thermoscientific

42iQD
Instruction Manual

NO$_x$ Analyzer

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ThermoFisher
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Chapter 1
Introduction

The Thermo Scientific™ 42iQD NO$_x$ Analyzer utilizes chemiluminescence technology to measure the amount of nitrogen oxides in the air from sub-ppb levels up to 100 ppm.

This analyzer is a single chamber, single photomultiplier tube design that measures NO$_x$ only. Dual range and auto range are standard features in this instrument. The instrument operates continuously in the NO$_x$ mode, providing a response time of less than 10 seconds.

Temperature and pressure correction are standard offerings of the 42iQD analyzer. User settable alarm levels for concentration and a variety of internal diagnostics are available from an easy to follow menu structure.

iQ Series Instrument Platform

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

- Distributed Measurement and Control (DMC) module design simplifies serviceability. Each DMC module contains its own microprocessor control enabling functional performance validation at the module level.

- Built-in predictive diagnostics and preventive maintenance schedules identify problems before they occur. The iQ Series platform sends email notifications directly to Thermo Fisher Scientific's world class service support team or locally identified addressees in order to proactively communicate analyzer performance conditions and identify spare parts needs before an operational concern arises.

- The iQ Series platform supports Modbus, streaming and VNC protocols over serial and Ethernet as well as analog and digital I/O for easy integration into most data management systems.

- Three standard USB ports afford convenient data download capability as well as the ability to connect additional hardware, such as a computer keyboard or mouse.

- The iQ Series GUI runs on a 7" color touchscreen display. The GUI is highly flexible and can be customized to enable a tailored

experience to simplify daily operations. Custom designed ePort 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. 42iQD Front

Principle of Operation

The 42iQD 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 molybdenum NO_2-to-NO converter heated to about 325 °C.

The ambient air sample is drawn into the 42iQD through the *sample* bulkhead, as shown in Figure 1–2. The sample flows through a capillary, to the NO_2-to-NO converter, and then to the reaction chamber (NO_x mode). A flow sensor prior to the reaction chamber measures the sample flow.

Dry air enters the 42iQD through the *dry air* bulkhead, 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_x concentrations are stored in memory. The 42iQD outputs NO_x concentrations to the front panel display and the analog outputs, and also makes the data available over the serial or Ethernet connection.
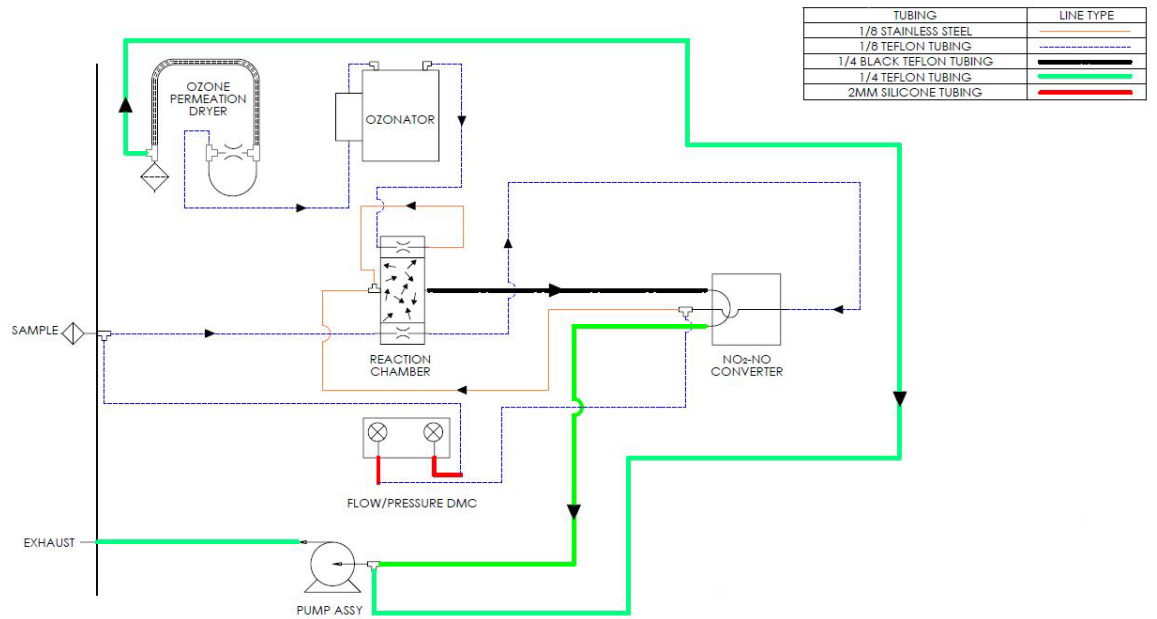
Figure 1–2. 42iQD Flow Schematic
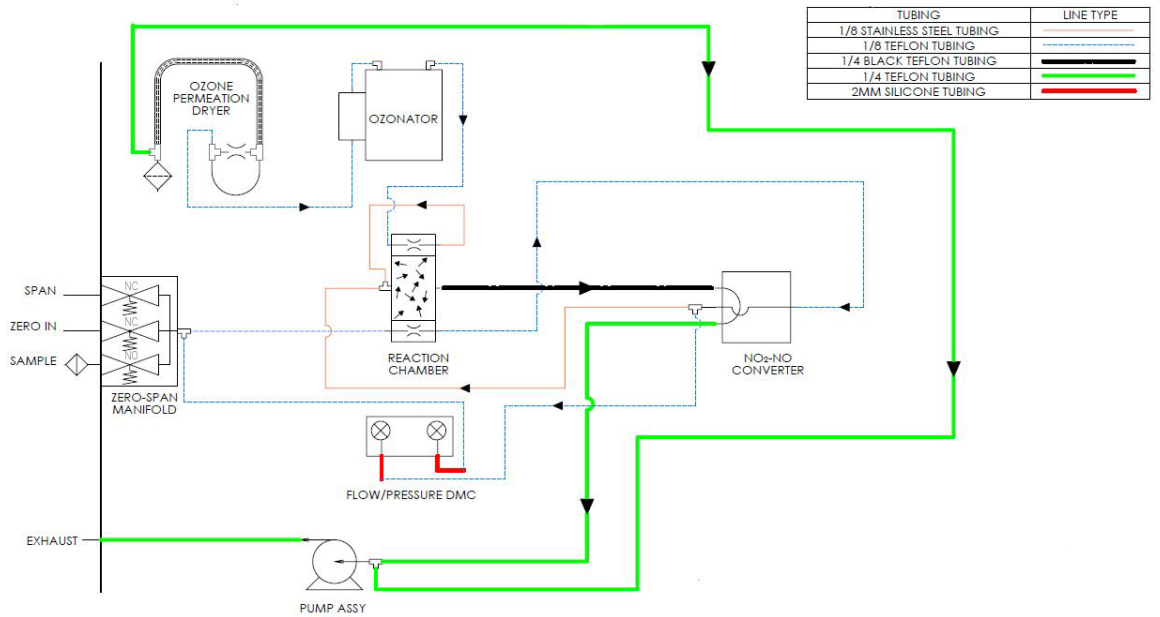
Figure 1–3. 42iQD Flow Schematic with Zero Span

Specifications

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

Table 1–1. 42iQD Specifications

Range	0–20 ppm 0–30 mg/m^3
Extended Ranges	0–200 ppm 0–150 mg/m^3
Zero Noise	0.20 ppb RMS (60 second averaging time)
Detection Limit	0.40 ppb (60 second averaging time)
Zero Drift	<0.40 ppb (24 hour)
Span Drift	±1% full-scale
Response Time (in automatic mode)	40 sec (10 second averaging time) 80 sec (60 second averaging time) 300 sec (300 second averaging time)
Linearity	±1% full-scale
Flow Rate	0.6–0.8 lpm
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	40 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, streaming, Bayern Hessen
Approvals and Certifications	CE, TUV-SUD Safety, UKCA

Dimensions

Figure 1–4. Bench Mount Assembly (dimensions in inches [mm])
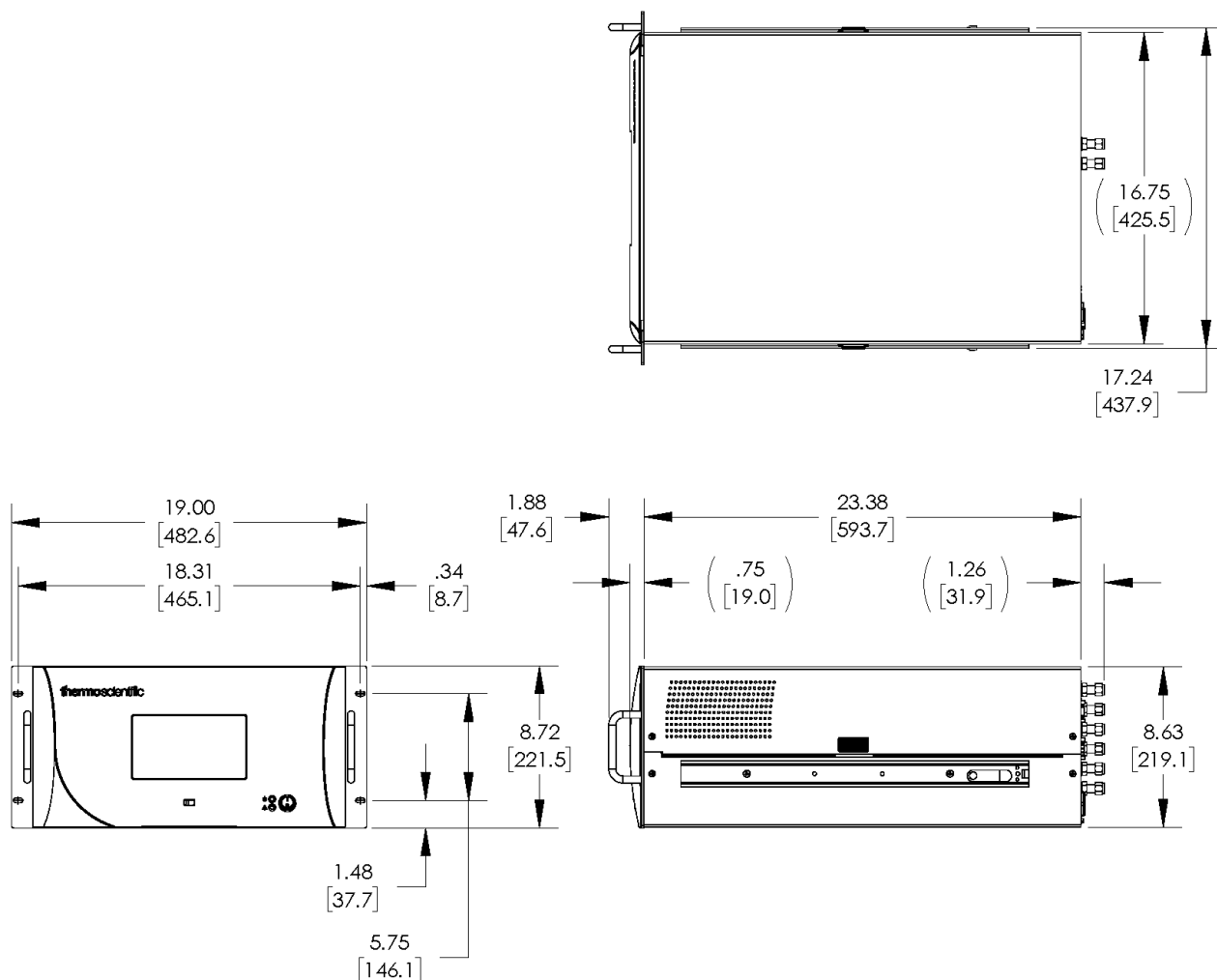
Figure 1–5. Rack Mount Assembly (dimensions in inches [mm])

17.81
[452.4]
RAIL CLEARANCE

10-32 X 3/8
PAN HEAD SCREWS

BAR NUT

RACK SLIDE
P/N 116300-00

22.00
[558.8]
REQUIRED

BAR NUT

10-32 X 3/8
PAN HEAD SCREWS OR

FOR FLUSH MOUNTING
COUNTERSINK FOR #10 FLAT HEAD
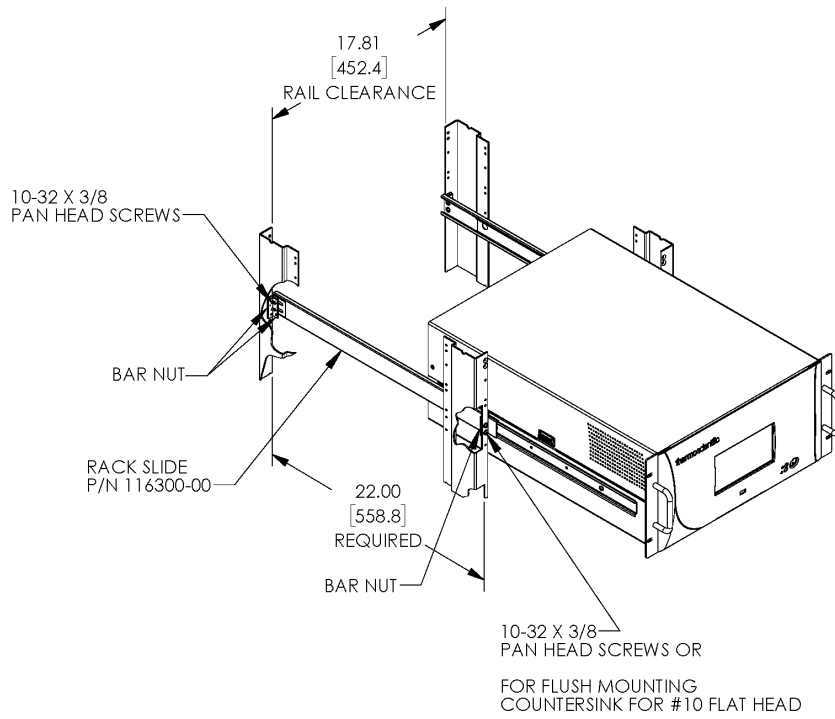
Figure 1–6. Rack Mount Requirements

EXTENDER BRACKET
OPTION 5235

BAR NUT

10-32 X 3/8
PAN HEAD SCREWS

BAR NUT

RACK SLIDE
P/N 116300-00

22.00 TO 28.75
[558.8 TO 730.3]
REQUIRED
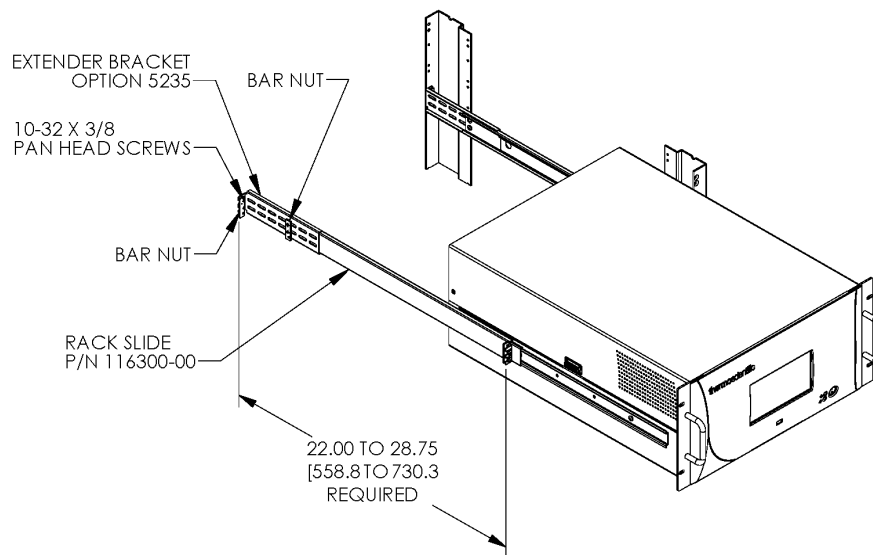
Figure 1–7. Rack Requirements Part 2

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 42iQD is shipped complete in one container. If there is obvious damage to the shipping container when you receive the instrument, notify the carrier immediately and hold for inspection. The carrier is responsible for any damage incurred during shipment.

Use the following procedure to unpack and inspect the instrument.

1. Remove the instrument from the shipping container and set it on a table or bench that allows easy access to both the front and rear.

2. Remove the cover to expose the internal components. (See "Figure 2–1" on page 2-2.)

3. Check for possible damage during shipment.

4. Check that all connectors and circuit boards are firmly attached.

5. Re-install the cover.

6. Remove any protective plastic material from the case exterior.

Cover Removing and Replacing

Use the following procedure to remove and replace the cover.

Equipment required:

Phillips screwdriver, #2

1. Unfasten the four 8-32 screws securing the cover (shipping screws).

2. Press in both latches located on top cover and hold while pulling up to remove. Set upright.

UNFASTEN
4X SCREWS
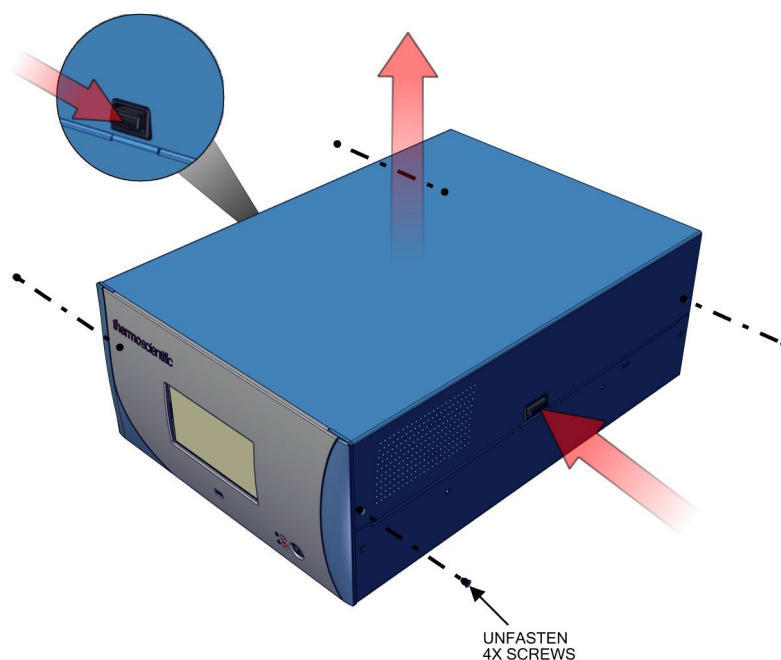
Figure 2–1. Removing the Cover

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

Mounting Options

The instrument can be installed in the following configurations:

- Bench Mount
- Rack Mount

Bench Mount

Positioned on bench, includes installing feet. See Figure 2–2.

