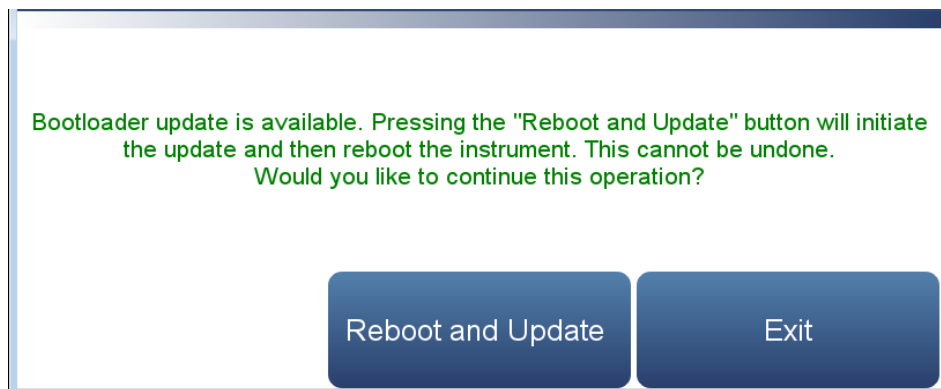
The User Contact Information screen contains the following information:

- Business Name
- User Name
- Alternate User Name
- User ID
- Business Address
- Business Shipping Address
- To: User Email Address
- CC: User Email Address 1–10
- User Phone Number
- Alternate User Phone Number
- Shelter / Lab Phone Number

## Update Bootloader

The Update Bootloader screen allows the user to update bootloader and reboot the instrument. The bootloader is a small program that interfaces with our hardware and runs our operating system on power-up. The bootloader may change to optimize hardware settings or if there are changes to the hardware. If the button is blue, an update to the bootloader is available. If button is greyed out, no update is needed.

**Home Screen>Settings>More>Update Bootloader**



The Update Bootloader screen contains the following information:

- *Reboot and Update*: Update bootloader and reboot instrument.
- *Exit*: Exits screen.

## Chapter 4

# Calibration

Regular verification of the performance of, and if necessary, calibration of the various modules of the multi-gas calibrator is recommended in order to achieve optimal performance of the instrument. These various modules of the 146iQ are as follows:

- **Mass Flow Controllers (MFCs):** Achieving accuracy of calibration source gas mixtures is dependent largely on the accuracy of the various mass flow controllers (Zero and Gas) used to generate them from bottled gases. The 146iQ provides a set of inherently linear mass flow controllers, operating on the principle of Multiple Parameter Laminar Flow measurement, that are ideal for this task. The accuracy of their output should be periodically verified, and if necessary, adjusted.
- **Ozone Generator Calibration:** If the 146iQ is equipped with the optional ozone generator, its output should be periodically calibrated.
- **Photometer Calibration:** If the 146iQ is equipped with the optional photometer, its performance should be periodically verified, and if necessary, adjusted against an external transfer standard.

### Calibration of the individual MFC outputs

The inherent linearity of the MFCs result in a more accurate and more predictable device due to the device's tendency to naturally follow the pre-defined calibration curve. Additionally, the superfluousness of the need to "linearize" output over the entire measurement range of the MFC implies that the calibration can be customized to include anywhere between 2-7 calibration points, ideally spread out uniformly over the measurement range. In order to calibrate the individual MFC outputs, properly calibrated NIST traceable flow meters with the right measurement ranges are required. The following step-by step procedure should be adhered to, for each MFC, to ensure the most accurate mix gas output during normal operation.

1. Connect a source of appropriately pressurized (20–40 psi) clean, dry air to the ZERO AIR IN port on the rear panel of the instrument.
2. Connect an appropriate flow meter to the outlet of the MFC being calibrated.

## Calibration

Calibration of the individual MFC outputs

- From the Home Screen, press Calibration>**MFC Calibration** to see the screen as below:

	Full Scale (sccm)	Calibration	Cal Status	Reset Coefficients	
Zero MFC	10000.0	Zero MFC Points	Ok	Reset Zero MFC	▲
Gas 1 MFC	100.0	Gas 1 MFC Points	Ok	Reset Gas 1 MFC	▼
Gas 2 MFC	1000.0	Gas 2 MFC Points	Ok	Reset Gas 2 MFC	◀
Cal Temp (C)	25.0				
Cal Pres (mmHg)	760.0				▶

- Choose the calibration temperature and pressure (this should reflect what the flow meter is using, standard or volumetric).
- If using measured, enter the barometric pressure and ambient temperature as measured by the flow meter or appropriate device under the user defined temperature and pressure buttons after disabling the 'Standard Temp and Pressure' option, as shown below:

Standard Temp and Pressure Disabled	User Defined Temperature 25.0 °C	User Defined Pressure 760.0 mmHg
---	--	--

- Choose the MFC to be calibrated under the 'Calibration' column, as described in the "[Operation](#)" Chapter, and continue to the MFC calibration to see the screen below:



Zero MFC	% Full Scale	Target (sccm)	Calculated (sccm)	Enter Measured (ccm)	
Point 1	5	500.0	0.0	0.0	▲
Point 2	20	2000.0	0.0	0.0	▼
Point 3	35	3500.0	0.0	0.0	◀
Point 4	50	5000.0	0.0	0.0	▶
Point 5	65	6500.0	0.0	0.0	
Point 6	80	8000.0	0.0	0.0	

- As alluded to earlier, a calibration of 2-7 points can be accomplished by pressing the corresponding entry for the point on the 'Enter Measured (ccm)' column. It is recommended to ideally start from the highest desired flow controller set point and move toward the lowest. After entering the screen corresponding to the desired point, as shown below, allow sufficient time for the flow meter reading to stabilize. It is also recommended to apply averaging to the flow meter reading, if available, to obtain the best possible reading.

Enter Measured Flow  
0.0 ccm

Zero MFC Cal Point 7  
95% Full Scale  
9500.0 sccm

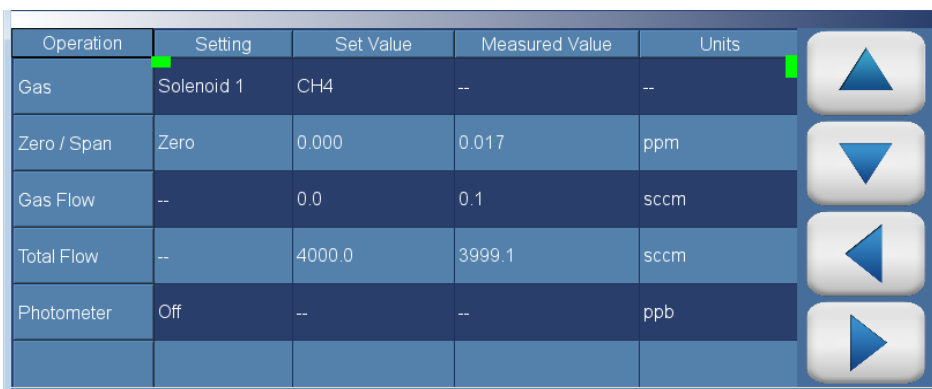
- Enter the flow meter reading in the 'Enter Measured Flow' field, and go back to the previous screen.
- Repeat Steps 7 and 8 for the rest of the desired calibration points.
- After completing the calibration, proceed to the previous screen to confirm that the calibration is valid (Cal Status: OK). Based on the entered flow meter readings for the corresponding flow set points, the instrument calculates a linear fit and evaluates the slope and r2 values against internally defined limits. A Cal Status of "Fail" will set the slope back to 1.0, and will require a re-calibration to clear the "Fail" Status.

## Calibration of the Ozone Generator

The ozone generator used on the 146iQ qualifies as a transfer standard under current U.S Environmental Protection Agency (EPA) requirements. In order to use it as a transfer standard, the user must certify the generator following the procedures laid out in the Technical Assistance Document for the calibration of ozone transfer standards.

In order to calibrate the ozone generator, ideally, an external reference photometer is required. The procedure to calibrate the ozonator generator with an external photometer is as follows:

1. Confirm that the internal photometer, if available as an option is set to OFF, as shown below, in Settings>**Operation**.



The screenshot shows a settings menu with a table of parameters. The 'Photometer' row is highlighted, showing it is set to 'Off'. To the right of the table are four navigation buttons: up, down, left, and right arrows.

Operation	Setting	Set Value	Measured Value	Units
Gas	Solenoid 1	CH4	--	--
Zero / Span	Zero	0.000	0.017	ppm
Gas Flow	--	0.0	0.1	sccm
Total Flow	--	4000.0	3999.1	sccm
Photometer	Off	--	--	ppb

2. From the Home Screen, press Calibration>Manual Ozonator Calibration>**Continue to Ozonator Lamp Power to Concentration** screen that correlates Lamp Power expressed in % drive to Concentration. As detailed in the encountered informational screen, confirm that the external reference photometer has been connected to the bulkhead labeled 'To Analyzer' on the rear panel prior to proceeding.
3. The calibration screen should look as below:

	Ozonator Drive %	Select Drive	Enter O3 Concentration (ppb)	
1	28	Start	14.31	▲
2	32	Start	38.69	▼
3	34	Start	85.29	◀
4	36	Start	178.37	▶
5	38	Start	288.28	
6	40	Start	408.09	

The ozonator calibration is a 10-point calibration starting at 28% drive power up to 90% drive power. It is recommended that all 10 points be calibrated to achieve optimal ozone generator performance. However, selectively desired points can be calibrated as well.

- Press 'Start' under the 'Select Drive' column for the desired drive % to activate the setting (The cell turns yellow), and wait until the reference photometer readings have stabilized before entering the concentration in ppb under the 'Enter O3 Concentration (ppb)' column in the same row (a wait time of less than 45 seconds is not accepted by the instrument, longer wait times are recommended for a more stable calibration). It is recommended that the external reference photometer be set to a sufficiently long averaging time to obtain an optimal calibration.

An alternate method to automatically calibrate the ozone generator with the internal photometer is also available, if the internal photometer option is available and enabled on the 146iQ. It is recommended that the internal photometer be calibrated with a primary standard (as detailed in the succeeding section on Photometer Calibration) prior to proceeding with automatic ozone generator calibration. The procedure to calibrate the ozone generator with the internal photometer is as follows:

- Confirm that the Photometer is set to 'Internal' in Settings>**Operation** as shown below:

## Calibration

### Calibration of the Ozone Generator

Operation	Setting	Set Value	Measured Value	Units
Gas	Solenoid 1	CH4	--	--
Zero / Span	Zero	0.000	0.002	ppm
Gas Flow	--	0.0	0.0	sccm
Total Flow	--	4000.0	3997.7	sccm
Photometer	Internal	--	41.4	ppb

2. Confirm that the bulkhead labeled 'To Analyzer' is closed off, so that the Internal Photometer is the only bench/analyzer drawing flow from the output manifold, and the surplus flow is exhausted.
3. Prior to the calibration, confirm that the Internal Photometer is reading ~0 ppb on zero air. It is also recommended that the Photometer be set to a long averaging time such as 300 seconds (See "Operation" chapter on how to view/set Photometer averaging time).
4. Proceed to Calibration>Ozonator Calibration>**Continue to Ozonator Lamp Power to Concentration** screen that should look as below:

Description	Lamp Power to Concentration		
Auto Cal	Start		
End Cal	Stop		

5. Press 'Start' to start the automatic ozone generator calibration. The calibration may take as long as 60 minutes if the 300 second averaging time is chosen. Stay on this screen until a popup conveying successful completion of the calibration is displayed. Exiting this screen when the 'Start' button is highlighted will prematurely end the calibration.

## Calibration of the Photometer

The accuracy of the ozone concentrations generated in the 146iQ is dependent on the accuracy of the internal photometer when the internal photometer is used to calibrate the ozone generator or when it is used in feedback control of the ozone output in normal operation. The calibration of the photometer requires an external zero air source (ZERO) and ozone source (SPAN), as well as an external reference photometer to validate the zero and span concentrations. These sources should be capable of providing the flow required by the internal photometer in addition to that of the external reference photometer. The procedure for calibration of the internal photometer is as follows:

1. Connect the external ZERO/SPAN source to the bulkhead labeled 'External Sample' on the rear panel.
2. Set the Internal Photometer to 'External' mode as shown below in Settings>**Operation**:

Operation	Setting	Set Value	Measured Value	Units
Gas	Solenoid 1	CH4	--	--
Zero / Span	Zero	0.000	-0.013	ppm
Gas Flow	--	0.0	-0.1	sccm
Total Flow	--	4000.0	4009.7	sccm
Photometer	External	--	33.2	ppb

3. From the Home Screen, press Calibration>**Photometer Calibration**. It is recommended that the averaging time for the photometer be set to a sufficiently long value, such as 300 seconds to obtain an optimal calibration.
4. Ensure that the external zero air is activated, and the photometer readings have stabilized prior to going to Calibration>Photometer Calibration>**Calibrate Background** to perform a background calibration of the photometer. Alternately, a manual background calibration can also be accomplished via Calibration>Photometer Calibration>Advanced Photometer Calibration>Manual Calibration>**Adjust Background** (Details in the '**Operation**' Chapter). Confirm that the external reference photometer is also reading ~ 0.0 ppb.

## Calibration

### Calibration of the Photometer

5. Activate the external ozone source to supply a concentration that is ~80% of the user-set range of the photometer, and ensure that the photometer readings have stabilized prior to going to Calibration>Photometer Calibration>**Calibrate Span Coefficient** to execute a span calibration of the internal photometer. Enter the concentration read by the external reference photometer as the internal photometer span concentration prior to pressing 'Calibrate'. Alternately, a manual span calibration can also be accomplished via Calibration>Photometer Calibration>Advanced Photometer Calibration>Manual Calibration>**Adjust Span Coefficient** (Details in the 'Operation' Chapter).

## Verification of Photometer Performance

Verification of the 146iQ internal photometer performance (assuming the Ozone Generator option is available and enabled) can be performed by means of an ozone generator control check, with an external reference photometer, as follows:

1. Connect the external reference photometer to the bulkhead labeled 'To Analyzer' on the rear panel.
2. Set the Internal Photometer to 'Control' mode as shown below in Settings>**Operation**:

Operation	Setting	Set Value	Measured Value	Units
Gas	Solenoid 1	CH4	--	--
Zero / Span	Zero	0.000	0.010	ppm
Gas Flow	--	0.0	0.0	sccm
Total Flow	--	4000.0	4003.3	sccm
Photometer	Control	--	75.8	ppb

3. Set up the ozonator to provide ozone concentrations at ~80%, 50% and 20% of the user-set range in the Settings>Ozonator Setup>**Ozonator Setup** (Details in the 'Operation' Chapter). Ensure that the total flow set at the various span levels provides adequate flow to the internal photometer and the external reference photometer.
4. Activate the various span levels in Settings>**Operation** and record the responses of the internal and external photometers. The discrepancy between the readings should be within 1%.

## Photometer Detector Calibration

The Photometer detector gain is determined at the factory and should only be adjusted by a qualified technician. The only time the Detector Gain should be adjusted is if there were changes to the elements that affect the light path or detection (including the detector itself). Ensure that zero air is being sampled when the detector gain adjustment is being performed. There are two ways of calibrating the detector gain:

1. From the Home Screen, press Calibration>Photometer Calibration>Advanced Photometer Calibration>Photometer Detector Calibration, **Continue to Detector Calibration**. The user can manually change the detector gain by clicking on the Detector Manual Entry cell corresponding to the 'Detector Cal' column. The user will be brought to a numeric keypad screen where a new value can be entered. It is recommended that the detector gain be adjusted to obtain an Intensity of ~100,000 Hz.
2. The recommended method, however, is to run an Auto Calibration for the Detector Gain. This is accomplished by pressing on the cell labeled 'Start' under the 'Detector Cal' column. It is advised to allow up to 5 minutes for the detector gain to be calibrated. Leaving the screen prematurely terminates the calibration. The user can stop the calibration at any time by pressing the cell labeled 'Stop' under the 'Detector Cal' column. Additionally, the user can set the detector gain to its factory default value by pressing on the cell labeled 'Default Detector Cal' under the 'Detector Cal' column.

The screen for the photometer detector gain adjustment is shown below for reference:

Description	Detector Cal	Intensity (Hz)	
Detector Manual Entry	156	95957	
Auto Cal	Start		
End Cal	Stop		
Default Values	Default Detector Cal		





## Chapter 5

# Maintenance

This chapter describes the periodic maintenance procedures that should be performed on the instrument to ensure proper operation. Since usage and environmental conditions vary greatly, you should inspect the components frequently until an appropriate maintenance schedule is determined.

### Safety Precautions



Read the safety precautions before beginning any procedures in this chapter.

**Equipment Damage** Some internal components can be damaged by small amounts of static electricity. A properly grounded antistatic wrist strap must be worn while handling any internal component. For more information about appropriate safety precautions, see the “[Servicing](#)” chapter. ▲

### Fan Filter Inspection and Cleaning

Use the following procedure to inspect and clean the fan filter.

1. Remove the fan guard from the fan and remove the filter.
2. Flush the filter with warm water and let dry (a clean, oil-free purge will help the drying process) or blow the filter clean with compressed air.
3. Re-install the filter and fan guard.

## Pump Rebuilding

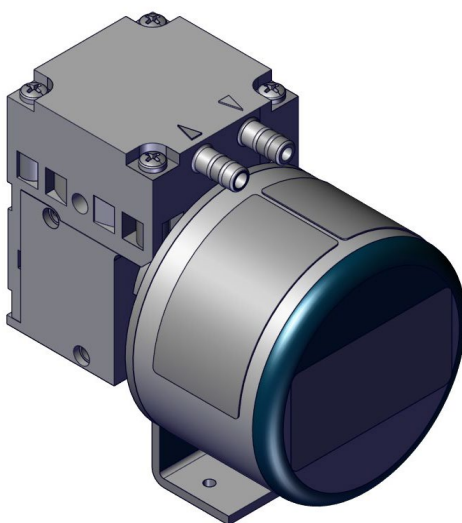
Use the following procedure to rebuild the pump.

Equipment required:

Pump rebuild kit (qty. 1)

Phillips drive, #1 or Torque drive, T10 (depending on pump version)

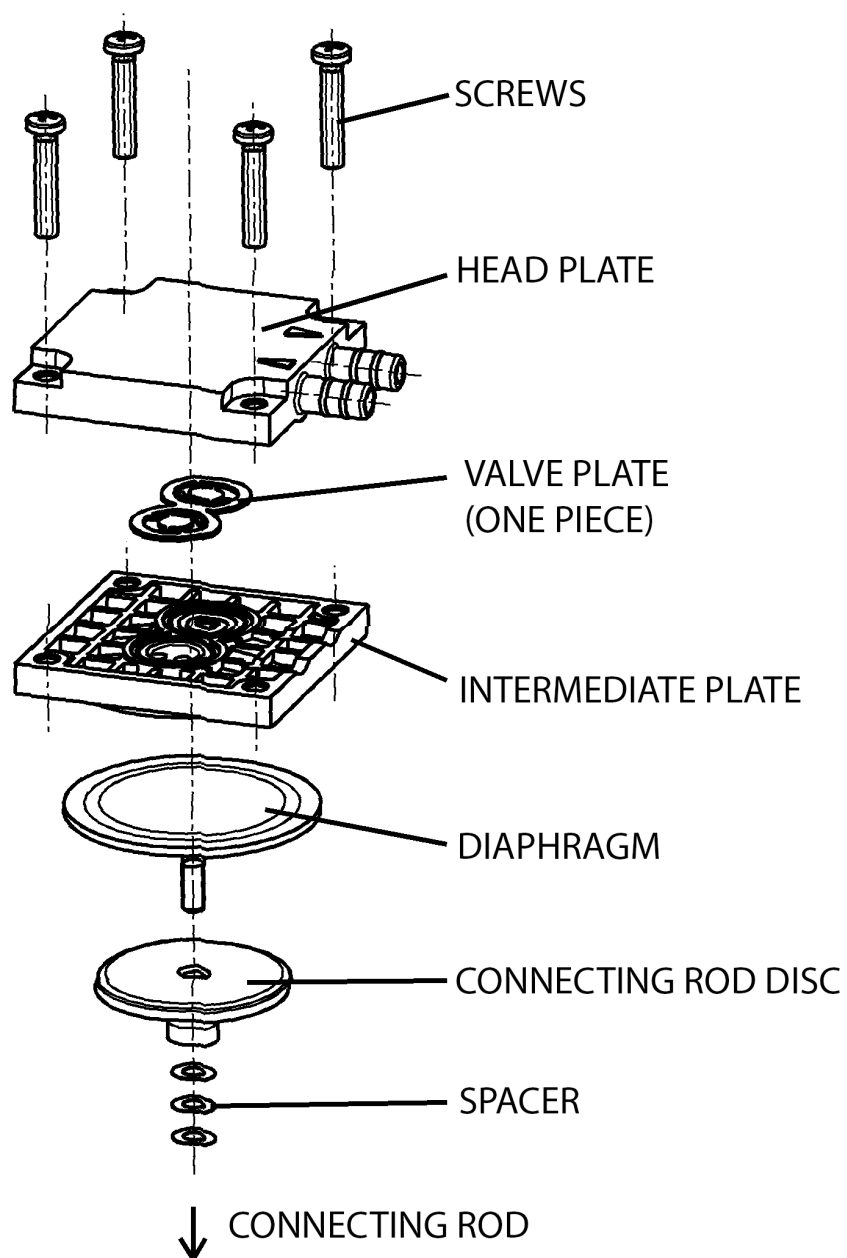
Pencil or marker



**Figure 5–1.** Single Stage Pump

1. Turn instrument OFF, unplug the power cord, and remove the cover.
2. Mark the position of head parts relative to each other by drawing a line with a pencil. This helps avoid incorrect assembly later.
3. Undo the four screws in the head.
4. Lift the head plate and the intermediate plate off the housing.
5. Hold the pump with one hand, so that the diaphragm is pointing downwards. Lift the diaphragm by the opposing side edges, grasp it and unscrew it in the counter-clockwise direction.

6. Remove connection rod disc and diaphragm spacers from the threaded pin of the diaphragm.
7. Push the connection rod disc and the diaphragm spacers in this order onto the threaded pin of the new diaphragm.
8. Move the connecting rod to the upper point.
9. Screw the new diaphragm with connection rod disc and spacers clockwise onto the connection rod and tighten hand-tight.
10. Place the intermediate plate on housing, in the position indicated by the drawing line.
11. Place the new valve plate on the intermediate plate.
12. Place the head plate on the intermediate plate, in the position indicated by the drawing line; gently tighten the four screws, evenly and diagonally (if a torque screwdriver is available: torque about 0.30 Nm).
13. Let the pump run.



**Figure 5–2.** Pump Rebuilding

## Leak Test

Use the following procedure to perform a leak test.

Equipment Required:

Cap

Vacuum Tester with Gauge (with a resolution of .5 in Hg or better)

1. Turn instrument OFF, unplug the power cord.
2. Block the SAMPLE bulkhead on the rear panel with a leak-tight cap.
3. Connect the vacuum tester tool to the EXHAUST bulkhead on the rear panel.
4. Squeeze trigger until gauge reads to pull in 10 in Hg.
5. Observe vacuum gauge for stable reading for 5 minutes. If reading remains at 10 in Hg, no leak is present.

**Note** Acceptable leak rate is .5 in Hg over 10 minutes. ▲



# Chapter 6

## Troubleshooting

This chapter presents guidelines for diagnosing analyzer failures, isolating faults, and includes recommended actions for restoring proper operation.

### Safety Precautions

Read the safety precautions in Appendix A, “[Safety](#)” before performing any actions listed in this chapter.

### Troubleshooting Guide

[Table 6–1](#) provides general troubleshooting information for the common platform and indicates the checks that you should perform if you experience an instrument problem. It also lists 146iQ specific troubleshooting information and alarm messages you may see on the graphics display and provides recommendations about how to resolve the alarm condition.

**Table 6–1.** 146iQ Troubleshooting Guide

Problem	Possible Cause	Action
Instrument does not start (LEDs on front panel do not come on and display is blank)	No power	Verify that the power cord is plugged in, power is available and that it matches the voltage and frequency configuration of the instrument.
	Fuse is blown or missing	Disconnect power and check fuses with a volt meter.
	Bad switch or wiring connection to switch	Check for 24V @ J9 on the Backplane board (middle pins). Check all wiring connections.
Front panel display does not start (LEDs on front panel are off)	Disconnected ribbon cable	Power down and evaluate connections of display ribbon cable.
Front panel display does not start (LEDs on front panel are on)	Defective Display	Connect to the instrument using ePort. Select “Remote Interface”. If normal GUI is displayed, replace defective display.
Front panel display stays white after power up (LEDs on front panel are on)	Unseated or missing Micro SD card	Power off, re-seat Micro SD or install if missing.

Problem	Possible Cause	Action
	Micro SD Card Programming	If Micro SD card was just replaced, re-install the old one. If the problem is fixed, request a replacement Micro SD card.
Instrument temperature out of range	Fan failure	Replace fan if not operating properly.
	Dirty fan filter	Clean or replace filter.
	Overheating PCBA	Locate defective PCBA reporting the error and replace if needed.
Voltage levels out of range	Poor PCBA or cable connection	Locate PCBA where out of range voltage level is being detected and inspect connections. Replace PCBA if damaged.
Solenoid current out of range (option)	Sticking or damaged solenoid	Reset solenoid via Settings>Health Check>Status and Alarms>Valve and Pump Resets screen. If damaged, replace solenoid valve block.
Pump current out of range	Damaged or dirty pump	Reset pump via Settings>Health Check>Status and Alarms>Valve and Pump Resets. Inspect and refurbish pump. If pump motor is damaged, replace pump.
Out of range pressure high – upstream flow	Too much positive pressure in sample line	Regulate line to lower pressure, or install flow bypass near rear panel.
Out of range pressure low – upstream flow	Ineffective pump	Evaluate for refit/replacement of pump.
	Internal leak	Inspect lines downstream of flow capillary. Replace tubing if needed.
	Stuck solenoid valve (zero/span gas valve option only)	Reset valve via Settings>Health Check>Status and Alarms>Valve and Pump Resets. Replace manifold valve block if necessary.
Bench temperature out of range	Thermistor disconnected or shorted	Check to ensure range corresponds with expected value. If not, select proper range.
	High: Excessive high temperature in instrument, duty cycle of temperature control at zero	Check external temperature (must be under 45 °C); check rear panel fan for operation, replace if necessary.
	Low: Excessive low temperature in instrument, ineffective or disconnected heater,	Check external temperature (must be above 0 °C); check heater connection for disconnect or crimps.



Problem	Possible Cause	Action
	duty cycle temperature at 100%	
Flow, pressure or vacuum are too low, or: pump produces no flow	Diaphragm or valve plates are worn or dirt in the head	Rebuild or replace pump.
	Connections or lines are blocked	Let the pump run for a few minutes pumping air.
	An external valve is closed or a filter blocked	Install the pump at the highest point in the system.
	There is a leak at a connector, in a line or in the pump head	Find and repair leak.
	Liquid (condensate) has collected in the pump head	Clean and dry. Pump may need replacement.
	Pump cable not seated	Verify the pump cable is properly seated into the Step POL board.
	The cross-section of pneumatic lines, or connected components are too small or they are restricted	The pump is not designed for this condition.
Alarm – board communication failure	Internal cables not connected properly	Verify cables to DMC PCB are seated properly. Replace DMC PCB if necessary.
Alarm – power supply	Internal cables not connected properly	Verify cables to DMC PCB are seated properly. Replace DMC PCB if necessary.
Cell frequency (Photometer)	Light adjustment	Readjust Lamp setting
	Defective detector	Interchange detectors at Photometer DMC PCB connectors to determine if detector is defective.
Ozone frequency	Lamp supply	
Low or Zero frequency	Light adjustment	Re-adjust lamp setting
	Dirty cell	Clean cell.
Excessive noise	Foreign material in cell	Clean cell.
	Defective lamp	Replace lamp as needed.
	Defective detector	Interchange detectors at photometer DMC PCB connectors to determine if detector is defective.

Problem	Possible Cause	Action
Output signal noisy	Recorder	Replace or repair recorder.
	Sample is varying	Run instrument on stable ozone source. If quite, No malfunction?
	Foreign material in cell	Clean cell.
	Sticky solenoid valve	Replace with known-good solenoid valve.
Analyzer does not calibrate properly	Leak	Check all tubing connections for leak.
	Contaminated scrubber	Perform scrubber efficiency test. Replace if needed.
	Flow/Pressure out of calibration	Recalibrate flow/pressure. Refer to the “ <a href="#">Calibration</a> ” chapter.
	Dirty system	Clean cells and flow components.
	Solenoid defective	Replace with known-good solenoid valve.
Slow response	Averaging time	Verify averaging time is set properly.
	Contaminated photometer	Clean bench and then condition system overnight.
Flow controller unstable	Leak	Perform a leak check.
	Defective MFC	Replace mass flow controller as needed.
No Ozone output	Defective lamp	Check for blue light when removing ozone lamp from ozonator and replace lamp if light is not visible.
	Ozonator heater failure	Verify the ozonator is warm (>50 °C). If not warm replace heater.
	Defective DMC board	Replace DMC board as needed.
Alarm – O <sub>3</sub> Lamp temp	Defective lamp heater	Replace ozonator, lamp driver board or lamp assembly.
Alarm –Lamp temp	Defective lamp heater	Replace bench lamp driver board or lamp assembly.
Alarm – Perm Gas Temp	Incorrect Perm oven set temperature or alarm setting	Check that the alarm settings match the set temperature.
	Perm oven heater thermistor or gas thermistor error	Replace thermistor.
	Perm oven failure	Replace the Perm oven.
Alarm – Flow	Flow low	Check sample capillary for blockage. Replace as necessary.

