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42iQHL Instruction Manual

High Level NO-NO_2-NO_x Analyzer

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ThermoFisher SCIENTIFIC

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Chapter 1
Introduction

The Thermo Scientific™ 42iQ High Level NO-NO_2-NO_x Analyzer utilizes chemiluminescence technology to measure the amount of nitrogen oxides in the air from 10 ppm up to 5000 ppm.

The 42iQHL analyzer is a single chamber, single photo multiplier tube design that cycles between the NO and NO_x modes. This instrument has independent outputs for NO, NO_2 and NO_x and each can be calibrated separately. Dual range and auto range are standard features as well. If required, the instrument can be operated continuously in either the NO or NO_x modes allowing for response times of less than 5 seconds. Temperature and pressure correction are standard offerings of the 42iQHL analyzer.

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 touch screen display. The GUI is highly flexible and can be customized to enable a tailored experience to simplify daily operations. Custom designed ePort 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. 42iQHL Front

Principle of Operation

The 42iQHL operates on the principle that nitric oxide (NO) and ozone (O_3) react to produce a characteristic luminescence with an intensity linearly proportional to the NO concentration. Infrared light emission results when NO_2 molecules decay to lower energy states. Specifically:

$$NO + O_3 \rightarrow NO_2 + O_2 + h\nu$$

Nitrogen dioxide (NO_2) must first be transformed into NO before it can be measured using the chemiluminescent reaction. NO_2 is converted to NO by a stainless steel NO_2-to-NO converter heated to about 625 °C (the optional molybdenum converter is heated to 325 °C).

The ambient air sample is drawn into the 42iQHL through the *sample* bulkhead, as shown in Figure 1–2. The sample flows through a capillary, and then to the mode solenoid valve. The solenoid valve routes the sample either straight to the reaction chamber (NO mode) or through the NO_2-to-NO converter and then to the reaction chamber (NO_x mode). The reaction chamber pressure is measured to infer the sample flow. Pressure deviations outside of the acceptable range are reported as a fault.

Dry air enters the 42iQHL through the permeation dryer, passes through a flow switch, and then through a silent discharge ozonator. The ozonator generates the ozone needed for the chemiluminescent reaction. At the reaction chamber, the ozone reacts with the NO in the sample to produce excited NO_2 molecules. A photomultiplier tube (PMT) housed in a thermoelectric cooler detects the luminescence generated during this reaction. From the reaction chamber, the exhaust travels through the ozone (O_3) converter to the pump, and is released through the vent.

The NO and NO_x concentrations calculated in the NO and NO_x modes are stored in memory. The difference between the concentrations is used to calculate the NO_2 concentration. The 42iQHL outputs NO, NO_2, and NO_x concentrations to the front panel display and the analog outputs, and also makes the data available over the serial or Ethernet connection.

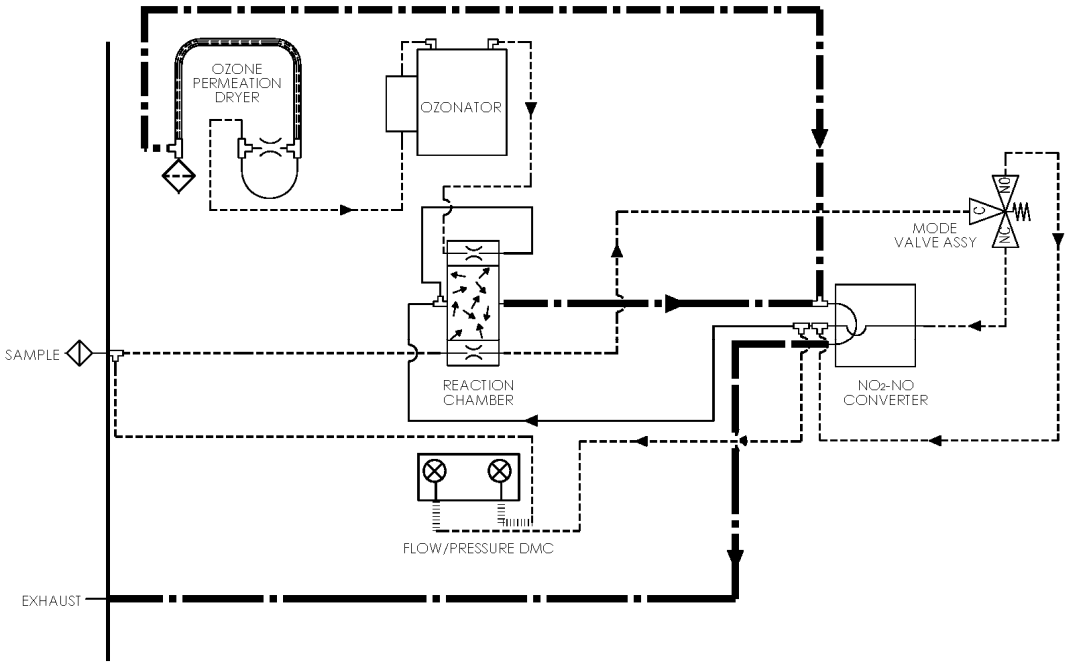


Figure 1–2. 42iQHL Flow Schematic

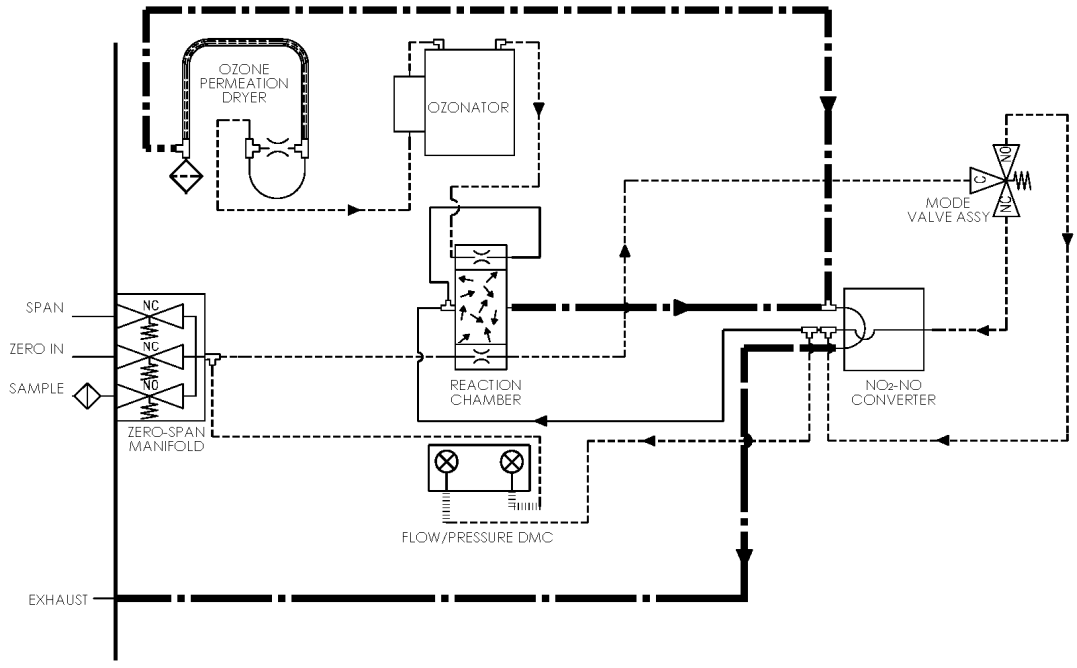


Figure 1–3. 42iQHL Flow Schematic with Zero Span

Specifications

Table 1–1 lists the specifications for the 42iQHL.

Table 1–1. 42iQHL Specifications

Range	0–5000 ppm 0–7500 mg/m^3
Zero Noise	0.025 ppm RMS (60 second averaging time)
Detection Limit	0.050 ppm (60 second averaging time)
Zero Drift	0.050 ppm (24 hour)
Span Drift	±1% full-scale
Response Time (in manual mode)	2.5 seconds NO 5.0 seconds NO_x
Vacuum	28,.5" Hg
Linearity	±1% full-scale
Sample Flow Rate	25 cc/min.
Bypass Flow Rate (option)	250–1100 cc/min.
Operating Temperature Range	0–40 °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	60 lbs
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, Bayern Hessen, Streaming
Approvals and Certifications	CE, TUV-SUD Safety

Table 1–2. 42iQHL Optional Internal Oxygen Sensor Specifications

Technology	Paramagnetic
Range	0-100% O_2
Accuracy (Intrinsic error)	<±0.1% O_2
Linearity	<±0.1% O_2
Repeatability	<±0.1% O_2
Zero Drift	<±0.2% O_2 per month (excludes up to 0.1% O_2 in the first 24 hours of operation)
Response Time (T_{10}-T_{90})	<2.5 seconds
Weight	Approximately 2 lbs. (in addition to standard instrument)

Dimensions

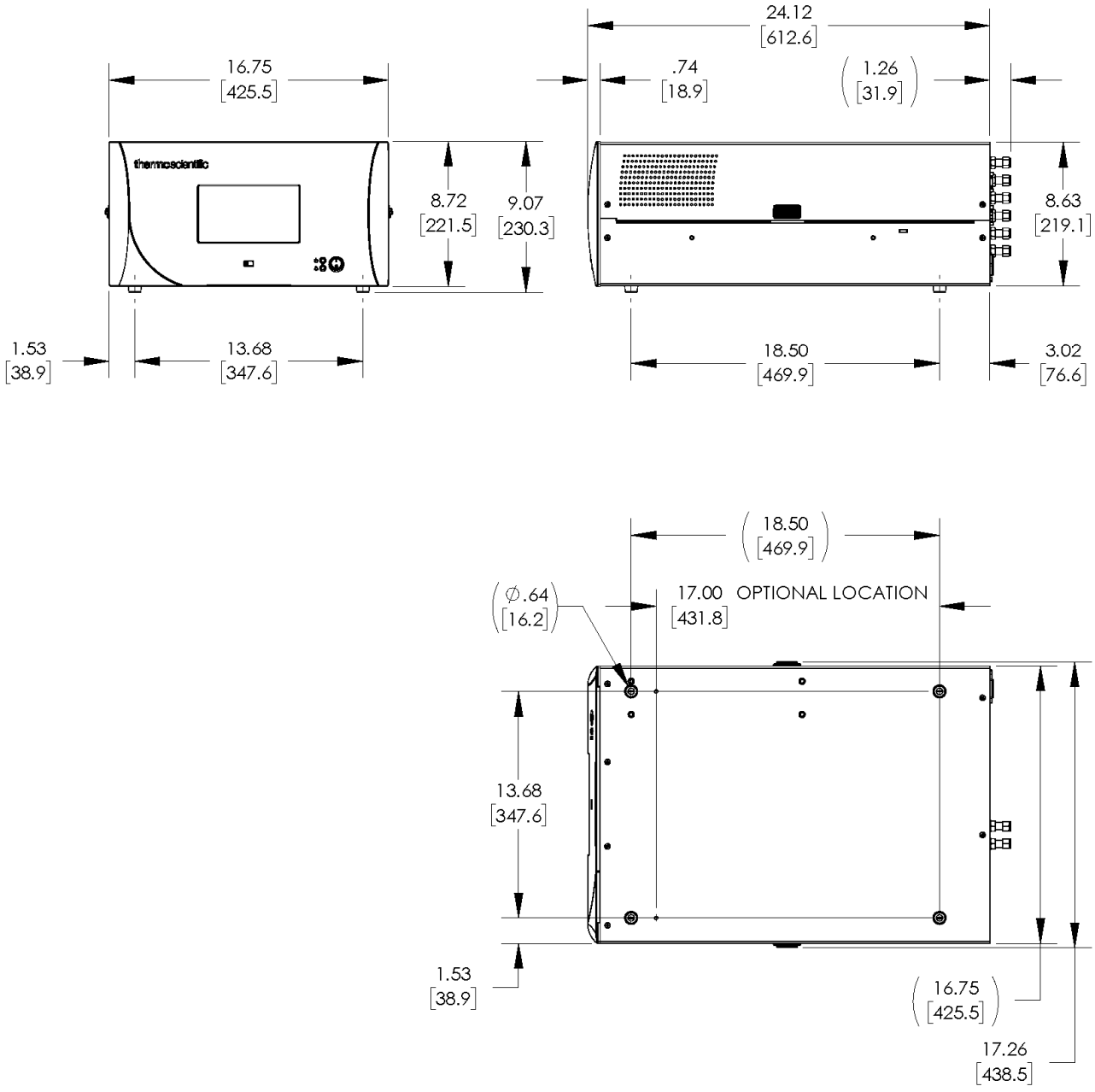


Figure 1–4. Bench Mount Assembly (dimensions in inches [mm])

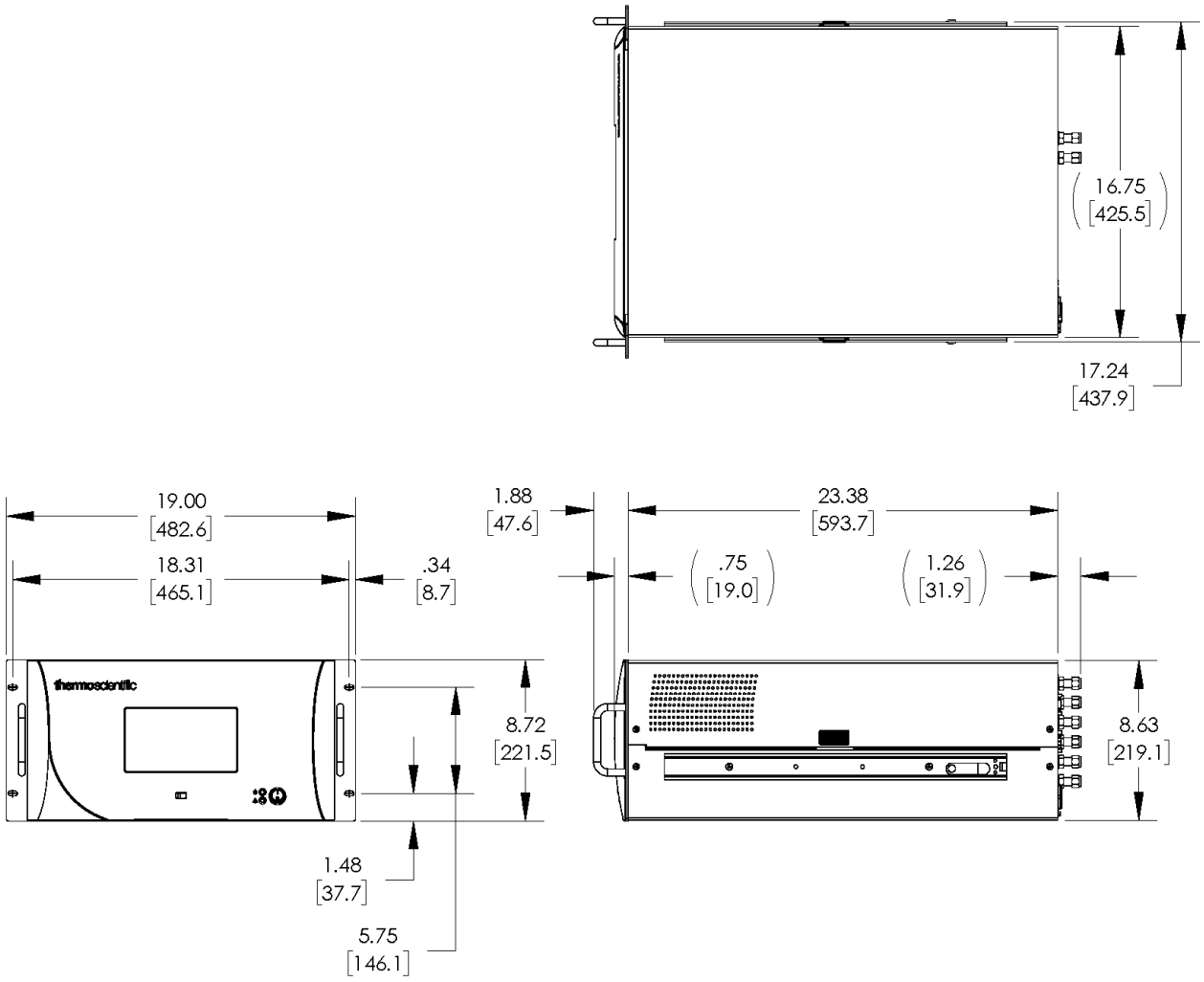


Figure 1–5. Rack Mount Assembly (dimensions in inches [mm])

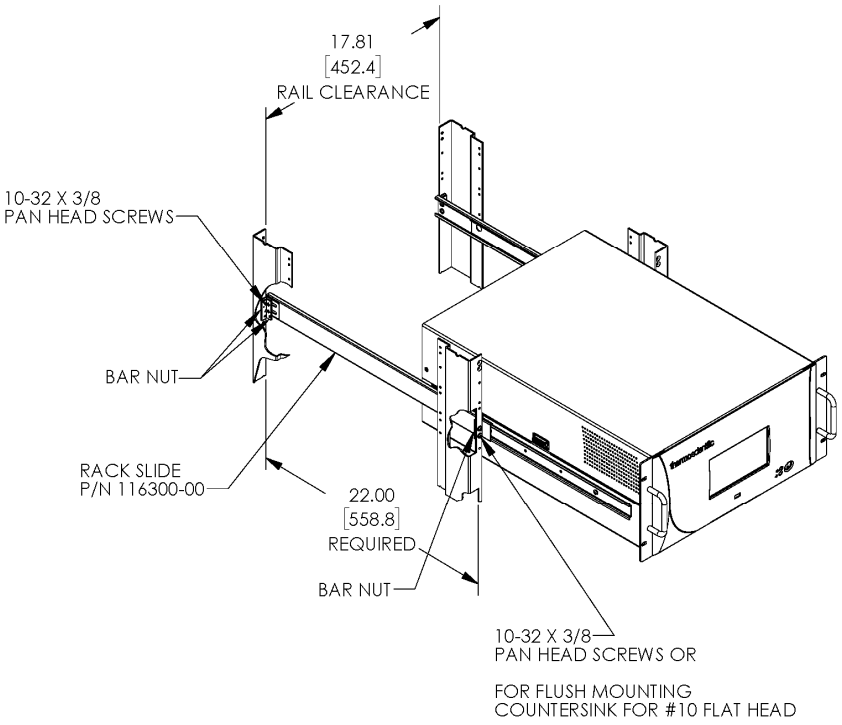


Figure 1–6. Rack Mount Requirements

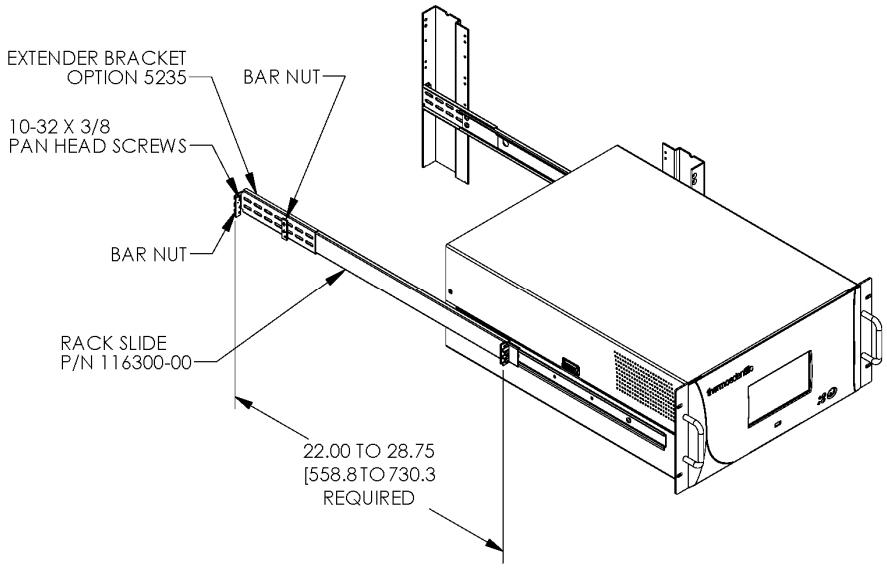


Figure 1–7. Rack Requirements Part 2

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 42iQHL is shipped complete in two containers. 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.

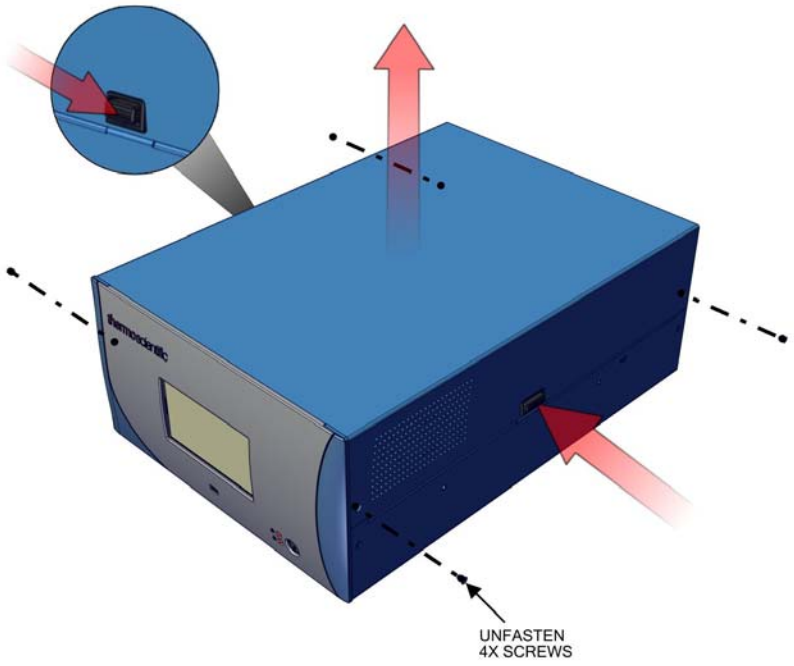


Figure 2–1. Removing the Cover

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

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

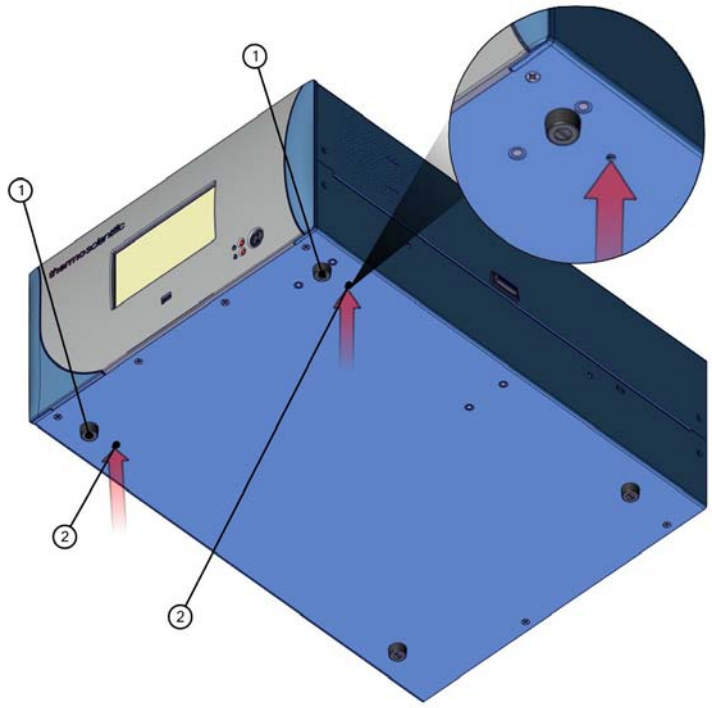


Figure 2–2. Installing Feet

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.

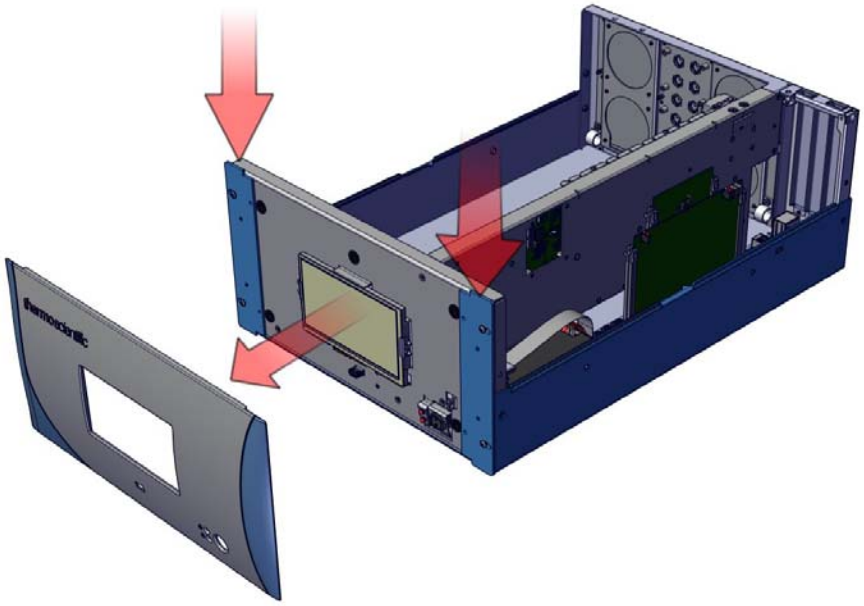


Figure 2–3. Removing the Front Panel

2. Unfasten the four 8-32 x 3/16-inch pan head screws.

3. Slide ears outwards.

4. Use the same four 8-32 x 3/16-inch pan head screws to secure it.

5. Install the handles with the four 8-32 x 3/16-inch flat head screws.

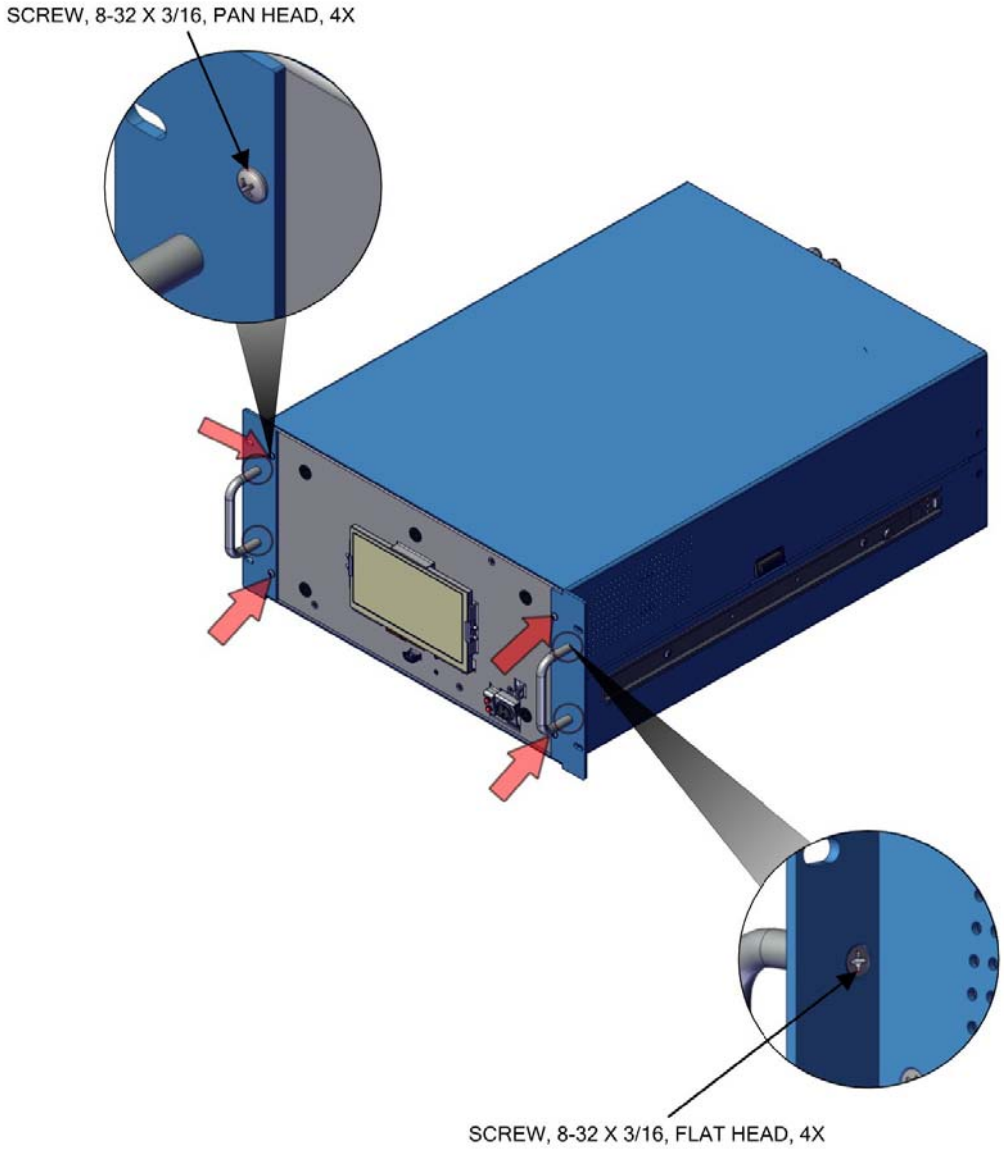


Figure 2–4. Installing Ears and Handles

Setup Procedure

Use the following procedure to setup the instrument:

1. Connect the sample line to the SAMPLE bulkhead on the rear panel (Figure 2–6). Ensure that the sample line is not contaminated by dirty, wet, or incompatible materials. All tubing should be constructed of PTFE, 316 stainless steel, borosilicate glass, or similar tubing with an OD of 1/4-inch and a minimum ID of 1/8-inch. The length of the tubing should be less than 10 feet.

Note Gas must be delivered to the instrument free of particulates. It may be necessary to use the PTFE particulate filter as described in "PTFE Particulate Filter" on page 9-20. ▲

Note Gas must be delivered to the instrument at atmospheric pressure. It may be necessary to use an atmospheric bypass plumbing arrangement as shown in Figure 2–7 if gas pressure is greater than atmospheric pressure. ▲

2. Connect the pump vacuum port (inlet) to the CHAMBER bulkhead (Figure 2–5).

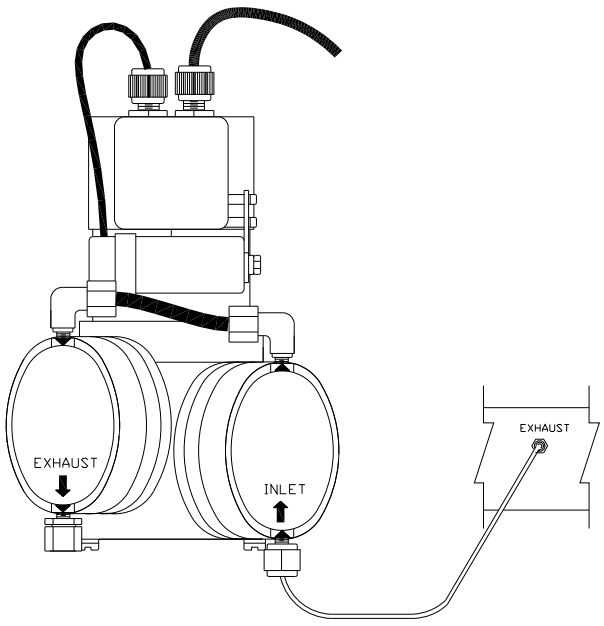


Figure 2–5. Twin-Head Vacuum Pump Installation

3. Connect the pump exhaust to a suitable vent or ozone scrubber. 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.

Equipment Damage DO NOT connect the pump exhaust port to the CHAMBER bulkhead. This can cause permanent damage to both the cooler and the photomultiplier tube. ▲

4. Plug the pump into an outlet of the appropriate voltage and frequency.

5. If the equipment contains the Bypass option, the Bypass pump is now internal to the instrument. Connect the Bypass bulkhead to a suitable vent. The length of the exhaust line should not exceed 10 feet.

6. Connect the bypass pump exhaust to a suitable vent or ozone scrubber.

7. If the optional zero/span solenoid valves are installed, connect a source of NO_x-free air to the ZERO IN bulkhead, and connect a source of NO span gas to the SPAN bulkhead.

8. 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 3-107 and "Digital I/O" on page 3-108.

9. Plug the instrument into an outlet of the appropriate voltage and frequency.

⚠WARNING The 42iQHL is supplied with a three-wire grounding cord. Under no circumstances should this grounding system be defeated. ▲

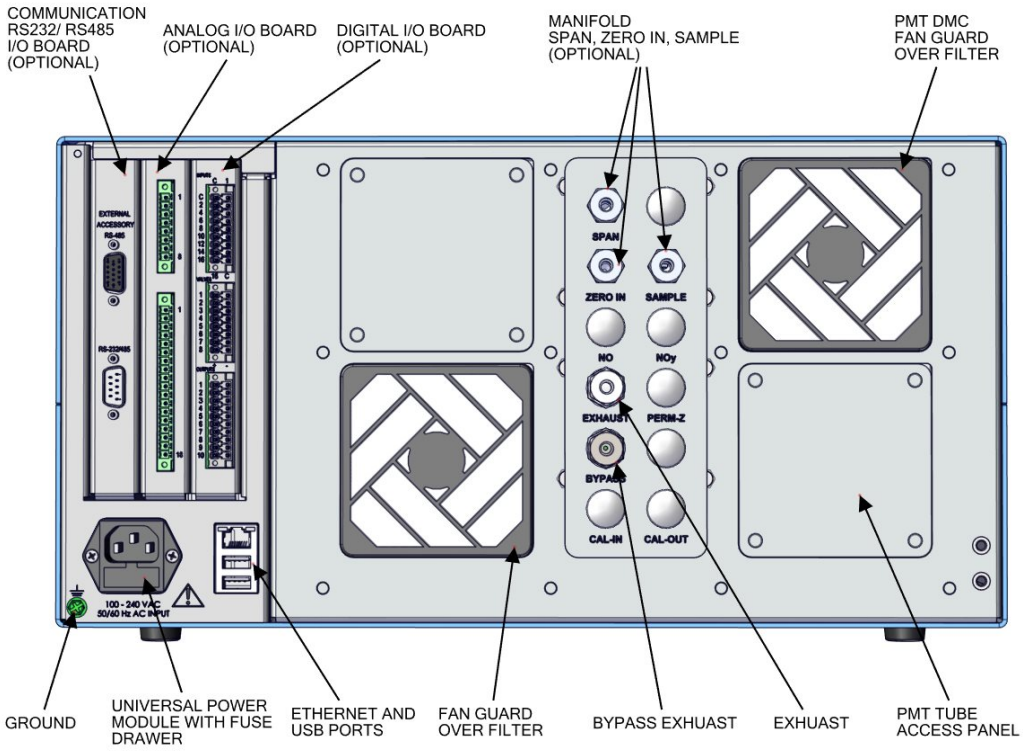


Figure 2–6. 42iQHL Rear Panel

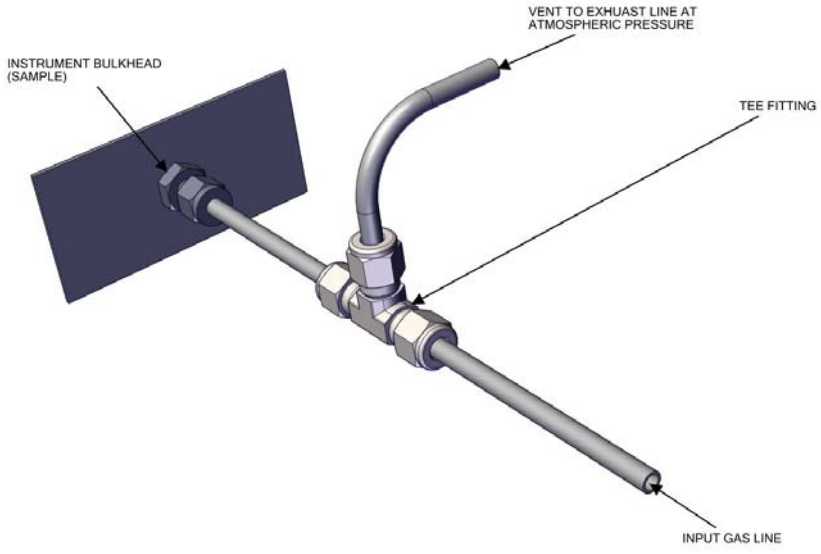


Figure 2–7. Atmospheric Dump Bypass Plumbing

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. Set instrument parameters such as operating ranges and averaging times to their appropriate settings. For more information about instrument parameters, see the "Operation" chapter.

4. Before beginning the actual monitoring, perform a multipoint calibration as described in the "Calibration" chapter.

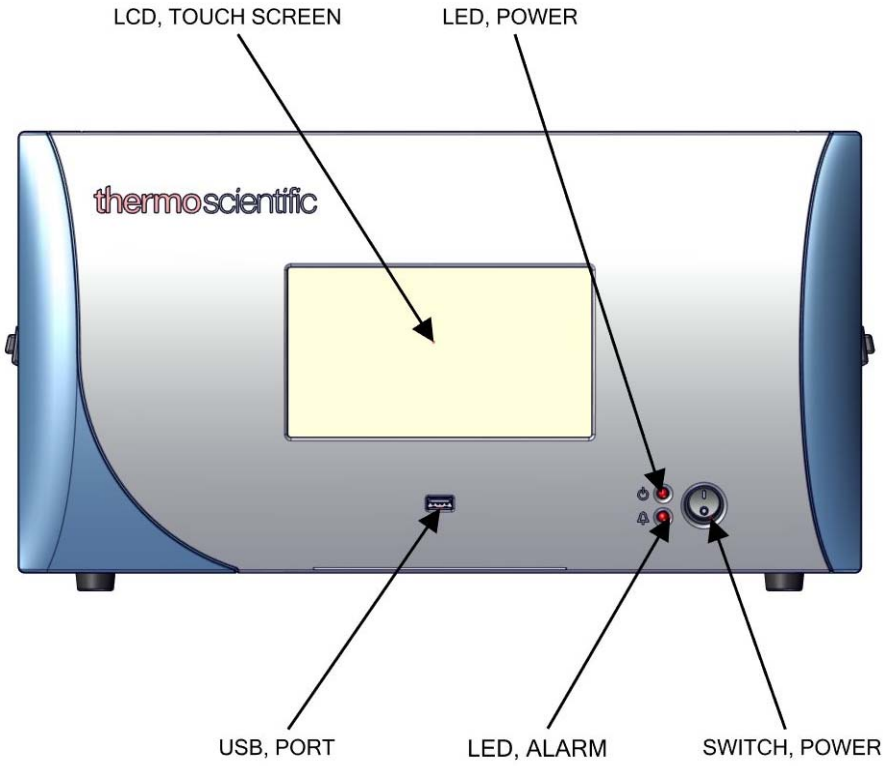


Figure 2–8. Front Panel and touch Screen Display

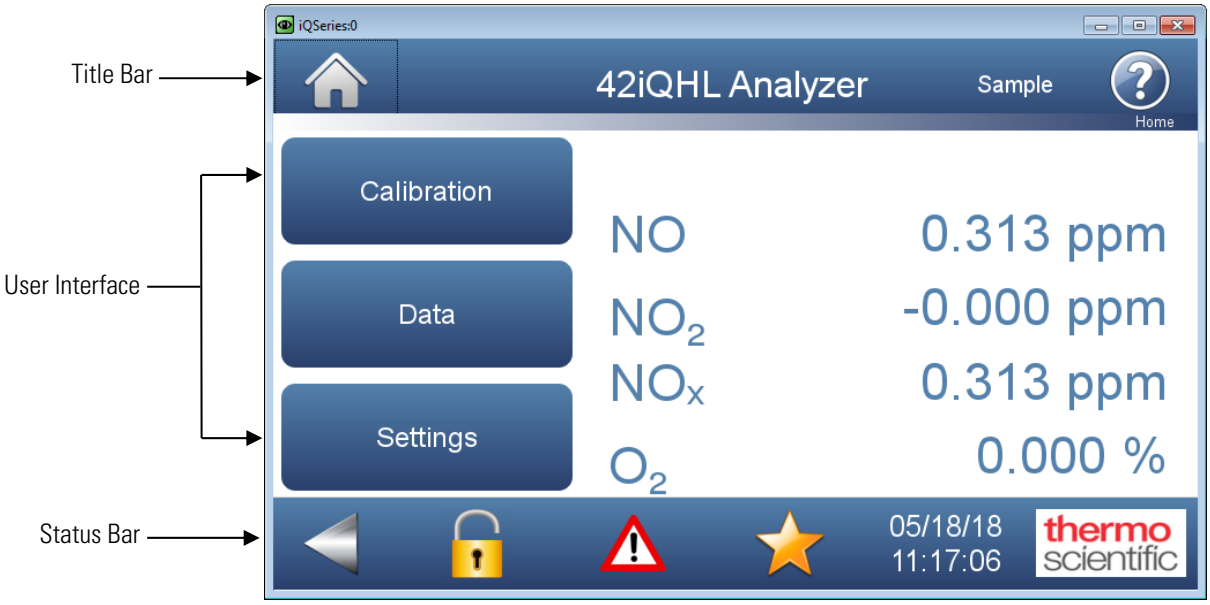
Chapter 3
Operation

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(s), concentration value(s) and unit(s). The Status Bar, located at the bottom, includes the Back button, Access Levels, Health Check, Favorites, Date and Time, and Contact Information.

Home Screen (single range mode with O_2 option)



Home Screen (dual or auto range mode)

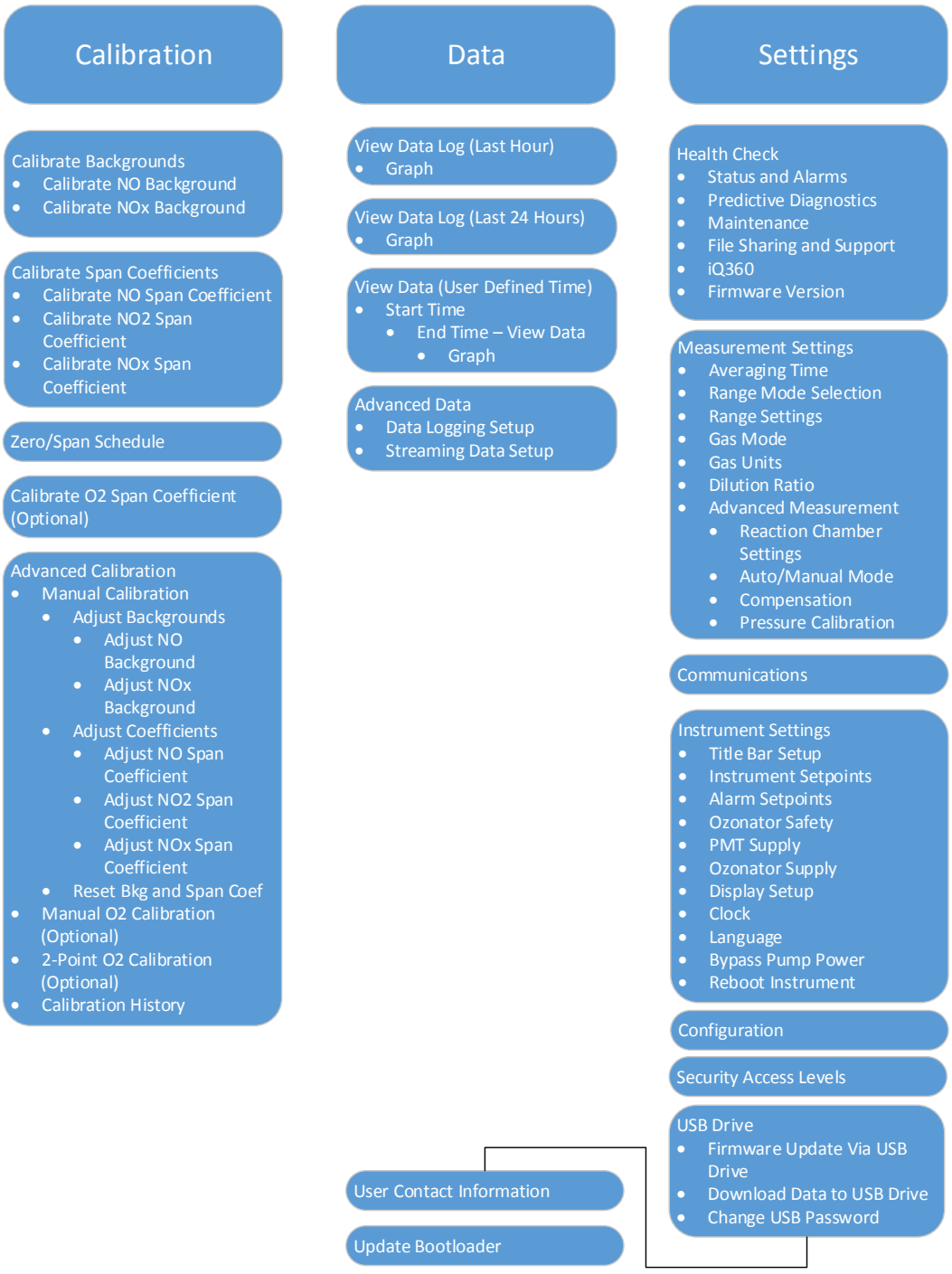
The Instrument Display contains the following information:

- 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 chemical name, current concentration reading and unit when in all other screens. When unit is pressed, it brings you to the gas unit selection screen.
  - *Gas Mode button:* Displays current gas mode of the instrument. When pressed, brings you to the Gas Mode selection screen.
  - *Help button:* When pressed, brings you to the help screens.
- User Interface:
  - *Calibration button:* Allows the user to calibrate the instrument, setup automatic calibrations, 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.
  - *Concentration*: When in single mode, displays NO, NO_2, and NO_x concentrations in big, bold characters, depending on operating mode. When in dual or auto mode, displays either high range or low range values based on the range setting.
- 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 button for 2 seconds.
  - *Clock:* Displays current date and time.

- *Thermo Scientific Information button:* Shows contact information.

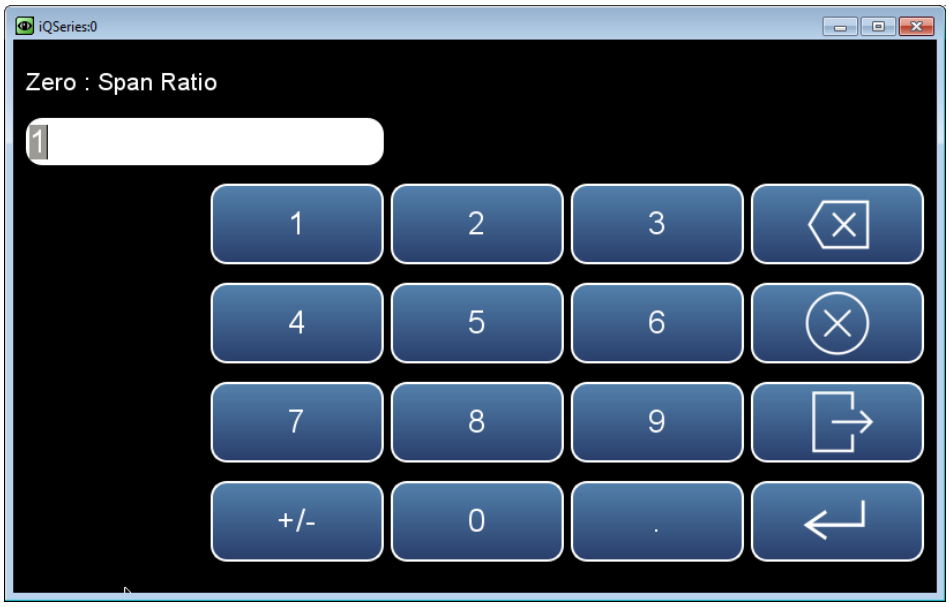
Main Menus and Keypads

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.



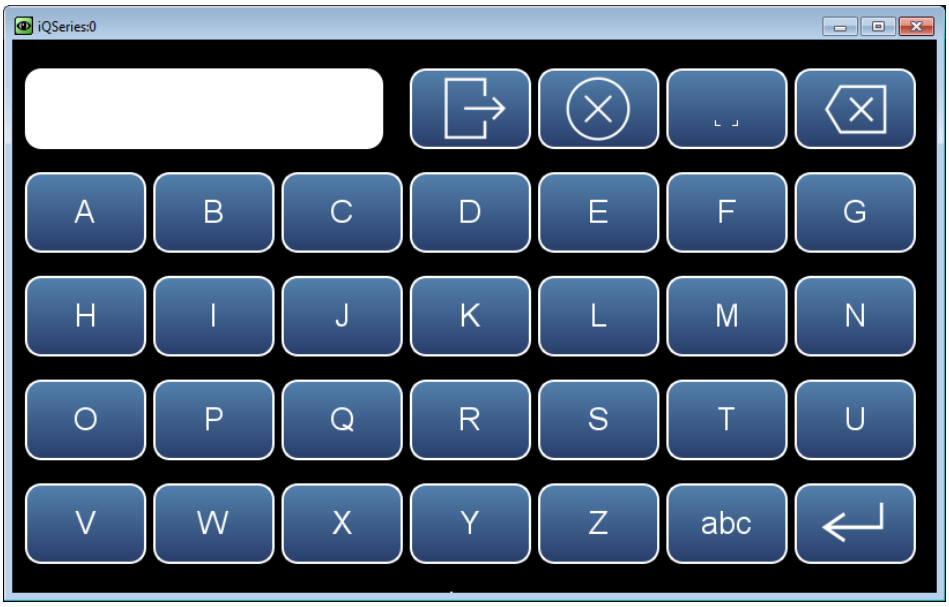
Numeric Keypad

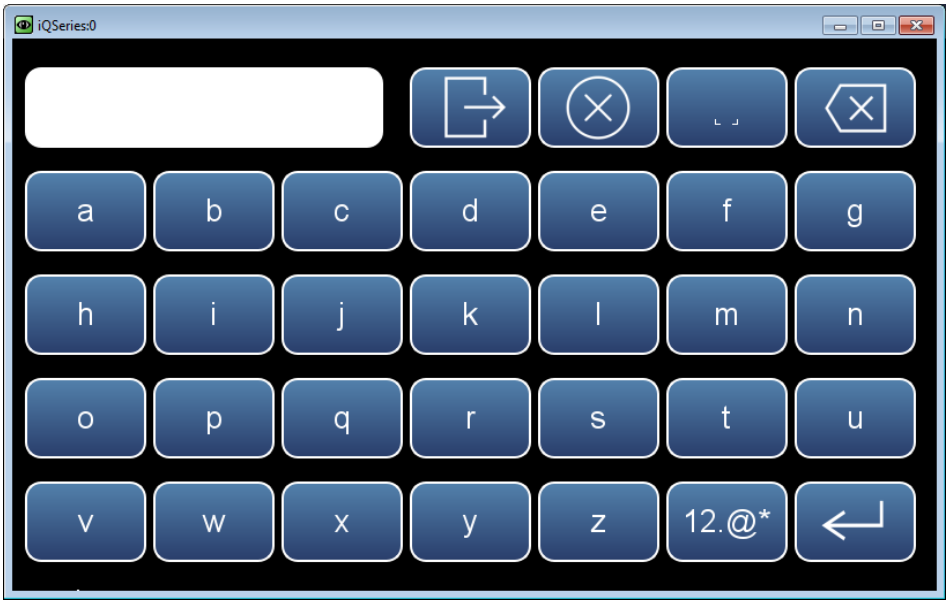
User enters a value into the box using the number keypad. When the user needs to change a value, such as for flow rates, temperatures or pressures, the keypad screen will automatically display. Initially, the box above the keypad will display the current value. Enter a new value using the keypad, and 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.

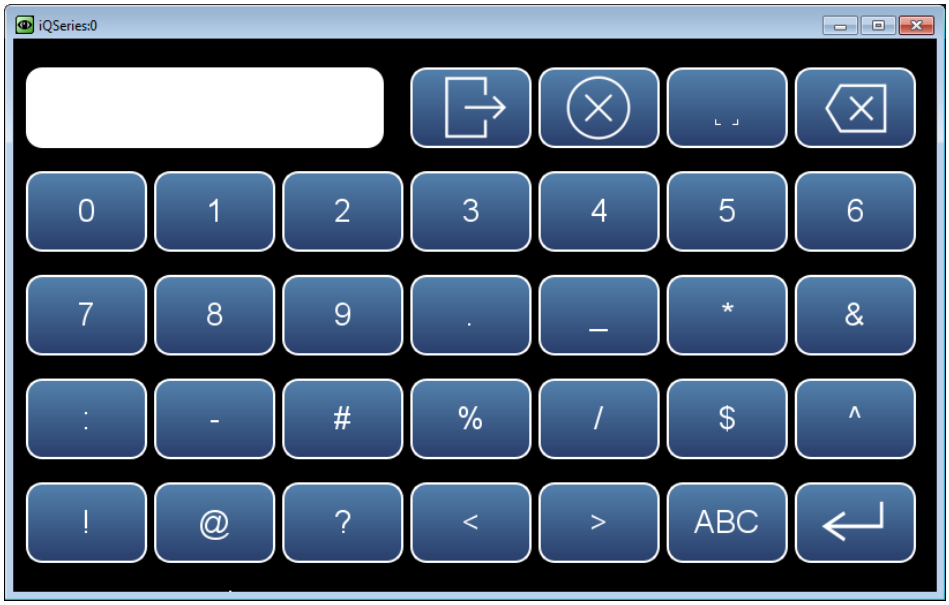


Alphanumeric Keypad

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.



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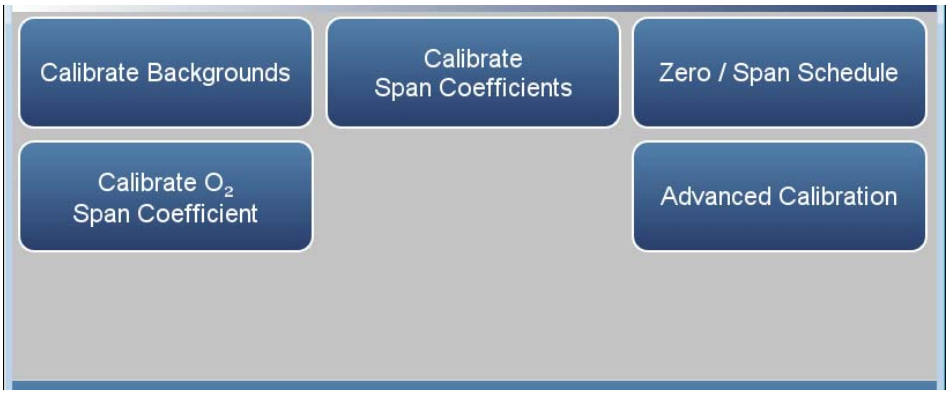
Calibration

The Calibration screen allows the user to calibrate the system, setup automatic calibrations, and view calibration data. See Chapter 4 "Calibration" for further instructions on how to run a calibration.

Home Screen>Calibration (with O_2 option)



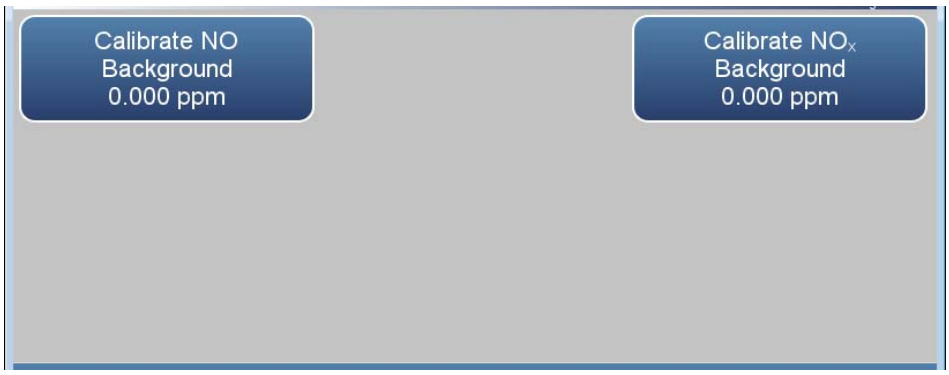
The Calibration screen contains the following information:

- *Calibrate Backgrounds:* Sets the NO and NO_x reading to zero.
- *Calibrate Span Coefficients:* Sets the NO, NO_2, and NO_x span coefficients.
- *Zero/Span Schedule:* Programs the instrument to perform fully automated zero and span checks or adjustments.
- *Calibrate O_2 Span Coefficient:* When the O_2 Sensor option is turned on (in the Settings>Configuration screen), this button will appear. It allows an O_2 calibration to be performed.
- *Advanced Calibration:* Calibrates the instrument using manual zero/span calibration and provides calibration history.