Equipment required:

Slot drive, 5/16-inch

1. Fasten feet in position 1 or 2 to fit to the desired depth.
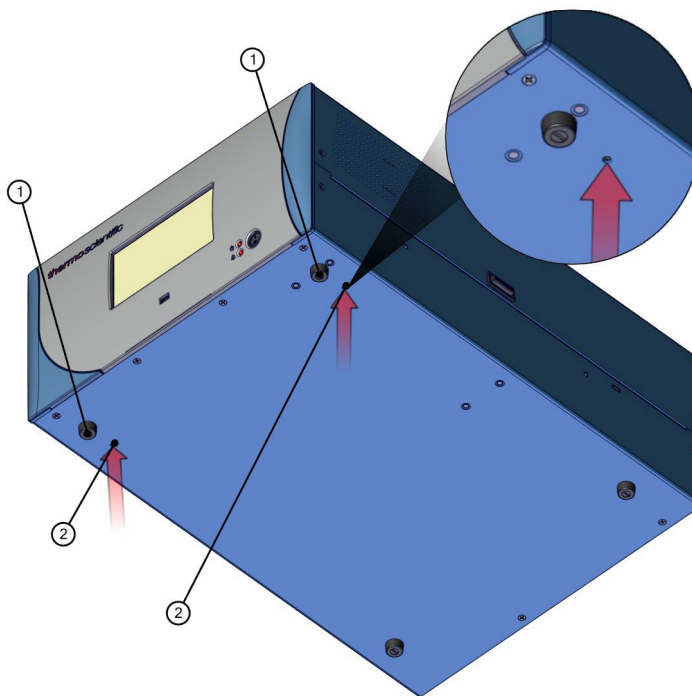
Figure 2–2. Installing Feet

Rack Mount

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

Equipment required:

Phillips drive, #2

1. Start by gripping from the top corners of the front panel and pull outwards.
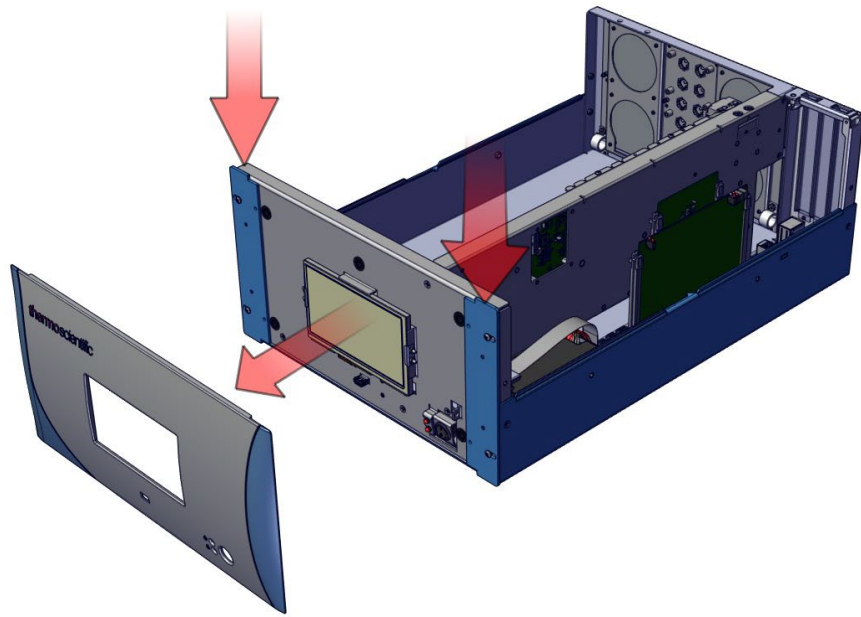
Figure 2–3. Removing the Front Panel

2. Unfasten the four 8-32 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.

SCREW, 8-32 X 3/16, PAN HEAD, 4X

SCREW, 8-32 X 3/16, FLAT HEAD, 4X
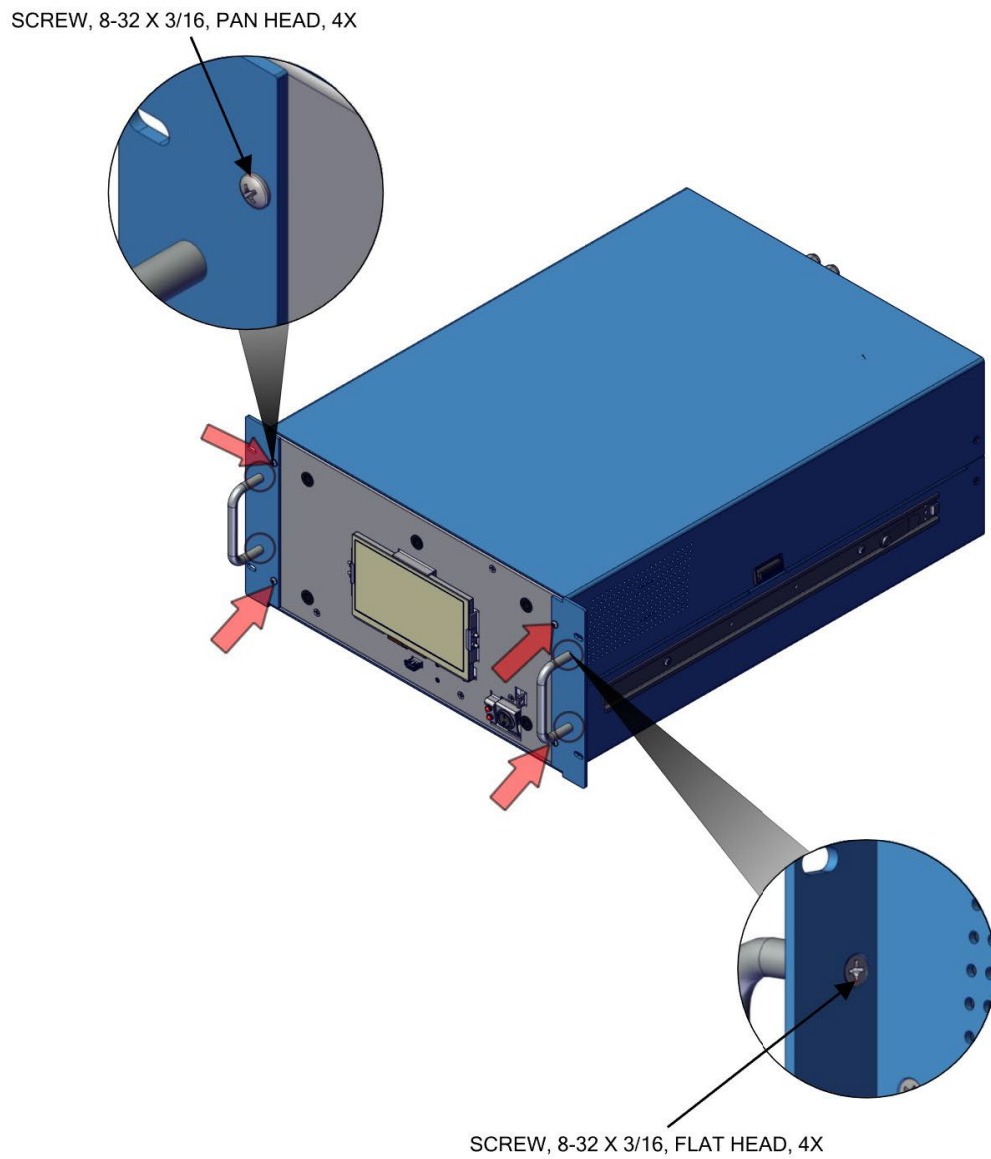
Figure 2–4. Installing Ears and Handles

Setup Procedure

Use the following procedure to setup the instrument:

1. Connect the sample line to the SAMPLE bulkhead on the rear panel (Figure 2–5). 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 9-18. ▲

    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 2–6 if gas pressure is greater than atmospheric pressure. ▲

2. Connect the EXHAUST bulkhead 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.

3. 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.

4. Connect a suitable recording device to the rear panel connector. For detailed information about connecting to the instrument, refer to:

    "Connecting External Devices" on page 9-1

    Communications > "Analog I/O" on page 3-52 and "Digital I/O" on page 3-54.

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

⚠ WARNING   The 42iQD is supplied with a three-wire grounding cord. Under no circumstances should this grounding system be defeated. ▲
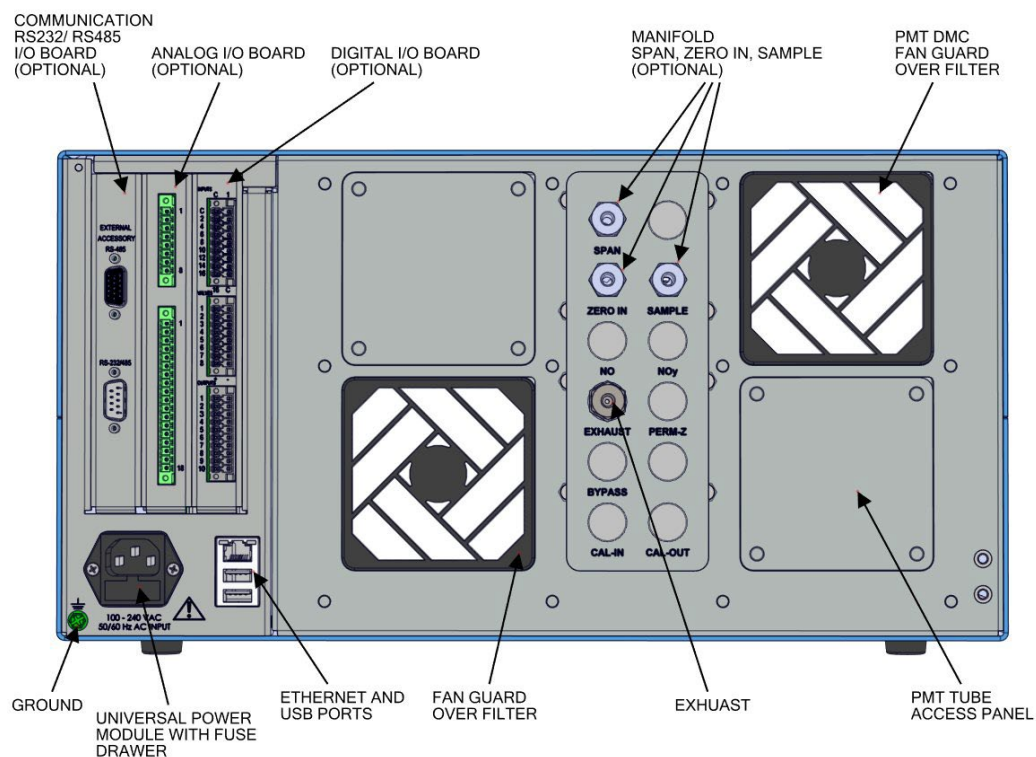
Figure 2–5. 42iQD Rear Panel
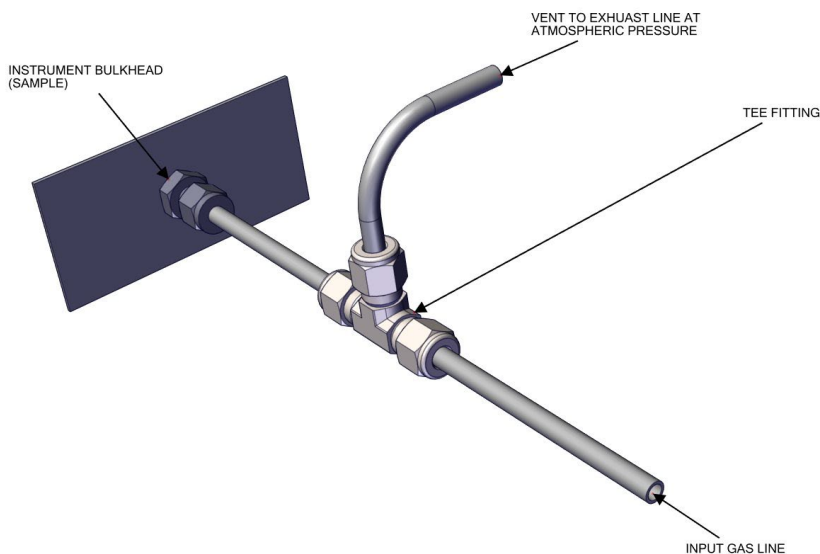
Figure 2–6. Atmospheric Dump Bypass Plumbing

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.
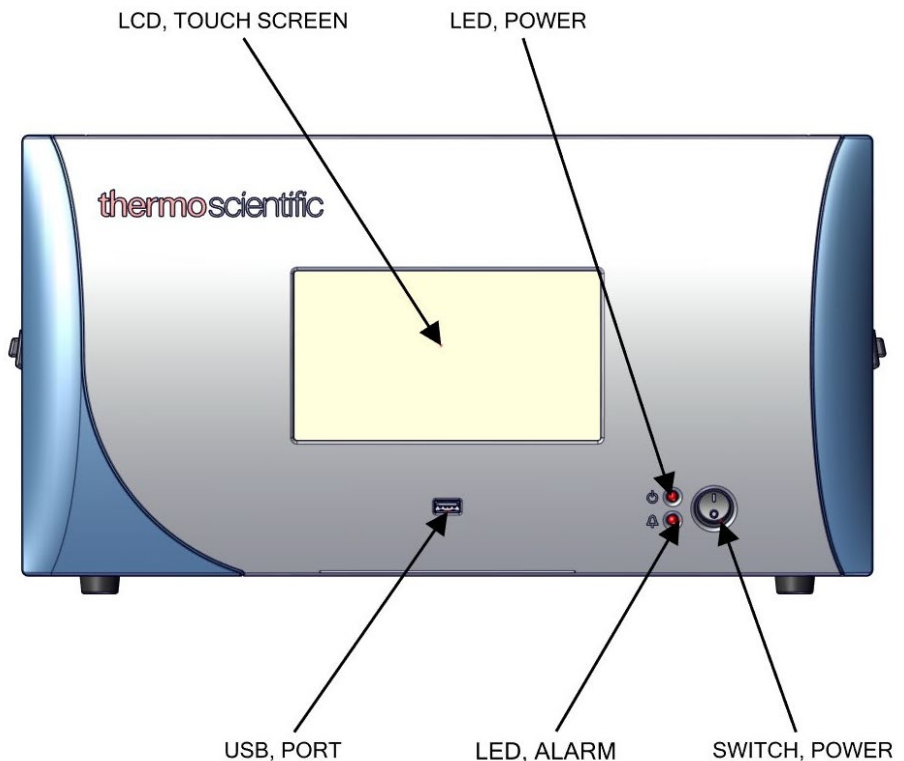
Figure 2–7. Front Panel and Touchscreen Display

Chapter 3
Operation

This chapter describes the functionality of the touchscreen user interface.

Instrument Display

The Instrument Display consists of a Title Bar, a User Interface, and a Status Bar. The Title Bar, located at the top, includes the Home button, instrument name, instrument gas mode, and Help button. The User Interface, located in the middle, is where the Home Screen and all other screens are accessed. The Home Screen has three Main Menu buttons, located on the left side, which include Calibration, Data, and Settings, while the user interface to the right of the buttons displays the chemical names, concentration values and units. 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)
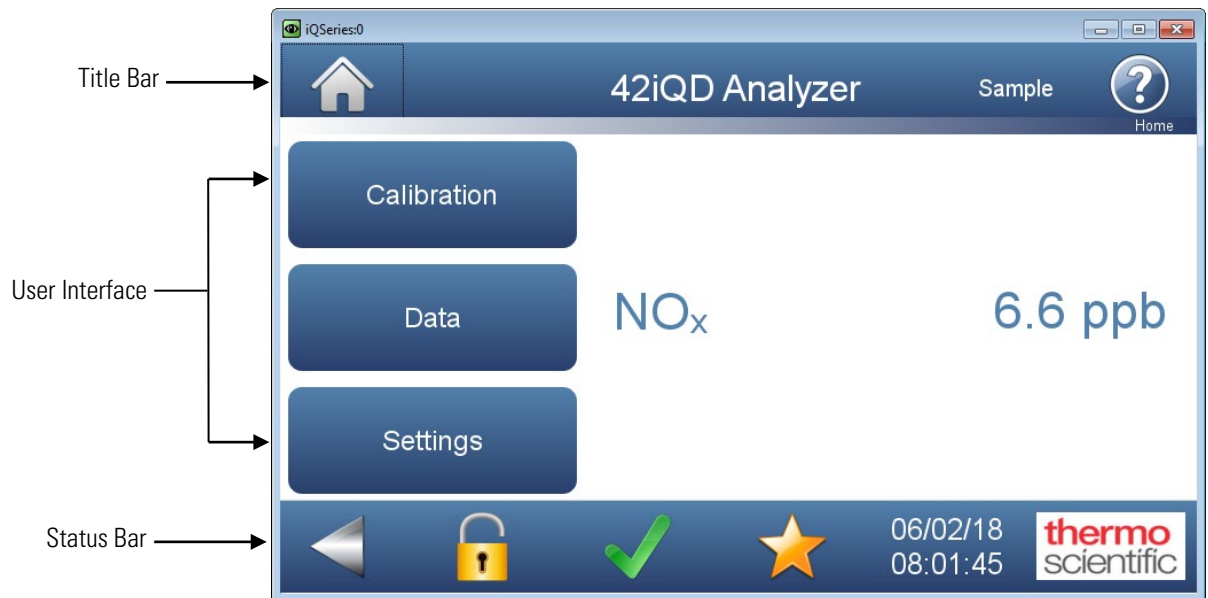
Home Screen (dual or auto range mode)

Title Bar

User Interface

Status Bar

iQSeries:0

42iQD Analyzer   Sample   Home

Calibration

Data   NOₓ High   6.8 ppb

Settings

06/02/18
08:03:06   thermo scientific
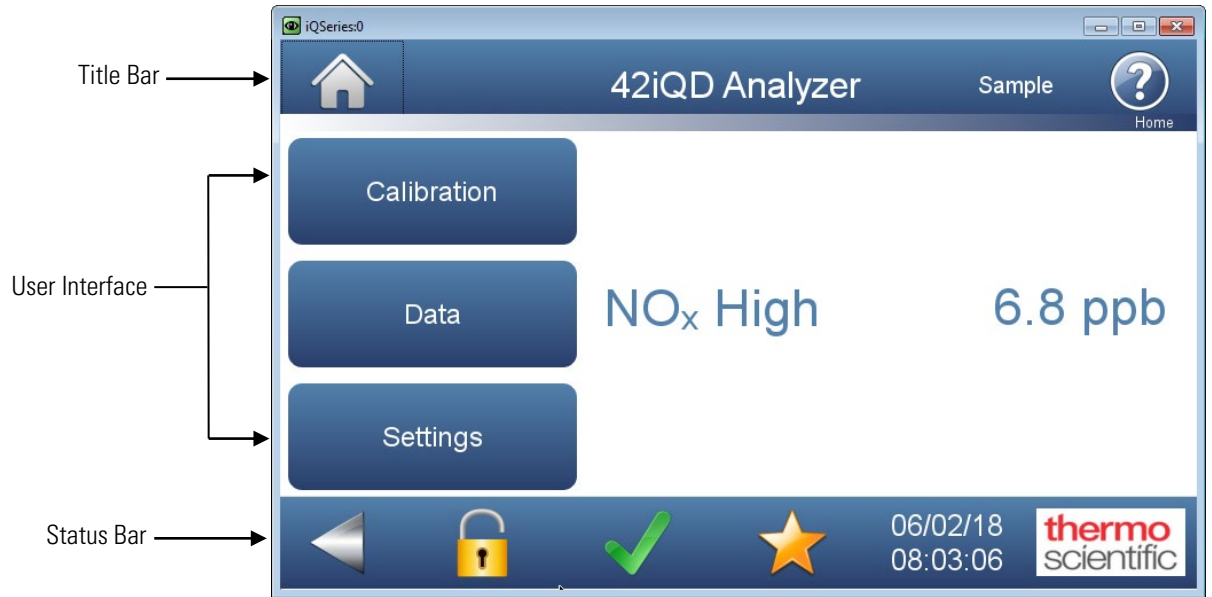
The Instrument Display contains the following information:

- 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 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_x concentration 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.