Problem	Possible Cause	Action
		If using a sample particulate filter, make sure it is not blocked. Disconnect sample particulate filter from the sample bulkhead; if flow increases, replace filter.
Alarm – Intensity	Defective detector	Replace detector as needed.
	Defective DMC board	Replace DMC board as needed.
Alarm – Zero Check (Option)	Instrument out of calibration	Recalibrate instrument.
		Check gas supply.
		Perform a manual calibration.
Alarm – O <sub>3</sub> Concentration	Concentration has exceeded range limit	Check to ensure range corresponds with expected value. If not, select proper range.
	Concentration low	Check user-defined low set point, set to zero.
Alarm – Lamp Heater Current (Photometer)	Defective heater	Replace heater as needed.
Alarm – Lamp Temp Sensor Short (Photometer)	Defective sensor	Replace sensor as needed.
Alarm – Lamp Temp Sensor Open (Photometer)	Defective sensor	Replace sensor as needed.
Alarm – Bench Temp Sensor Open (Photometer)	Defective sensor	Replace sensor as needed.
Alarm – Bench Temp Sensor Short (Photometer)	Defective sensor	Replace sensor as needed.
Alarm – Lamp Connection (Photometer)	Defective lamp	Replace lamp as needed.
Alarm – Lamp Short (Photometer)	Defective lamp	Replace lamp as needed.
Alarm – Lamp Heater Current (Ozone)	Defective heater	Replace heater as needed.
Alarm – Bench Temperature (Ozone)	Dirty fan filter	Clean fan filter as needed.
Alarm – Lamp Temp Sensor Short (Ozone)	Defective sensor	Replace sensor as needed.
Alarm – Lamp Temp Sensor Open (Ozone)	Defective sensor	Replace sensor as needed.
Alarm – Lamp Connection (Ozone)	Defective lamp	Replace lamp as needed.
	Defective DMC board	Replace DMC board as needed.

**Troubleshooting**  
Troubleshooting Guide

Problem	Possible Cause	Action
Alarm – Lamp Short (Ozone)	Defective lamp	Replace lamp as needed.
	Defective DMC PCB	Replace DMC board as needed.

## Chapter 7

# Servicing

This chapter describes the periodic servicing procedures that should be performed on the instrument to ensure proper operation and explains how to replace the 146iQ subassemblies.

### Safety Precautions

Read the safety precautions before beginning any procedures in this chapter.



The service procedures in this manual are restricted to qualified service representatives. ▲



If the equipment is operated in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired. ▲



**CAUTION** If the LCD panel breaks, do not let the liquid crystal contact your skin or clothes. If the liquid crystal contacts your skin or clothes, wash immediately using soap and water. ▲

Do not remove the LCD panel or frame from the LCD module. ▲

The LCD polarizing plate is very fragile, handle it carefully. ▲

Do not wipe the LCD polarizing plate with a dry cloth, as it may easily scratch the plate. ▲

Do not use alcohol, acetone, MEK or other Ketone based or aromatic solvents to clean the LCD module, but rather use a soft cloth moistened with a naphtha cleaning solvent. ▲

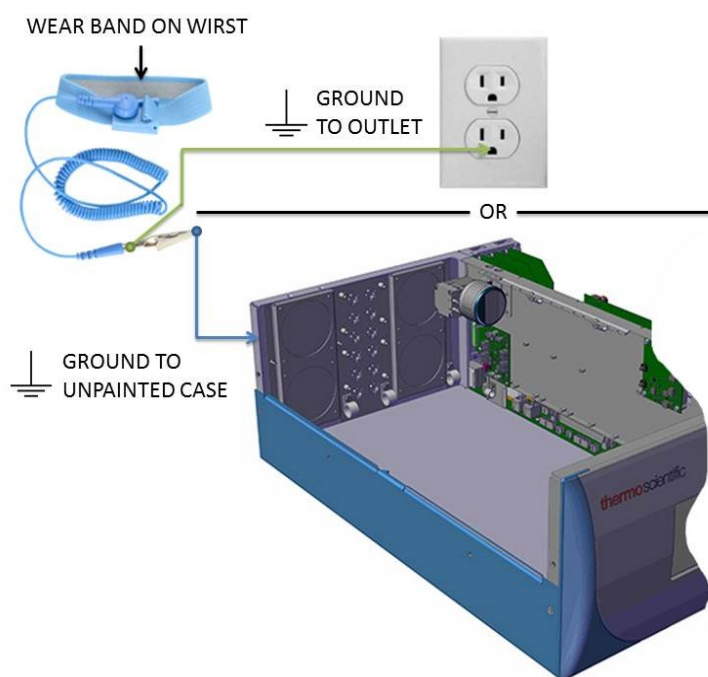
Do not place the LCD module near organic solvents or corrosive gases. ▲

Do not shake or jolt the LCD module. ▲



**Equipment Damage** Some internal components can be damaged by small amounts of static electricity. A properly grounded antistatic wrist strap must be worn while handling any internal component. For more information about appropriate safety precautions, see “[Safety](#)”. ▲

**Note** If an antistatic wrist strap is not available, be sure to touch the instrument chassis before touching any internal components. When the instrument is unplugged, the chassis is not at earth ground. ▲



**Figure 7–1.** Properly Grounded Antistatic Wrist Strap

**Note** Ground to unpainted case or outlet as shown. ▲

## **Firmware Updates**

New versions of the instrument software are periodically made available over Ethernet, USB flash drive, or company website at:

<http://www.thermofisher.com>

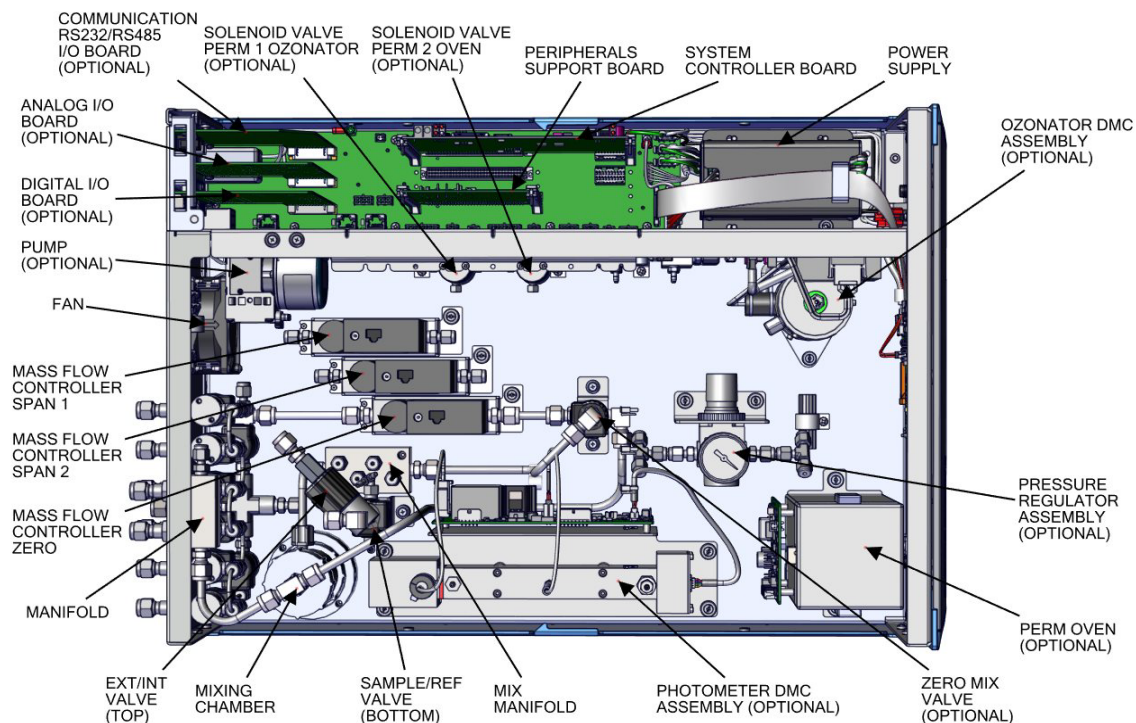
For more information on installing new firmware, see “Installing New Firmware” in the *iQ Series Communications* manual.

## **Replacement Parts List**

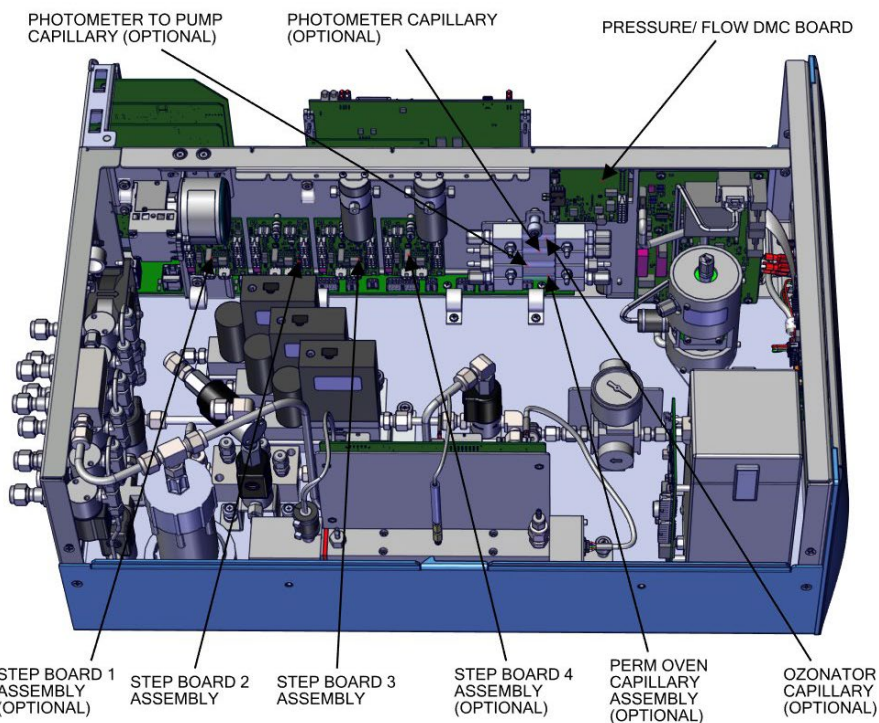
For a complete list of spare parts, visit the company website at:

<https://www.analyticalinstrumentparts.com/products/source-gas-monitoring.aspx>

Refer to [Figure 7–2](#) and [Figure 7–3](#) to identify the component location.



**Figure 7-2.** 146iQ Component Layout Top View



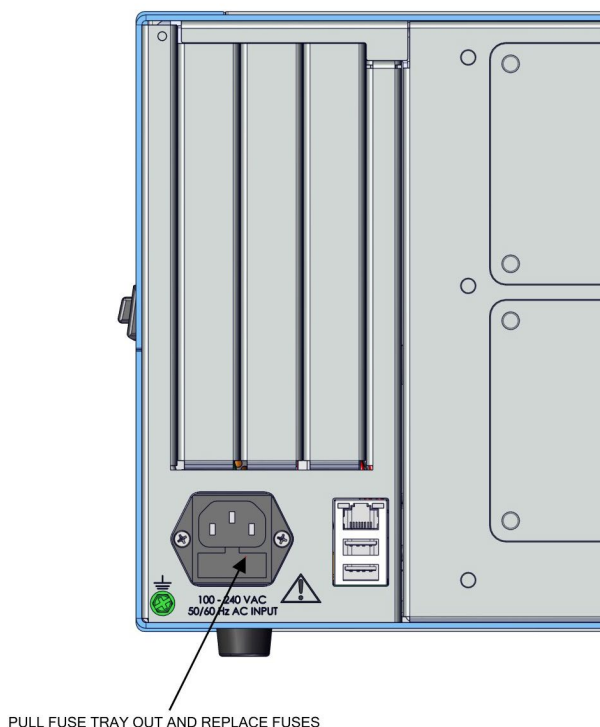
**Figure 7-3.** 146iQ Component Layout Side View



## Fuse Replacement

Use the following procedure to replace the fuses.

1. Turn instrument OFF and unplug the power cord.
2. Remove fuse drawer, located on the AC power connector.
3. If either fuse is blown, replace both fuses.
4. Insert fuse drawer and reconnect power cord.

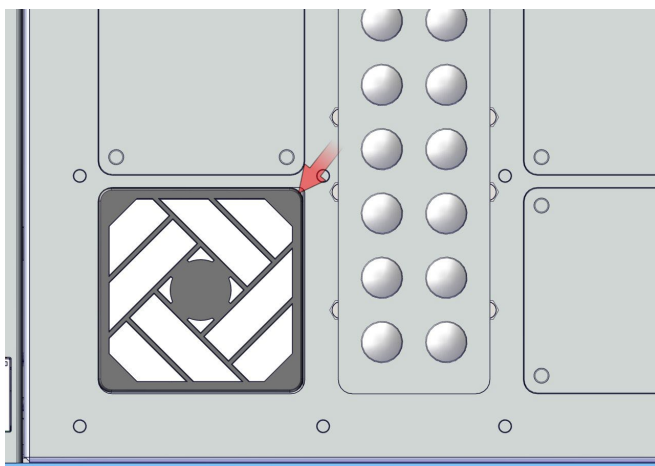


**Figure 7–4.** Replacing the Fuses

## Filter Replacement

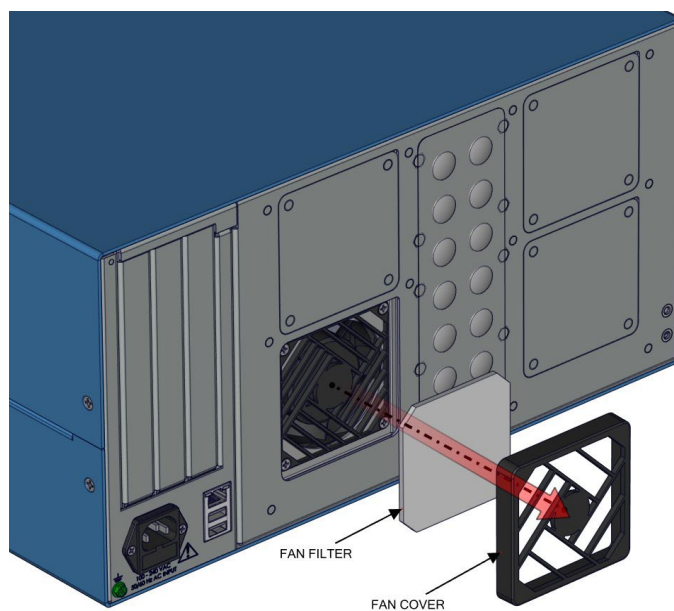
Use the following procedure to replace the filter.

1. Turn instrument OFF and unplug the power cord.
2. Starting with top right corner, pull out to remove fan cover.



**Figure 7-5.** Start with Top Right Corner of Fan Cover

3. Replace filter and snap fan cover back in place.



**Figure 7-6.** Removing the Fan Cover

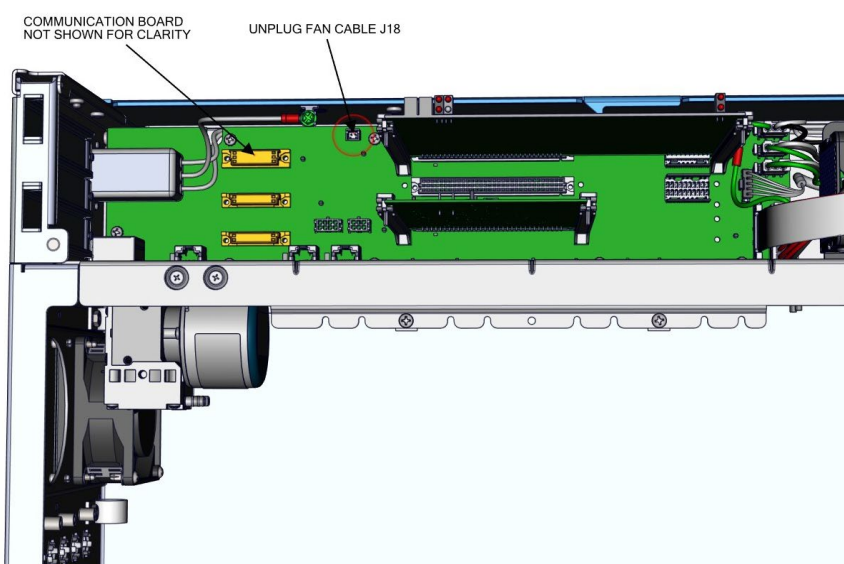
## Fan Replacement

Use the following procedure to replace the fan.

Equipment required:

Phillips drive, #2

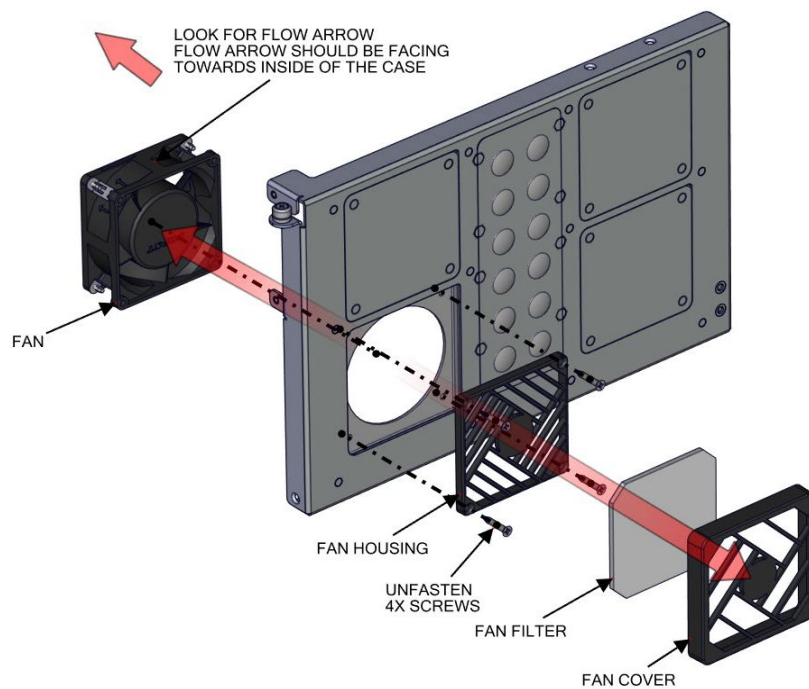
1. Turn instrument OFF, unplug power cord, and remove the cover (Figure 2–1).
2. Unplug the fan cable J18.



**Figure 7–7.** Unplugging the Fan Cable

3. Starting with top right corner, pull out to remove fan cover.
4. Unhook the four latches of the fan cover.
5. Unfasten the four 6-32 screws from the fan housing.
6. Replace fan and reassemble in reverse order.

### Fan Replacement



### Figure 7–8. Replacing the Fan

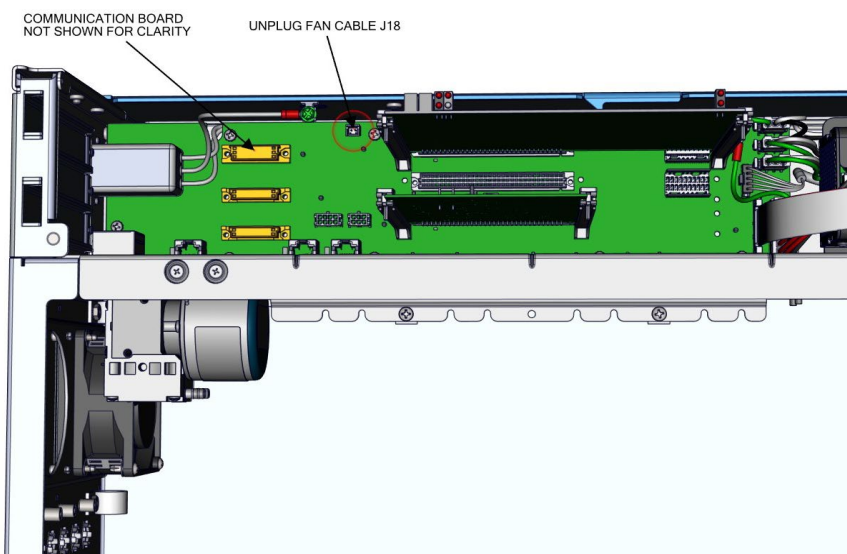
## Measurement Side Removal and Replacing

Use the following procedure to remove and replace the measurement side if necessary.

Equipment required:

Phillips drive, #2

1. Turn instrument OFF, unplug power cord, and remove the cover (Figure 2–1).
2. Unplug the fan cable J18 (Figure 7–9).

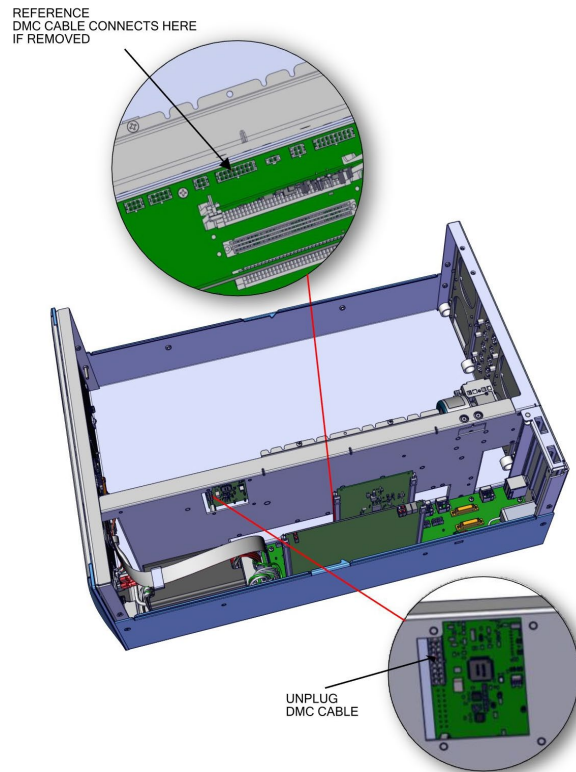


**Figure 7–9.** Unplugging the Fan Cable

3. Unplug DMC cable (Figure 7–10).

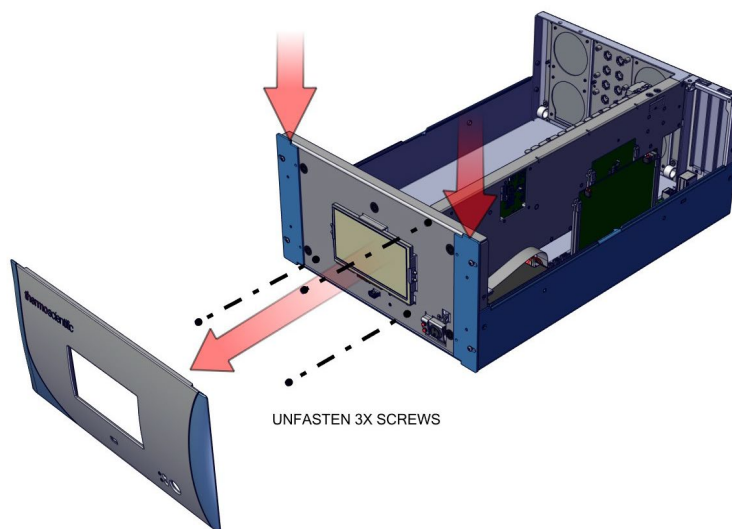
## Servicing

### Measurement Side Removal and Replacing



**Figure 7–10.** Unplugging the DMC Cable

4. Gripping from the top corners of the front panel and pull outwards.
5. Remove three 8-32 flat head screws ([Figure 7–11](#)).

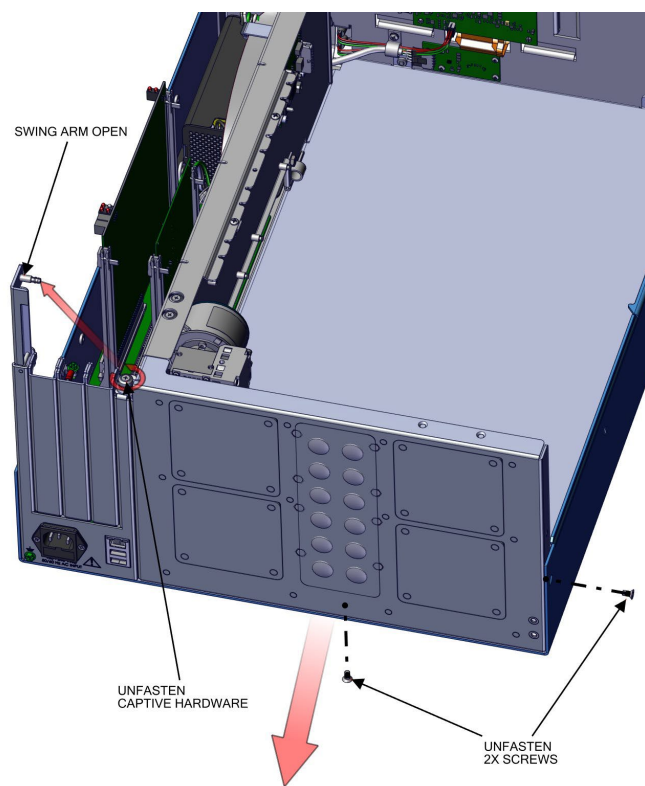


**Figure 7–11.** Unfasten Hardware Front for Measurement Side Removal

6. Swing arm open.
7. Unfasten captive hardware.
8. Remove two 8-32 flat head screws.
9. Pull measurement side out.
10. Replace in reverse order.

## Servicing

### Measurement Side Removal and Replacing



**Figure 7-12.** Unfasten Hardware Rear for Measurement Side Removal



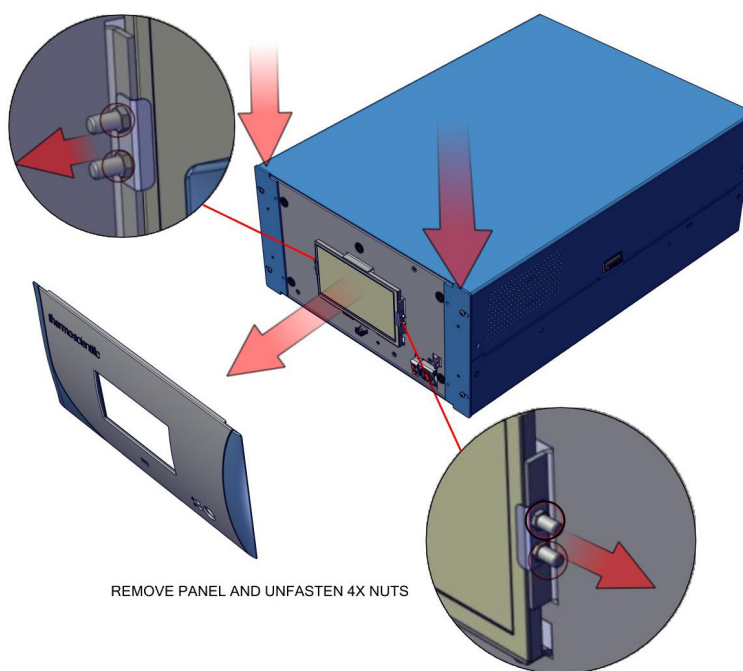
## LCD Module Replacement

Use the following procedure to replace the LCD module.

Equipment required:

Wrench, 1/4

1. Turn instrument OFF and unplug the power cord.
2. Gripping from the top corners of the front panel and pull outwards.
3. Unfasten four nuts (Figure 7–13).

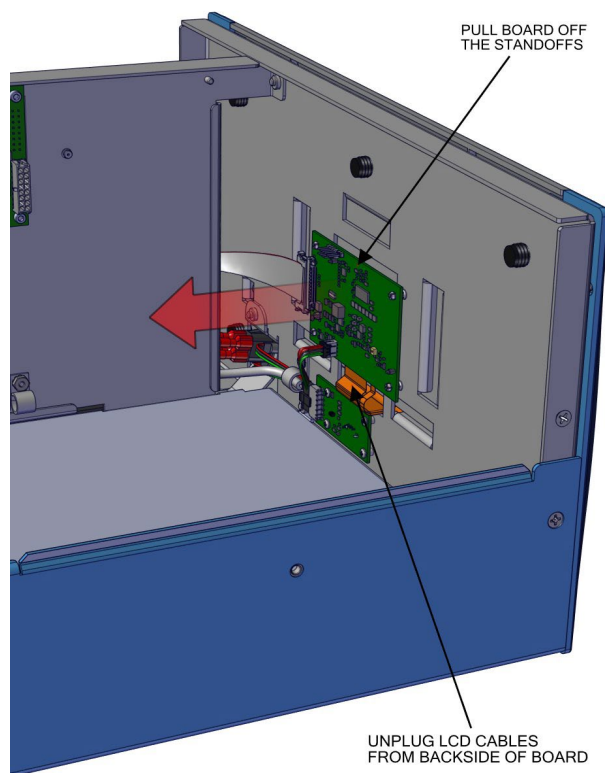


**Figure 7–13.** Replacing the LCD Module

4. Remove cover.
5. Unplug LCD cables from backside of board.
6. Pull board off the standoffs.

## Servicing

### LCD Module Replacement



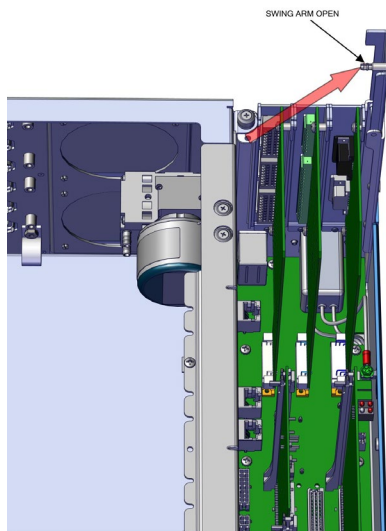
**Figure 7-14.** Remove Electrical Cables from LCD

7. Replace LCD module and reassemble in reverse order.

## I/O Replacement

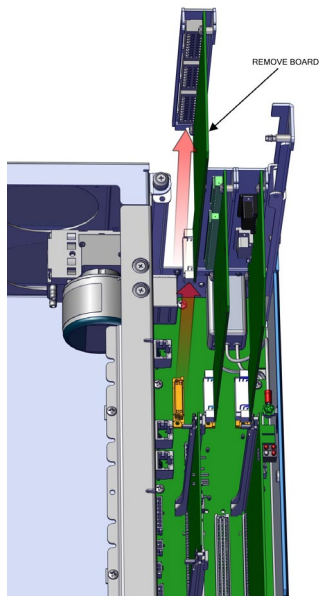
Use the following procedure to replace the I/O boards.