Calibrate Backgrounds

The Calibrate Backgrounds screen is used to calibrate the instrument zero background of NO and NO_x.

Home Screen>Calibration>Calibrate Backgrounds



The Calibrate Backgrounds screen contains the following information:

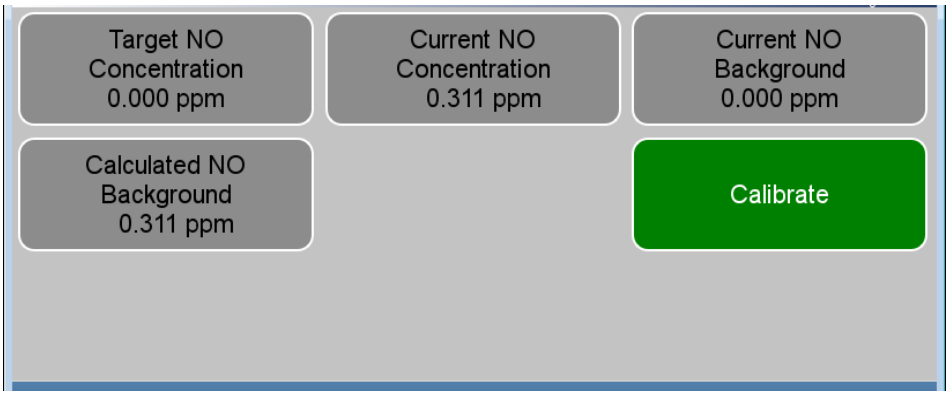
- *Calibrate NO Background:* Sets the NO background to zero.
- *Calibrate NO_x Background:* Sets the NO_x background to zero.

Calibrate NO and NO_x Background

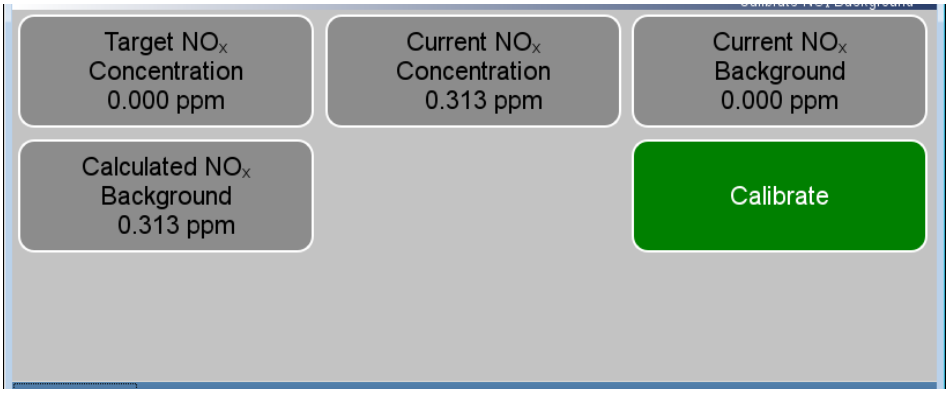
The Calibrate NO and NO_x Background screens are used to calibrate the instrument zero background. Before making an adjustment, be sure the analyzer samples zero air for at least 5 minutes.

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>Calibrate Backgrounds>Calibrate NO Background



Home Screen>Calibration>Calibrate Backgrounds>Calibrate NO_x Background



The Calibrate Background screen contains the following information:

- *Target NO Concentration:* Read only. Displays what the NO concentration value will become when the calibrate button is pressed.
- *Current NO Concentration:* Read only. Displays what the current NO concentration is.

- *Current NO Background:* Read only. Displays what the current user-set NO background is.
- *Calculated NO Background:* Read only. Displays what the current user-set NO background will become when the calibrate button is pressed.
- *Calibrate:* When pressed, updates the background value, making the concentration go to 0.
- *Target NO_x Concentration:* Read only. Displays what the NO_x concentration value will become when the calibrate button is pressed.
- *Current NO_x Concentration:* Read only. Displays what the current NO_x concentration is.
- *Current NO_x Background:* Read only. Displays what the current user-set NO_x background is.
- *Calculated NO_x Background:* Read only. Displays what the current user-set NO_x background will become when the calibrate button is pressed.
- *Calibrate:* When pressed, updates the background value, making the concentration go to zero.

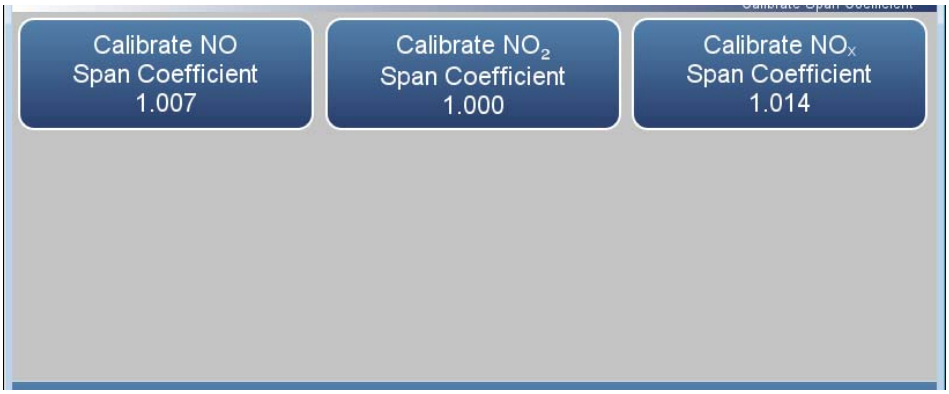
Calibrate Span Coefficients

The Calibrate Span Coefficients screens are used to calibrate the NO, NO_2, and NO_x span coefficients.

The following screens show the calibration screen in single range mode and dual or auto range mode. The dual and auto range modes have two span factors (high and low). This allows each range to be calibrated separately. When calibrating the instrument in dual or auto range, be sure to use a low span gas to calibrate the low range and a high span gas to calibrate the high range. For more information about range modes, see "Range Mode Selection" on page 3-86.

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>Calibrate Span Coefficients (single range mode)



Home Screen>Calibration>Calibrate Span Coefficients (dual or auto range mode)

The Calibrate Coefficients screen contains the following information:

- *Calibrate NO Span Coefficient:* Sets the NO span coefficient when in single range mode.
- *Calibrate High Range NO Span Coefficient:* Sets the high range NO span coefficient when in dual or auto range mode.
- *Calibrate Low Range NO Span Coefficient:* Sets the low range NO span coefficient when in dual or auto range mode.
- *Calibrate NO_2 Span Coefficient:* Sets the NO_2 span coefficient when in single range mode.
- *Calibrate High Range NO_2 Span Coefficient:* Sets the high range NO_2 span coefficient when in dual or auto range mode.
- *Calibrate Low Range NO_2 Span Coefficient:* Sets the low range NO_2 span coefficient when in dual or auto range mode.
- *Calibrate NO_x Span Coefficient:* Sets the NO_x span coefficient when in single range mode.
- *Calibrate High Range NO_x Span Coefficient:* Sets the high range NO_x span coefficient when in dual or auto range mode.
- *Calibrate Low Range NO_x Span Coefficient:* Sets the low range NO_x span coefficient when in dual or auto range mode.

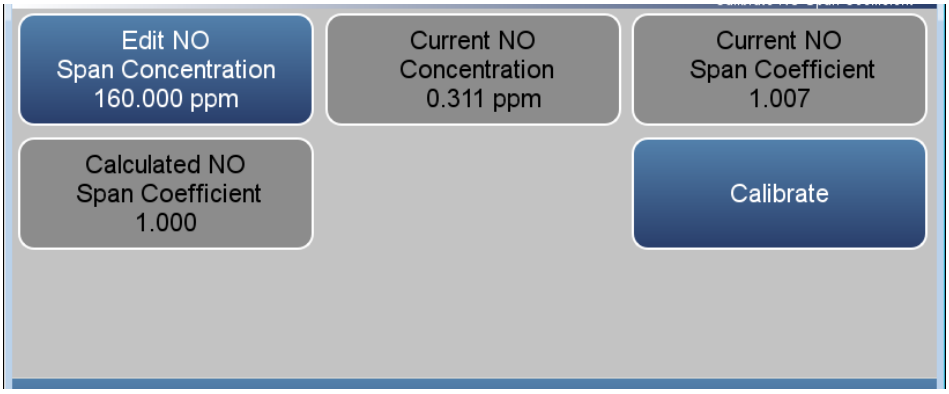
Calibrate NO, NO_2, and NO_x Span Coefficient

The Calibrate NO, NO_2, and NO_x Span Coefficient screens are used to enter span concentrations and calibrate the NO, NO_2, and NO_x coefficients. The NO span coefficient is calculated, stored, and used to correct the current reading. All calibration screens function the same way. Therefore, the following example of the NO screen applies to the NO_2 and NO_x calibration screens as well.

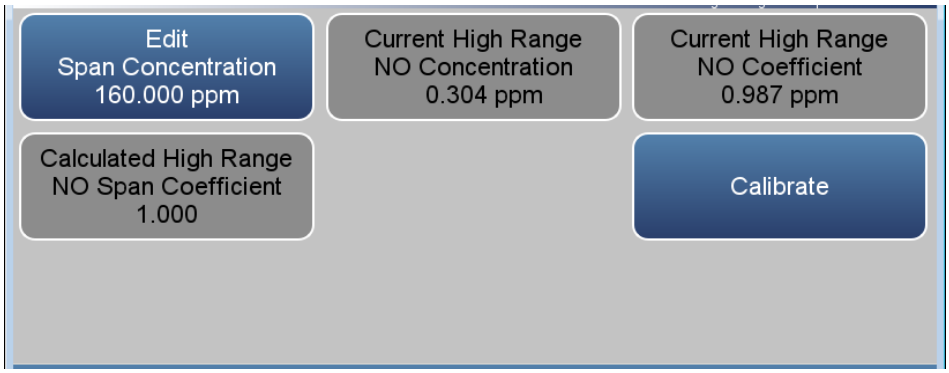
The following screens are shown in single range mode and dual or auto range mode. In dual or auto range modes, "High" or "Low" is displayed to indicate the calibration of the high or low coefficient. The Calibrate High Span Coefficient and Calibrate Low Span Coefficient screens function the same way.

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>Calibrate Span Coefficients>Calibrate NO Span Coefficient (single range mode)



Home Screen>Calibration>Calibrate Span Coefficients>Calibrate High Range NO Span Coefficient (dual or auto range mode)



The Calibrate NO, NO_2, and NO_x Span Coefficient screens contain the following information:

- *Edit NO Span Concentration:* User enters the NO span concentration when in single range mode.
- *Edit Span Concentration:* User enters the high range or low range span concentration when in dual or auto range mode.
- *Current NO Concentration:* Read only. Current NO concentration reading when in single range mode.
- *Current High Range NO Concentration:* Read only. Current high range NO concentration reading when in dual or auto range mode.
- *Current Low Range NO Concentration:* Read only. Current low range NO concentration reading when in dual or auto range mode.
- *Current NO Span Coefficient:* Read only. Displays the current user-set NO span coefficient when in single range mode.
- *Current High Range NO Coefficient:* Read only. Displays the current user-set high range NO span coefficient when in dual or auto range mode.
- *Current Low Range NO Coefficient:* Read only. Displays the current user-set low range NO span coefficient when in dual or auto range mode.
- *Calculated NO Span Coefficient:* Read only. After the "Edit NO Span Concentration" value is entered, the new calculated NO span coefficient is displayed.
- *Calculated High Range NO Span Coefficient:* Read only. After the "Edit Span Concentration" value is entered, the new calculated high range NO span coefficient is displayed.

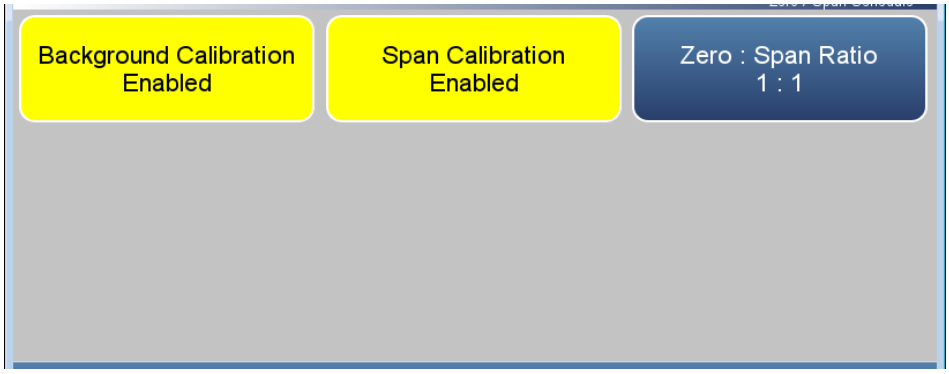
- *Calculated Low Range NO Span Coefficient:* Read only. After the "Edit Span Concentration" value is entered, the new calculated low range NO span coefficient is displayed.
- *Calibrate:* When pressed, updates the coefficient and the concentration should match the span concentration.

Zero/Span Schedule

The Zero/Span Schedule is used to program the instrument to perform fully automated zero and span checks or adjustments.

Home Screen>Calibration>Zero/Span Schedule

Home Screen>Calibration>Zero/Span Schedule>More



The Zero/Span Schedule contains the following information:

- *Zero/Span Schedule:* Toggles zero/span schedule Enabled or Disabled.
- *Next Time:* Allows the user to view and set the initial date and time (24-hour format) of the zero/span schedule.
- *Period:* Defines the period or interval between zero/span checks or calibrations. If period = 0, the schedule runs continuously.
- *Zero Duration:* Sets how long zero air is sampled by the instrument.
- *Span Duration:* Sets how long span gas is sampled by the instrument.
- *Purge Duration:* Sets how long the purge period will be at the end of the schedule.
- *Total Duration:* Read only. Displays the total time duration of all scheduled events.

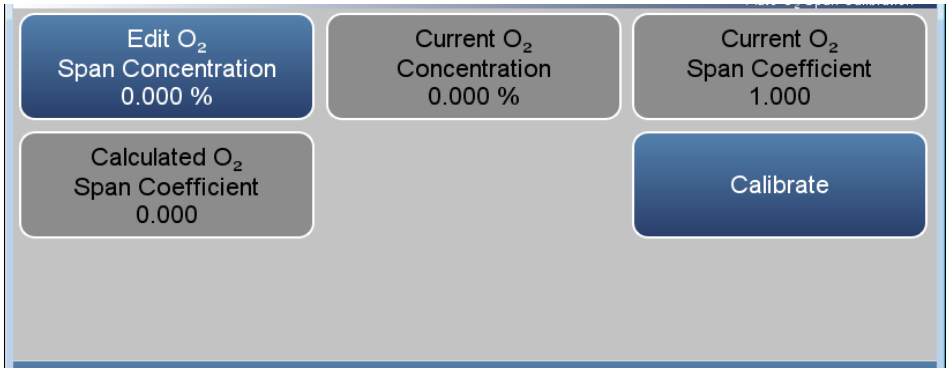
- *Schedule Averaging Time:* Allows the user to adjust the zero/span schedule averaging time. This averaging time only affects the zero/span schedule.
- *Background Calibration:* Toggles Enabled/Disabled. If enabled, background value is calibrated. If disabled, schedule runs a background check only and background value is not updated.
- *Span Calibration:* Toggles Enabled/Disabled. If enabled, span coefficient is calibrated. If disabled, schedule runs a calibration check only and span coefficient is not updated.
- *Zero : Span Ratio:* Allows the user to perform more scheduled background calibration checks to span calibration checks. Default is 1 and therefore reads 1:1. (This means that each time the schedule is run, both the zero duration and span duration occurs.) The zero/span ratio is allowable between 1 to 99. If 99 is chosen, the schedule should only perform the Span on the 99th iteration.

Calibrate O_2 Span Coefficient

The Calibrate O_2 Span Coefficient screen is used to enter the O_2 span concentration and calibrate the O_2 span coefficient while sampling span gas of known concentration. This button appears if the O_2 Sensor option is selected in the configuration screen.

It is important to note the O_2 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. The O_2 Averaging Time is located at Settings>Measurement Settings>Averaging Time.

Home Screen>Calibration>Calibrate O_2 Span Coefficient (single range mode)



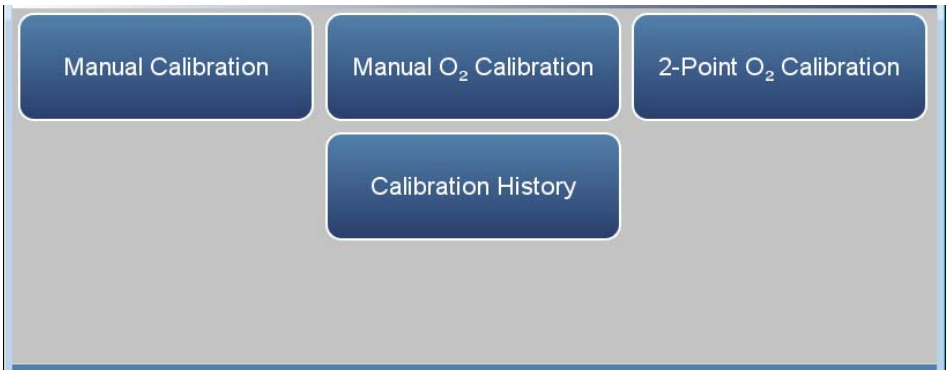
The Calibrate O_2 Span Coefficients screen contains the following information:

- *Edit O_2 Span Concentration:* User enters the O_2 span concentration.
- *Current O_2 Concentration:* Read only. Current O_2 concentration reading.
- *Current O_2 Span Coefficient:* Read only. Current O_2 span coefficient value.
- *Calculated O_2 Span Coefficient:* Read only. After the "Edit O_2 Span Concentration" value is entered, the new calculated O_2 span coefficient is displayed.
- *Calibrate:* When pressed, updates the O_2 coefficient and the O_2 concentration should match the span concentration.

Advanced Calibration

The Advanced Calibration screen provides a manual way to calibrate the instrument and view the calibration history. See Chapter 4 "Calibration" for further instructions on how to run a calibration.

Home Screen>Calibration>Advanced Calibration



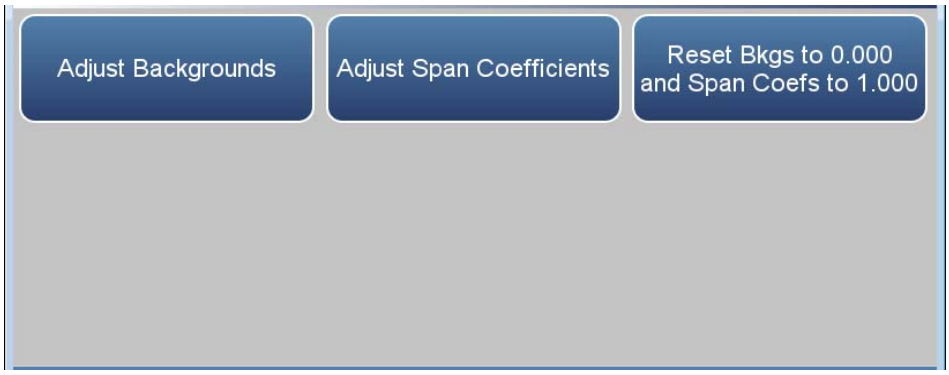
The Advanced screen contains the following information:

- *Manual Calibration:* The user manually adjusts the background or span coefficient.
- *Manual O_2 Calibration:* The user manually adjusts the O_2 span coefficient based on the current O_2 concentration value.
- *2-Point O_2 Calibration:* The user manually performs a 2-point calibration of the O_2 sensor.
- *Calibration History:* Lists all calibrations performed and calibration checks.

Manual Calibration

The Manual Calibration screen adjusts the zero background or span coefficient based on a user entered value. See Chapter 4, "Calibration" for instructions on how to run a Manual Calibration.

Home Screen>Calibration>Advanced Calibration>Manual Calibration



The Manual Calibration screen contains the following information:

- *Adjust Backgrounds:* Allows the user to manually adjust the zero backgrounds.
- *Adjust Span Coefficients:* Allows the user to manually adjust the span coefficients.
- *Reset Bkgs to 0.000 and Span Coef to 1.000:* Resets all backgrounds and coefficients.

Adjust Backgrounds

The Adjust Background screens are used to manually adjust the NO and NO_x zero background.

Home Screen>Calibration>Advanced Calibration>Manual Calibration>Adjust Backgrounds

The Adjust Backgrounds screen contains the following information:

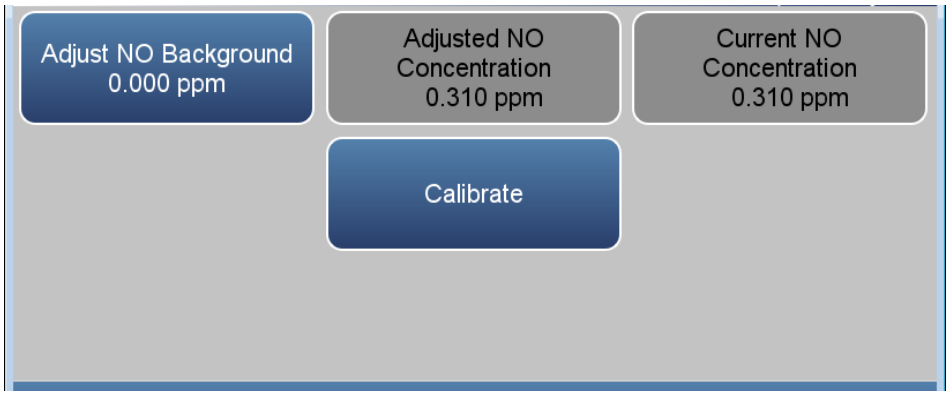
- *Adjust NO Background:* User manually adjusts zero NO background.
- *Adjust NO_x Background:* User manually adjusts zero NO_x background.

Adjust NO and NO_x Background

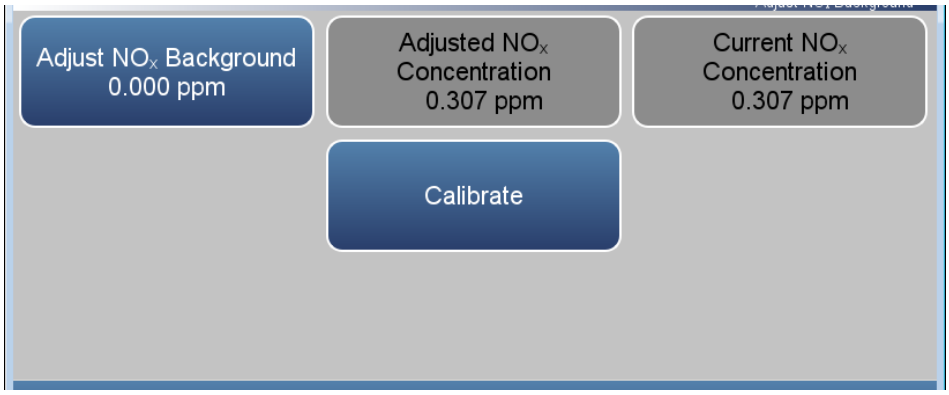
The Adjust NO and NO_x Background screens are used to adjust the instrument zero background. Before making an adjustment, be sure the analyzer samples zero air for at least 5 minutes.

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> Advanced Calibration>Manual Calibration>Adjust Backgrounds>Adjust NO Background



Home Screen>Calibration>Advanced Calibration>Manual Calibration>Adjust Backgrounds>Adjust NO_x Background



The Adjust NO and NO_x Background screens contain the following information:

- *Adjust NO Background:* User manually adjusts zero NO background.
- *Adjusted NO Concentration:* Read only. Displays what the NO concentration value will become when the calibrate button is pressed.

- *Current NO Concentration:* Read only. Displays the current NO concentration.
- *Adjust NO_x Background:* User manually adjusts zero NO_x background.
- *Adjusted NO_x Concentration:* Read only. Displays what the NO_x concentration value will become when the calibrate button is pressed.
- *Current NO_x Concentration:* Read only. Displays the current NO_x concentration.
- *Calibrate:* When pressed, updates the background.

Adjust Span Coefficients

The Adjust Span Coefficients screen is used to manually adjust the span coefficients.

The following screens show the manual calibration screens in single range mode and dual or auto range mode. In dual or auto range modes, "High Range" or "Low Range" buttons are displayed to indicate the calibration of the high or low coefficient. The Adjust High Span Coefficient and Adjust Low Span Coefficient screens function the same way as the (single range) Adjust Span Coefficient screen.

Home Screen>Calibration>Advanced Calibration>Manual Calibration>Adjust Span Coefficients (single range mode)

Home Screen>Calibration>Advanced Calibration>Manual Calibration>Adjust Span Coefficients (dual or auto range mode)

The Adjust Span Coefficients screen contains the following information:

- *Calibrate NO Coefficient:* Adjusts the NO coefficient when in single range mode.
- *Calibrate NO High Range Coefficient:* Adjusts the NO high range coefficient when in dual or auto range mode.

- *Calibrate NO Low Range Coefficient:* Adjusts the NO low range coefficient when in dual or auto range mode.
- *Calibrate NO_2 Coefficient:* Adjusts the NO_2 coefficient when in single range mode.
- *Calibrate NO_2 High Range Coefficient:* Adjusts the NO_2 high range coefficient when in dual or auto range mode.
- *Calibrate NO_2 Low Range Coefficient:* Adjusts the NO_2 low range coefficient when in dual or auto range mode.
- *Calibrate NO_x Coefficient:* Adjusts the NO_x coefficient when in single range mode.
- *Calibrate NO_x High Range Coefficient:* Adjusts the NO_x high range coefficient when in dual or auto range mode.
- *Calibrate NO_x Low Range Coefficient:* Adjusts the NO_x low range coefficient when in dual or auto range mode.

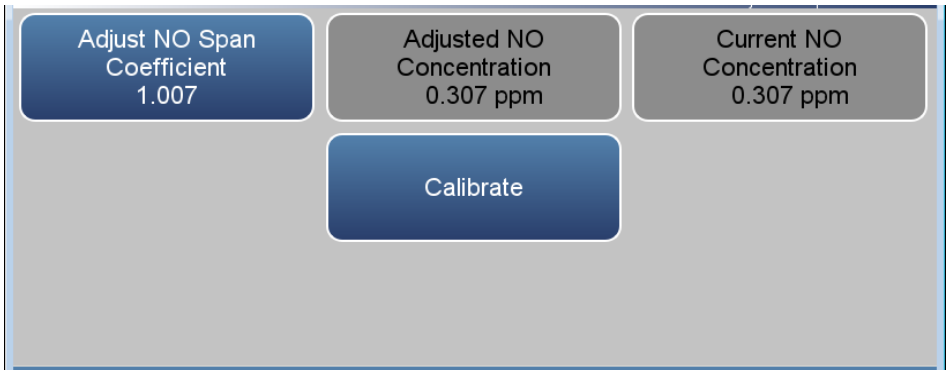
Adjust NO, NO_2, and NO_x Span Coefficients

The Adjust NO, NO_2, and NO_x Span Coefficient screens are used to manually adjust the coefficient and enter the span concentration. The NO span coefficient is calculated, stored, and used to correct the current reading. All calibration screens function the same way. Therefore, the following example of the NO screen applies to the NO_2 and NO_x calibration screens as well.

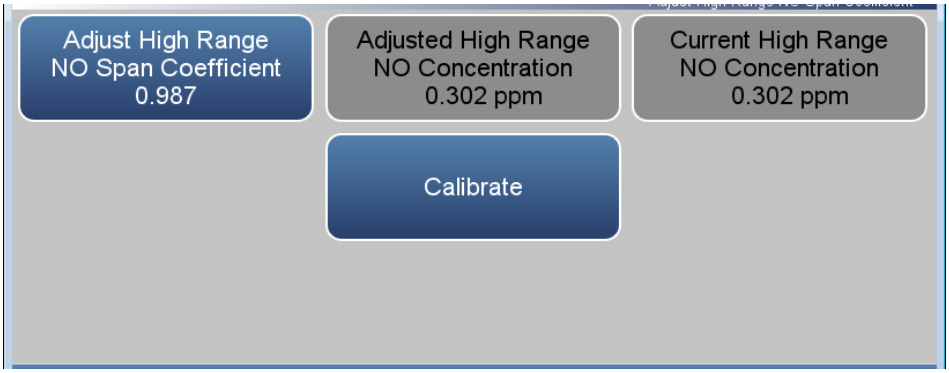
The following screen is shown in single range mode and dual or auto range mode. In dual or auto range modes, "High Range" or "Low Range" is displayed to indicate the calibration of the high or low coefficient. The Adjust High Range NO Span Coefficient and Adjust Low Range NO Span Coefficient screens function the same way.

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>Advanced Calibration>Manual Calibration>Adjust Span Coefficients>Adjust NO Span Coefficient (single range mode)



Home Screen> Calibration>Advanced Calibration>Manual Calibration>Adjust Coefficients> Adjust High Range NO Span Coefficient (dual or auto range mode)



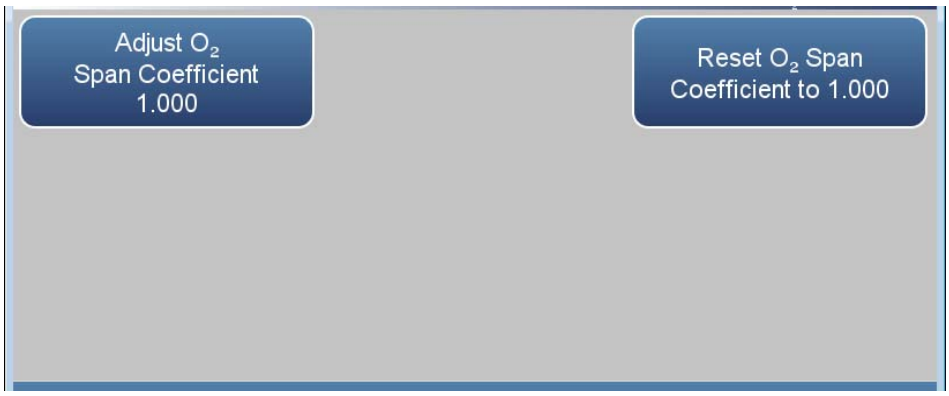
The Adjust NO Span Coefficient screens contain the following information:

- *Adjust NO Span Coefficient:* User manually adjusts NO span coefficient when in single range mode.
- *Adjusted NO Concentration:* Read only. Shows adjusted NO concentration based on adjusted NO span coefficient when in single range mode.
- *Current NO Concentration:* Read only. Shows current NO concentration when in single range mode.
- *Adjust High Range NO Span Coefficient:* User manually adjusts the high range NO span coefficient when in dual or auto range mode.
- *Adjusted High Range NO Concentration:* Read only. Shows adjusted high range NO concentration based on adjusted high range NO span coefficient when in dual or auto range mode.
- *Current High Range NO Concentration:* Read only. Shows current high range NO concentration when in dual or auto range mode.
- *Adjust Low Range NO Span Coefficient:* User manually adjusts the NO low span coefficient when in dual or auto range mode.
- *Adjusted Low Range NO Concentration:* Read only. Shows adjusted NO concentration based on adjusted low range NO span coefficient when in dual or auto range mode.
- *Adjusted Low Range NO Concentration:* Read only. Shows current low range NO concentration when in dual or auto range mode.
- *Calibrate:* Calibrates span coefficient by saving the newly adjusted span coefficient.

Manual O_2 Calibration

The Manual O_2 Calibration screen allows the O_2 span coefficients to be changed manually while sampling span gas of known concentration. This button appears if the O_2 Sensor option is selected in the Configuration screen.

Home Screen>Calibration>Advanced Calibration>Manual Calibration (single range mode)



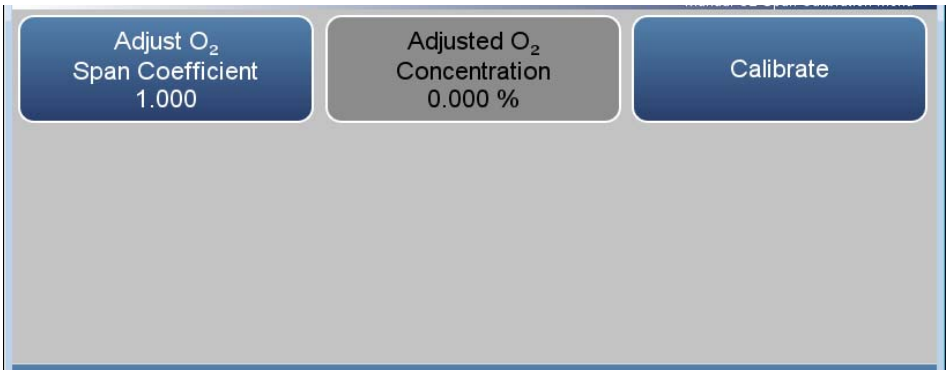
The Manual O_2 Calibration screen contains the following information:

- *Adjust O_2 Span Coefficient:* Allows the user to manually adjust the O_2 span coefficient.
- *Reset O_2 Coefficient to 1.000:* Resets coefficient.

Adjust O_2 Span Coefficient

The Adjust O_2 Span Coefficient screen is used to manually adjust the O_2 span coefficient.

Home Screen>Calibration>Advanced>Manual Calibration>Adjust O_2 Span Coefficient



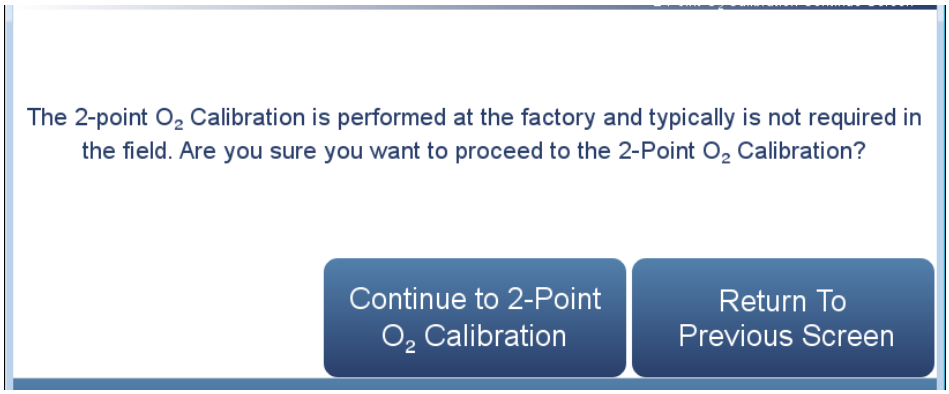
The Adjust O_2 Span Coefficient menu contains the following information:

- *Adjust O_2 Span Coefficient:* User manually adjusts span coefficient.
- *Adjusted Concentration:* Read only. Shows adjusted O_2 concentration based on adjusted O_2 span coefficient.
- *Calibrate:* Calibrates span coefficient by saving the newly adjusted O_2 span coefficient.

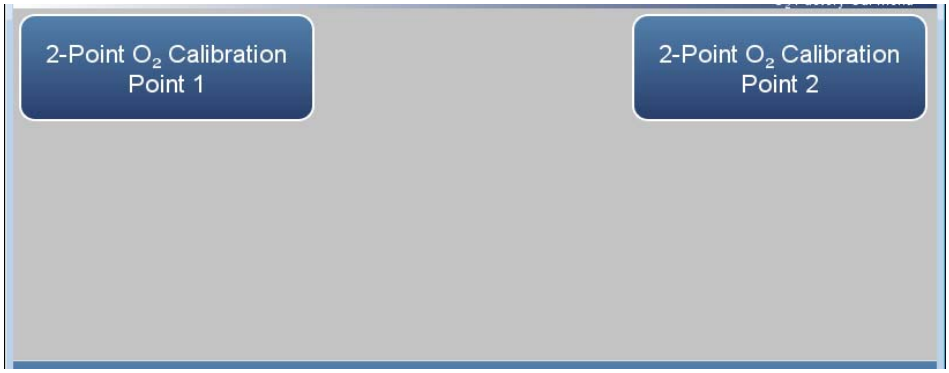
2-Point O_2 Calibration

The 2-Point O_2 Calibration screen is used to calibrate the O2 sensor using 2 different gas concentrations. Both points need to be calibrated for a successful calibration. It is suggested that the two O_2 concentrations used for this calibration be 0% and 20.9%. This button appears if the O_2 Sensor option is selected in the Configuration screen.

Home Screen>Calibration>Advanced Calibration>2-Point O_2 Calibration>



Home Screen>Calibration>Advanced Calibration>2-Point O_2 Calibration>Continue to 2-Point O_2 Calibration



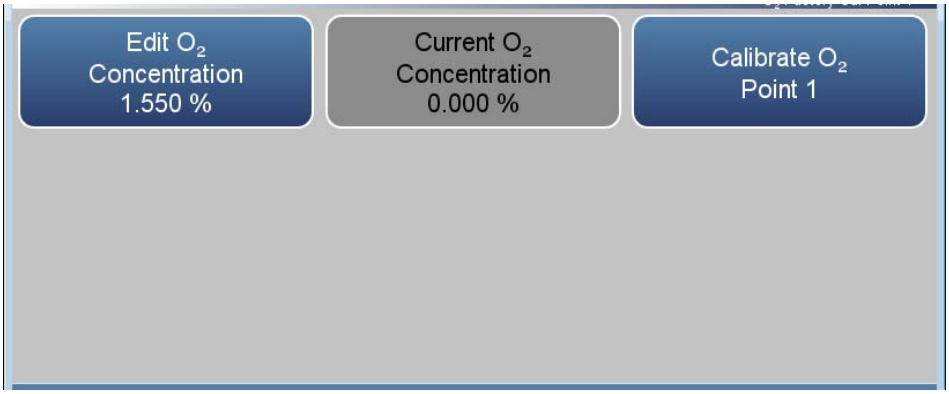
The 2-Point O_2 Calibration screen contains the following information:

- *2-Point O_2 Calibration Point 1:* First cal point used in the 2 point O_2 calibration. Defaults to 0.000%.
- *2-Point O_2 Calibration Point 2:* Second cal point used in the 2 point O_2 calibration. Defaults to 20.900%.

Point 1–2

The Point 1 screen allows the user to view and set the selected calibration point. The point 2 screen functions the same way. Therefore, the following example of point 1 screen applies to point 2 as well.

Home Screen>Calibration>Advanced Calibration>2-Point O_2 Calibration>Continue to 2-Point O_2 Calibration>Point 1



The Point 1 screen contains the following information:

- *Edit O_2 Span Concentration:* User enters O_2 span concentration.
- *Current O_2 Concentration:* Read only. After selecting the value on the Edit O_2 Concentration button and after pressing the Calibrate O_2 button, the Point 1 Concentration value is updated.
- *Calibrate O_2:* Calibrates point 1 coefficient.

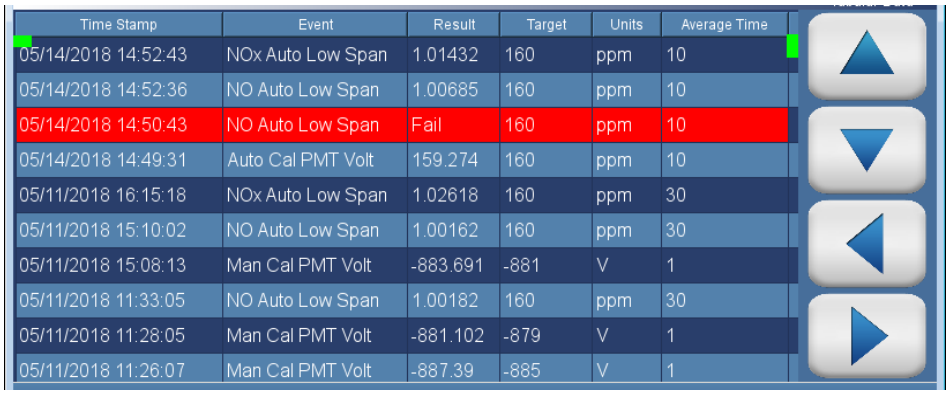
Calibration History

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... ▲



Time Stamp	Event	Result	Target	Units	Average Time
05/14/2018 14:52:43	NOx Auto Low Span	1.01432	160	ppm	10
05/14/2018 14:52:36	NO Auto Low Span	1.00685	160	ppm	10
05/14/2018 14:50:43	NO Auto Low Span	Fail	160	ppm	10
05/14/2018 14:49:31	Auto Cal PMT Volt	159.274	160	ppm	10
05/11/2018 16:15:18	NOx Auto Low Span	1.02618	160	ppm	30
05/11/2018 15:10:02	NO Auto Low Span	1.00162	160	ppm	30
05/11/2018 15:08:13	Man Cal PMT Volt	-883.691	-881	V	1
05/11/2018 11:33:05	NO Auto Low Span	1.00182	160	ppm	30
05/11/2018 11:28:05	Man Cal PMT Volt	-881.102	-879	V	1
05/11/2018 11:26:07	Man Cal PMT Volt	-887.39	-885	V	1

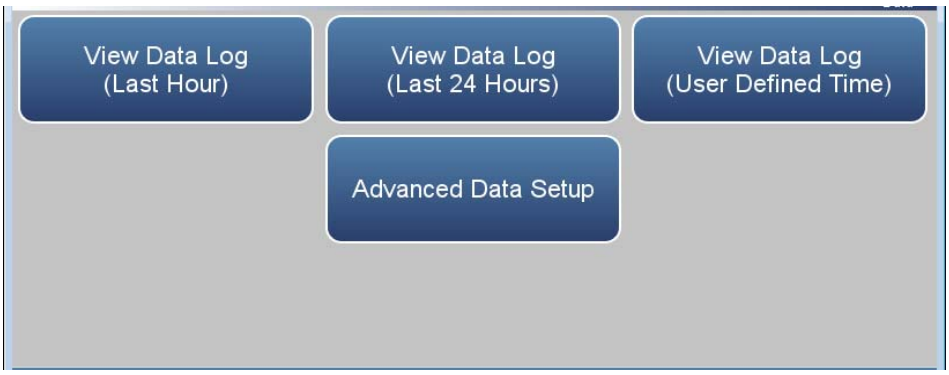
The Calibration History screen contains the following information:

- *Time Stamp:* Time of calibration or calibration check.
- *Event:* Lists the type of calibration event.
- *Result:* Concentration result.
- *Target:* Concentration setpoint value.
- *Units:* Displays units for each item.
- *Average Time:* Averaging time used during the calibration or calibration check.

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.

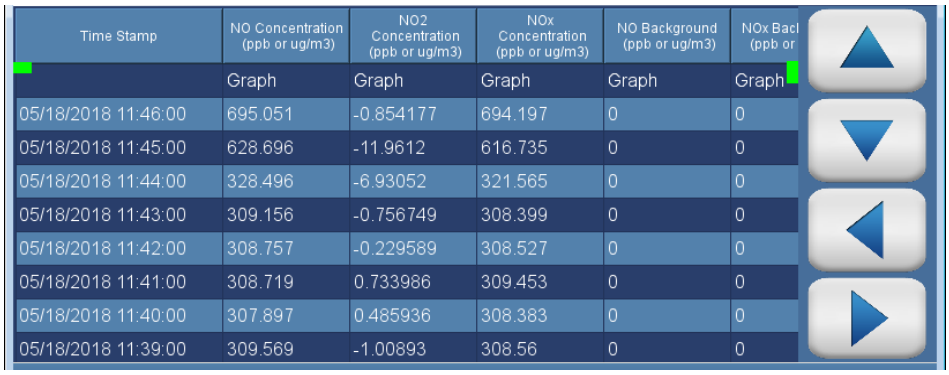
View Data Log (Last Hour)

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)

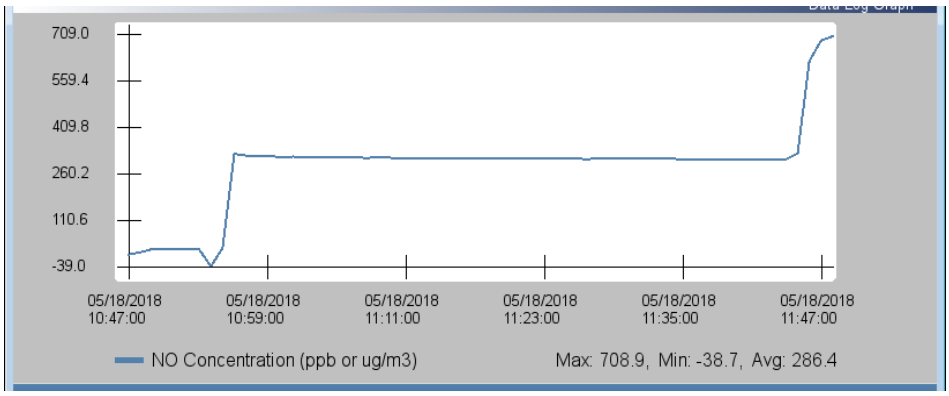
Note Pressing the View Data Log ((Last Hour) responds with Retrieving user log data, it may take a few seconds... ▲



Time Stamp	NO Concentration (ppb or ug/m3)	NO2 Concentration (ppb or ug/m3)	NOx Concentration (ppb or ug/m3)	NO Background (ppb or ug/m3)	NOx Bacl (ppb or
	Graph	Graph	Graph	Graph	Graph
05/18/2018 11:46:00	695.051	-0.854177	694.197	0	0
05/18/2018 11:45:00	628.696	-11.9612	616.735	0	0
05/18/2018 11:44:00	328.496	-6.93052	321.565	0	0
05/18/2018 11:43:00	309.156	-0.756749	308.399	0	0
05/18/2018 11:42:00	308.757	-0.229589	308.527	0	0
05/18/2018 11:41:00	308.719	0.733986	309.453	0	0
05/18/2018 11:40:00	307.897	0.485936	308.383	0	0
05/18/2018 11:39:00	309.569	-1.00893	308.56	0	0

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.



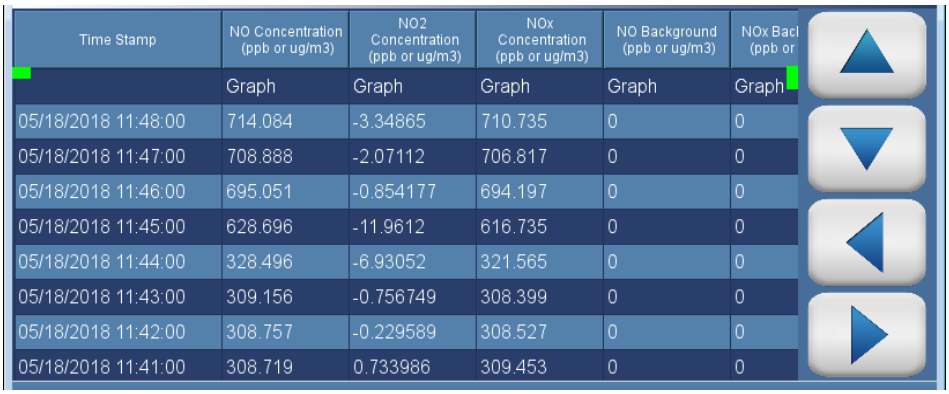
View Data Log (Last 24 Hours)

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)

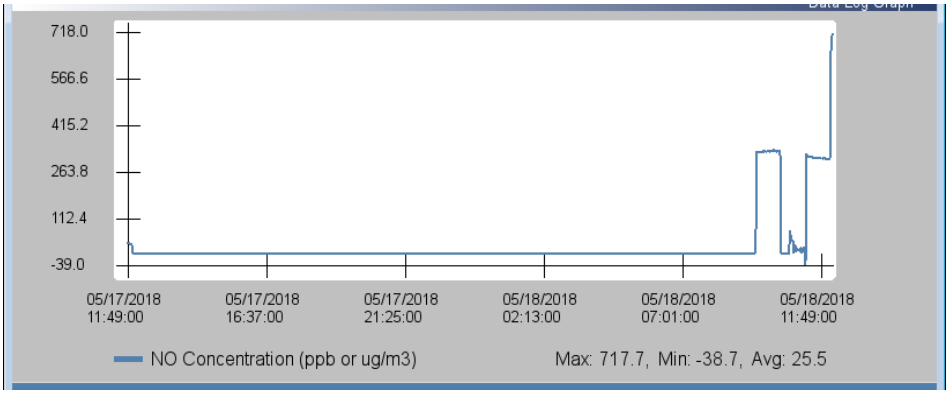
Note Pressing the View Data Log ((Last 24 Hours) responds with Retrieving user log data, it may take a few seconds... ▲



Time Stamp	NO Concentration (ppb or ug/m3)	NO2 Concentration (ppb or ug/m3)	NOx Concentration (ppb or ug/m3)	NO Background (ppb or ug/m3)	NOx Bacl (ppb or
	Graph	Graph	Graph	Graph	Graph
05/18/2018 11:48:00	714.084	-3.34865	710.735	0	0
05/18/2018 11:47:00	708.888	-2.07112	706.817	0	0
05/18/2018 11:46:00	695.051	-0.854177	694.197	0	0
05/18/2018 11:45:00	628.696	-11.9612	616.735	0	0
05/18/2018 11:44:00	328.496	-6.93052	321.565	0	0
05/18/2018 11:43:00	309.156	-0.756749	308.399	0	0
05/18/2018 11:42:00	308.757	-0.229589	308.527	0	0
05/18/2018 11:41:00	308.719	0.733986	309.453	0	0

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

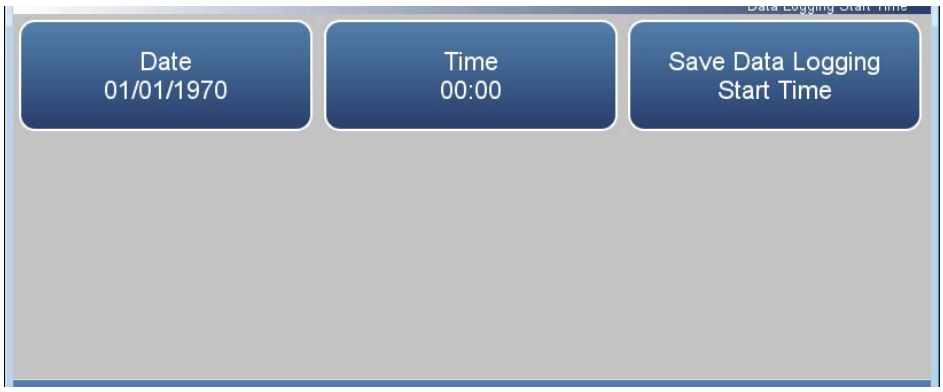
- *Graph:* Displays data graph for the column selected. The graph time axis is defined by the data set in the table.



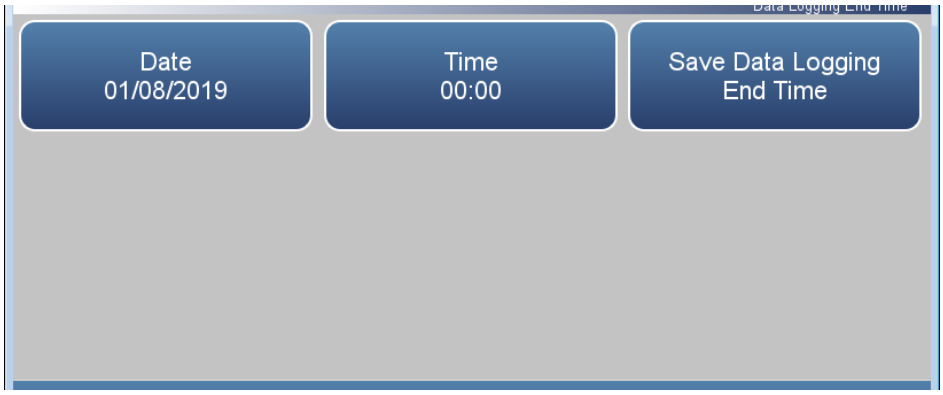
View Data Log (User Defined Time)

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)



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



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.

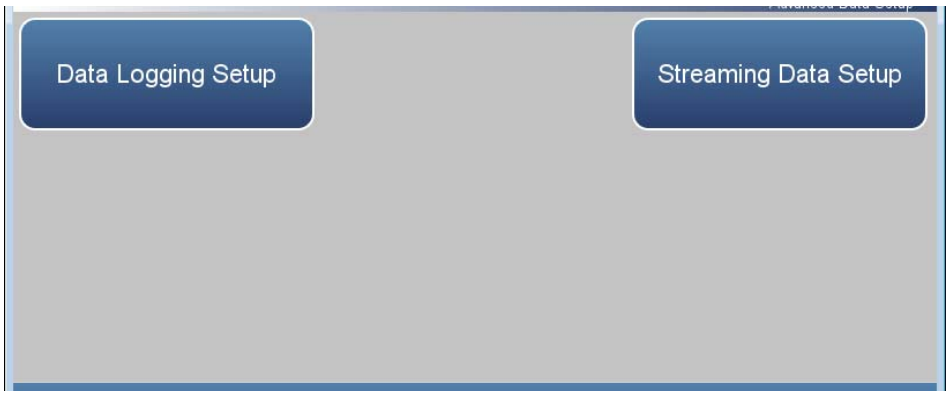
Note End time should not be greater than 1 year from start time . ▲

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:

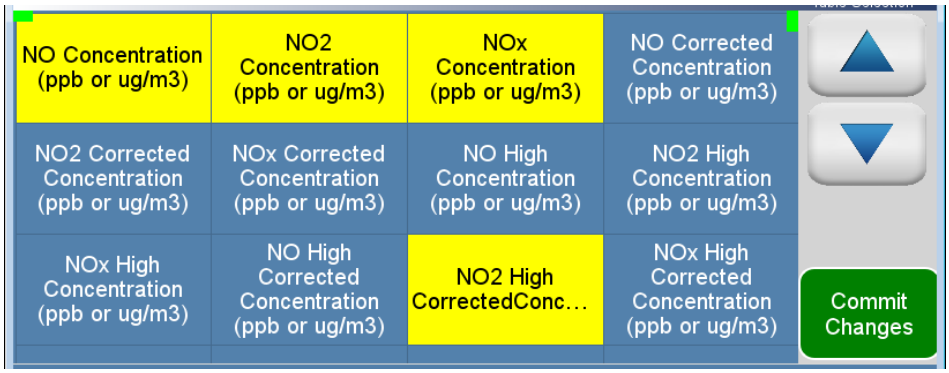
- *Select Data Logging Variables*: User selects instrument variables to log.
- *Period*: User selects how often data is collected by setting the duration between logged data.
- *Data Treatment*: Toggles between Average, Current, Minimum and Maximum. When set to average, the average value during the period 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.

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.

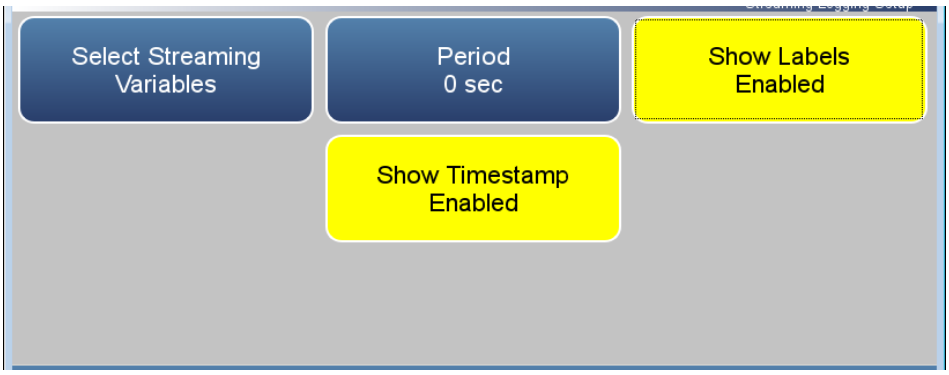
Home Screen>Data>Advanced>Data Logging Setup>Select Data Logging Variables



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:

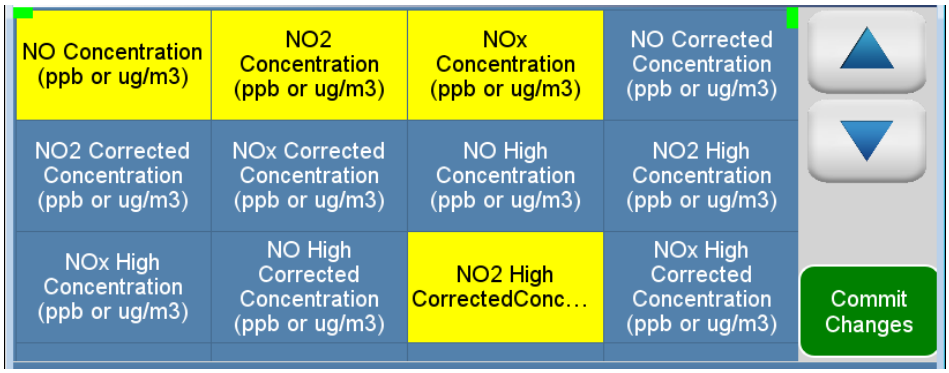
- *Select Streaming Variables*: User selects which variables to stream.
- *Period*: Sets the time between streamed data.
- *Show Labels*: Toggles on/off. When on, shows variable labels to the left of the variable values.
- *Show Timestamp*: Toggles on/off. When on, shows timestamp at the beginning of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

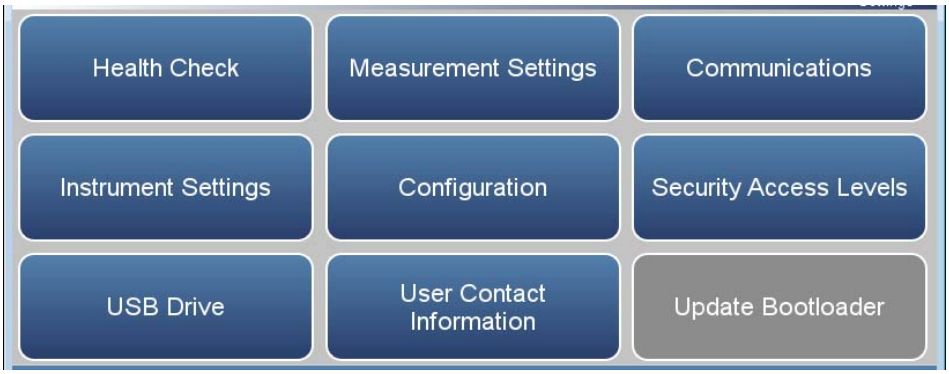
Home Screen>Data>Advanced>Streaming Data Setup>Select Streaming Variables



Settings

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

Home Screen>Settings



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.
- *Measurement Settings:* Allows the user to setup user preferences as related to the concentration readings.
- *Communications:* Allows the user to communicate with outside devices.
- *Instrument Settings:* Allows the user to setup alarm setpoints and user preferences.
- *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.