Calibration

Calibrate Background
- Calibrate NOx Background

Calibrate Span Coefficient
- Calibrate NOx Span Coefficient

Zero/Span Schedule

Advanced Calibration
- Manual Calibration
  - Adjust Background
    - Adjust NOx Background
  - Adjust Coefficient
    - Adjust NOx Span Coefficient
  - Reset Bkg and Span Coef
- Calibration History

Data

View Data Log (Last Hour)
- Graph

View Data Log (Last 24 Hours)
- Graph

View Data (User Defined Time)
- Start Time
  - End Time – View Data
    - Graph

Advanced Data
- Data Logging Setup
- Streaming Data Setup

Settings

Health Check
- Status and Alarms
- Predictive Diagnostics
- Maintenance
- File Sharing and Support
- iQ360
- Firmware Version

- Measurement Settings
- Averaging Time
- Range Mode Selection
- Range Settings
- Gas Mode
- Gas Units
- Dilution Ratio
- Advanced Measurement
  - Reaction Chamber Settings
  - Extended Ranges
  - Compensation
  - Pressure Calibration

Communications

Instrument Settings
- Instrument Setpoints
- Alarm Setpoints
- Ozonator Safety
- PMT Supply
- Ozonator Supply
- Display Setup
- Clock
- Language
- Pump Power
- Reboot Instrument

Configuration

Security Access Levels

USB Drive
- Firmware Update Via USB Drive
- Download Data to USB Drive
- Change USB Password

User Contact Information

Update Bootloader

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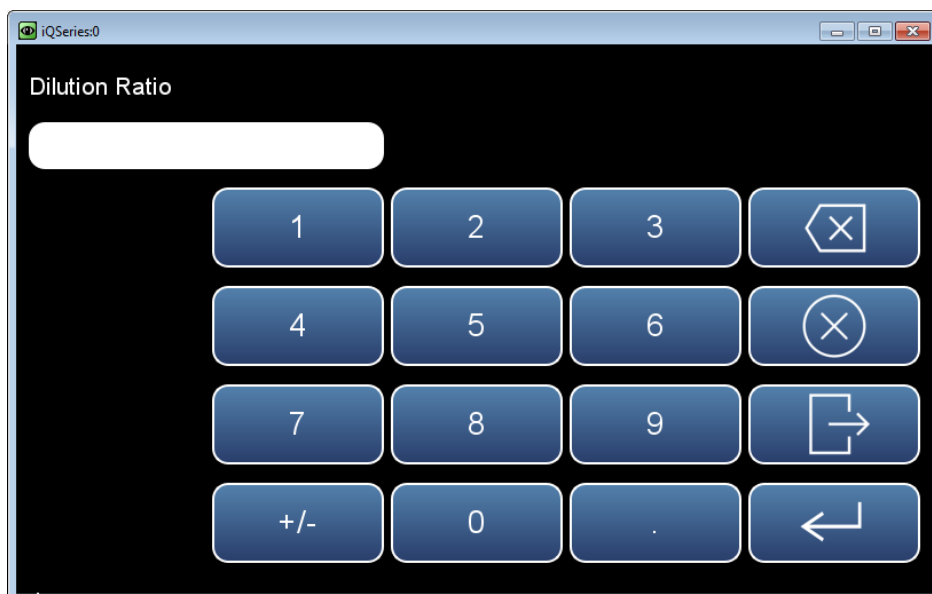
Alphanumeric Keypad

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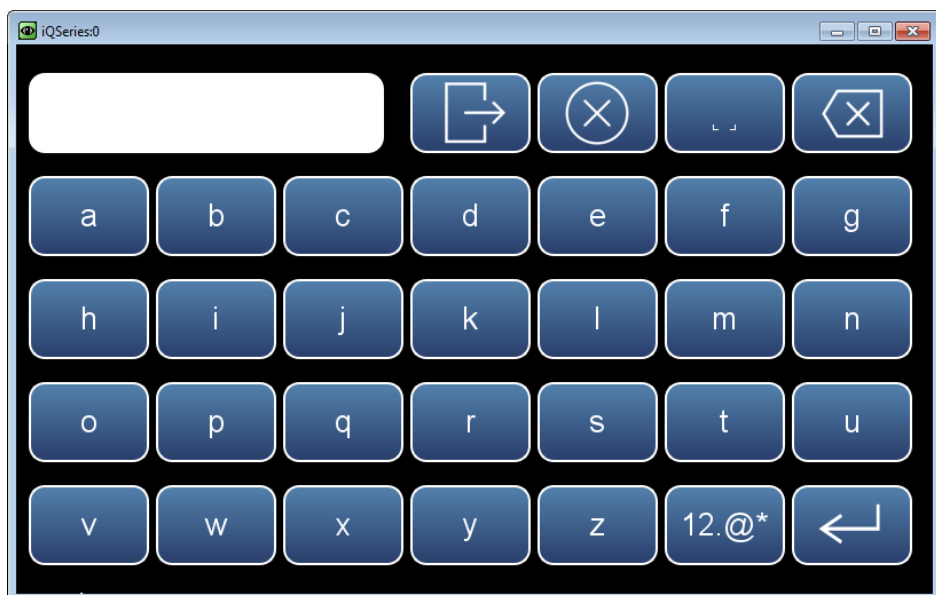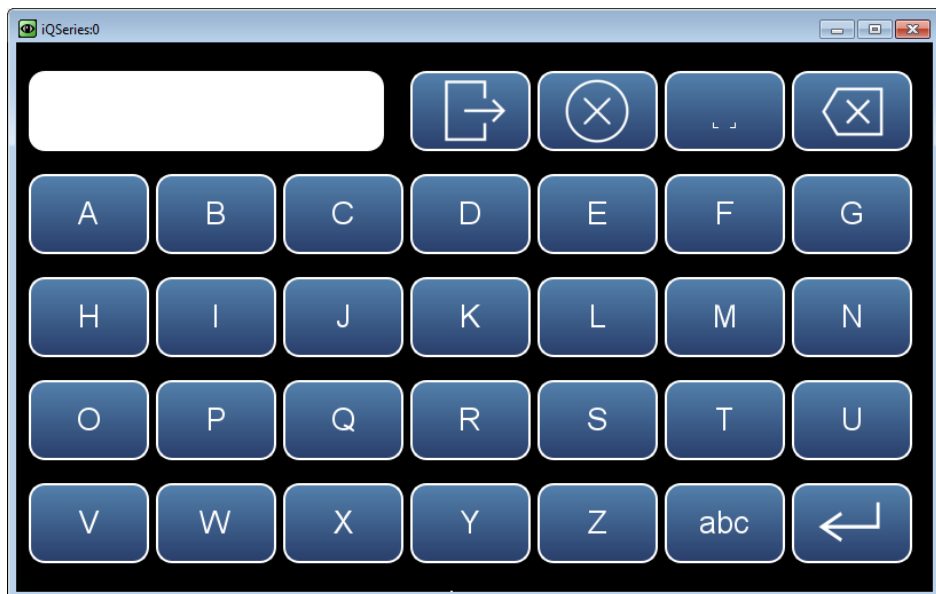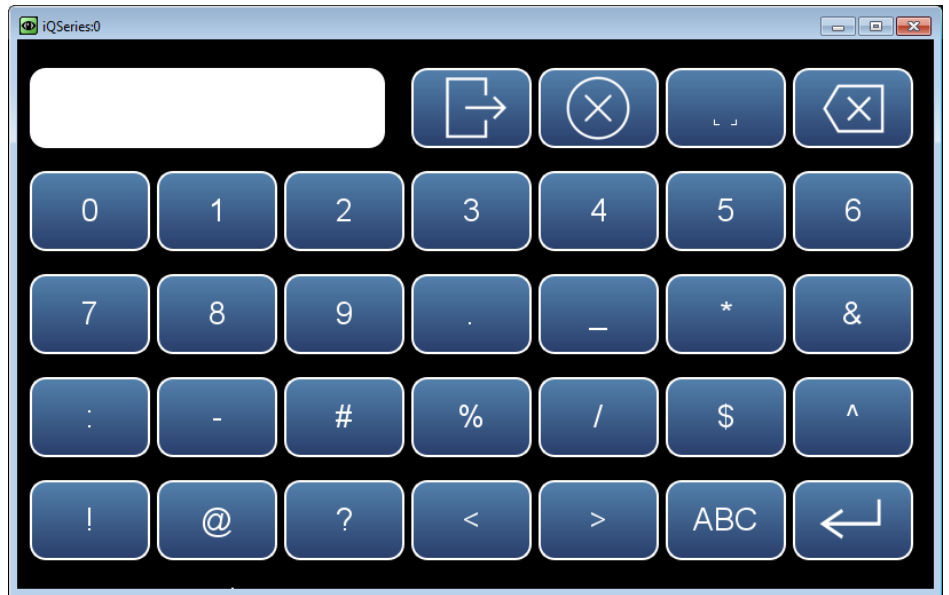
Calibration

The Calibration screen allows the user to calibrate 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
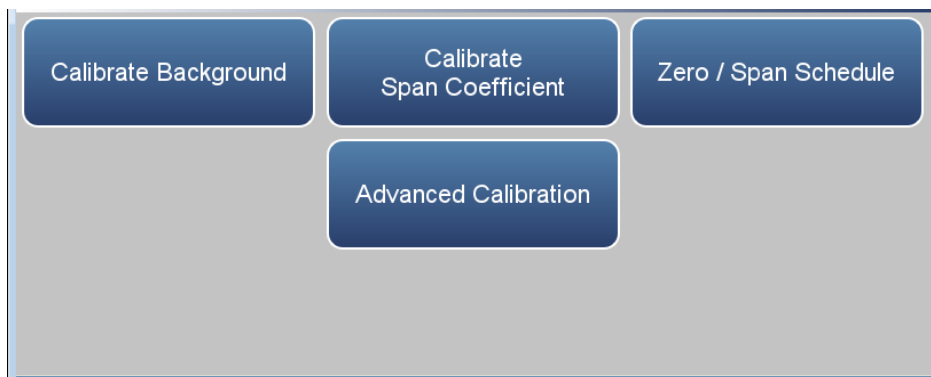
The Calibration screen contains the following information:

- *Calibrate Background:* Sets the NO_x reading to zero.

- *Calibrate Span Coefficients:* Sets the NO_x span coefficient.

- *Zero/Span Schedule:* Programs the instrument to perform fully automated zero and span checks or adjustments.

- *Advanced Calibration:* Calibrates the instrument using manual zero/span calibration and provides calibration history.

Calibrate Background

The Calibrate Background screen is used to calibrate the instrument zero background of NO_x.

Home Screen>Calibration>Calibrate Background
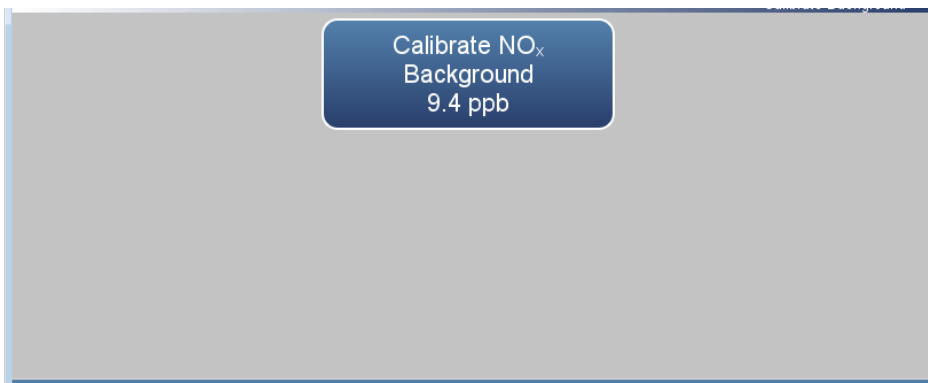
The Calibrate Background screen contains the following information:

- *Calibrate NO_x Background:* Sets the NO_x background to zero.

Calibrate NO$_x$ Background

The Calibrate NO$_x$ Background screen is 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 NO$_x$ Background
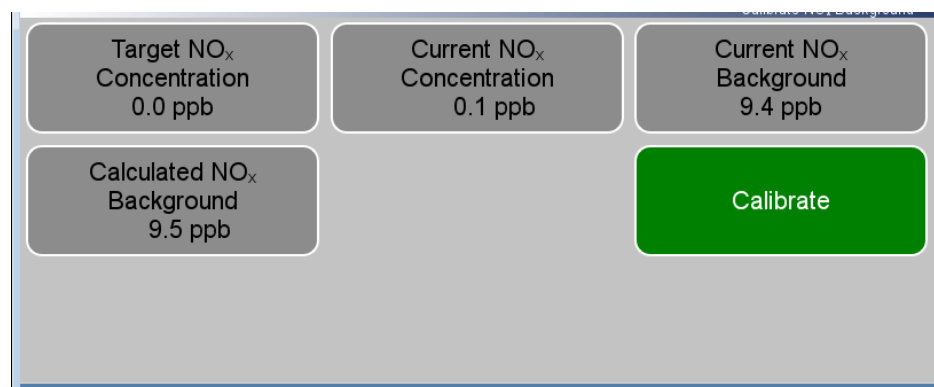
The Calibrate Background screen contains the following information:

● *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 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 Coefficient

The Calibrate Span Coefficient screen is used to calibrate the NO_x span coefficient.

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 3-70.

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 Coefficient (single range mode)

Calibrate NO_x
Span Coefficient
0.988

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

Calibrate High Range
NO_x Span Coefficient
1.000

Calibrate Low Range
NO_x Span Coefficient
0.988
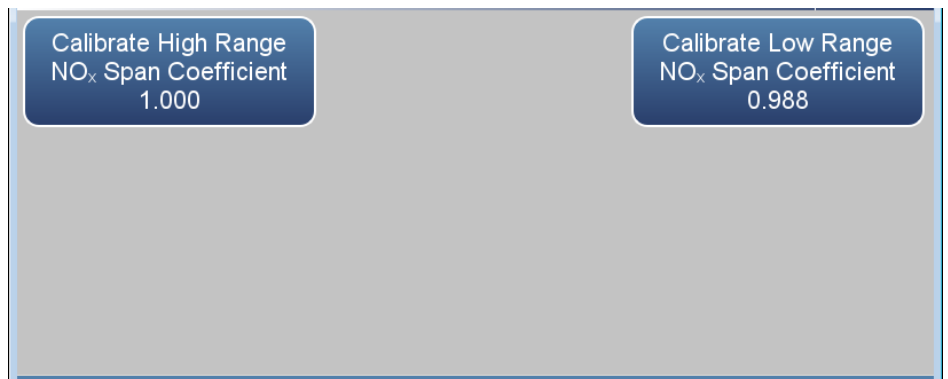
The Calibrate Coefficients screen contains the following information:

- *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$_x$ Span Coefficient

The Calibrate NO$_x$ Span Coefficient screen is used to enter span concentration and calibrate the NO$_x$ span coefficient. The span coefficient is calculated, stored, and used to correct the current reading.

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 Coefficient (single range mode)

Edit NO$_x$ Span Concentration 400 ppb	Current NO$_x$ Concentration -0.1 ppb	Current NO$_x$ Span Coefficient 0.988
Calculated NO$_x$ Span Coefficient -5064.312		Calibrate

Home Screen>Calibration>Calibrate High Range Coefficient (dual or auto range mode)

Edit Span Concentration 0.0 ppb	Current High Range NO$_x$ Concentration -0.1 ppb	Current High Range NO$_x$ Coefficient 1.000 ppb
Calculated High Range NO$_x$ Span Coefficient 0.000		Calibrate
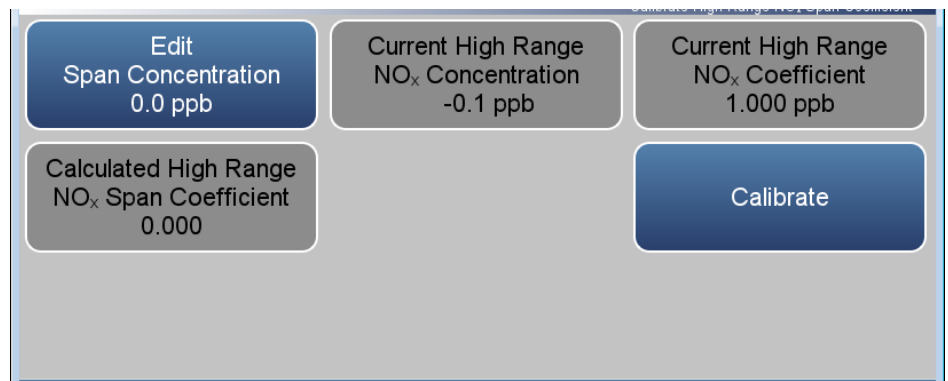
The Calibrate NO$_x$ Span Coefficient screens contain the following information:

- *Edit NO$_x$ Span Concentration:* User enters the NO$_x$ 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$_x$ Concentration:* Read only. Current NO$_x$ concentration reading when in single range mode.