1. Turn instrument OFF, unplug power cord, and remove the cover (Figure 2–1).
2. Swing arm open.



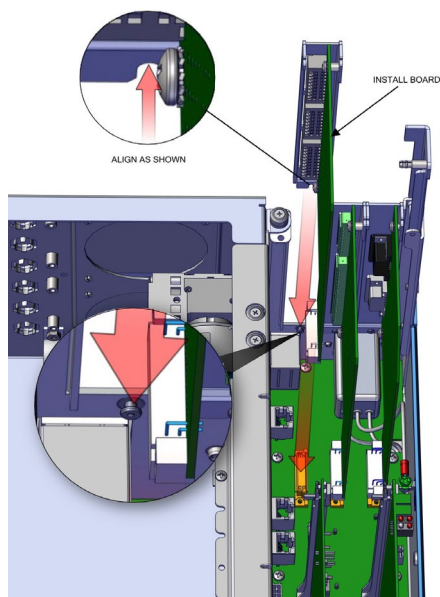
**Figure 7–15.** I/O Replacement, Arm

3. Pull board upwards.



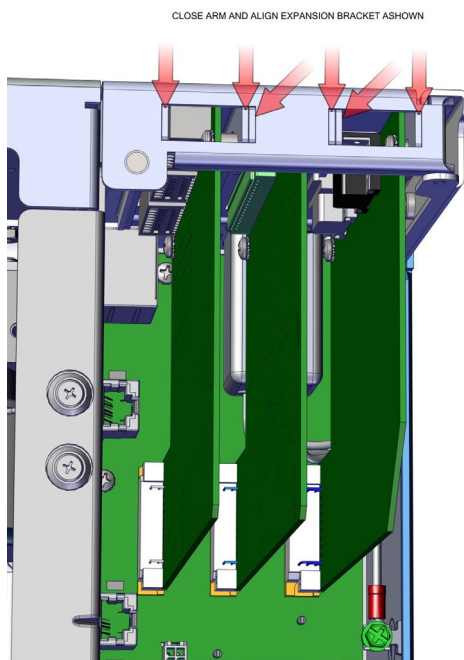
**Figure 7–16.** I/O Replacement, Remove Board

4. During install, make sure to align cutout circular to keyway.
5. Insert board downwards.



**Figure 7–17.** I/O Replacement, Install

6. Close arm. Make sure expansion bracket aligns to the inside of the rectangular cutouts.

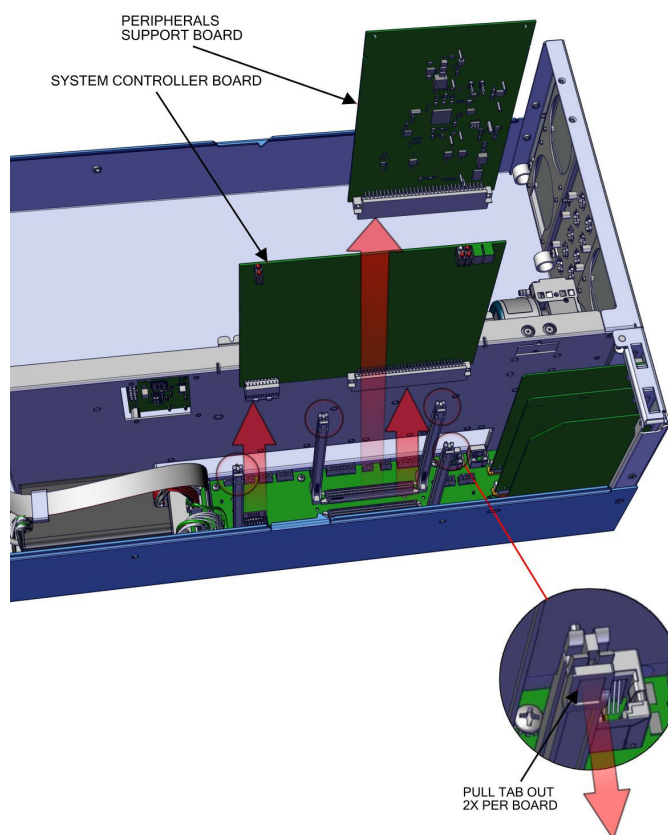


**Figure 7–18.** I/O Replacement, Close Arm Alignment

## Peripheral Support Board and System Controller Board Replacement

Use the following procedure to replace the peripheral support board or system control board.

7. Turn instrument OFF, unplug power cord, and remove the cover (Figure 2–1).
8. Pull tab out (two per board).
9. Pull board out.



**Figure 7–19.** Replacing the Peripheral Support Board

10. Replace board and reassemble in reverse order.

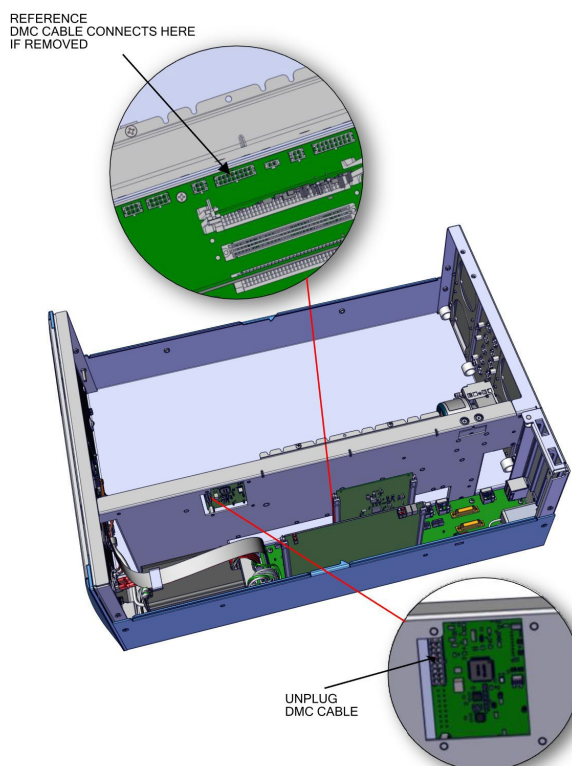
## DMC Pressure and Flow Board

Use the following to replace the DMC pressure and flow board.

Equipment required:

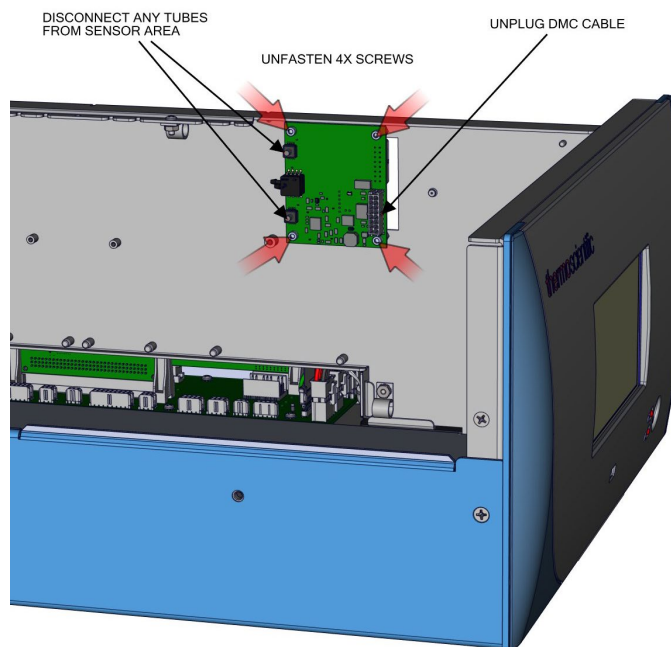
Hex drive, 7/16

1. Turn instrument OFF, unplug power cord, and remove the cover (Figure 2-1).
2. Unplug cables from the pressure and flow board.



**Figure 7-20.** Flow Pressure Board, Disconnect DMC Cable

3. Disconnect plumbing.
4. Using 7/16 hex drive, unfasten four #6-32 socket cap head screws.



**Figure 7–21.** Flow Pressure Board, Screws

5. Replace board and reassemble in reverse order.

## **Pump Replacement (Optional)**

Use the following procedure to replace the pump.

Equipment required:

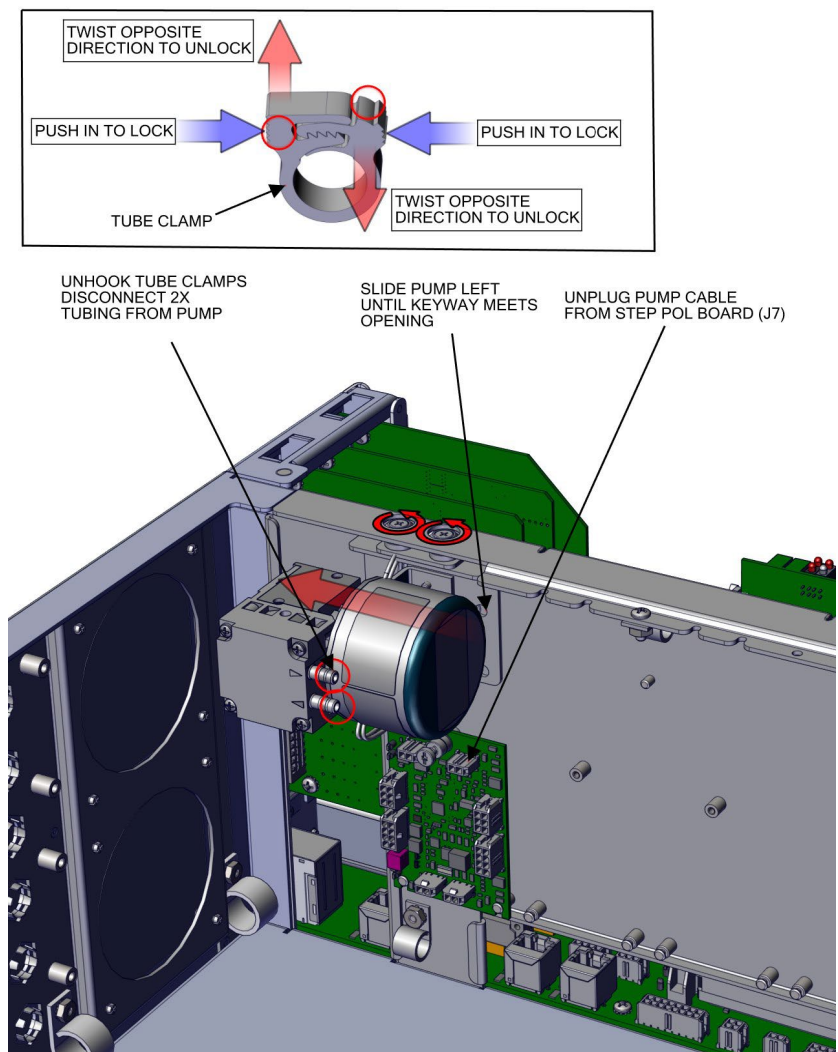
Phillips drive, #1 and #2

1. Turn instrument OFF, unplug power cord, and remove the cover (Figure 2–1).
2. Unplug pump cable from Step POL board J7.
3. Twist opposite direction to unlock tube clamps.

**Note** Push in tube clamp to lock. ▲

4. Disconnect tubing from pump.
5. Unfasten two captive hardware.
6. Slide pump left until keyway meets opening.





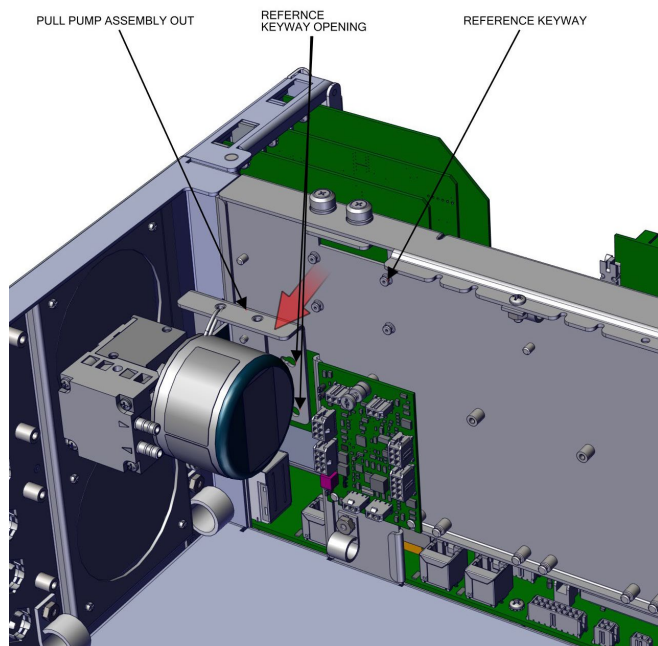
**Figure 7–22.** Remove Pump, Disconnect and Unfasten

7. Pull pump outwards.

**Note** When installing pump, make sure the pump keyway opening goes over the keyway. ▲

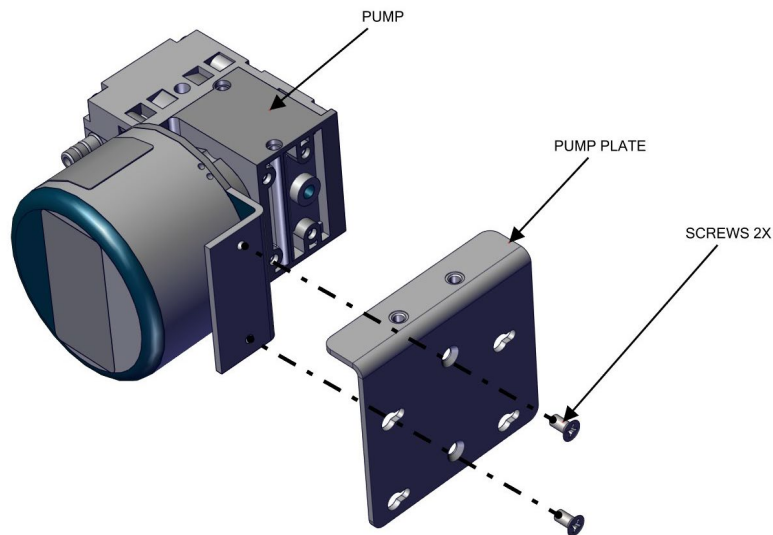
## Servicing

### Pump Replacement (Optional)



**Figure 7–23.** Pump Removal, Keyway

8. Remove two screws.



**Figure 7–24.** Pump replacing, Unfasten Screws

9. Replace pump and reassemble in reverse order.

## Capillary Cleaning and/or Replacement

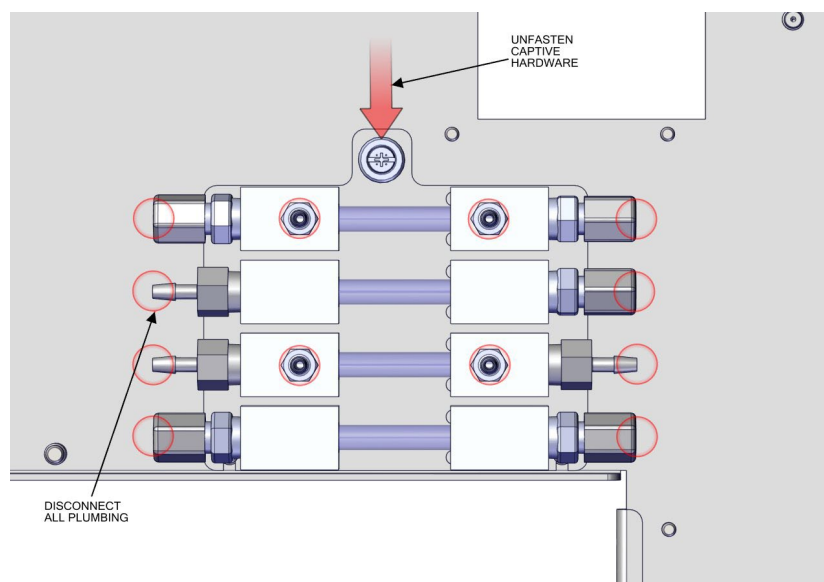
Use the following procedure to clean or replace the capillary.

Equipment required:

Phillips drive, #2

Hex drive, 7/64

1. Turn instrument OFF, unplug power cord, and remove the cover (Figure 2–1).
2. Disconnect the plumbing.
3. Unfasten captive hardware.

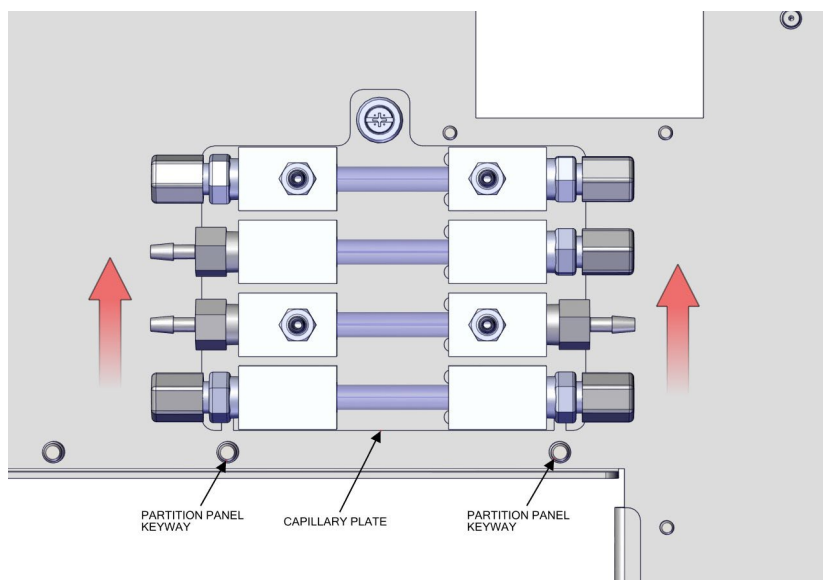


**Figure 7–25.** Remove Capillary, Disconnect and Unfasten

4. Slide capillary plate upwards clearing the partition panel keyway.

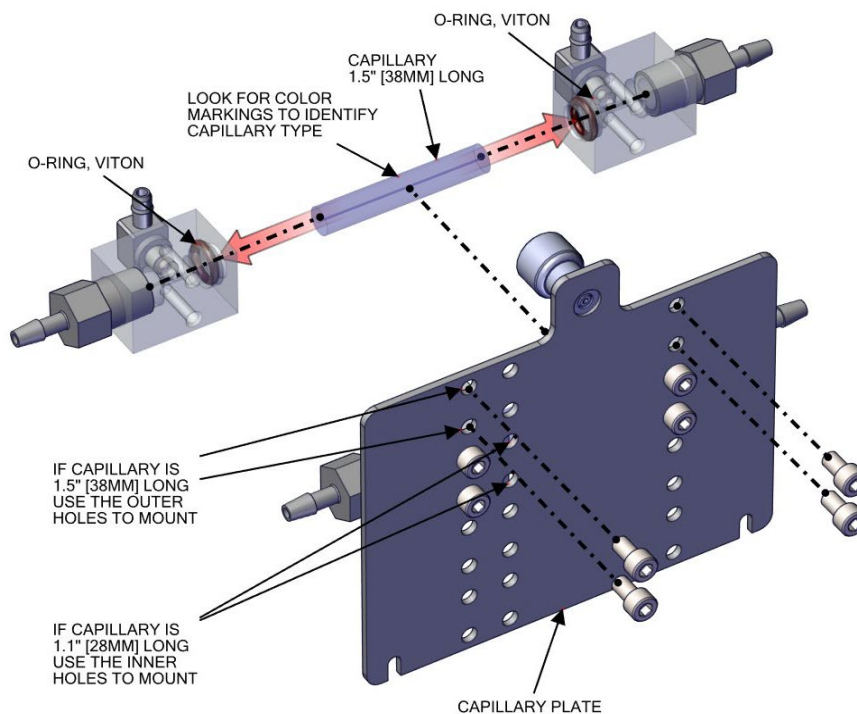
## Servicing

### Capillary Cleaning and/or Replacement



**Figure 7-26.** Capillary Plate, Keyway

5. Using 7/64 hex drive, remove four #6-32 socket cap head screws.
6. Pull apart the capillary blocks.



**Figure 7-27.** Capillary and O-Ring Replace

7. Replace capillary and reassemble in reverse order.

**Note** Fitting arrangements, number of capillaries and capillary sizes will vary per instrument configuration. ▲

## Capillary O-Ring Replacement

Use the following procedure to replace the capillary o-rings.

Equipment required:

O-ring pick tool

1. Using a metal o-ring pick tool, remove the o-ring.

**Note** Be careful in not damaging the o-ring walls during this process Refer to [Figure 7–27](#). ▲

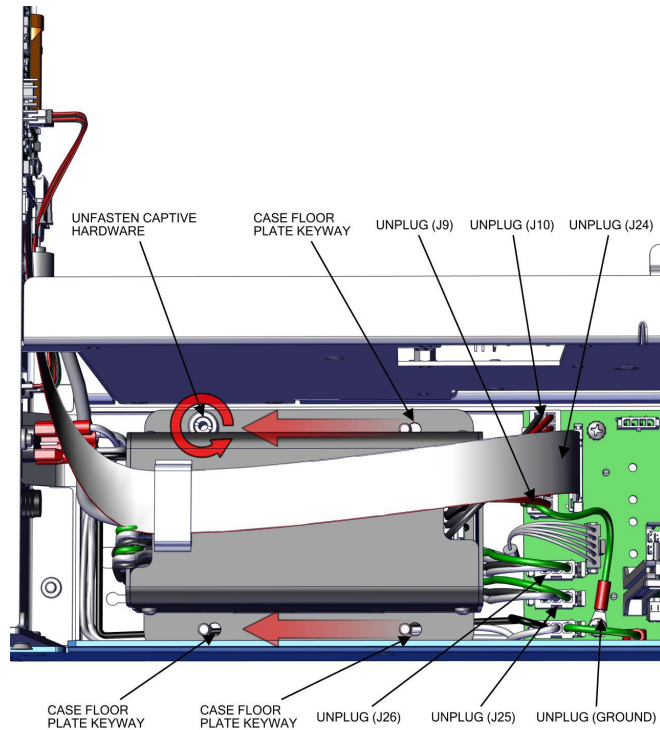
## Power Supply Replacement

Use the following procedure to replace the power supply.

Equipment required:

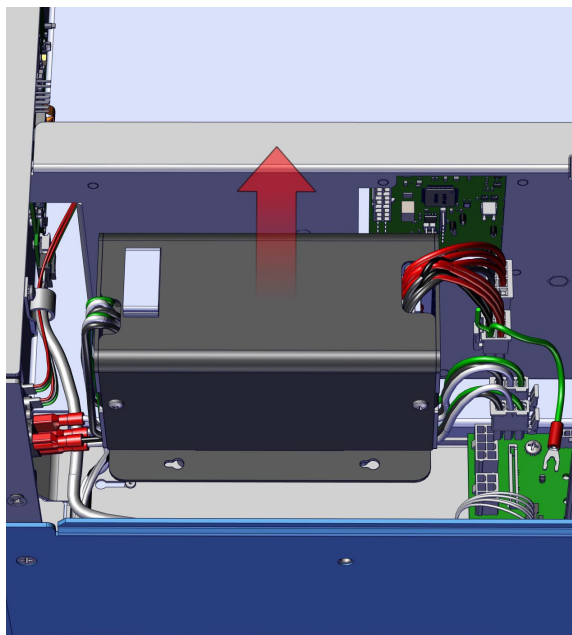
Phillips drive, #2

1. Turn instrument OFF, unplug power cord, and remove the cover ([Figure 2–1](#)).
2. Unplug all electrical shown J9, J10, J24, J25, J26, and ground.
3. Unfasten captive hardware.
4. Slide power supply left clearing three case floor plate keyways.



**Figure 7–28.** Removing Power Supply

5. Pull power supply up.
6. Replace power supply and reassemble in reverse order.



**Figure 7–29.** Replacing Power Supply

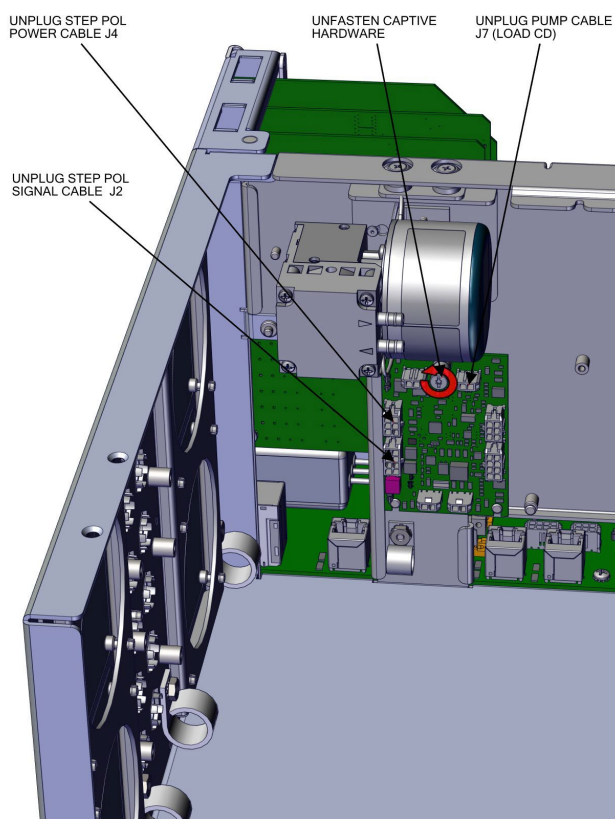
## Step POL Board Replacement

Use the following procedure to replace the Step POL board.

Equipment required:

Torque screwdriver, T15 or Slot screwdriver, 3/16

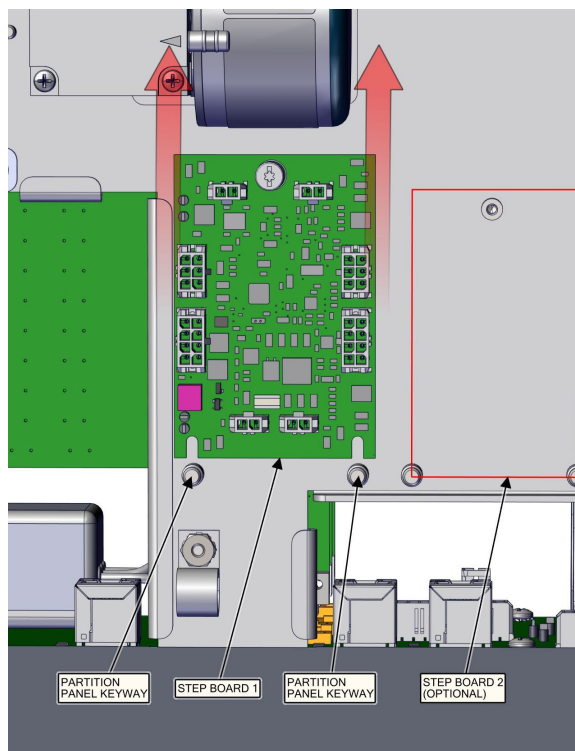
1. Turn instrument OFF, unplug power cord, and remove the cover (Figure 2–1).
2. Unplug Step POL power cable J4.
3. Unplug Step POL signal cable J2.
4. Unplug pump cable J7.
5. Unfasten captive hardware.



**Figure 7–30.** Unplug and Unfasten Step POL Board

## Servicing

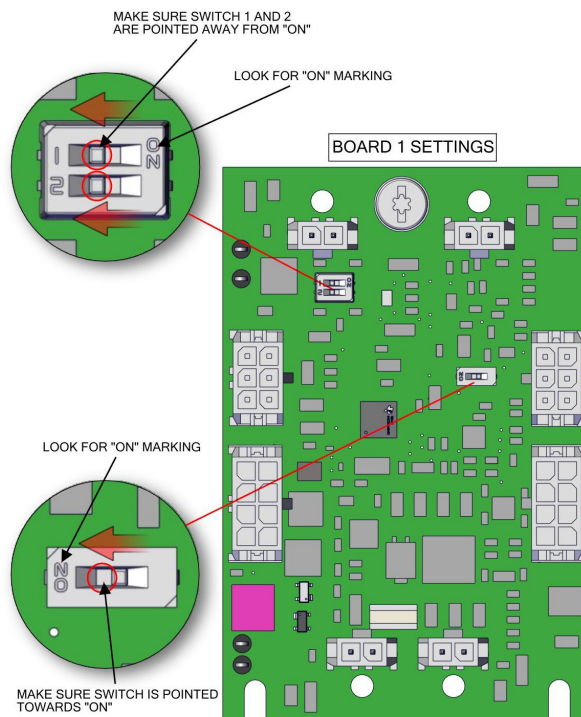
### Step POL Board Replacement



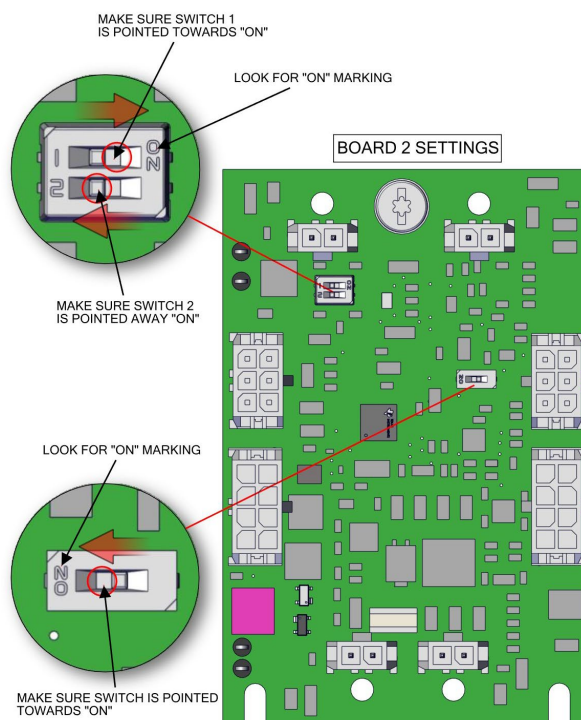
**Figure 7–31.** Clear Partition Keyway Step POL Board

6. Slide step board 1 upwards clearing the partition panel keyway.
7. If replacing step board 1, make sure switch 1 and 2 are pointed away from ON (Figure 7–32). If replacing optional step board 2, make sure switch 1 is pointed towards ON and switch 2 is pointed away from ON (Figure 7–33).
8. Replace Step POL board and reassemble in reverse order.