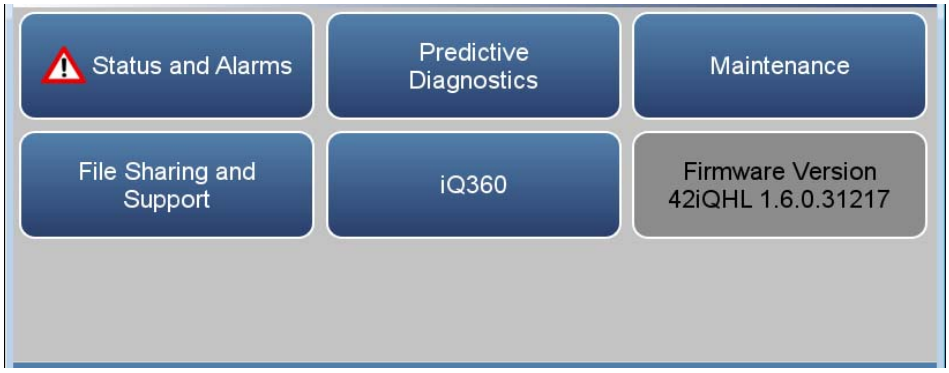
Health Check

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:

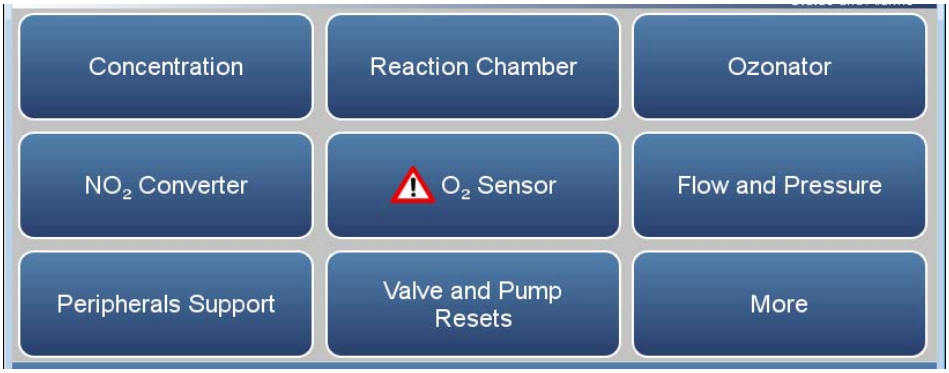
- *Status and Alarms:* Allows the user to view the status and alarm menus. Menus are broken down according to modules where the user can view instrument readings, setpoints and alarms.
- *Predictive Diagnostics:* Smart module diagnostics, which shows possible future issues.
- *Maintenance History:* Allows 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:

- *Concentration:* Displays NO/NO_2/NO_x concentrations and alarms.
- *Reaction Chamber:* Displays reaction chamber alarms and faults.
- *Ozonator:* Displays ozonator alarms and faults.
- *NO_2 Converter:* Displays NO_2 converter alarms and faults.
- *O_2 Sensor:* Displays O_2 sensor concentrations, alarms and faults (if enabled).

- *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.

Concentration

The Concentration screen provides status and alarms for $NO/NO_2/NO_x$ concentration, background cal/checks, and span cal/checks. 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>Concentration

The Concentration screen contains the following information:

- Across:
  - *Concentration:* This column lists items associated with the $NO/NO_2/NO_x$ concentrations.
  - *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.
  - *Span Conc:* Span concentration used in the span calibration or span check.
  - *Units:* Displays units for each item.
- Down:
  - *NO:* NO concentration.
  - *NO_2:* NO_2 concentration.
  - *NO_x:* NO_x concentration.
  - *O_2:* O_2 concentration.

- *NO Bkg Check Offset:* Displays NO concentration based on the last attempted background calibration. High alarm shows user defined limit for acceptable background check offset.
- *NO_x Bkg Check Offset:* Displays NO_x concentration based on the last attempted background calibration. High alarm shows user defined limit for acceptable background check offset.
- *NO Span Check Offset:* Displays NO concentration based on the last attempted span calibration. High alarm shows user defined limit for acceptable span check offset (compared to the span concentration value). Span concentration shows span setpoint.
- *NO_x Span Check Offset:* Displays NO_x concentration based on the last attempted span calibration. High alarm shows user defined limit for acceptable span check offset (compared to the span concentration value). Span concentration shows span setpoint.

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

Reaction Chamber

The Reaction Chamber screen provides status and alarms related to the reaction chamber 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>Reaction Chamber

The Reaction Chamber screen contains the following information:

- Across:
  - *Chamber:* This column lists items associated with the reaction chamber.
  - *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:
  - *Instrument Temperature:* Displays the current instrument temperature reading.
  - *Flow:* Displays the current sample flow reading.
  - *Chamber Pressure:* Displays the current chamber pressure reading.
  - *Chamber Temperature:* Displays the current chamber temperature reading. User can adjust low and high alarm limits.
  - *Chamber Temp Sensor Short:* Displays OK/Fail for chamber temperature sensor short.

- *Chamber Temp Sensor Open:* Displays OK/Fail for chamber temperature sensor open.
- *Cooler Temperature:* Displays OK/Fail for cooler temperature. User can adjust low and high alarm limits.
- *Cooler Temp Sensor Short:* Displays OK/Fail for cooler temperature sensor short.
- *Cooler Temp Sensor Open:* Displays OK/Fail for cooler temperature sensor open.
- *Cooler Current:* Displays the cooler current reading.
- *Cooler Current too Low:* Displays OK/Fail for cooler current too low.
- *Cooler Current too High:* Displays OK/Fail for cooler current too high.
- *Cooler Voltage:* Displays the current cooler voltage reading.
- *Cooler Voltage too Low:* Displays OK/Fail for cooler voltage too low.
- *Cooler Voltage too High:* Displays OK/Fail for cooler voltage too high.
- *PMT Voltage:* Displays the current PMT voltage reading.
- *PMT Voltage too Low:* Displays OK/Fail for PMT voltage too low.
- *PMT Voltage too High:* Displays OK/Fail for PMT voltage too high.
- *Frequency:* Displays the current frequency reading.
- *Frequency too Low:* Displays OK/Fail for frequency too low.
- *Frequency too High:* Displays OK/Fail for frequency too high.
- *Low Gain:* Displays the current low gain reading.
- *Gain:* Displays the current gain reading.
- *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.
    - *3.3 V Diagnostic:* Displays current voltage readings. Alarm limits are not changeable.
    - *5 V Diagnostic:* Displays current voltage readings. Alarm limits are not changeable.

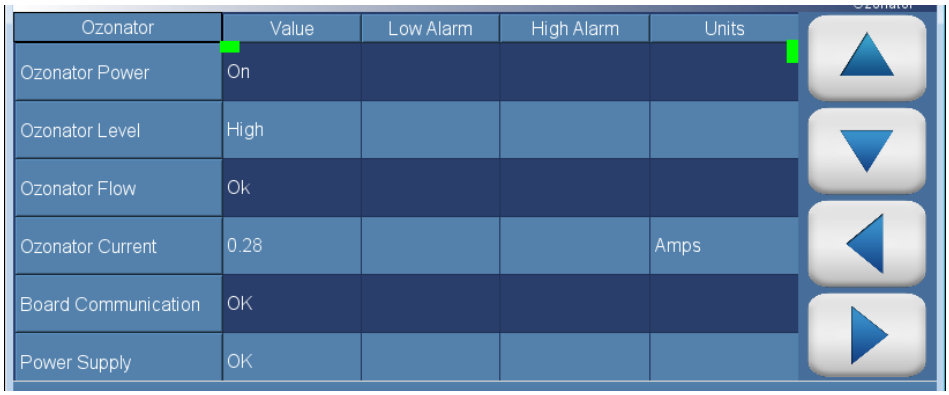
- *12 V Diagnostic:* Displays current voltage readings. Alarm limits are not changeable.
- *-12 V Diagnostic:* Displays current voltage readings. Alarm limits are not changeable.
- *24 V Diagnostic:* Displays current voltage readings. Alarm limits are not changeable.

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



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 status for each item.
  - *High Alarm:* Displays high alarm status for each item.
  - *Units:* Displays units for each item.
- Down:
  - *Ozonator Power:* Displays the current ozonator power on or off.
  - *Ozonator Level:* Displays the current ozonator level.
  - *Ozonator Flow:* Displays OK/Fail for ozonator flow.
  - *Ozonator Current:* Displays the current ozonator Current.
  - *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.

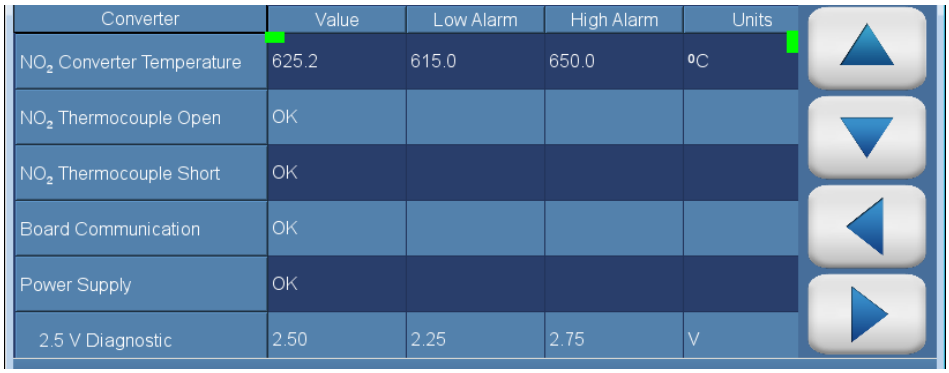
- *3.3 V Diagnostic:* Displays current voltage readings. Alarm limits are not changeable.
- *5 V Diagnostic:* Displays current voltage readings. Alarm limits are not changeable.
- *15 V Diagnostic:* Displays current voltage readings. Alarm limits are not changeable.
- *24 V Diagnostic:* Displays current voltage readings. Alarm limits are not changeable.

NO_2 Converter

The NO_2 Converter screen provides status and alarms related to the NO_2 converter. 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>NO_2 Converter



The NO_2 Converter screen contains the following information:

- Across:
  - *Converter:* This column lists items associated with the NO_2 converter.
  - *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:
  - *NO_2 Converter Temperature:* Displays the current NO_2 converter temperature reading. User can adjust low and high alarm limits.
  - *NO_2 Thermocouple Open:* Displays OK/Fail for NO_2 thermocouple open.
  - *NO_2 Thermocouple Short:* Displays OK/Fail for NO_2 thermocouple short.
  - *Board Communication:* Displays OK/Fail for board communication status.

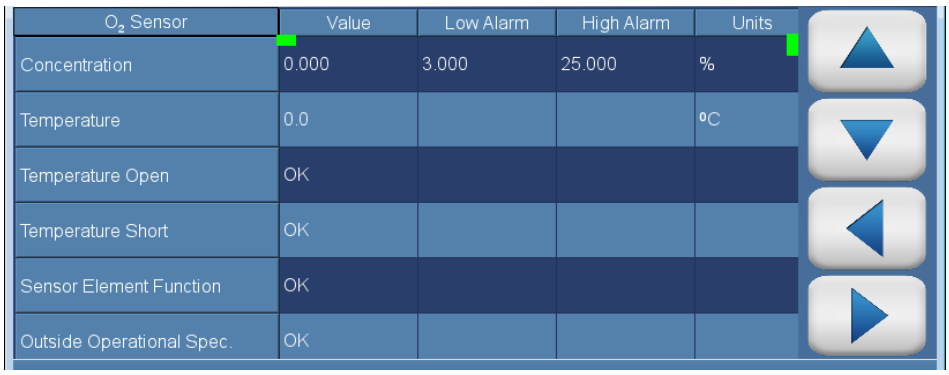
- *Power Supply:* Displays OK/Fail of power supplies. Power supply goes red if any voltages are outside their limits. No voltage rows ever get highlighted.
    - *2.5 V Diagnostic:* Displays current voltage readings. Alarm limits are not changeable.
    - *3 V Diagnostic:* Displays current voltage readings.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

O_2 Sensor

The O_2 Sensor screen provides status and alarms related to the O_2 Sensor. 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>O_2 Sensor



The O_2 Sensor screen contains the following information:

- Across:
  - *O_2 Sensor:* This column lists items associated with the O_2 sensor.
  - *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:
  - *Concentration:* Displays the current O_2 sensor concentration reading. User can adjust low and high alarm limits.
  - *Temperature:* Displays the current temperature reading.
  - *Temperature Open:* Displays OK/Fail for temperature open.
  - *Temperature Short:* Displays OK/Fail for temperature short.
  - *Sensor Element Function:* Displays OK/Fail for sensor element function.
  - *Outside Operational Spec.:* Displays OK/Fail for outside operational specification.

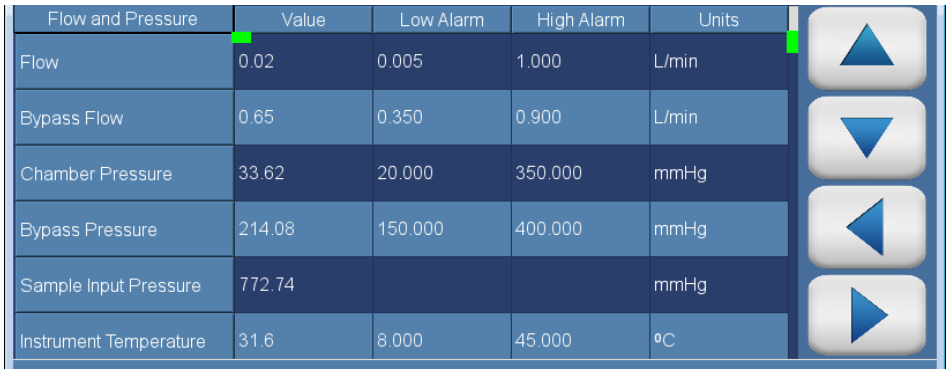
- *Photodiode Current Too Low:* Displays OK/Fail for Photodiode Current Too Low.
- *Sensor Detected:* Displays OK/Fail for sensor detected.
- *Sensor Communication:* Displays OK/Fail for sensor communication.
- *Valid Calibration:* Displays OK/Fail for valid calibration.
- *Board Communication:* Displays 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.
    - *2.5V 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.

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



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:
  - *Flow:* Displays the current flow reading. User can adjust low and high alarm limits.
  - *Chamber Pressure:* Displays the current chamber pressure reading. User can adjust low and high alarm limits.
  - *Sample Input Pressure:* Displays the current sample input pressure reading.
  - *Instrument Temperature:* Displays the current instrument temperature reading. User can adjust low and high alarm limits.

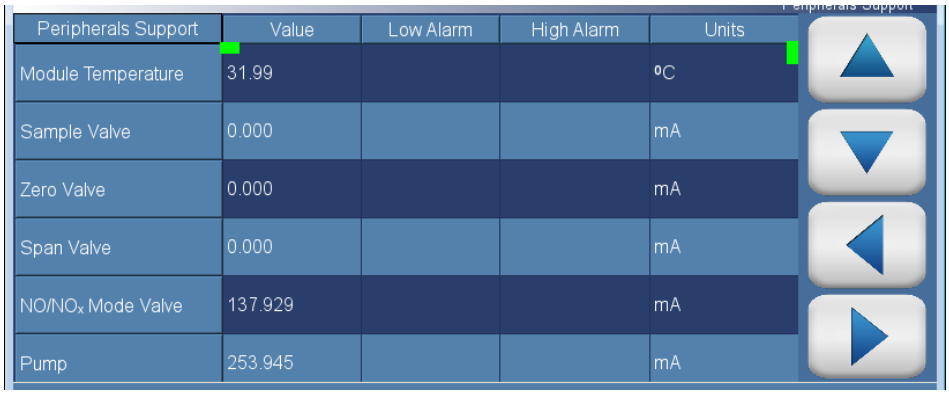
- *Board Communication:* Displays OK/Fail for board communication status.
- *Power Supply:* Displays OK/Fail of power supplies. Power supply goes red if any voltages are outside their limits. No voltage rows ever get highlighted.
    - *2.5V Diagnostic:* Displays current voltage readings. Alarm limits 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.

Peripherals Support

The Peripherals Support screen provides status and alarms related to the peripherals 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



The Peripherals Support screen contains the following information:

- Across:
  - *Peripherals Support:* This column lists items associated with the peripherals support.
  - *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:
  - *Module Temperature:* Displays the current temperature of the module.
  - *Sample Valve:* Displays whether or not the sample valve is activated.
  - *Zero Valve:* Displays whether or not the zero valve is activated.
  - *Span Valve:* Displays whether or not the span valve is activated.
  - *NO/NOx Mode Valve:* Displays whether or not the NO/NO_x mode valve is activated.

- *Pump:* Displays the current pump reading.
- *Instrument Error:* Displays OK/Fail for PCP, datalogging, streaming, serial server, and Modbus protocols.
- *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.
    - *2.5V 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.
- *5.0V Step Board 1:* Displays OK/Fail.
- *24V Step Board 1:* Displays OK/Fail.
- *5.0V Step Board 2:* Displays OK/Fail.
- *24V Step Board 2:* Displays OK/Fail.

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. ▲

Note Resetting one valve will reset all valves. ▲

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

The Valve and Pump Resets screen contains the following information:

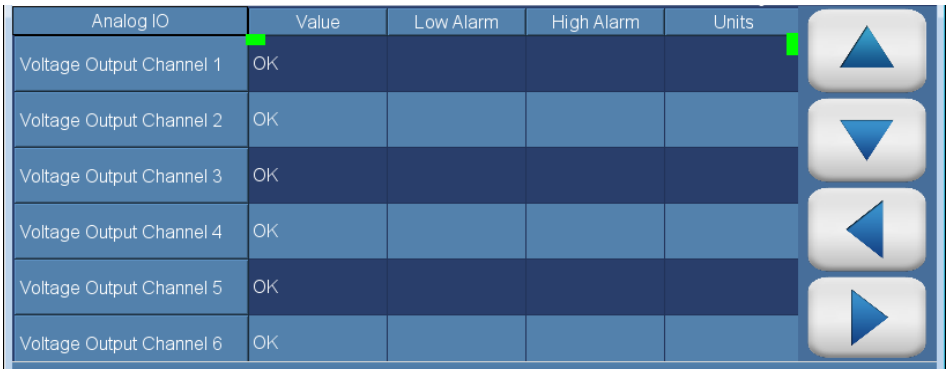
- *Sample Valve Reset:* Resets sample valve.
- *Zero Valve Reset:* Resets zero valve.
- *Span Valve Reset:* Resets span valve.
- *NO/NO$_x$ Valve Reset:* Resets NO/NO$_x$ valve.
- *Bypass Pump Reset:* Resets bypass pump.

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



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

The Digital I/O screen contains the following information:

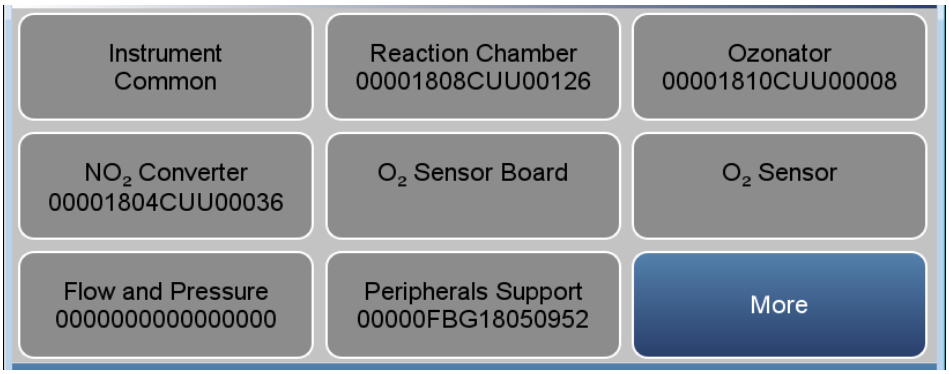
- Across:
  - *Digital IO:* This column lists items associated with the digital I/O.
  - *Value:* Displays the current value for each item.
  - *Reset:* Resets item.
  - *Low Alarm:* Displays low alarm status for each item.
  - *High Alarm:* Displays high alarm status for each item.
  - *Units:* Displays 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.

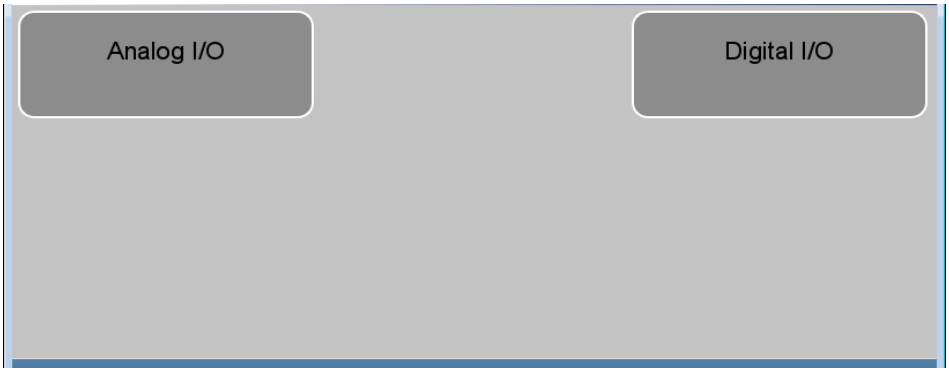
Serial Numbers

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

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



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



The Serial Numbers screen contains the following information:

- *Instrument:* Instrument serial number.
- *Reaction Chamber:* Reaction chamber serial number.
- *Ozonator:* Ozonator serial number.
- *NO_2 Converter:* NO_2 converter serial number.
- *O_2 Sensor Board:* O_2 sensor board serial number.
- *O_2 Sensor:* O_2 sensor 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.

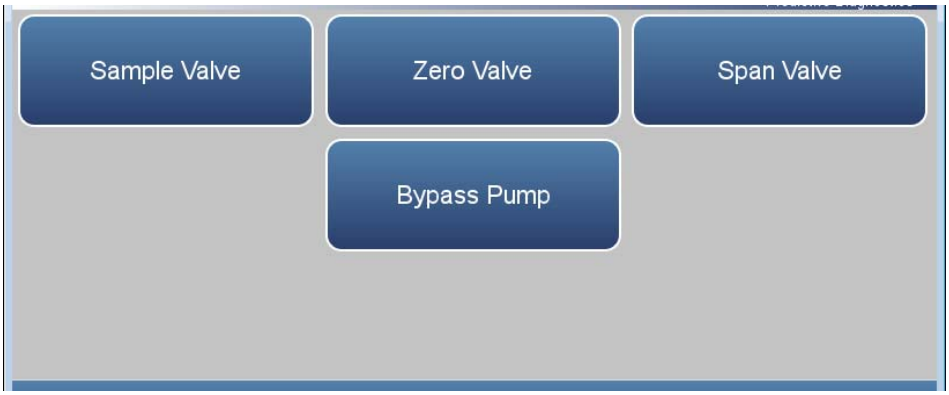
Predictive Diagnostics

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

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



The Predictive Diagnostics screen contains the following information:

- Reaction Chamber
- NO_2 Converter
- Capillary
- Flow Path
- Case Fan

- Sample Valve
- Zero Valve
- Span Valve
- Bypass 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:

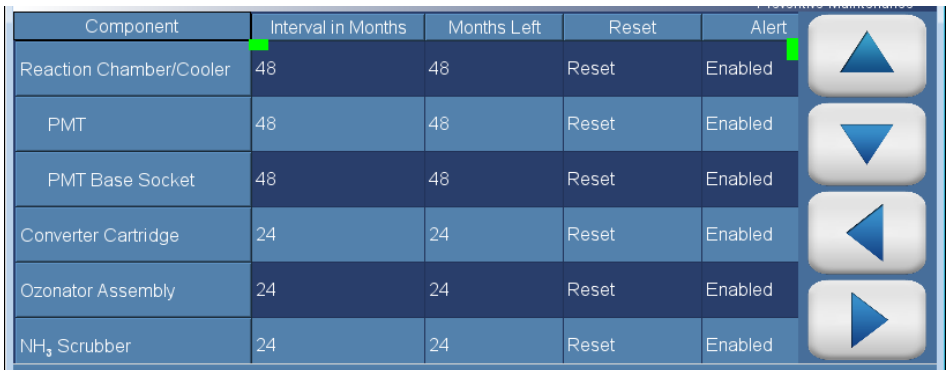
- *Preventive Maintenance:* Shows suggested service interval and time left for component replacement.
- *Change Part:* User logs component fix.
- *Maintenance History:* Shows the log of all recorded component fixes.
- *Service Tips:* Provides video and procedural service tips.
- *Advanced Maintenance:*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



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 "Service Interval in Months" value.
  - *Alert:* Allows the user to opt out of receiving preventive maintenance alerts. Displays Enabled/Disabled for each component.

- Down:
  - *Reaction Chamber/Cooler:* Consists of the PMT and PMT base socket. Each highlights on their own.
    - *PMT:* Service interval for PMT.
    - *PMT Base Socket:* Service interval for PMT base socket.
  - *Converter Cartridge:* Service interval for converter cartridge.
  - *Ozonator Assembly:* Service interval for ozonator assembly.
  - *NH_3 Scrubber:* Service interval for NH_3 scrubber.
  - *Permeation Dryer:* Service interval for permeation dryer.
  - *Flow System:* Service interval for the flow system components.
    - *Pump:* Service interval for pump.
    - *Capillary (Sample):* Service interval for capillaries.
    - *Capillary (Ozone):* Service interval for capillaries.
  - *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

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.

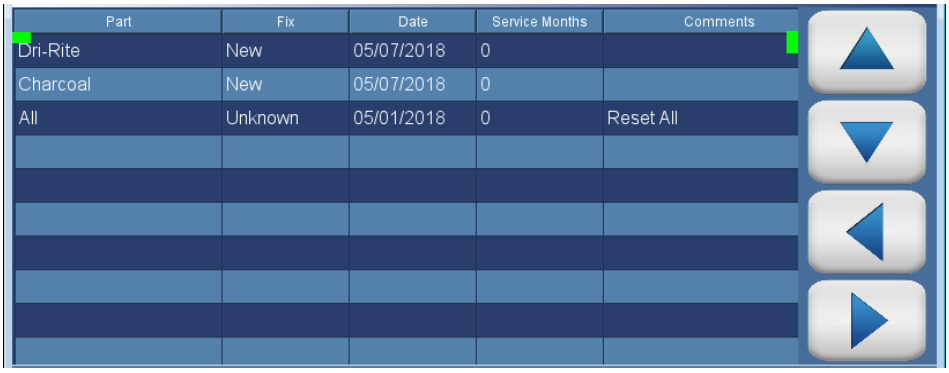
Maintenance History

The Maintenance History screen allows the user to view when components were replaced, rebuilt, or cleaned. When a user changes a part in the change part screen, a 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... ▲



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). ▲

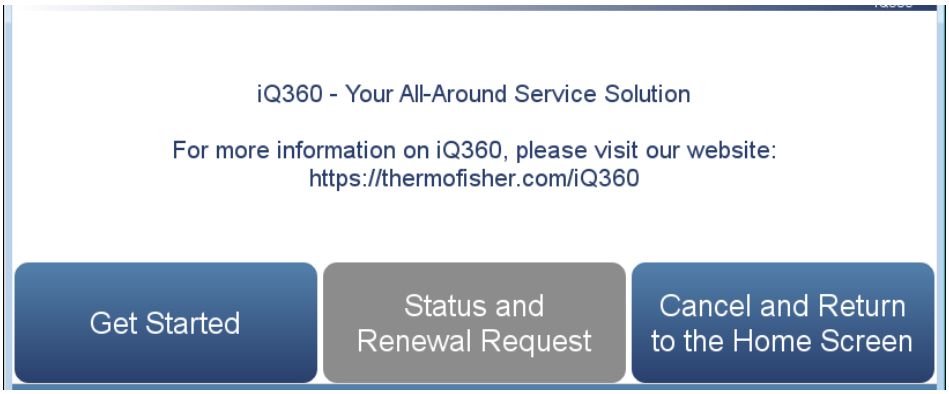
Home Screen>Settings>Health Check>File Sharing and Support

The File Sharing and Support screen contains the following information:

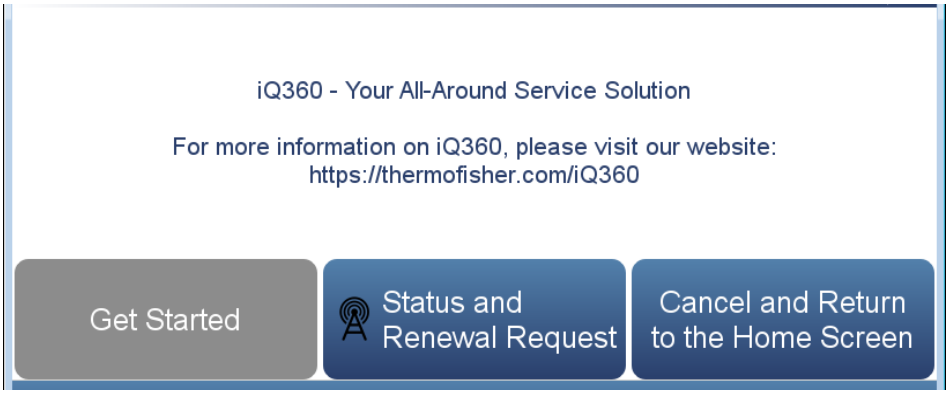
- *Download Health Check Report to USB Drive:* Sends the health report to USB drive.
- *Email Health Check Report File to Technical Support:* Sends the health report file to technical support and the customer email addresses via email.
- *Email Health Check Report to Personal Account:* Sends the health 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.
- *3rd Party Services:* The 3rd 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)



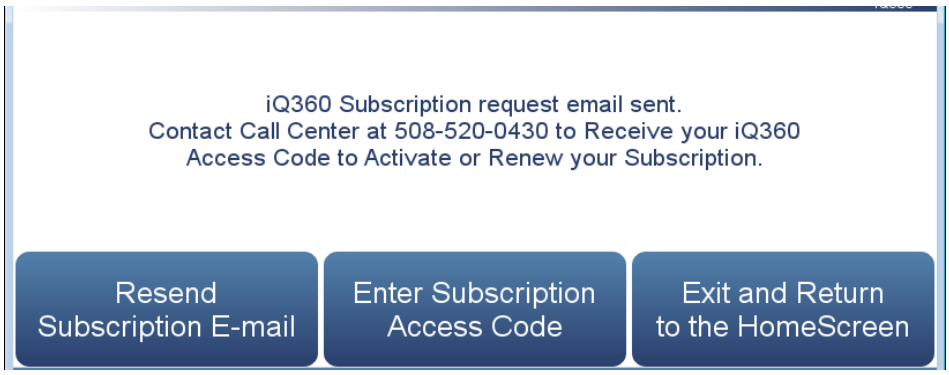
The iQ360 screen contains the following information:

- *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



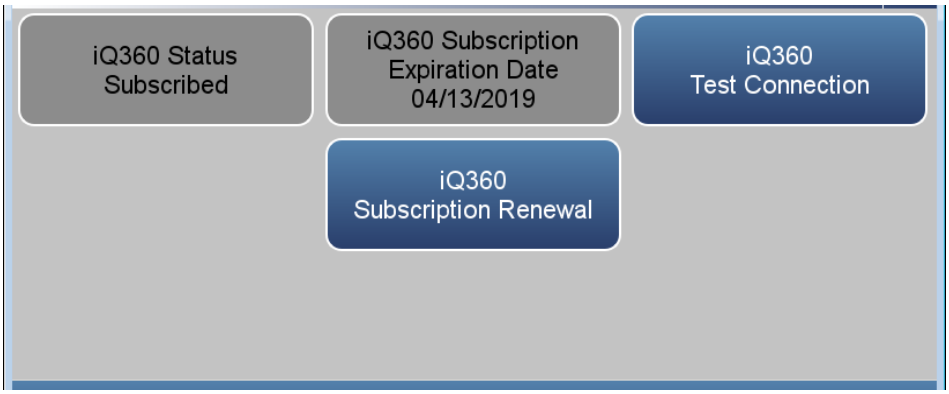
The Get Started screen contains the following information:

- *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.

Measurement Settings

The Measurement Settings screen contains a number of submenus where instrument parameters and settings can be read and modified.

Home Screen>Settings>Measurement Settings

The Measurement Settings screen contains the following information:

- *Averaging Time:* Sets the averaging time for the NO, NO_2, and NO_x sample measurements.
- *Range Mode Selection:* User can choose between the various range modes: single, dual, or auto. For more information, see "Range Mode Selection" on page 3-86.
- *Range Setting:* Defines the concentration range for the analog outputs.
- *Gas Mode:* User can manually choose sample, zero or span mode.
- *Gas Units:* Defines how the NO, NO_2, and NO_x concentration readings are expressed.
- *Dilution Ratio:* Serves as a multiplier when dilution gas is utilized.
- *Advanced Measurement Settings:* Advanced settings affecting NO, NO_2, and NO_x readings.

Averaging Time

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

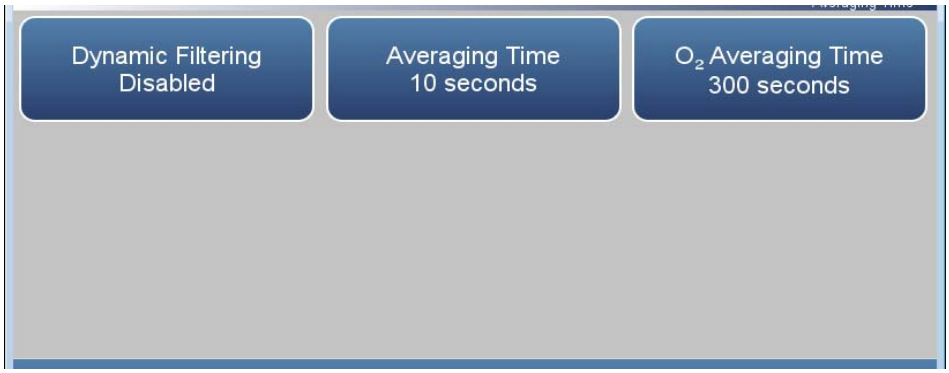
The following screens are shown in single range mode and dual or auto range mode. In the dual and auto range modes, both the “High Range” or “Low Range ” averaging buttons will be available.

Averaging Time defines the time period (1 to 300 seconds) during which NO, NO_2, and NO_x measurements are taken. The average concentration of the readings are calculated for that time period. The front panel display and analog outputs are updated every 10 seconds for averaging times between 10 and 300 seconds. For averaging times of 1, 2, and 5 seconds, the front panel display and analog outputs are updated every second. An averaging time of 10 seconds, for example, means that the average concentration of the last 10 seconds will be displayed every 10 seconds. 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.

Dynamic Filtering allows for data smoothing without compromising response time. Automatically changes the averaging time giving the user faster response times when conditions are rapidly changing; smoother and stable readings, when conditions aren’t changing as rapidly; and as an added bonus, it better processes spikes to minimize their impact on the data. At the same time it will preserve the representative nature of the filtered data to the conditions being sampled.

Note When Dynamic Filtering is selected, the user selected Averaging Time button is disabled. ▲

Home Screen>Settings>Measurement Settings>Averaging Time (single range mode and O_2 option)



Home Screen>Settings>Measurement Settings>Averaging Time (dual or auto range mode and O_2 option)

The Averaging Time screen contains the following information:

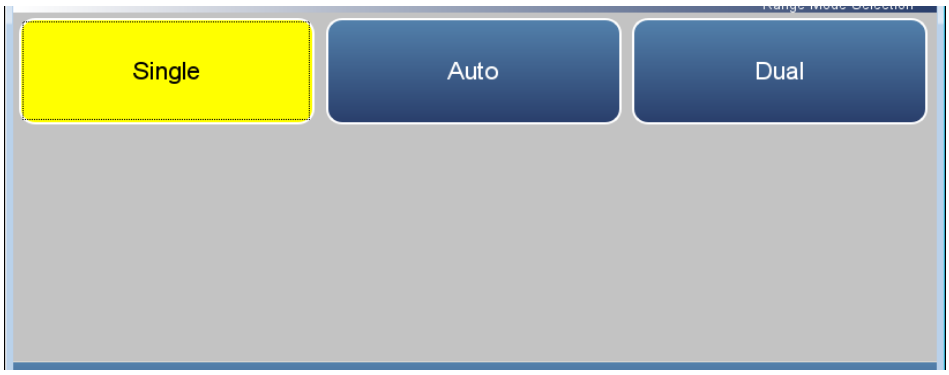
- *Dynamic Filtering:* Enables/disables dynamic filtering when in single range mode.
- *High Range Dynamic Filtering:* Enables/disables high range dynamic filtering when in dual or auto range mode.
- *Low Range Dynamic Filtering:* Enables/disables low range dynamic filtering when in dual or auto range mode.
- *Averaging Time:* Sets averaging time period when in single range mode and when dynamic filtering is disabled.
- *High Range Averaging Time:* Sets high averaging time when in dual or auto range mode and when dynamic filtering is disabled.
- *Low Range Averaging Time:* Sets high averaging time when in dual or auto range mode and when dynamic filtering is disabled.

- *O_2 Averaging Time:* Sets high averaging time when in dual or auto range mode and when dynamic filtering is disabled and the O_2 sensor is enabled.

Range Mode Selection

The Range Mode Selection screen is used to switch between the various range modes: Single, Dual, and Auto Range.

Home Screen>Settings>Measurement Settings>Range Mode Selection



The Range Mode Selection screen contains the following information:

- *Single:* In single range mode, there is one range, one averaging time, and one span coefficient.
- *Dual:* In the dual range mode, there are two independent analog outputs. These are labeled simply as the "High Range" and the "Low Range". Each channel has its own analog output range setting, averaging time, and span coefficient.

  This enables the sample concentration reading to be sent to the analog outputs at two different ranges. For example, the low NO analog output can be set to output concentrations from 0 to 50 ppm and the high NO analog output set to output concentrations from 0 to 100 ppm.

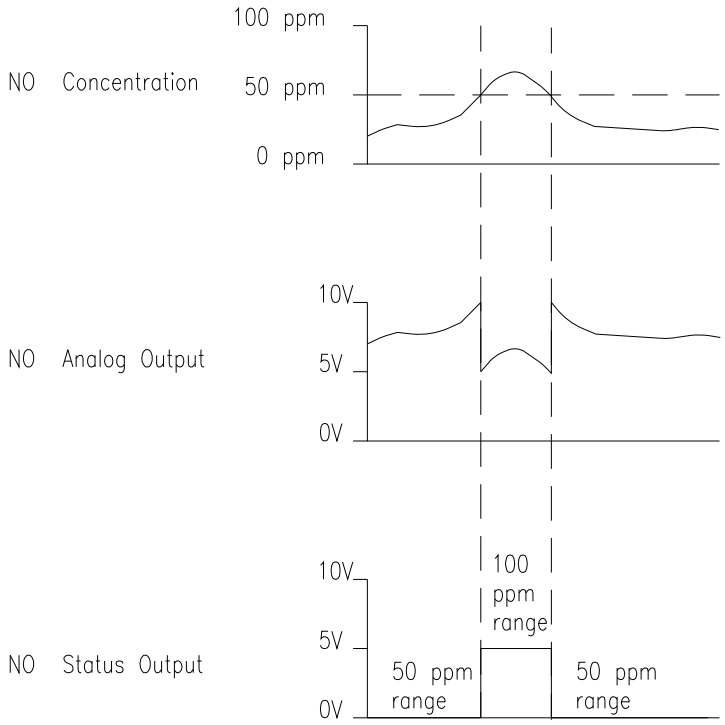
  In addition to each channel having two ranges, each channel has two span coefficients. There are two span coefficients so that each range can be calibrated separately. This is especially necessary if the two ranges are not close to one another. For example, the low NO range is set to 0–50 ppm and the high NO range is set to 0–1000 ppm.
- *Auto:* The auto range mode switches the NO, NO_2, and NO_x analog outputs between high and low range settings, depending on the concentration level. The high and low ranges are defined in the Range Settings screen.

  For example, suppose the low range is set to 50 ppm and the high range is set to 100 ppbm, as shown below. Sample concentrations below 50 ppm are output based on low range selection and sample concentrations above 50 ppm are output based on high range selection.

When the low range is active, the range mode selection status output is at 0 volts. When the high range is active, the range mode selection status output is at half of full-scale.

When the high range is active, the NO_x concentration must drop to 95% of the low NO_x range for the low range to become active.

In addition to each channel having two ranges, each channel has two span coefficients. There are two span coefficients so that each range can be calibrated separately. This is especially necessary if the two ranges are not close to one another. For example, the low NO range is set to 0–50 ppm and the high NO range is set to 0–1000 ppm.



Range Settings

The Range Settings screen defines the concentration range of the analog outputs. For example, an NO_2 range of 0–50 ppm restricts the NO_2 analog output to concentrations between 0 and 50 ppm.

The screen shows the current NO, NO_2, and NO_x range. The range screen is similar for the single, dual, and auto range modes. The only difference between the screens are the words "High" or "Low" displayed to indicate which range is displayed. For more information about the dual and auto range modes, see "Range Mode Selection" on page 3-86. Pressing Range Setting, High Range Setting or Low Range Setting, brings up a numeric keypad whereby the user can select a range.

Home Screen>Settings>Measurement Settings>Range Settings (single range mode)

Home Screen>Settings>Measurement Settings>Range Settings (dual or auto range mode)

The Range Settings screen contains the following information:

- *NO Range Setting:* Sets the NO concentration range for the analog outputs when in single range mode.

- *High Range NO Setting:* Sets the high range NO concentration range for the analog output when in dual or auto range mode.
- *Low Range NO Setting:* Sets the low range NO concentration range for the analog output when in dual or auto range mode.
- *NO_2 Range Setting:* Sets the NO_2 concentration range for the analog outputs when in single range mode.
- *High Range NO_2 Setting:* Sets the high range NO_2 concentration range for the analog output when in dual or auto range mode.
- *Low Range NO_2 Setting:* Sets the low range NO_2 concentration range for the analog output when in dual or auto range mode.
- *NO_x Range Setting:* Sets the NO_x concentration range for the analog outputs when in single range mode.
- *High Range NO_x Setting:* Sets the high range NO_x concentration range for the analog output when in dual or auto range mode.
- *Low Range NO_x Setting:* Sets the low range NO_x concentration range for the analog output when in dual or auto range mode.

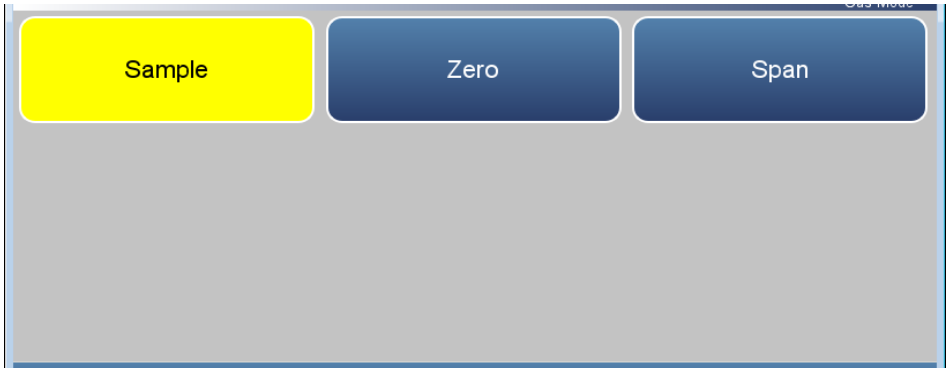
Settable ranges according to unit selection include:

ppb	10000–5000000 ppb
ppm	10–5000 ppm
%	0.001–0.5 %
µg/m^3	20000–7500000 µg/m^3
mg/m^3	20–7500 mg/m^3
g/m^3	0.02–7.5 g/m^3

Gas Mode

The Gas Mode screen defines what gas mode the instrument is set to.

Home Screen>Settings>Measurement Settings>Gas Mode



The Gas Mode screen contains the following information:

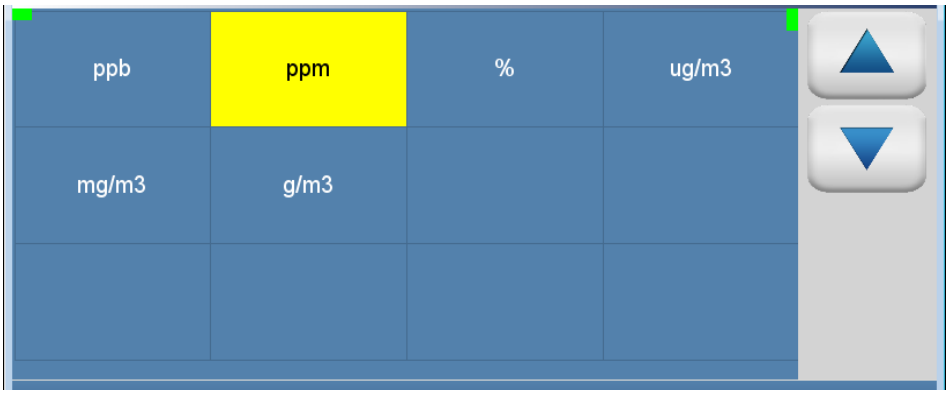
- *Sample:* Sets the instrument to measure sample gas.
- *Zero:* Used when calibrating the background of the instrument. When pressed, sets the instrument to zero mode.
- *Span:* Used when calibrating the span coefficient. When pressed, sets the instrument to span mode.

Gas Units

The Gas Units screen defines how the NO, NO_2, and NO_x concentration readings are expressed. The µg/m^3, mg/m^3, and g/m^3 gas concentration modes are calculated using a standard pressure of 760 mmHg and a standard temperature of 0 °C. The temperature can be changed in the compensation screen.

Use the ▲ and ▼ buttons to select.

Home Screen>Settings>Measurement Settings>Gas Units



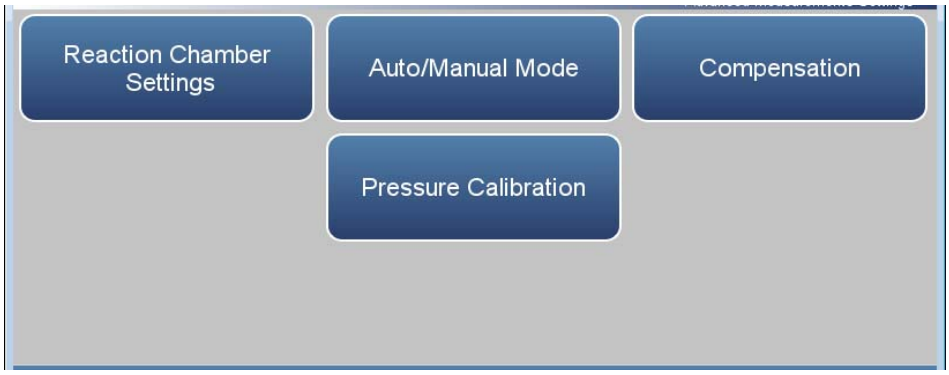
The Gas Units screen contains the following information:

- *ppb:* parts per billion.
- *ppm:* parts per million.
- *%:* percent.
- *µg/m3:* micrograms per meter cubed.
- *mg/m3:* milligrams per meter cubed.
- *g/m3:* grams per meter cubed.

Advanced Measurement Settings

The Advanced Measurement Settings screen allows the user to calibrate the reaction chamber and set other advanced settings.

Home Screen>Settings>Measurement Settings>Advanced Measurement Settings



The Advanced Measurements Settings screen contains the following information:

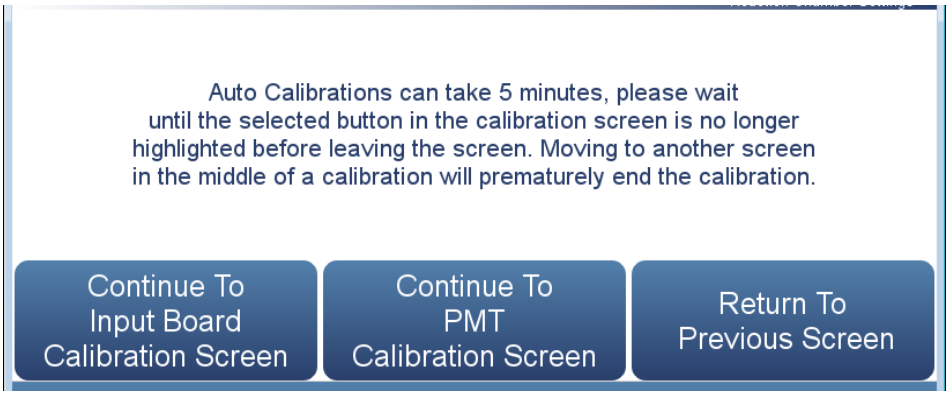
- *Reaction Chamber Settings:* User can calibrate Input board and PMT.
- *Auto/Manual Mode:* User can choose to measure single gas or switching mode.
- *Compensation:* Allows the user to compensate for changes in temperature and pressure concentration, and O_2 (if enabled).
- *Pressure Calibration:* Calibrates pressure.

Reaction Chamber Settings

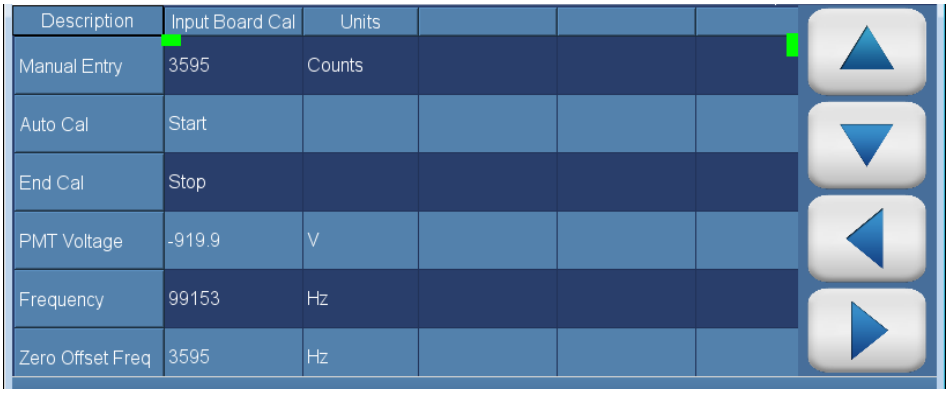
The Reaction Chamber Settings screen allows the user to calibrate the Input board and PMT.

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

Home Screen>Settings>Measurement Settings>Advanced Measurement Settings>Reaction Chamber Settings



Home Screen>Settings>Measurement Settings>Advanced Measurement Settings>Reaction Chamber Settings>Continue to Input Board Calibration Screen

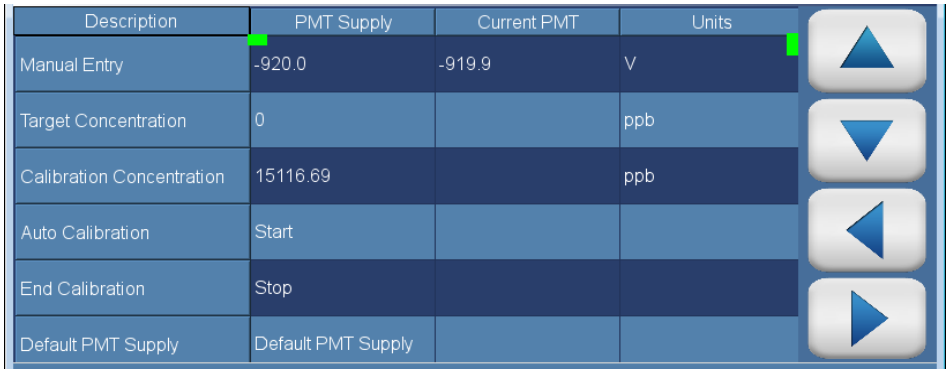


The Input Board Calibration screen contains the following information:

- Across:
  - *Description:* Defines the actions the user can do.
  - *Input Board Cal:* User can manually adjust the input board value, start/stop automatic calibration, read voltage, frequency and zero offset frequency values, and reset default values.
  - *Units:* Displays units for each item.

- Down:
  - *Manual Entry:* Shows current value. If the input board cal cell is pressed, user can manually change the value.
  - *Auto Cal:* When pressed, the auto-calibration process is initiated. Please allow up to 5 minutes for calibration to complete.
  - *End Cal:* When pressed, the auto calibration is interrupted and the value does not change.
  - *PMT Voltage:* Displays PMT voltage.
  - *Frequency:* Displays frequency.
  - *Zero Offset Freq:* Displays zero offsets frequency.
  - *Default Values:* When pressed, the default values are saved.

Home Screen>Settings>Measurement Settings>Advanced Measurement Settings>Reaction Chamber Settings>Continue to PMT Calibration Screen



The PMT Calibration screen contains the following information:

- Across:
  - *Description:* Defines the actions the user can do.
  - *PMT Supply:* User can manually adjust the PMT supply value, adjust target concentration and read calibration concentration, start/stop automatic calibration, read voltage, frequency and zero offset frequency values, and reset default values.
  - *Current PMT:* Displays the current PMT voltage value.
  - *Units:* Displays units for each item.

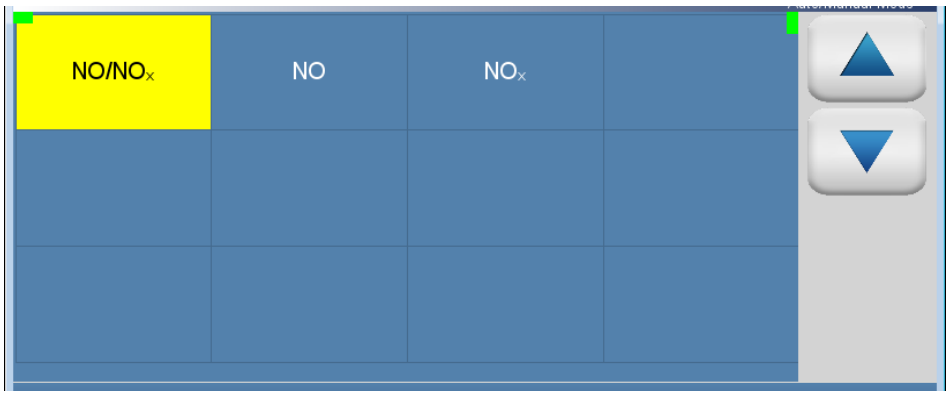
- Down:
  - *Manual Entry:* Shows current value. If the PMT supply cell is pressed, user can manually change the value.
  - *Target Concentration:* Displays target concentration. If target concentration cell is pressed, user can enter target concentration.
  - *Calibration Concentration:* Displays calibration concentration.
  - *Auto Calibration:* When pressed, the auto-calibration process is initiated. Please allow up to 5 minutes for calibration to complete. PMT voltage is automatically adjusted until calibration concentration is with 1% of target concentration.
  - *End Calibration:* When pressed, the auto calibration is interrupted and the value does not change.
  - *Default PMT Supply:* When pressed, the default PMT supply value is saved.