- *Current High Range NO$_x$ Concentration:* Read only. Current high range NO$_x$ concentration reading when in dual or auto range mode.

- *Current Low Range NO$_x$ Concentration:* Read only. Current low range NO$_x$ concentration reading when in dual or auto range mode.

- *Current NO$_x$ Span Coefficient:* Read only. Displays the current user-set NO$_x$ span coefficient when in single range mode.

- *Current High Range NO$_x$ Coefficient:* Read only. Displays the current user-set high range NO$_x$ span coefficient when in dual or auto range mode.

- *Current Low Range NO$_x$ Coefficient:* Read only. Displays the current user-set low range NO$_x$ span coefficient when in dual or auto range mode.

- *Calculated NO$_x$ Span Coefficient:* Read only. After the "Edit NO$_x$ Span Concentration" value is entered, the new calculated NO$_x$ span coefficient is displayed.

- *Calculated High Range NO$_x$ Span Coefficient:* Read only. After the "Edit Span Concentration" value is entered, the new calculated high range NO$_x$ span coefficient is displayed.

- *Calculated Low Range NO$_x$ Span Coefficient:* Read only. After the "Edit Span Concentration" value is entered, the new calculated low range NO$_x$ 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
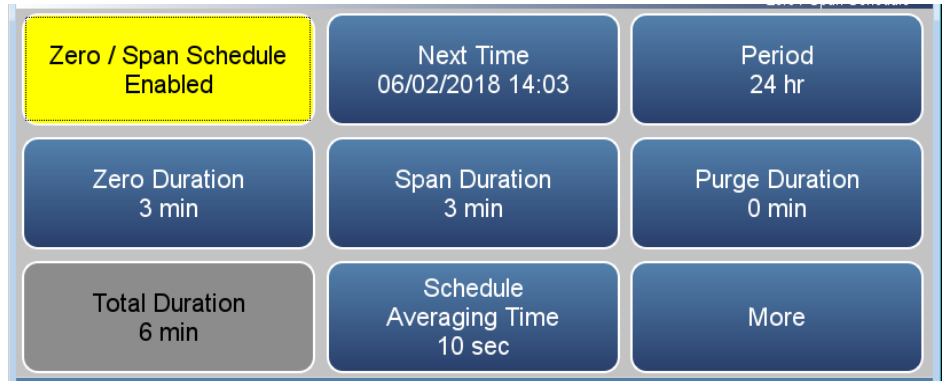
Home Screen>Calibration>Zero/Span Schedule>More
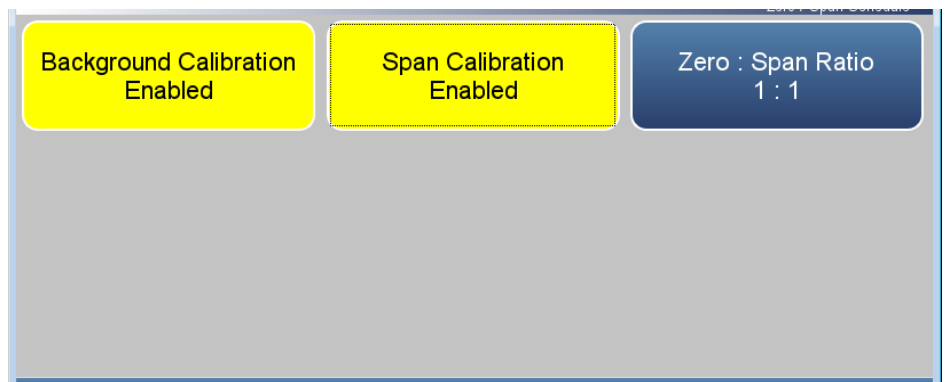
The Zero/Span Schedule contains the following information:

- *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.

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
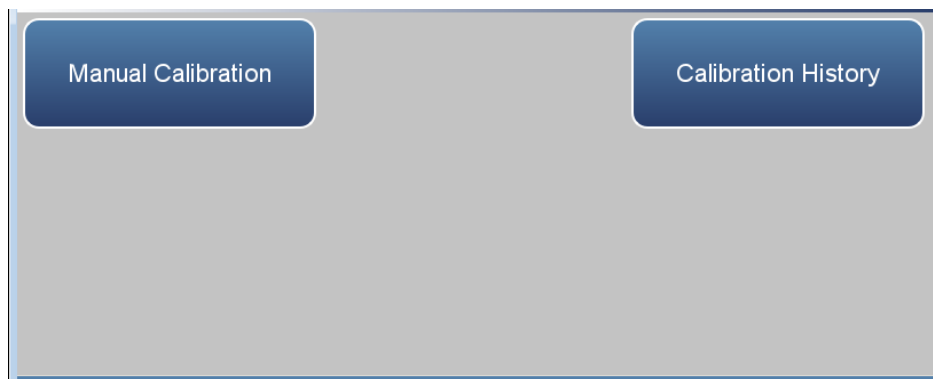
The Advanced screen contains the following information:

● *Manual Calibration:* The user manually adjusts the background or span coefficient.

● *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

| Adjust Background | Adjust Span Coefficient | Reset Bkg to 0.000 and Span Coef to 1.000 |

The Manual Calibration screen contains the following information:

● *Adjust Background:* Allows the user to manually adjust the zero background.

● *Adjust Span Coefficient:* Allows the user to manually adjust the span coefficient.

● *Reset Bkg to 0.000 and Span Coef to 1.000:* Resets background and coefficient.

Adjust Background   The Adjust Background screens is used to manually adjust the NO_x zero
background.

**Home Screen>Calibration>Advanced Calibration>Manual
Calibration>Adjust Background**
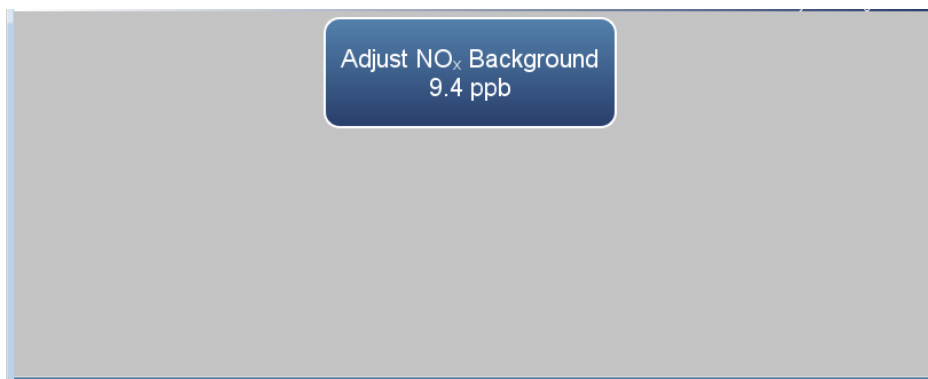
The Adjust Background screen contains the following information:

● *Adjust NO_x Background:* User manually adjusts zero NO_x background.

Adjust NO$_x$ Background   The Adjust NO$_x$ Background screen is 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 Background>Adjust NO$_x$ Background
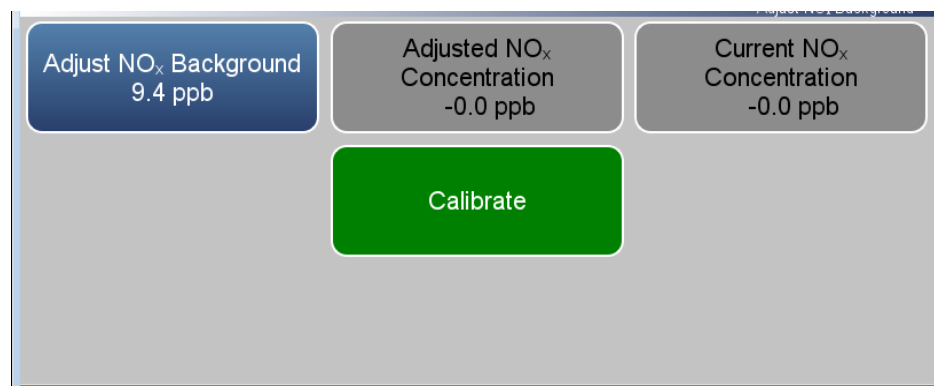
The Adjust NO$_x$ Background screens contains the following information:

● *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 NO$_x$ Span Coefficient

The NO$_x$ Span Coefficient screen is used to manually adjust the coefficient and enter the span concentration. The span coefficient is calculated, stored, and used to correct the current reading.

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$_x$ Span Coefficient and Adjust Low Range NO$_x$ 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 Coefficient>Adjust NO$_x$ Span Coefficient (single range mode)

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

Adjust High Range NO$_x$ Span Coefficient 1.000		Adjust Low Range NO$_x$ Span Coefficient 0.988
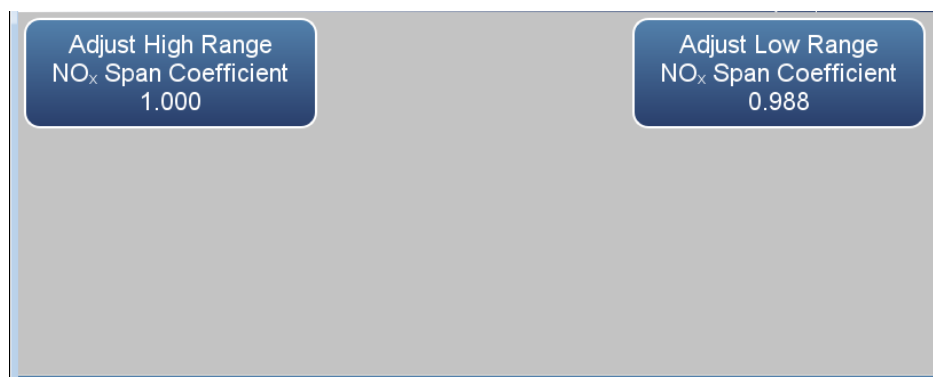
The Adjust NO$_x$ Span Coefficient screens contain the following information:

● *Adjust NO$_x$ Span Coefficient:* User manually adjusts NO$_x$ span coefficient when in single range mode.

● *Adjusted NO$_x$ Concentration:* Read only. Shows adjusted NO$_x$ concentration based on adjusted NO$_x$ span coefficient when in single range mode.

● *Current NO$_x$ Concentration:* Read only. Shows current NO$_x$ concentration when in single range mode.

● *Adjust High Range NO$_x$ Span Coefficient:* User manually adjusts the high range NO$_x$ span coefficient when in dual or auto range mode.

● *Adjusted High Range NO$_x$ Concentration:* Read only. Shows adjusted high range NO$_x$ concentration based on adjusted high range NO$_x$ span coefficient when in dual or auto range mode.

● *Current High Range NO$_x$ Concentration:* Read only. Shows current high range NO$_x$ concentration when in dual or auto range mode.

● *Adjust Low Range NO$_x$ Span Coefficient:* User manually adjusts the NO$_x$ low span coefficient when in dual or auto range mode.

● *Adjusted Low Range NO$_x$ Concentration:* Read only. Shows adjusted NO$_x$ concentration based on adjusted low range NO$_x$ span coefficient when in dual or auto range mode.

● *Adjusted Low Range NO$_x$ Concentration:* Read only. Shows current low range NO$_x$ concentration when in dual or auto range mode.

● *Calibrate:* Calibrates span coefficient by saving the newly adjusted span coefficient.
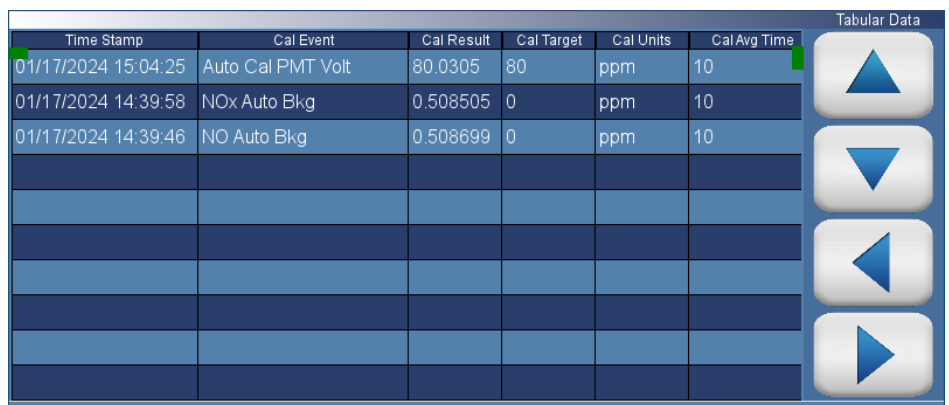
Calibration History
The Calibration History screen shows the log of calibrations and calibration checks performed.

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	Cal Event	Cal Result	Cal Target	Cal Units	Cal Avg Time
01/17/2024 15:04:25	Auto Cal PMT Volt	80.0305	80	ppm	10
01/17/2024 14:39:58	NOx Auto Bkg	0.508505	0	ppm	10
01/17/2024 14:39:46	NO Auto Bkg	0.508699	0	ppm	10

Tabular Data

The Calibration History screen contains the following information:

● *Time Stamp:* Time of calibration or calibration check.

● *Cal Event:* Lists the type of calibration event.

● *Cal Result:* Concentration result.

● *Cal Target:* Concentration setpoint value.

● *Cal Units:* Displays units for each item.

● *Cal Avg Time:* Averaging time used during the calibration or calibration check.

● *Serial No:* Displays the module serial number.

Data

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

Home Screen>Data
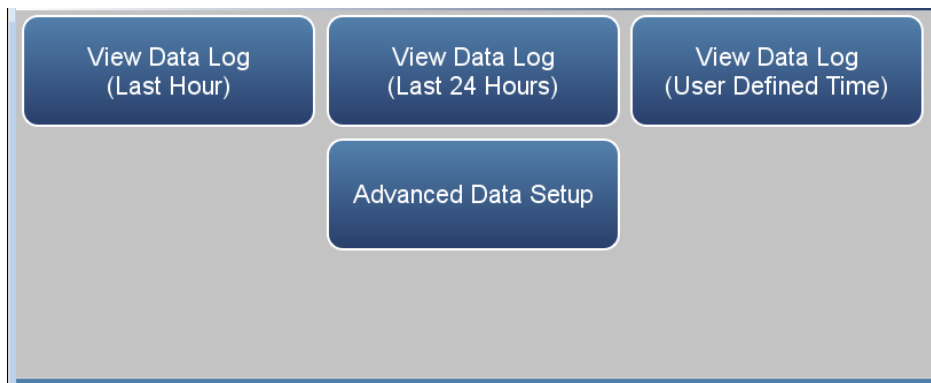
The Data screen contains the following information:

- *View Data Log (Last Hour):* User views last hour of historical data. Table shows most recent data on top.

- *View Data Log (Last 24 Hours):* User views 24-hour of historical data. Table shows most recent data on top.

- *View Data Log (User Defined Time):* User selects the start and end time for viewing the data. Table shows most recent data on top.

- *Advanced Data Setup:* Allows the user to set up the parameters of how the data is stored.
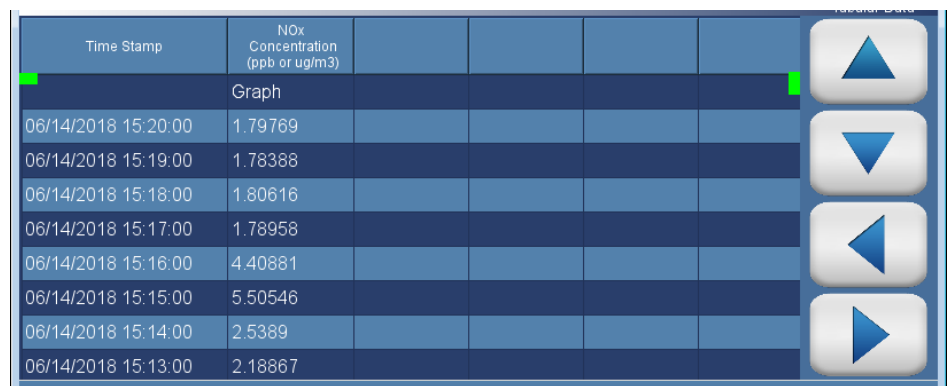
View Data Log (Last Hour)

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

Use the ▲ and ▼ buttons to move up and down and the ◄ and ► buttons to move left and right.