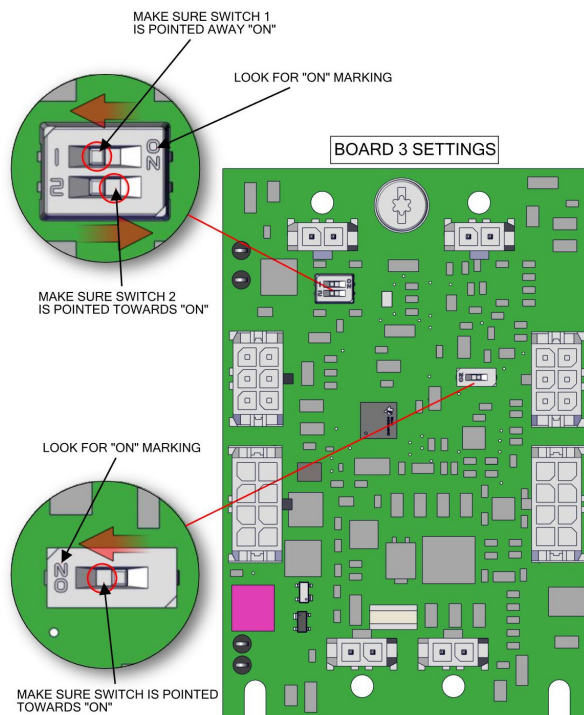




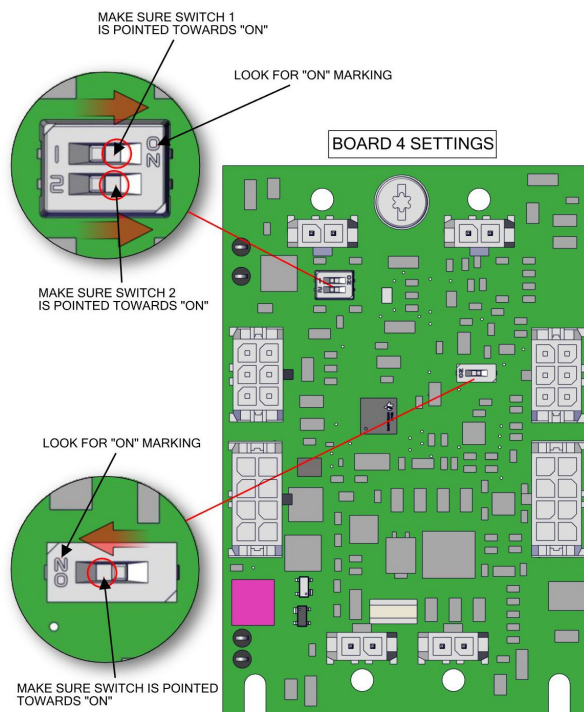
**Figure 7–32.** Step POL Board 1 Switch Settings (Optional)



**Figure 7–33.** Step POL Board 2 Switch Settings



**Figure 7–34.** Step POL Board 3 Switch Settings

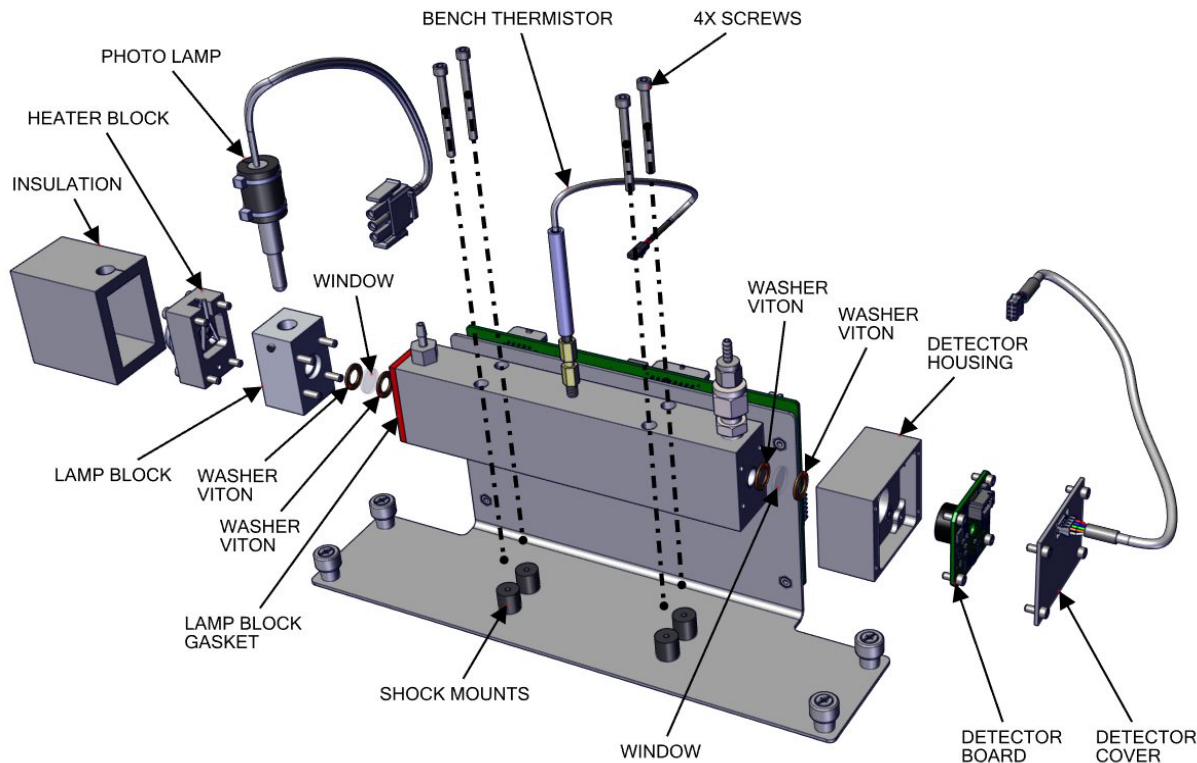


**Figure 7–35.** Step POL Board 4 Switch Settings (Optional)

## Optional Photometer DMC

Use the following procedure to service the Photometer DMC and replace the following as necessary:

- Photometer DMC removal
- Photometer lamp replacement
- Photometer heater replacement
- Photometer DMC board replacement
- Detector board replacement
- Thermistor replacement



**Figure 7–36.** Photometer Bench DMC Layout

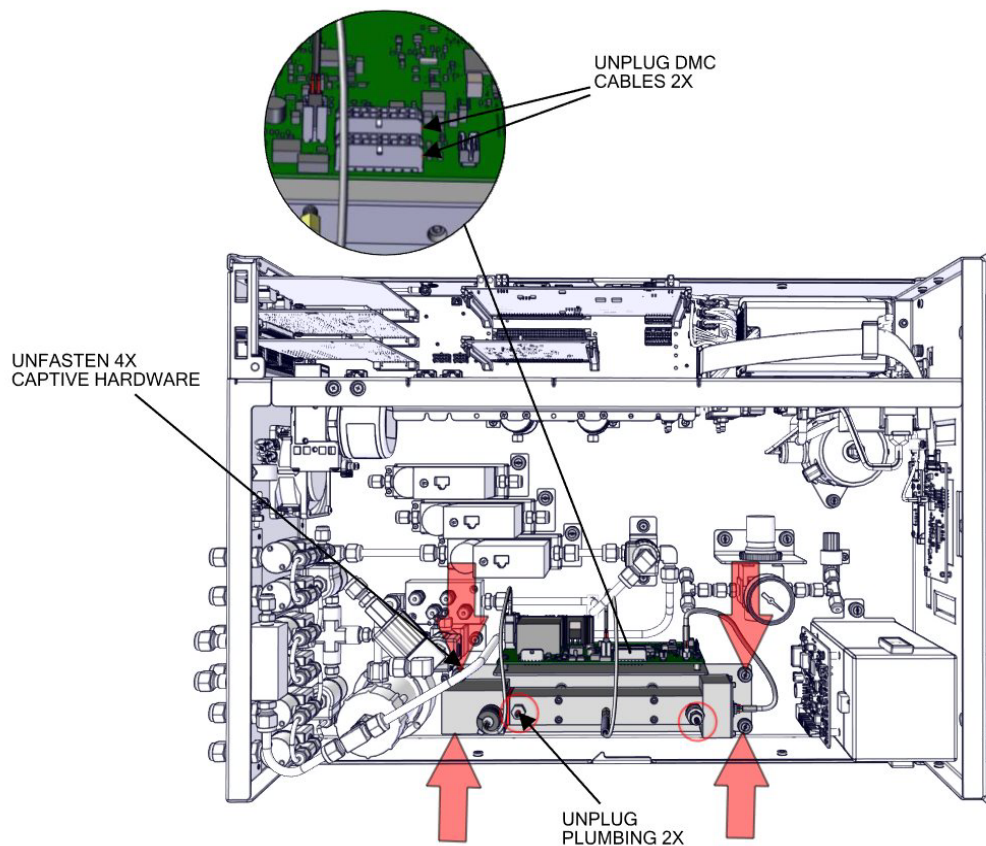
## Photometer DMC Removal

Use the following procedure to remove the Photometer DMC and replace the board.

Equipment required:

Phillips drive, #2

1. Turn instrument OFF, unplug power cord, and remove the cover (Figure 2-1).
2. Unplug DMC cables.
3. Disconnect 2X plumbing (Figure 7-37).
4. Using a #2 Phillips drive, unfasten 4X captive hardware.



**Figure 7-37.** Photometer Bench DMC Removal

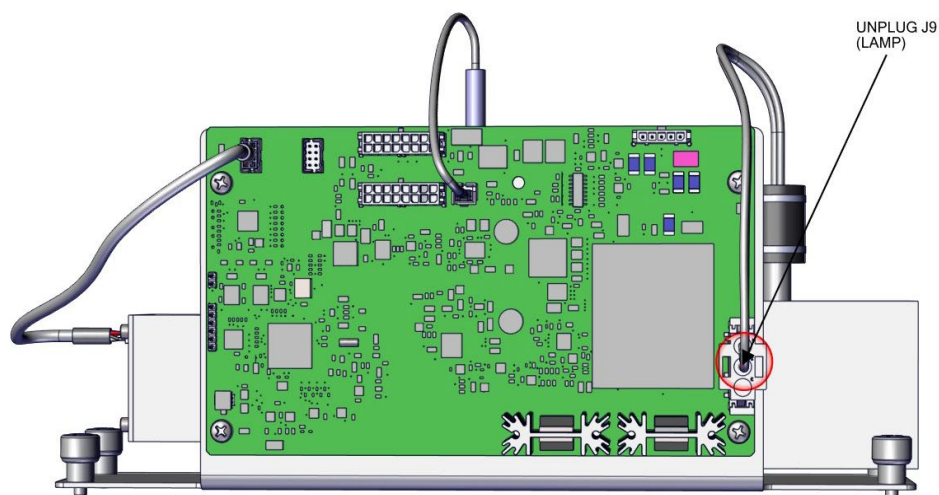
## Photometer Lamp Replacement

Use the following procedure to remove and replace the photometer lamp.

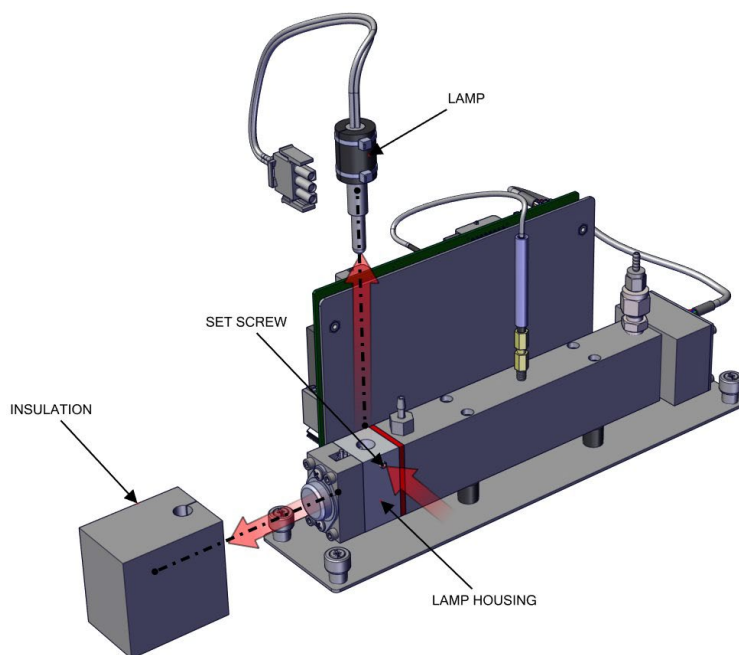
Equipment required:

Hex drive, 1/16

1. Turn instrument OFF, unplug power cord, and remove the cover (Figure 2–1).
2. Unplug J9 lamp connector.



**Figure 7–38.** Lamp Removal pt 1



**Figure 7–39.** Lamp Removal pt 2

3. Slide insulation outwards.
4. Using a 1/16 hex drive, unfasten the #6-32 set screw.
5. Replace lamp and reassemble in reverse order.



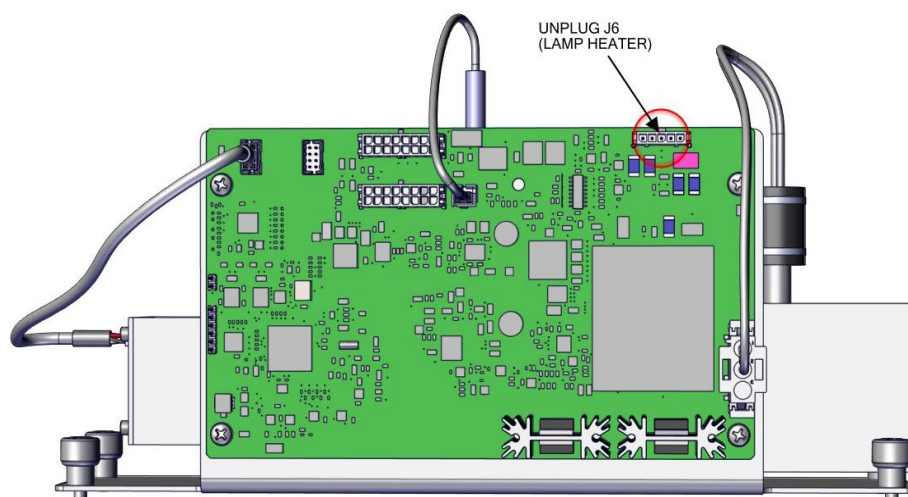
## Photometer Lamp Heater Replacement

Use the following procedure to remove and replace the photometer lamp heater.

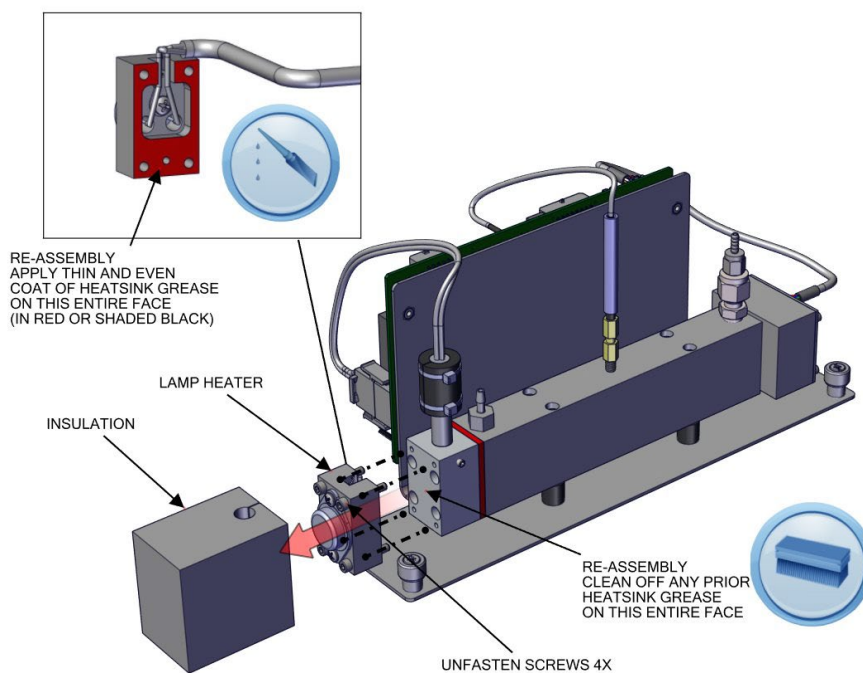
Equipment required:

Hex drive, 7/64

1. Turn instrument OFF, unplug power cord, and remove the cover (Figure 2–1).
2. Unplug J6 lamp heater connector.



**Figure 7–40.** Lamp Removal pt 1



**Figure 7-41.** Lamp Heater Removal pt 2

3. Slide insulation outwards.
4. Using a 7/64 hex drive, unfasten four #6-32 cap head screws.
5. Clean off any prior heatsink grease on the entire face.
6. Apply a thin and even coat of heatsink grease on this entire face (in red or shaded black).
7. Replace lamp heater and reassemble in reverse order.



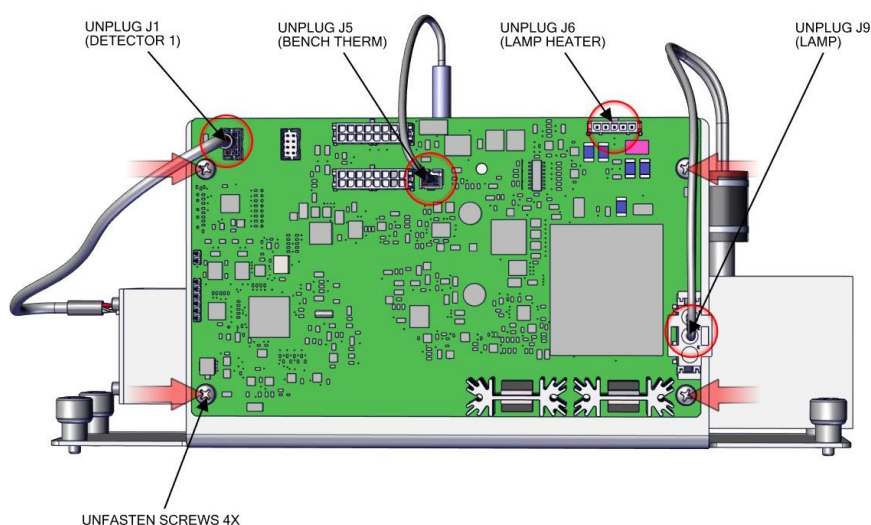
## Photometer DMC Board Replacement

Use the following procedure to replace the board.

Equipment required:

Phillips drive, #2

1. Unplug electrical, detector 1, bench thermistor, lamp heater and lamp.
2. Using a #2 Phillips drive, unfasten four 6-32 pan head screws.



**Figure 7–42.** Photometer Board Replacement

3. Replace board and reassemble in reverse order.

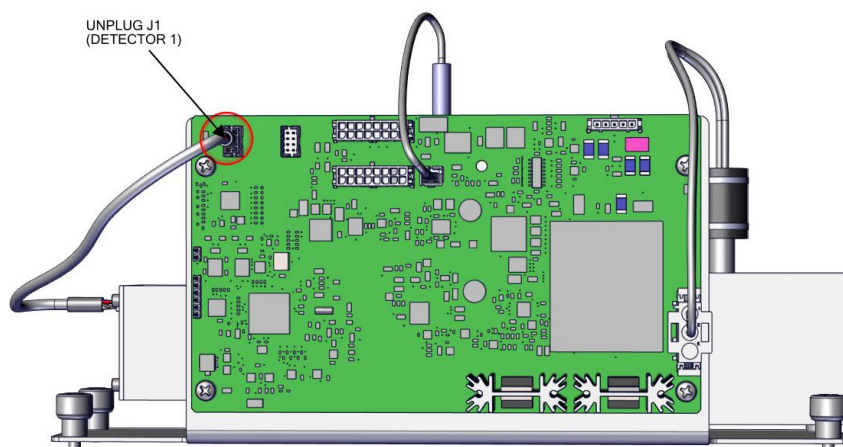
## Detector Board Replacement

Use the following procedure to remove the pre-amplifier/detector assembly.

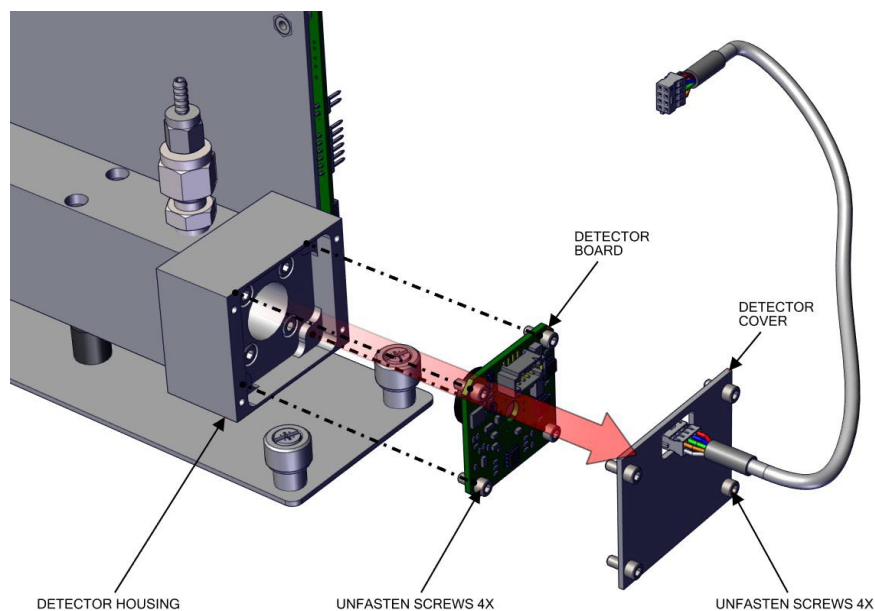
Equipment required:

Hex drive, 3/32

1. Turn instrument OFF, unplug power cord, and remove the cover (Figure 2-1).
2. Unplug electrical cable from detector 1.



**Figure 7-43.** Preamp Detector Cover Removal



**Figure 7–44.** Replacing Detector Board

3. Using a 3/32 hex drive, unfasten four #4-40 cap head screws to remove the cover.
4. Remove detector cover.
5. Using a 3/32 hex drive, unfasten four #4-40 cap head screws to replace per board.
6. Replace detector board and reassemble in reverse order.

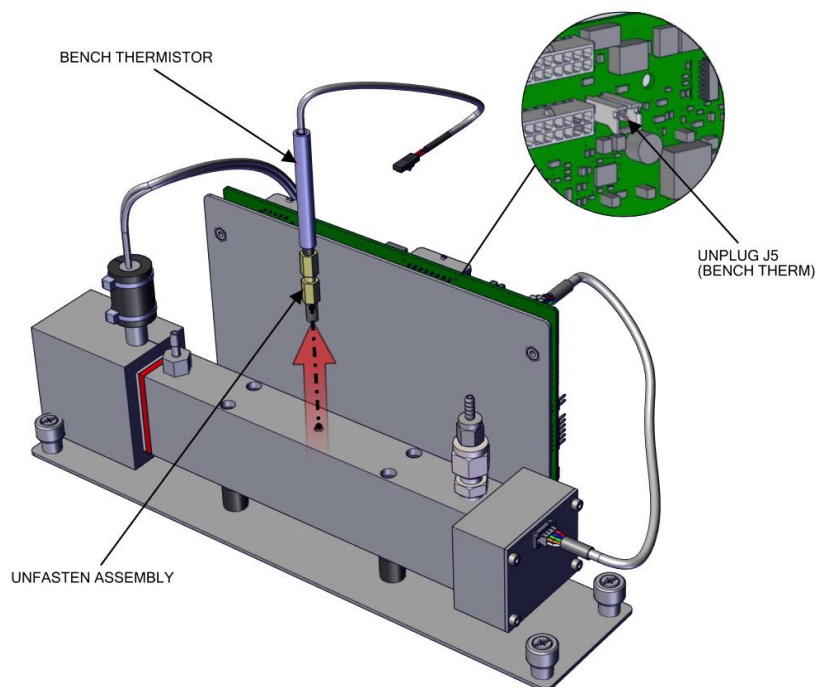
## Thermistor Replacement

Use the following procedure to replace the thermistor.

Equipment required:

Wrench

1. Turn instrument OFF, unplug power cord, and remove the cover (Figure 2–1).
2. Unplug J5 bench therm from the photometer DMC board.
3. Using a wrench, unfasten 1/4 hex nut.
4. Pull thermistor outward.
5. Replace thermistor and reassemble in reverse order.



**Figure 7–45.** Replacing the Thermistor

## **Optional DMC Ozonator**

Use the following procedure to remove the DMC from the instrument case. It is easier to do the following by removing the DMC first then remove and replace the following as necessary:

- Ozonator DMC removal
- Lamp replacement
- Ozonator DMC board replacement
- Ozonator detector board replacement
- Ozonator replacement
- Ozonator DMC reassemble

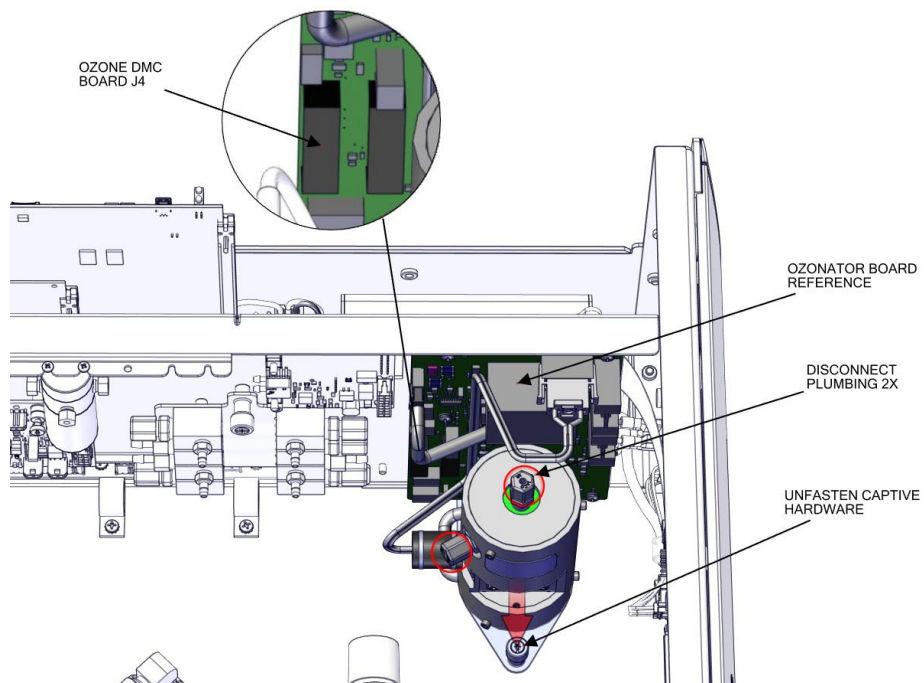
## **DMC Ozonator Removal**

Use the following procedure to remove and replace the ozonator.

Equipment required:

Phillips drive, #2

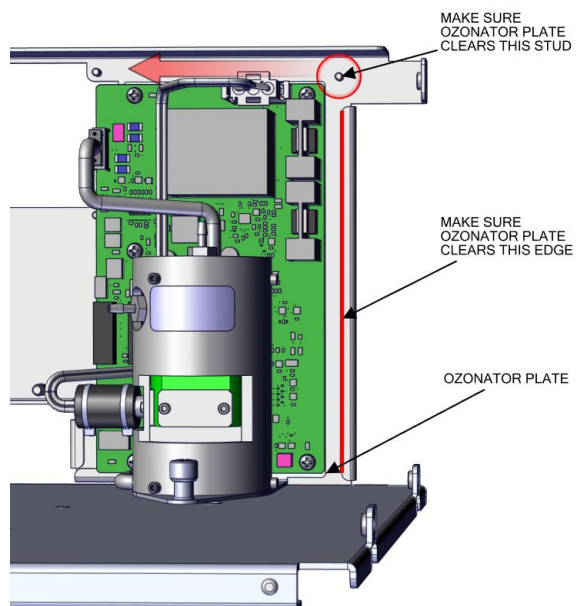
1. Turn instrument OFF, unplug power cord, and remove the cover (Figure 2–1).
2. Unplug electrical, unplug DMC cable to ozonator board DMC (J4).
3. Disconnect 2X plumbing.
4. Using a #2 Phillips drive, unfasten captive hardware.



**Figure 7-46.** Ozone remove pt 1

5. Slide ozonator assembly left.

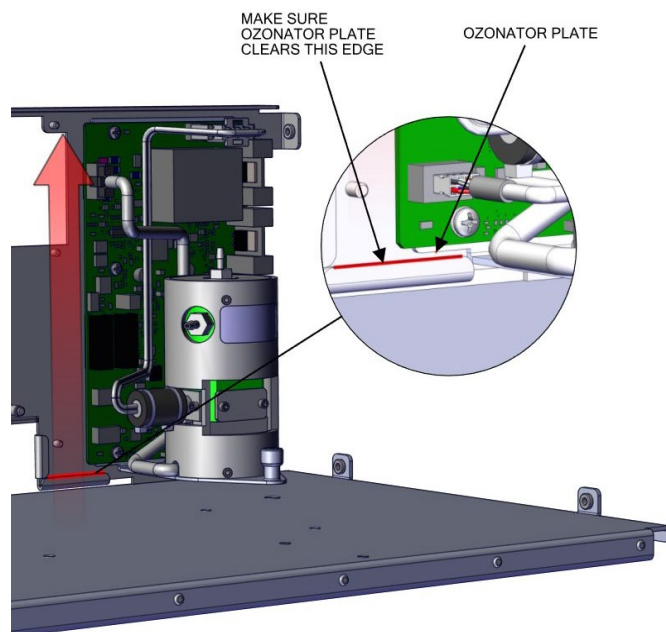
**Note** Make sure ozonator plate clears the edge and stud. ▲



**Figure 7-47.** Ozone remove pt 2

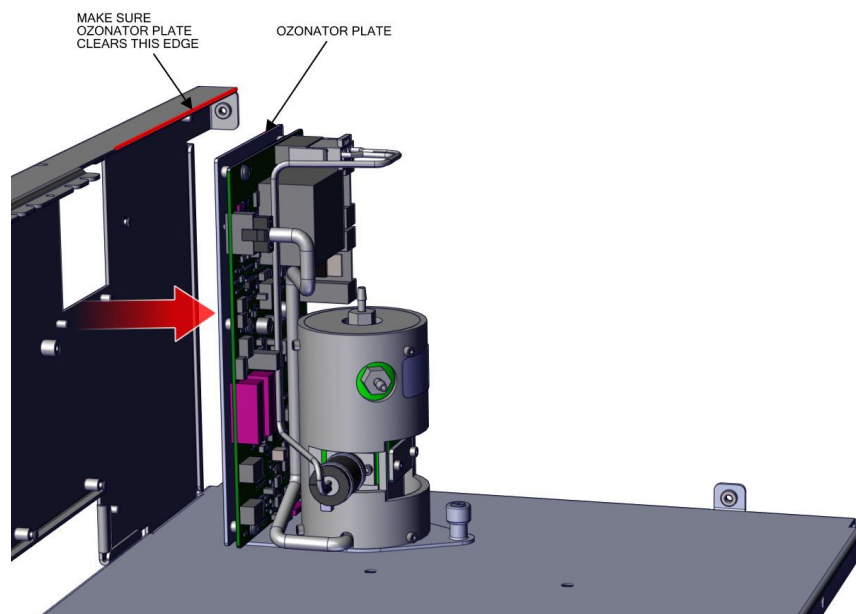
- Slide ozonator assembly upwards.