Auto/Manual Mode

The Auto/Manual Mode screen is used to display single gases or multiple gases (switching mode).

Use the ▲ and ▼ buttons to select.

Home Screen>Settings>Measurement Settings>Advanced Measurement Settings>Auto/Manual Mode



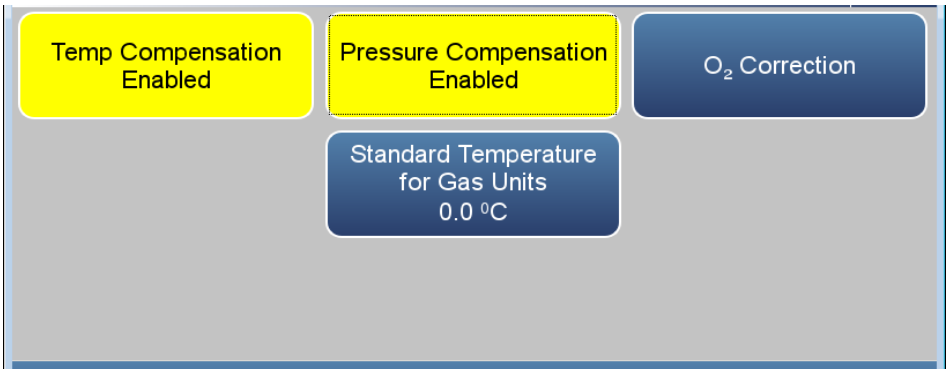
The Auto/Manual Mode screen contains the following information:

- NO/NO_x
- NO
- NO_x

Compensation

The Compensation screen provides compensation for any changes to the instrument's output signal due to internal instrument temperature, pressure, and oxygen variations (if enabled).

Home Screen>Settings>Measurement 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 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 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 chamber pressure.
- *O_2 Correction:* Allows for the correction of the NO, NO_2, and NO_x concentrations based on O_2 readings.
- *Standard Temperature for Gas Units:* Allows the user to enter a value between 0 and 30 °C to correct the µg/m^3, mg/m^3, and g/m^3 concentration calculations.

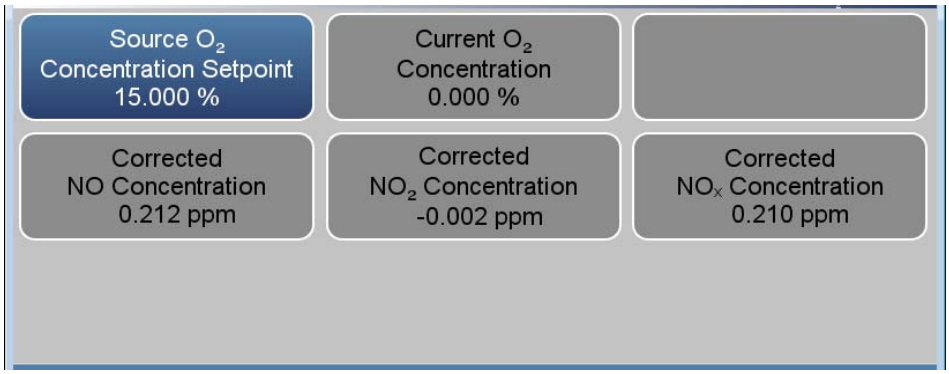
O_2 Correction

When O_2 correction is enabled, the following equation is applied to the NO, NO_2, and NO_x concentration values to generate a corrected value. The corrected value may be output on the analog outputs, stored in logging memory, or output as streaming data. The corrected values are not displayed on the Home Screen on the front panel, only the non-corrected values.

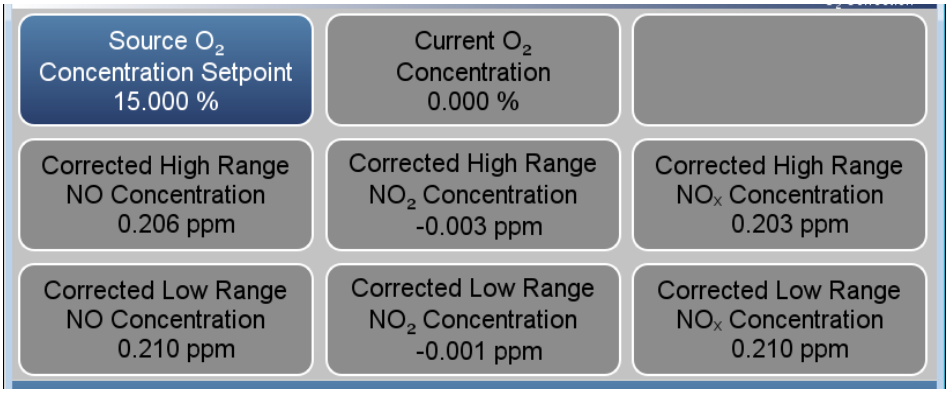
$$C_{comp} @ O2_{corr} = C * \left(\frac{20.9 - O2_{corr}}{20.9 - O2_{meas}} \right)$$

Abbreviations: C is the measured concentration, $O2_{corr}$ is the oxygen concentration that C is corrected to (this value is set by the user in the Source O_2 Concentration Setpoint screen and defaults to 15%). $O2_{meas}$ is the measured O_2 concentration, which is clamped at 20.8% to prevent divide-by-zero errors. C_{comp} is the corrected concentration that may be used for analog outputs or datalogging.

Home Screen>Settings>Measurement Settings>Advanced Measurement Settings>Compensation>O_2 Correction (single range mode)



Home Screen>Settings>Measurement Settings>Advanced Measurement Settings>Compensation>O_2 Correction (dual or auto range mode)



The O_2 Correction screen contains the following information:

- *Source O_2 Concentration Setpoint:* User sets the expected O_2 sample concentration.
- *Current O_2 Concentration:* Read only. Displays the current O_2 concentration.
- *Corrected NO Concentration:* Read only. Displays the corrected NO concentration when in single range mode.
- *Corrected NO_2 Concentration:* Read only. Displays the corrected NO_2 concentration when in single range mode.
- *Corrected NO_x Concentration:* Read only. Displays the corrected NO_x concentration when in single range mode.
- *Corrected High Range NO Concentration:* Read only. Displays the corrected high range NO concentration when in dual or auto range mode.
- *Corrected High Range NO_2 Concentration:* Read only. Displays the corrected high range NO_2 concentration when in dual or auto range mode.
- *Corrected High Range NO_x Concentration:* Read only. Displays the corrected high range NO_x concentration when in dual or auto range mode.
- *Corrected Low Range NO Concentration:* Read only. Displays the corrected low range NO concentration when in dual or auto range mode.
- *Corrected Low Range NO_2 Concentration:* Read only. Displays the corrected low range NO_2 concentration when in dual or auto range mode.

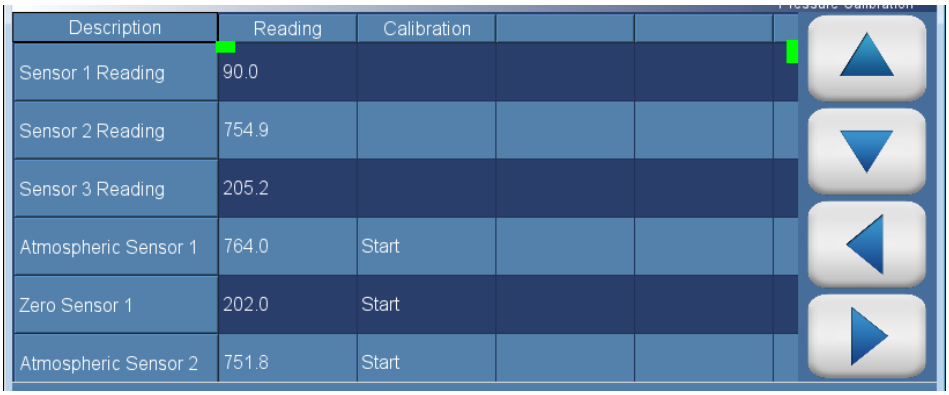
- *Corrected Low Range NO_x Concentration:* Read only. Displays the corrected low range NO_x concentration when in dual or auto range mode.

Pressure Calibration

The Pressure Calibration screen is used to calibrate the pressure sensor to zero, span, or factory default values.

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

Home Screen>Settings>Measurement Settings>Advanced Measurement Settings>Pressure Calibration



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.
  - *Atmospheric Sensor 1–3:* Under the column labeled reading, the user enters the current atmospheric pressure in mmHg units. Under the column labelled Calibration, the user presses the Start button to calibrate the high point of the sensor.
  - *Zero Sensor 1–3:* User should put the pressure sensor under a strong vacuum. Under the column labeled reading, the user enters the pressure in mmHg. Under the column labeled Calibration, the user presses the Start button to calibrate the low point of the sensor.
  - *Reset all values:* Resets values to default.

Communications

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

Home Screen>Settings>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 42iQHL has a default instrument ID of 1.
- *Bayern Hessen Settings:* User selects the registers (measured values) that the instrument should respond with, in response to a valid data query (DA) command.

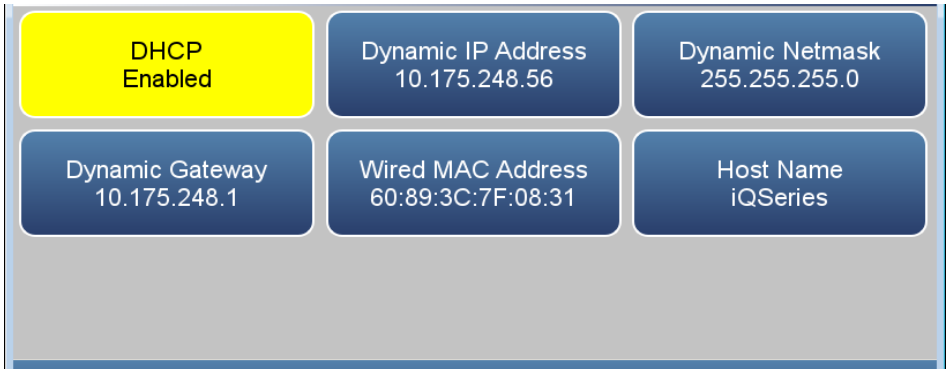
Note Refer to the "Bayern Hessen Protocol" section in the *Communications Manual* for a detailed description. ▲

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>Communications>Wired TCP/DHCP (with DHCP enabled)



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

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.
- *DNS Server Address:* DNS IP address of instrument. This is settable when DHCP is disabled.
- *Wired MAC Address:* Instrument MAC address.
- *Host Name:* Host name of instrument.

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>Communications>Serial RS-232/485

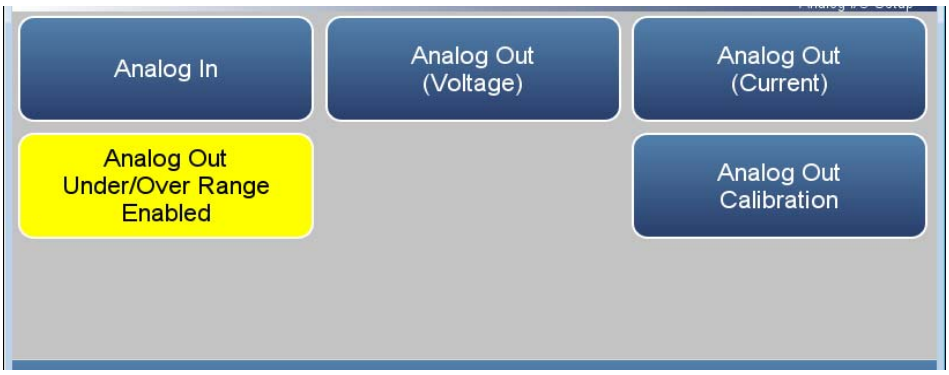
The Serial RS-232/485 screen contains the following information:

- *Protocol:* User selects Streaming, Modbus, or Bayern Hessen.
- *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>Communications>Analog I/O



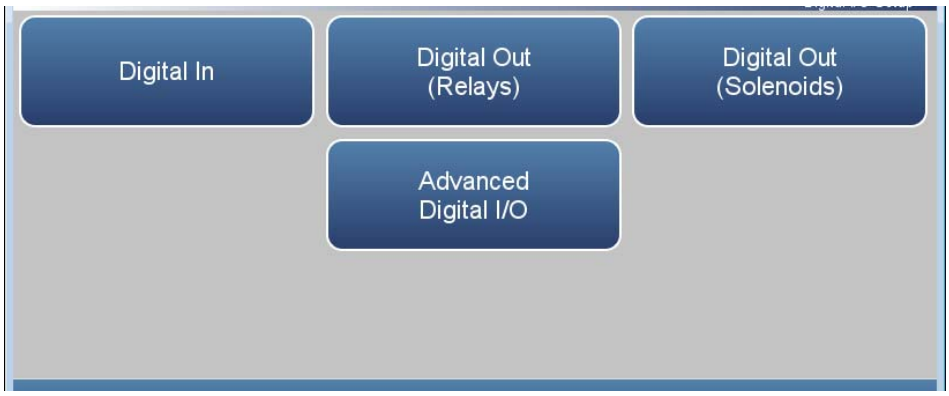
The Analog I/O screen contains the following information:

- *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>Communications>Email Server (SMTP)

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.

Bayern Hessen Settings

The Bayern Hessen Settings screen allows the user to select the registers that will be read with a valid data query (DA) command.

Home Screen>Settings>Communications>Bayern Hessen Settings

The Bayern Hessen Settings screen contains the following information:

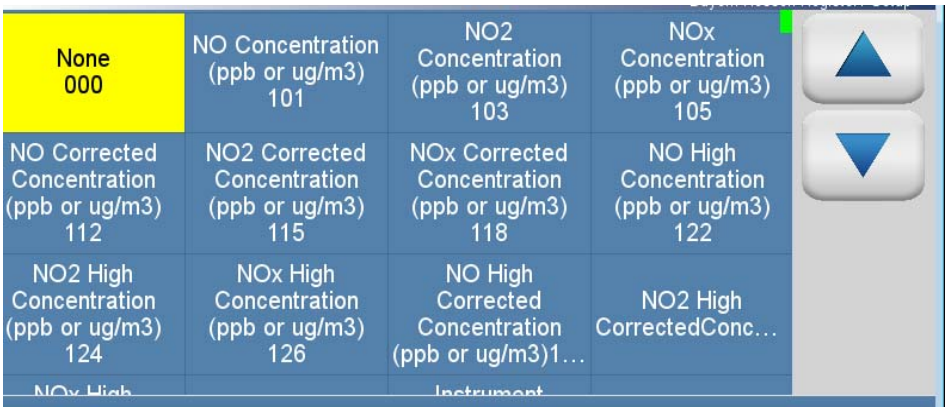
- *Register 1–8:* Sets the measured value logged in the respective register location, in response to a valid query (DA) command.

Register 1–8

The Register 1–8 screen allows the user to select the measured value to be logged in the corresponding register location. The register numbers corresponding to each measured value (appearing after the register name in the selection) will preface the measured value in the response to the "DA" command.

Use the ▲ and ▼ buttons to scroll through the registers. Select the variable to log by pressing the corresponding cell. The list is based on the instrument's configuration.

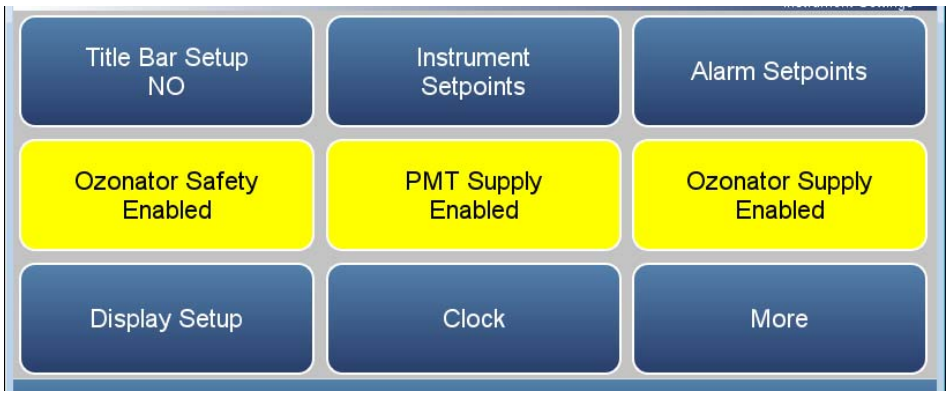
Home Screen>Settings>Communications>Bayern Hessen Settings>Register 1–8



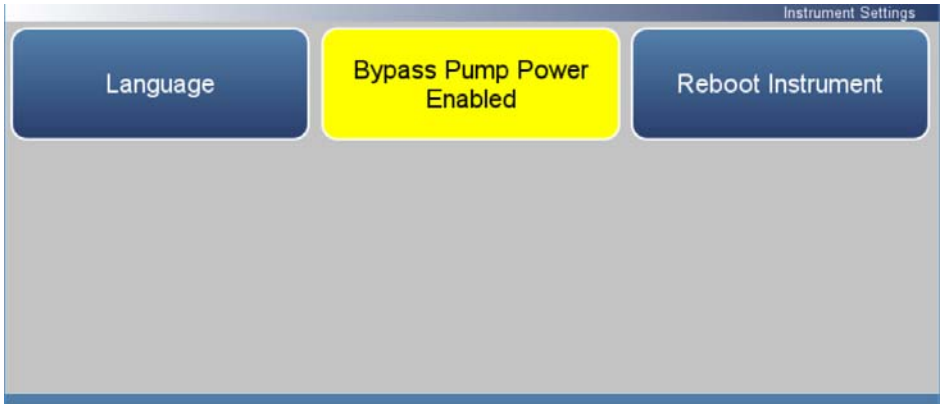
Instrument Settings

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

Home Screen>Settings>Instrument Settings



Home Screen>Settings>Instrument Settings>More



The Instrument Settings screen contains the following information:

- *Titlebar Setup:* User chooses what concentration reading to display on the titlebar.
- *Instrument Setpoints:* View and set all available setpoints.
- *Alarm Setpoints:* View and set all available alarm minimum and maximum values.
- *Ozonator Safety Enabled/Disabled:* Enables/disables ozonator safety.
- *PMT Supply Enabled/Disabled:* Enables/disables PMT supply.
- *Ozonator Supply Enabled/Disabled:* Enables/disables ozonator supply.
- *Display Setup:* Sets touchscreen display settings.
- *Clock:* Sets date and time.

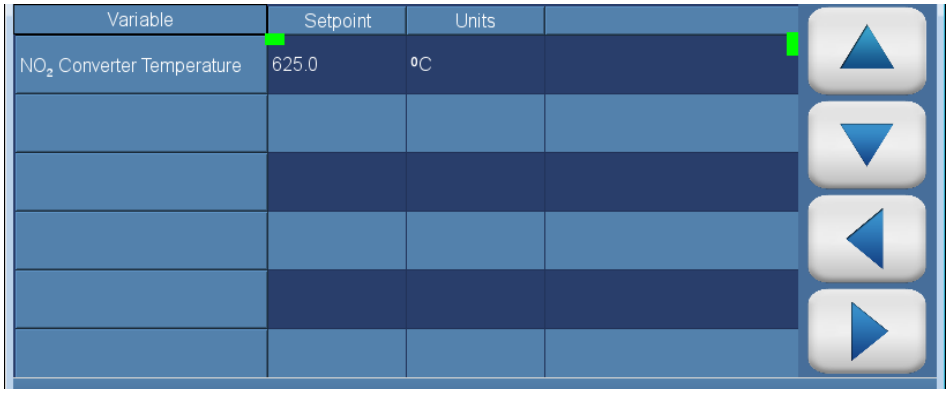
- *Language:* Sets language.
- *Bypass Pump Power:* Manually enables/disables the pump.
- *Reboot Instrument:* Reboots the instrument.

Instrument Setpoints

The Instrument Setpoints screen allows the user to view and set all settable instrument setpoints.

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

Home Screen>Settings>Instrument Settings>Instrument Setpoints



The Instrument Setpoints screen contains the following information:

- Across:
  - *Variable:* Lists the items that have settable setpoints.
  - *Setpoint:* User sets setpoint for item.
  - *Units:* Units for each item (not settable).
- Down:
  - *NO_2 Converter Temperature:* NO_2 converter temperature setpoint.

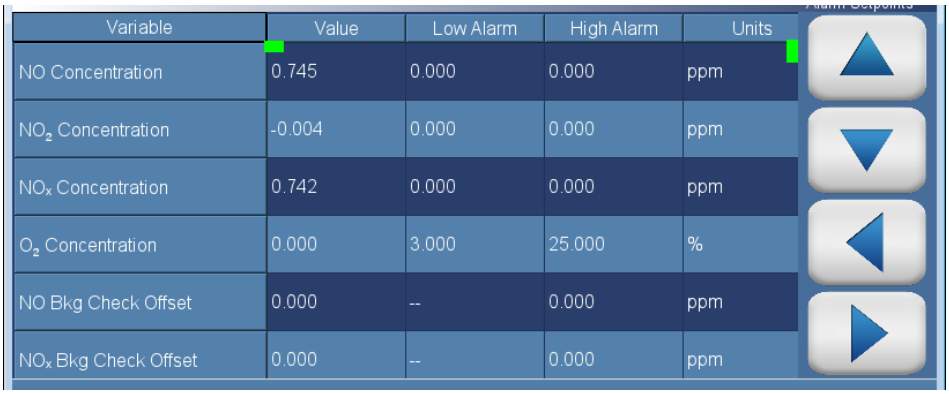
Alarm Setpoints

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 3-47. ▲

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

Home Screen>Settings>Instrument Settings>Alarm Setpoints



The Alarm Setpoints screen contains the following information:

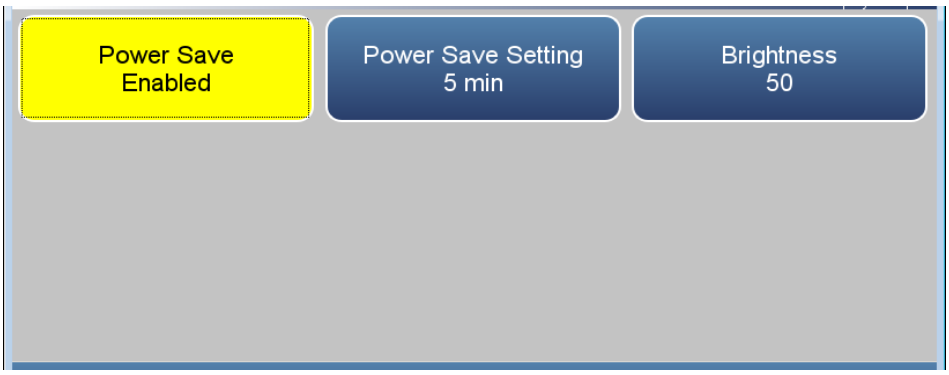
- Across:
  - *Variable:* Lists the items that have settable alarm limits.
  - *Value:* Displays the current value for each item.
  - *Low Alarm:* User sets low alarm for item.
  - *High Alarm:* User sets high alarm for item.
  - *Units:* Units for each item (not settable).
- Down:
  - *NO Concentration:* NO concentration alarm.
  - *NO_2 Concentration:* NO_2 concentration alarm.
  - *NO_x Concentration:* NO_x concentration alarm.
  - *O_2 Concentration:* O_2 concentration alarm.

- *NO Bkg Check Offset:* User can set the maximum allowable background reading offset for calibration and calibration checks. This is set with the high alarm only.
- *NO_x Bkg Check Offset:* User can set the maximum allowable background reading offset for calibration and calibration checks. This is set with the high alarm only.
- *NO Span Check Offset:* User can set the maximum allowable span reading offset for calibration and calibration checks. This is set with the high alarm only.
- *NO_x Span Check Offset:* User can set the maximum allowable span reading offset for calibration and calibration checks. This is set with the high alarm only.
- *Instrument Temperature:* Instrument temperature alarm.
- *Chamber Pressure:* Bench pressure alarm.
- *Flow:* Flow pressure alarm.
- *Chamber Temperature:* Bench temperature alarm.
- *Cooler Temperature:* Cooler temperature alarm.
- *NO_2 Converter Temperature:* NO_2 converter temperature alarm.

Display Setup

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

Home Screen>Settings>Instrument Settings>Display Setup



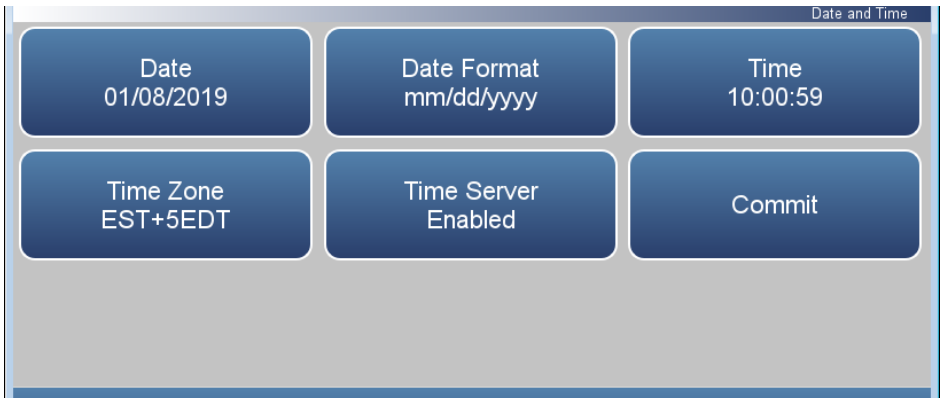
The Display Setup screen contains the following information:

- *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.

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



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.

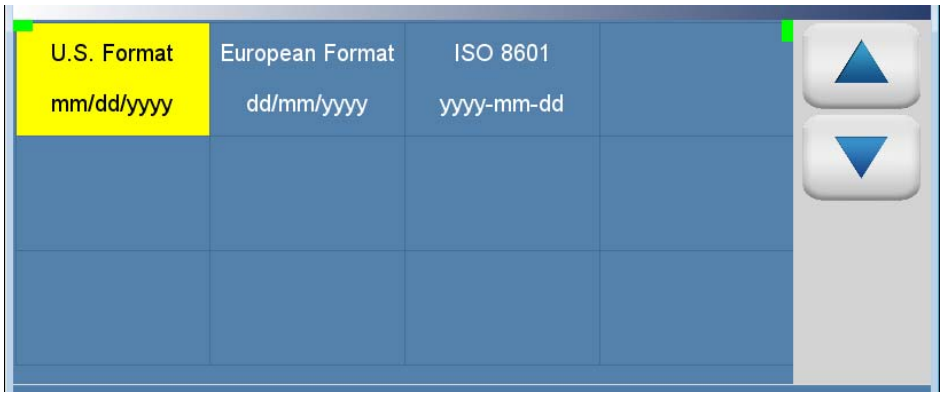
Home Screen>Settings>Instrument Settings>Clock>Date

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:

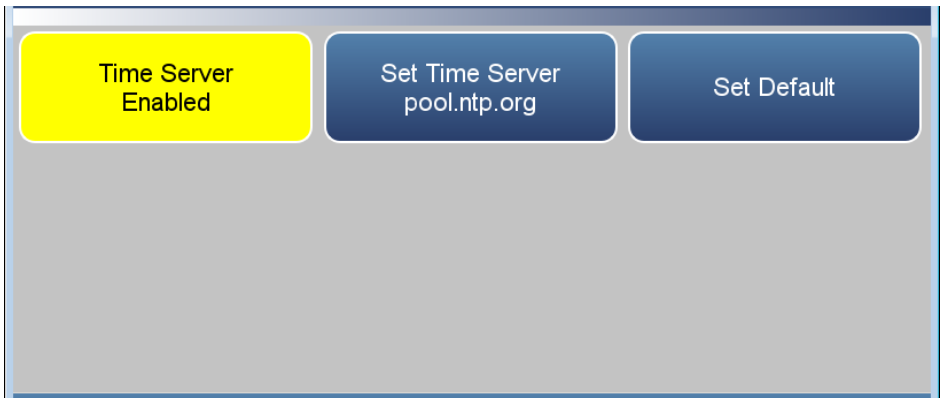
- Date Line West(UTC-12)
- Samoa Time Zone(UTC-11)
- Aleutian Time Zone(UTC-10)
- Alaskan Time Zone(UTC-9)
- Pacific Time Zone(UTC-8)
- Pacific Daylight Savings(UTC-7)
- Mountain Time Zone(UTC-7)
- Mountain Daylight Savings(UTC-6)
- Central Time Zone(UTC-6)
- Central Daylight Savings((UTC-5)
- Eastern 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.

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:

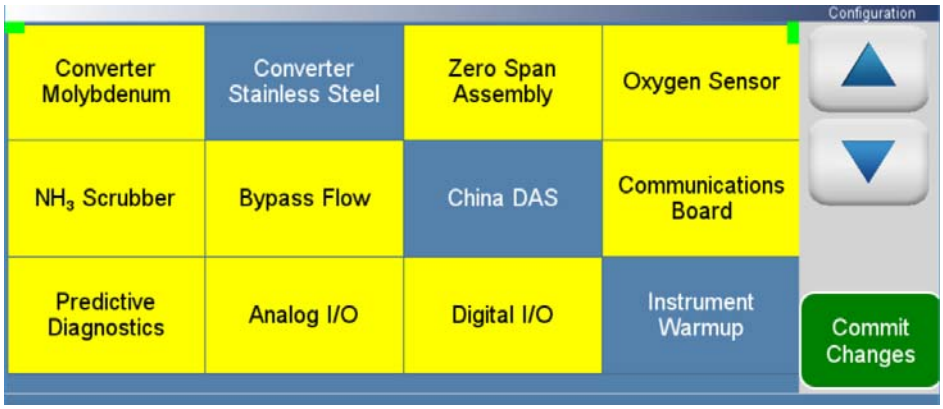
- English
- Chinese
- Spanish

Configuration

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

Use the ▲ and ▼ buttons to select the variables. Next, press the **Commit Changes** button to save selections. Yellow buttons indicate that the variable is selected. More than one can be chosen.

Home Screen>Settings>Configuration



The Configuration screen contains the following information:

- *Converter Molybdenum:* Select if molybdenum converter is used.
- *Converter Stainless Steel:* Select if stainless steel converter is used.
- *Zero Span Assembly:* Enables zero/span valves.
- *Oxygen Sensor:* Enables O_2 sensor option.
- *NH_3 Scrubber:* Removes NH_3 from sample.
- *Bypass Flow:* Enables bypass flow option.
- *Communications Board:* Enables RS-232 or RS485 communications board option.
- *Predictive Diagnostics:* Enables predictive diagnostics.
- *Analog I/O:* Enables analog I/O option.
- *Digital I/O:* Enables digital I/O option.
- *Instrument Warmup:* Enables instrument warm up 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>Security Access Levels (Full Access)

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

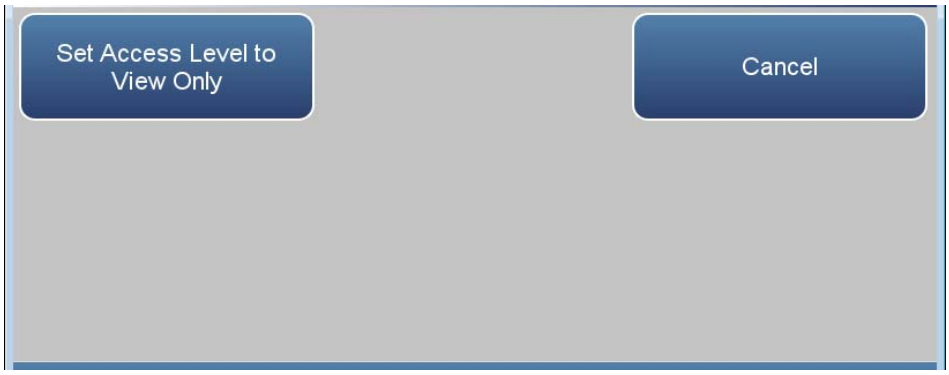
The Security Access Levels screen contains the following information:

- *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 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>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.

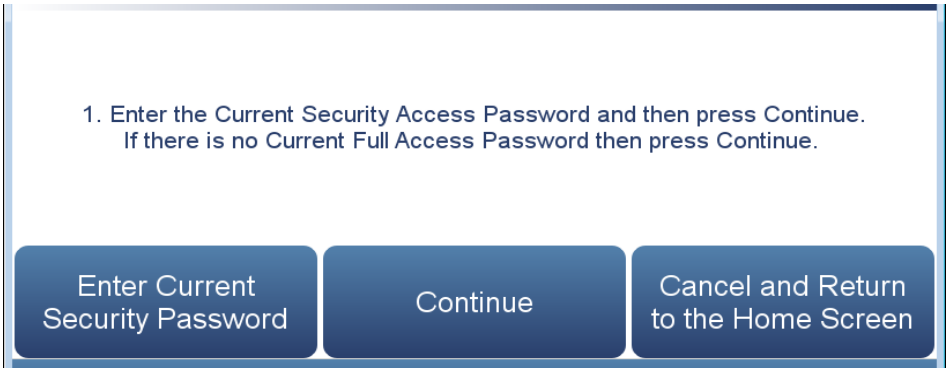
Note To change security access from view only access to full access, a keypad will be displayed where the user can enter full access password. ▲

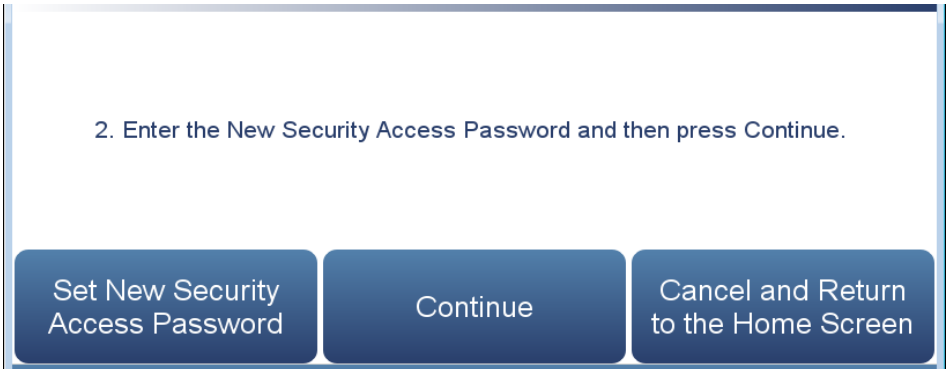
Change Full Access Security Password

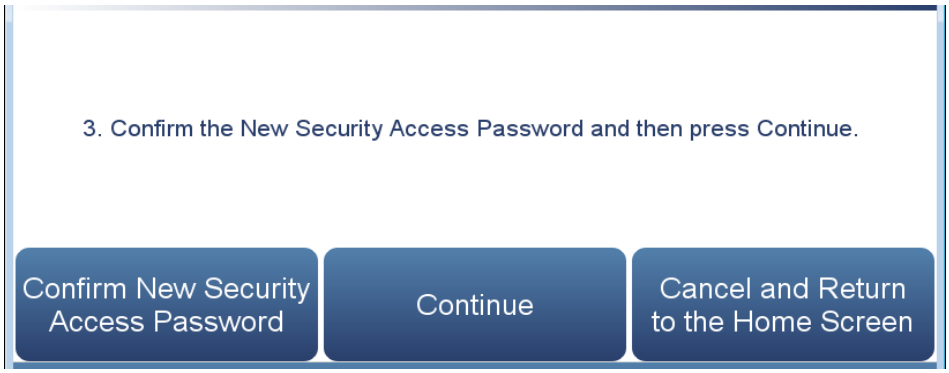
The Change Full Access Security Password screen allows the user to set a new password for allowing full access.

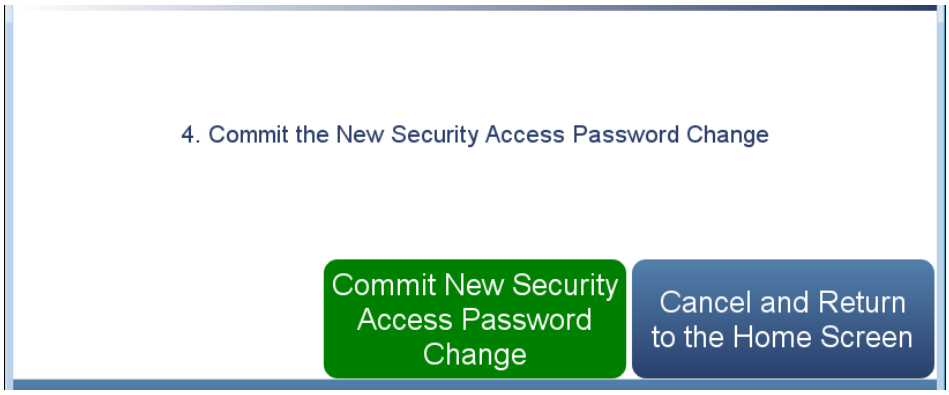
Home Screen>Settings>Security Access Levels>Change Full Access Security Password

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









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

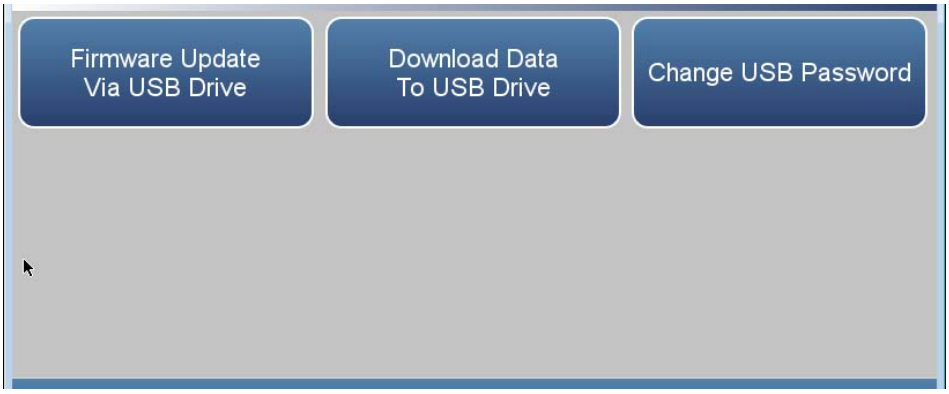
- *Enter Current Security Password:* User enters current security password.
- *Continue:* Proceeds to next screen.
- *Enter New Security Access Password:* User enters new security password.
- *Confirm New Security Access Password:* User confirms new security password for spelling confirmation.
- *Commit 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.

USB Drive

The USB Drive screen allows the user to update firmware, download/upload information, and change the USB password.

Note The USB drive screen only is 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. ▲

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.

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>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.

Download Data To USB Drive

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

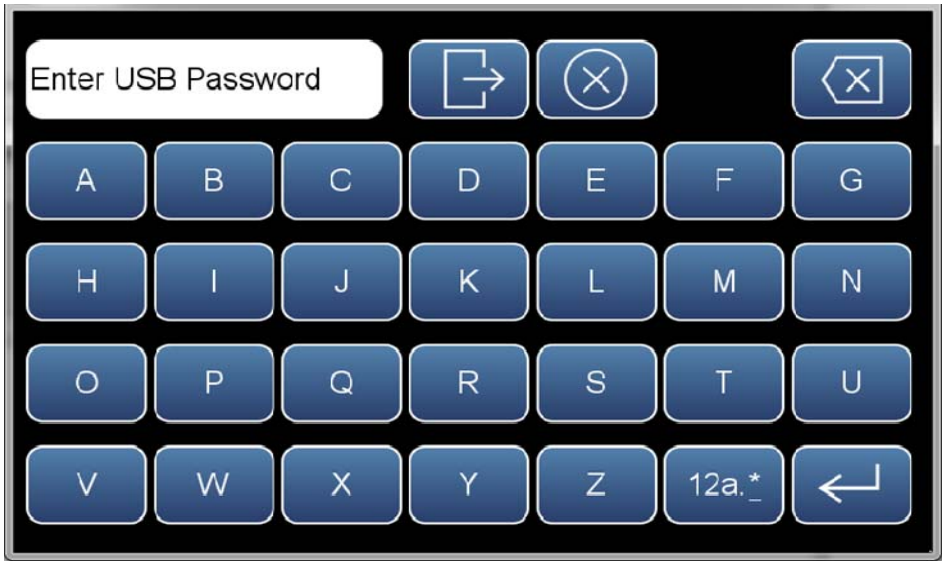
Home Screen>Settings>USB Drive>Download Data To USB Drive

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.
- *Restore:* 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.

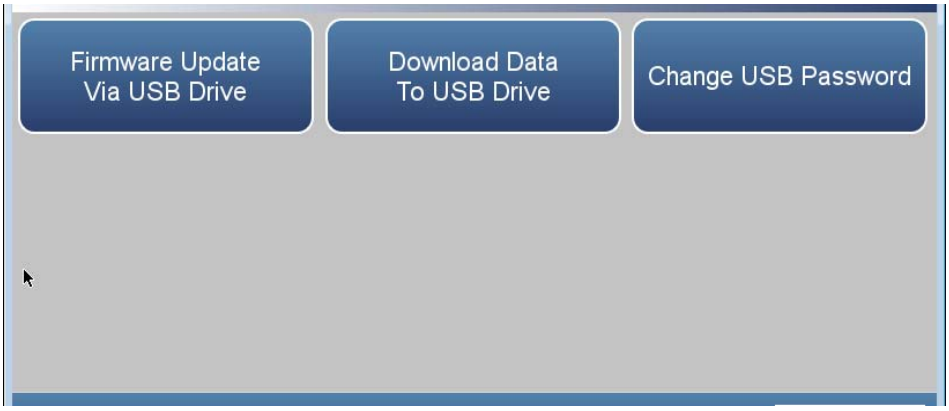
Use the following procedure to download data using the USB connection.

1. Plug a 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. ▲

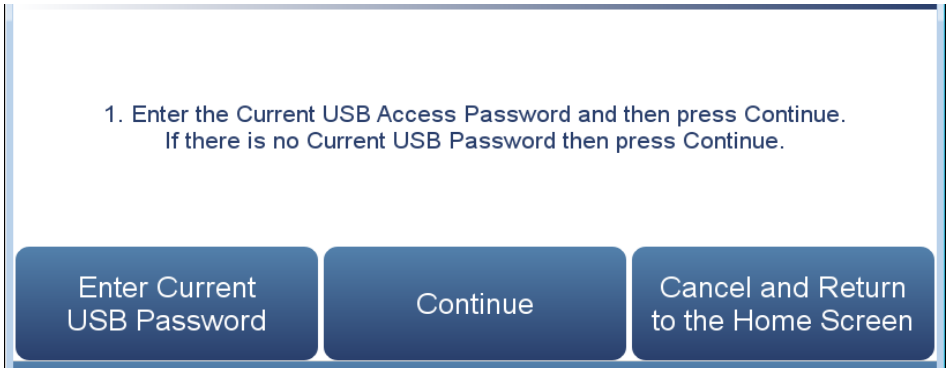
6. When the data download is complete, the instrument will display a “Success!” message and display the file name as it is stored on the USB flash drive. (The file name format is the instrument serial number, name of download, followed by a date/time stamp.) Remove the USB flash drive and select the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

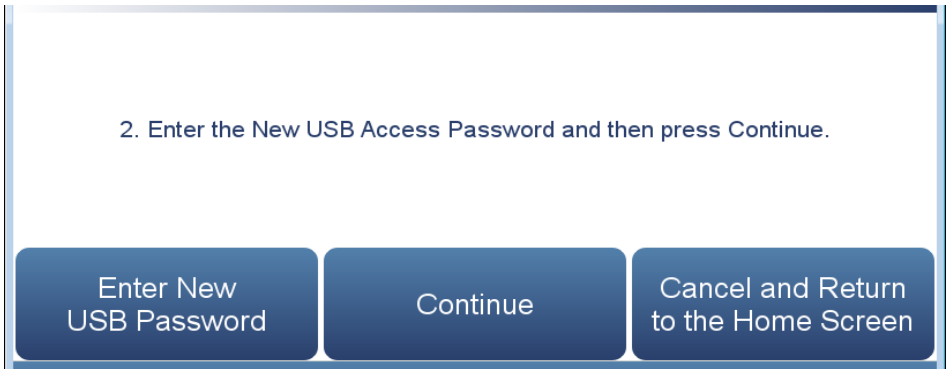
Change USB Password

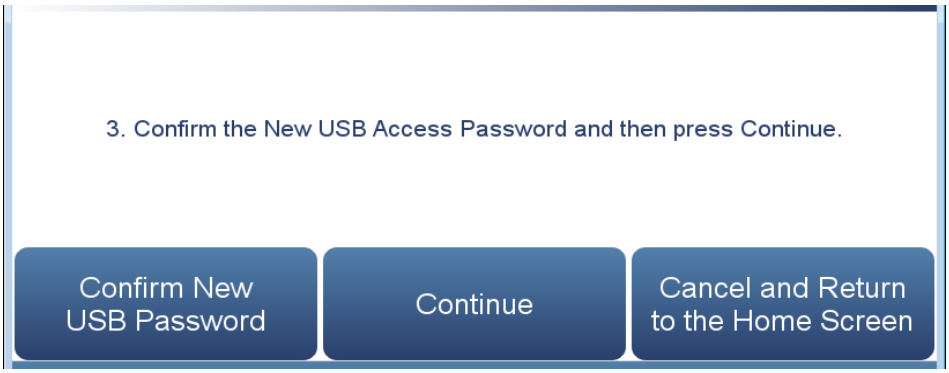
The Change USB Password screen allows the user to set a new password for accessing USB.

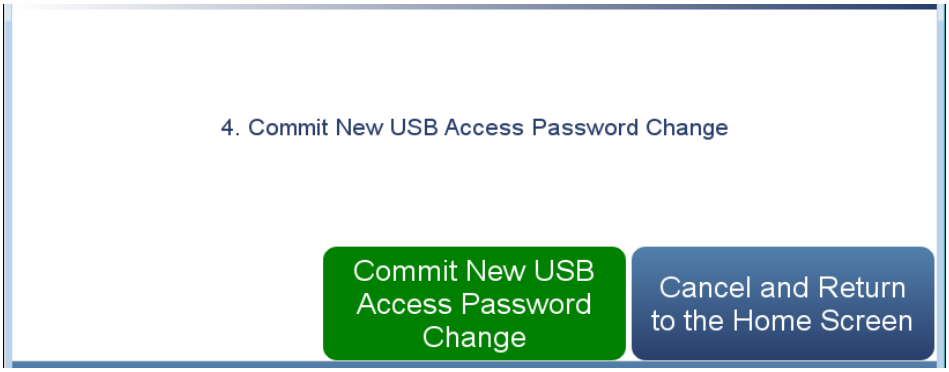
Home Screen>Settings>USB Drive>Change USB Password

Home Screen>Settings>Security Access Levels>Change Standard Access Password>Continue









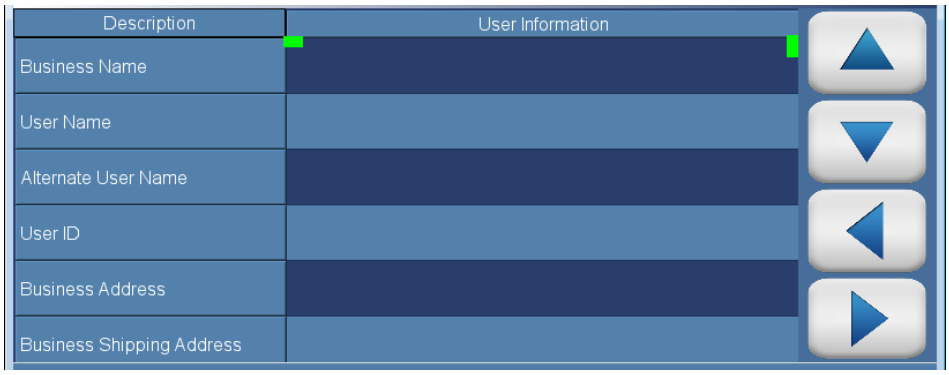
The Change USB Password screens contain the following information:

- *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.

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>User Contact Information



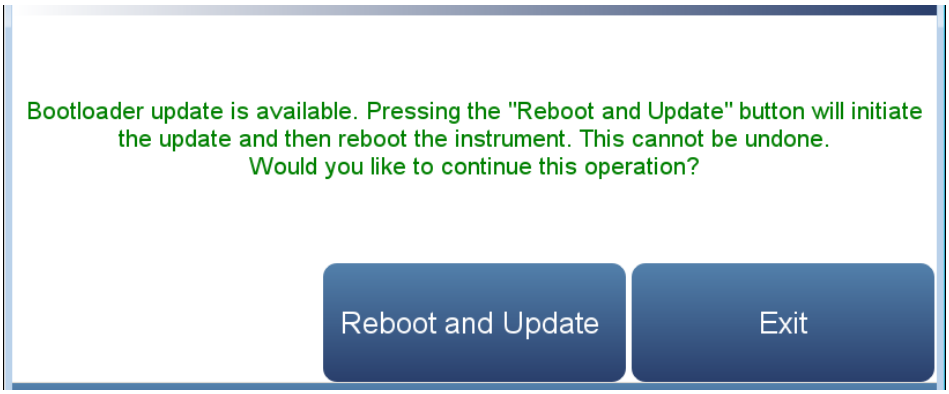
The User Contact Information screen contains the following information:

- 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>Update Bootloader



The Update Bootloader screen contains the following information:

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

Chapter 4
Calibration

This chapter describes the procedures for performing a standard zero/span calibration.

The 42iQHL requires initial and periodic calibration according to the procedures described in this chapter. A quality control plan that allows the frequency and number of calibration points to be modified depending on calibration and zero/span check data should be implemented. Such a quality control program is essential to ascertain the accuracy and reliability of the air quality data collected. The data compiled for such a program might include items such as dates of calibration, atmospheric conditions, control settings and other pertinent data. For more detailed quality assurance guidelines, see the *Quality Assurance Handbook for Air Pollution Measurement Systems*, published by the U.S. EPA, Research Triangle Park, NC, 27711.

There are a number of conditions which should be met prior to a calibration or a zero/span check. First, the instrument should have at least 90 minutes to warm up and stabilize. Second, the range used during the calibration or zero/span check should be the same as that used during normal monitoring. Third, all operational adjustments to the instrument should be completed prior to calibration. Fourth, all parts of the gas flow system, such as sample lines, and particulate filters, which are used in normal monitoring, should also be used during calibration. Finally, it is recommended that the recording devices and outputs used during normal monitoring be calibrated prior to the instrument calibration and that they be used during the calibration or the zero/span check.

The following describes procedures for performing a multipoint calibration of the 42iQHL. The information described here is considered adequate to perform the calibration. However, if greater detail is desired, the user is referred to the Code of Federal Regulations, Title 40, Part 50, Appendix F.

The calibration technique is based on the rapid gas phase reaction between NO and O_3 which produces stoichiometric quantities of NO_2 in accordance with the reaction:

$$NO + O_3 \rightarrow NO_2 + O_2$$

The quantitative nature of this reaction is such that when the NO concentration is known, the concentration of NO_2 can be determined. Ozone is added to excess NO in a dynamic calibration system, and the NO channel of the chemiluminescence NO-NO_2-NO_x analyzer is used as an indicator of changes in NO concentration.

When O_3 is added, the decrease in NO concentration observed on the calibrated NO channel is equivalent to the concentration of NO_2 produced. Adding variable amounts of O_3 from a stable O_3 generator can change the amount of NO_2 generated.

Equipment Required

The following equipment is required to calibrate the analyzer:

- Zero gas generator
- Gas phase titrator

Zero Gas Generator

A zero air source, such as a Thermo Scientific *111iQ Zero Air Supply*, free of contaminants such as NO, NO_2, and O_3 is required for dilution, calibration, and gas phase titration.

Compression

The zero air source should be at an elevated pressure to allow accurate and reproducible flow control and to aid in subsequent operations such as drying, oxidation, and scrubbing. An air compressor that gives an output of 10 psig is usually sufficient for most applications.

Drying

Several drying methods are available. Passing the compressed air through a bed of silica gel, using a heatless air dryer, or removing water vapor with a permeation dryer, are three possible approaches.

Oxidation

NO is usually oxidized to NO_2 in order to ease its scrubbing. Oxidation can be accomplished by either ozonation or chemical contact. During ozonation, the air is passed through an ozone generator. The O_3 that is produced reacts with the NO to form NO_2. Care must be taken to allow sufficient residence time for the ozonation reaction to go to completion.

Chemical oxidation is accomplished by passing the air stream through a reacting bed. Such agents as CrO_3 on an alumina support or Purafil® are very efficient at oxidizing NO to NO_2. The chemical contact approach has the advantage of needing no electrical power input for its application.

Scrubbing

Fixed bed reactors are commonly used in the last step of zero air generation to remove the remaining contaminants by either further reaction or absorption. Table 4–1 lists materials that can be effective in removing contaminants.

Table 4–1. Scrubbing Materials

To Remove	Use
NO	Soda-Lime (6-12 mesh), Purafil
Hydrocarbons	Molecular Sieve (4A), Activated Charcoal
O_3 and NO_2	Activated Charcoal

Gas Phase Titrator

A gas phase titrator (GPT), such as is included in the Thermo Scientific 146iQ Multi-gas Calibrator, is used to generate NO_2 concentrations from NO concentrations. Figure 4–1 shows the suggested placement of the component parts of a gas phase titration apparatus.

Equipment Damage All connections between components in the system should be made with glass, PTFE, or other non-reactive material. ▲

Flow Controllers

The airflow controllers should be devices capable of maintaining constant airflows within ±2% of the required flow rate. The NO flow controller should be capable of maintaining constant NO flows within ±2% of the required flow rate.

Pressure Regulator

The pressure regulator for the standard NO cylinder must have a non-reactive diaphragm and internal parts, and a suitable delivery pressure.

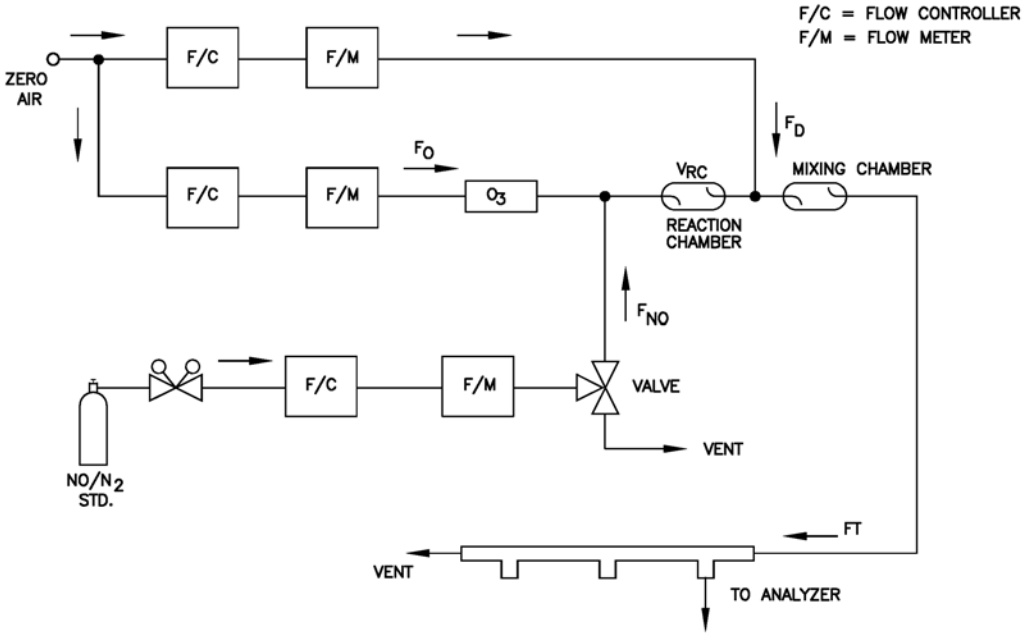


Figure 4–1. GPT System

Ozone Generator

The ozone generator must be capable of generating sufficient and stable levels of ozone for reaction with NO to generate NO_2 concentrations in the range required.

Note Ozone generators of the electric discharge type may produce NO and NO_2 and are not recommended. ▲

Diverter Valve

A valve can be used to divert the NO flow when zero air is required at the manifold.