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

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

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.
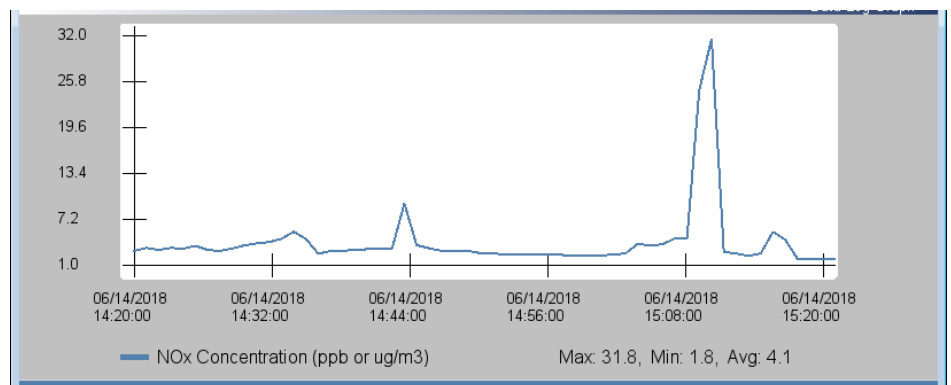
View Data Log (Last 24 Hours)

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	NOx Concentration (ppb or ug/m3)				
	Graph				
06/14/2018 15:21:00	1.79782				
06/14/2018 15:20:00	1.79769				
06/14/2018 15:19:00	1.78388				
06/14/2018 15:18:00	1.80616				
06/14/2018 15:17:00	1.78958				
06/14/2018 15:16:00	4.40881				
06/14/2018 15:15:00	5.50546				
06/14/2018 15:14:00	2.5389				

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.
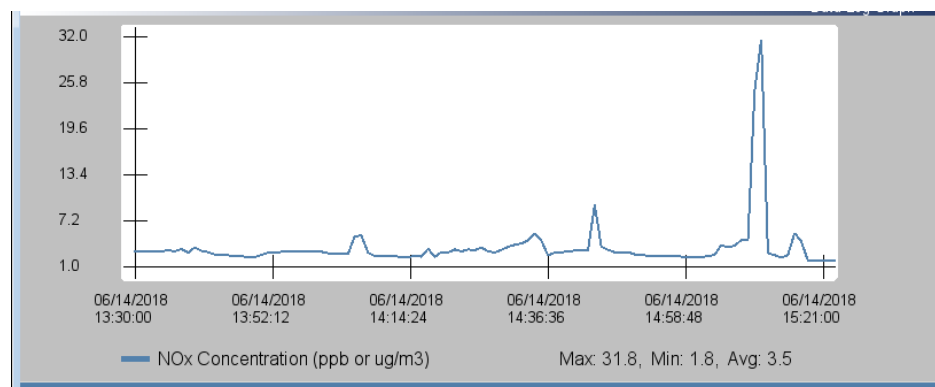
View Data Log (User Defined Time)

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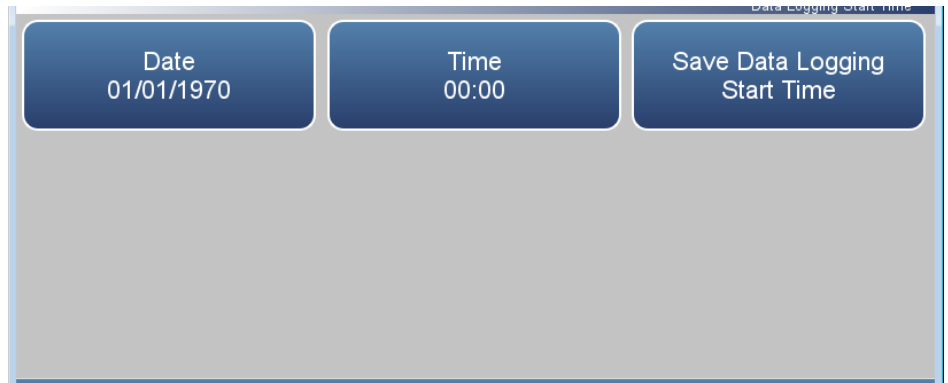
Home Screen>Data>View Data Log (User Defined Time)>Save Data Logging Start Time

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
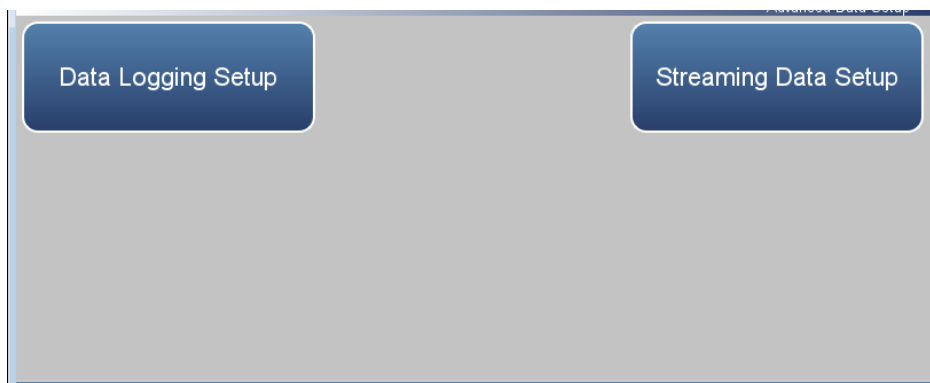
The Advanced Data Setup screen contains the following information:

- *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

Select Data Logging Variables	Period 1 min	Data Treatment Current
	Erase Data Log Records	
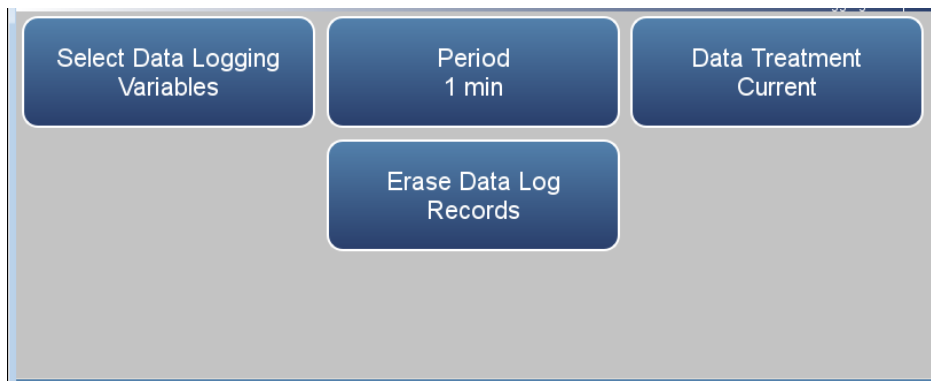
The Data Logging Setup screen contains the following information:

● *Select Data Logging Variables*: User selects instrument variables to log.

● *Period*: User selects how often data is collected by setting the duration between logged data.

● *Data Treatment*: Toggles between Average, Current, Minimum and Maximum. When set to average, the average value during the period will be recorded. When set to current, the latest data will be recorded. When set to minimum or maximum, the minimum or maximum value during the period will be recorded.

● *Erase Data Log Records*: Allows the user to erase all values in the data log and updates the data logging table.
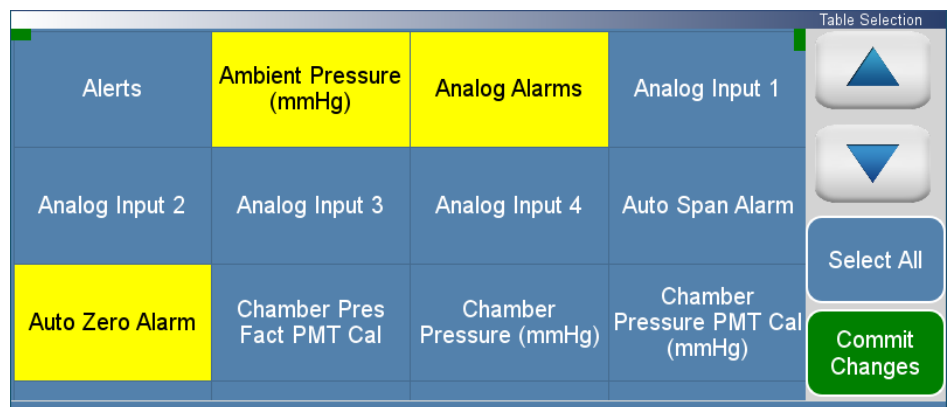
Note The User Log stores up to 1 year or 525600 data points and the Service Log stores up to 10080 data points (1 week worth of 1-minute data). ▲

Select Data Logging Variables

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

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

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

				Table Selection
Alerts	Ambient Pressure (mmHg)	Analog Alarms	Analog Input 1	▲
Analog Input 2	Analog Input 3	Analog Input 4	Auto Span Alarm	▼
				Select All
Auto Zero Alarm	Chamber Pres Fact PMT Cal	Chamber Pressure (mmHg)	Chamber Pressure PMT Cal (mmHg)	Commit Changes

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

Home Screen>Data>Advanced>Streaming Data Setup
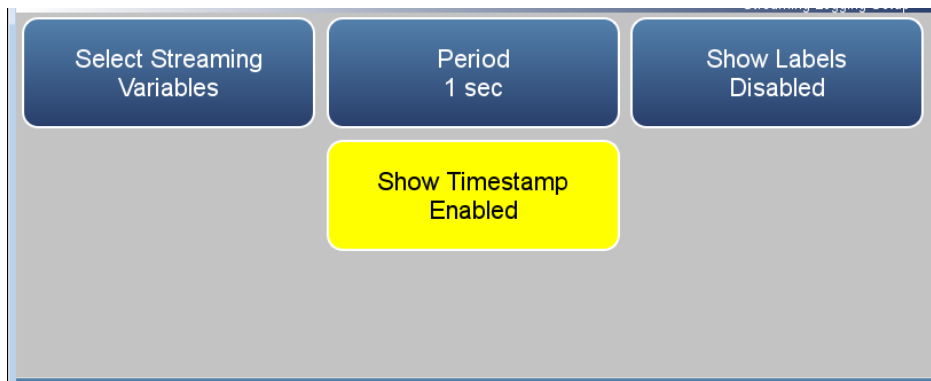
The Streaming Data Setup screen contains the following information:
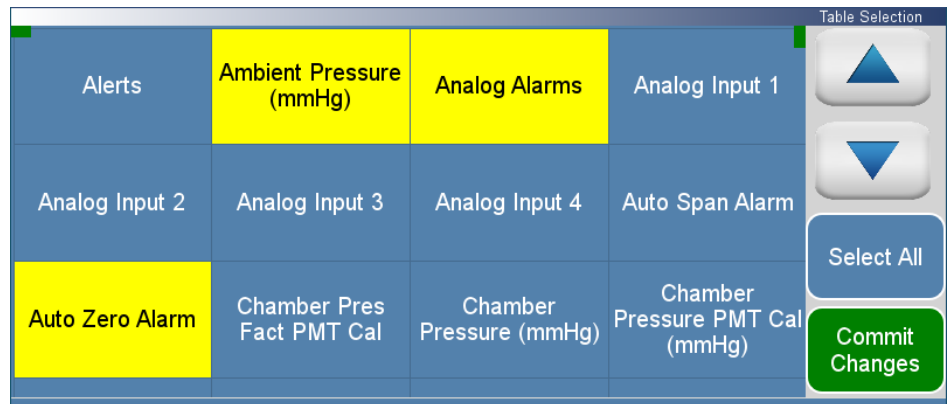
● *Select Streaming Variables*: User selects which variables to stream.

● *Period*: Sets the time between streamed data.

● *Show Labels*: Toggles Enabled/Disabled. When enabled, shows variable labels to the left of the variable values.

● *Show Timestamp*: Toggles Enabled/Disabled. When enabled, shows timestamp at the beginning of each row of data.

Select Streaming Variables

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

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

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

Operation
Settings

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
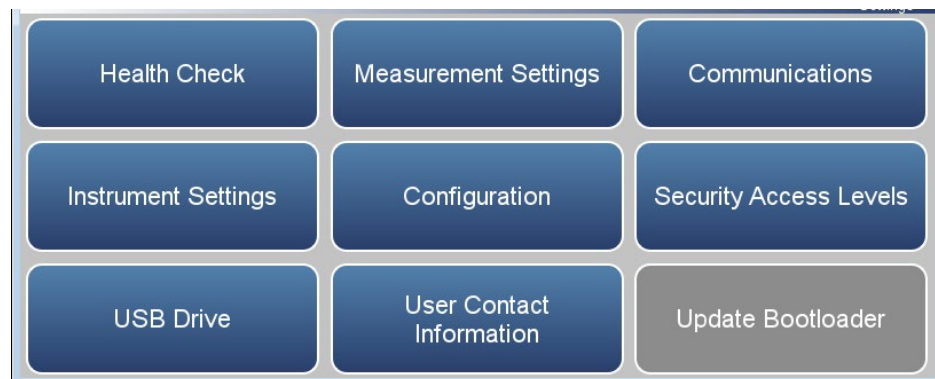
The Settings screen contains the following information:

- *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 Setting:* 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.

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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
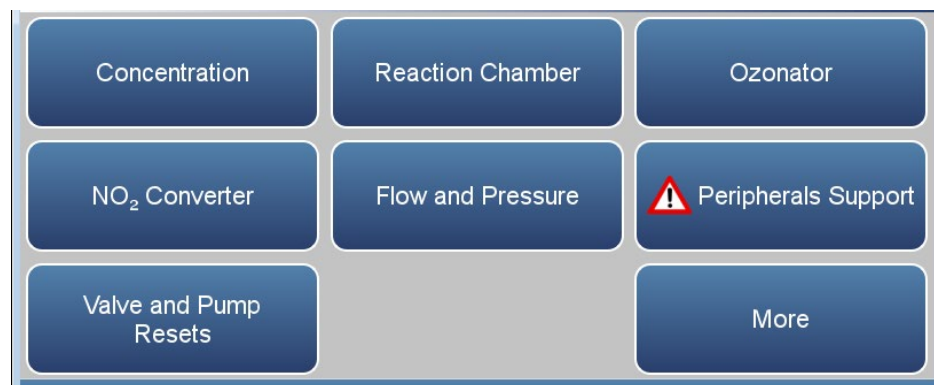
Home Screen>Settings>Health Check>Status and Alarms>More
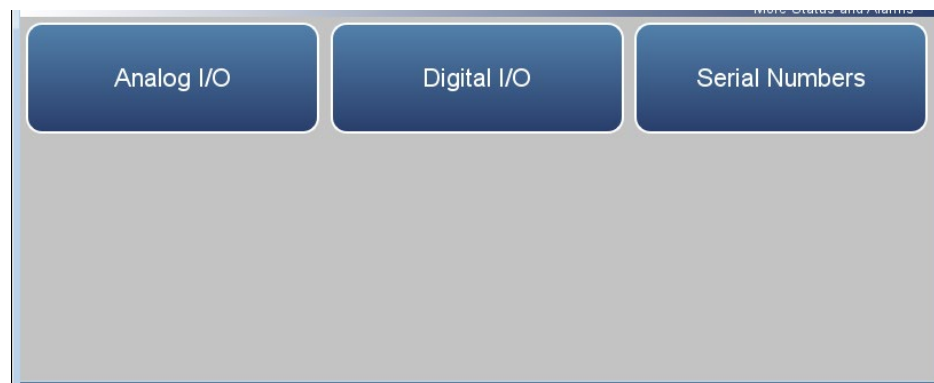
The Status and Alarms screen contains the following information:

● *Concentration:* Displays NO/NO₂/NOₓ concentrations and alarms.

● *Reaction Chamber:* Displays reaction chamber alarms and faults.

● *Ozonator:* Displays ozonator alarms and faults.

● *NO₂ Converter:* Displays NO₂ converter alarms and faults.

● *Flow and Pressure:* Displays flow and pressure alarms and faults.

● *Peripherals Support:* Displays peripherals support alarms and faults.

- *Valve and Pump Resets:* User can reset valve and pump power.

- *Analog I/O:* Displays analog input/output alarms and faults.

- *Digital I/O:* Displays digital input/output alarms and faults.

- *Serial Numbers:* Displays all the serial numbers for the instrument.

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

Concentration	Value	Low Alarm	High Alarm	Span Conc	
NO_x	-0.3	0.0	0.0		p
NO_x Bkg Check Offset	0.0	--	0.0		p
NO_x Span Check Offset	0.0	--	0.0	400.0	p

The Concentration screen contains the following information:

● Across:

   • *Concentration:* This column lists items associated with the NO_x concentrations.

   • *Value:* Displays the current value for each item.

   • *Low Alarm:* Displays low alarm for each item.

   • *High Alarm:* Displays high alarm for each item.

   • *Span Conc:* Span concentration used in the span calibration or span check.

   • *Units:* Displays units for each item.

● Down:

   • *NO_x:* NO_x concentration.

   • *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_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

Chamber	Value	Low Alarm	High Alarm	Units
Instrument Temperature	30.6			ºC
Flow	0.65			L/min
Chamber Pressure	197.52			mmHg
Chamber Temperature	49.95	48.000	52.000	ºC
Chamber Temp Sensor Short	OK			
Chamber Temp Sensor Open	OK			

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 Voltage:* Displays the current cooler voltage reading.

- *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.

- *PMT Current:* Displays the PMT current reading.

- *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

Ozonator	Value	Low Alarm	High Alarm	Units	
Ozonator Power	On				
Ozonator Level	High				
Ozonator Flow	Ok				
Ozonator Current	0.271	0.150	0.350	Amps	
Board Communication	OK				
Power Supply	OK				

The Ozonator screen contains the following information:

● Across:

  • *Ozonator:* This column lists items associated with the ozonator.

  • *Value:* Displays the current value for each item.

  • *Low Alarm:* Displays low alarm 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.

NO₂ 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

Converter	Value	Low Alarm	High Alarm	Units
NO$_2$ Converter Temperature	325.1	300.0	350.0	⁰C
NO$_2$ Thermocouple Open	OK			
NO$_2$ Thermocouple Short	OK			
Board Communication	OK			
Power Supply	OK			
2.5 V Diagnostic	2.50	2.25	2.75	V

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:

  • *NO₂ Converter Temperature:* Displays the current NO$_2$ converter temperature reading. User can adjust low and high alarm limits.

  • *NO₂ Thermocouple Open:* Displays OK/Fail for NO$_2$ thermocouple open.

  • *NO₂ 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.

Flow and Pressure

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

Use the ▲ and ▼ buttons to move up and down and the ◄ and ► buttons to move left and right.

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

Flow and Pressure	Value	Low Alarm	High Alarm	Units
Flow	0.65	0.350	0.900	L/min
Chamber Pressure	197.52	150.000	400.000	mmHg
Sample Input Pressure	744.21			mmHg
Instrument Temperature	30.6	8.000	45.000	ºC
Board Communication	OK			
Power Supply	OK			

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

Peripherals Support	Value	Low Alarm	High Alarm	Units	
Module Temperature	29.79			⁰C	
Sample Valve	0.000			mA	
Zero Valve	0.000			mA	
Span Valve	0.000			mA	
Pump	308.085			mA	
Instrument Error	OK				

The Peripherals Support screen contains the following information:

● Across:

  • *PSB:* This column lists items associated with the peripherals support.

  • *Value:* Displays the current value for each item.

  • *Low Alarm:* Displays low alarm 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.