**Note** Make sure ozonator plate clears the edge. ▲



**Figure 7–48.** Ozone remove pt 3

- Pull away from the partition panel.



**Figure 7–49.** Ozone remove pt 4

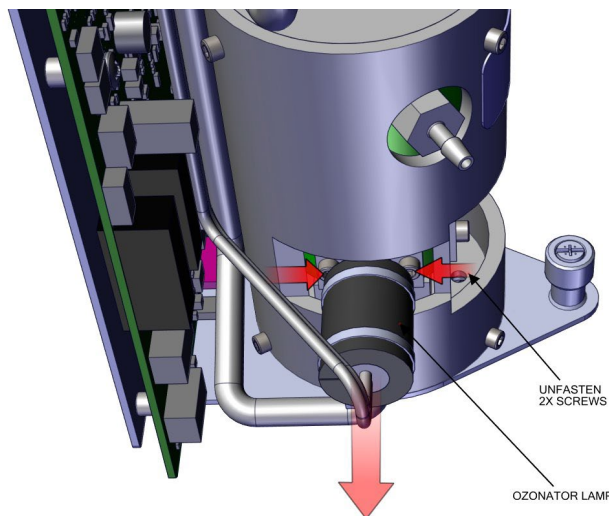
## Lamp Replacement

Use the following to replace the lamp.

Equipment required:

Ball-end hex drive, 3/32

1. Remove the ozonator DMC from the instrument. Refer to “[DMC Ozonator Removal](#)” on page 7-41.
2. Using a 3/32 ball-end hex drive (angle alignment of screws), unfasten two #4-40 cap screws.
3. Pull lamp out.



**Figure 7–50.** Replacing the Lamp

4. Replace lamp and reassemble in reverse order.



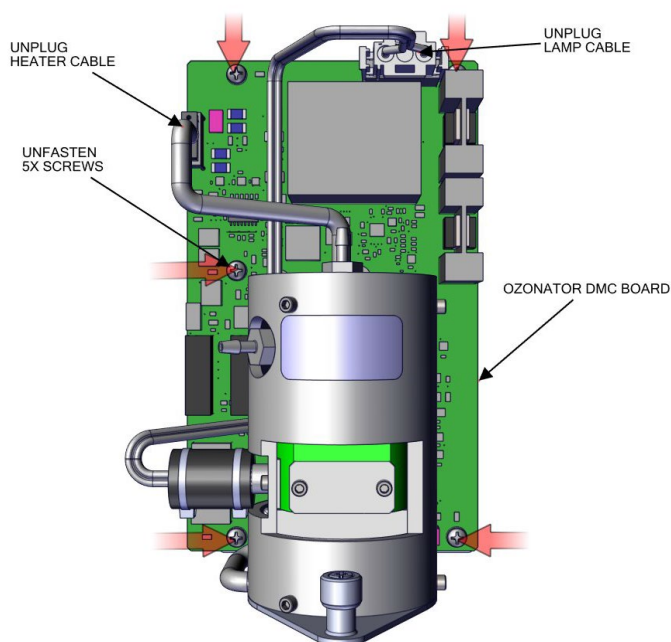
## Ozonator DMC Board Replacement

Use the following procedure to replace the ozonator DMC board.

Equipment required:

Phillips drive, #2

1. Remove the ozonator DMC from the instrument. Refer to “[DMC Ozonator Removal](#)” on page 7-41.
2. Unplug heater and lamp cable.
3. Using a #2 Phillips drive, unfasten five #6-32 pan head screws.



**Figure 7–51.** Replacing the Ozonator DMC Board

4. Replace ozonator DMC board and reassemble in reverse order.

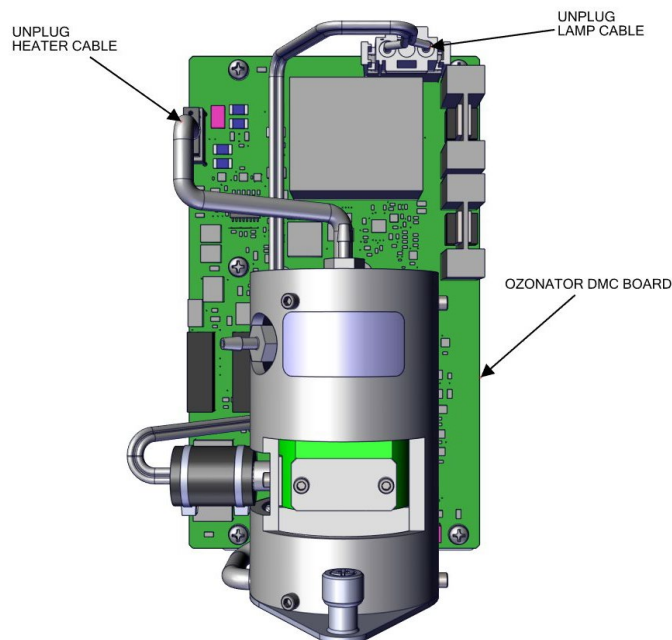
## Ozonator Replacement

Use the following to replace the ozonator.

Equipment required:

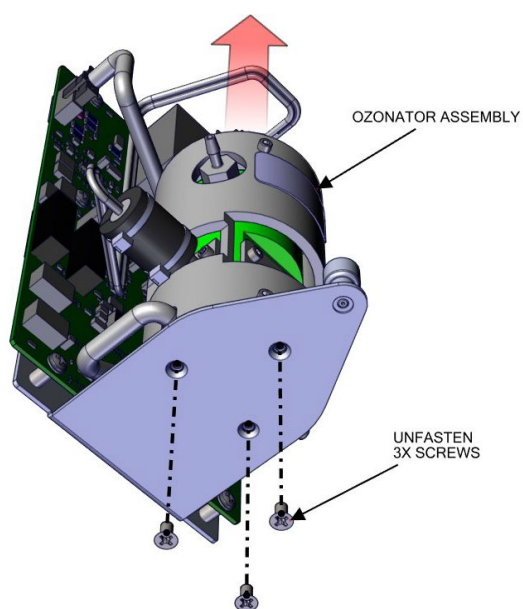
Phillips drive, #2

1. Remove the ozonator DMC from the instrument. Refer to “[DMC Ozonator Removal](#)” on page 7-41.
2. Unplug heater and lamp cable.



**Figure 7-52.** Ozonator replace pt 1

3. Using a #2 Phillips drive, unfasten three #6-32 flat head screws.
4. Pull out ozonator



**Figure 7–53.** Replacing the Ozonator

5. Replace ozonator and reassemble in reverse order.

## Ozonator DMC Install

Use the following to install the Ozonator DMC.

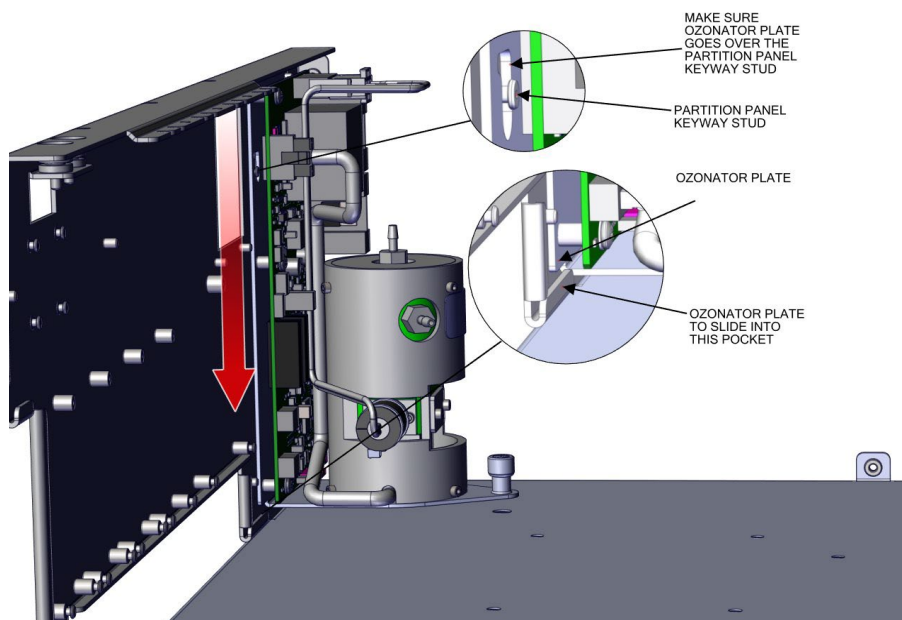
Equipment required:

Phillips drive, #2

1. Slide ozonator assembly downwards.

**Note** Make sure ozonator plate slides into bottom pocket. ▲

**Note** Make sure ozonator plate goes over the partition panel keyway stud. ▲



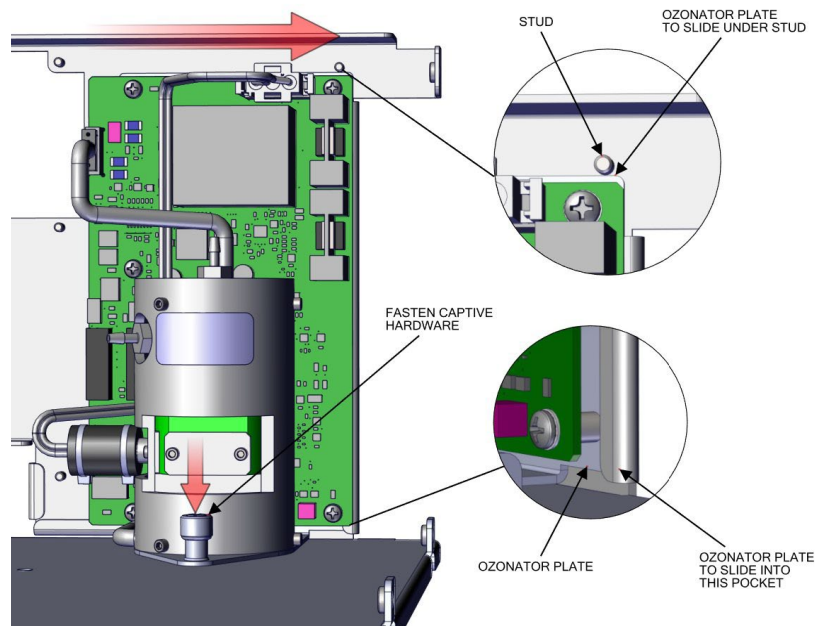
**Figure 7-54.** Installing the Ozonator DMC

2. Slide ozonator assembly right.

**Note** Make sure ozonator plate fits under the stud. ▲

**Note** Make sure ozonator plate slides into side pocket. ▲

3. Using a #2 Phillips drive, fasten captive hardware.



**Figure 7–55.** Ozone DMC install pt 2

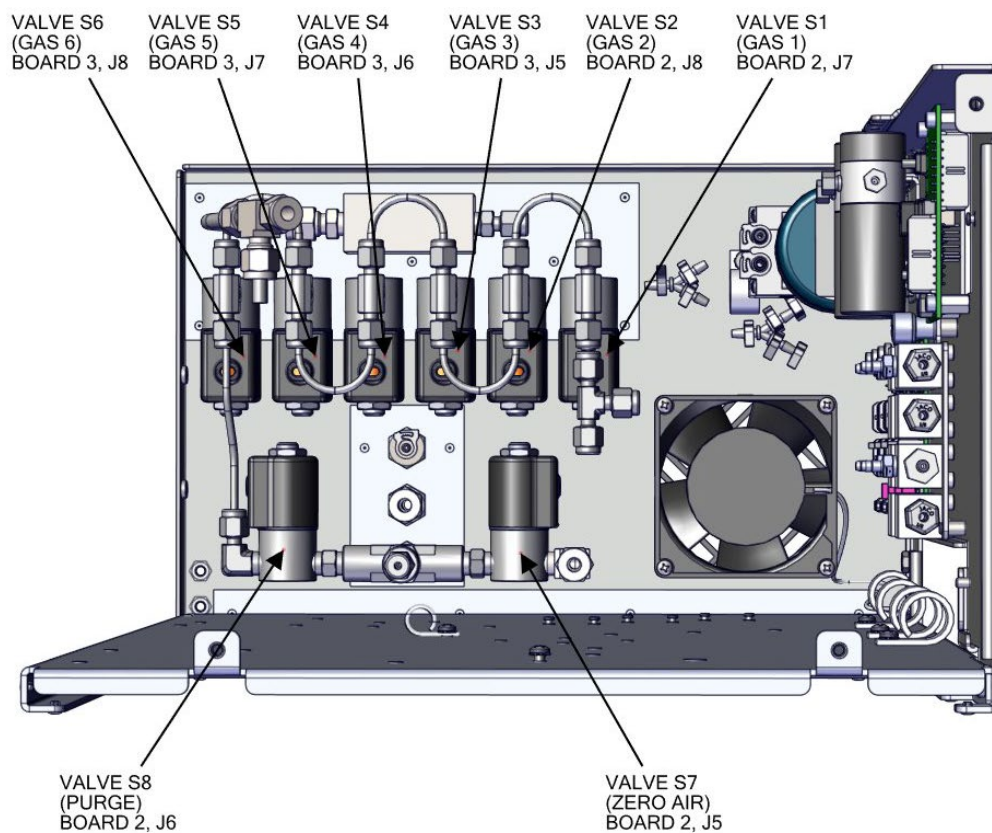
## Valve Replacement

Use the following procedure to replace the valves.

Equipment required:

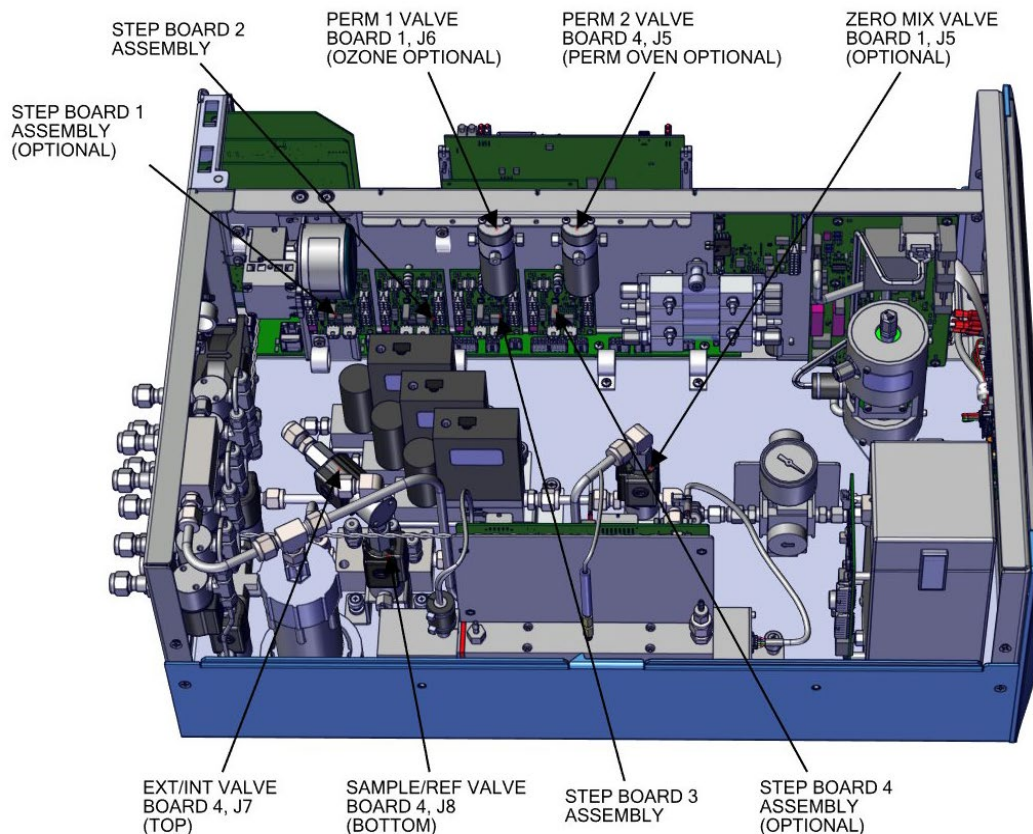
Wrench

1. Turn instrument OFF, unplug power cord, and remove the cover (Figure 2-1).
2. Unplug desired valve. Refer to Figure 7-56, Figure 7-57, and Figure 7-58.

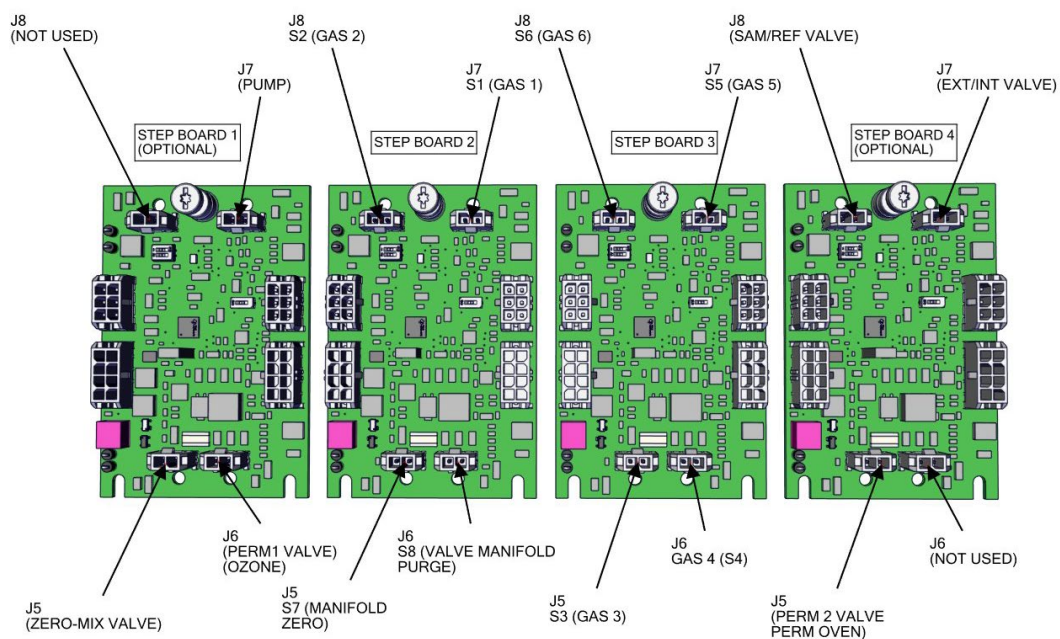


**Figure 7-56.** Valve Replacement pt 1



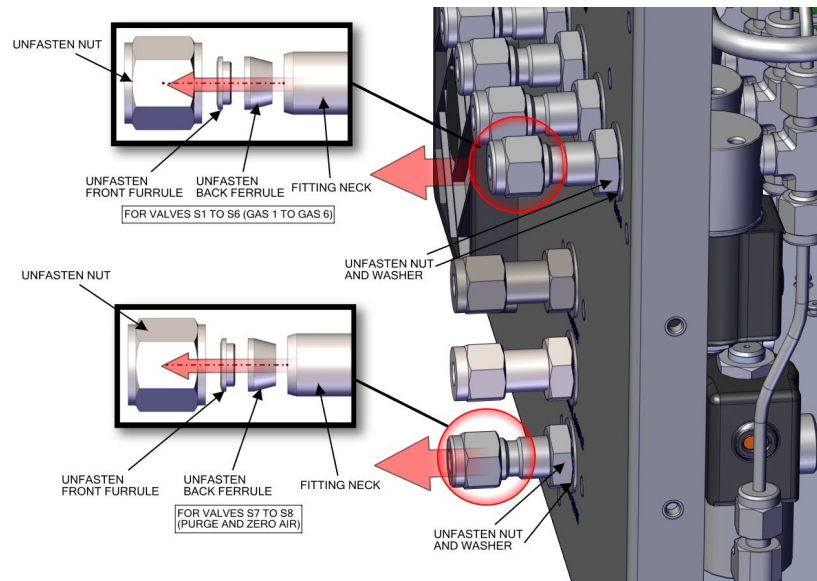


**Figure 7-57.** Valve Replacement pt 2



**Figure 7-58.** Valve Replacement pt 3

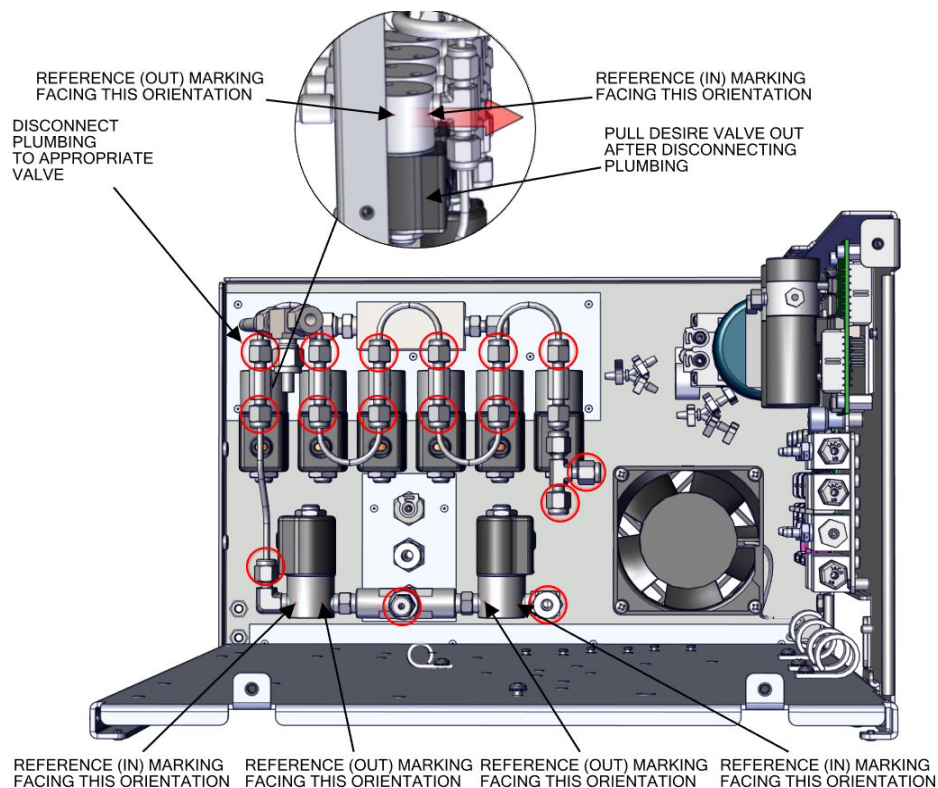
3. Unfasten the appropriate valve nut, remove the nut, front and back ferrules as shown.



**Figure 7–59.** Rear Panel Valves Replacement pt 4

4. Disconnect plumbing to appropriate valve.
5. Pull desired valve out.





**Figure 7–60.** Valve Replacement pt 5

6. Replace valve and reassemble in reverse order.

## Optional Zero Mix Valve Replacement

Use the following procedure to replace the zero mix valve.

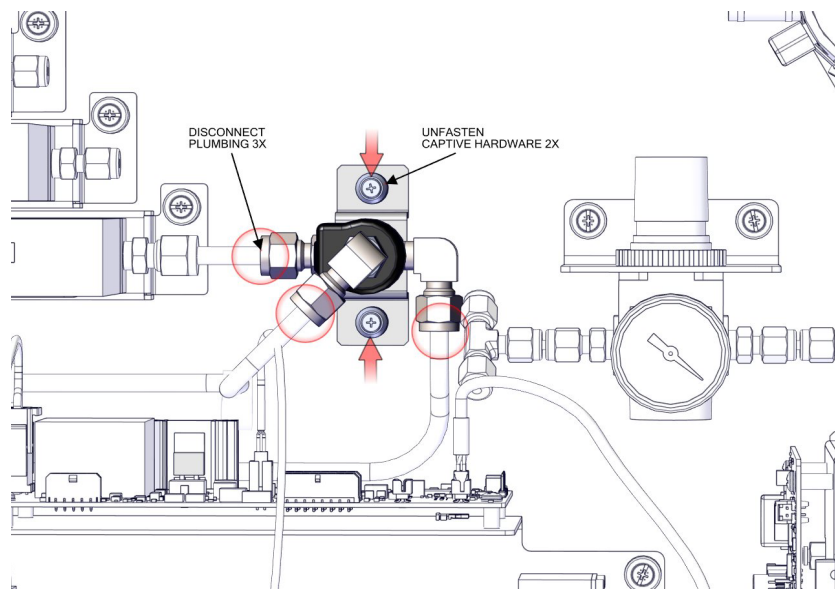
Equipment required:

Phillips drive, #2

Hex drive, 9/64

Adjustable wrenches, qty 2

1. Turn instrument OFF, unplug power cord, and remove the cover (Figure 2-1).
2. Unplug zero mix valve. Refer to Figure 7-57 and Figure 7-58.
3. Using two adjustable wrenches (one to hold fitting body and one to loosen the nut), disconnect plumbing 3X.
4. Using #2 Phillips drive, unfasten two captive hardware.

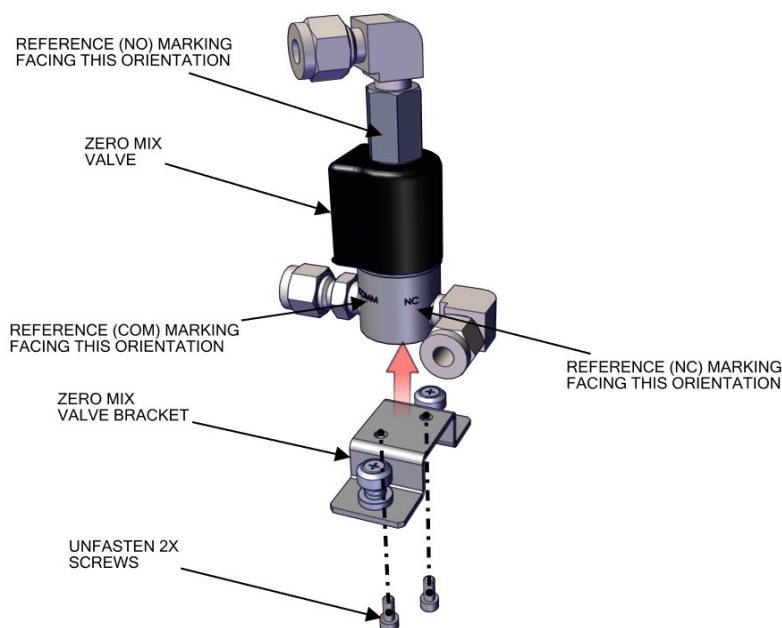


**Figure 7-61.** Replacing the Zero Mix Valve, Electrical

5. Using a 9/64 hex drive, unfasten two 8-32 soc cap head screws.
6. Pull zero mix valve upwards away from bracket.

7. Replace valve with same fitting orientation related to the markings on the valve (COM, NC, NO). Reassemble in reverse order.

**Note** All National Pipe Thread fittings require PTFE tape for sealing. Remove the existing PTFE tape and apply new. Wrap PTFE tape in the same direction of the thread spiral. Wrap around approximate two times around depending on the thickness of the PTFE tape. Make sure PTFE tape does not overhang the first thread (the lead in thread). ▲



**Figure 7–62.** Zero Mix Valve Replacement

## Sample/Ref Valve and Ext/Int Valve Replacement

Use the following procedure to replace the sample/reference valve and external/internal valve.

Equipment required:

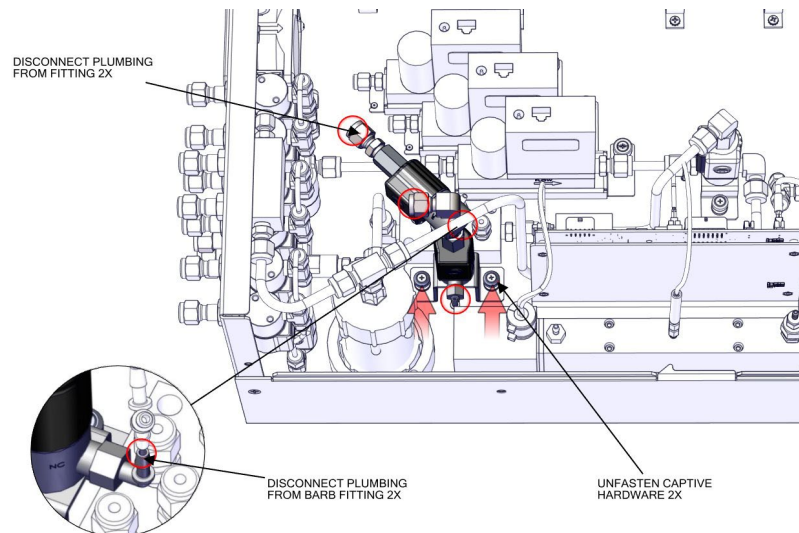
Phillips drive, #2

Hex drive, 9/64

Adjustable wrenches, qty 2

Needle nose pliers

1. Turn instrument OFF, unplug power cord, and remove the cover (Figure 2-1).
2. Unplug desired valve. Refer to Figure 7-57 and Figure 7-58.
3. Using two adjustable wrenches (one to hold fitting body and one to loosen the nut), disconnect plumbing 2X. **Do not disconnect the other 2X barb fitting with wrench.** Use needle nose pliers.
4. Using a #2 Phillips drive, unfasten captive hardware.