Reaction Chamber

The reaction chamber used for the reaction of ozone with excess NO should have sufficient volume so that the residence time meets the requirements specified in this chapter.

Mixing Chamber

The mixing chamber is used to provide thorough mixing of the reaction products and diluent air.

Output Manifold

The output manifold should be of sufficient diameter to insure an insignificant pressure drop at the analyzer connection. The system must have a vent designed to insure atmospheric pressure at the manifold and to prevent ambient air from entering the manifold.

Reagents

The following information describes the NO concentration standard and the method for calculating the NO concentration standard and the NO_2 impurity.

NO Concentration Standard

A cylinder containing 10 to 50 ppm NO in N_2 with less than 1 ppm NO_2 is usually used as the concentration standard. The cylinder must be traceable to a National Institute of Standards and Technology (NIST) NO in N_2 Standard Reference Material or NO_2 Standard Reference Material.

Procedures for certifying the NO cylinder (working standard) against an NIST traceable NO or NO_2 standard and for determining the amount of NO_2 impurity are given in EPA Publication No. EPA-600/4-75-003, "Technical Assistance Document for the Chemiluminescence Measurement of Nitrogen Dioxide."

In addition, the procedure for the certification of a NO working standard against an NIST traceable NO standard and determination of the amount of NO_2 impurity in the working standard is reproduced here. The cylinder should be re-certified on a regular basis as determined by the local quality control program.

Use the NIST traceable NO standard and the GPT calibration procedure to calibrate the NO, NO_2, and NO_x responses of the instrument. Also determine the converter efficiency of the analyzer. Refer to the calibration procedure in this manual and in the Code of Federal Regulations, Title 40, Part 50, Appendix F for exact details. Ignore the recommended zero offset adjustments.

Assaying a Working NO Standard Against a NIST-traceable NO Standard

Use the following procedure to calculate the NO concentration standard and NO_2 impurity.

1. Generate several NO concentrations by dilution of the NO working standard.

2. Use the nominal NO concentration, $[NO]_{NOM}$, to calculate the diluted concentrations.

3. Plot the analyzer NO response (in ppm) versus the nominal diluted NO concentration and determine the slope, S_{NOM}.

4. Calculate the [NO] concentration of the working standard, $[NO]_{STD}$, from:

$$[NO]_{STD} = [NO]_{NOM} \times S_{NOM}$$

5. If the nominal NO concentration of the working standard is unknown, generate several NO concentrations to give on-scale NO responses.

6. Measure and record F_{NO} and F_T for each NO concentration generated.

7. Plot the analyzer NO response versus F_{NO}/F_T and determine the slope which gives $[NO]_{STD}$ directly. The analyzer NO_x responses to the generated NO concentrations reflect any NO_2 impurity in the NO working standard.

8. Plot the difference between the analyzer NO_x and NO responses versus F_{NO}/F_T. The slope of this plot is $[NO_2]_{IMP}$.

Zero Air

A source of zero air free of contaminants should be used as described earlier in this chapter. Contaminants can cause a detectable response on the instrument and may also react with the NO, O_3, or NO_2 during the gas phase titration.

Dynamic Parameter Specifications for Gas Titrator

Use the following definitions for the remainder of this chapter.

P_R =	Dynamic parameter specification to ensure complete reaction of the available O_3, ppm-min
$[NO]_{RC}$ =	NO concentration in the reaction chamber, ppm
t_R =	residence time of the reactant gases in the reaction chamber, min
$[NO]_{STD}$ =	Concentration of the undiluted NO standard, ppm
F_{NO} =	NO flow rate, sccm
F_O =	O_3 generator air flow rate, sccm
V_{RC} =	Volume of the reaction chamber, cc
F_T =	Analyzer demand plus 10 to 50% excess

The O_3 generator (ozonator) airflow rate and the NO flow rate must be adjusted such that the following relationships hold:

$$P_R = [NO]_{RC} \times t_R \geq 2.75 \text{ ppm-min}$$

$$[NO]_{RC} = [NO]_{STD} \frac{F_{NO}}{(F_O + F_{NO})}$$

$$t_R = \frac{V_{RC}}{F_O + F_{NO}} < 2 \text{ min}$$

Determining GPT System Flow Conditions

Use the following procedure to determine the flow conditions to be used in the GPT system.

1. Determine FT, the total flow required at the output manifold, which should be equal to the analyzer demand plus 10 to 50 percent excess.

2. Establish $[NO]_{OUT}$ as the highest NO concentration that will be required at the output manifold. $[NO]_{OUT}$ should be about equal to 90% of the upper range limit (URL) of the NO_2 concentration range to be covered.

3. Determine F_{NO} as:

$$F_{NO} = \frac{[NO]_{OUT} \times F_T}{[NO]_{STD}}$$

4. Select a convenient or available reaction chamber volume. Initially a trial volume may be selected in the range of 200 to 500 cc.

5. Compute F_O as:

$$F_O = \sqrt{\frac{[NO]_{STD} \times F_{NO} \times V_{RC}}{2.75}} - F_{NO}$$

6. Compute t_R as:

$$t_R = \frac{V_{RC}}{F_O + F_{NO}}$$

7. Verify that t_R < 2 minutes. If not, select a reaction chamber with a smaller V_{RC}.

8. Compute the diluent air flow rate as:

$$F_D = F_T - F_O - F_{NO}$$

9. If F_O turns out to be impractical for the desired system, select a reaction chamber having a different V_{RC} and recompute F_D and F_O.

Pre-Calibration

Perform the following pre-calibration procedure before calibrating the 42iQHL. For detailed information about the menu parameters and the icons used in these procedures, see the "Operation" chapter.

Note The calibration and calibration check duration times should be long enough to account for the transition (purge) process when switching from sample to zero and from zero to span. This transition time is the time required to purge the existing air. ▲

Note Depending on the plumbing configuration and the instrument, data from approximately the first minute of a zero calibration or check should be disregarded because of residual sample air. Also, data from approximately the first minute of a span calibration or check should be disregarded because the span is mixing with the residual zero air. ▲

1. Allow the instrument to warm up and stabilize.

2. Be sure the ozonator is enabled. If the ozonator is disabled:
   a. From the Home screen choose **Settings>Instrument Settings**.
   b. Press **Ozonator Supply** to toggle the ozonator to show **Enabled**.

3. Be sure the instrument is in the auto mode, that is, NO, NO_2, and NO_x measurements are being displayed on the front panel display. If the instrument is not in auto mode:

   a. From the Home screen choose **Settings>Measurement Settings>Advanced Measurement Settings>Auto/Manual Mode**.

   b. Select **NO/NOx**.

4. Check the averaging time. It is recommended that a higher averaging time be used for best results.

   a. From the Home screen choose **Settings>Measurement Settings>Averaging time**. (Ensure Dynamic Filtering is disabled to access Averaging Time.)

Note The averaging time should be less than the zero duration and less than the span duration. ▲

5. Verify that any filters used during normal monitoring are also used during calibration.

Calibration

The following procedure calibrates the analyzer using the gas phase titrator and zero in gas generator described previously in this manual. It is suggested that a calibration curve have at least seven points between the zero and full scale NO concentrations. Although the seven-point curve is optional, two of whatever number of points is chosen should be located at the zero and 90% levels and the remaining points equally spaced between these values.

Note When the instrument is equipped with internal zero/span and sample valves, the ZERO IN and SPAN ports should give identical responses to the SAMPLE port when test gases are introduced. The user should calibrate the instrument using the SAMPLE port to introduce the zero and span gas sources. ▲

After calibration, the zero in and span sources should be plumbed to the appropriate ports on the rear panel of the instrument, and then reintroduced to the instrument. The instrument should give identical responses to the test gases whether they are introduced via the SAMPLE port or the ZERO IN or SPAN ports. If not, the plumbing and/or valves should be serviced.

Connect GPT Apparatus to the Analyzer

Use the following procedure to connect the GPT apparatus to the analyzer.

1. Assemble a dynamic calibration system such as the one shown in Figure 4–1.

2. Ensure that all flow meters are calibrated under the conditions of use against a reliable standard, such as a soap-bubble meter or wet-test meter. All volumetric flow rates should be corrected to 25 °C and 760 mmHg.

3. Precautions should be taken to remove O_2 and other contaminants from the NO pressure regulator and delivery system prior to the start of calibration to avoid any conversion of NO to NO_2. Failure to do so can cause significant errors in calibration. This problem can be minimized by:

   a. Carefully evacuating the regulator after the regulator has been connected to the cylinder and before opening the cylinder valve.

   b. Thoroughly flushing the regulator and delivery system with NO after opening the cylinder valve.

   c. Not removing the regulator from the cylinder between calibrations unless absolutely necessary.

4. Connect the analyzer sample bulkhead input to the output of the GPT system.

Adjust Instrument Gain

Use the following procedure to adjust the instrument gain. This includes:

- Setting the NO and NO_x background to zero
- Calibrating the NO channel to the NO calibration gas
- Calibrating the NO_x channel to the NO_x calibration gas

Set NO and NO_x Backgrounds to Zero

The NO and NO_x background corrections are determined during zero calibration. The background signal is the combination of electrical offsets, PMT dark current, and trace substances undergoing chemiluminescence. For more detailed information, see "Calibrate NO and NOx Background" in the "Operation" chapter.

Use the following procedure to set the NO and NO_x backgrounds to zero. Both the NO and NO_x background screens operate the same way.

Note The NO channel should be calibrated first and then calibrate the NO_x channel. ▲

For detailed information about the menu parameters and the icons used in these procedures, see the "Operation" chapter.

1. Determine the GPT flow conditions required to meet the dynamic parameter specifications as indicated in "Dynamic Parameter Specifications for Gas Titrator" earlier in this chapter.

2. Adjust the GPT diluent air and O_3 generator air flows to obtain the flows determined in "Dynamic Parameter Specifications for Gas Titrator" earlier in this chapter. The total GPT airflow must exceed the total demand of the analyzer. The 42iQHL requires approximately 100 cc/min of sample flow, and a total GPT airflow of at least 0.5 liters/min is recommended.

   a. Allow the analyzer to sample zero air until the NO, NO_x, and NO_2 responses stabilize.

   b. After the responses have stabilized, from the Home Screen, choose **Calibration>Calibrate Backgrounds>Calibrate NO Background**.

      The Target NO Concentration button will read 0.000. The Calculated NO Background button will display the background needed to make the current NO concentration go to 0.000.

   c. Press **Calibrate** to set the NO reading to zero and save the new background.

   d. Press the Back button to return to the Calibration Backgrounds screen and repeat this procedure to set the **Calibrate NO_x Background** to zero.

   e. Record the stable zero air responses as Z_{NO}, Z_{NOX}, and Z_{NO2}.

3. Adjust the NO flow from the standard NO cylinder to generate a NO concentration of about 80% of the upper range limit (URL) of the NO range. The exact NO concentration is calculated from:

$$[NO]_{OUT} = \frac{F_{NO} \times NO_{STD}}{F_{NO} + F_O + F_D}$$

   Where:

$[NO]_{OUT}$ = Diluted NO concentration at the output manifold, ppm

NO_{STD} = No feed concentration

F_{NO} = No flow

F_O = Ozone flow

F_D = Dilution flow

Calibrate the NO Channel to the NO Calibration Gas

Use the following procedure to calibrate the NO channel to the NO calibration gas.

1. Allow the analyzer to sample the NO calibration gas until the NO, NO_2, and NO_x readings have stabilized.

2. When the responses stabilize, from the Home Screen, choose **Calibration>Calibrate Span Coefficients>Calibrate NO Span Coefficient**.

   The user sets the span concentration by pressing the Edit NO Span Concentration button. The Calculated NO Span Coefficient button will show what the span coefficient will be set to if the Calibrate button is pressed. Pressing the Calibrate button will save the new NO span coefficient and calibrate the instrument.

3. Enter the NO calibration gas concentration using the pushbuttons, and then press **Calibrate** to calibrate the instrument to the NO calibration gas.

4. Record the $[NO]_{OUT}$ concentration and the instrument's response.

Calibrate the NO_x Channel to the NO_x Calibration Gas

Use the following procedure to calibrate the NO_x channel to the NO_x calibration gas.

1. Press the Back button to return to the Calibration menu, and choose **Calibrate NO_x Span Coefficient**.

2. Verify that the NO_x calibration gas concentration is the same as the NO calibration gas concentration plus any known NO_2 impurity.

   The user sets the span concentration by pressing the Edit NO_x Span Concentration button. The Calculated NO_x Span Coefficient button will show what the span coefficient will be set to if the Calibrate button

is pressed. Pressing the Calibrate button will save the new NO_x span coefficient and calibrate the instrument.

3. Enter the NO_x calibration gas concentration using the pushbuttons, and then press **Calibrate** to calibrate the instrument to the NO_x calibration gas.

   The exact NO_x concentration is calculated from:

$$[NO_x]_{OUT} = \frac{F_{NO} \times ([NO]_{STD} + [NO_2]_{IMP})}{F_{NO} + F_O + F_D}$$

   Where:

   $[NO_x]_{OUT}$ = diluted NO_x concentration at the output manifold, ppm

   $[NO_2]_{IMP}$ = concentration of NO_2 impurity in the standard NO cylinder, ppm

4. Record the NO_x concentration and the analyzer's NO_x response.

Preparing NO, NO_x, and NO_2 Calibration Curves

Use the following procedures to prepare the NO, NO_x, and NO_2 calibration curves.

1. Generate several additional NO and NO_x concentrations by decreasing F_{NO} or increasing F_D.

2. For each concentration generated, calculate the exact NO and NO_x concentrations using the above equations for $[NO]_{OUT}$ and $[NO_x]_{OUT}$.

3. Record the NO and NO_x responses.

4. Plot the analyzer responses versus the respective calculated NO and NO_x concentrations and draw or calculate the respective calibration curves. For subsequent calibrations where linearity can be assumed, these curves may be checked with a three-point calibration consisting of a zero point, NO and NO_x concentrations of approximately 80% of the URL, and an intermediate concentration.

5. Adjust the GPT system to generate a NO concentration near 90% of the URL of the instrument range selected.

6. Sample this NO concentration until the NO and NO_x responses have stabilized, then measure and record the NO concentration as $[NO]_{ORIG}$.

7. Adjust the O_3 generator in the GPT system to generate sufficient O_3 to produce a decrease in the NO concentration equivalent to about 80% of the URL of the NO_2 range. The decrease must not exceed 90% of the NO concentration determined in Steps 5 and 6 above.

8. When the analyzer responses stabilize, record the resultant NO concentrations as $[NO]_{REM}$.

9. Press the Back button to return to the Calibration menu, and choose **Calibrate NO_2 Span Coefficient**.

   The user sets the span concentration by pressing the Edit NO_2 Span Concentration button. The Calculated NO_2 Span Coefficient button will show what the span coefficient will be set to if the Calibrate button is pressed. Pressing the Calibrate button will save the new NO_2 span coefficient and calibrate the instrument.

10. Enter the NO_2 calibration gas concentration using the pushbuttons, and then press **Calibrate** to concentration to reflect the sum of the following: the NO_2 concentration generated by GPT, ($[NO]_{ORIG}$ - $[NO]_{REM}$), and any NO_2 impurity.

    The exact NO_x concentration is calculated from:

$$[NO_2]_{OUT} = ([NO]_{ORIG} - [NO]_{REM}) + \frac{F_{NO} \times [NO_2]_{IMP}}{F_{NO} + F_O + F_D}$$

    Where:

    $[NO_2]_{OUT}$ = diluted NO_2 concentration at the output manifold, ppm

    $[NO]_{ORIG}$ = original NO concentration, prior to addition of O_3, ppm

    $[NO]_{REM}$ = NO concentration remaining after addition of O_3, ppm

    The analyzer does a one point NO_2 span coefficient calculation, corrects the NO_2 reading for converter inefficiency, and then adds the corrected NO_2 to the NO signal to give a corrected NO_x signal.

    If the analyzer calculates a NO_2 span coefficient of less than 0.96, either the entered NO_2 concentration is incorrect, the converter is not being heated to the proper temperature, the instrument needs servicing (leak or imbalance), or the converter needs replacement or servicing. The NO_2 analog output will reflect the NO_2 concentration generated by GPT, any NO_2 impurity, and the NO_2 zero offset.

11. Record the NO_2 concentration and the analyzer's NO_2 response.

12. Maintaining the same F_{NO}, F_O, and F_D, adjust the ozone generator to obtain several other concentrations of NO_2 over the NO_2 range (at least five evenly spaced points across the remaining scale are suggested).

13. Record the stable responses and plot the analyzer's NO_2 responses versus the corresponding calculated (using the above equation for $[NO_2]_{OUT}$) concentrations and draw or calculate the NO_2 calibration curve.

Note It is important that the curve be linear within ±1% FS over the NO_2 range. If the curve is nonlinear, the analyzer is not operating correctly, (possible leak, or converter failure, etc.), and should be serviced. Assuming the curve is linear, subsequent data should be reduced using this NO_2 calibration curve response. ▲

Note The user can also manually change the calibration factors. This is often useful in a troubleshooting situation. From the Home screen, choose Calibration>Advanced Calibration>Manual Calibration>**Adjust Span Coefficients**.

However, after the above calibration procedure is completed, all subsequent data reduction depends on the calibration parameters remaining the same as during the initial calibration. Therefore, never change any calibration factor without first recording the value so that after any troubleshooting procedure is completed, the initial value can be re-entered thereby not altering the multipoint calibration. ▲

Calibration in Dual Range and Auto Range Mode

The dual/auto range calibration feature is used to calibrate the analyzer at two different span levels (as opposed to a single span level in the standard mode) generating a "tailored multi-point" calibration curve stored in the analyzer's memory. This feature may be used:

- When widely different gas levels are being monitored, such as a factor of 10 or greater apart
- If precision and span levels are being introduced using separate tanks
- If more than one multi-component cylinder is being used to calibrate the instrument

Properly designed chemiluminescence analyzers are inherently linear over a wide dynamic range; and under normal U.S. EPA compliance situations this feature is not required. Dual calibration may be used for span levels less than a factor of 10 apart, however if this is done to correct for a significant non-linearity, it may mask the problems causing the effect, such as, bad calibration cylinder, leaks in sampling lines, or low ozonator output.

Set NO and NO_x Background to Zero

Use the following procedure to set the NO and NO_x backgrounds to zero. Both the NO and NO_x background screens operate the same way.

For detailed information about the menu parameters and the icons used in these procedures, see the "Operation" chapter.

1. Follow the "Pre-Calibration" procedure described previously in this chapter.

2. Be sure the instrument is in the auto or dual mode. If the instrument is not in auto or dual mode:
   a. From the Home screen choose **Settings>Measurement Settings>Range Mode Selection**.
   b. Select **Auto** or **Dual** mode.

3. Introduce zero air to the SAMPLE bulkhead and allow the analyzer to sample zero air until the NO, NO_2, and NO_x responses stabilize.

4. After the responses have stabilized, from the Home Screen, choose **Calibration>Calibrate Backgrounds>Calibrate NO Background**.

The Target Concentration button will read 0.00. The New Background button will display the background needed to make the current NO concentration go to 0.00.

5. In the Calibrate Backgrounds screen, press **Calibrate** to set the NO reading to zero and to save the new background.

6. Press the Back button to return to the Calibration Backgrounds screen and repeat this procedure to set the **Calibrate NO_x Background** to zero.

Calibrate NO Low

Use the following procedure to calibrate NO channel to the NO calibration gas.

1. Disconnect the source of zero air from the SAMPLE bulkhead. In its place, connect a source of NO calibration gas of about 80% of the low NO full-scale range.

2. Allow the analyzer to sample the low NO calibration gas until the NO, NO_2, and NO_x readings stabilize.

3. When the responses stabilize, from the Home screen, choose **Calibration>Calibrate Span Coefficients>Calibrate Low Range NO Span Coefficient**.

   The user sets the span concentration by pressing the Edit Span Concentration button. The New Span Coefficient button will show what the span coefficient will be set to if the Calibrate button is pressed.

4. Enter the NO calibration gas concentration using the pushbuttons, and then press **Calibrate** to calculate and save the new low range NO span coefficient based on the entered span coefficient.

Calibrate NO_x Low

Use the following procedure to calibrate the NO_x channel to the NO_x calibration gas.

1. Press the Back button to return to the Calibration menu and choose **Calibrate Low Range NO_x Span Coefficient**.

The user sets the span concentration by pressing the Edit Span Concentration button. The New Span Coefficient button will show what the span coefficient will be set to if the Calibrate button is pressed.

2. Verify that the low NO_x calibration gas concentration is the same as the low NO calibration gas concentration plus any known NO_2 impurity.

3. Enter the NO_x calibration gas concentration using the pushbuttons, and then press **Calibrate** to calculate and save the new low range NO_x span coefficient based on the entered span coefficient.

Calibrate NO_2 Low

Use the following procedure to calibrate the NO_2 channel to the NO_2 calibration gas.

1. Adjust the O_3 generator in the GPT system to generate sufficient O_3 to produce a decrease in the low NO concentration equivalent to about 80% of the URL of the low NO_2 range. The decrease must not exceed 90% of the low NO concentration determined in the "Calibrate NOx Low" procedure.

2. Press the Back button to return to the Calibration menu and choose **Calibrate Low Range NO_2 Span Coefficient**.

   The user sets the span concentration by pressing the Edit Span Concentration button. The New NO_2 Span Coefficient button will show what the span coefficient will be set to if the Calibrate button is pressed.

3. Set the low NO_2 calibration gas concentration to reflect the sum of the NO_2 concentration generated by GPT and any NO_2 impurity using the pushbuttons, and then press **Calibrate** to calculate and save the new low range NO_2 span coefficient based on the entered span coefficient.

Calibrate NO High

Use the following procedure to calibrate the NO channel to the NO calibration gas.

1. Connect a source of high NO calibration gas of about 80% of the high NO full-scale range. Allow the analyzer to sample the high NO calibration gas until the NO, NO_2, and NO_x readings have stabilized.

2. After the responses stabilize, from the Home screen, choose **Calibration>Calibrate Span Coefficients>Calibrate High Range NO Span Coefficient**.

   The user sets the span concentration by pressing the Edit Span Concentration button. The New Span Coefficient button will show what the span coefficient will be set to if the Calibrate button is pressed.

3. Enter the NO calibration gas concentration using the pushbuttons, and then press **Calibrate** to calculate and save the new high range NO span coefficient based on the entered span coefficient.

Calibrate NO_x High

Use the following procedure to calibrate the NO_x channel to the NO_x calibration gas.

1. Press the Back button to return to the Calibration menu and choose **Calibrate High Range NO_x Span Coefficient**.

   The user sets the span concentration by pressing the Edit Span Concentration button. The New Span Coefficient button will show what the span coefficient will be set to if the Calibrate button is pressed.

2. Verify that the high NO_x calibration gas concentration is the same as the high NO calibration gas concentration plus any known NO_2 impurity.

3. Enter the NO_x calibration gas concentration using the pushbuttons, and then press **Calibrate** to calculate and save the new high range NO_x span coefficient based on the entered span coefficient.

Calibrate NO_2 High

Use the following procedure to calibrate the NO_2 channel to the NO_2 calibration gas.

1. Adjust the O_3 generator in the GPT system to generate sufficient O_3 to produce a decrease in the high NO concentration equivalent to about 80% of the URL of the high NO_2 range. The decrease must not exceed 90% of the high NO concentration determined in the "Calibrate NOx High" procedure.

2. Press the Back button to return to the Calibration menu and choose **Calibrate High Range NO_2 Span Coefficient**.

   The user sets the span concentration by pressing the Edit Span Concentration button. The New NO_2 Span Coefficient button will show what the span coefficient will be set to if the Calibrate button is pressed.

3. Set the high NO_2 calibration gas concentration to reflect the sum of the NO_2 concentration generated by GPT and any NO_2 impurity using the pushbuttons, and then press **Calibrate** to calculate and save the new high range NO_2 span coefficient based on the entered span coefficient.

Zero and Span Check

The analyzer requires initial and periodic calibration according to the procedures outlined in this manual. Initially, the frequency of the calibration procedure should be determined by the stability of the zero and span checks, which may be run daily. You should generate a new calibration curve when zero and span checks indicate a shift in instrument gain of more than 10 percent from that determined during the most recent multipoint calibration. You can adjust the frequency of calibration and even zero and span checks appropriately as you gain confidence with the instrument.

It is recommended to have a quality control plan where the frequency and the number of points required for calibration can be modified on the basis of calibration and zero and span check data collected over a period of time. Note however, that the EPA requires a minimum of one multipoint calibration per calendar quarter. Such a quality control program is essential to ascertain the accuracy and reliability of the air quality data collected and to alert the user if the accuracy or reliability of the data should become unacceptable. A compilation of this kind might include items such as dates of calibration, atmospheric conditions, calibration factors, and other pertinent data.

Use the following procedure to perform a zero and span check.

1. Connect the zero gas to the SAMPLE bulkhead in a standard instrument or to the ZERO IN bulkhead in a 42iQHL equipped with the zero/span and sample solenoid valve option.

2. Allow the instrument to sample zero gas until a stable reading is obtained on the NO, NO_2, and NO_x channels then record the zero readings. Unless the zero has changed by more than ±0.010 ppm, it is recommended that the zero not be adjusted. If an adjustment larger

than this is indicated due to a change in zero reading, a new multipoint calibration curve should be generated.

3. Attach a supply of known concentration of NO and NO_2 (usually generated via an NIST traceable NO working standard and a GPT system) to the SAMPLE bulkhead (or SPAN bulkhead for instruments equipped with the zero/span and sample solenoid valve option) on the rear panel.

4. Allow the instrument to sample the calibration gas until a stable reading is obtained on the NO, NO_2, and NO_x channels. If the calibration has changed by more than ±10%, a new multipoint calibration curve should be generated.

5. When the calibration check has been completed, record the NO, NO_2, and NO_x values.

6. Reconnect the analyzer sample line to the SAMPLE bulkhead.

Manual Calibration

The Manual Calibration screen allows the user to view and manually adjust the zero background and span coefficient. These are used to correct the NO, NO_2, and NO_x readings that the instrument generates using its own internal calibration data.

Normally, the zero background and span coefficient are calculated automatically at the Calibrate Background and Calibrate Span Coefficient described earlier in the chapter. However, the calibration factors can also be set manually using the functions as described below.

The following screen is shown in single range mode. In dual or auto range modes, “High Range” or “Low Range” buttons are displayed to indicate the calibration of the high or low coefficient. The Adjust High Range Span Coefficient and Adjust Low Range Span Coefficient screens function the same way.

Home Screen>Calibration>Advanced Calibration>Manual Calibration

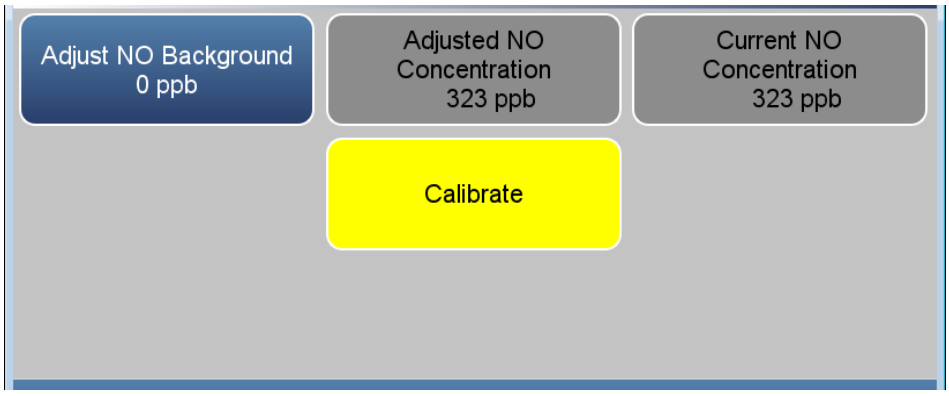
Adjust NO and NO_x Backgrounds

The NO background is the amount of signal read by the analyzer in the NO channel while sampling zero air. The NO_x background is the amount of signal read by the analyzer in the NO_x channel while sampling zero air.

The Adjust Background screens are used to perform a manual zero background calibration of the instrument. As such, the instrument should sample zero air until stable readings are obtained. The NO channel should be calibrated first. Both the NO and NO_x Adjust Background screens operate the same way.

The button labeled Adjust NO Background allows the user to change zero background. The second button called Adjusted NO Concentration shows what the new NO concentration would be based on the changed zero background. Press the Calibrate button to save the adjusted zero background value.

Home Screen>Calibration>Advanced Calibration>Manual Calibration>Adjust Backgrounds>Adjust NO Background

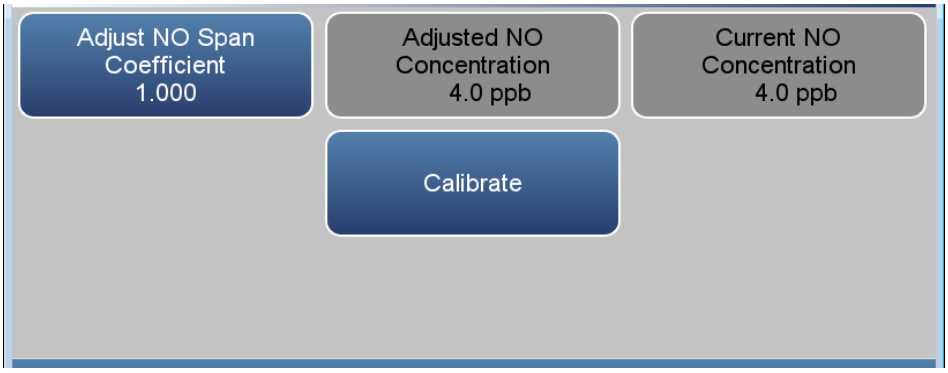


Adjust Span Coefficient

The span coefficients are used to correct the NO, NO_2, and NO_x readings. The NO and NO_x span coefficient normally has a value near 1.000. The NO_2 span coefficient normally has a value between 0.95 and 1.050.

The user can manually change the span coefficient by entering a value in the Adjust Span Coefficient button. The second button called Adjusted Concentration shows what the new concentration would be based on the adjusted span coefficient. Press the Calibrate button to save the adjusted span coefficient value. The NO, NO_2, and NO_x coefficient screens operate the same way.

Home Screen>Calibration>Advanced Calibration>Manual Calibration>Adjust Span Coefficients>Adjust NO Span Coefficient (single range mode)



Home Screen> Calibration>Advanced Calibration>Manual Calibration>Adjust Coefficients> Adjust High Range NO Span Coefficient (dual or auto range mode)

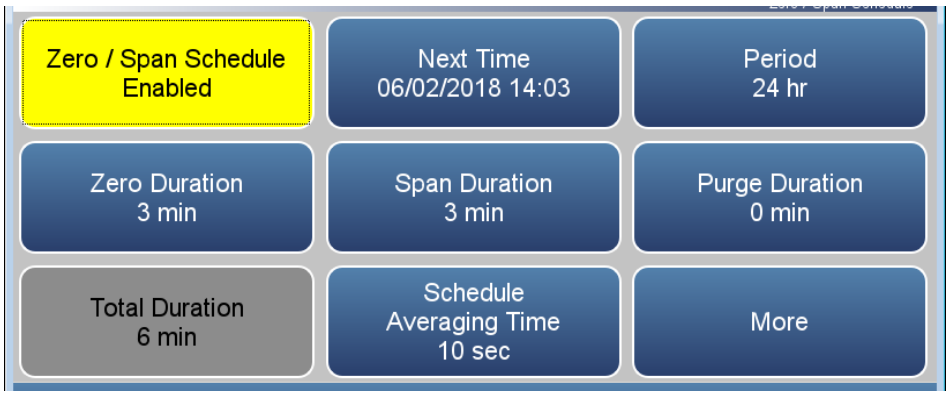
Reset Bkg to 0.000 and Span Coef to 1.000

The Reset Bkg to 0.000 and Span Coef to 1.000 screen allows the user to reset the calibration configuration values to factory defaults.

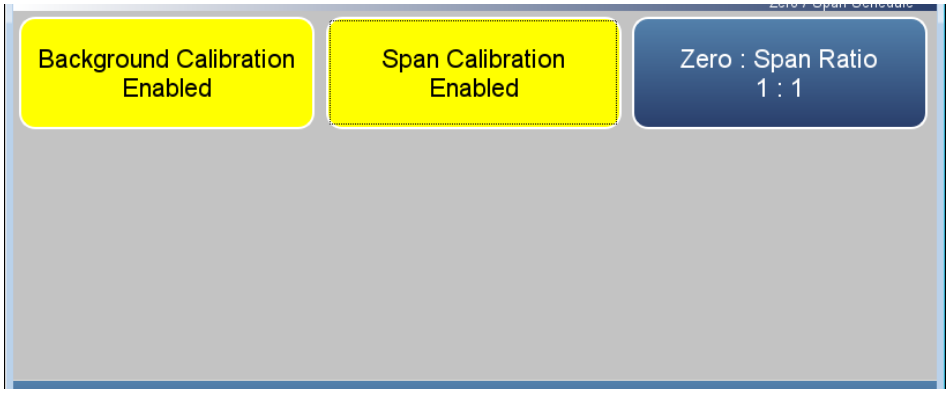
Zero/Span Schedule

The Zero/Span Schedule is used to program the instrument to perform fully automated zero and span checks or adjustments.

Home Screen>Calibration>Zero/Span Schedule



Home Screen>Calibration>Zero/Span Schedule>More



Next Time

The Next Time button is used to view and set the initial date and time (24-hour format) of the zero/span schedule. Once the zero/span schedule begins, the date and time of the next zero/span schedule is calculated and displayed.

Period

The Period button defines the period or interval between zero/span schedule. Periods between 0 and 999 hours are acceptable. To turn the zero/span schedule off, set the period to 0.

Zero/Span/Purge Duration Minutes

The Zero Duration button defines how long zero air is sampled by the instrument. The Span and Purge Duration buttons look and function the same way as the zero duration button. The span duration button is used to set how long the span gas is sampled by the instrument. The purge duration button is used to set how long the purge period will be after doing a zero and/or span. This gives the instrument time to flush out the zero and span gas before any meaningful sample data is taken. Logged data is flagged as taken during a purge to show that the data is suspect. Durations between 0 and 99 minutes are acceptable. Each time a zero/span schedule occurs the zero is done first, followed by the span. To perform just a zero, set the span duration to 0 (off). The same applies to perform just a span.

Schedule Averaging Time

The Schedule Averaging Time button allows the user to adjust the schedule averaging time. The schedule averaging time is used by the analyzer only when performing a zero/span schedule. The analyzer's averaging time is used for all other functions. Range is 1–300 seconds.

Background Calibration and Span Calibration

Background Calibration and Span Calibration are toggle buttons that change between enabled or disabled.

If the background calibration is set to enabled, then a zero adjustment is made. If the span calibration is set to enabled, then a span adjustment is made. (This is how to set up a scheduled, recurring auto calibration.)

Zero/Span Ratio

The Zero/Span Ratio button is used to set the ratio of zero checks or adjustments to span checks or adjustments. For example, if this value is set to 1, a span duration will follow every zero duration. If this value is set to 3, there will be two zero checks between each span check. This value may be set from 1 to 99, with 1 as default.

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. Refer to "Filter Replacement"on page 7-6.

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.

Thermoelectric Cooler Fins Inspection and Cleaning

Use the following procedure to inspect and clean the thermoelectric cooler fins.

1. Turn the instrument OFF and unplug the power cord.

2. Remove the PMT cooler from the instrument. Refer to "PMT Cooler Shroud Removal" on page 7-31.

3. Blow off the cooler fins using clean pressurized air. It may be more convenient to vacuum the cooler fins. In either case, make sure that particulate accumulation between the fins has been removed.

4. If necessary, use a small brush to remove residual particulate accumulation.

Capillaries Inspection and Replacement

The capillaries normally only require inspection when instrument performance indicates that there may be a flow problem.

Equipment Damage Some internal components can be damaged by small amounts of static electricity. A properly ground antistatic wrist strap must be worn while handling any internal component. ▲

Use the following procedure to inspect and replace the capillaries. This procedure can be used to check any or all of the capillaries.

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

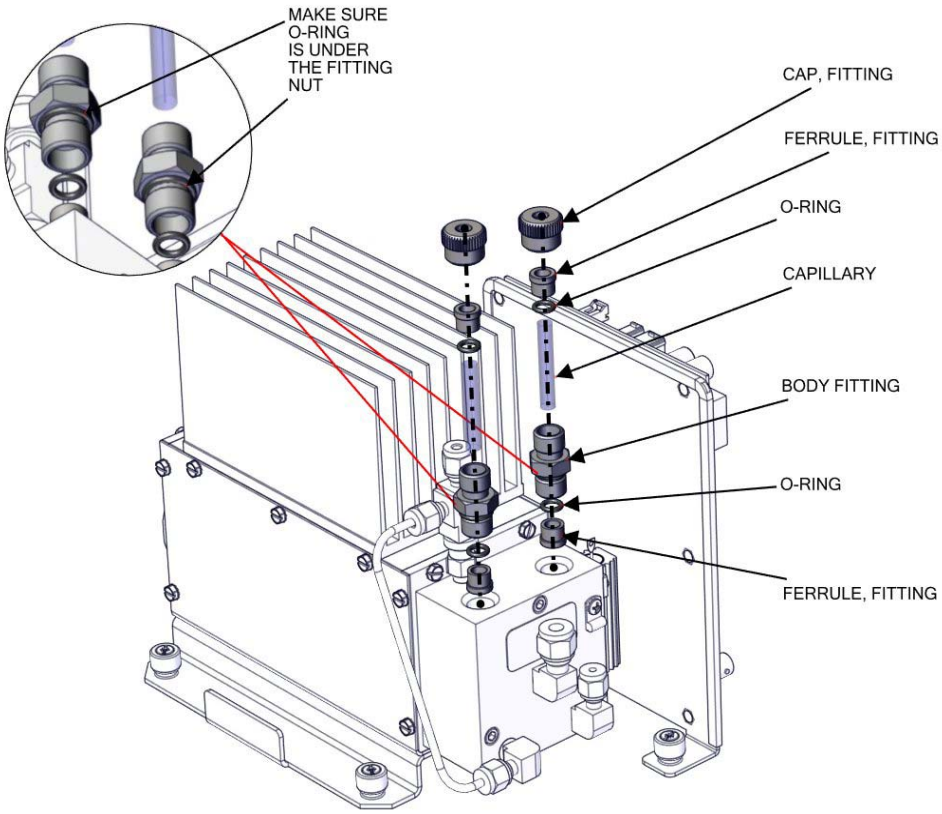


Figure 5–1. Inspecting and Replacing the Capillaries

2. Remove the fitting(s) from the reaction chamber body using a 5/8-inch wrench being careful not to lose the ferrule or o-ring.

3. Remove the glass capillaries, ferrule, and o-ring. Inspect o-ring for cuts or abrasion, and replace as necessary.

4. Check capillary for particulate deposits. Clean or replace as necessary.

5. Replace capillary in reaction chamber body, making sure the o-ring is around the capillary before inserting it into the body.

6. Replace fitting. Note that the fitting should be tightened slightly more than hand tight.

7. Reconnect tubing to top of fittings, being careful to insert ferrule and o-ring properly, and tighten knurled nut finger tight.

8. Re-install the cover.

9. Connect the power cord and turn the instrument ON.

Pump Rebuilding

Use the following procedure to rebuild the pump.

Equipment required:

Pump rebuild kit (qty. 2)

Allen wrench, 3 mm and 4 mm

Wrench, 9/16-inch

Needlenose pliers

1. Turn instrument off, unplug the power cord, and disconnect the pump plumbing from the instrument.

2. Note the orientation of the pump head top plate for later reassembly. Using a 3 mm Allen wrench, remove the eight socket head screws and washers securing the pump head top plate.

3. Discard the old PTFE gasket.

4. Note the orientation of the diaphragm head for later reassembly. Remove the diaphragm head. Using a 4 mm Allen wrench, remove the four socket head screws securing the diaphragm head to the pump body.

5. Insert the tips of blunt needlenose pliers in the dimples of the clamping disk, then loosen and remove the clamping disk.

6. Remove and discard the old PTFE gasket.

7. Insert the clamping disk into the new Teflon diaphragm (three pieces) and screw the clamping disk into the pump. Do not over tighten.

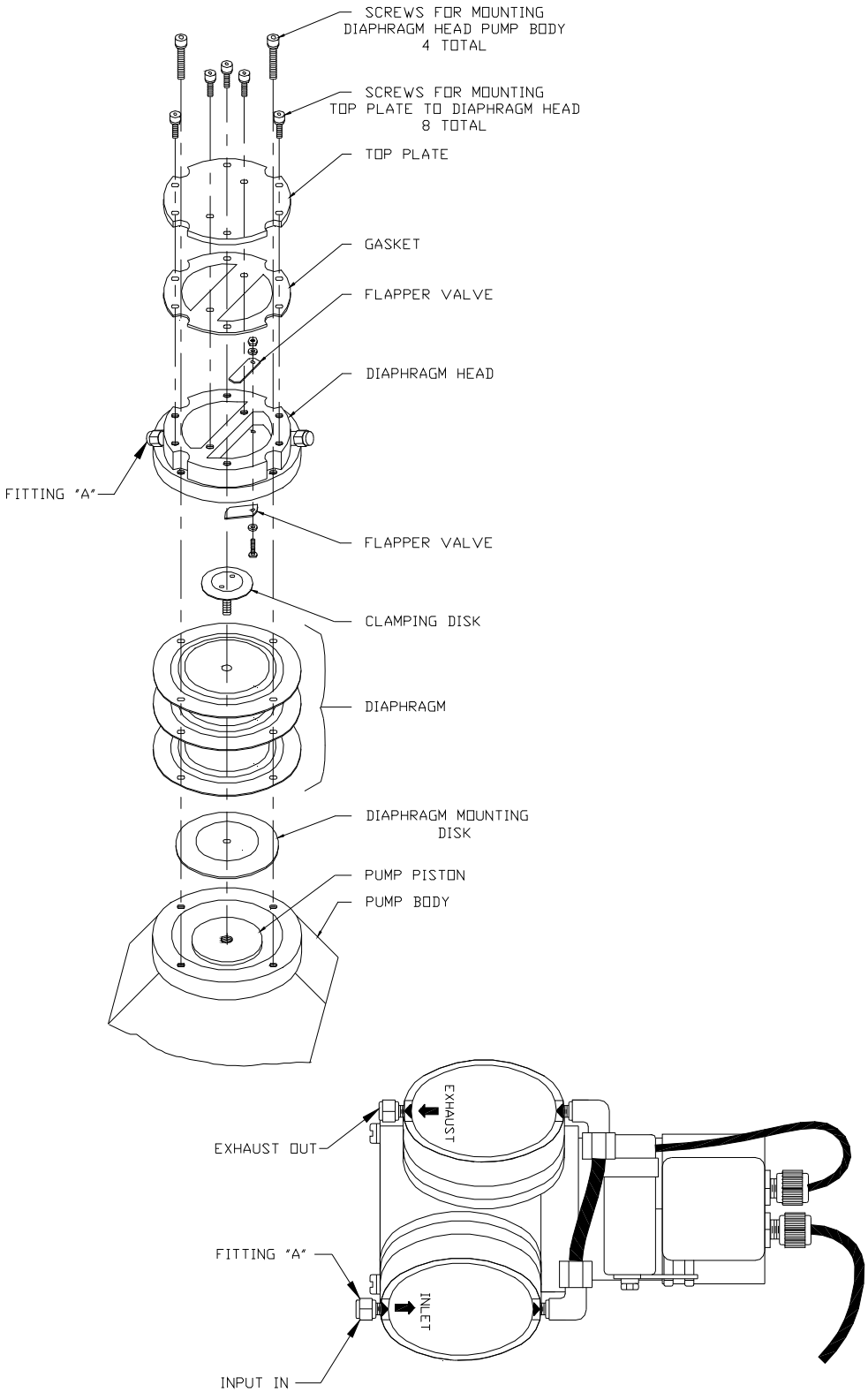


Figure 5–2. Pump Rebuilding

8. Remove the screw and nut securing the flapper valves and remove and discard old flapper valves.

9. Install the new flapper: check that the screw head and not the washer is on the smooth side of the pump, and check that the flappers are completely flat and straight.

10. Align the diaphragm head correctly as noted in Step 2, and secure with the four socket head screws.

11. Place the new PTFE gasket over the pump head so that the eight screws holes are aligned.

12. Replace the top plate and secure with the eight screws and washers being sure that the Teflon gasket stays in place.

13. Reconnect the plumbing to the instrument and plug in the pump power cord.

Leak Test

Use the following procedure to perform a leak test.

Equipment Required:

Swage Lock cap (sample port)

Small rubber cap (Perm Dryer filter)

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. Cap the filter at the end of the Perm Dryer.
4. Connect the vacuum tester tool to the EXHAUST bulkhead on the rear panel.
5. Squeeze trigger until gauge reads to pull in 10 in Hg.
6. 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

The troubleshooting guide presented in this chapter is designed to help isolate and identify instrument problems.

Safety Precautions

Read the safety precautions in Appendix A, "Safety, Warranty, and WEEE" 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 42iQHL 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. 42iQHL 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.
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 (Bypass option)	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.
No output signal (or very low output)	No sample gas reaching the analyzer	Check input sample flow.
	Ruptured pump diaphragm	Rebuild pump head.
	Blocked sample capillary	Unplug power cord. Clean or replace capillary.
	No ozone reaching the reaction chamber	Check the "Configuration" menu to see if the ozonator is ON. If it is ON, check dry air supply.
No output signal	Disconnected or defective input or high voltage supply	Unplug power cord. Check that cables are connected properly. Check cable resistance.
	Analyzer not calibrated	Recalibrate.
	Defective ±12 volt	Check supply voltages in Status and Alarms>Reaction Chamber screen
Calibration drift	Dryer to ozonator depleted	Replace.
	Line voltage fluctuations	Check to see if line voltage is within specifications.
	Defective pump	Rebuild pump.
	Unstable NO or NO_2 source	Replace.
	Clogged capillaries	Unplug power cord. Clean or replace capillary.
	Clogged sample air filter	Replace filter element.
Excessive noise	Defective or low sensitivity PMT	Unplug power cord. Remove PMT. Install known good PMT. Plug in power cord. Check performance.

Problem	Possible Cause	Action
	Defective cooler	Check temperature (less than -2 °C at T_{amb} = 25 °C).
Non-linear response	Incorrect calibration source	Verify accuracy of multipoint calibration source gas.
	Leak in sample probe line	Check for variable dilution.
Excessive response time	Partially blocked sample capillary	Unplug power cord. Clean or replace capillary.
	Hang up/blockage in sample filter	Change element.
Improper converter operation	Questionable calibration gas	Verify accuracy.
	Converter temperature too high or too low	Temperature should be 625 °C for stainless steel.
	Low line voltage	Check to see if line voltage is within specifications.
Alarm – Instrument Temperature	Fan failure	Replace fan if not operating properly.
	Dirty fan filter	Clean or replace filter.
	Overheating PCB	Locate defective PCB reporting the error and replace if needed.
Alarm – Bench Temperature	Heaters failed	Replace heaters as needed.
	Defective PCB	Replace PCB.
Alarm – Cooler Temp Sensor	Check fan operation	Replace defective fan.
	Check fan filter	Clean or replace filter.
	Bad thermistor	Replace thermistor.
Alarm – NO_2 Converter Temperature	Converter temperature low	Stainless steel converter should be hot to the touch. If not, the heater may have failed. Check that converter temperature setpoint is approximately 625 °C.
Alarm – Pressure	High pressure indication	Check plumbing for leaks.
		Check the pump for a tear in the diaphragm.
		Replace if needed.
		Check the capillary is properly installed and o-rings are in good shape.
Alarm – Flow	Flow low	Check sample capillary for blockage. Replace as necessary.

Problem	Possible Cause	Action
		If using sample particulate filter, make sure it is not blocked. Disconnect sample particulate filter from the sample bulkhead. If flow increases, replace the filter.
	Flow high	When delivering zero air or gas to the instrument, use an atmospheric dump.
	Flow = 0 LPM	Check that Step POL board #1 has both dip switch settings of SW2 off (both facing the rear of the instrument). Verify the pump is plugged into the Step POL board.
	Worn Diaphragm	Rebuild pump every 12 months or as needed.
Alarm – Ozonator Flow	Ozone flow low	Check ozone capillary for blockage. Replace as necessary.
Alarm – NO, NO_2, NO_x Concentration	Concentration has exceeded range limit	Check to ensure range corresponds with expected value. If not, select proper range.
		Check user-defined low set point; set to zero.
Alarm – Board Communication	Cable connection	Check that DMC cable is connected properly. Reseat if needed.
	Defective DMC PCB	Replace DMC board.
Alarm – Power Supply	Cable connection	Check that DMC cable is connected properly. Reseat if needed.
	Defective component	Check for other alarms, as it is possible that another component of that DMC is drawing too much current.
	Defective DMC PCB	Replace DMC board.
Alarm – Module Temperature	Cable connection	Check that DMC cable is connected properly. Reseat if needed.
	Other alarm	Make sure the instrument temperature is not too high or in alarm.
	Defective DMC PCB	Replace DMC board.
Alarm – 5V/24V Step Board	Cable connection	Check the cable connections to that Step POL board.

Problem	Possible Cause	Action
Alarm – Analog I/O	Defective PCB	Replace Analog board.
Alarm – Digital I/O	Defective PCB	Replace Digital board.
Alarm – NO Bkg Check Offset	Incorrect high alarm limit	Verify the high limit is correct via Settings>Status and Alarms>Concentrations screen.
	Instrument background calibration failed	Recalibrate the instrument.
Alarm – NO Span Check Offset	Incorrect high alarm limit	Verify the high limit is correct via Settings>Status and Alarms>Concentrations screen.
	Instrument span calibration failed	Recalibrate the instrument.
Alarm – Ambient Thermistor	Defective Flow/Pressure board	Replace defective DMC board as needed.
Alarm – Chamber Pressure	Defective Flow/Pressure board	Replace defective DMC board as needed.
Alarm – Bench Temperature Short	Cable connection	Check the cable connection from the heater to the DMC board.
	Broken wire	Verify the wires are properly connected to both sides of the heater.
	Defective heater	Replace heater as needed.
	Defective DMC board	Replace defective DMC board as needed.
Alarm – Bench Temperature Open	Cable connection	Check the cable connection from the heater to the DMC board.
	Broken wire	Verify the wires are properly connected to both sides of the heater.
	Defective heater	Replace heater as needed.
	Defective DMC board	Replace defective DMC board as needed.
Alarm – Cooler Current too Low	Defective cooler	Replace cooler as needed.
	Defective DMC board	Replace DMC board as needed.
Alarm – Cooler Current too High	Defective cooler	Replace cooler as needed.
	Defective DMC board	Replace DMC board as needed.
Alarm – Cooler Voltage too Low	Defective cooler	Replace cooler as needed.
	Defective DMC board	Replace DMC board as needed.

Problem	Possible Cause	Action
Alarm – Cooler Voltage too High	Defective cooler	Replace cooler as needed.
	Defective DMC board	Replace DMC board as needed.
Alarm – PMT Voltage too Low	Defective PMT	Replace PMT as needed.
	Defective DMC board	Replace DMC board as needed.
Alarm – PMT Voltage too High	Defective PMT	Replace PMT as needed.
	Defective DMC board	Replace DMC board as needed.
Alarm – Frequency too Low	Input board is out of calibration	Recalibrate the Input board.
Alarm – Frequency too High	Input board is out of calibration	Recalibrate the Input board.

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 42iQHL subassemblies.

Safety Precautions

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

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

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

⚠CAUTION **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. ▲

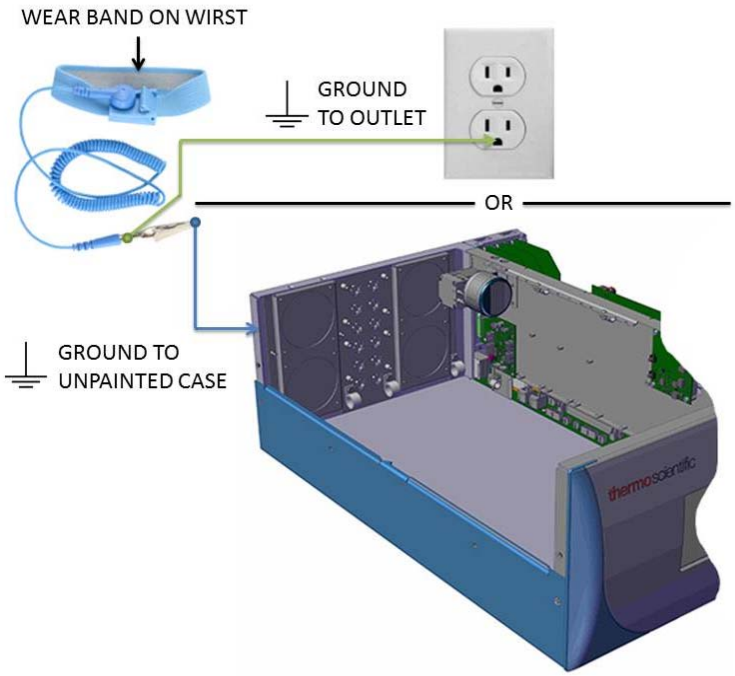


Figure 7–1. Properly Grounded Antistatic Wrist Strap

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:

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:

www.thermofisher.com/42iQHL

Refer to Figure 7–2 and Figure 7–3 to identify the component location.

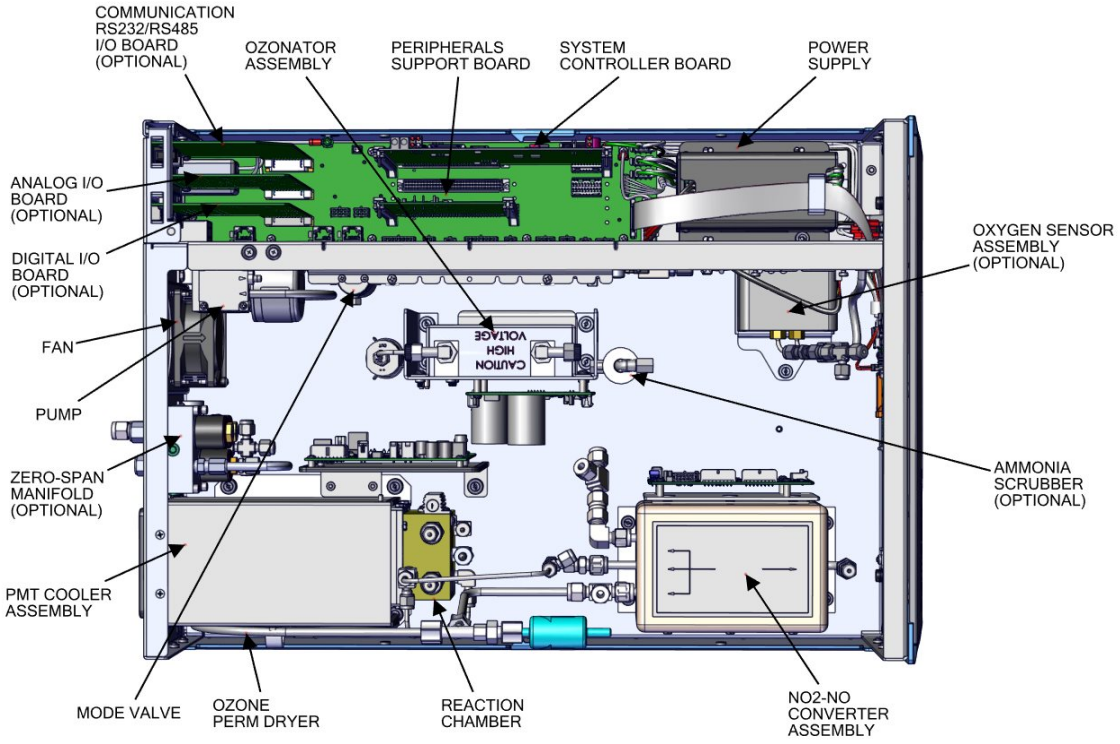


Figure 7–2. 42iQHL Component Layout Top View

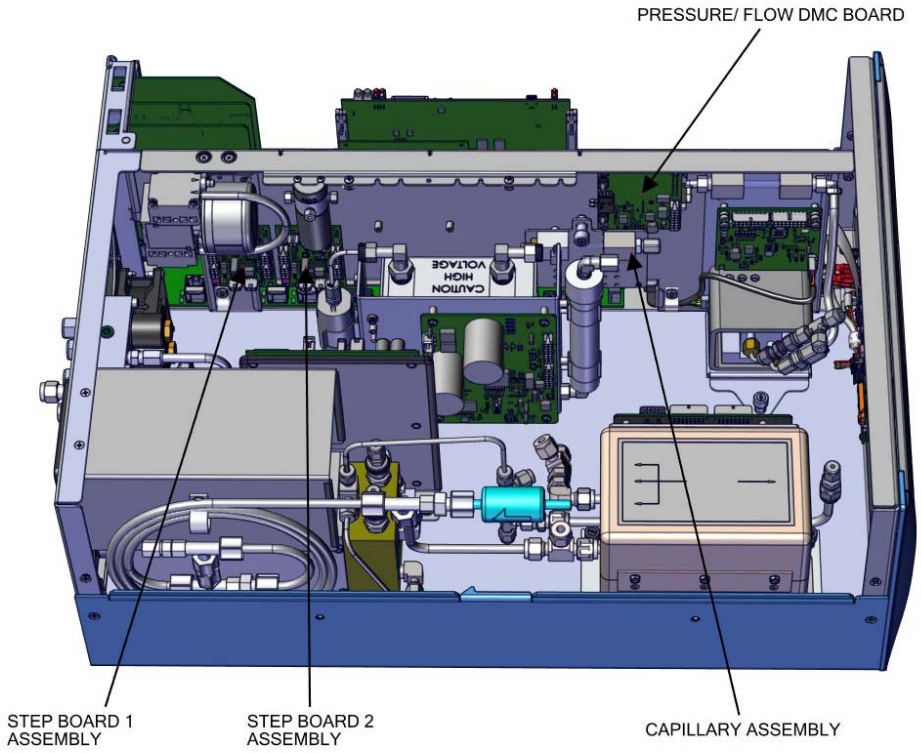


Figure 7–3. 42iQHL Component Layout Side View

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.