  • *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
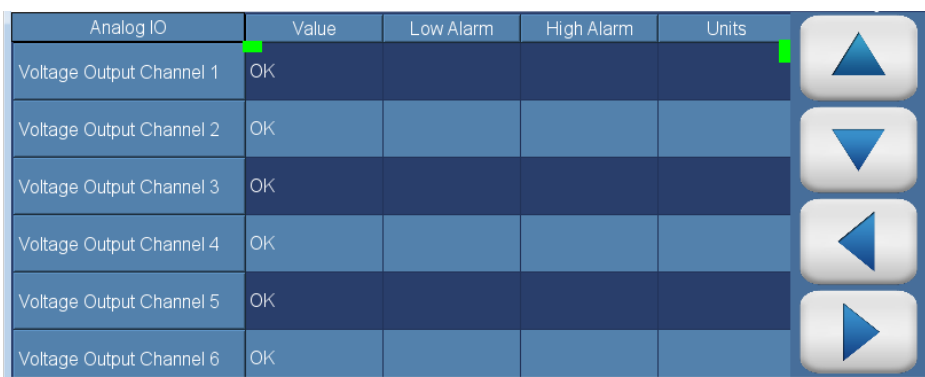
The Valve and Pump Resets screen contains the following information:

● *Sample Valve Reset:* Resets sample valve.

● *Zero Valve Reset:* Resets zero valve.

● *Span Valve Reset:* Resets span valve.

● *Pump Reset:* Resets pump.

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

Use the ▲ and ▼ buttons to move up and down and the ◄ and ► buttons to move left and right.

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

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

The Analog I/O screen contains the following information:

● Across:

  • *Analog IO:* This column lists items associated with the analog I/O.

  • *Value:* Displays the current value for each item.

  • *Low Alarm:* Displays low alarm status for each item.

  • *High Alarm:* Displays high alarm status for each item.

  • *Units:* Displays units for each item.

● Down:

  • *Voltage Output Channel 1–6:* Displays real-time voltage output for each channel.

  • *Current Output Channel 1–6:* Displays real-time current output for each channel.

  • *Chip Temperatures:* Displays OK/Fail for chip temperatures.

  • *Chip 1–3 Communication:* Displays OK/Fail for each chip communication.

  • *Test Mode:* Displays test mode on or off.

- *Board Communication:* Displays OK/Fail for board communication status.

- *Power Supply:* Displays OK/Fail of power supplies. Power supply goes red if any voltages are outside their limits. No voltage rows ever get highlighted.

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

  - *5.0V Diagnostic:* Displays current voltage readings. Alarm limits are not changeable.

  - *5.0V Ref Diagnostic:* Displays current voltage readings. Alarm limits are not changeable.

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

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

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

Use the ▲ and ▼ buttons to move up and down and the ◄ and ► buttons to move left and right.

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

Digital IO	Value	Reset	Low Alarm	High Alarm	Units	
Solenoid 1	0.0	Reset	OK	OK	mA	
Solenoid 2	0.0	Reset	OK	OK	mA	
Solenoid 3	0.0	Reset	OK	OK	mA	
Solenoid 4	0.0	Reset	OK	OK	mA	
Solenoid 5	0.0	Reset	OK	OK	mA	
Solenoid 6	0.0	Reset	OK	OK	mA	
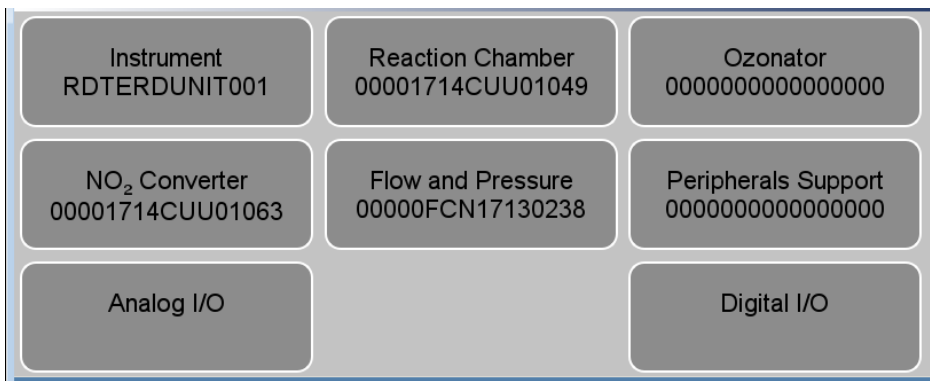
The Digital I/O screen contains the following information:

● Across:

  • *Digital IO:* This column lists items associated with the digital I/O.

  • *Value:* Displays the current value for each item.

  • *Reset:* Resets item.

  • *Low Alarm:* Displays low alarm status for each item.

  • *High Alarm:* Displays high alarm status for each item.

  • *Units:* Displays units for each item.

● Down:

  • *Solenoid 1–8:* Displays whether or not the solenoid is activated by showing the current in mA.

  • *External Alarm 1–3:* Displays OK/Fail for external alarms.

  • *Relay Test Mode:* Displays relay test mode on or off.

  • *Solenoid Test Mode:* Displays solenoid test mode on or off.

  • *Board Communication:* Displays OK/Fail for communication status.

- *Power Supply:* Displays OK/Fail of power supplies. Power supply goes red if any voltages are outside their limits. No voltage rows ever get highlighted.

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

  - *5.0V Diagnostic:* Displays current voltage readings. Alarm limits are not changeable.

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

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

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

Instrument RDTERDUNIT001	Reaction Chamber 00001714CUU01049	Ozonator 0000000000000000
NO$_2$ Converter 00001714CUU01063	Flow and Pressure 00000FCN17130238	Peripherals Support 0000000000000000
Analog I/O		Digital I/O

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.

● *Flow and Pressure:* Flow and pressure serial number.

● *Peripherals Support:* Peripherals support serial number.

● *Analog I/O:* Analog I/O serial number.

● *Digital I/O:* Digital I/O serial number.

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

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

Home Screen>Settings>Health Check>Predictive Diagnostics
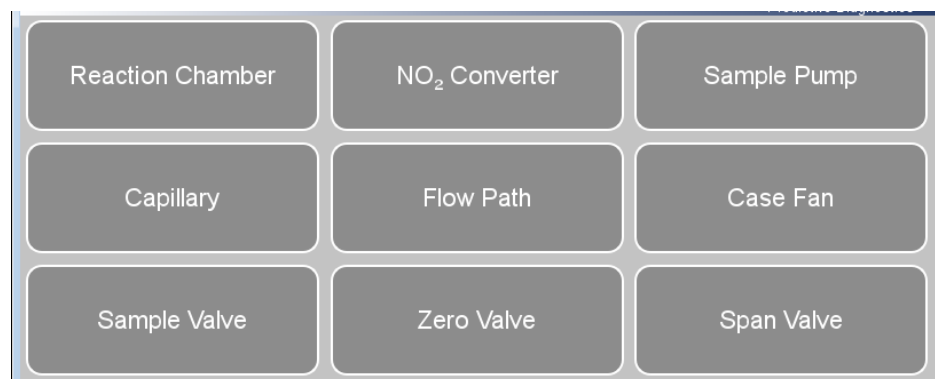
The Predictive Diagnostics screen contains the following information:

● Reaction Chamber

● NO$_2$ Converter

● Sample Pump

● Capillary

● Flow Path

● Case Fan

● Sample Valve

● Zero Valve

● Span Valve

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 alarm in the module. ▲

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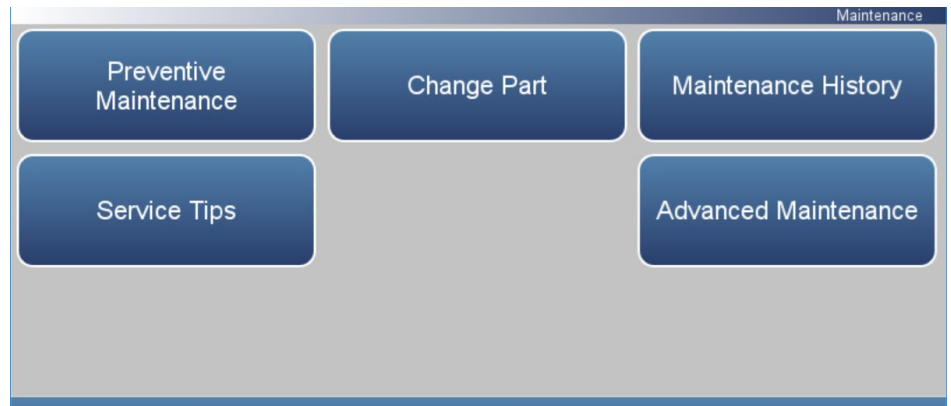
Home Screen>Settings>Health Check>Maintenance>Advanced Maintenance

The Maintenance screen contains the following information:

● *Preventive Maintenance:* Shows suggested service interval and time left for component replacement.

● *Change Part:* User logs component fix.

● *Maintenance History:* Shows the log of all recorded component fixes.

● *Service Tips:* Provides video and procedural service tips.

● *Advanced Maintenance:* Resets all preventive maintenance items.

Preventive Maintenance

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

Use the ▲ and ▼ buttons to move up and down and the ◄ and ► buttons to move left and right.

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

Component	Interval in Months	Months Left	Reset	Alert
Reaction Chamber/Cooler	48	48	Reset	Enabled
PMT	48	48	Reset	Enabled
PMT Base Socket	48	48	Reset	Enabled
Converter Cartridge	24	24	Reset	Enabled
Ozonator Assembly	24	24	Reset	Enabled
Ozone Permeation Dryer	24	24	Reset	Enabled

The Preventive Maintenance screen contains the following information:

● Across:

  • *Component:* Device to be routinely serviced or replaced.

  • *Interval in Months:* Expected period of time before a component needs to be checked and/or serviced.

  • *Months Left:* Count down timer in months. Remaining time since the beginning of the service interval. When the value is 1 or less, the row will be highlighted and it is suggested that the component should be checked and/or serviced.

  • *Reset:* Once the component is serviced/replaced, the user presses the Reset button and the "Months Left" value resets to the "Interval in Months" value.

  • *Alert:* Allows the user to opt out of receiving preventive maintenance alerts. Displays Enabled/Disabled for each component.

- Down:

  - *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.

  - *Ozone Permeation Dryer:* Service interval for ozone 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.
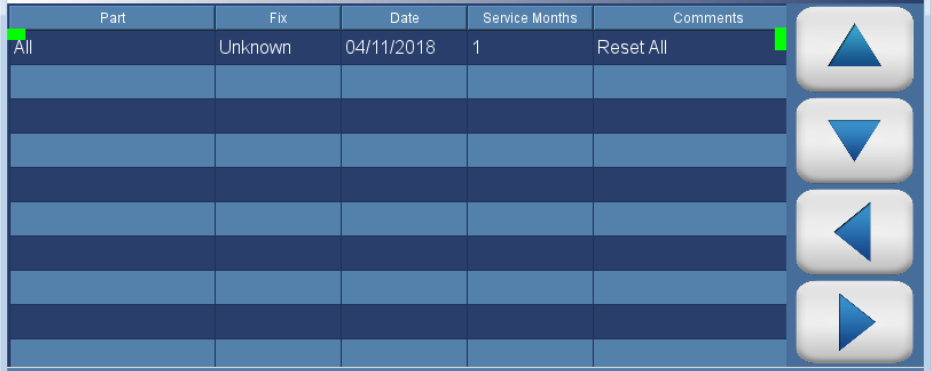
Maintenance History   The Maintenance History screen allows the user to view when components are replaced, rebuilt, or cleaned. When a user changes a part in the change part screen, the new row will be automatically created at the top in the maintenance history table.

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

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

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

Part	Fix	Date	Service Months	Comments	
All	Unknown	04/11/2018	1	Reset All	

The Maintenance History screen contains the following information:

● *Part:* Component that has been fixed.

● *Fix:* The type of maintenance.

● *Date:* Shows date/time when service was logged.

● *Service Months:* Amount of time in months since last service.

● *Comments:* Shows comments entered from time of change.

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

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

Home Screen>Settings>Health Check>File Sharing and Support
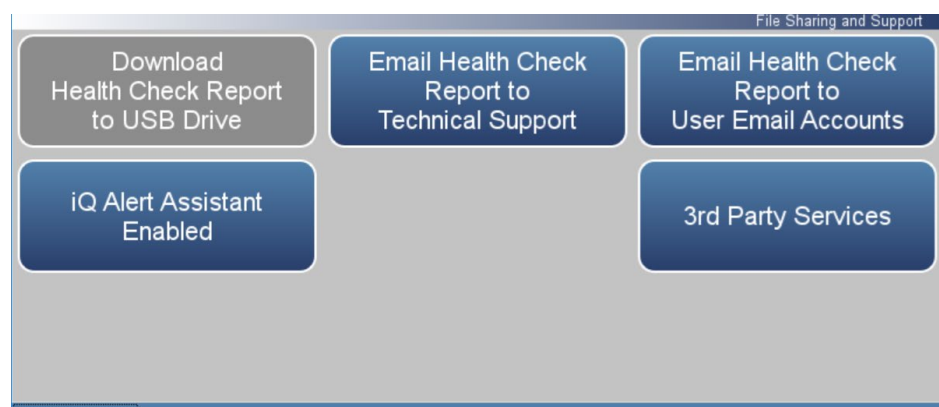
The File Sharing and Support screen contains the following information:

● *Download Health Check Report to USB Drive:* Sends the health report to
  USB drive.

● *Email Health Check Report File to Technical Support:* Sends the health
  report file to technical support and the customer email addresses via
  email.

● *Email Health Check Report to Personal Account:* Sends the health report
  file to a personal account via email.

● *iQ Alert Assistant:* With the iQ Alert Assistant enabled, the instrument
  will email Thermo Scientific Technical Support the health check report
  after each event. After each maintenance alert or predictive diagnostic
  alert, Customer Service will produce a quote for the components that
  require service. This quote will get emailed to the email addresses that
  have been entered into the "User Contact Information" menu.

● *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)
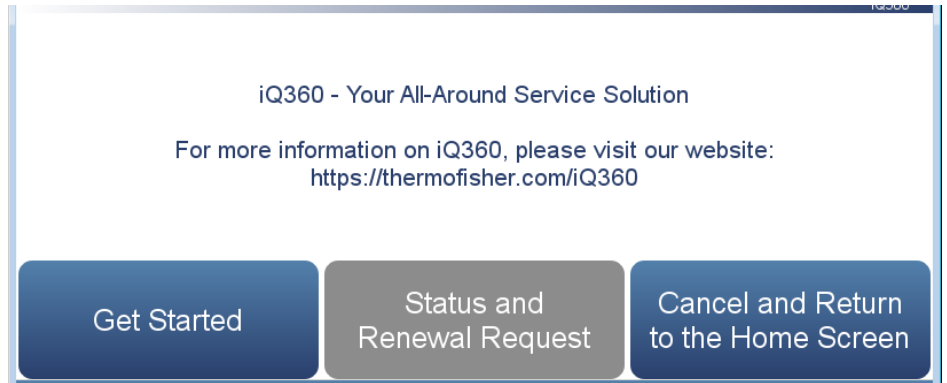
Home Screen>Settings>Health Check>iQ360 (Status and Renewal Request)
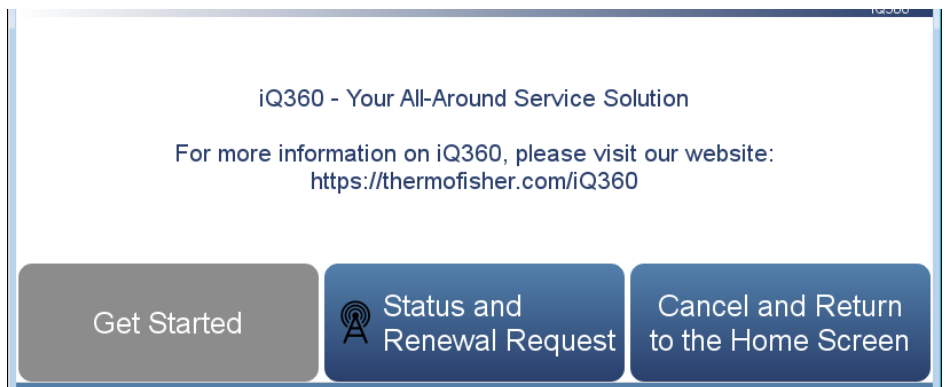
The iQ360 screen contains the following information:

● *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
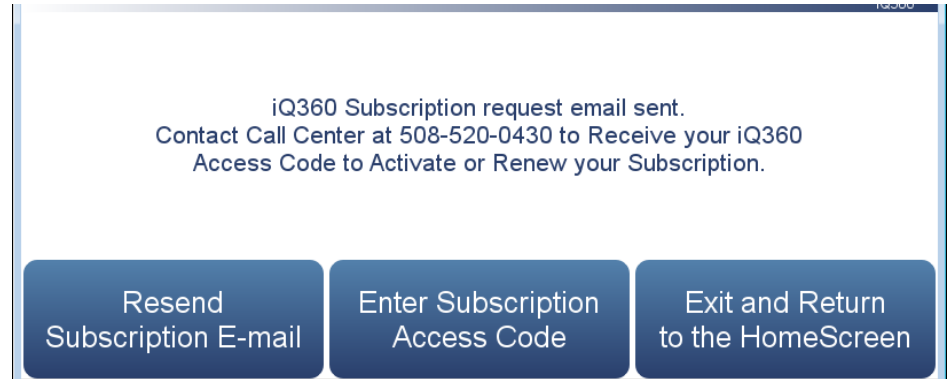
The Get Started screen contains the following information:

● *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
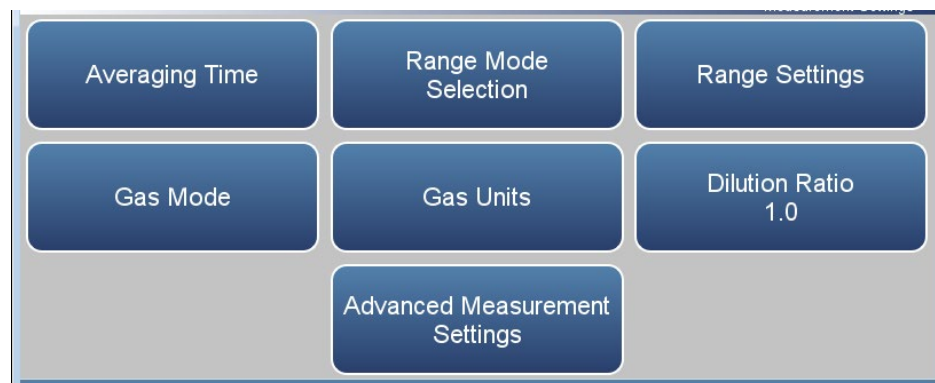
The Measurement Settings screen contains the following information:

- *Averaging Time:* Sets the averaging time for the NO_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 3-70.