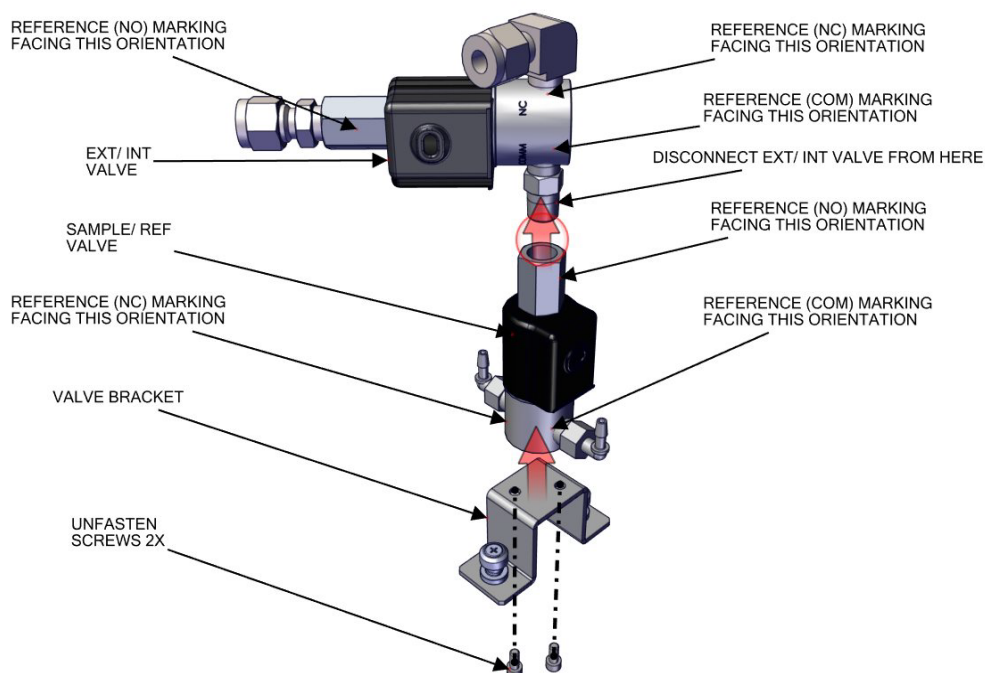


**Figure 7-63.** Replacing Sample/Ref Valve and Ext/Int Valve, Electrical

5. Using a 9/64 hex drive, unfasten two 8-32 soc cap head screws.

6. Pull sample/reference valve upwards away from bracket.
7. Unfasten external/internal valve from fitting.
8. Replace desired valve with same fitting orientation related to the markings on the valve (COM, NC, NO). Reassemble in reverse order.

**Note** All National Pipe Thread fittings require PTFE tape for sealing. Remove the existing PTFE tape and apply new. Wrap PTFE tape in the same direction of the thread spiral. Wrap around approximate two times around depending on the thickness of the PTFE tape. Make sure PTFE tape does not overhang the first thread (the lead in thread). ▲



**Figure 7–64.** Sample/Ref Valve and Ext/Int Valve Replacement

## MFC Replacement

Use the following procedure to replace the MFCs.

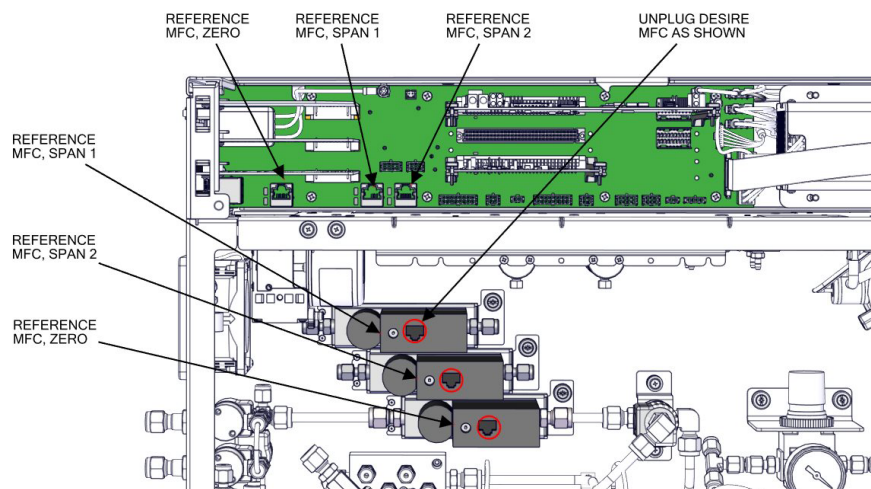
Equipment required:

Phillips drive, #2

Hex drive, 9/64

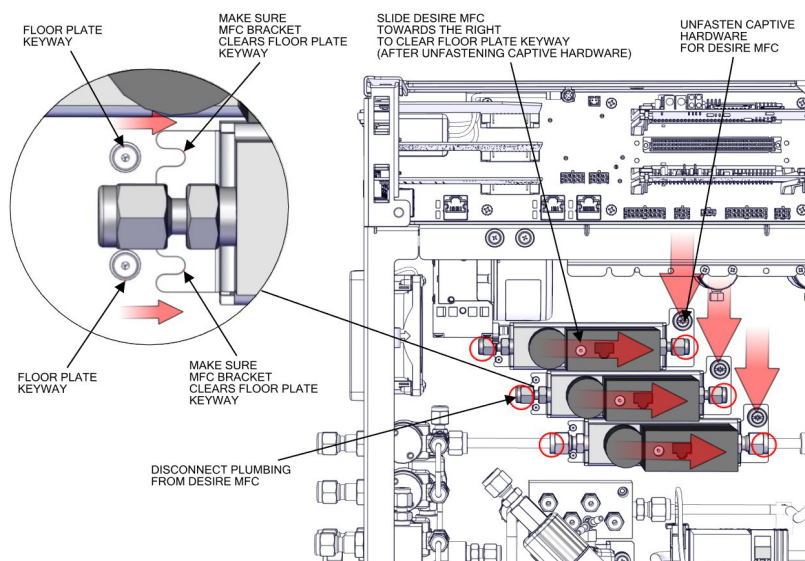
Adjustable wrenches, qty 2

1. Turn instrument OFF, unplug power cord, and remove the cover (Figure 2-1).
2. Unplug desired MFC (as shown, top of MFC).



**Figure 7-65.** MFC Replacement, Electrical

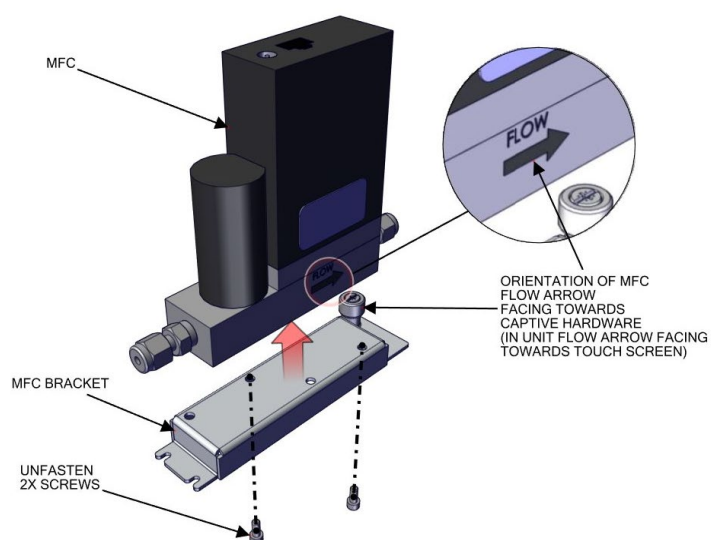
3. Using two Adjustable wrenches (one to hold fitting body and one to loosen the nut), disconnect desire MFC, plumbing 2X.
4. Using a #2 Phillips drive, unfasten captive hardware.
5. Slide towards the right, clearing the floor plate keyway.



**Figure 7-66.** MFC Replacement, Plumbing

6. Using a 9/64 hex drive, unfasten two 8-32 soc cap head screws.
7. Pull MFC upwards.
8. Replace MFC and assemble in reverse order.

**Note** Orientation of MFC flow arrow facing towards captive hardware (in unit flow arrow facing towards touchscreen). ▲



**Figure 7-67.** MFC Replacement



## Optional Pressure Regulator Replacement

Use the following procedure to replace the pressure regulator.

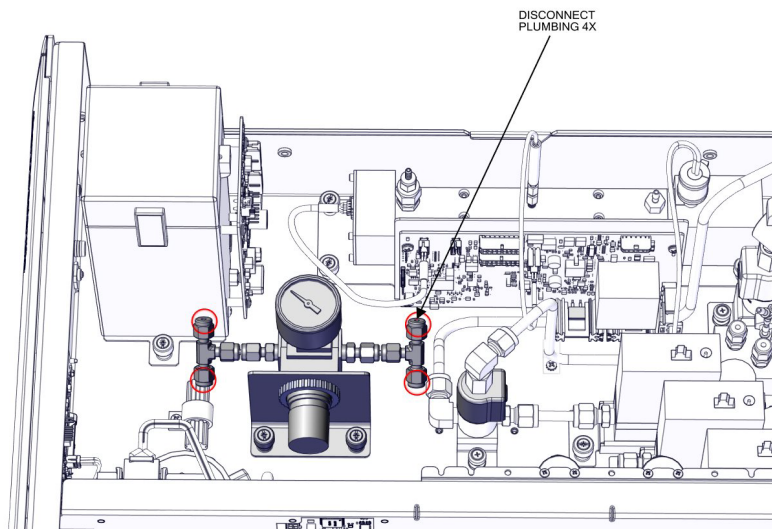
Equipment required:

Phillips drive, #2

Hex drive, 9/64

Adjustable wrenches, qty 2

1. Turn instrument OFF, unplug power cord, and remove the cover (Figure 2-1).
2. Using two Adjustable wrenches (one to hold fitting body and one to loosen the nut), disconnect plumbing 4X.



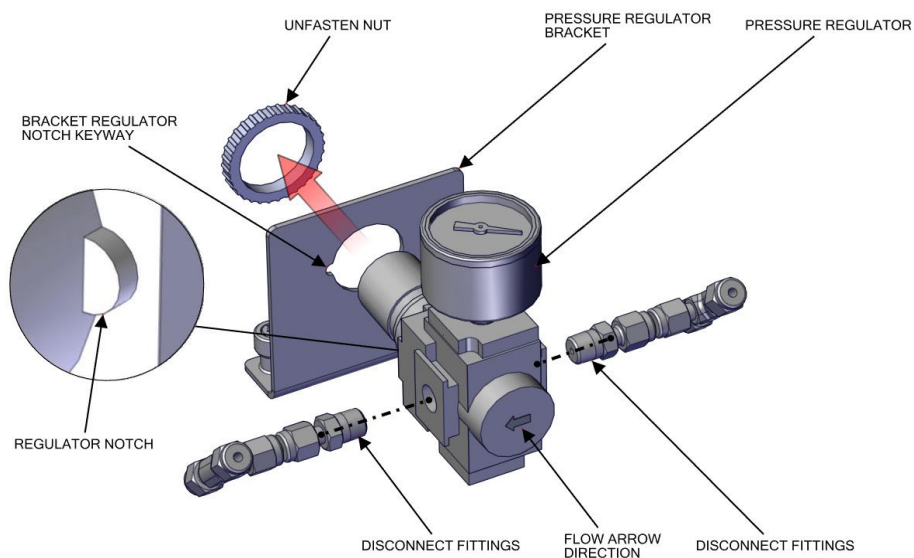
**Figure 7-68.** Pressure Regulator Replacement, Plumbing

3. Using an adjustable wrench, unfasten nut.
4. Pull pressure regulator outwards, away from pressure regulator bracket.
5. Using an adjustable wrench and vice (wrench fitting and vice valve body), remove fittings as shown.
6. Replace pressure regulator with same fitting orientation related to the markings on the flow arrow. Make sure regulator notch aligns to the



regulator notch on the bracket. This will keep the regulator from rotating. Resemble in reverse order.

**Note** All National Pipe Thread fittings require PTFE tape for sealing. Remove the existing PTFE tape and apply new. Wrap PTFE tape in the same direction of the thread spiral. Wrap around approximate two times around depending on the thickness of the PTFE tape. Make sure PTFE tape does not overhang the first thread (the lead in thread). ▲



**Figure 7–69.** Pressure Regulator Replacement, Hardware

## Mixing Chamber Replacement

Use the following procedure to replace the mixing chamber.

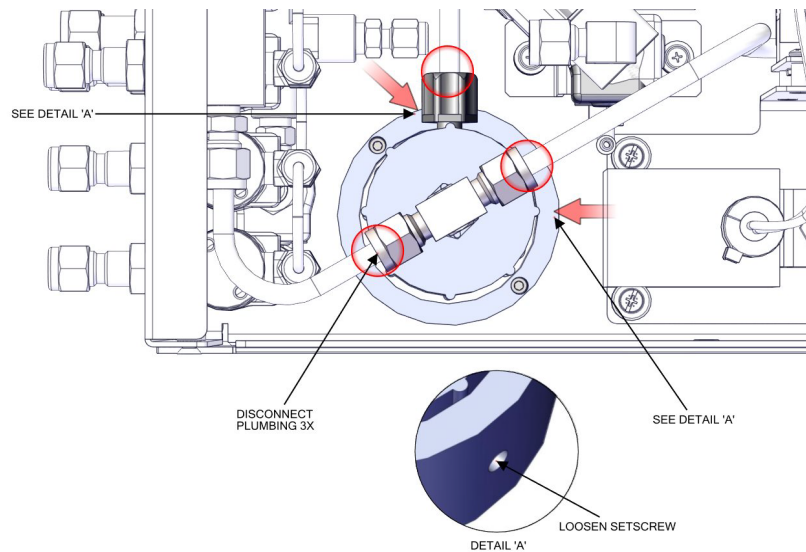
Equipment required:

Phillips drive, #2

Hex drive, 9/64

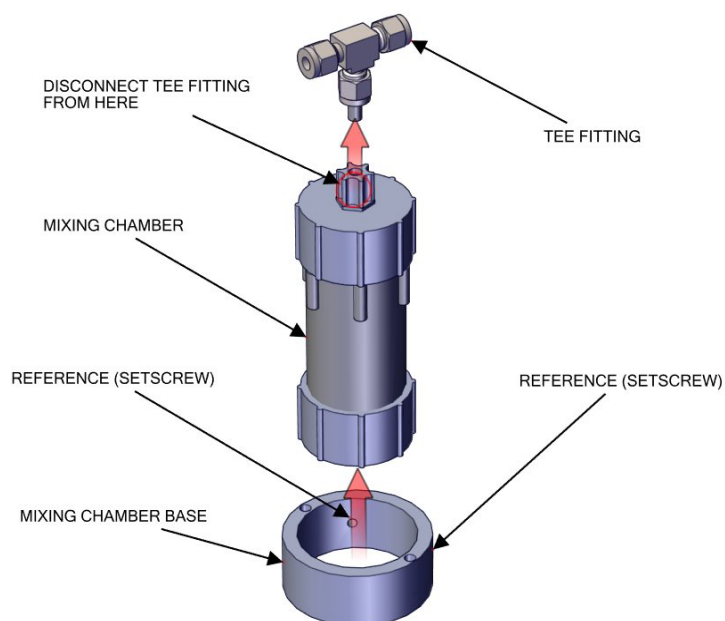
Adjustable wrenches, qty 2

1. Turn instrument OFF, unplug power cord, and remove the cover (Figure 2-1).
2. Using two Adjustable wrenches (one to hold fitting body and one to loosen the nut), disconnect plumbing 3X.
3. Using 3/32 hex drive, loosen the two setscrews (detail 'A').



**Figure 7-70.** Mixing Chamber Replacement, Plumbing

4. Pull mixing chamber upwards.
5. Using adjustable wrench, disconnect tee fitting as shown.
6. Replace mixing chamber and reassemble in reverse order.



**Figure 7–71.** Mixing chamber Replacement

## Optional DMC Permeation Oven Solenoid Valve Replacement



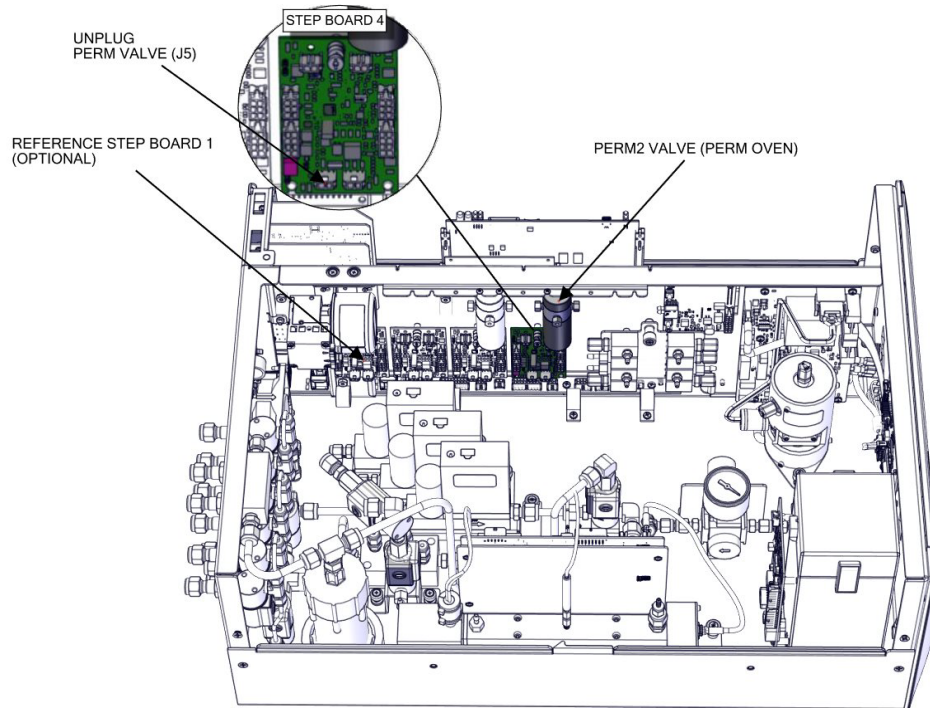
Use the following procedure to replace the DMC permeation oven solenoid valve option.

Equipment required:

Phillips drive, #1

**CAUTION** Allow the oven to cool down prior to servicing. ▲

1. Turn the instrument OFF, unplug the power cord, and remove the cover (Figure 2-1).
2. Unplug perm valve J5 from Step POL board 4.

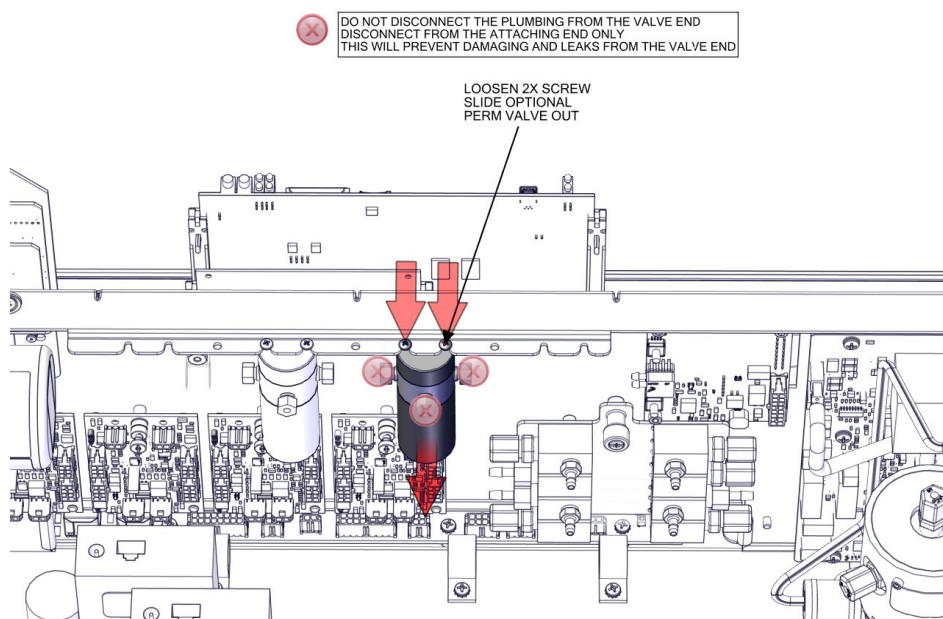


**Figure 7-72.** Removing and Replacing the Solenoid Valve pt 1

3. Loosen two 4-40 screws and slide optional perm valve out.



**Equipment Damage** Do not disconnect the plumbing from the valve end. Disconnect from the attaching end only. This will prevent damaging and leaks from the valve end. ▲



**Figure 7–73.** Removing and Replacing the Solenoid Valve pt 2

4. Replace the permeation oven solenoid valve and assemble in reverse order.

## Permeation Oven Replacement

Use the following procedure to replace the permeation oven.

Equipment required:

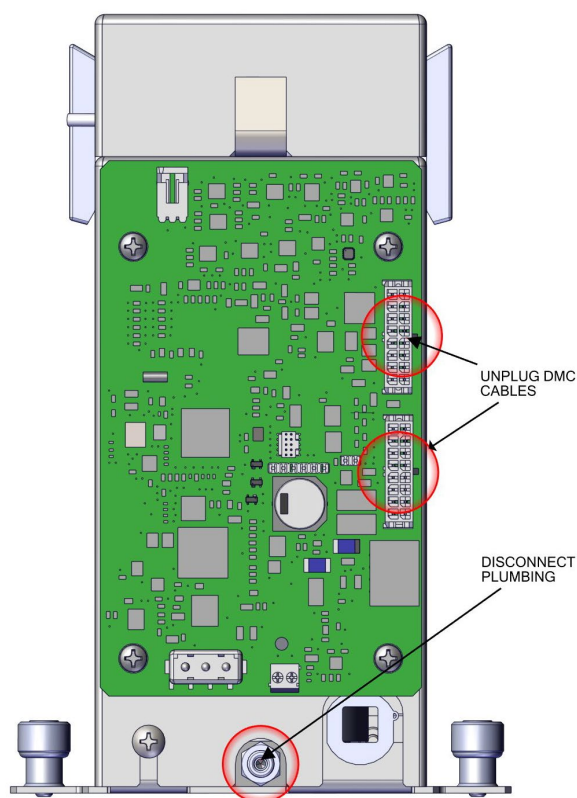
Phillips drive, #2

Tube release tool (optional)



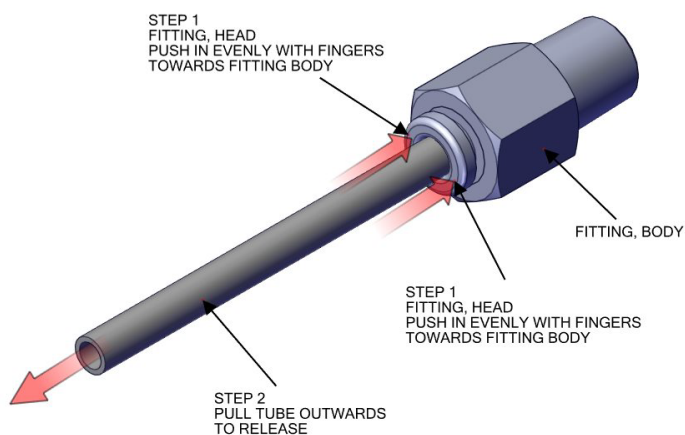
**CAUTION** Allow oven to cool down prior to servicing. ▲

1. Turn the instrument OFF, unplug the power cord, and remove the cover (Figure 2-1).
2. Unplug DMC cables as shown.
3. Disconnect plumbing.



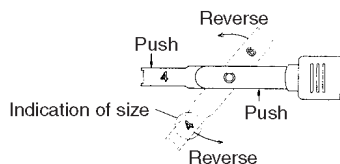
**Figure 7-74.** Perm Oven pt 1

4. Push in fitting head evenly with fingers towards fitting body.

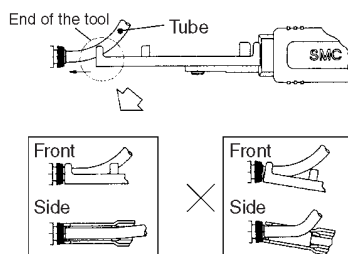


**Figure 7–75.** Finger Push and Release Tubing

5. Pull tube outwards to release. If using the tool provided:
  - a. Adjust tool size to 1/4 tube as indicated on the back side.



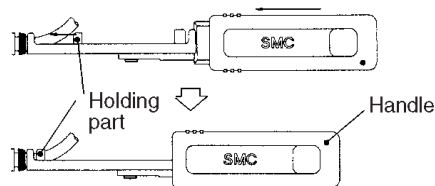
- b. Tool edge should be pushed straightforward into the edge of the release button along with the tube in the axial fitting direction.



- c. After inserting, grasp handle tightly and insert the end of the tubing to the stroke end.

**Note** Insert firmly to the guard against an accidental tube release. ▲

- d. After inserting end of tube, relax your grip on the tool. Returning force of spring releases the tube.

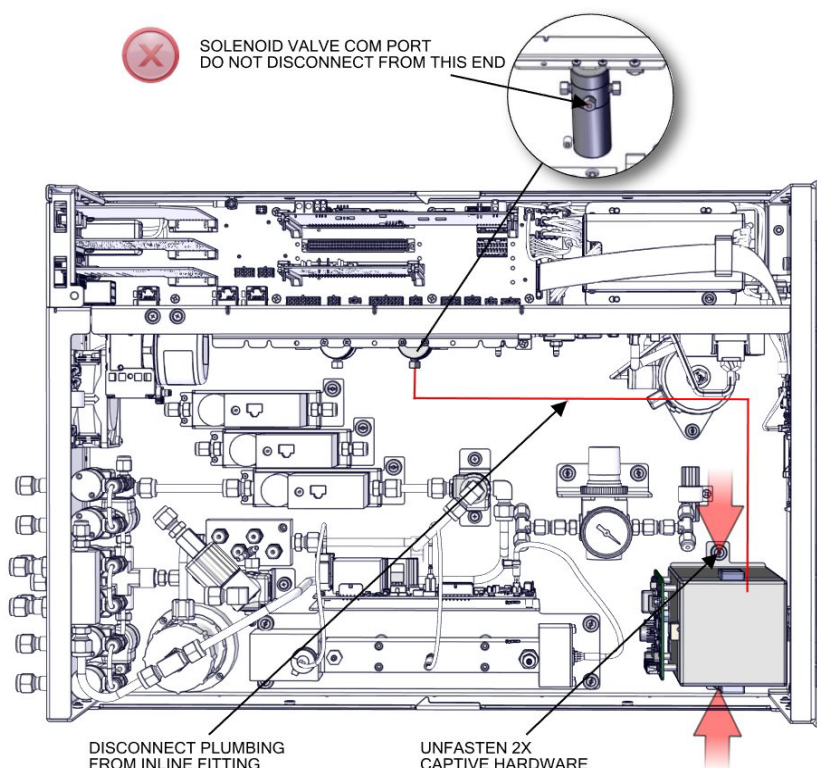


Push both sides at once to release. Reverse and fix at the same position as before. Applicable tube size is indicated on the back side.

6. Disconnect plumbing from inline fitting.

**Note** Do not disconnect from valve end. ▲

7. Unfasten two captive hardware.



**Figure 7-76.** Perm Oven Replacement pt 2

8. Replace DMC permeation oven and assemble in reverse order.



## Permeation Oven Board Replacement

Use the following procedure to replace the permeation oven board.

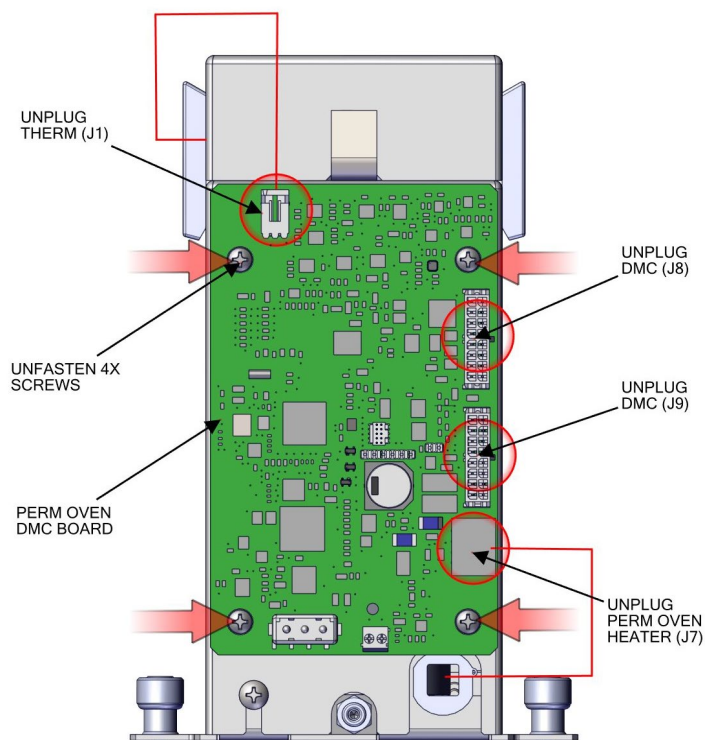
Equipment required:

Phillips drive, #2



**CAUTION** Allow oven to cool down prior to servicing. ▲

1. Turn instrument OFF, unplug power cord, and remove the cover (Figure 2–1).
2. Unplug all electrical J1, J7, J8, J9 as shown.
3. Using #2 Phillips drive, unfasten four 6-32 pan head screws.



**Figure 7–77.** Replacing the Permeation Oven Board

4. Replace permeation board and assemble in reverse order.



## Chapter 8

# System Description

The 146iQ deploys a set of modular subsystems that comprise the total instrument function. The core measurements for concentration are contained in Distributed Measurement and Control (DMC) modules. This chapter describes the function and location of the system components in the module framework, including firmware, electronics, and I/O function.

The 146iQ components include:

- Flow Controllers
  - Zero air/dilution gas flow controller
  - Span gas flow controller
  - Span gas flow controller range 2 (optional)
- Photometer DMC with lamp (optional)
  - Detector assembly
  - Photometer lamp power supply
  - Photometer DMC board
- Ozonator DMC (optional)
  - Ozonator lamp power supply
  - Ozonator DMC board
- Permeation Oven (optional)
- Common Electronics
  - Power supply
  - System Control board
  - Backplane board
  - Front panel
  - I/O (optional)
- Peripherals Support System
  - Fan (on rear panel)

- Step POL board
- Sample pump (with photometer)
- Solenoid valve assemblies
- Flow Pressure DMC with flow restricting capillaries

## **Flow Controllers**

The 146iQ can be configured with flow controllers for providing calibration gas to other instruments. These flow controllers regulate the amount of calibration gas by mixing a flow of span gas using one flow controller with zero air or a dilution gas using a second flow controller. The flow controllers are digitally controlled via a RS-485 interface.