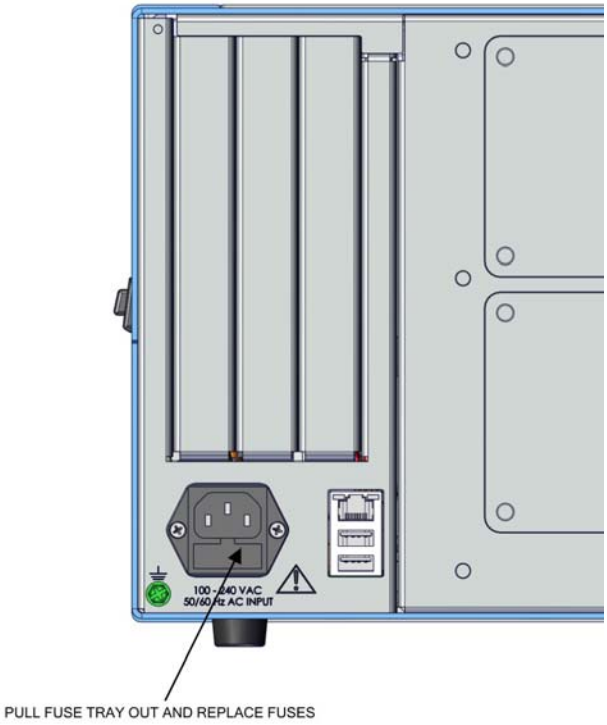


Figure 7–4. Replacing the Fuses

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.

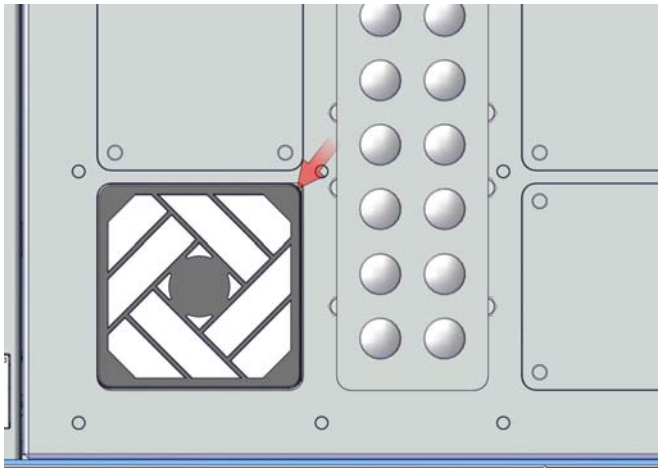


Figure 7–5. Start with Top Right Corner of Fan Cover

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

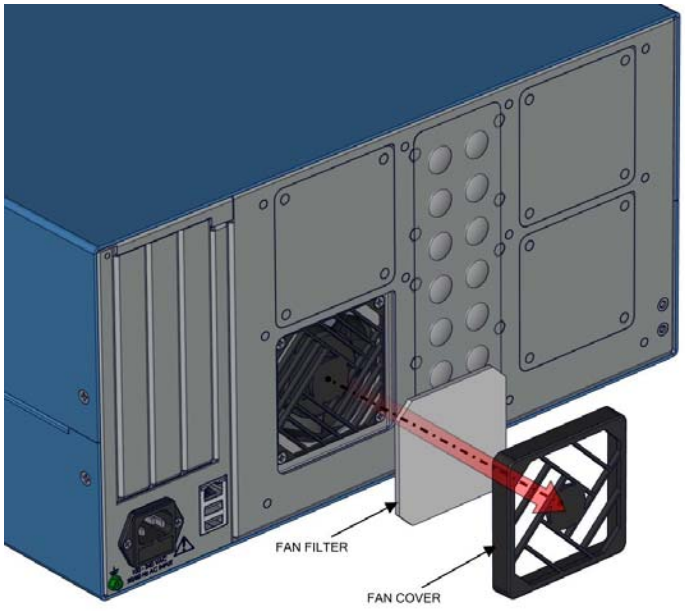


Figure 7–6. Removing the Fan Cover

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.

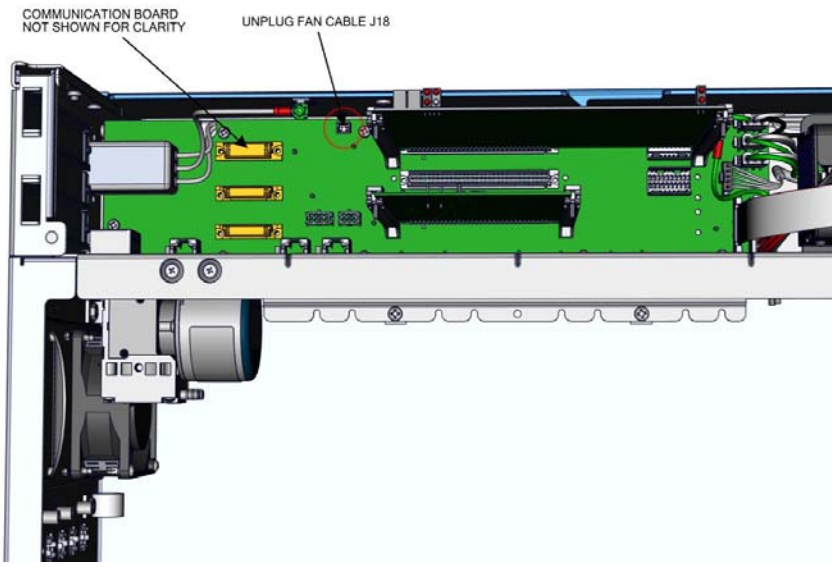


Figure 7–7. Unplugging the Fan Cable

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.

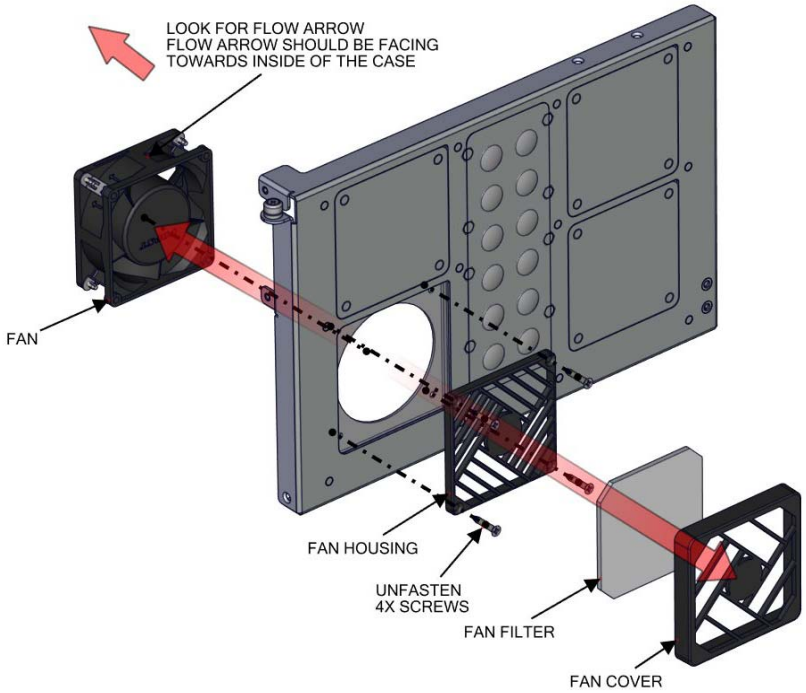


Figure 7–8. Replacing the Fan

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.

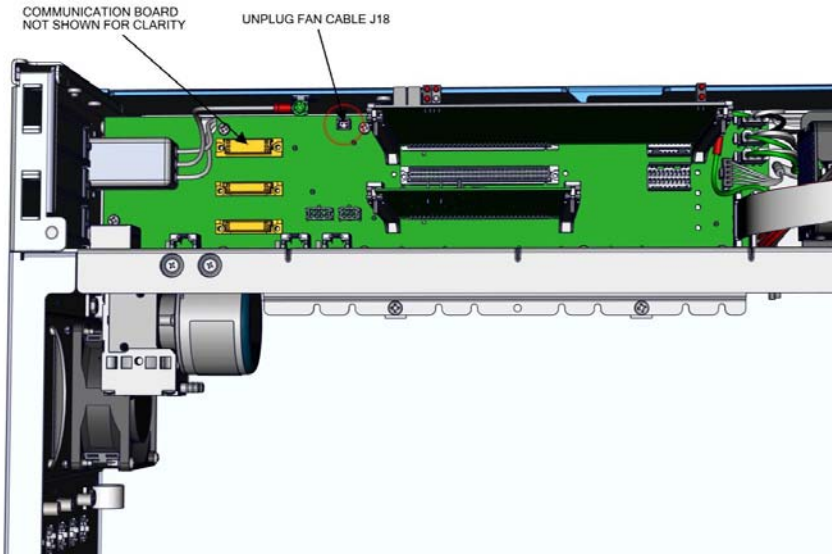


Figure 7–9. Unplugging the Fan Cable

3. Unplug DMC cable.

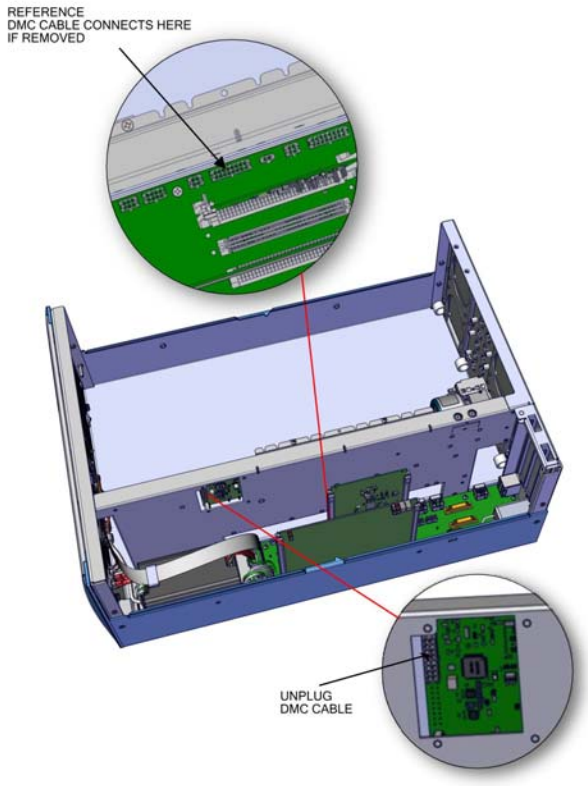


Figure 7–10. Unplugging the DMC Cable

4. Gripping from the top corners of the front panel and pull outwards.

5. Remove three 8-32 flat head screws.

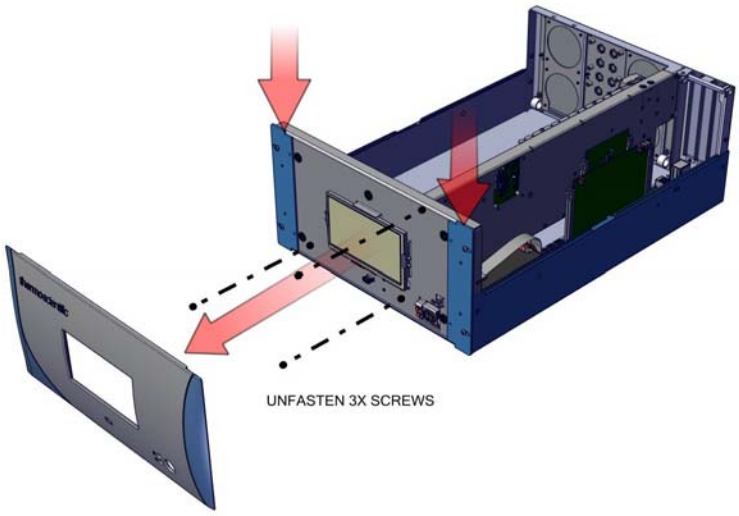


Figure 7–11. Unfasten Hardware Front for Measurement Side Removal

6. Swing arm open.

7. Unfasten captive hardware.

8. Remove two 8-32 flat head screws.

9. Pull measurement side out.

10. Replace and reassemble in reverse order.

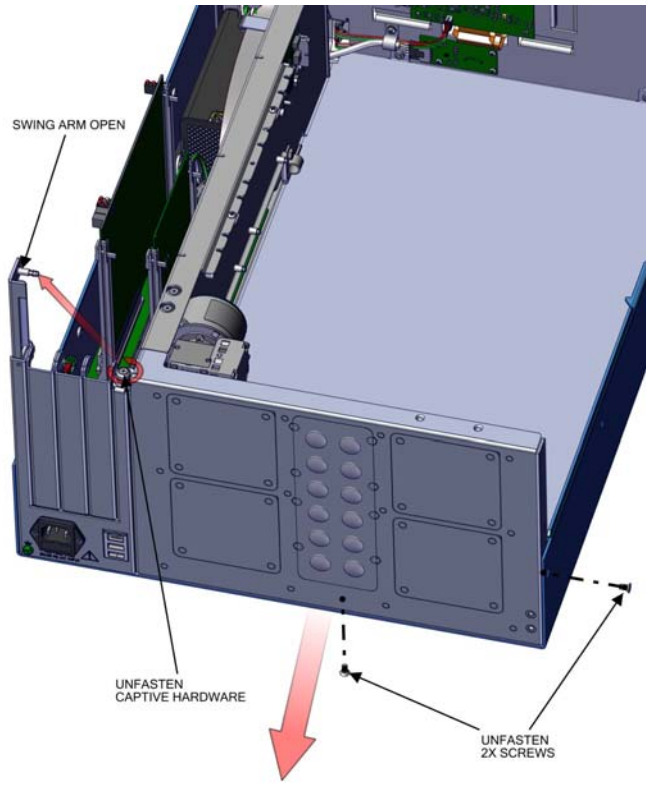


Figure 7–12. Unfasten Hardware Rear for Measurement Side Removal

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.

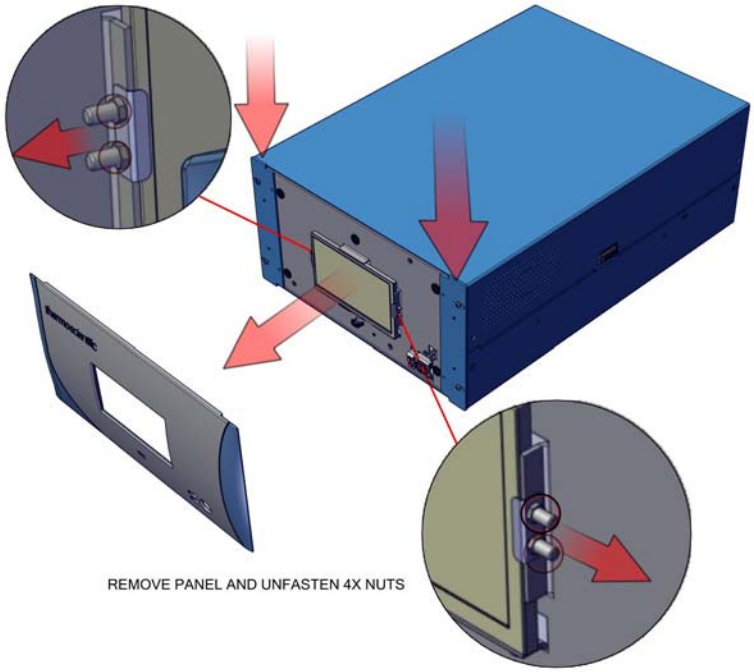


Figure 7–13. Replacing the LCD Module

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

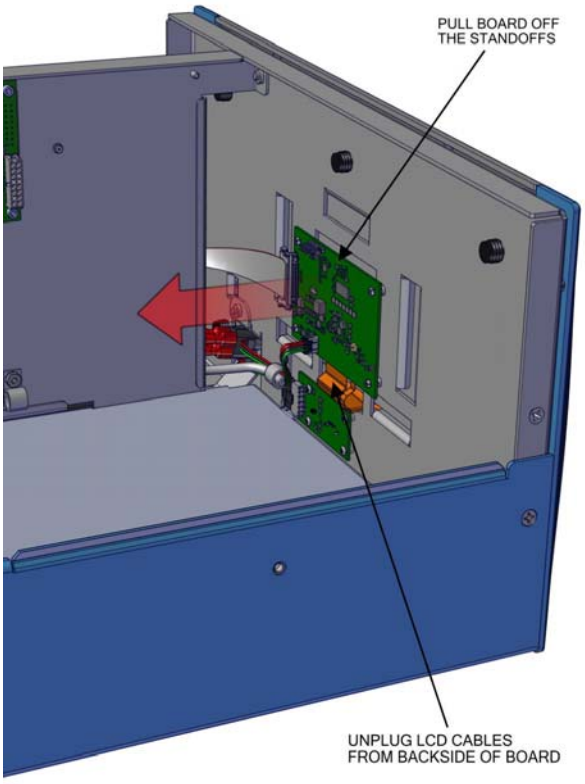


Figure 7–14. Remove Electrical Cables from LCD

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.

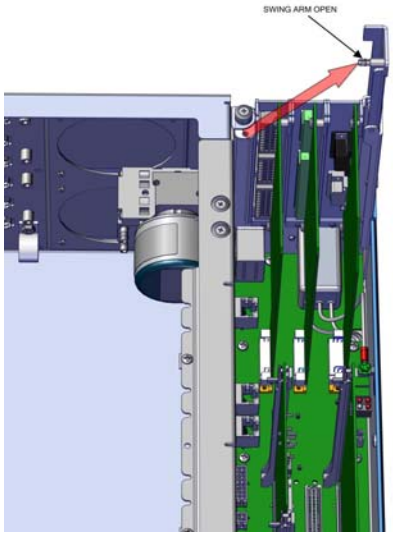


Figure 7–15. I/O Replacement, Arm

3. Pull board upwards.

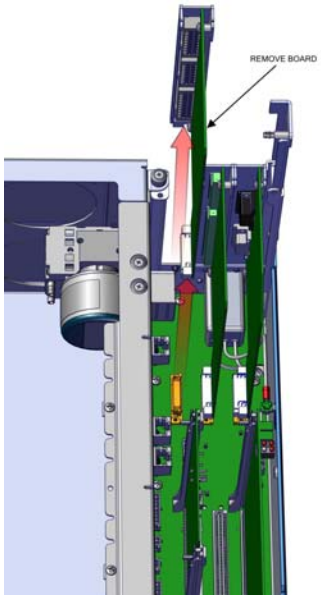


Figure 7–16. I/O Replacement, Remove Board

4. During install, make sure to align cutout circular to keyway.

5. Insert board downwards.

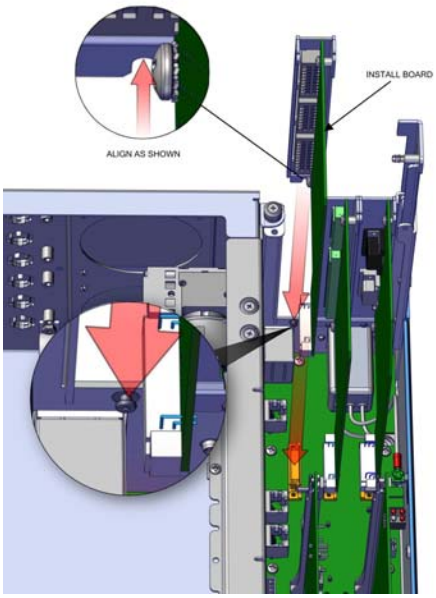


Figure 7–17. I/O Replacement, Install

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

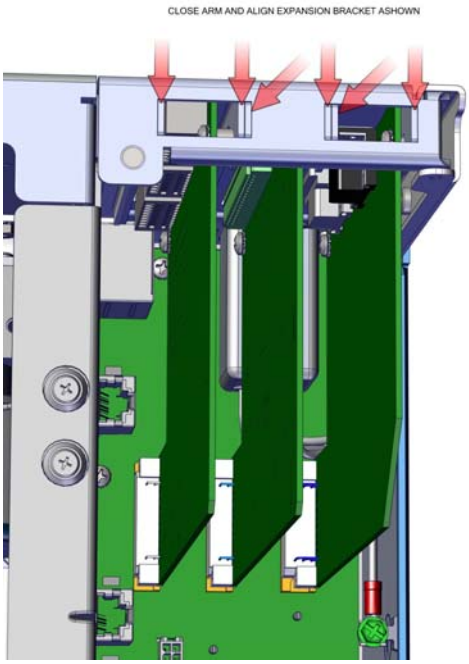


Figure 7–18. I/O Replacement, Close Arm Alignment

Peripherals Support Board and System Controller Board Replacement

Use the following procedure to replace the peripherals support board or system controller board.

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

2. Pull tab out (two per board).

3. Pull board out.

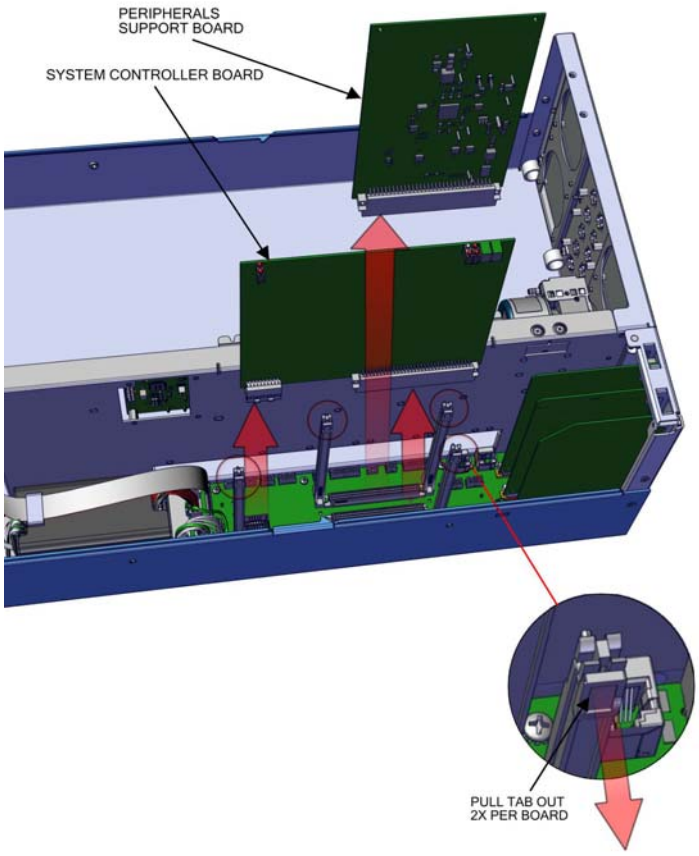


Figure 7–19. Replacing the Peripherals Support or System Controller Board

4. 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.

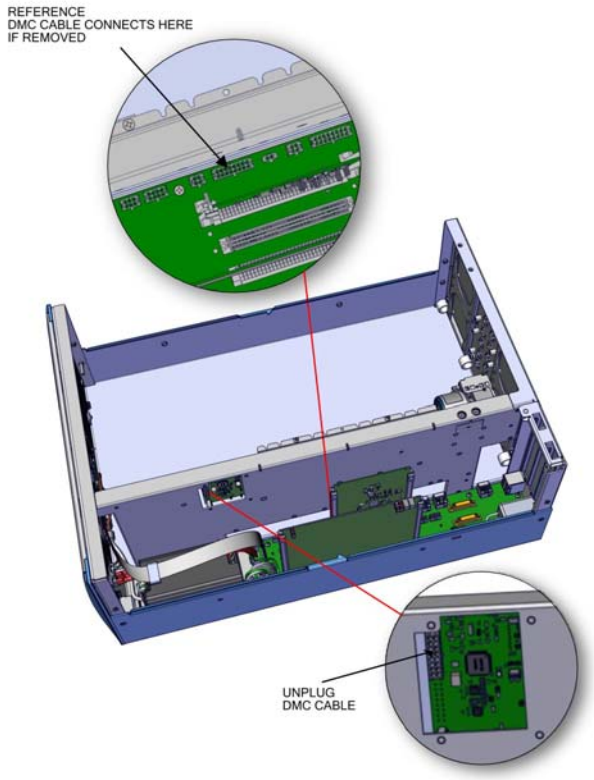


Figure 7–20. Flow Pressure Board, Disconnect DMC Cable

3. Disconnect plumbing.

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

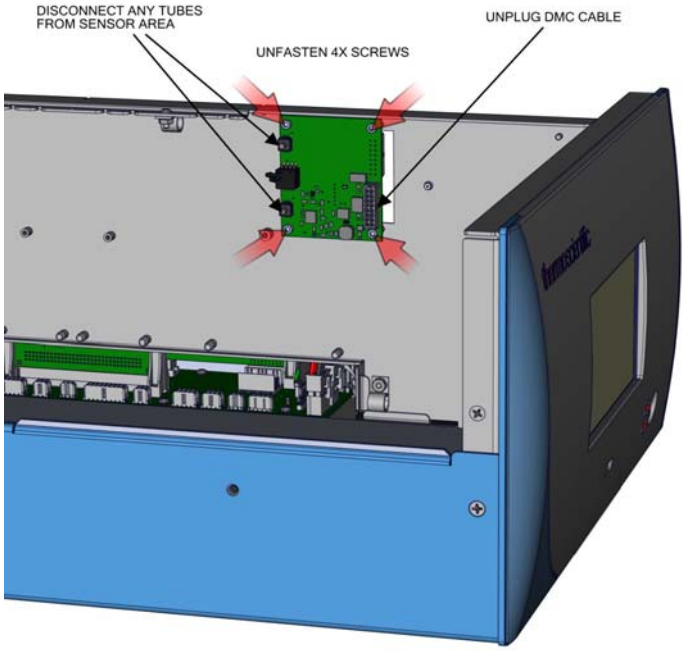


Figure 7–21. Flow Pressure Board, Screws

5. Replace board and reassemble in reverse order.

Pump Replacement

Use the following procedure to replace the pump.

Equipment required:

110V pump or 220V pump

1. Disconnect the pump power line from the AC power outlet.

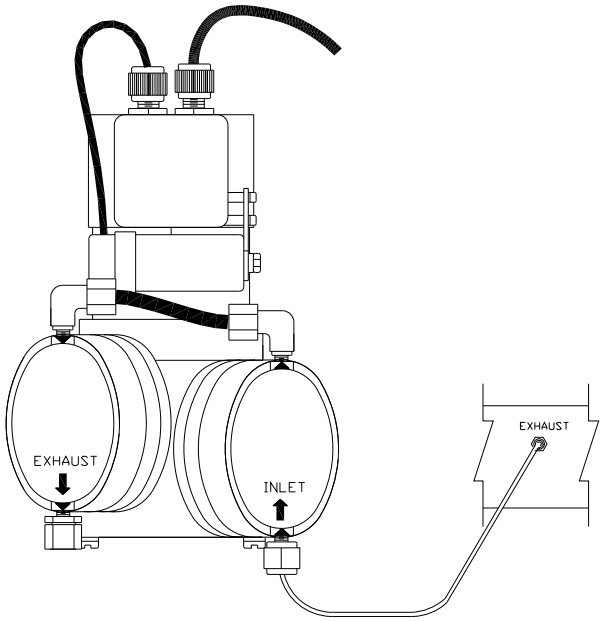


Figure 7–22. Replacing the Pump

2. Remove both inlet and exhaust lines from the pump

3. Install the new pump by following the previous steps in reverse.

Vacuum Pump Diaphragm and Valve Replacement

Use the following procedures to replace the diaphragm and valve for the vacuum pumps.

Equipment Required:

Allen wrench, 4 mm

Nut driver, 7/32-inch or 5.5 mm

Allen wrench, 3 mm

Spanner wrench, 3.8 mm diameter by 4.5 mm long inserts

Small flat-blade screwdriver

Large flat-blade screwdriver

Cleaning agent (alcohol)

Fine-grade steel wool

"LOC-TITE" blue breakable thread adhesive

Diaphragm Replacement

Use the following procedure to replace the diaphragm (Figure 7–5).

1. Undo the four socket head cap screws and washers ("C") for each head and lift off the heads with tubing from the pump body. Keep the heads connected if at all possible: disconnecting and then reconnecting the PTFE tube can cause leaks.

2. Check for smooth opening and closing of the reed valves ("Q"): a number of sets of diaphragms can be replaced before there is a need to replace the valves. Follow the instructions for "valve replacement" if changing of the valves is required.

3. Use the spanner wrench to loosen and remove the one-piece clamping disc/screw ("E"). Remove the old diaphragms from both heads ("G").

4. Remove the four pan head screws with M5 washers ("J") and remove the housing cover ("K") from the front of the pump body. If necessary,

carefully use a small flat-bladed screwdriver to pry-off the housing cover.

5. Install the two PTFE (white color) diaphragms together with one TFM (translucent) diaphragm as shown in Figure E-1. Install with the ridges of the diaphragm convolutions as shown in the diaphragm stack cross-section inset.

6. Temporarily insert two of the head screws through the diaphragms and screw into the pump body to keep the position of the diaphragms as the clamping disc is tightened. Any stress applied re-aligning the diaphragm in the process of assembling the head will significantly reduce diaphragm life

7. Check the threads of the clamping disc to insure that they are clean and free of debris. Apply a small amount of the breakable thread adhesive to the clamping disc threads and install.

8. Rotate the counterweight until the connecting rod is in mid-stroke and then tighten the clamping disc. Do not over tighten the clamping disc.

Note Over tightening of the clamping disc will significantly reduce diaphragm life. Tighten enough to avoid contact with the head. If a significant amount of torque is required to tighten, first re-check to see if the threads are clear, then check that the connection rod support disc (“H”) is properly seated on the connection rod. Over-torque of the clamping disc must never be a way to avoid contact with the head. ▲

9. Remove the two temporary aligning screws and re-install the heads on to the pump body. The correct head bolt torque range is 20-30 inch-pounds.

10. Turn the counterweight (“M”) through at least one full revolution to check for smooth operation.

11. Re-install the housing cover and check the pump for correct performance.

Valve Replacement

Use the following procedure to replace the valve.

1. With the head off the pump, unscrew the socket head cap screws with M4 lock washers (“S”) to remove the head lid (“T”) and gasket (“V”).

2. Loosen the single pan head screw, washers and nut (“P”) and remove the two stainless steel reed valves (“Q”). If necessary, hold the nut in place with a nut-driver.

3. Lightly clean the valve seat area of debris or deposits with fine-grade steel wool. This area must be clean and smooth, without pits or scratches. Do not scratch the head plate. Finish the cleaning with alcohol and then air-dry the parts.

4. Lay the two replacement reed valves on a flat surface to the direction of any slight bend.

5. Lay the replacement reed valves in place, center bowed out (see valve installation), and tighten the pan head screw, both washers, and the nut. Be certain that the reed valves lay straight and smooth with clearance from the recessed edge to prevent sticking. If a reed valve curves away from the valve hole, remove the screw, flip the valve over and reinstall.

6. Match the holes of the PTFE head gasket (“V”) with the head seal surface, install the head lid, and tighten the two center bolts with M4 lock washers first and then cross alternate tightening of the perimeter bolts. Re-tighten the two center bolts after the other bolts are tight.

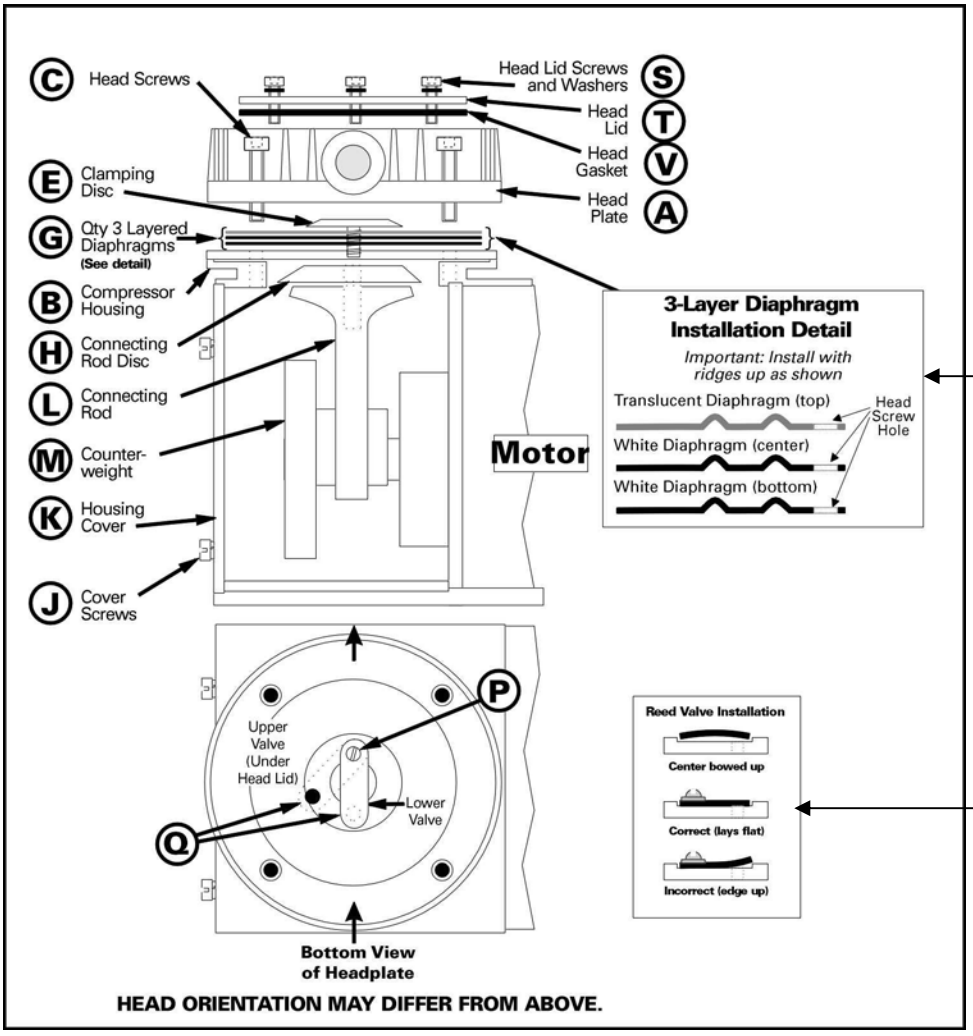


Figure 7–23. Vacuum Pump – Head Plate and Motor View

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. Using #2 Phillips drive, unfasten captive hardware.

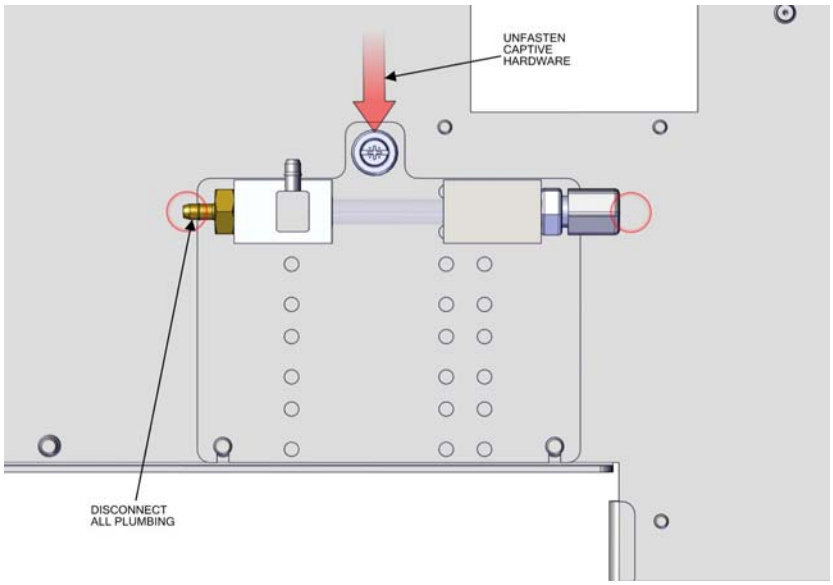


Figure 7–24. Remove Capillary, Disconnect and Unfasten

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

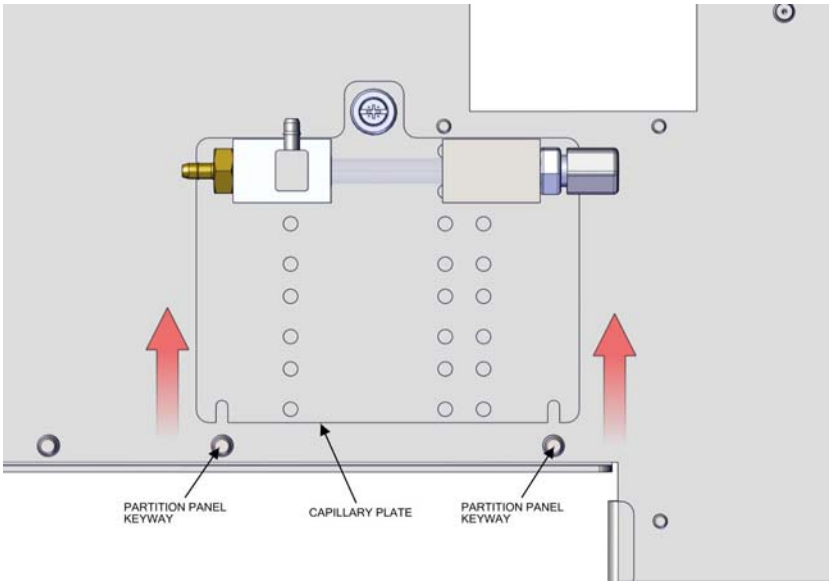


Figure 7–25. Capillary Plate, Keyway

5. Using 7/64 hex drive, remove four #6-32 socket cap head screws.

6. Pull apart the capillary blocks.

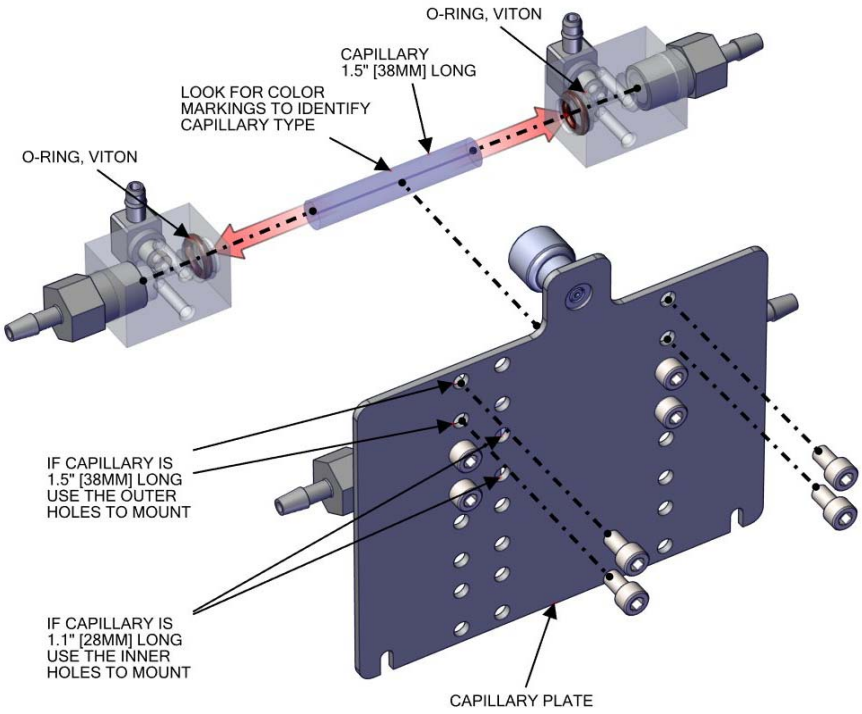


Figure 7–26. Capillary and O-Ring Replace

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 7–26. ▲

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.

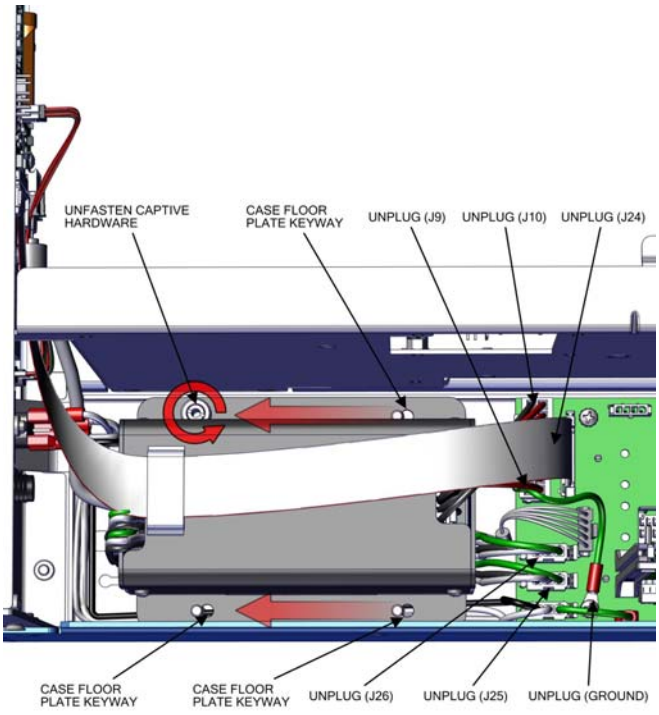


Figure 7–27. Removing Power Supply

5. Pull power supply up.

6. Replace power supply and reassemble in reverse order.

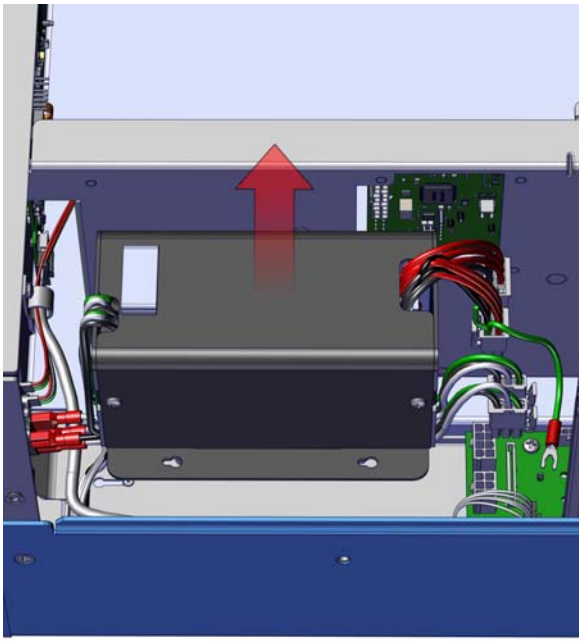


Figure 7–28. Replacing Power Supply

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.

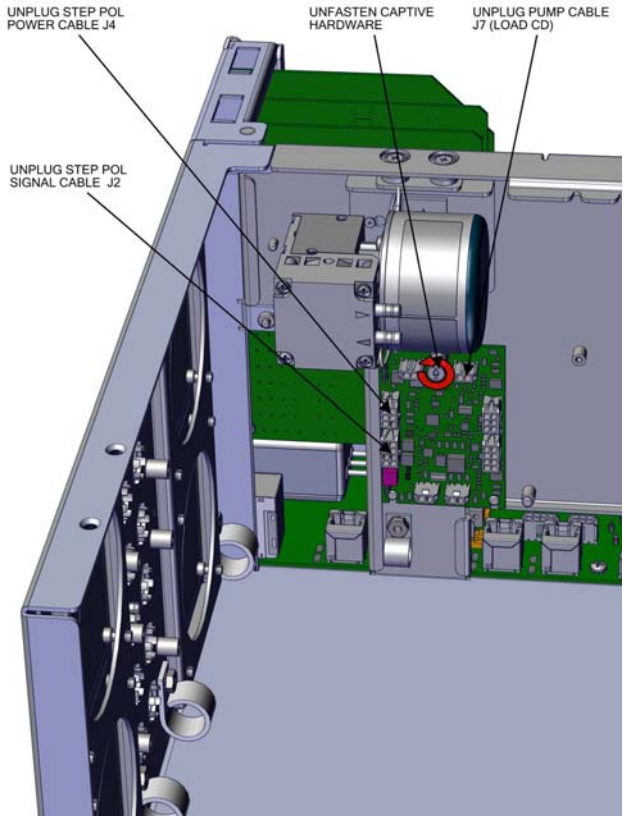


Figure 7–29. Unplug and Unfasten Step POL Board

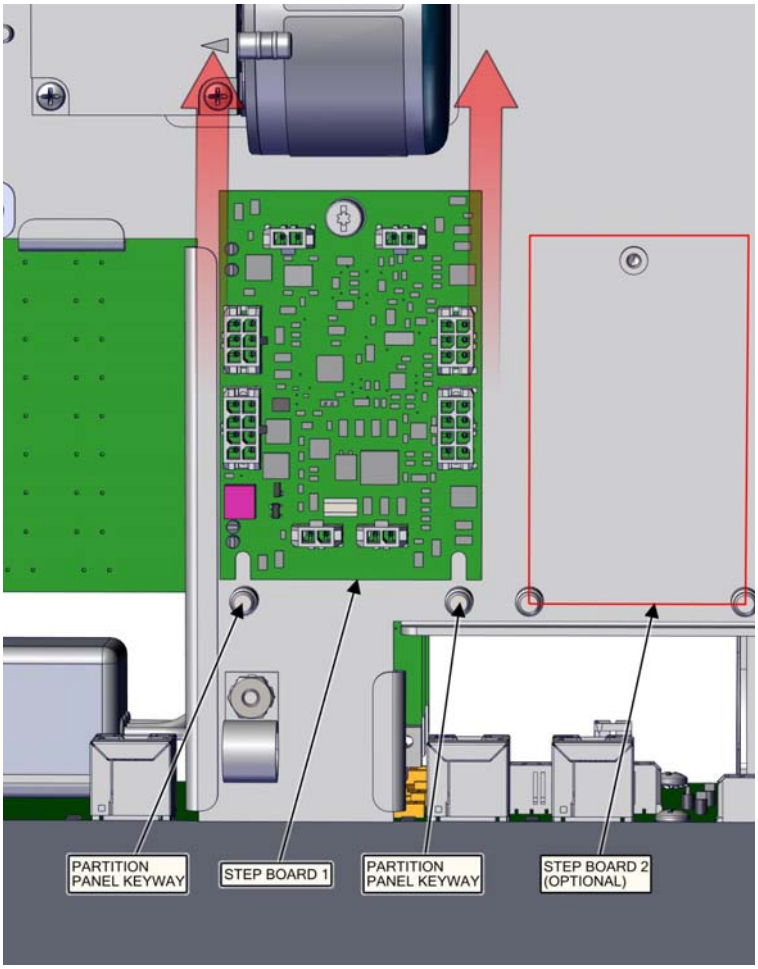


Figure 7–30. Clear Partition Keyway Step POL Board

6. Slide step board 1 upwards clearing the partition panel keyway.

   If replacing step board 1, make sure switch 1 and 2 are pointed away from ON (Figure 7–31). If replacing optional step board 2, make sure switch 1 is pointed towards ON and switch 2 is pointed away from ON (Figure 7–32).

7. Replace Step POL board and reassemble in reverse order.

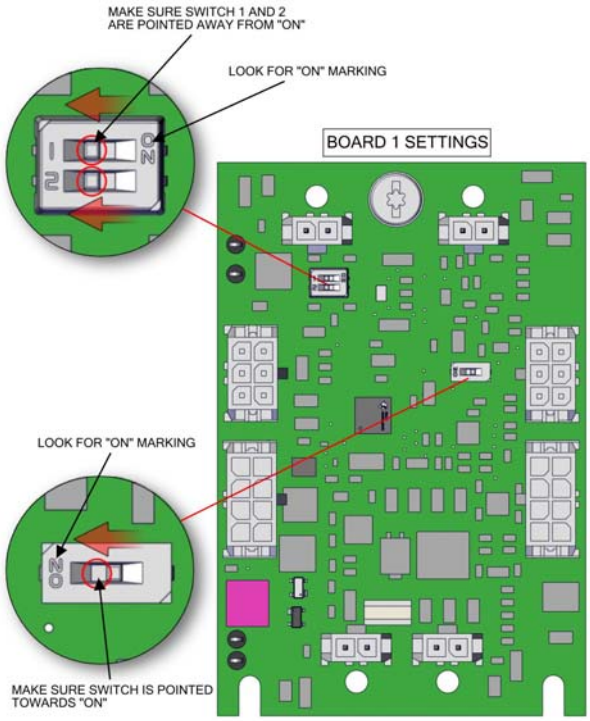


Figure 7–31. Step POL Board 1 Switch Settings

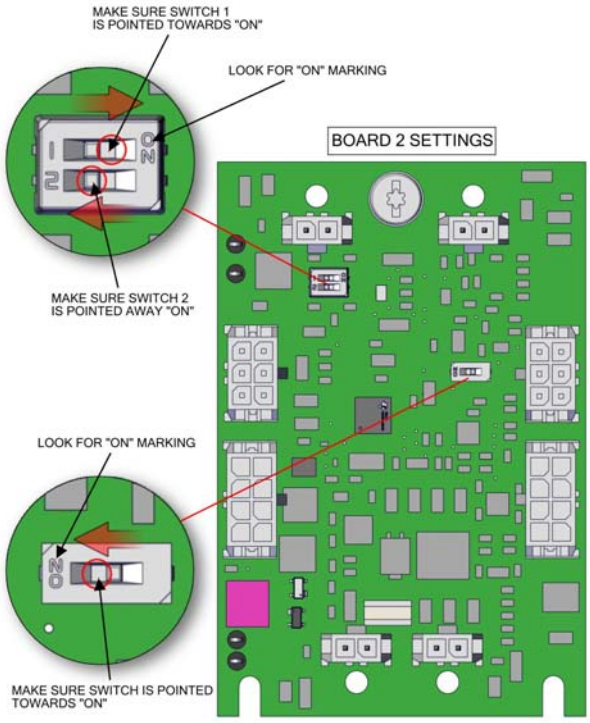


Figure 7–32. Step POL Board 2 Switch Settings

DMC PMT Cooler and Reaction Chamber Replacement

Use the following procedure to replace the PMT cooler and clean or replace the reaction chamber assembly.

- Remove the PMT Cooler
- Replacing the PMT board
- Removing and Cleaning the Reaction chamber
- Replacing the PMT Cooler and Reaction chamber
- PMT Replacement

PMT Cooler Shroud Removal

Use the following procedure to remove the PMT cooler from the instrument.

Equipment Required:

Phillips drive, #2

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

⚠WARNING Make sure the PMT has cooled down before touching. ▲

2. Unhook plumbing by pulling loop downwards and unhook tubing.

3. Using a #2 Phillips drive, unfasten two 6-32 flat head screws.

4. Pull shroud outwards.

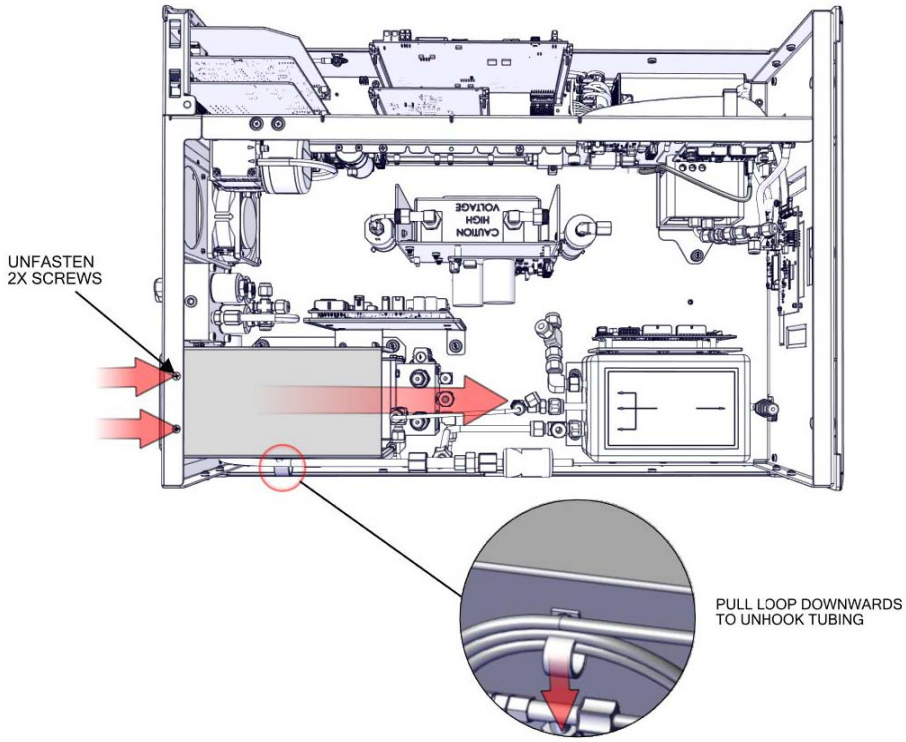


Figure 7–33. Remove PMT Cooler Shroud

5. Unplug J3, J1, and J6 (fan).

6. Disconnect all plumbing depending on the options. Configuration plumbing connections will vary.

7. Using #2 Phillips drive, unfasten four captive hardware.

8. Pull PMT cooler upwards.

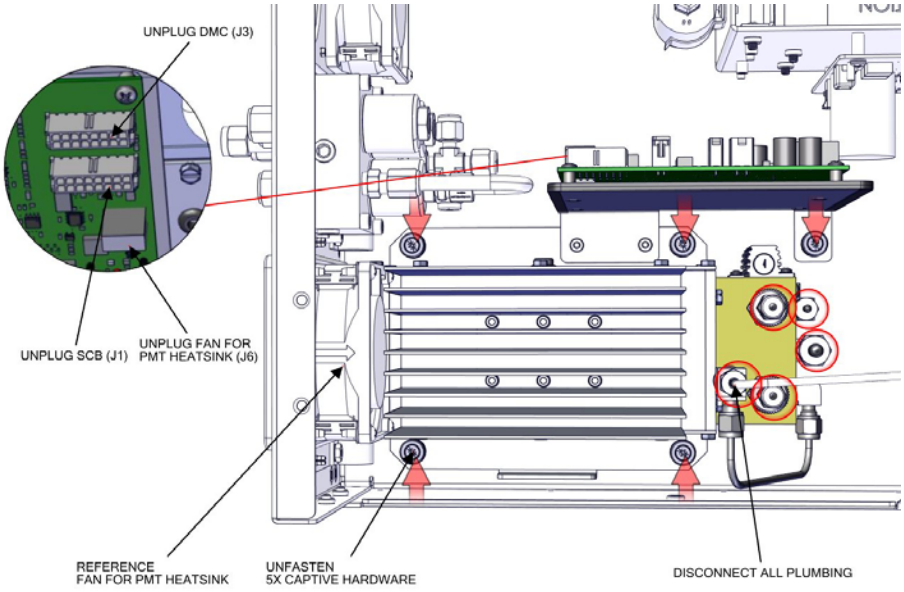


Figure 7–34. Remove PMT Cooler

PMT Cooler Board Replacement

Use the following procedure to replace the PMT cooler board.