- *Range Settings:* Defines the NO_x concentration range for the analog outputs.

- *Gas Mode:* User can manually choose sample, zero or span mode.

- *Gas Units:* Defines how the NO_x concentration readings are expressed.

- *Dilution Ratio:* Serves as a multiplier when dilution gas is utilized.

- *Advanced Measurement Settings:* Advanced settings affecting 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_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)
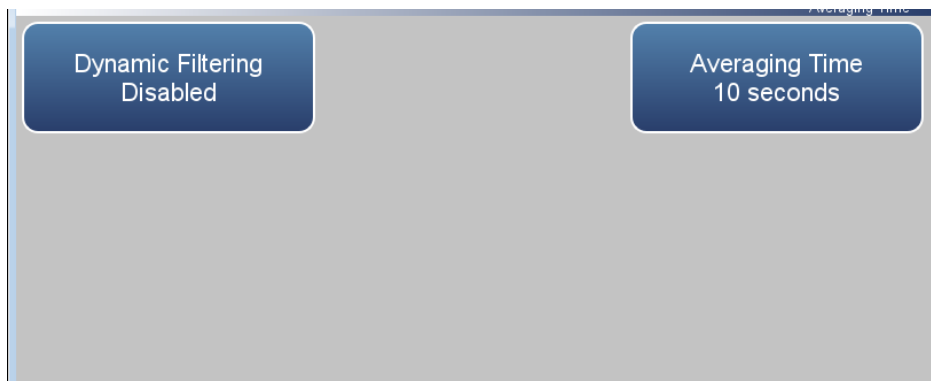
Home Screen>Settings>Measurement Settings>Averaging Time (dual or auto range mode)

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.

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
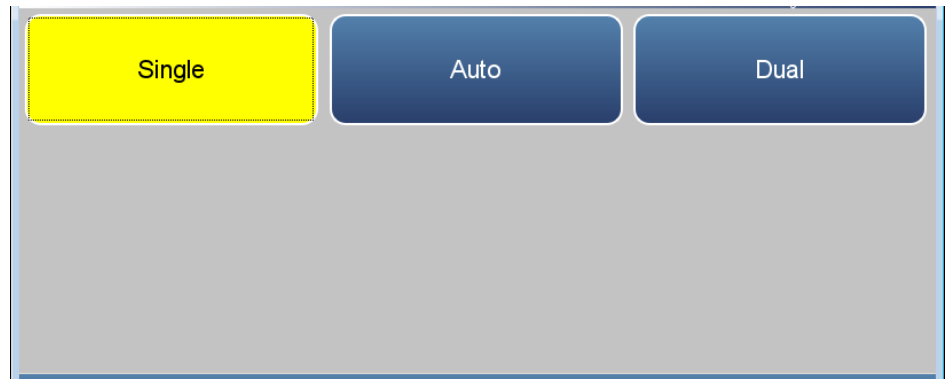
The Range Mode Selection screen contains the following information:

● *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_x analog output can be set to output concentrations from 0 to 50 ppb and the high NO_x analog output set to output concentrations from 0 to 500 ppb.

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_x range is set to 0–50 ppb and the high NO_x range is set to 0–20000 ppb.

● *Auto:* The auto range mode switches the 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 ppb and the high range is set to 100 ppb, as shown below. Sample concentrations below 50 ppb are output based on low range selection and sample concentrations above 50 ppb 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_x range is set to 0– 50 ppb and the high NO_x range is set to 0–20000 ppb.
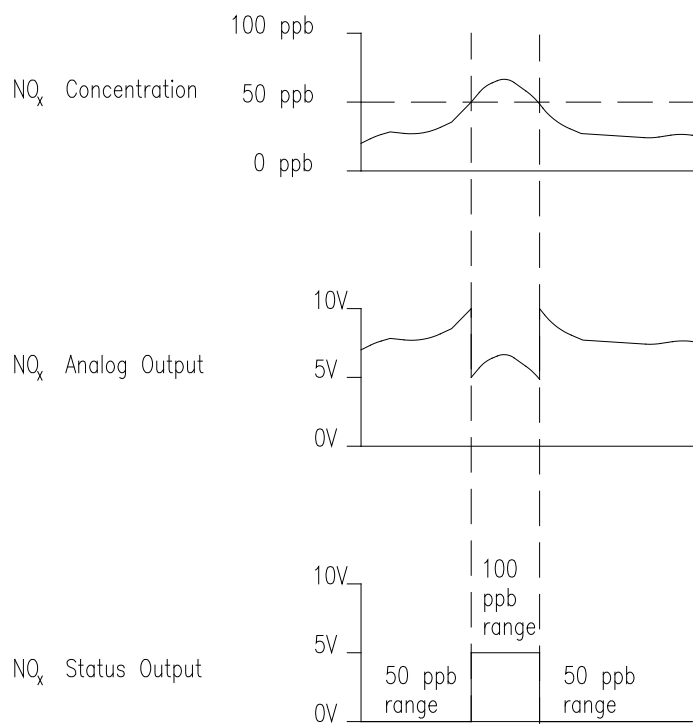
Range Settings   The Range Settings screen defines the concentration range of the analog
outputs. For example, an NO$_x$ range of 0–50 ppb restricts the NO$_x$ analog
output to concentrations between 0 and 50 ppb.

The screen shows the current 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 3-70. 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)**

NO$_x$ Range Setting
500.0
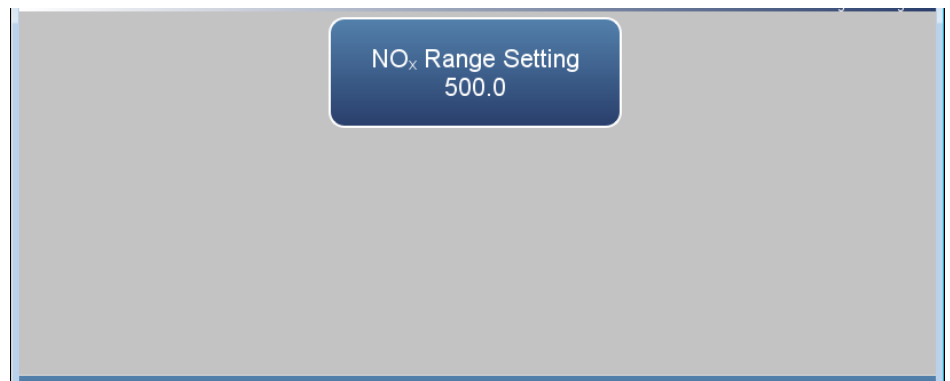
**Home Screen>Settings>Measurement Settings>Range Settings (dual or
auto range mode)**

High Range NO$_x$ Setting
200.0 ppb

Low Range NO$_x$ Setting
500.0 ppb
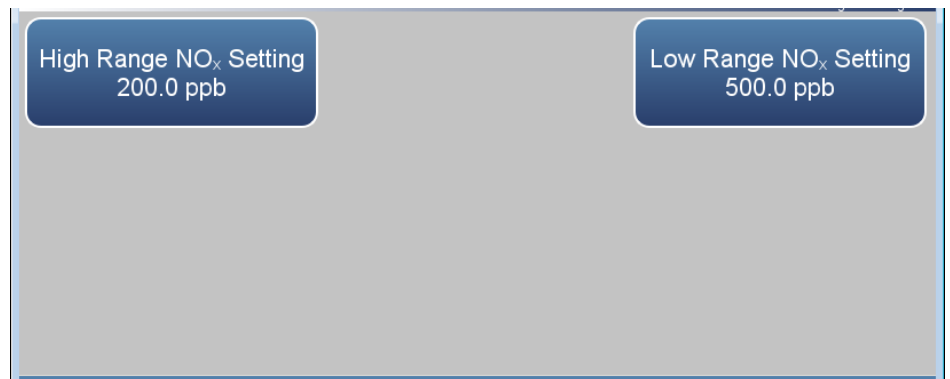
The Range Settings screen contains the following information:

● *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 standard ranges according to unit selection include:

ppb	50–20000 ppb
ppm	0.05–20 ppm
%	0.000005–0.002 %
µg/m^3	100–30000 µg/m^3
mg/m^3	0.1–30 mg/m^3
g/m^3	.0001–0.030 g/m^3

Settable extended ranges according to unit selection include:

ppb	200–100000 ppb
ppm	0.2–200 ppm
%	00002–0.01 %
µg/m^3	500–150000 µg/m^3
mg/m^3	0.5–150 mg/m^3
g/m^3	.0005–0.150 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
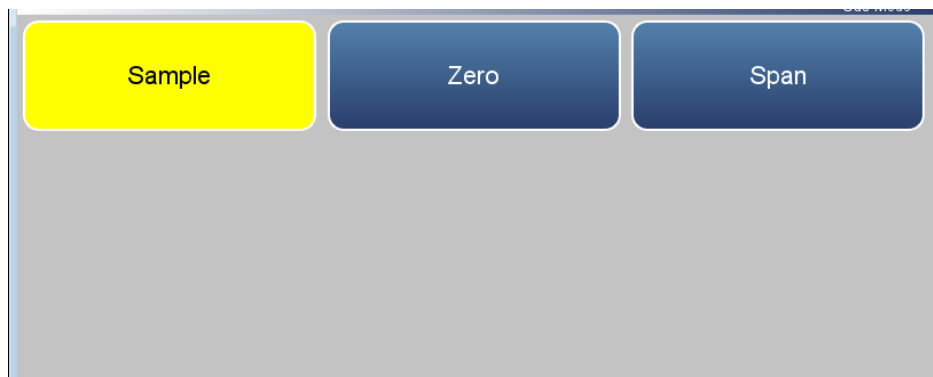
The Gas Mode screen contains the following information:

● *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_x concentration readings are expressed. The µg/m³, mg/m³, and g/m³ 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

ppb	ppm	%	ug/m3	▲
mg/m3	g/m3			▼
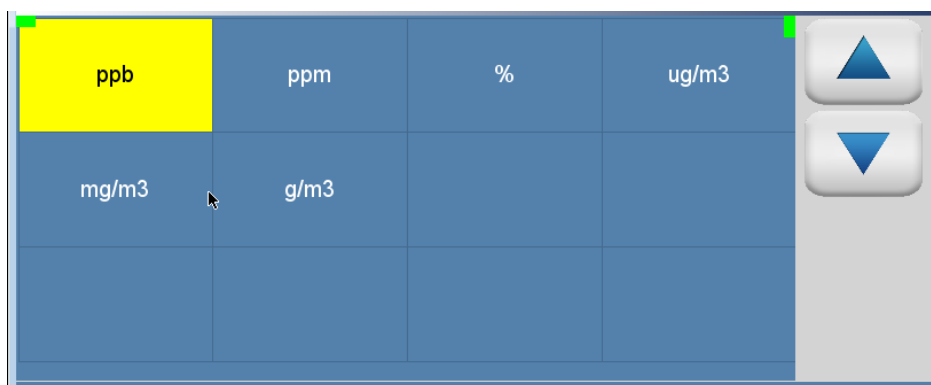
The Gas Units screen contains the following information:

● *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
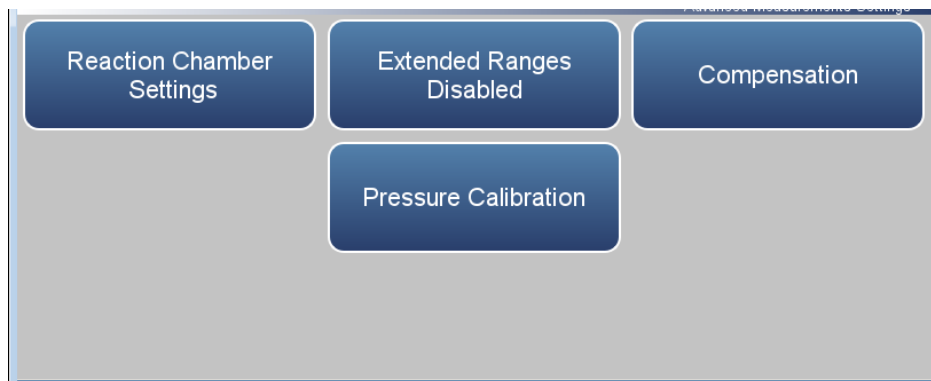
The Advanced Measurements Settings screen contains the following information:

● *Reaction Chamber Settings:* User can calibrate Input board and PMT.

● *Extended Ranges:* Enables/disables extended ranges feature.

● *Compensation:* Allows the user to compensate for changes in temperature and pressure concentration.

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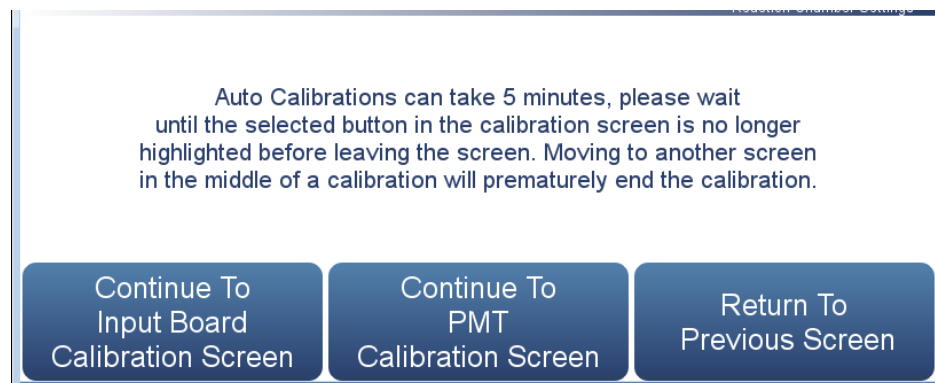
Home Screen>Settings>Measurement Settings>Advanced Measurement Settings>Reaction Chamber Settings>Continue to Input Board Calibration Screen

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

Description	PMT Supply	Current PMT	Units	
Manual Entry	-773.9	-767.9	V	
Target Concentration	0.0		ppb	
Calibration Concentration	2642.33		ppb	
Auto Calibration	Start			
End Calibration	Stop			
Default PMT Supply	Default PMT Supply			

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.

Compensation

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

Home Screen>Settings>Measurement Settings>Advanced Measurement Settings>Compensation
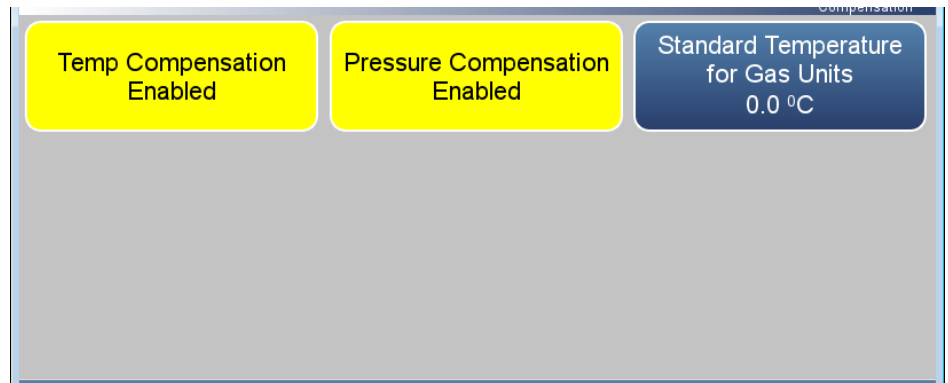
The Compensation screen contains the following information:

● *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 bench pressure.

● *Standard Temperature for Gas Units:* Allows the user to enter a value between 0 and 30 °C to correct the $\mu g/m^3$, mg/m^3, and g/m^3 concentration calculations.

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

Description	Reading	Calibration			
Sensor 1 Reading	197.1				
Sensor 2 Reading	744.2				
Sensor 3 Reading	112.5				
Atmospheric Sensor 1	740.0	Start			
Zero Sensor 1	390.3	Start			
Atmospheric Sensor 2	743.4	Start			

The Pressure Calibration screen contains the following information:

● Across:

  • *Description:* Lists items in table.

  • *Reading:* Displays reading of each pressure sensor.

  • *Calibration:* Starts calibration or resets default values.

● Down:

  • *Sensor 1–3 Reading:* Under the column labeled Reading, current reading of each pressure sensor.

  • *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, Instrument ID, Bayern Hessen Settings, and Ethernet Protocol Selection. 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 42iQD 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. ▲

- *Ethernet Protocol Selection:* Allows the user to enable VNC, Streaming, Modbus, or Bayern Hessen to utilize the mobile app and/or those communication protocols.

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

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

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

DHCP Enabled	Dynamic IP Address 10.175.248.71	Dynamic Netmask 255.255.255.0
Dynamic Gateway 10.175.248.1	Wired MAC Address 70:B3:D5:F7:60:48	Host Name iQSeries

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

DHCP Disabled	Static IP Address 10.175.248.249	Static Netmask 255.255.255.0
Static Gateway 10.175.248.1	Static DNS Server 1 10.0.2.217	Static DNS Server 2 0.0.0.0
Wired MAC Address 70:B3:D5:F7:60:3D	Host Name iQSeries	Commit
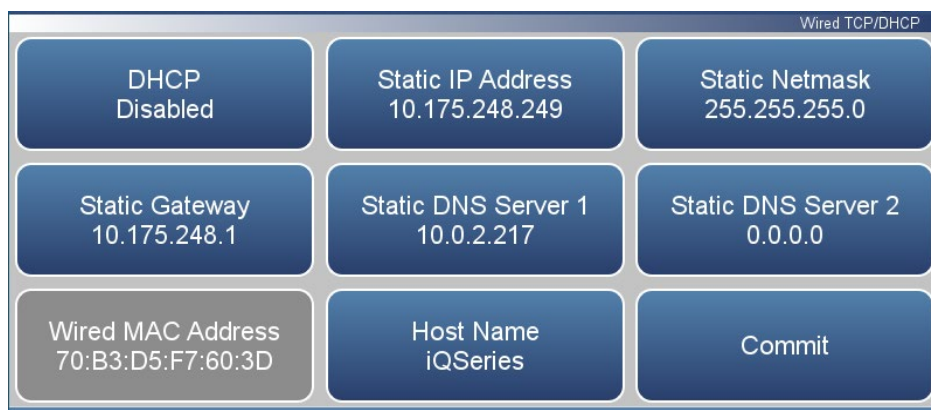
The Wired TCP/DHCP screen contains the following information:

● *DHCP:* Toggles DHCP Enabled/Disabled.