### **Zero Air/Dilution Gas Flow Controller**

Provides controlled amounts of zero air or a dilution gas for diluting span or calibration gases by a specified amount to provide a known calibration gas output from the 146iQ to the external analyzer.

### **Span Gas Flow Controller**

A flow controller to provide a known amount of calibration gas to be diluted.

### **Span Gas Flow Controller Range 2 (optional)**

The 146iQ can be configured with a second span gas flow controller to provide a greater operating range of calibration gas output from the 146iQ to the external analyzer.

## **Photometer DMC with Lamp**

The optical bench has an airtight chambers that alternately contain the sample and reference gases with a photometer lamp at one end and a detector at the other end.

### **Detector System**

The photo-diode in the detector transmits light intensity information to the DMC board for sample measurement computations.

### **Photometer Lamp Power Supply**

The photometer lamp power supply generates high voltage AC and contains heater control circuits for the photometer lamp.

## **Ozonator DMC**

The optional internal ozonator operates on the photolytic principle. The ozone level produced is a function of light intensity at 185 nm and gas flow. The light intensity is varied by changing the current into the lamp.

The gas flow is held constant by a pressure regulator followed by a capillary, and is actively measured by the flow pressure DMC.

### **Ozonator Lamp Power Supply**

The optional ozonator lamp power supply generates high voltage AC and contains heater control circuits for the ozonator lamp.

## **Permeation Oven (Optional)**

The 146iQ can be configured with an optional permeation oven for generating stable concentrations of calibration gases that can then be diluted down to the user-desired concentrations and flows with the help of the Zero Air Mass Flow Controller. The permeation oven is configured as a DMC module with self-contained temperature measurements and heater controls. For more information, see “[Permeation Oven](#)” as described in Chapter 9, “[Optional Equipment](#)”.

## **Common Electronics**

The common electronics contain the core computational and power routing hardware for the 146iQ, and is replicated throughout other iQ series products ([Figure 8–1](#)). It also contains the front panel display, the USB ports, the Ethernet port, and the optional I/O interfaces (RS-485, analog, and digital).

[Figure 8–2](#) shows the PCBA interconnect structure for the 146iQ, including options. The modular design of the instrument is conveyed in the architecture. Brief descriptions of the specific PCBAs follow.

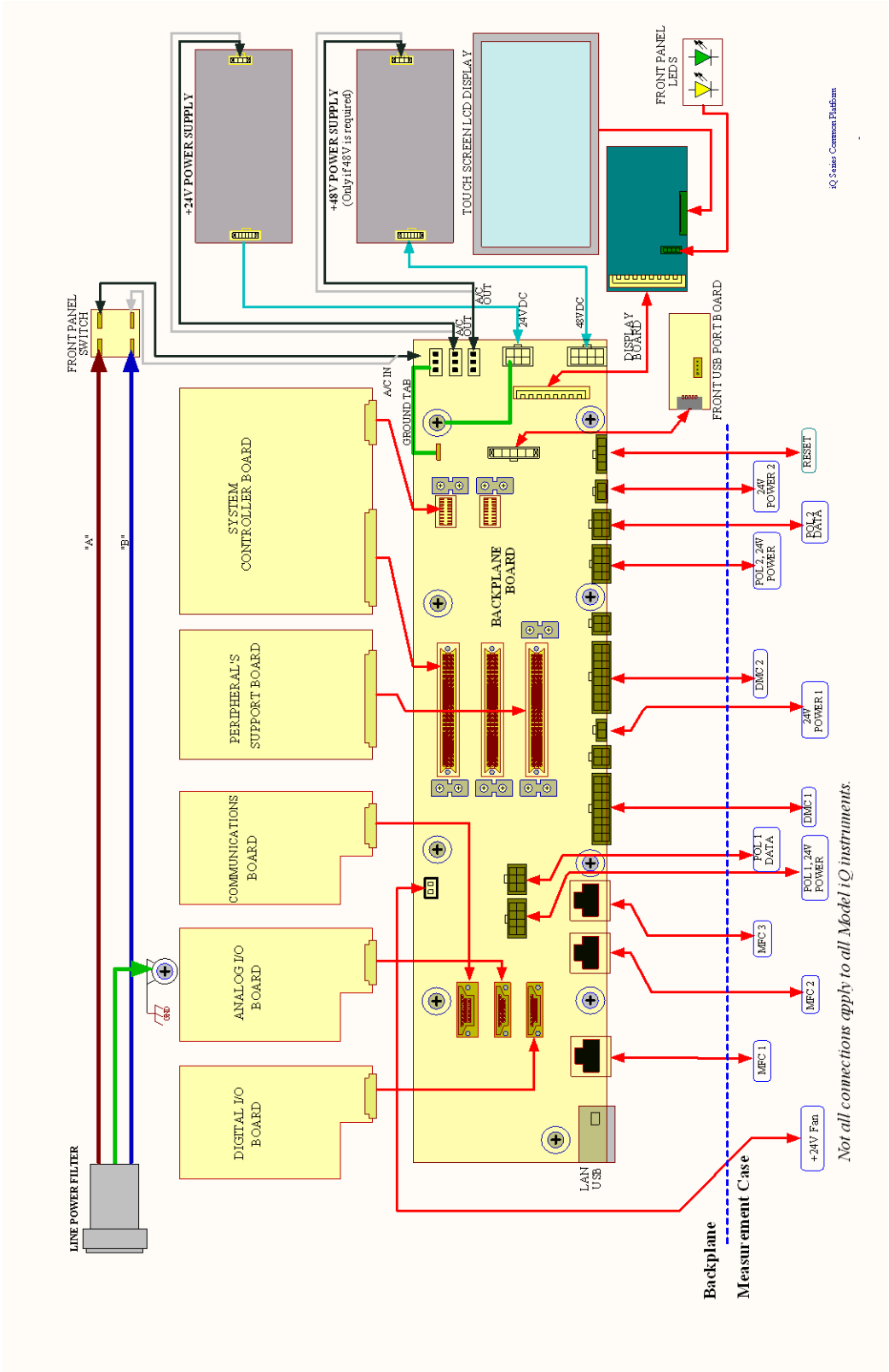


Figure 8–1. Common System Interconnect Diagram

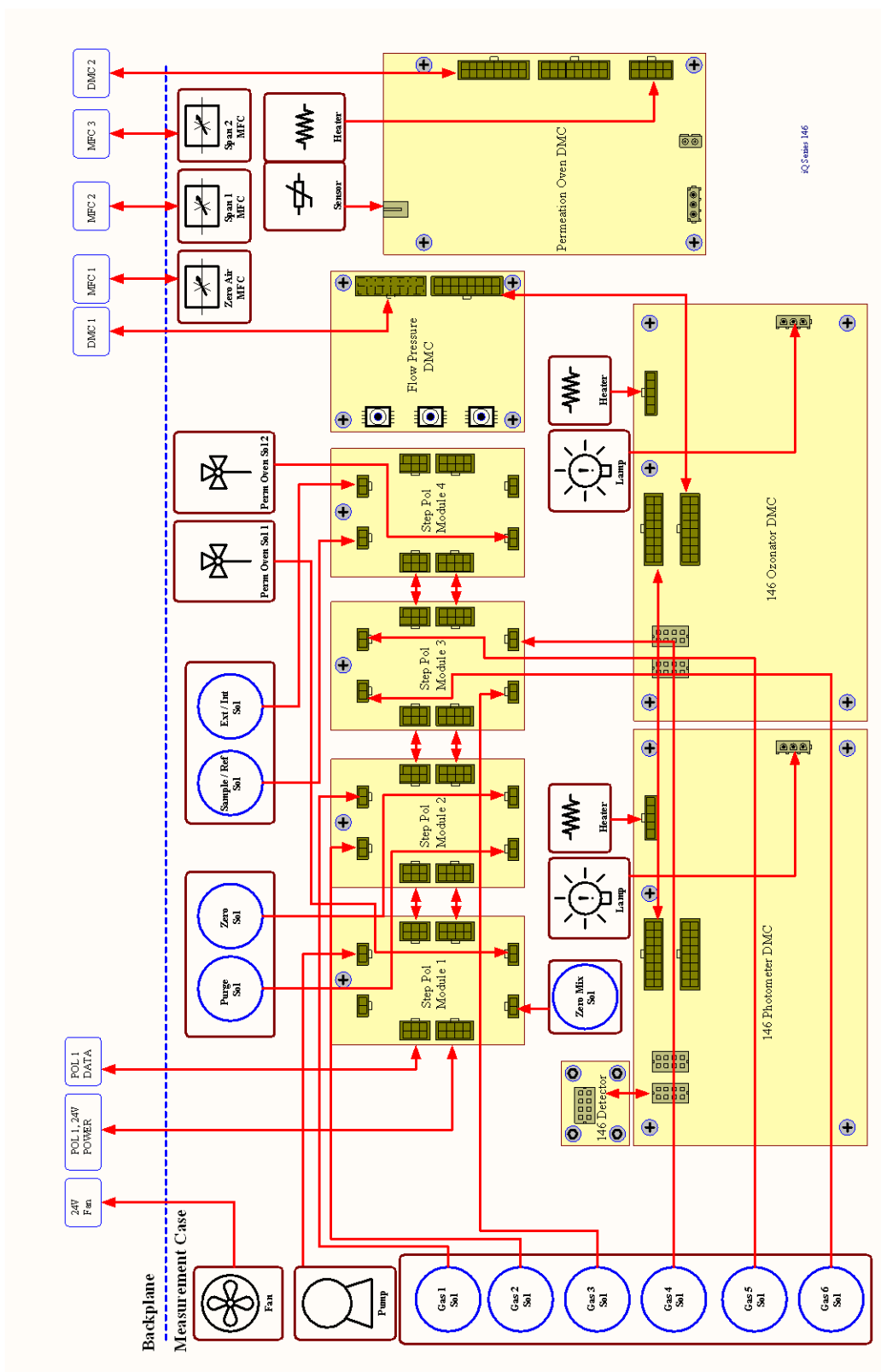


Figure 8–2. 146iQ System Interconnect Diagram

## **Power Supply**

All electronics operate from a universal VDC supply, which is capable of auto-sensing the input voltage and working over all specified operating ranges. The 146iQ contains a 24 VDC channel for most electronics operation, including the pump and fan, and a 48 VDC channel dedicated specifically for optical bench heating.

## **System Controller Board**

The System Controller Board (SCB) contains the main processor, power supplies, and a sub-processor, and serves as the communication hub for the instrument. The SCB receives operator inputs from the front panel GUI and/or over optional I/O connections on the rear panel. The SCB sends commands to the other boards to control the functions of the instrument and to collect measurement and diagnostic information. The SCB outputs instrument status and measurement data to the GUI, Ethernet/USB, and to the optional rear-panel I/O. The SCB plugs into the backplane via a single connector and has physical retainers to secure placement.

## **Backplane Board**

The backplane board provides the routing and conditioning for +24 VDC (optional +48 VDC) and RS-485 communications within the instrument. It hosts the System Controller Board (SCB) and Peripherals Support Board (PSB) via direct plug ins, and similarly hosts optional I/O (communication, analog, and digital) with rear panel interfaces via direct plug in. It has connections for RS485 communication with and powering of DMCs and the Step POL Module. It additionally routes the front panel display and driver, external USB and Ethernet.

## **Front Panel**

Front panel electronic components include the touch screen display, the on off switch, and two indicator LEDs for power and alarm status, as described in operational detail in Chapter 2, “[Installation and Setup](#)”.

## **I/O and Communication Components**

The iQ series instruments provide a number of methods for communicating the instrument results to the operator or external equipment. Every iQ series instrument includes a front panel display, 3 USB ports (one in front, two in rear), and one Ethernet data port as standard equipment.

In addition, optional RS-232/485, analog I/O, and digital I/O ports are available to provide data to external systems as described in Chapter 9, “[Optional Equipment](#)”. The front panel GUI allows the operator to configure these output communication channels as described in Chapter 3, “[Operation](#)”.



## **Peripherals Support System**

The peripheral support system operates those additional devices that are needed, but do not require special feedback control or processing. These components are connected to a Peripherals Support Board (PSB).

### **Fan**

The chassis fan provides air cooling of the active electronic components.

### **Step POL Board**

The Step POL board(s) provide high/low outputs for continuous operation or on/off states. The Step POL board contains the basic circuitry to provide a programmable load to passive devices, either continuously, or on user or automated command. In the iQ Series instruments, the pump, solenoids, etc., are controlled off of the Step POL board from commands generated via the PSB.

### **Sample Pump**

Internal vacuum pump for generating air/sample through the instrument

### **Solenoid Valve Panel**

Solenoid valves for switching gas standards, zero air, and other optional components.

### **Flow/Pressure DMC**

The sample and reference gas flows to the photometer and/or the flow to the ozonator are regulated by the use of flow restricting capillaries on each path and are monitored by absolute and/or differential pressure sensors on the flow pressure DMC. Two absolute pressure sensors are utilized to measure pressure upstream (bench) and downstream (pump) of the flow restricting capillary providing sample flow to the pump. The pressure differential between these two sensors determines the sample flow through the photometer. A single differential pressure sensor across the ozonator flow restricting capillary determines the flow through the ozonator.

### **Firmware**

Like the hardware, the firmware is modular and located within microprocessors distributed throughout the instrument. In the 146iQ, microprocessors containing firmware are located as follows:

- Photometer DMC
- Ozonator DMC
- Permeation Oven
- Flow/Pressure DMC

- Peripherals Support Board
- Optional I/O (Communications, Digital, and Analog)

The firmware contains the active controls for their application, as well as self-identification and configuration for “plug and play” style operation. Each are associated with specific registers of two types:

- Modbus registers that are communicated from each microprocessor to the System Controller Board (SCB) via internal RS-485
- SNMP registers that are maintained in the software and SCB for health and data processing computation

The Modbus communication system operates on 1 second intervals. Within those intervals, data treatment like integration (whether analog or digital) and servo control, are embedded in the module firmware. The SCB receives the 1 second updates for higher level “software” processing and control via SNMP registers, some of which is interfaced with the front panel Graphical User Interface (GUI).

In addition to the operating registers, the 146iQ stores a historical data log in a MySQL database. The memory is provided on the same micro SD card where the operating software resides, for which there is capability to store up to a year of data at 1 minute intervals. Chapter 3, “[Operation](#)” describes how this database is accessed and used including external memory downloads.

## Chapter 9

# Optional Equipment

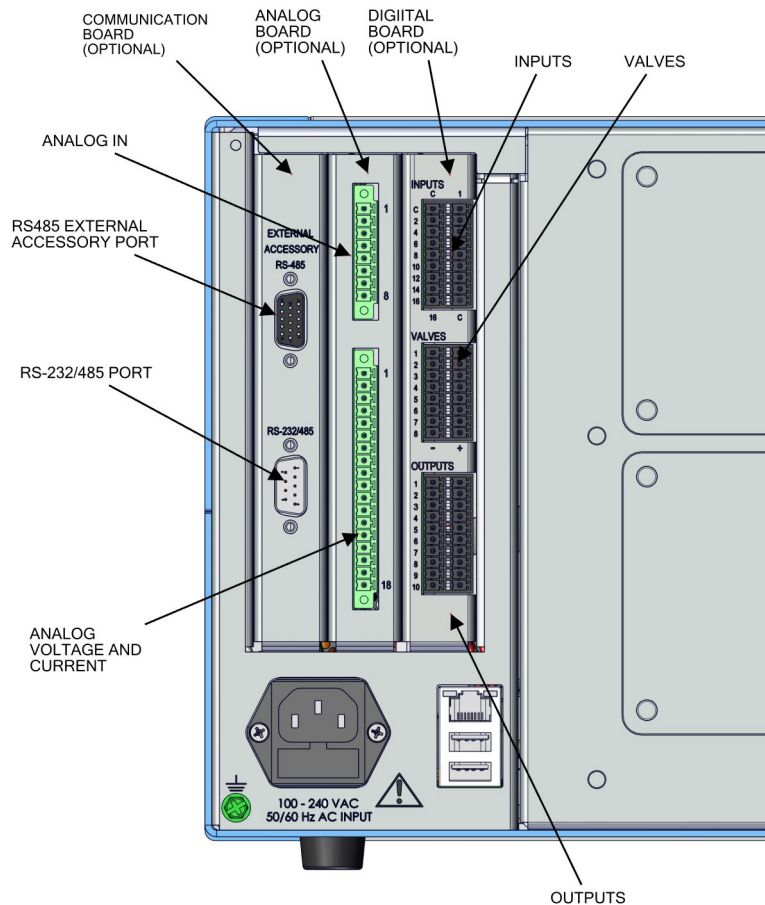
The 146iQ is available with the following options:

### Connecting External Devices

Several components are available for connecting external devices.

These connection options consist of three plug-in boards:

- Communication Board
- Analog I/O Board
- Digital I/O Board



**Figure 9–1.** I/O Expansion Replacement Boards

Communication Board

The communication board consists of:

- RS-232/485 Port
- RS-485 External Accessory Port

RS-232/RS-485 Port

The RS-232/RS-485 port uses a 9-pin serial connector with a bi-directional serial interface that can be configured for either RS-232 or RS-485 communication.

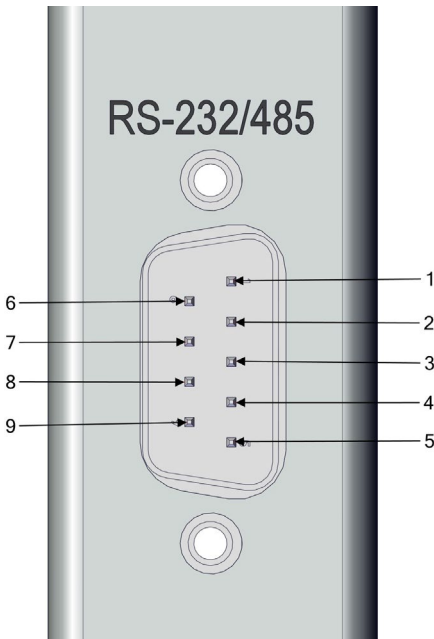


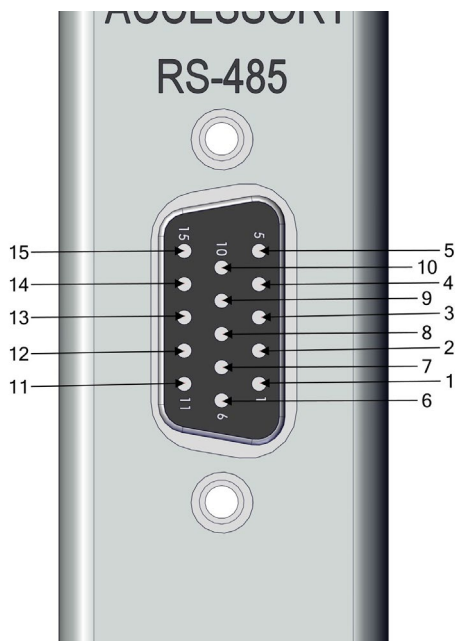
Figure 9–2. RS-232/RS-485 Port

Table 9–1. RS-232/RS-485 Port Terminal Assignment

Terminal Number	Signal Name
1	No Connect
2	RX/RS485_RX_P
3	TX/RS485_TX_N
4	No Connect
5	GND
6	No Connect
7	RTS/RS485_TX_P
8	CTS/RS485_RX_N
9	No Connect

## RS-485 External Accessory Port

The RS-485 external accessory port uses a 15-pin serial connector for communication with external smart devices.



**Figure 9–3.** RS-485 External Accessory Port

**Table 9–2.** RS-485 External Accessory Port Terminal Assignment

Terminal Number	Signal Name
1	EXT_RS485_RX_N
2	EXT_RS485_RX_P
3	+5V (Fused @0.4A)
4	+5V (Fused @0.4A)
5	+5V (Fused @0.4A)
6	GND
7	GND
8	GND
9	EXT_RS485_TX_N
10	EXT_RS485_TX_P
11	+24V (Fused @0.4A)
12	+24V (Fused @0.4A)
13	+24V (Fused @0.4A)
14	+24V (Fused @0.4A)
15	+24V (Fused @0.4A)

Analog I/O Board

The Analog I/O Board consists of:

- 4 Isolated Analog Voltage Inputs, Input Voltage Range: 0–10 V
- 6 Isolated Analog Voltage Outputs, Three Ranges: 0–1.0 V, 0–5.0 V, 0–10 V
- 6 Isolated Analog Current Outputs, Two Ranges: 0mA–20mA, 4mA–20mA

Analog Voltage Inputs

Table 9–3 lists the analog voltage inputs are used to monitor four external 0–10V signals.

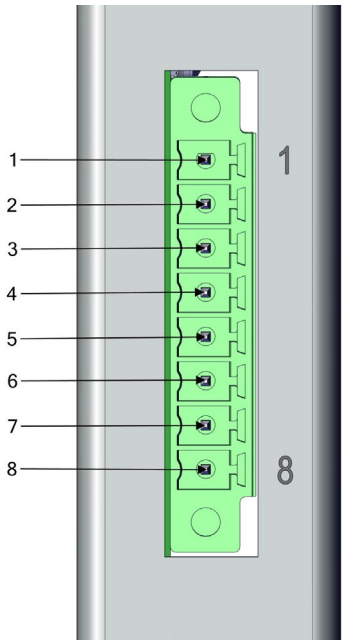


Figure 9–4. Analog Voltage Inputs

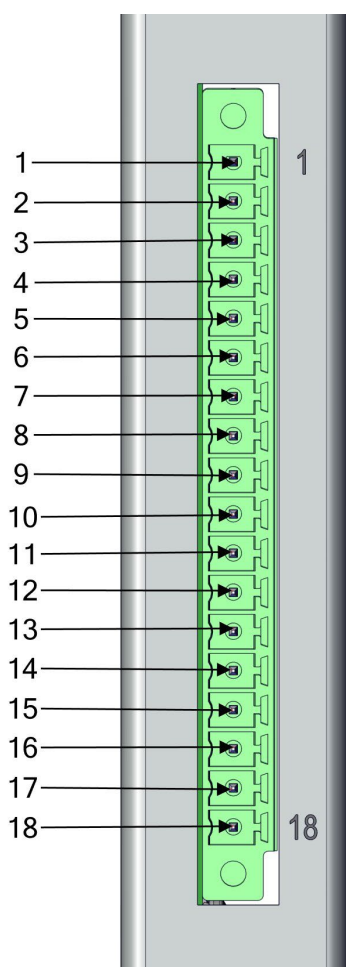
Table 9–3. Analog Voltage Inputs Assignment

Terminal Number	Signal Name
1	Analog In 1
2	Analog GND
3	Analog In 2
4	Analog GND
5	Analog In 3
6	Analog GND
7	Analog In 4
8	Analog GND

## Analog Voltage Outputs

There are six globally isolated, 16-bit, Analog Output channels, each with a Voltage Output, a Current Output and a common Return (isolated ground). The Analog Outputs are configured through the software control registers to select Voltage Output ranges 0–1 V, 0–5 V or 0–10 V, as well as Current Output ranges 0–20 mA or 4–20 mA. The maximum allowable load for each Current Output is 1000  $\Omega$ . All Voltage Outputs and Current Outputs are continuously monitored separately for accuracy.

The Analog Outputs may be used to control and report parameters pertinent to the analyzers' measured functions.



**Figure 9–5.** Analog Voltage and Current

**Table 9–4.** Analog Voltage and Current Assignment

Terminal Number	Signal Name
1	Current Out 1
2	Voltage Out 1
3	C/V Return 1
4	Current Out 2
5	Voltage Out 2
6	C/V Return 2
7	Current Out 3
8	Voltage Out 3
9	C/V Return 3
10	Current Out 4
11	Voltage Out 4
12	C/V Return 4
13	Current Out 5
14	Voltage Out 5
15	C/V Return 5
16	Current Out 6
17	Voltage Out 6
18	C/V Return 6

## Analog Output Calibration

The iQ series instruments provide for the ability to calibrate the analog outputs (both voltage and current) of the instruments. The basic procedure for both voltage and current are the same using the following procedure:

- Complete the connections of the recording device to the desired analog output channel. (See page 9-5 for the channel information).
- Calibrate the output channel low level.

**Note** When calibrating the current output when using the 0-20 mA scale, the low level will be set to 4 mA due to the inability to adjust the actual current output to below zero. ▲

- Calibrate the output channel full scale.

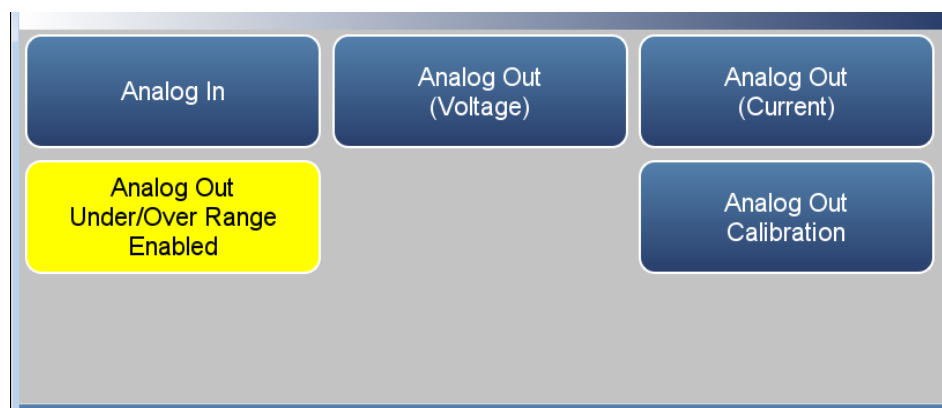


## Analog Output Zero Calibration

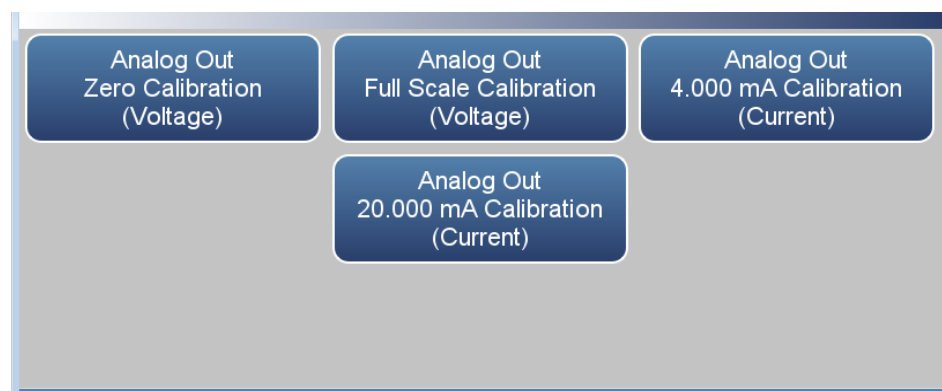
Use the following procedure to calibrate the output channel to low level. This analog output calibration procedure reflects the zero calibration for analog output voltage for demonstration purposes. To calibrate the 4 mA current calibration, follow the same procedure, by selecting the 4 mA current calibration option.

**Note** This adjustment should only be performed by an instrument service technician. ▲

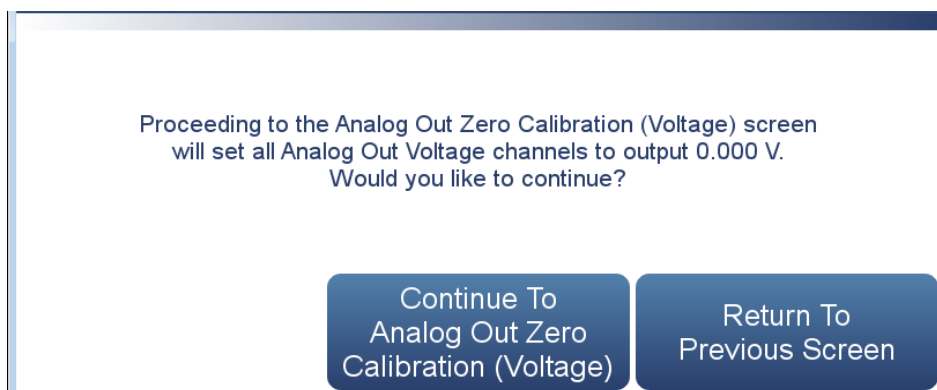
1. From the Home screen, choose **Settings>Communications>Analog I/O>Analog Out Calibration**.



2. Depending on the output type being used, select either Analog Out Zero Calibration (Voltage) or Analog Out 4.000 mA Calibration (Current).



3. A confirmation screen is presented. Select Continue to proceed with the calibration or Return to Previous Screen.



4. There are six columns for each of the six available output channels:

Channel	Output (V)	Dec	Dec	Dec	Inc	Inc	Inc	Commit
1	0.000	↓↓↓	↓↓	↓	↑	↑↑	↑↑↑	Commit
2	0.000	↓↓↓	↓↓	↓	↑	↑↑	↑↑↑	Commit
3	0.000	↓↓↓	↓↓	↓	↑	↑↑	↑↑↑	Commit
4	0.000	↓↓↓	↓↓	↓	↑	↑↑	↑↑↑	Commit
5	0.000	↓↓↓	↓↓	↓	↑	↑↑	↑↑↑	Commit
6	0.000	↓↓↓	↓↓	↓	↑	↑↑	↑↑↑	Commit

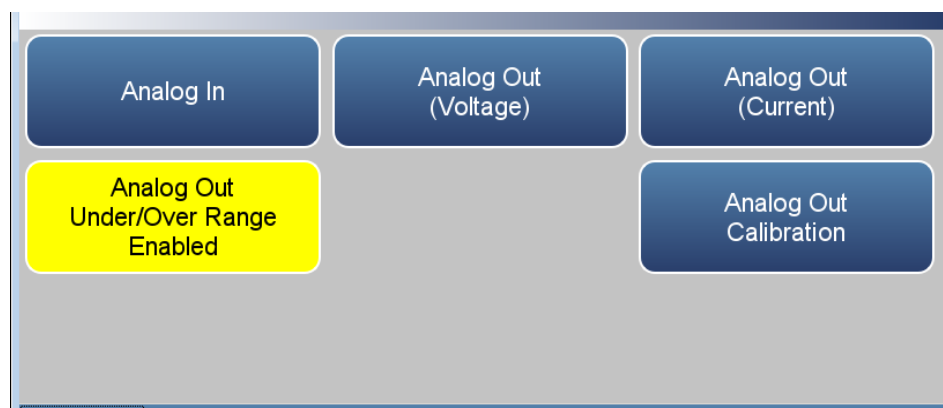
- *Output (V)*: Displays the actual output level at the terminal of the analog output board. For analog voltage, this value will default at zero. For analog current, this value will default at 4 mA.
  - *Decrease ↓↓↓, Decrease ↓↓, and Decrease ↓*: Decreases the output by coarse, medium, or fine amounts.
  - *Increase ↑, Increase ↑↑, and Increase ↑↑↑*: Increases the output by coarse, medium, or fine amounts.
  - *Commit*: Accepts the changes to the analog output levels.
5. For the desired analog output channel, increase or decrease the output until the reading on the recording device indicates the proper value.
6. After making changes to the output levels, the commit button will turn green. To accept the changes, press the Commit button. To revert to the previous values, press the back button to return to the previous analog output calibration screen.