Equipment Required:

Phillips drive, #2

1. Turn the instrument OFF, unplug the power cord, and remove the cover.
2. Remove DMC Converter as described in "PMT Cooler Shroud Removal" in this chapter.
3. Unplug all electrical connections from the board.
4. Using a #2 Phillips drive, unfasten six #6-32 pan head screws.
5. Pull board outwards.

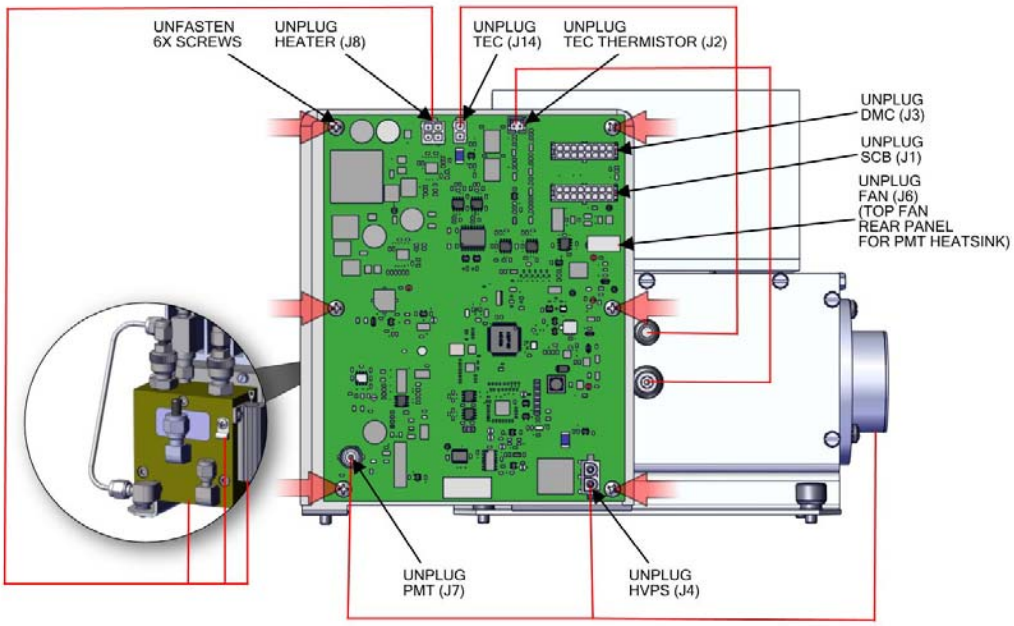


Figure 7–35. Remove PMT Cooler Board

Reaction Chamber Cleaning and/or Removal

Use the following procedure to clean or remove the reaction chamber.

Equipment Required:

Phillips drive, #2

1. Turn the instrument OFF, unplug the power cord, and remove the cover.

2. Remove cooler/reaction chamber DMC as described in "PMT Cooler Shroud Removal" in this chapter.

3. Unplug heater J8 from board.

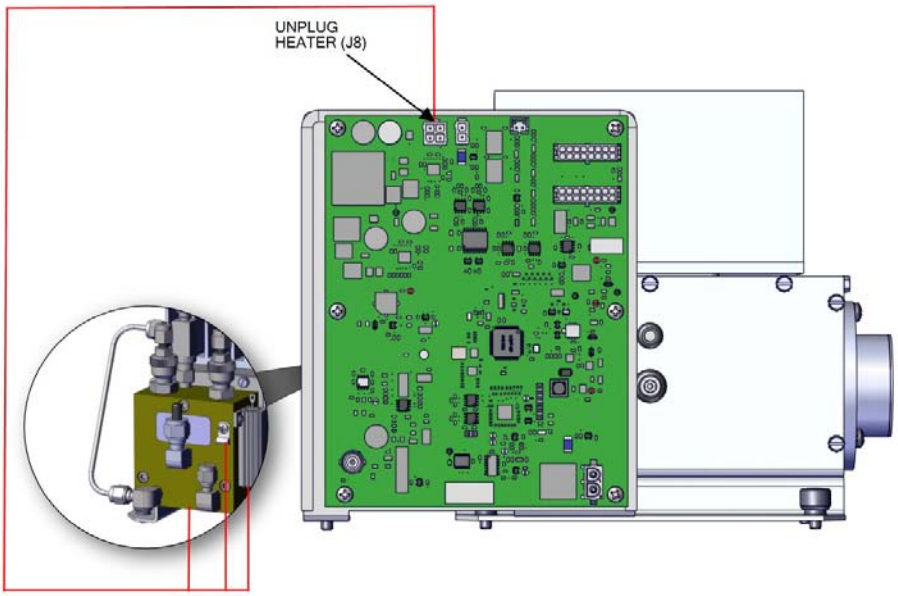


Figure 7–36. Photo Reaction Chamber Cleaning, Electrical

4. Disconnect plumbing as shown.

5. Using a 9/64-inch hex drive, unfasten three #8-32 socket cap head screws.

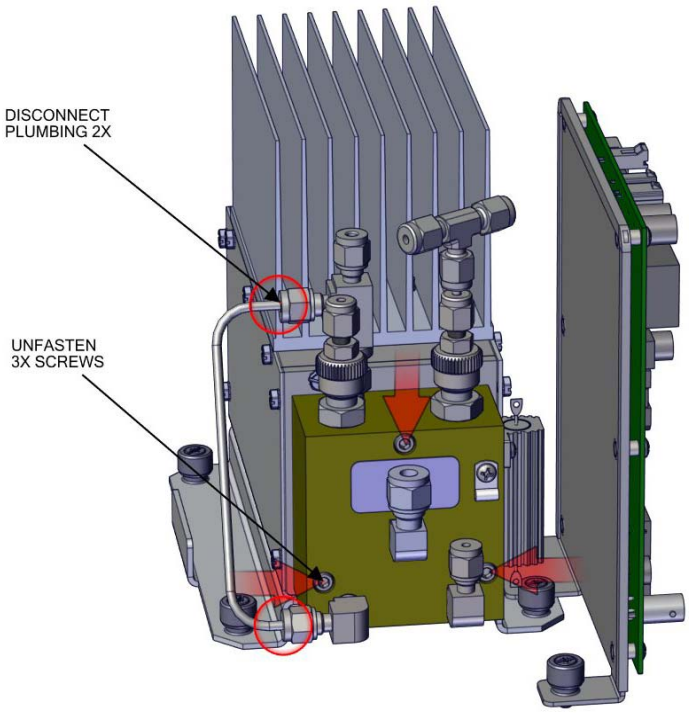


Figure 7–37. Photo Reaction Chamber Cleaning, Hardware

6. Pull reaction chamber outwards.

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 an internal component. ▲

7. To reinstall reaction chamber, follow previous steps in reverse, making sure to back fill the cooler with dry air or nitrogen prior to installing reaction chamber.

8. Reinstall the measurement bench. Refer to Figure 7–36 and Figure 7–37.

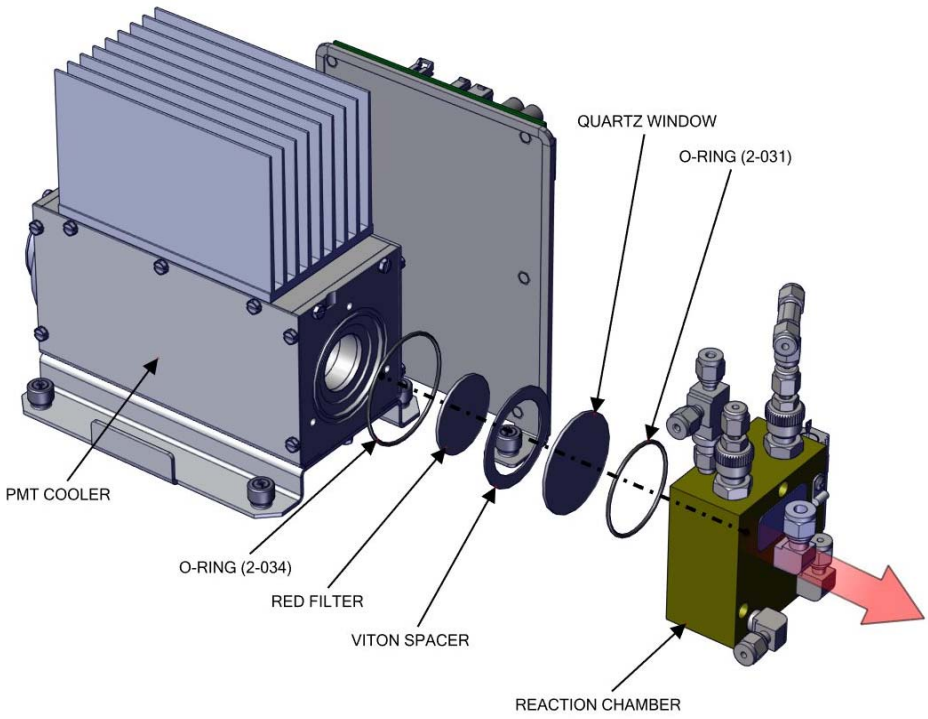


Figure 7–38. Photo Reaction Chamber Cleaning, Window

Photomultiplier Tube (PMT) Replacement

Use the following to replace the photomultiplier tube (PMT).

Equipment Required:

Screwdriver, flat head

Phillips drive, #2

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

2. Unplug electrical connections PMT (J7) and HVPS (J4).

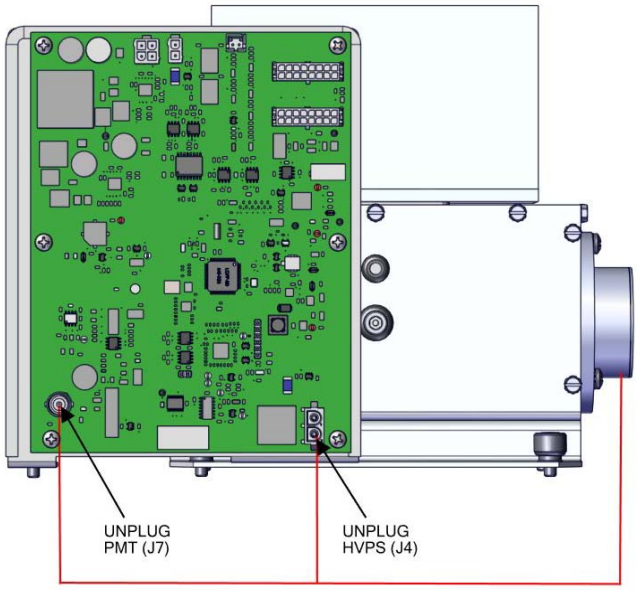


Figure 7–39. PMT Tube Replace-Elec-Pt1

3. Using a flat head screwdriver, wedge out of top right corner starting point, labeled 1 (Figure 7–40).

4. Continue to wedge out the four midpoints of the plate to remove the snap on access panel, labeled 2 (Figure 7–41).

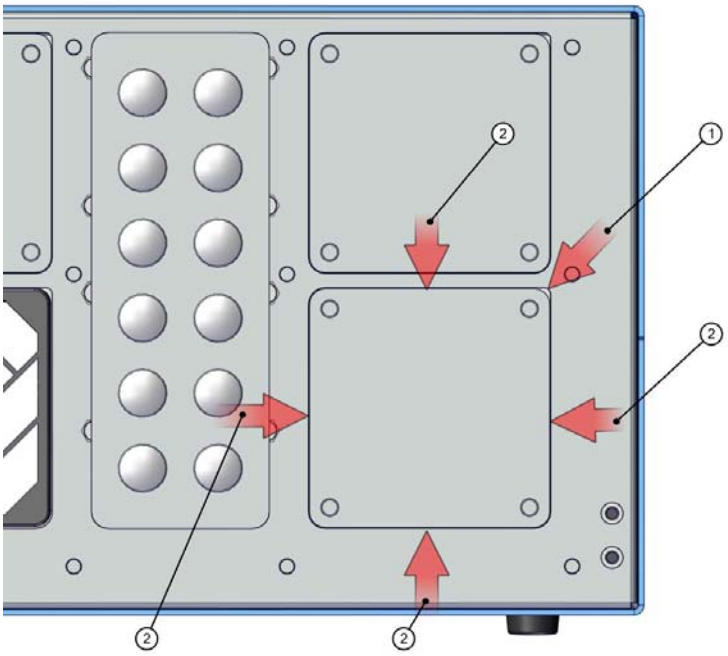


Figure 7–40. Removing the Access Panel, Starting Point

5. Pull access cover out.

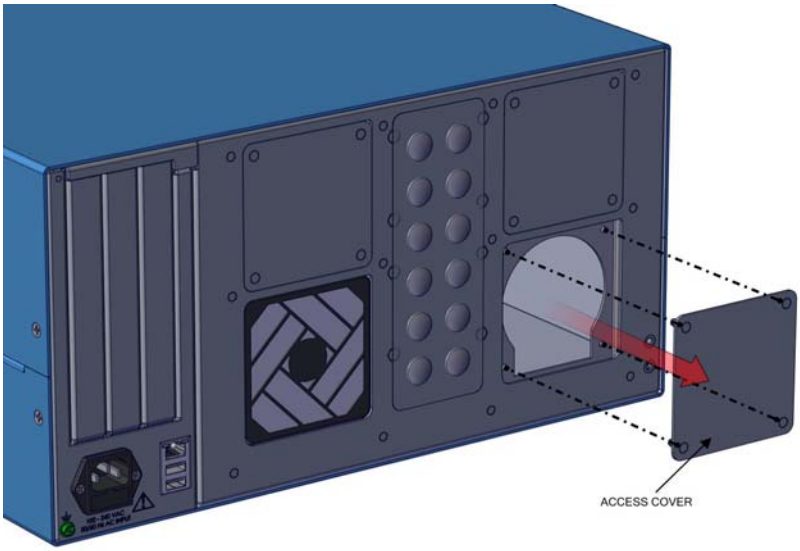


Figure 7–41. Access Cover

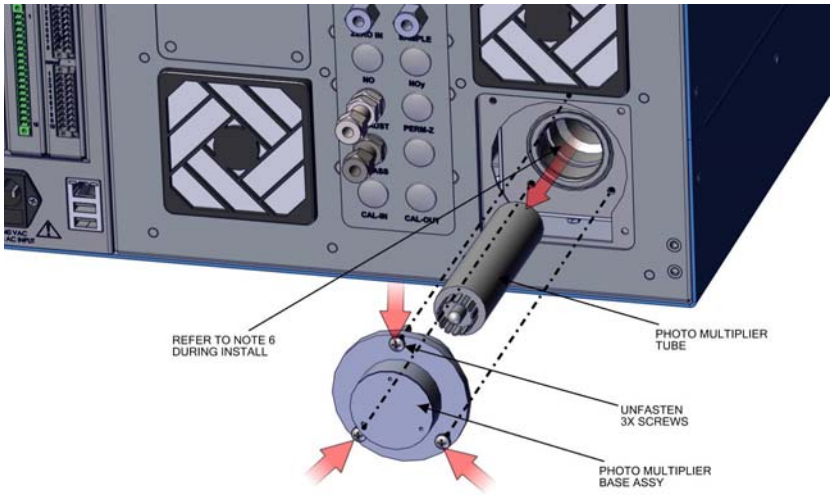


Figure 7–42. PMT Tube Replace-Screws

6. Using a #2 Phillips drive, unfasten three 8-32 pan head screws.

Equipment Damage Do not point the photomultiplier tube at a light source. This can permanently damage the tube. ▲

7. Pull the PMT and PMT base from cooler assembly by twisting it slightly back and forth.

8. To install PMT, follow previous steps in reverse order making sure to backfill the cooler with dry air or nitrogen prior to replacing the PMT.

9. Perform a PMT calibration as described on page 3-93.

DMC Converter Replacement

Use the following procedure to replace the converter.

Equipment Required:

Phillips drive, #2

1. Turn the instrument OFF, unplug the power cord, and remove the cover.

2. Unplug DMC cables 2X.

3. Disconnect all plumbing 7X.

Note The amount of connections will vary depending on the different options installed. ▲

4. Using a #2 Phillips drive, unfasten captive hardware 4X.

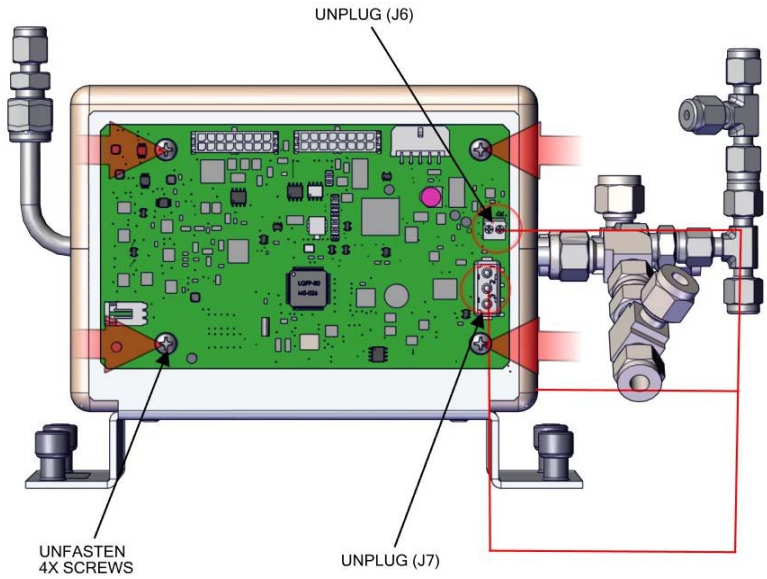


Figure 7–43. Converter DMC Assembly Remove

Converter Assembly Board Replacement

Use the following procedure to replace the converter assembly board.

Equipment Required:

Phillips drive, #2

1. Turn the instrument OFF, unplug the power cord, and remove the cover.

2. Remove DMC Converter as described in "DMC Converter Replacement" in this chapter.

3. Unplug electrical J6 and J7.

4. Using a #2 Phillips drive, unfasten four 6-32 pan head screws.

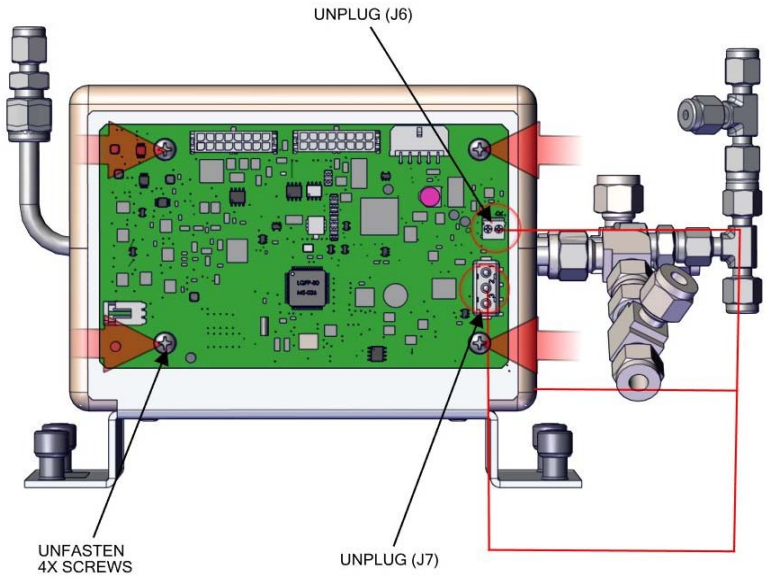


Figure 7–44. Converter Assembly Remove bd

5. Pull converter assembly board outwards.

6. Replace converter assembly board and assemble in reverse order.

Converter Cartridge Heater Replacement

Use the following procedure to replace the converter cartridge heater.

Equipment Required:

Phillips drive, #2

Hex drive, 1/4-inch

1. Turn the instrument OFF, unplug the power cord, and remove the cover.

2. Remove DMC Converter as described in "DMC Converter Replacement" in this chapter.

3. Using a 1/4-inch hex drive, unfasten six 6-32 hex head screws.

4. Take apart top housing assembly and insulator to get to the heater assembly.

5. Remove the converter cartridge/heater assembly from the bottom housing assembly.

6. Remove fitting body to allow clearance for heater to slide out.

7. Loosen the heater clamp, pry heater apart no wider than necessary and remove the converter cartridge noting the proper orientation of heater wires and thermocouple probe.

8. To replace converter, follow previous steps in reverse. Note be sure to wrap the O_3 converter tube snugly around the heater.

9. Reinstall in reverse order.

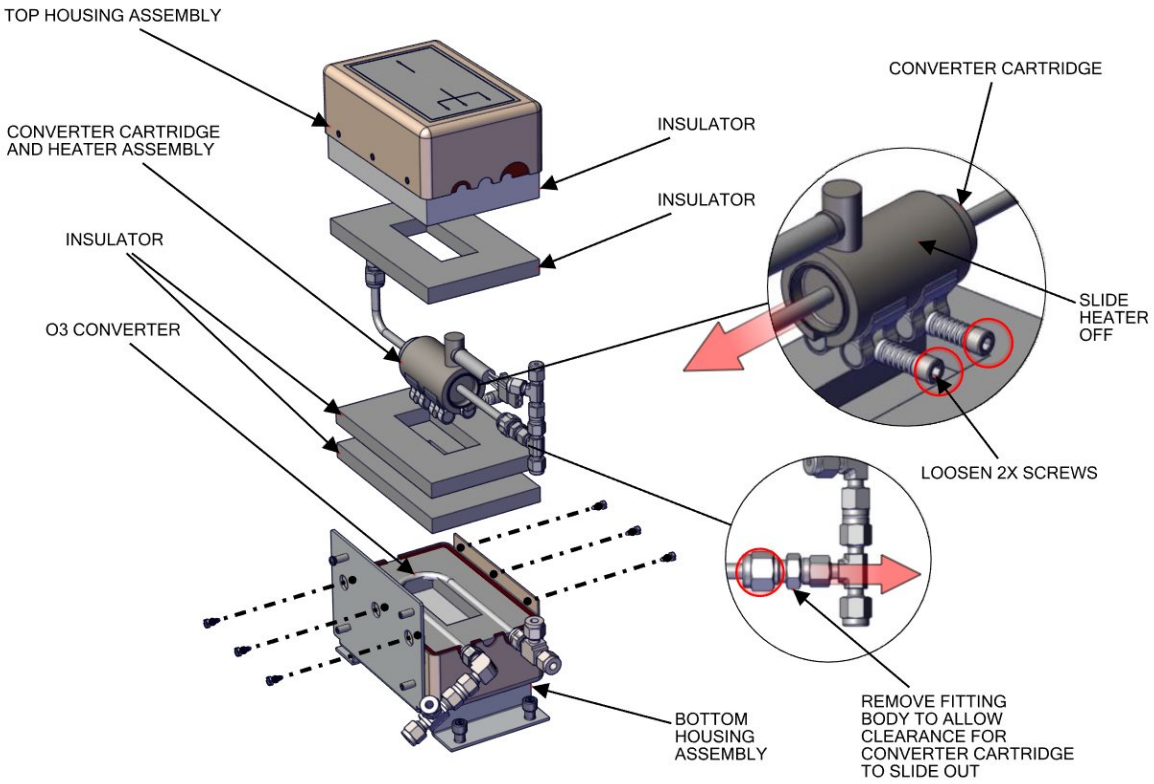


Figure 7–45. Converter Assembly Replace Heater

DMC Ozonator

Use the following procedure to replace the ozonator and transformer board, replace the flow switch and optional ammonia scrubber.

- Removing the ozonator and transformer
- Replacing the ozonator and transformer board
- Replacing the flow switch
- Replacing the ammonia scrubber (optional)

Ozonator and Transformer Removal

Use the following procedure to remove the ozonator and transformer.

Equipment Required:

Phillips drive, #2

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

2. Unplug converter DMC (J2) and flow pressure board (J4).

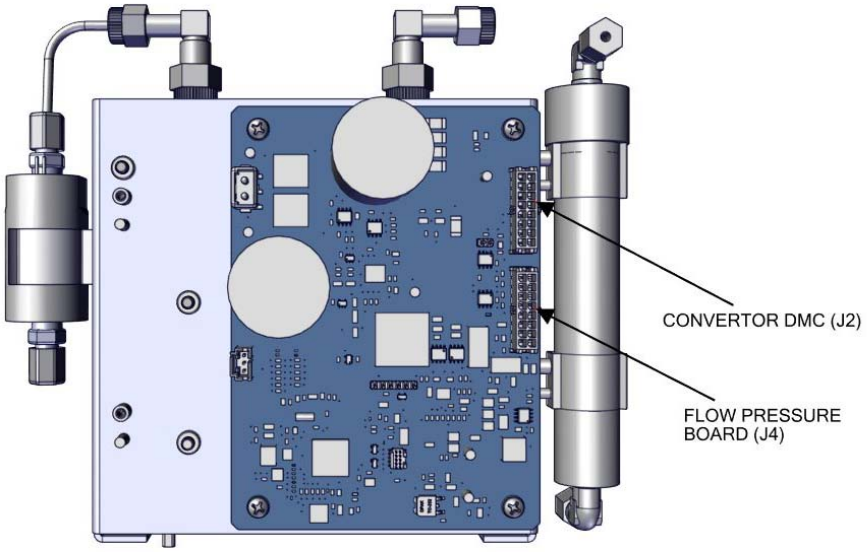


Figure 7–46. HVPS, Electrical

3. Disconnect plumbing.

4. Using a #2 Phillips drive, unfasten captive hardware 4X.

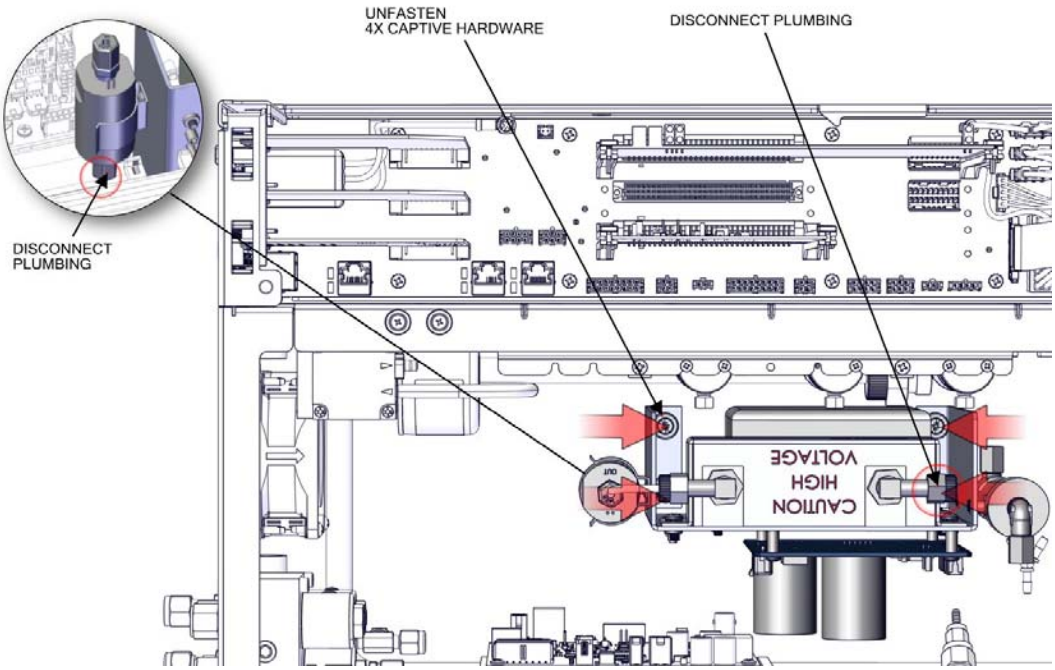


Figure 7–47. HVPS Remove

Ozonator Replacement

Use the following procedure to replace the ozonator.

1. Unplug ozonator (J1).

2. Disconnect plumbing 2X.

3. Ozonator—using a #2 Phillips drive, unfasten two #6-32 pan head screws.

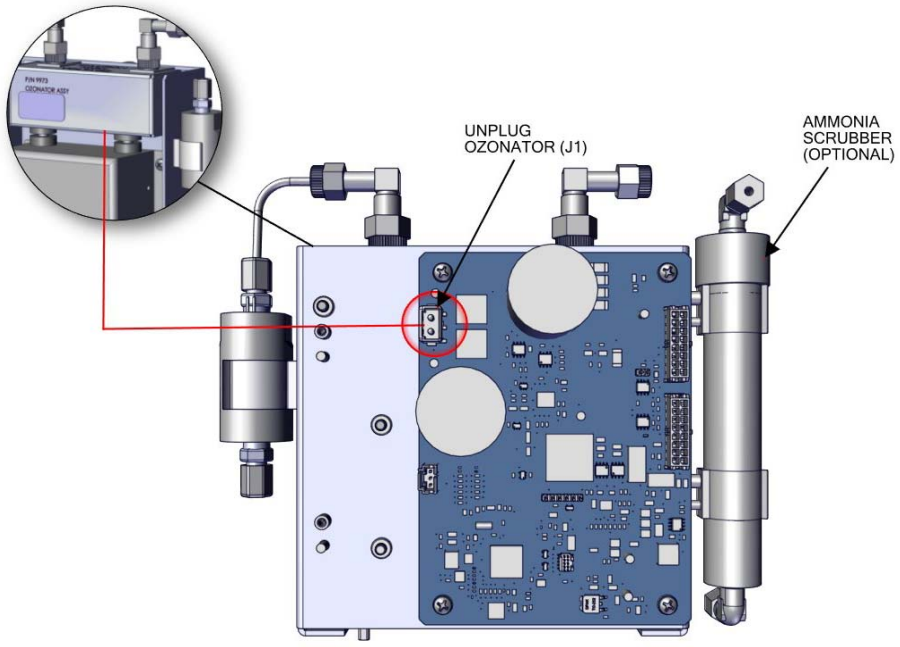


Figure 7–48. Replace Ozonator

Transformer Replacement

Use the following procedure to replace the transformer.

1. Ozonator transformer—using a #2 Phillips drive, unfasten four #6-32 pan head screws.

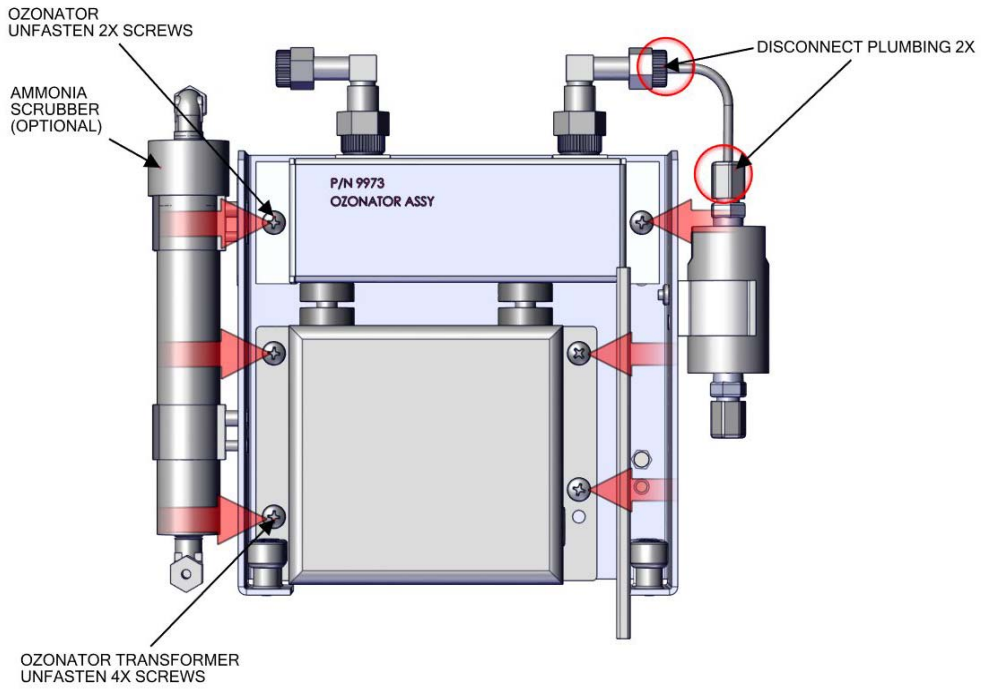


Figure 7–49. Replace Transformer

Ozonator and Transformer Board Replacement

Use the following procedure to replace the ozonator and transformer board.

Equipment Required:

Phillips drive, #2

1. Remove DMC Ozonator as described in "DMC Ozonator" in this chapter.

2. Unplug all electrical from HPVS board, ozonator (J1), flow switch (J5) converter DMC (J2) and flow pressure board (J4).

3. Using a #2 Phillips drive, unfasten four #6-32 pan head screws.

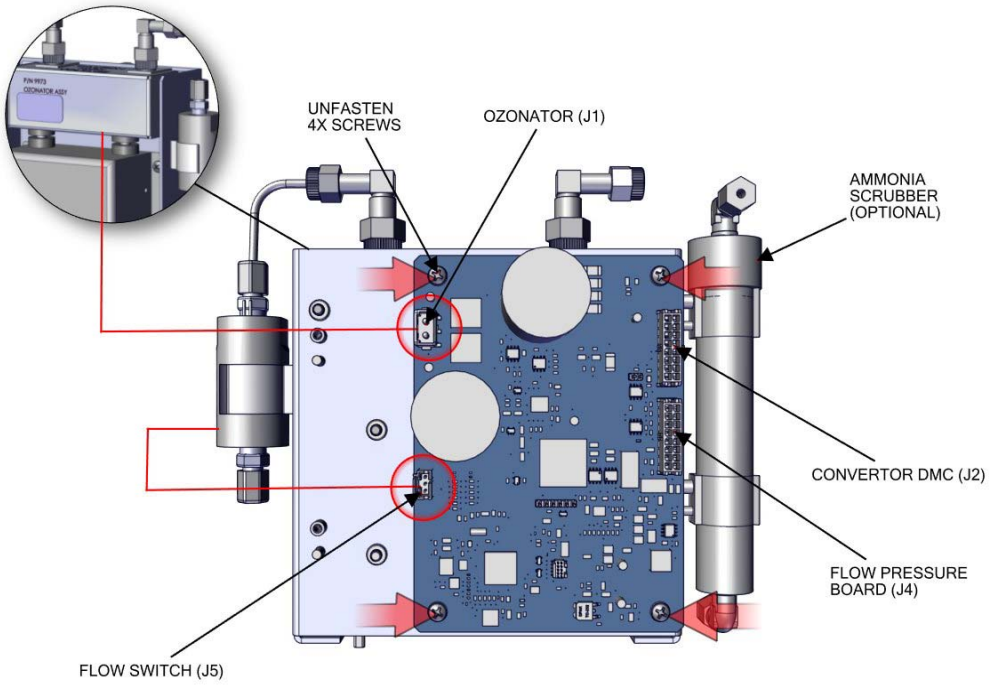


Figure 7–50. HPVS Remove Bd

Flow Switch Replacement

Use the following procedure to replace the flow switch.

Equipment Required:

Phillips drive, #2

1. Remove Ozonator as described in "DMC Ozonator" in this chapter.
2. Unplug flow switch (J5) from board.
3. Pull flow switch off clip after unplugging from board.

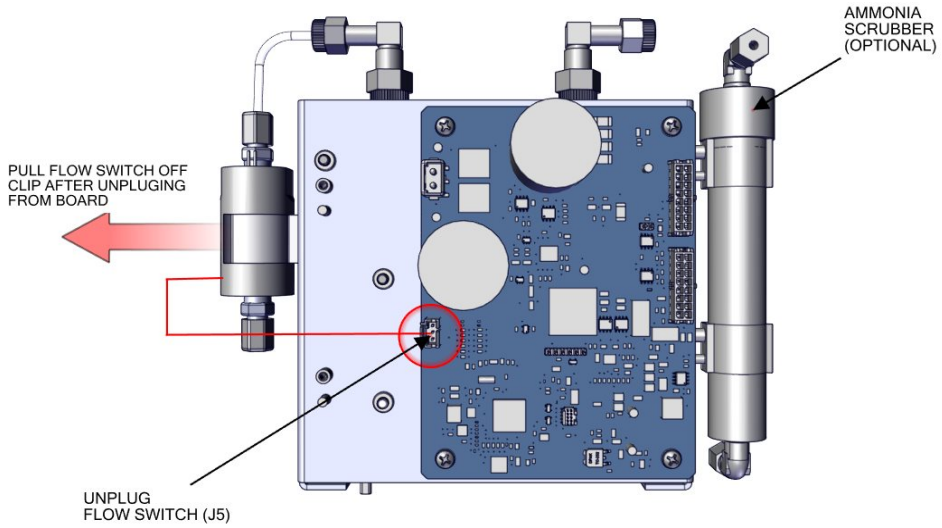


Figure 7–51. Flow Switch Remove

Optional Ammonia Scrubber Replacement

Use the following procedure to replace the optional ammonia scrubber.

Equipment Required:

Phillips drive, #2

1. Remove DMC Ozonator as described in "DMC Ozonator" in this chapter.
2. Disconnect plumbing 2X.
3. Pull Ammonia scrubber off clips 2X.

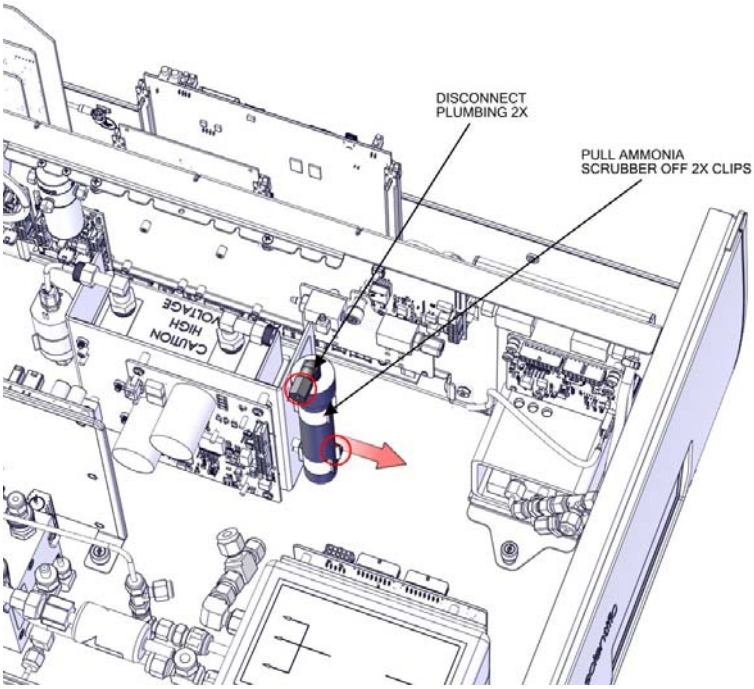


Figure 7–52. Remove Ammonia Scrubber

Optional Manifold Replacement

Use the following procedure to replace the manifold.

Equipment required:

Hex wrench, 9/16

Hex drive, 9/64

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

2. Unplug three electrical connections (J5, J6, and J8) from the Step POL board 1.

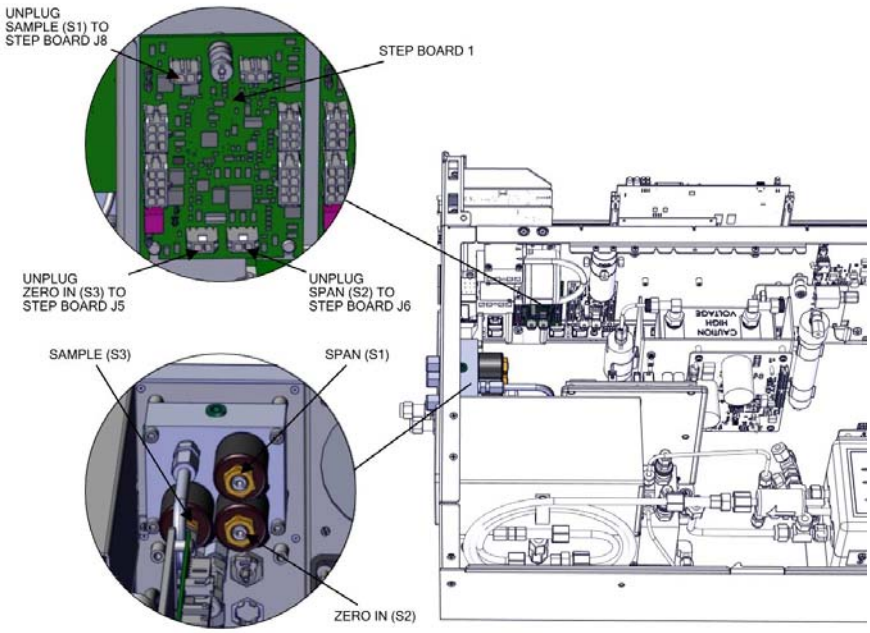


Figure 7–53. Replacing the Manifold pt 1

3. Unfasten three nuts. Remove the nuts, front and back ferrules as shown from span, zero in, sample back panel (Figure 7–54).

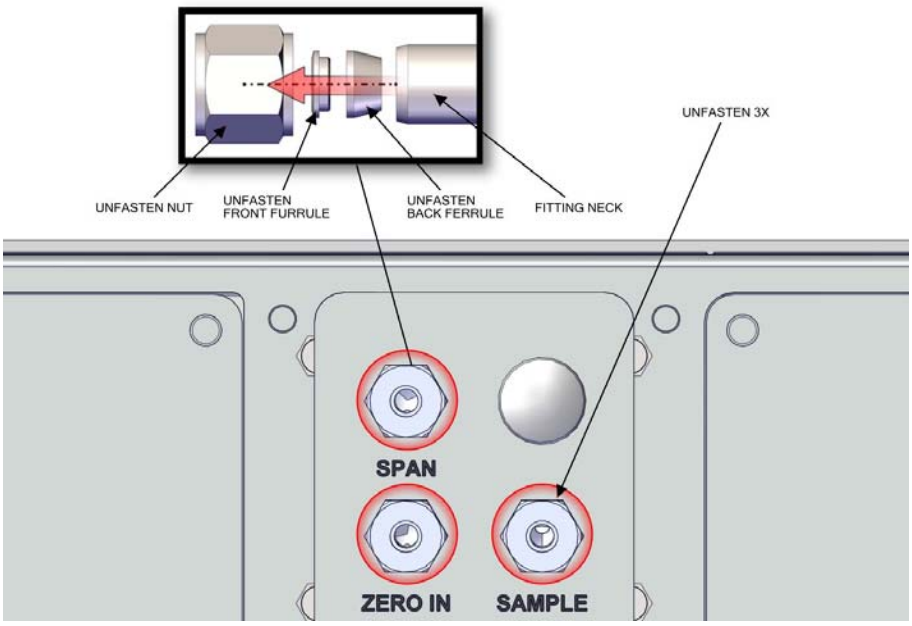


Figure 7–54. Replacing the Manifold pt 2

4. Disconnect tubing.

5. Using a 9/64 hex drive, unfasten four #8-32 socket cap head screws.

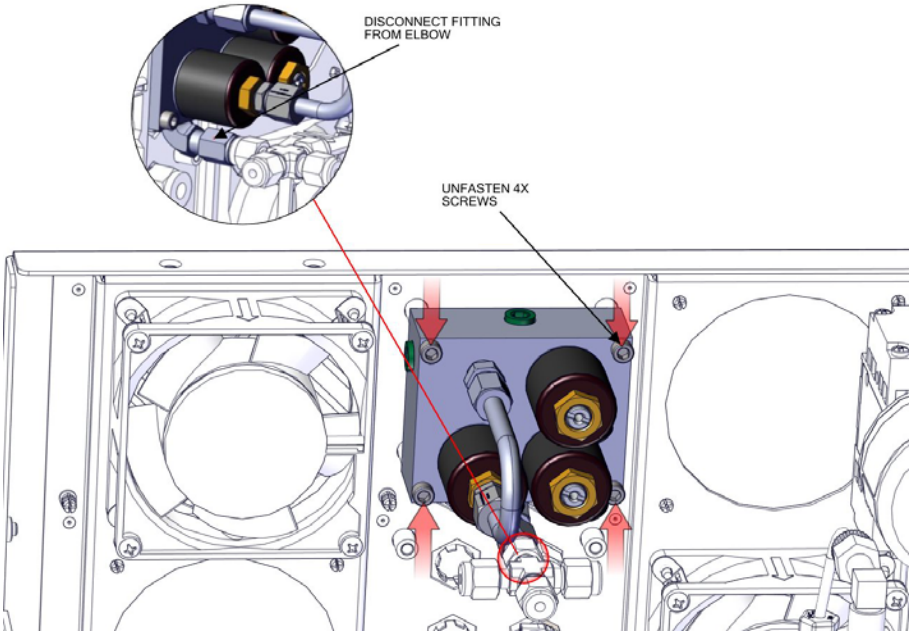


Figure 7–55. Replacing the Manifold pt 3

6. Replace the manifold and assemble in reverse order.

Solenoid Valve Removal

Use the following procedure to replace the mode valve.

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 mode valve (J5).

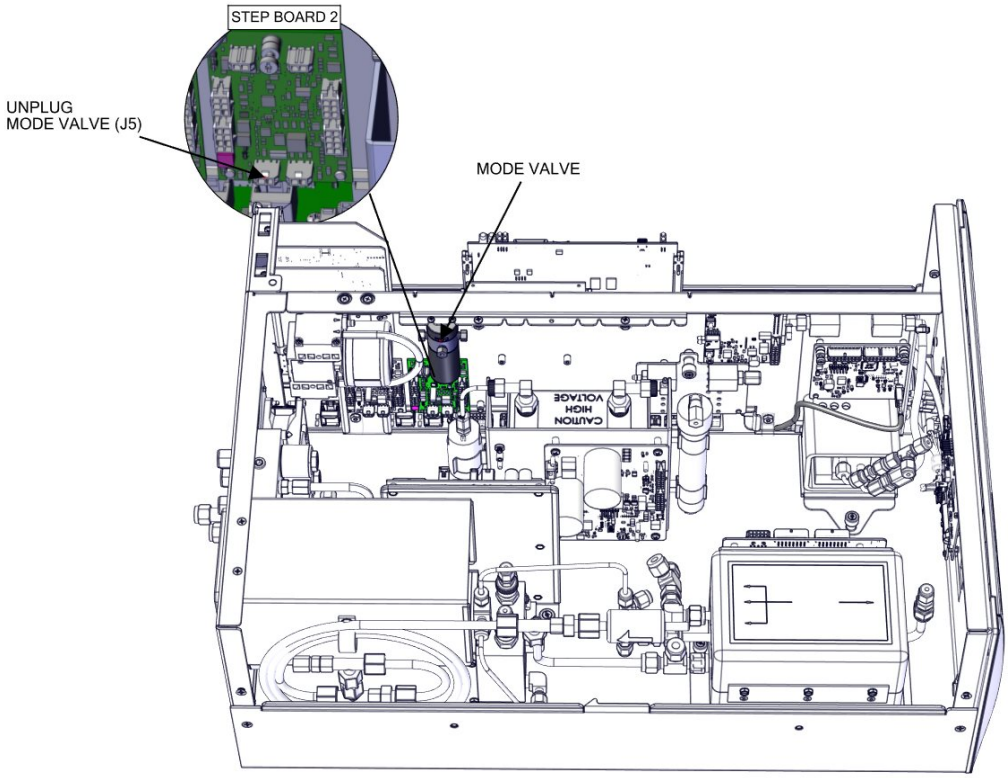


Figure 7–56. Mode Electrical Connection

3. Using a #1 Phillips drive, loosen two #4-40 pan head screws.

4. Slide 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. ▲

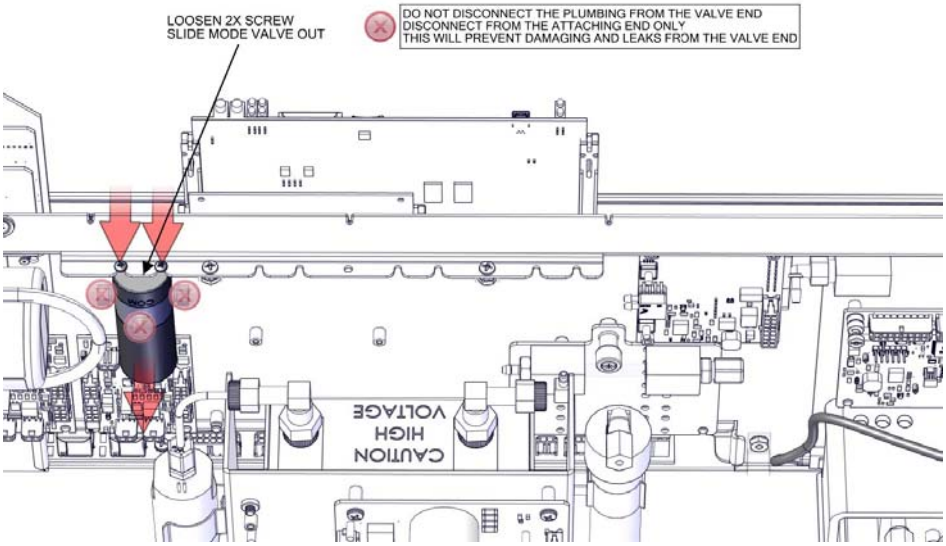


Figure 7–57. Mode Hardware, Plumbing

Optional DMC Oxygen Sensor

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

- Oxygen Sensor removal
- Oxygen Sensor board replacement
- Oxygen Sensor capillary replacement
- Oxygen Sensor replacement

Oxygen Sensor Removal

Use the following procedure to remove and replace the oxygen sensor.

Equipment required:

Phillips drive, #2

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

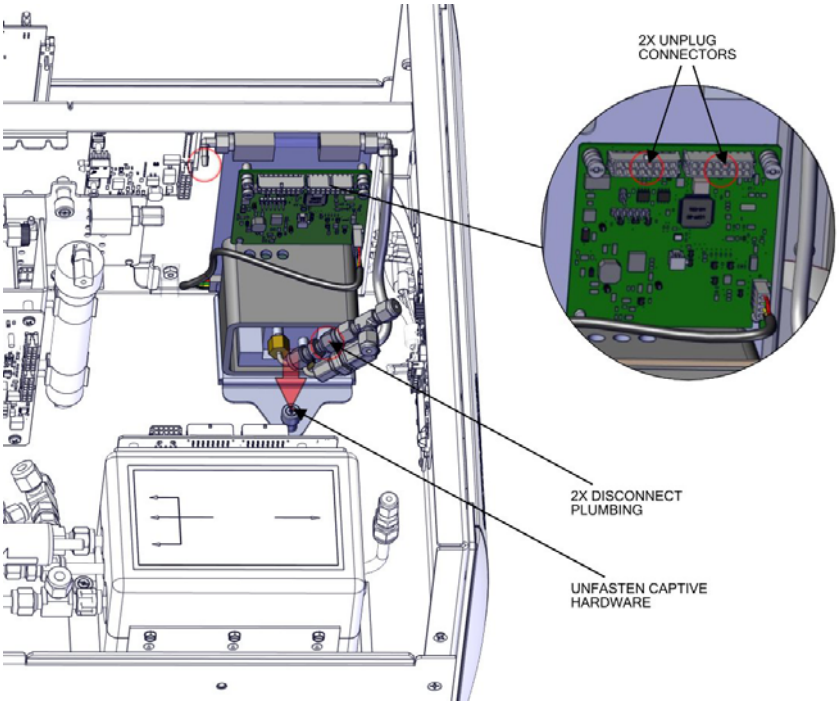


Figure 7–58. Oxygen Sensor Removal pt 1

5. Slide oxygen sensor assembly left.

Note Make sure oxygen sensor plate clears the edge and stud. ▲

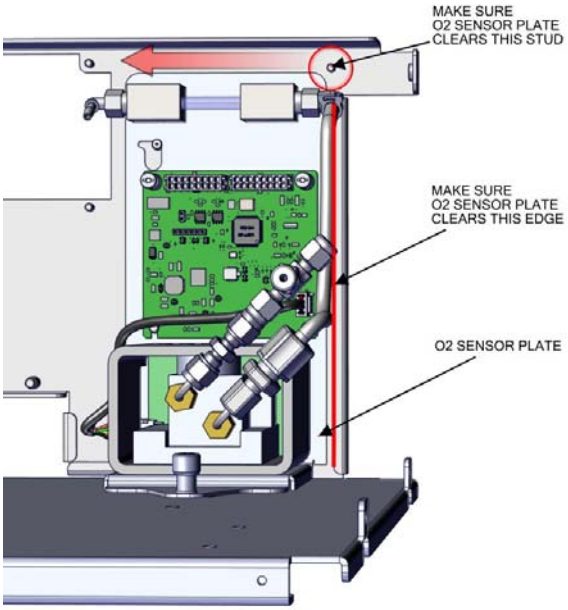


Figure 7–59. Oxygen Sensor Removal pt 2

6. Slide oxygen sensor assembly upwards.

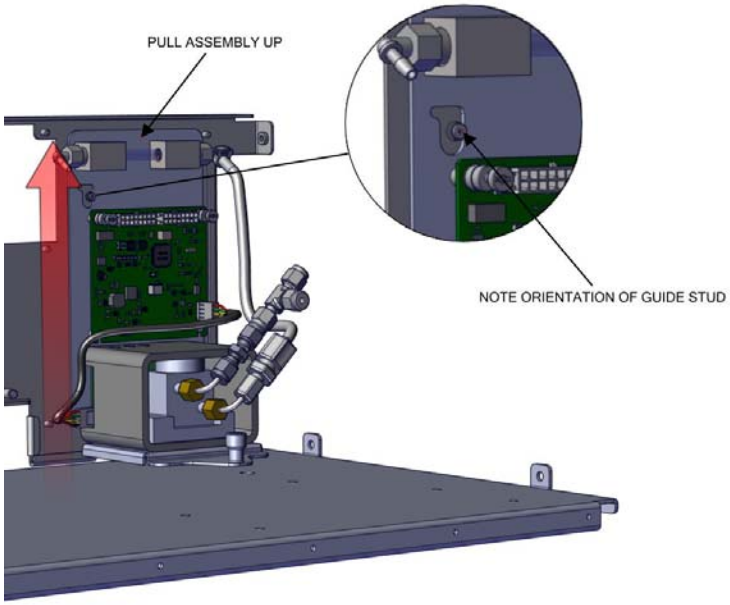


Figure 7–60. Oxygen Sensor Removal pt 3

7. Pull away from the partition panel.

Note Make sure oxygen sensor plate clears the edge. ▲

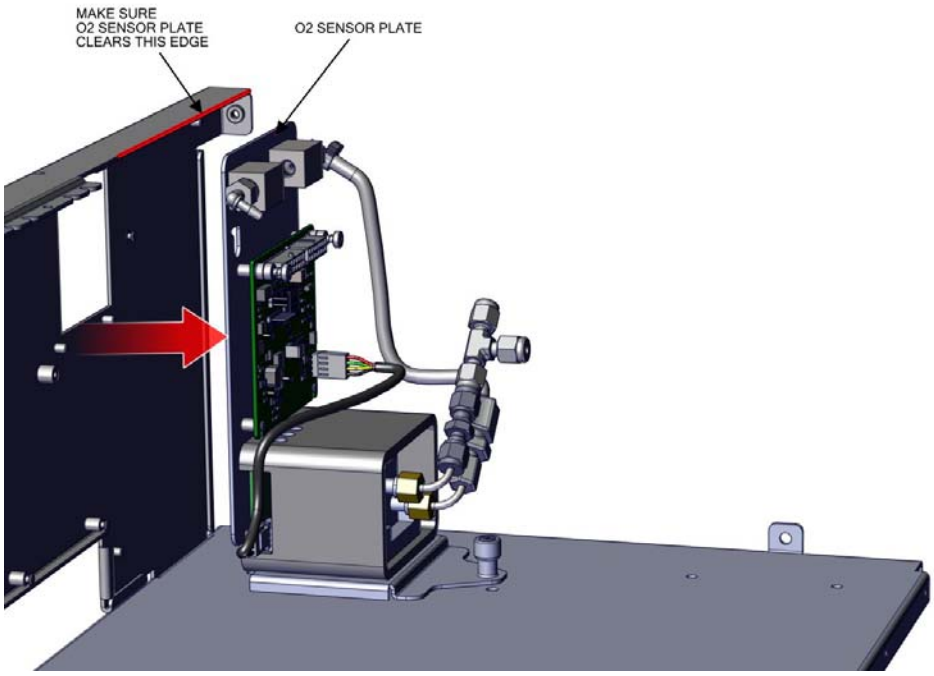


Figure 7–61. Oxygen Sensor Removal pt 4

Oxygen Sensor Board Replacement

Use the following procedure to replace the oxygen sensor board.