## Analog Output Full Scale Calibration

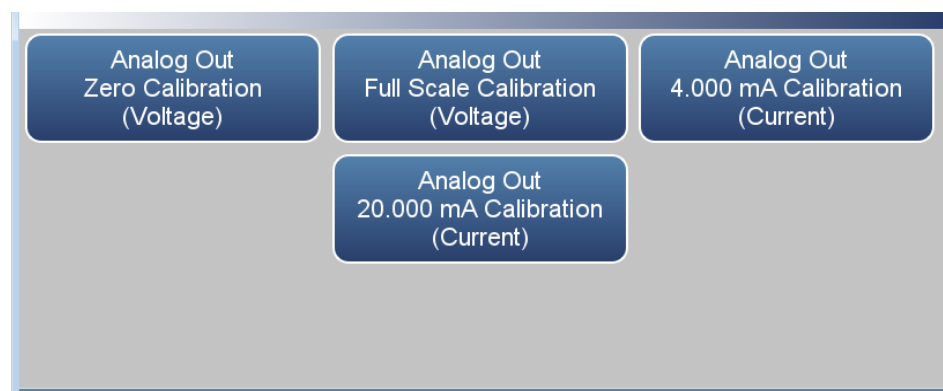
Use the following procedure to calibrate the output channel to full scale. This analog output calibration procedure reflects the full scale calibration for analog output voltage for demonstration purposes. To calibrate the 20 mA current calibration, follow the same procedure, by selecting the 20 mA current calibration option.

**Note** This adjustment should only be performed by an instrument service technician. ▲

1. From the Home screen, choose **Settings>Communications>Analog I/O>Analog Output Calibration**.



2. Depending on the output type being used, select either Analog Out Full Scale Calibration (Voltage) or Analog Out 20.000 mA Calibration (Current).



3. A confirmation screen is presented. Select Continue to proceed with the calibration or Return to Previous Screen.

Proceeding to the Analog Out Full Scale Calibration (Voltage) screen will set all Analog Out Voltage channels to output the user defined full scale voltages. Would you like to continue?

Continue To  
Analog Out Full Scale  
Calibration (Voltage)

Return To  
Previous Screen

4. There are six columns for each of the six available output channels:

Channel	Output (V)	Dec	Dec	Dec	Inc	Inc	Inc	Commit
1	10.000	↓↓↓	↓↓	↓	↑	↑↑	↑↑↑	Commit
2	1.000	↓↓↓	↓↓	↓	↑	↑↑	↑↑↑	Commit
3	1.000	↓↓↓	↓↓	↓	↑	↑↑	↑↑↑	Commit
4	1.000	↓↓↓	↓↓	↓	↑	↑↑	↑↑↑	Commit
5	1.000	↓↓↓	↓↓	↓	↑	↑↑	↑↑↑	Commit
6	10.000	↓↓↓	↓↓	↓	↑	↑↑	↑↑↑	Commit

- *Output (V)*: Displays the actual output level at the terminal of the analog output board. For analog voltage, this value will default at the setting of the output channel, 1, 5, or 10 V. For analog current, this value will default at 20 mA.
  - *Decrease ↓↓↓, Decrease ↓↓, and Decrease ↓*: Decreases the output by coarse, medium, or fine amounts.
  - *Increase ↑, Increase ↑↑, and Increase ↑↑↑*: Increases the output by coarse, medium, or fine amounts.
  - *Commit*: Accepts the changes to the analog output levels.
5. For the desired analog output channel, increase or decrease the output until the reading on the recording device indicates the proper value.
6. After making changes to the output levels, the commit button will turn green. To accept the changes, press the Commit button. To revert to the previous values, press the back button to return to the previous analog output calibration screen.

## Digital I/O Board

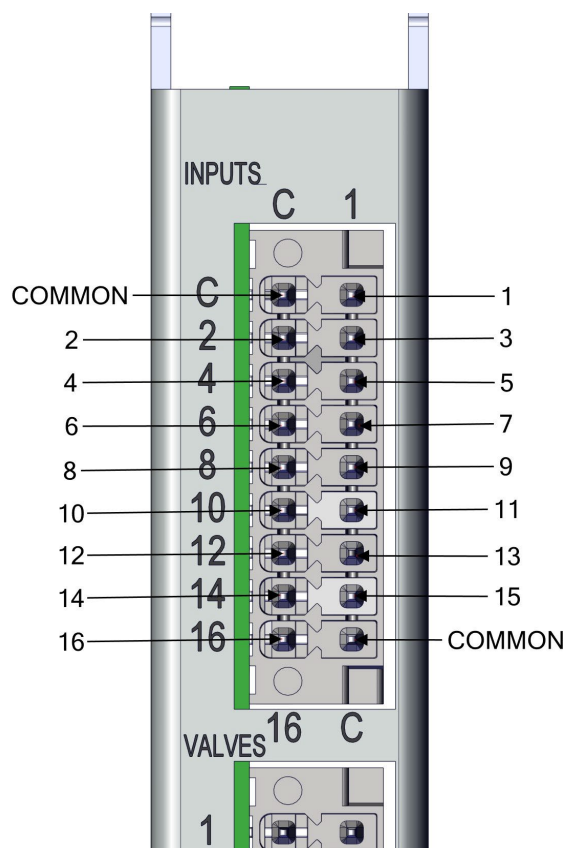
The digital I/O board consists of:

- 16 Digital Inputs (18 pin connector)
- 10 Digital Relay Switches (20 pin connector)
- 8 Valve Driver Outputs (16 pin connector)

### Digital Inputs

The digital inputs are TTL (3 V or 5 V) compatible and are pulled high within the instrument. The active state can be user defined in firmware.

- Logic Low Threshold: 0.8 V
- Logic High Threshold: 2.0 V
- Absolute allowable input voltages: -0.5 to 5.5 V



**Figure 9–6.** Digital Inputs

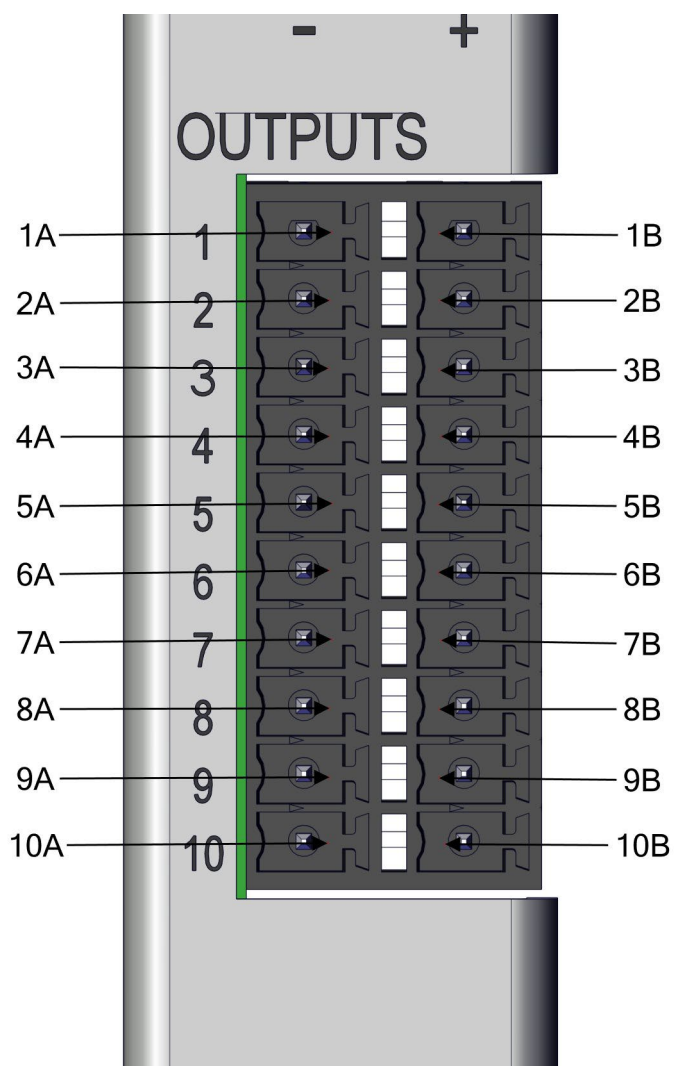
**Table 9–5.** Digital Inputs Terminal Assignment

Terminal Number	Signal Name
COMMON	
1	Digital In 1
2	Digital In 2
3	Digital In 3
4	Digital In 4
5	Digital In 5
6	Digital In 6
7	Digital In 7
8	Digital In 8
9	Digital In 9
10	Digital In 10
11	Digital In 11
12	Digital In 12
13	Digital In 13
14	Digital In 14
15	Digital In 15
16	Digital In 16
COMMON	

## Digital Relay Switches

Table 9–6 lists the digital relay switches.

- Maximum Voltage: 300 VDC
- Maximum Current: 500 mA
- Fuse: 800 mA



**Figure 9–7.** Digital Relay Switches

**Table 9–6.** Digital Relay Switch Assignment

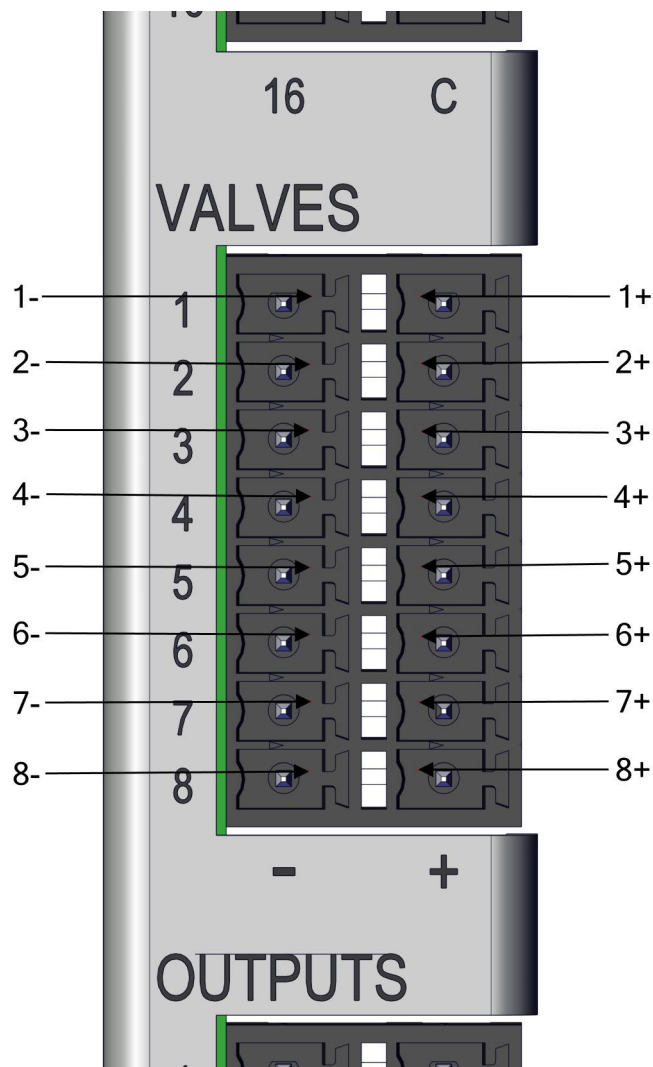
Terminal Number	Signal Name
1A	Relay 1A
1B	Relay 1B
2A	Relay 2A
2B	Relay 2B
3A	Relay 3A
3B	Relay 3B
4A	Relay 4A
4B	Relay 4B
5A	Relay 5A
5B	Relay 5B
6A	Relay 6A
6B	Relay 6B
7A	Relay 7A
7B	Relay 7B
8A	Relay 8A
8B	Relay 8B
9A	Relay 9A
9B	Relay 9B
10A	Relay 10A
10B	Relay 10B



## Valve Driver Outputs

Table 9–7 lists the valve driver outputs.

- Actual Output Voltage: 22–24 VDC
- Maximum Current: 300 mA per channel, 2A total
- Both positive and negative outputs are protected from over voltage and over current by 500 mA fuses.



**Figure 9–8.** Valve Driver Outputs

**Table 9–7.** Valve Driver Outputs Assignment

Terminal Number	Signal Name
1+	Valve Drive 1+
1-	Valve Drive 1-
2+	Valve Drive 2+
2-	Valve Drive 2-
3+	Valve Drive 3+
3-	Valve Drive 3-
4+	Valve Drive 4+
4-	Valve Drive 4-
5+	Valve Drive 5+
5-	Valve Drive 5-
6+	Valve Drive 6+
6-	Valve Drive 6-
7+	Valve Drive 7+
7-	Valve Drive 7-
8+	Valve Drive 8+
8-	Valve Drive 8-

**Note** Intended for 24 V valves. These outputs will also drive any DC load of 22–24 VDC, up to 300 mA. ▲

## Ozonator

The internal ozone generator provides easy determination of zero, precision, and Level 1 span checks. The ozone level produced is a function of light intensity at 185 nm and gas flow. The light intensity is varied by changing the current into the lamp. The gas flow is held constant by a pressure regulator followed by a capillary.

## Photometer

The photometer measures ozone concentration and is used to control ozone output.

## Permeation Oven

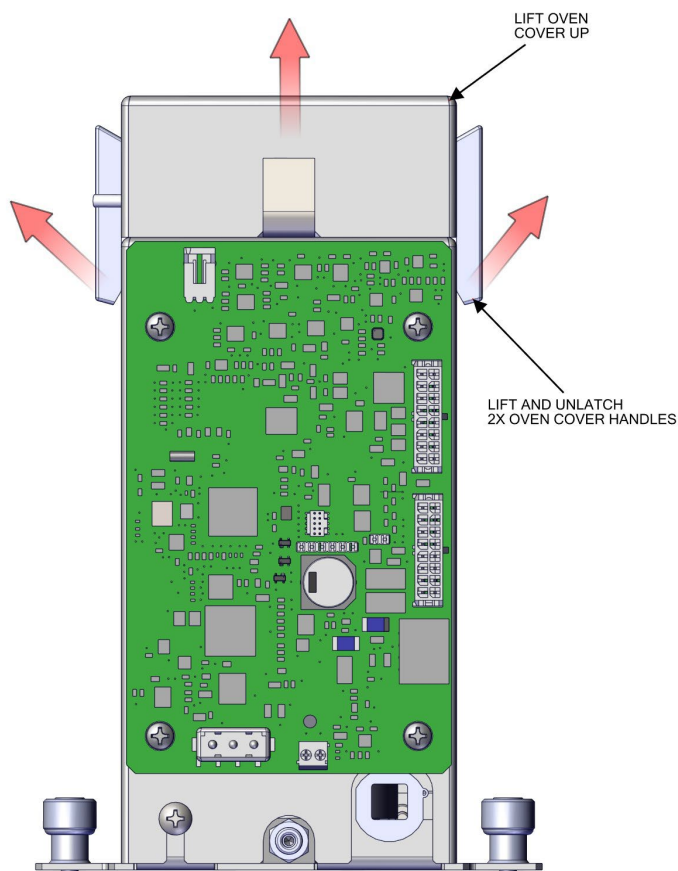
The permeation oven is an alternate method for producing span concentrations of stable gases such as SO<sub>2</sub>, H<sub>2</sub>S, NO<sub>2</sub>, etc. The operation of the permeation oven relies on precise regulation of the temperature of the oven in which a small container of liquified gas (permeation tube) that

permeates the gas into a zero air stream (150 sccm nominally) that can subsequently be diluted to provide the desired span gas output. When the permeation oven is not being actively utilized, the nominal zero air stream through the permeation oven is maintained, in order to precisely regulate temperature, with a solenoid directing this standby flow to exhaust.

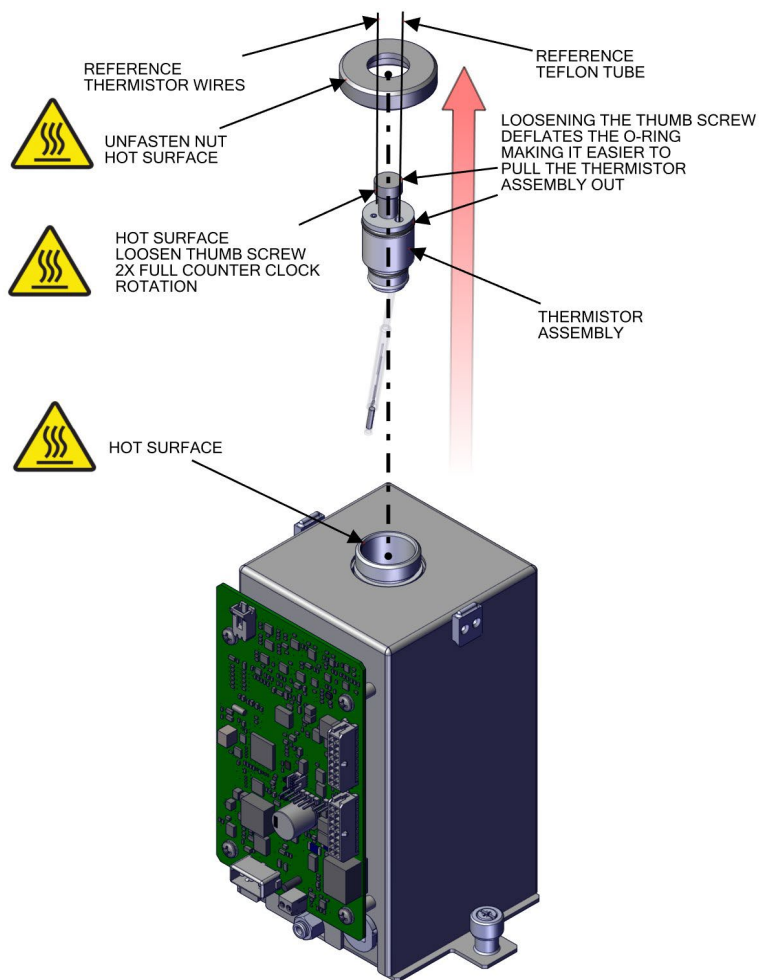
## Permeation Tube Installation

Use the following procedure to install the permeation tube.

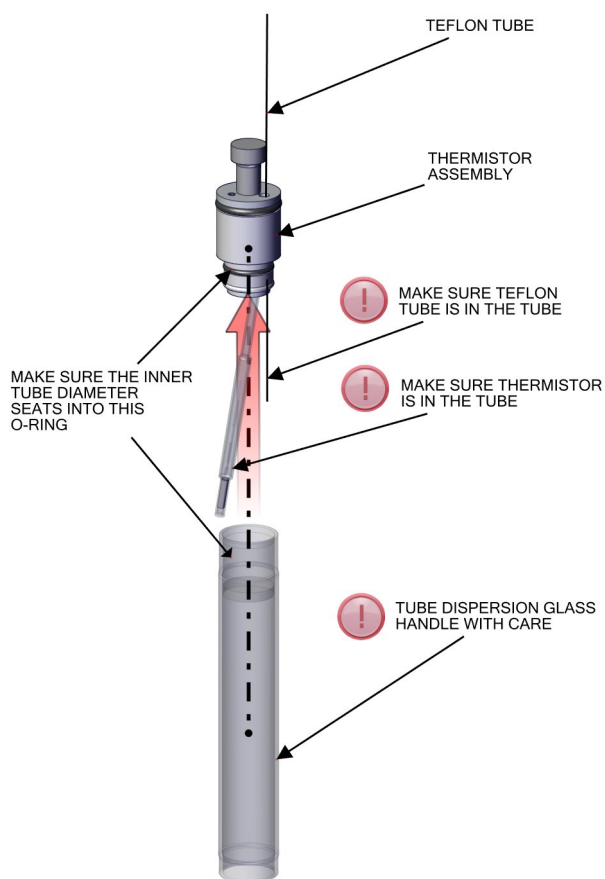
1. Lift oven cover up.
2. Lift and unlatch two oven cover handles.



**Figure 9–9.** Installing glass tube pt 1

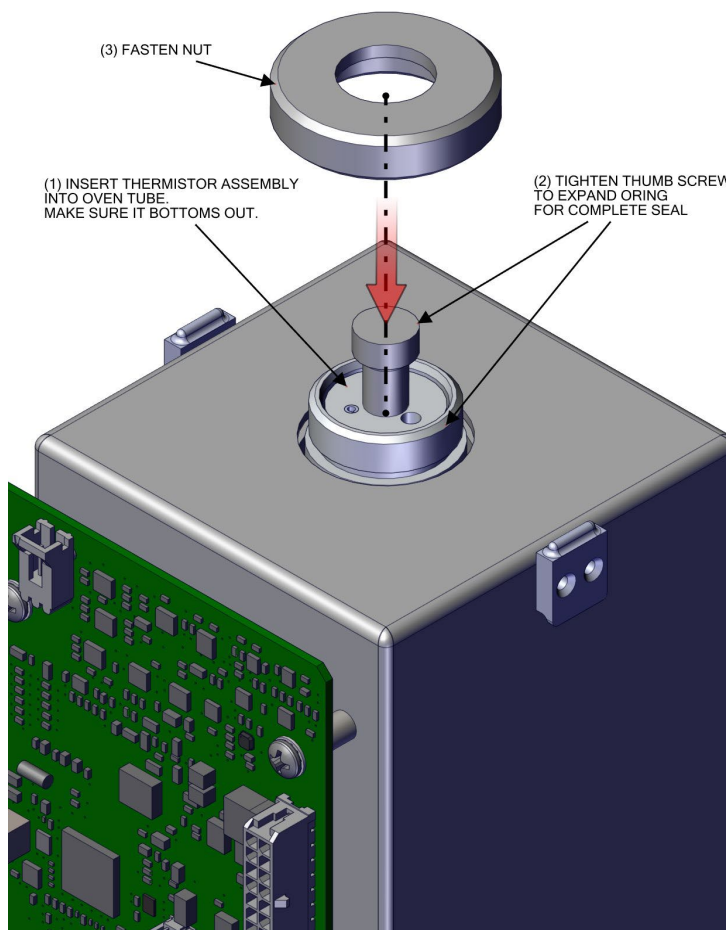


**Figure 9–10.** Installing glass tube pt 2



**Figure 9–11.** Installing glass tube pt 3

3. Insert thermistor assembly into oven tube. Make sure it bottoms out.
4. Tighten thumb screw to expand o-ring for complete seal.
5. Fasten nut.



**Figure 9-12.** Installing glass tube pt 4

## Computation of Concentrations

The computation of gas output level is shown in the following information. Note that it is assumed that all devices are properly calibrated and that all flows are corrected to 25 °C and 1 atm.

Permeation Tube:

$$Output (ppm) = \frac{(R)(K)}{Q_o}$$

Where:

R = permeation rate in ng/min

$Q_o$  = flow rate of gas (scc/min) into the charcoal scrubber during span mode

K = constant for the specific permeant = 24.45 / MW

MW = molecular weight

# Appendix A

## Safety, Warranty, and WEEE





### Safety

Review the following information carefully before using the instrument. This manual provides specific information on how to operate the instrument, however if the instrument is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.



### Safety and Equipment Damage Alerts

This manual contains important information to alert you to potential safety hazards and risks of equipment damage. Refer to the following types of alerts you may see in this manual.

#### Safety and Equipment Damage Alert Descriptions

Alert	Description
	<ul style="list-style-type: none"> <li>A hazard is present that will result in death or serious personal injury if the warning is ignored. ▲</li> </ul>
	<ul style="list-style-type: none"> <li>A hazard is present or an unsafe practice can result in serious personal injury if the warning is ignored. ▲</li> </ul>
	<ul style="list-style-type: none"> <li>The hazard or unsafe practice could result in minor to moderate personal injury if the warning is ignored. ▲</li> </ul>
 <b>Equipment Damage</b>	<ul style="list-style-type: none"> <li>The hazard or unsafe practice could result in property damage if the warning is ignored. ▲</li> </ul>

#### Safety and Equipment Damage Alerts in this Manual

Alert	Description
	<ul style="list-style-type: none"> <li>If the equipment is operated in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired. ▲</li> <li>The service procedures in this manual are restricted to qualified service personnel only. ▲</li> </ul>
 <b>Equipment Damage</b>	<ul style="list-style-type: none"> <li>Do not attempt to lift the analyzer by the cover or other external fittings. ▲</li> <li>This adjustment should only be performed by an instrument service technician. ▲</li> </ul>

## Warranty

Seller warrants that the Products will operate or perform substantially in conformance with Seller's published specifications and be free from defects in material and workmanship, when subjected to normal, proper and intended usage by properly trained personnel, for the period of time set forth in the product documentation, published specifications or package inserts. If a period of time is not specified in Seller's product documentation, published specifications or package inserts, the warranty period shall be two (2) years from the date of shipment to Buyer for equipment and ninety (90) days for all other products (the "Warranty Period"). Seller agrees during the Warranty Period, to repair or replace, at Seller's option, defective Products so as to cause the same to operate in substantial conformance with said published specifications; provided that (a) Buyer shall promptly notify Seller in writing upon the discovery of any defect, which notice shall include the product model and serial number (if applicable) and details of the warranty claim; (b) after Seller's review, Seller will provide Buyer with service data and/or a Return Material Authorization ("RMA"), which may include biohazard decontamination procedures and other product-specific handling instructions; and (c) then, if applicable, Buyer may return the defective Products to Seller with all costs prepaid by Buyer. Replacement parts may be new or refurbished, at the election of Seller. All replaced parts shall become the property of Seller. Shipment to Buyer of repaired or replacement Products shall be made in accordance with the Delivery provisions of the Seller's Terms and Conditions of Sale. Consumables, including but not limited to lamps, fuses, batteries, bulbs and other such expendable items, are expressly excluded from the warranty under this warranty.

Notwithstanding the foregoing, Products supplied by Seller that are obtained by Seller from an original manufacturer or third party supplier are not warranted by Seller, but Seller agrees to assign to Buyer any warranty rights in such Product that Seller may have from the original manufacturer or third party supplier, to the extent such assignment is allowed by such original manufacturer or third party supplier.

In no event shall Seller have any obligation to make repairs, replacements or corrections required, in whole or in part, as the result of (i) normal wear and tear, (ii) accident, disaster or event of force majeure, (iii) misuse, fault or negligence of or by Buyer, (iv) use of the Products in a manner for which they were not designed, (v) causes external to the Products such as, but not limited to, power failure or electrical power surges, (vi) improper storage and handling of the Products or (vii) use of the Products in combination with equipment or software not supplied by Seller. If Seller determines that Products for which Buyer has requested warranty services are not covered by the warranty hereunder, Buyer shall pay or reimburse Seller for all costs of investigating and responding to such request at Seller's then



prevailing time and materials rates. If Seller provides repair services or replacement parts that are not covered by the warranty provided in this warranty, Buyer shall pay Seller therefor at Seller's then prevailing time and materials rates. ANY INSTALLATION, MAINTENANCE, REPAIR, SERVICE, RELOCATION OR ALTERATION TO OR OF, OR OTHER TAMPERING WITH, THE PRODUCTS PERFORMED BY ANY PERSON OR ENTITY OTHER THAN SELLER WITHOUT SELLER'S PRIOR WRITTEN APPROVAL, OR ANY USE OF REPLACEMENT PARTS NOT SUPPLIED BY SELLER, SHALL IMMEDIATELY VOID AND CANCEL ALL WARRANTIES WITH RESPECT TO THE AFFECTED PRODUCTS.

THE OBLIGATIONS CREATED BY THIS WARRANTY STATEMENT TO REPAIR OR REPLACE A DEFECTIVE PRODUCT SHALL BE THE SOLE REMEDY OF BUYER IN THE EVENT OF A DEFECTIVE PRODUCT. EXCEPT AS EXPRESSLY PROVIDED IN THIS WARRANTY STATEMENT, SELLER DISCLAIMS ALL OTHER WARRANTIES, WHETHER EXPRESS OR IMPLIED, ORAL OR WRITTEN, WITH RESPECT TO THE PRODUCTS, INCLUDING WITHOUT LIMITATION ALL IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR ANY PARTICULAR PURPOSE. SELLER DOES NOT WARRANT THAT THE PRODUCTS ARE ERROR-FREE OR WILL ACCOMPLISH ANY PARTICULAR RESULT.

WEEE  
Compliance


This product is required to comply with the European Union’s Waste Electrical & Electronic Equipment (WEEE) Directive 2002/96/EC. It is marked with the following symbol:



Thermo Fisher Scientific has contracted with one or more recycling/disposal companies in each EU Member State, and this product should be disposed of or recycled through them. Further information on Thermo Fisher Scientific’s compliance with these Directives, the recyclers in your country, and information on Thermo Fisher Scientific products which may assist the detection of substances subject to the RoHS Directive are available at: [www.thermoscientific.com/WEEERoHS](http://www.thermoscientific.com/WEEERoHS).

WEEE Symbol

The following symbol and description identify the WEEE marking used on the instrument and in the associated documentation.

Symbol	Description
	Marking of electrical and electronic equipment which applies to electrical and electronic equipment falling under the Directive 2002/96/EC (WEEE) and the equipment that has been put on the market after 13 August 2005. ▲

# Appendix B

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# Appendix C

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Version 2.1, February 1999

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