Equipment required:

Torque screw driver, T15 or slot screw driver, 3/16

1. Remove the oxygen sensor DMC from the instrument. Refer to "Oxygen Sensor Removal" on page 7-56.

2. Unplug J1.

3. Using a T15 torque drive, unfasten two captive hardware.

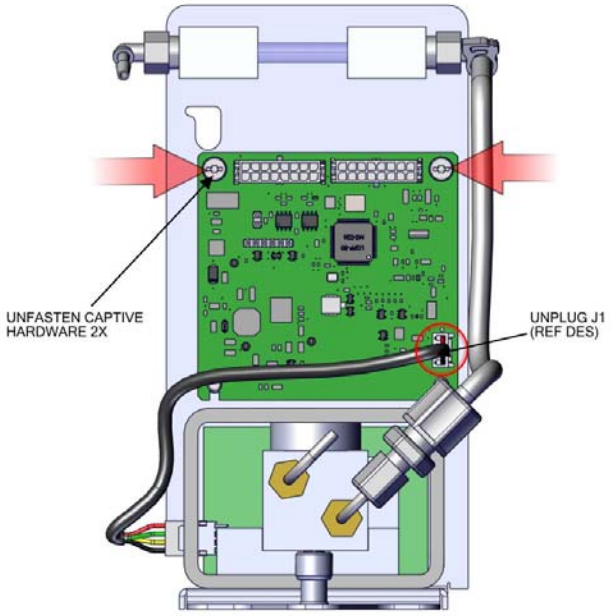


Figure 7–62. Replacing the Oxygen Sensor DMC Board

4. Slide board upwards.

Note Clear keyway. ▲

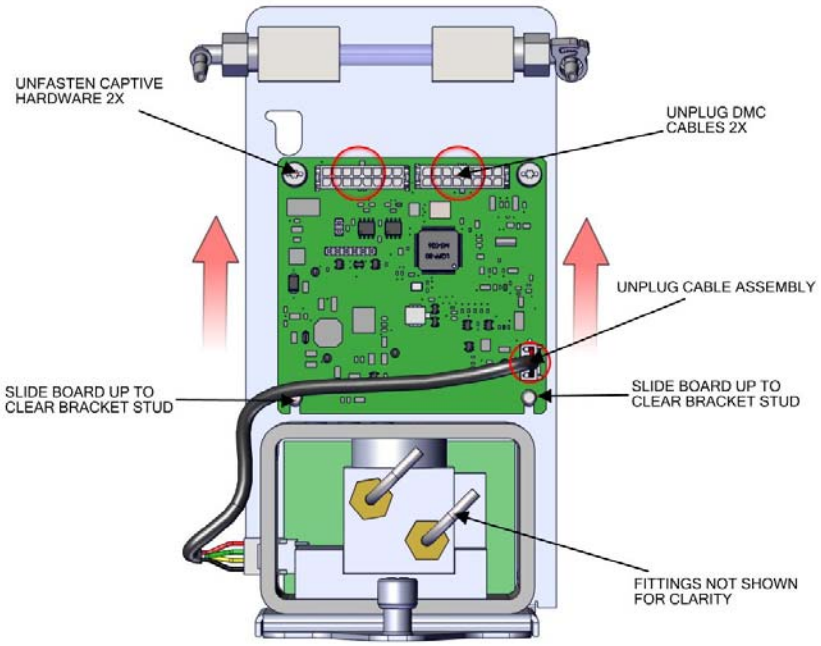


Figure 7–63. Replacing the Oxygen Sensor DMC Board pt 2

5. Replace oxygen sensor board and reassemble in reverse order.

Oxygen Sensor Capillary Replacement

Use the following to replace the oxygen sensor capillary.

Equipment required:

Phillips drive, #2

1. Remove the oxygen sensor DMC from the instrument. Refer to "Oxygen Sensor Removal" on page 7-56.

2. Unlock tube clamp.

3. Unplug tube after unlocking tube clamp.

4. Using a #2 Phillips drive, unfasten four #6-32 flat head screws.

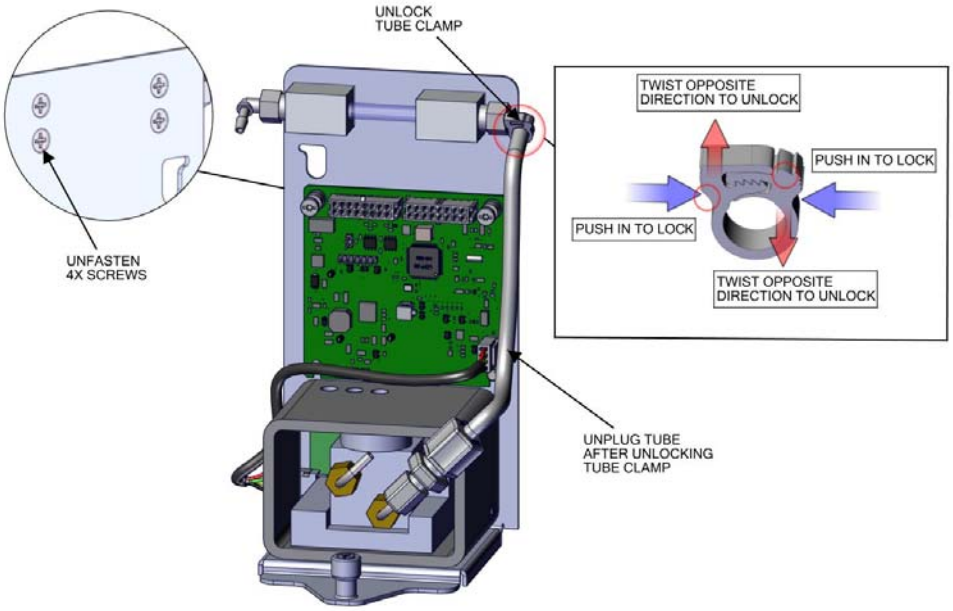


Figure 7–64. Replacing the Oxygen Sensor Capillary

5. Pull capillary assembly outwards and apart as shown.

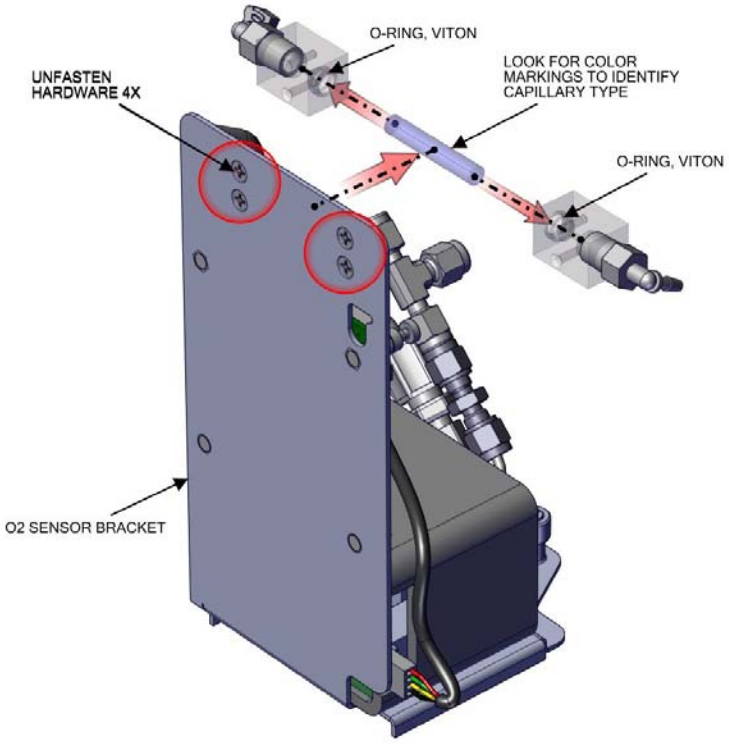


Figure 7–65. Replacing the Capillary pt 2

6. Replace capillary and reassemble in reverse order.

Oxygen Sensor Replacement

Use the following to replace the oxygen sensor.

Equipment required:

Hex drive, 3mm

1. Remove the oxygen sensor DMC from the instrument. Refer to "Oxygen Sensor Removal" on page 7-56.

2. Unplug oxygen sensor cable.

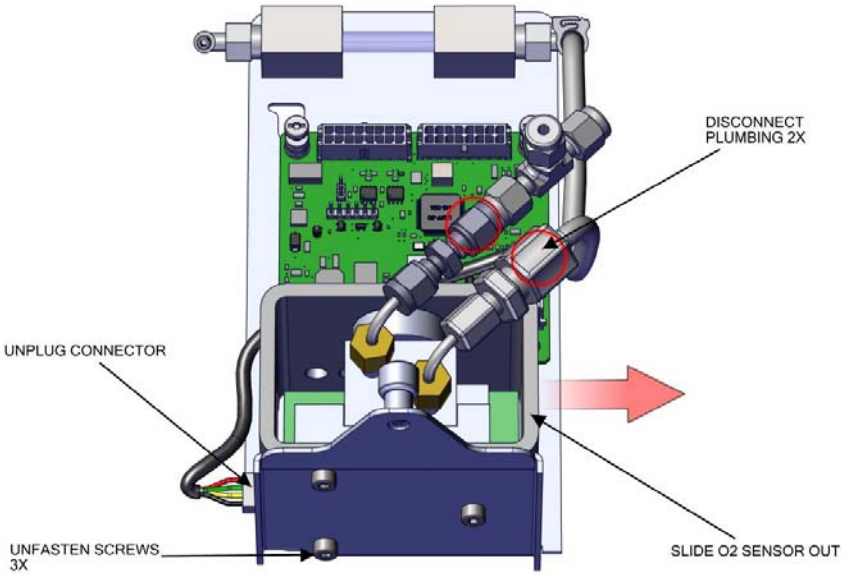


Figure 7–66. Replacing the Oxygen Sensor

3. Disconnect tubing.

4. Using a 3mm hex drive, unfasten three m4 socket cap head screws.

5. Slide out oxygen sensor.

6. Replace oxygen sensor and reassemble in reverse order.

Oxygen Sensor DMC Install

Use the following to install the oxygen sensor DMC.

Equipment required:

Phillips drive, #2

1. Slide oxygen sensor assembly downwards.

Note Make sure oxygen sensor plate goes over the partition panel keyway stud. ▲

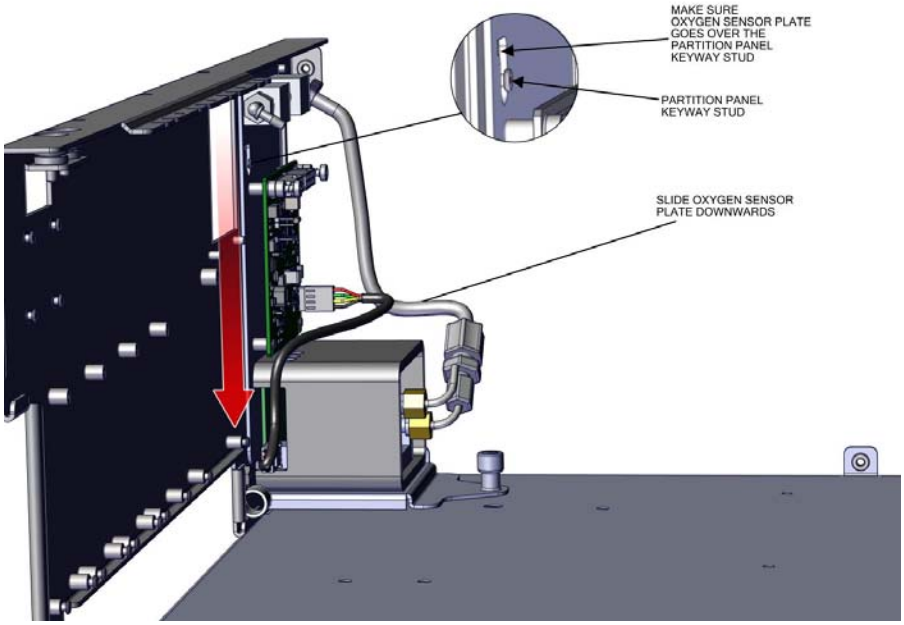


Figure 7–67. Installing the Oxygen Sensor DMC

2. Slide oxygen sensor assembly right.

Note Make sure oxygen sensor plate fits under the stud. ▲

Note Make sure oxygen sensor plate slides into side pocket. ▲

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

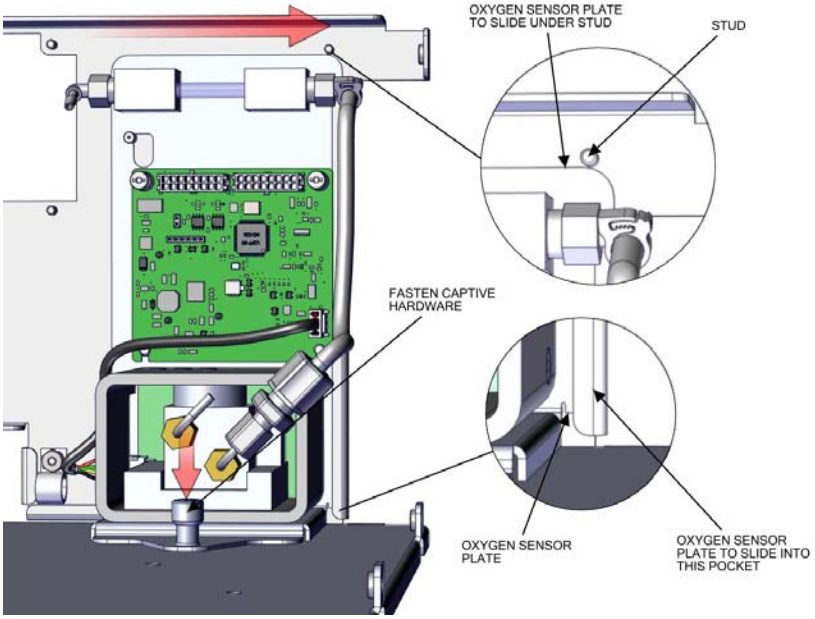


Figure 7–68. Oxygen Sensor DMC install pt 2

Chapter 8
System Description

The 42iQHL 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 42iQHL system components include:

- Reaction Chamber DMC
  - Optical filter
  - Photomultiplier tube (PMT)
  - Photomultiplier tube cooler
- Ozonator DMC
  - Ozonator DMC board
  - Ozone flow switch
- NO_2-to-NO converter DMC
  - Converter DMC board
- Common Electronics
  - Front panel
  - I/O (optional)
  - System control board
  - Backplane board
- Peripherals Support System
  - Fan (on rear panel)
  - Step POL board
  - Pump
  - Mode Solenoid
  - Solenoid valve panel (optional)

- Flow Pressure DMC with restricting capillary
- Firmware
- Oxygen sensor (optional)

Reaction Chamber DMC

The reaction chamber is where the sample reacts with ozone and produces excited NO_2 that gives off a photon of energy when it decays.

The reaction chamber is heated and controlled to approximately 50 °C in order to ensure the greatest instrument stability. The sample and ozone flow capillaries and a thermistor sensor are also housed in/on the reaction chamber assembly.

Optical Filter

The optical filter housed in the reaction chamber limits the spectral region viewed by the detector and eliminates possible interferences due to other chemiluminescent reactions.

Photomultiplier Tube

The Photomultiplier tube (PMT) provides the infrared sensitivity required to detect the NO_2 luminescence resulting from the reaction of the ozone with the ambient air sample.

Optical energy from the reaction is converted to an electrical signal by the PMT and sent to the input board that transmits it to the processor.

Photomultiplier Tube Cooler

The thermoelectric PMT cooler reduces the PMT temperature to approximately -3 °C to minimize dark current and increase instrument sensitivity. The cooler helps to increase zero and span stability over a wide ambient temperature range. The cooler housing also shields the PMT from external electrical and optical interferences.

Ozonator

The Ozonator generates the necessary ozone concentration required for the chemiluminescent reaction. The ozone reacts with the NO in the ambient air sample to produce the electronically excited NO_2 molecules.

Ozonator Flow Switch

The ozonator flow switch located at the ozonator inlet completes an electrical safety circuit when air flows through the sensor to the ozonator. If airflow stops, the flow sensor breaks the electrical circuit to the ozonator and shuts it off to prevent the ozonator from overheating.

NO_2-to-NO Converter

The NO_2-to-NO converter heats stainless steel to approximately 625 °C in order to convert and detect NO_2. The converter consists of an insulated housing, heater, replaceable cartridge, and a type K thermocouple sensor.

Common Electronics

The common electronics contain the core computational and power routing hardware for the 42iQHL, and is replicated throughout other iQ series products (Figure 8–1). It also contains 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 42iQHL, including options. The modular design of the instrument is conveyed in the architecture. Brief descriptions of the specific PCBAs follow.

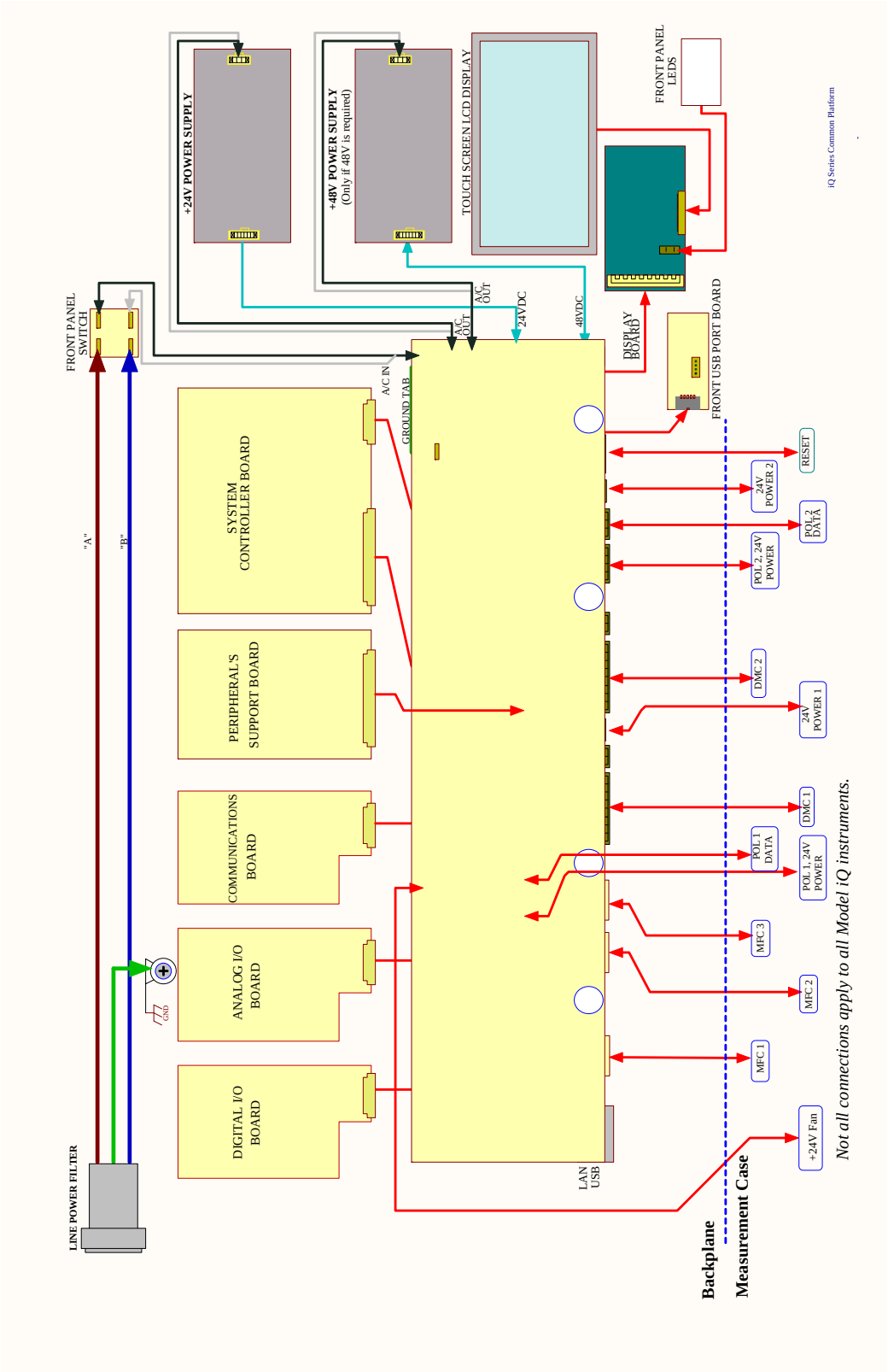


Figure 8–1. Common System Interconnect Diagram

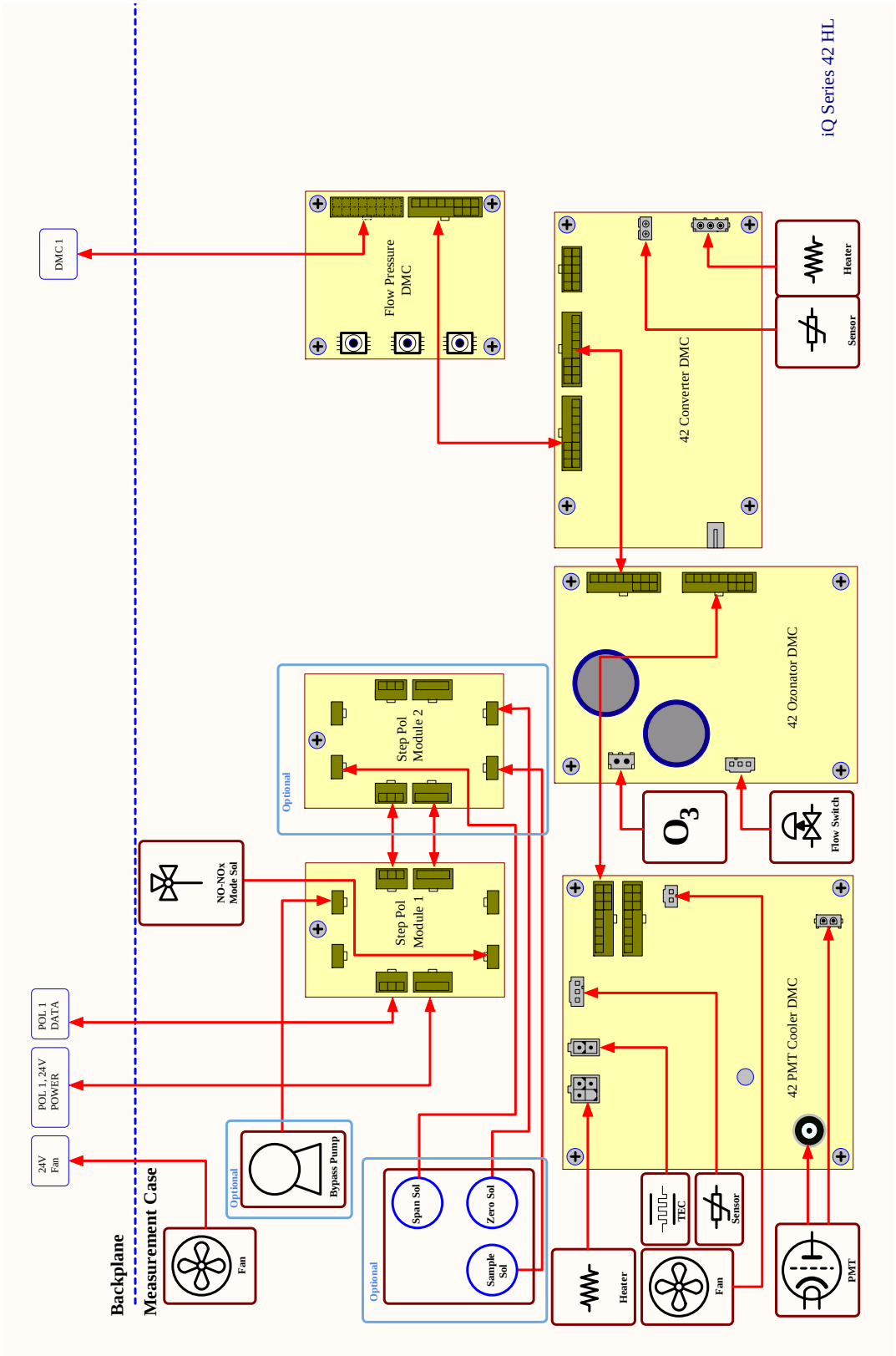


Figure 8–2. 42iQHL System Interconnect Diagram

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 42iQHL 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.

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, 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".

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 RS-485 communication with and powering of DMCs and the Step POL Module. It additionally routes the front panel display and driver, external USB and Ethernet.

Peripherals Support System

The peripherals support system operates these 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 provides 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.

External Pump

The external vacuum pump draws the reacted gases out of the reaction chamber.

Mode Solenoid

The mode solenoid valve switches analyzer operation between the NO mode and NO_x mode. It routes the ambient air sample either through the reaction chamber (NO mode) or through the NO_2-to-NO converter and then to the reaction chamber (NO_x mode).

Solenoid Valve Panel

Optional solenoid valves for switching between sample, zero, and span gases, and other optional components.

Flow/Pressure DMC

The flow pressure DMC performs the pressure measurements that assure proper flow regulation, and also for the sample pressure within the reaction chamber. It is coupled with a standard restricting capillary for flow when the downstream pump is operating: Upstream pressure is ambient, while downstream pressure allows determination of flow. A single PCBA with microprocessor provides the active controls for the pressure measurements, performs flow determination, and generates registers that interact with the higher level system controls.

Firmware

Like the hardware, the firmware is modular and located within microprocessors distributed throughout the instrument. In the 42iQHL, microprocessors containing firmware are located as follows:

- Reaction Chamber/PMT DMC
- Ozonator DMC
- Flow/Pressure DMC
- Peripherals Support Board
- Optional I/O (Communications, Digital, and Analog)
- Optional Oxygen Sensor

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 42iQHL 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.

Oxygen Sensor (optional)

The 42iQHL can be configured with an optional DMC based Oxygen (O_2) Sensor. This sensor is a paramagnetic sensor for O_2 concentration measurement and NO, NO_2, and NO_x correction. This option allows the user to correct the NO_x readings for the amount of oxygen in the sample. Selectable O_2 concentrations can be used as the correction factor.

Chapter 9
Optional Equipment

The 42iQHL 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

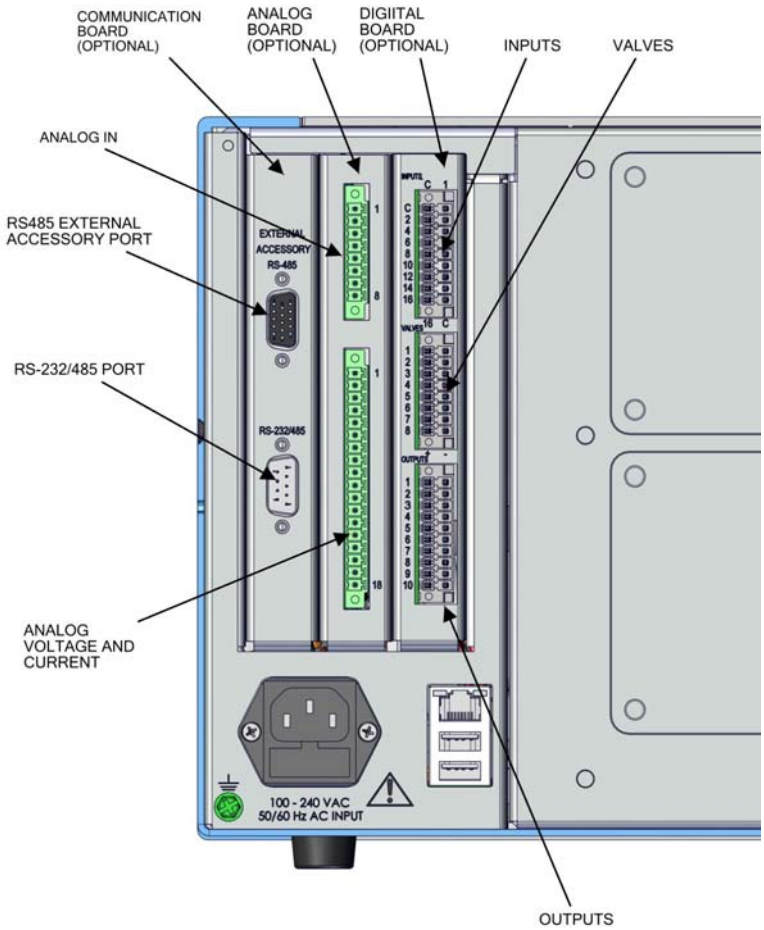


Figure 9–1. I/O Expansion Replacement Boards

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.

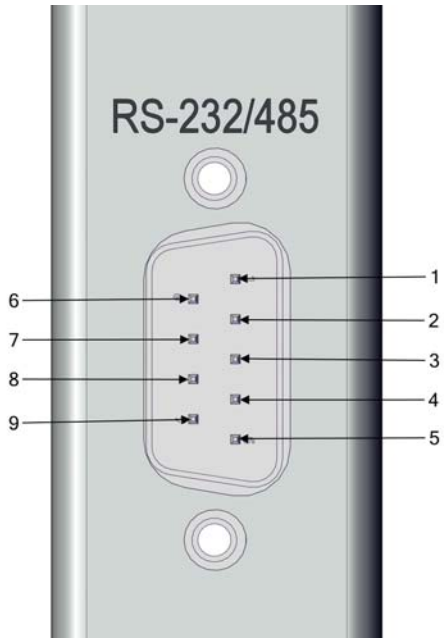


Figure 9–2. RS-232/RS-485 Port

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.

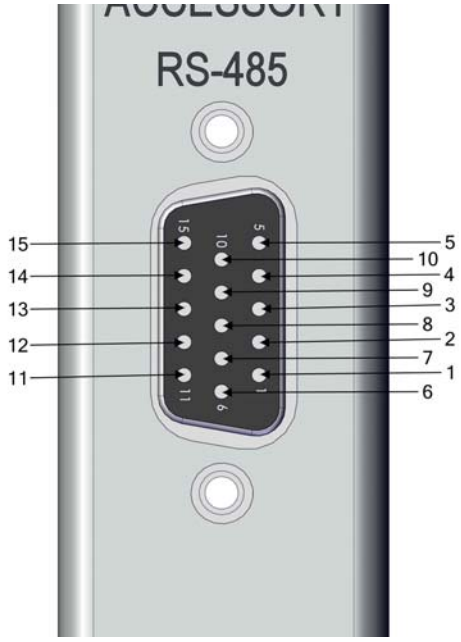


Figure 9–3. RS-485 External Accessory Port

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.

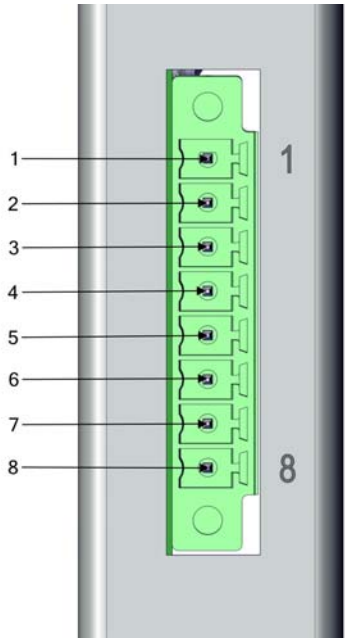


Figure 9–4. Analog Voltage Inputs

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 Ω. 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.

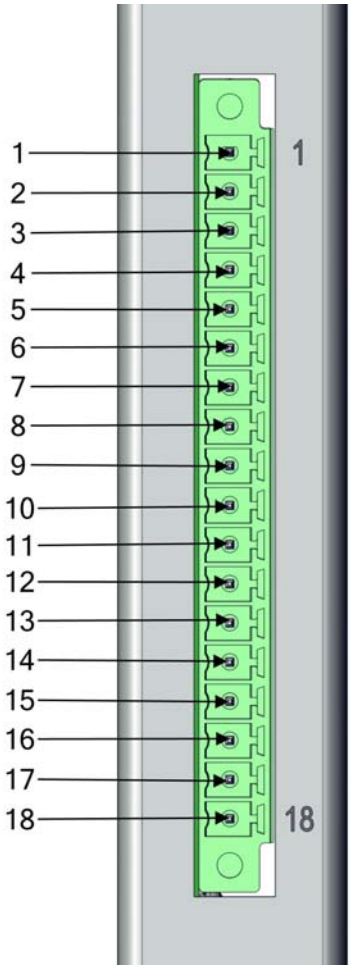


Figure 9–5. Analog Voltage and Current

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. ▲

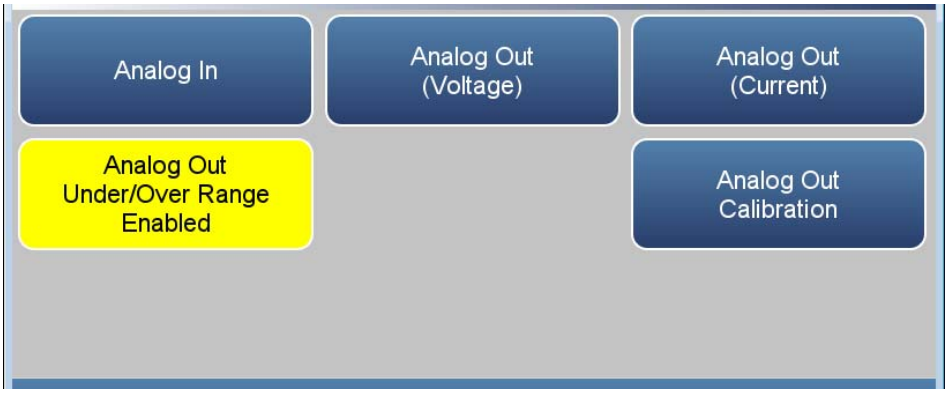
- Calibrate the output channel full scale.

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.

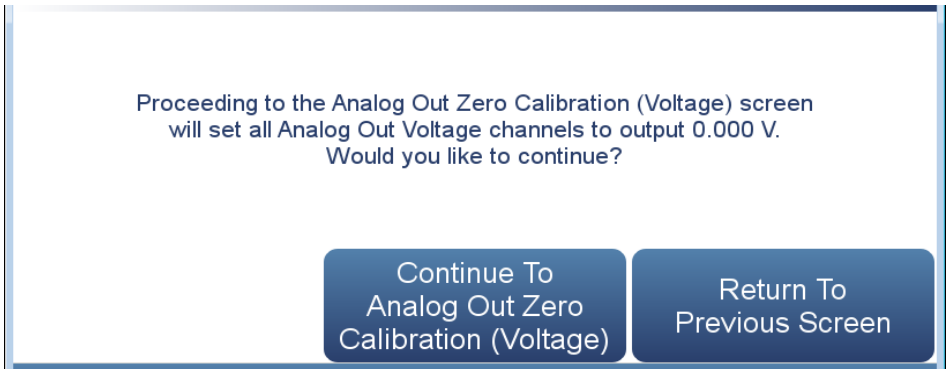
Note This adjustment should only be performed by an instrument service technician. ▲

1. From the Home screen, choose **Settings>Communications>Analog I/O>Analog Out Calibration.**

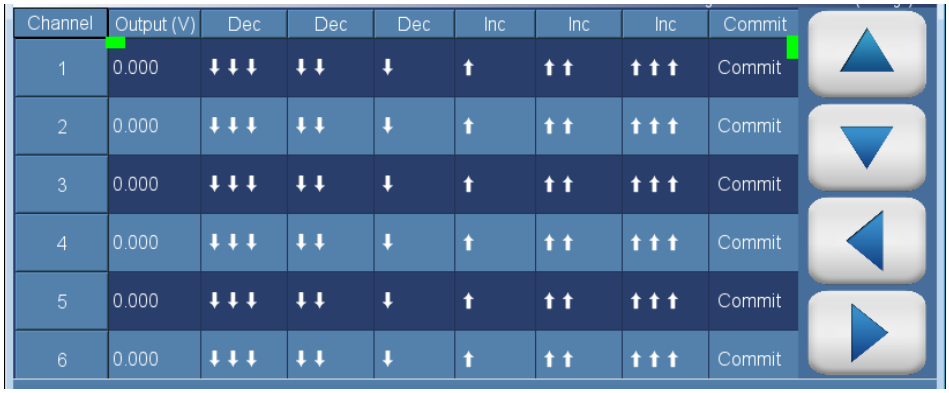


2. Depending on the output type being used, select either Analog Out Zero Calibration (Voltage) or Analog Out 4.000 mA Calibration (Current).

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:



- *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.

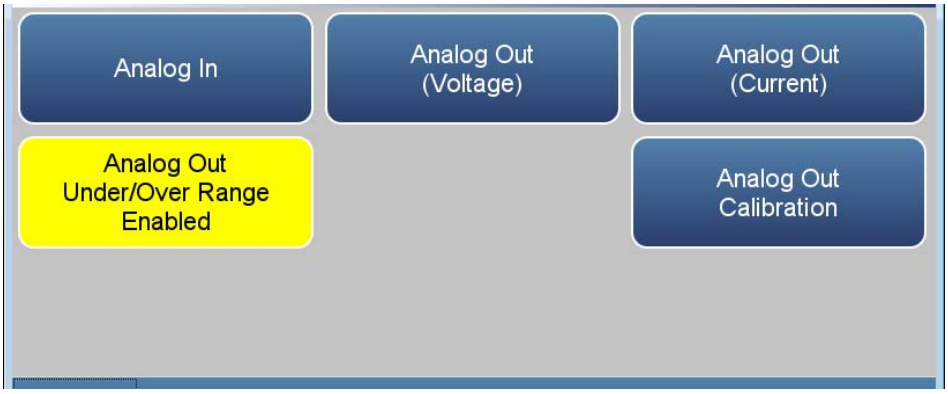
6. After making changes to the output levels, the commit button will turn green. To accept the changes, press the Commit button. To revert to the previous values, press the back button to return to the previous analog output calibration screen.

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.

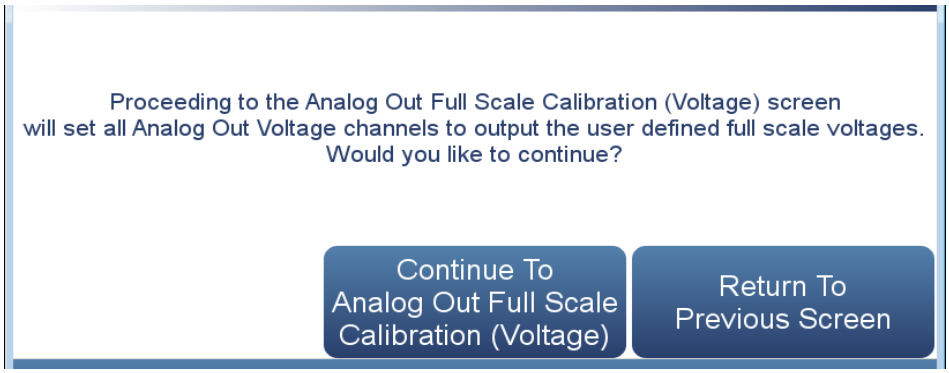
Note This adjustment should only be performed by an instrument service technician. ▲

1. From the Home screen, choose **Settings>Communications>Analog I/O>Analog Output Calibration.**

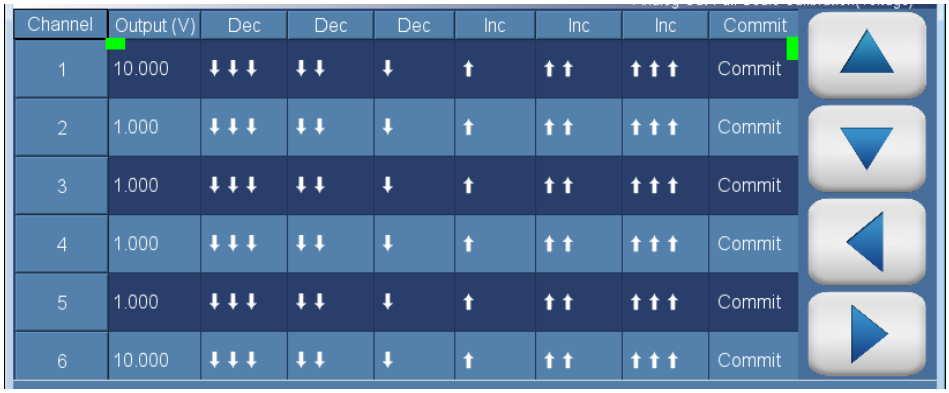


2. Depending on the output type being used, select either Analog Out Full Scale Calibration (Voltage) or Analog Out 20.000 mA Calibration (Current).

3. A confirmation screen is presented. Select Continue to proceed with the calibration or Return to Previous Screen.



4. There are six columns for each of the six available output channels:



- *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

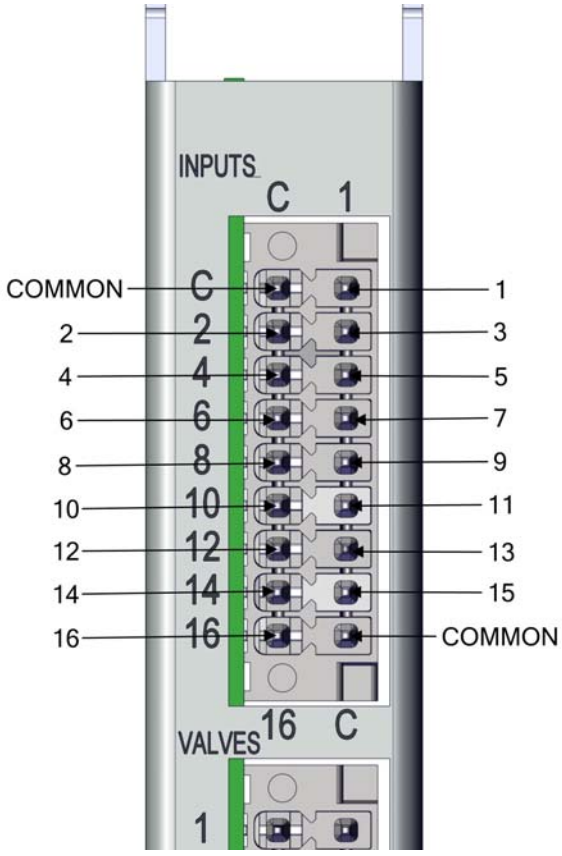


Figure 9–6. Digital Inputs

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

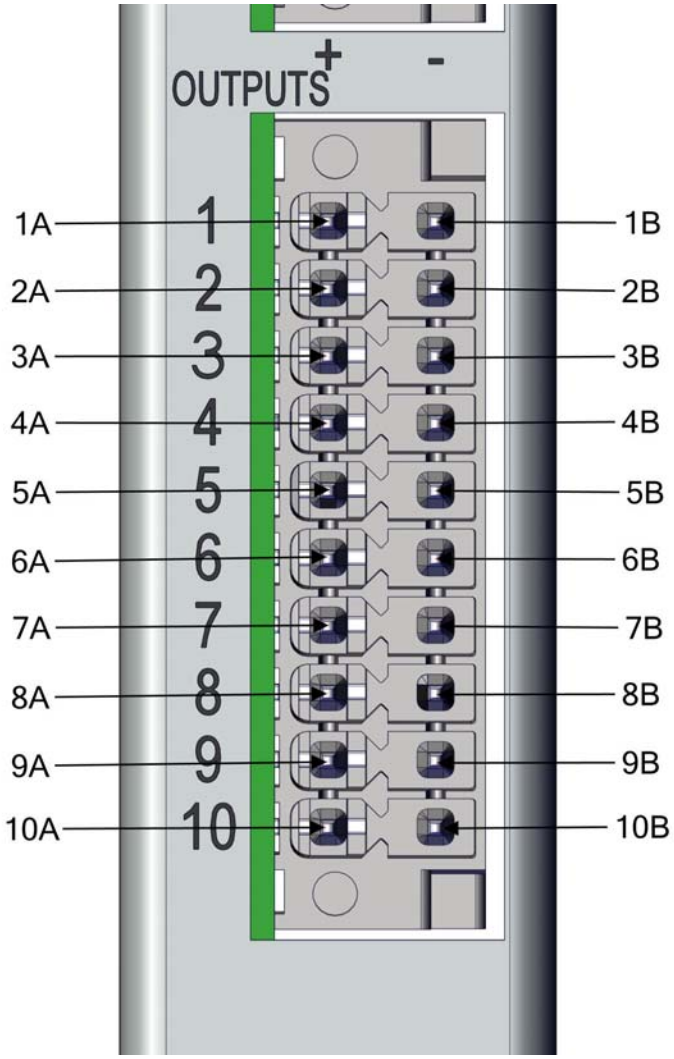


Figure 9–7. Digital Relay Switches

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
- Both positive and negative outputs are protected from over voltage and over current by 500 mA fuses.

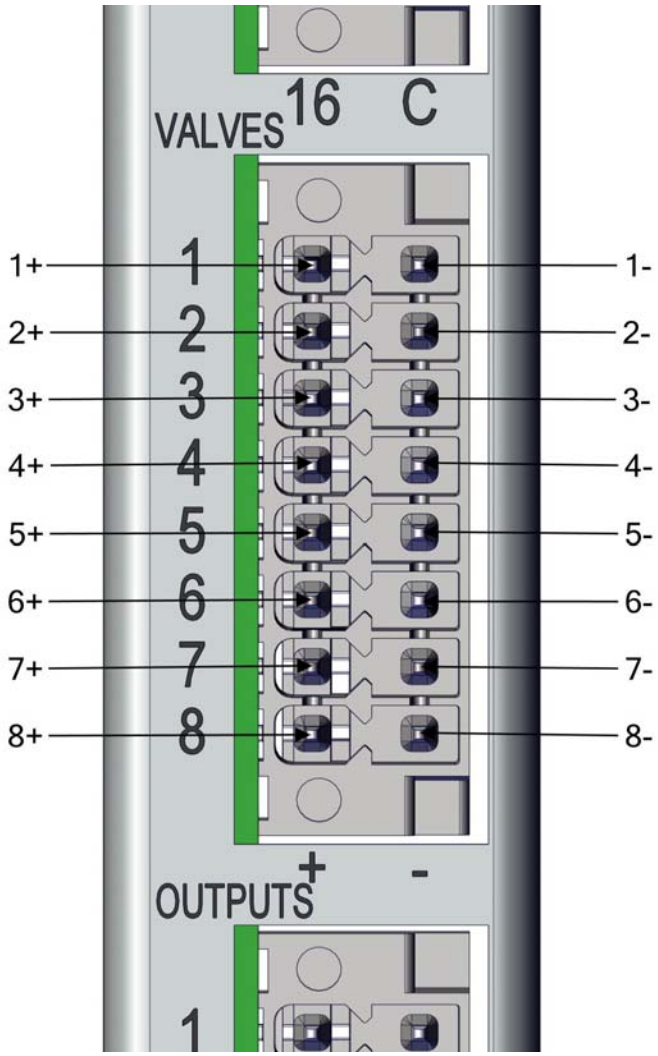


Figure 9–8. Valve Driver Outputs

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. ▲

Internal Zero/Span and Sample Valves

With the zero/span assembly option, a source of span gas is connected to the SPAN port and a source of zero air is connected to the ZERO IN port as shown in Figure 9–9. Zero in and span gas should be supplied at atmospheric pressure. It may be necessary to use an atmospheric dump bypass plumbing arrangement to accomplish this.

For more information, refer to the "Installation and Setup" chapter and the "Operation" chapter.

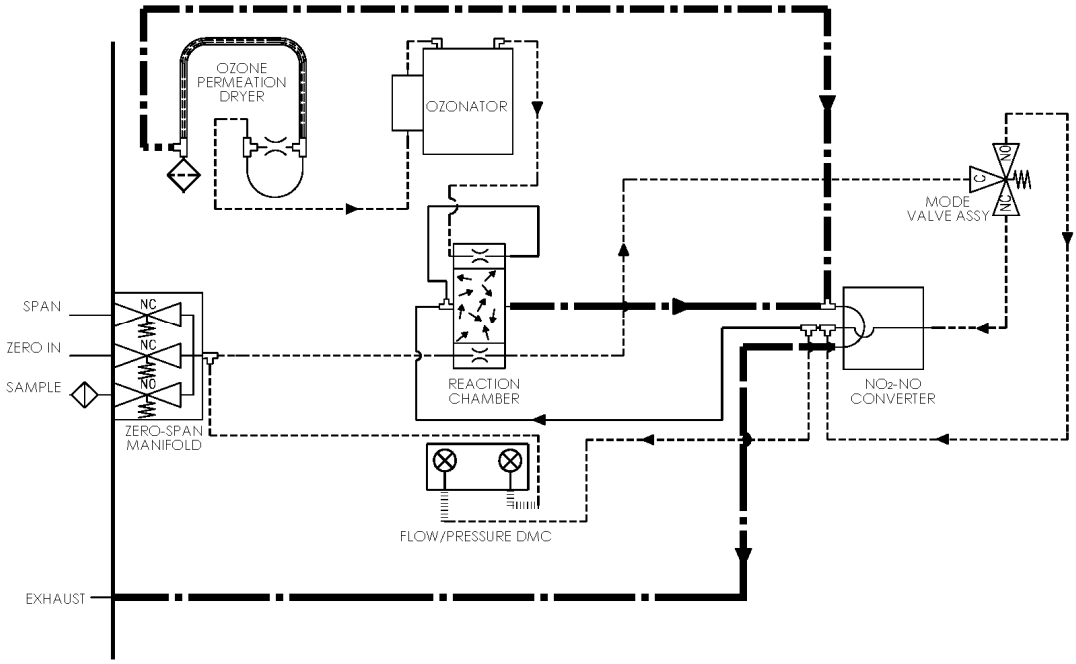


Figure 9–9. Flow Diagram, Zero/Span Option

Internal Oxygen (O_2) Sensor

The Internal Oxygen (O_2) Sensor option provides a paramagnetic sensor for O_2 concentration measurement and NO-NO_2-NO_x correction. This option allows the user to correct the NO_x readings for the amount of oxygen in the sample. Selectable O_2 concentrations can be used as the correction factor.

Figure 9–10 shows how this option is integrated with the 42iQHL.

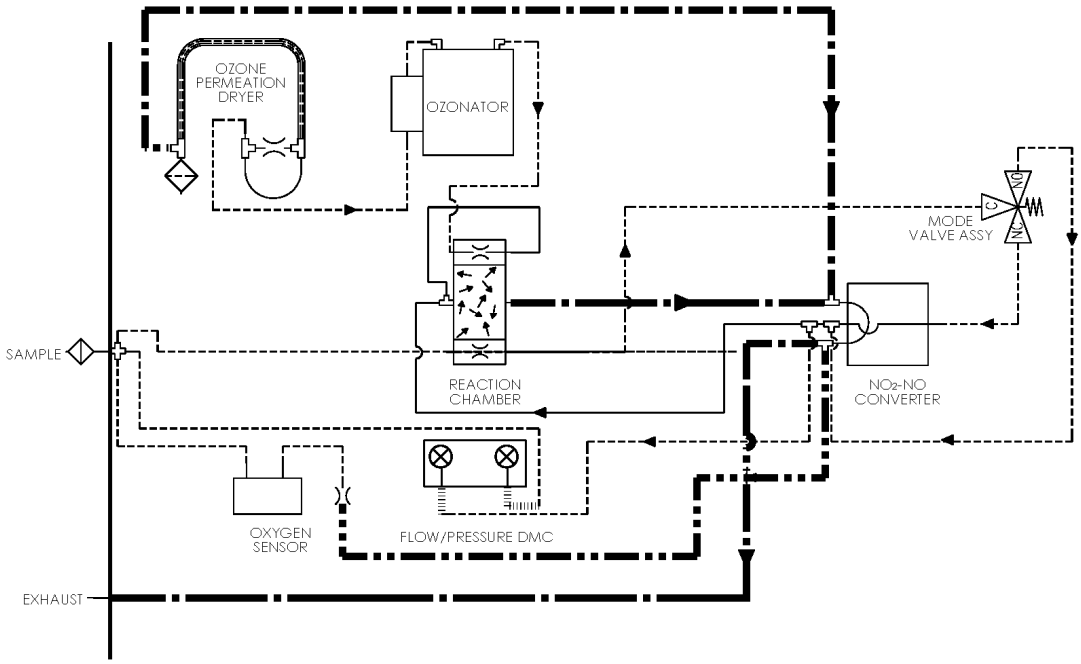


Figure 9–10. 42iQHL Flow Schematic with Internal O_2 Sensor

Bypass Flow

The bypass flow system is used when the sample must be transported over a long distance. The high level instrument now contains pressure compensation eliminating the need for the previous regulated flow system resulting in the much simplified 42iQHL bypass flow option.

Figure 9–10 shows how this option is integrated with the 42iQHL.

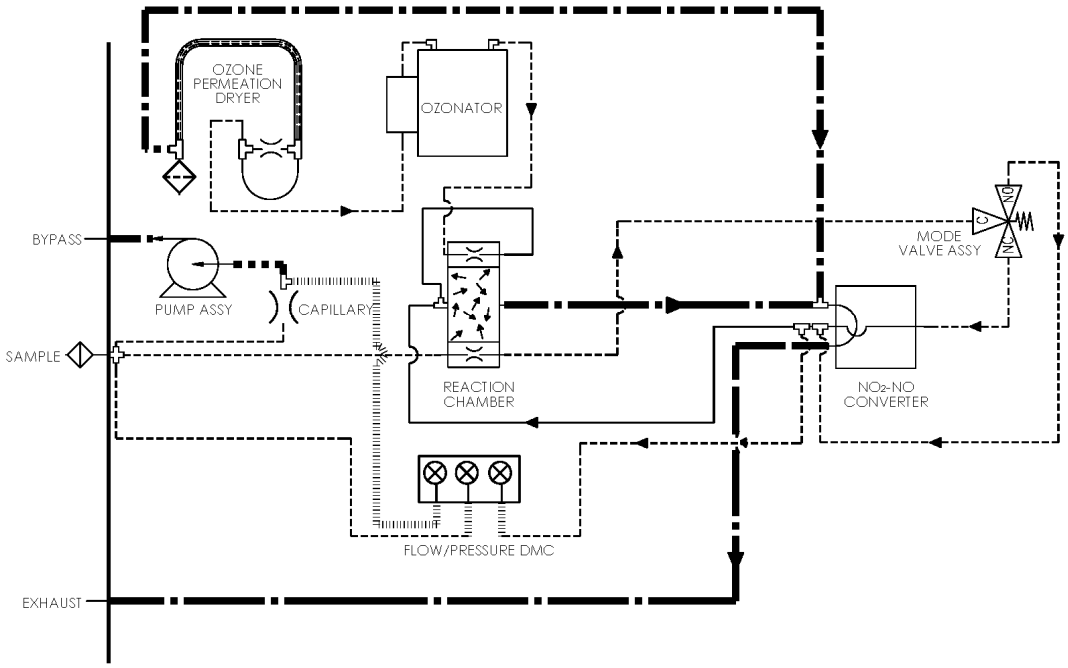


Figure 9–11. 42iQHL Flow Schematic with Bypass Flow Option

Ammonia Scrubber

The ammonia scrubber is mounted internally and removes ammonia from the sample air.

NO_2-to-NO Converter

The 42iQHL includes a stainless steel NO_2-to-NO converter as standard equipment.

Permeation Dryer

The permeation dryer minimizes routing maintenance procedures by providing a continuous stream of dry air to the ozonator (using the selective water permeation characteristics of the dryer). With the permeation dryer option, it is not necessary to constantly replenish the ozonator air-drying column as in the standard instrument.

PTFE Particulate Filter

A 5-10 micron pore size, two-inch diameter PTFE element is available for the 42iQHL. This filter should be installed just prior to the SAMPLE bulkhead. When using a filter, all calibrations and span checks must be performed through the filter.

Ozone Particulate Filter

The ozone particulate filter minimizes the potential for contamination of the capillary and reaction chamber by trapping any particulate matter before passing through the capillary and reaction chamber.

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
DANGER	A hazard is present that will result in death or serious personal injury if the warning is ignored. ▲
WARNING	A hazard is present or an unsafe practice can result in serious personal injury if the warning is ignored. ▲
CAUTION	The hazard or unsafe practice could result in minor to moderate personal injury if the warning is ignored. ▲
Equipment Damage	The hazard or unsafe practice could result in property damage if the warning is ignored. ▲

Safety and Equipment Damage Alerts in this Manual

Alert	Description
WARNING	If the equipment is operated in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired. ▲
	The service procedures in this manual are restricted to qualified service personnel only. ▲
Equipment Damage	Do not attempt to lift the analyzer by the cover or other external fittings. ▲
	This adjustment should only be performed by an instrument service technician. ▲

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 one (1) year 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.

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. ▲

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Quick Reference

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Appendix C
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Version 2.1, February 1999

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