● *Dynamic IP Address:* Dynamic IP address of the instrument.

● *Dynamic Netmask:* Dynamic Netmask of instrument.

● *Dynamic Gateway:* Dynamic Gateway of instrument.

- *Static IP Address:* Static IP address of instrument. This is settable when DHCP is disabled.

- *Static Netmask:* Static Netmask of instrument. This is settable when DHCP is disabled.

- *Static Gateway:* Static Gateway of instrument. This is settable when DHCP is disabled.

- *Static DNS Server 1:* Static DNS server 1 of instrument. This is settable when DHCP is disabled.

- *Static DNS Server 2:* Static DNS server 2 of instrument. This is settable when DHCP is disabled.

- *Wired MAC Address:* Instrument MAC address.

- *Host Name:* Host name of instrument.

- *Commit:* Commits the new network configuration.

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

Home Screen>Settings>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
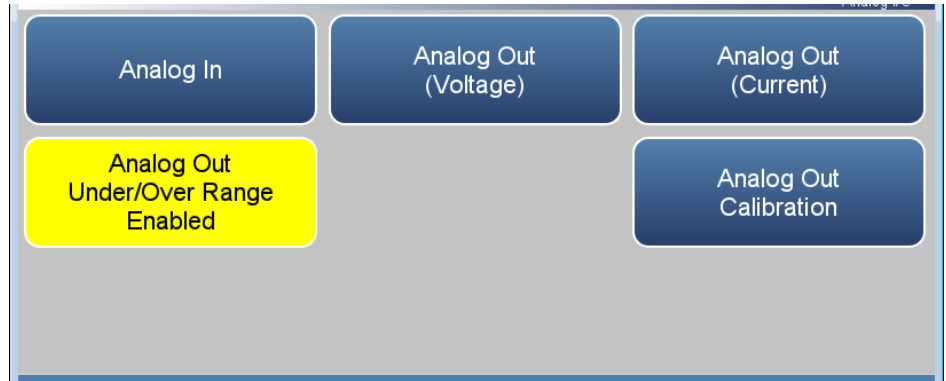
The Analog I/O screen contains the following information:

● *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)

SMTP Server Address smtprelay1.therm...	From Email Address larry.ferreira@t...	SMTP Server Port 25
Email Password		Email UserName monil.jhaveri@th...
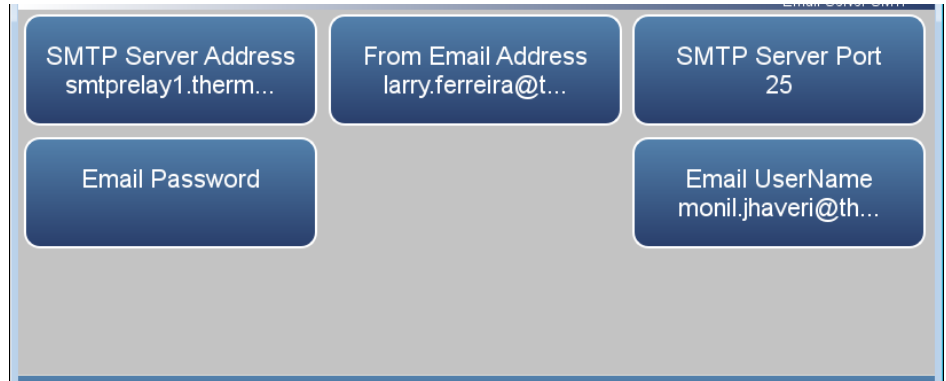
The Email Server (SMTP) screen contains the following information:
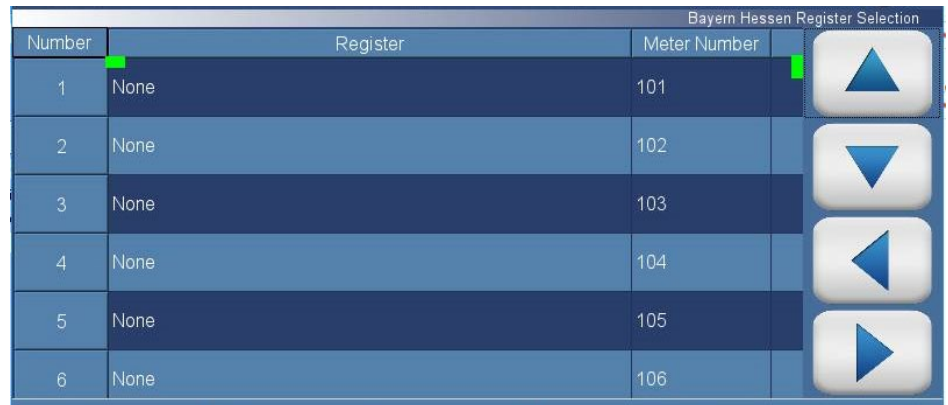
- *SMTP Server Address:* Address of the user's email server.

- *From Email Address:* The email address that goes in the From field in emails.

- *SMTP Server Port:* Server port of user's email server.

- *Email Password:* Password for SMTP server.

- *Email UserName:* User name that is authorized to send email through SMTP server.

Bayern Hessen Settings   The Bayern Hessen Settings screen allows the user to select up to 8 registers as the measured values to be logged.

Use the ▲ and ▼ buttons to move up and down and the ◄ and ► buttons to move left and right.

Home Screen>Settings>Communications>Bayern Hessen Settings

The Bayern Hessen Settings screen contains the following information:

● Across:

   • *Number:* Lists up to 8 registers that can selected by the user.

   • *Register:* User selects the measured values to be logged.

   • *Meter Number:* Allows the user to choose the meter/register number (001 to 999) that will preface the measured value in the response to the 'DA' command.

● Down:

   • *1–8:* Displays the register number and the measured values to be logged in the respective register location, in response to a valid query (DA) command.

Ethernet Protocol Selection

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

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

Home Screen>Settings>Communications>Ethernet Protocol Selection
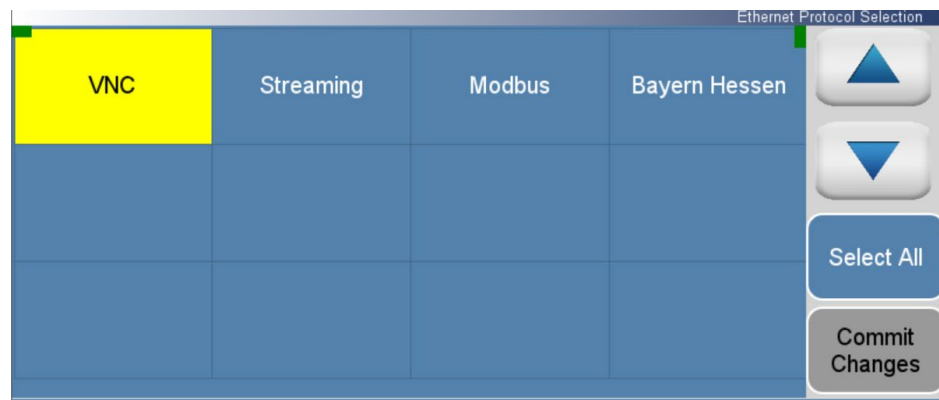
The Ethernet Protocol Selection screen contains the following information:

● VNC

● Streaming

● Modbus

● Bayern Hessen

Instrument Settings

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

Home Screen>Settings>Instrument Settings
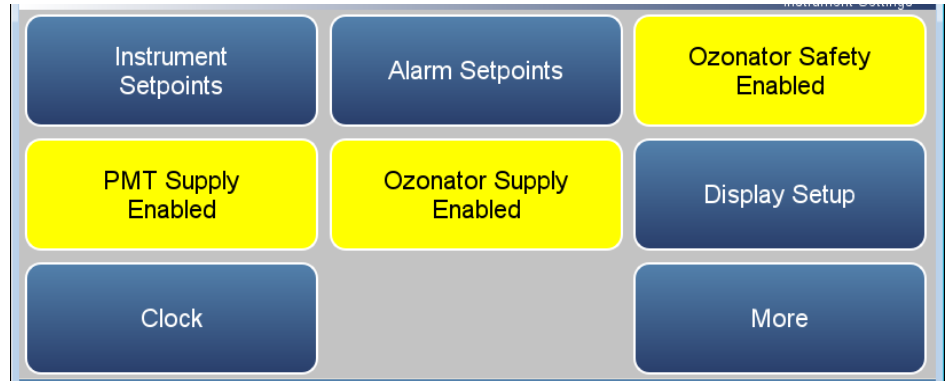
Home Screen>Settings>Instrument Settings>More
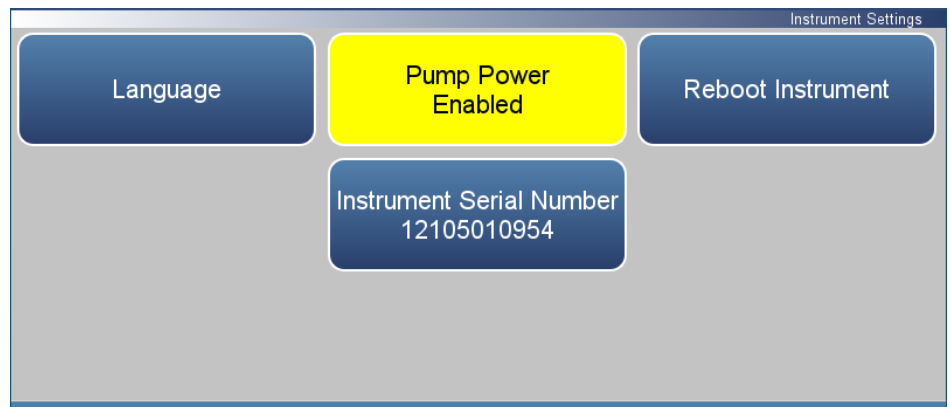
The Instrument Settings screen contains the following information:

- *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.
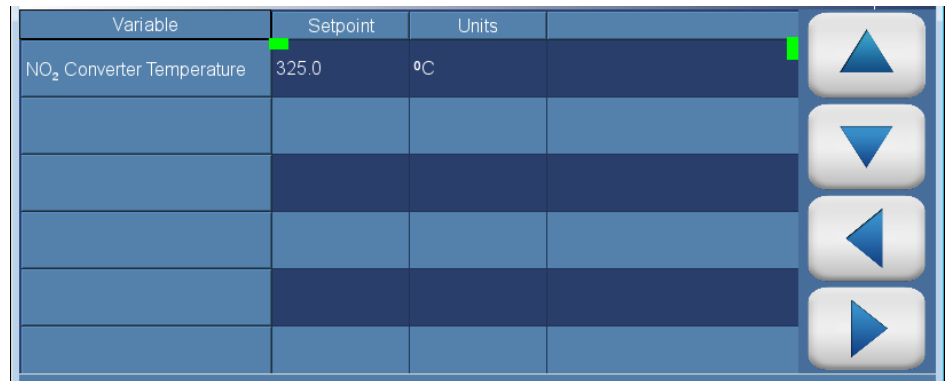
- *Pump Power:* Manually enables/disables the pump.

- *Reboot Instrument:* Reboots the instrument.

- *Instrument Serial Number:* Allows the user to change the instrument serial number.

Instrument Setpoints   The Instrument Setpoints screen allows the user to view and set all settable instrument minimum and maximum values.

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

Variable	Setpoint	Units		
NO₂ Converter Temperature	325.0	⁰C		▲
				▼
				◄
				►

The Alarm Setpoints screen contains the following information:

- Across:

  - *Variable:* Lists the items that have settable alarm limits.

  - *Setpoint:* User sets high alarm for item.

  - *Units:* Units for each item (not settable).

- Down:

  - *NO₂ Converter Temperature:* NO₂ converter temperature.

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.

Use the ▲ and ▼ buttons to move up and down and the ◄ and ► buttons to move left and right.

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 3-37. ▲

Home Screen>Settings>Instrument Settings>Alarm Setpoints

Variable	Value	Low Alarm	High Alarm	Units
NOₓ Concentration	-1.2	0.0	0.0	ppb
NOₓ Bkg Check Offset	0.000	--	0.000	ppb
NOₓ Span Check Offset	0.000	--	0.000	ppb
Instrument Temperature	30.8	8.000	45.000	ºC
Chamber Pressure	196.32	150.000	400.000	mmHg
Flow	0.65	0.350	0.900	L/min

The Alarm Setpoints screen contains the following information:

● Across:

  • *Variable:* Lists the items that have settable alarm limits.

  • *Low Alarm:* User sets low alarm for item.

  • *High Alarm:* User sets high alarm for item.

  • *Units:* Units for each item (not settable).

● Down:

  • *NOₓ Concentration* NOₓ concentration alarm.

  • *NOₓ 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 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
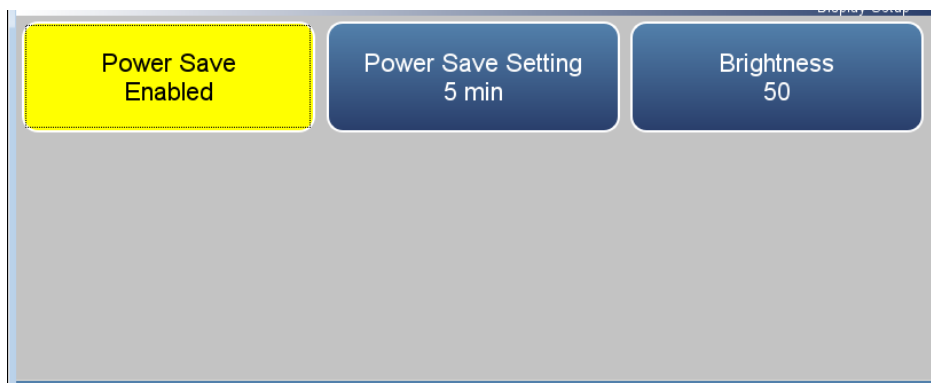
The Display Setup screen contains the following information:

● *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
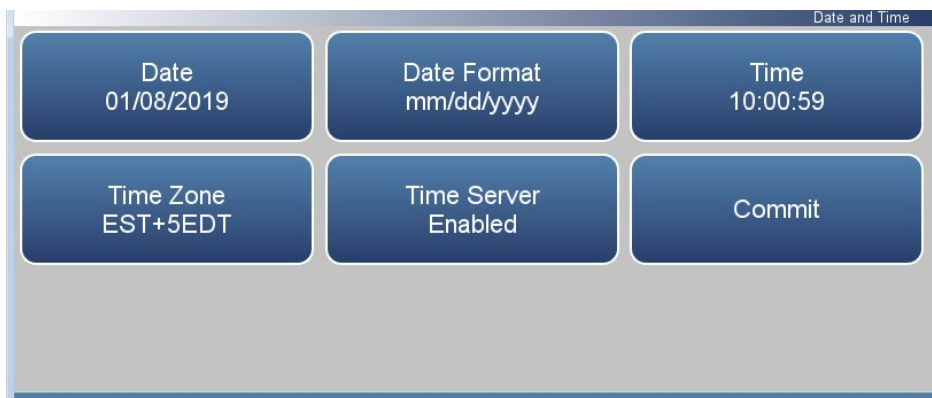
The Clock screen contains the following information:

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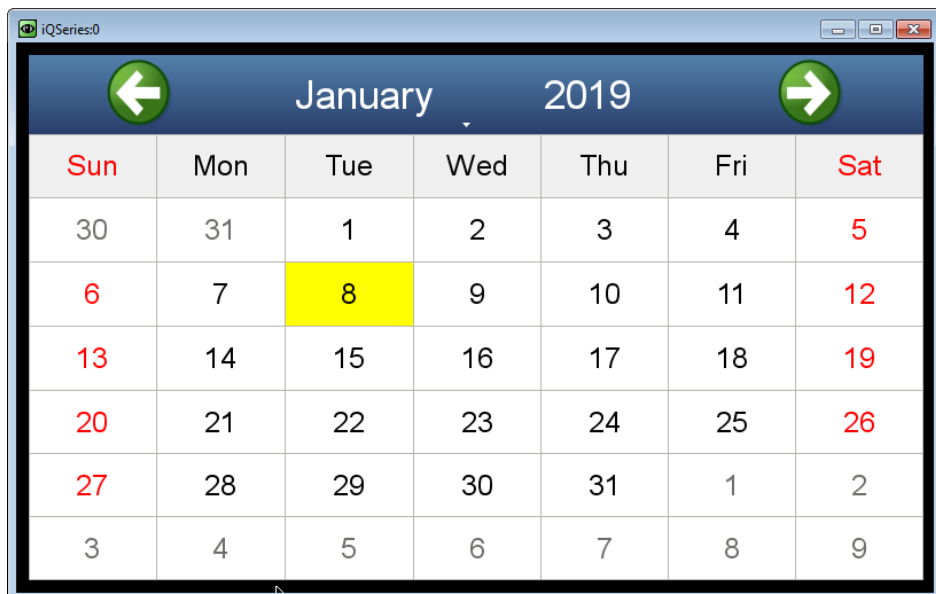
Date Format   The Date Format screen allows the user to choose from the following formats: mm/dd/yyyy or dd/mm/yyyy.

Use the ▲ and ▼ buttons to select.

Home Screen>Settings>Instrument Settings>Clock>Date Format
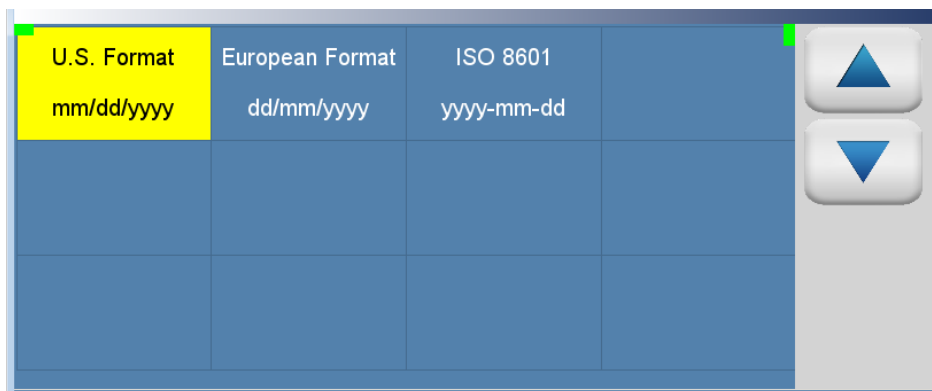
The Date Format screen contains the following information:

● 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
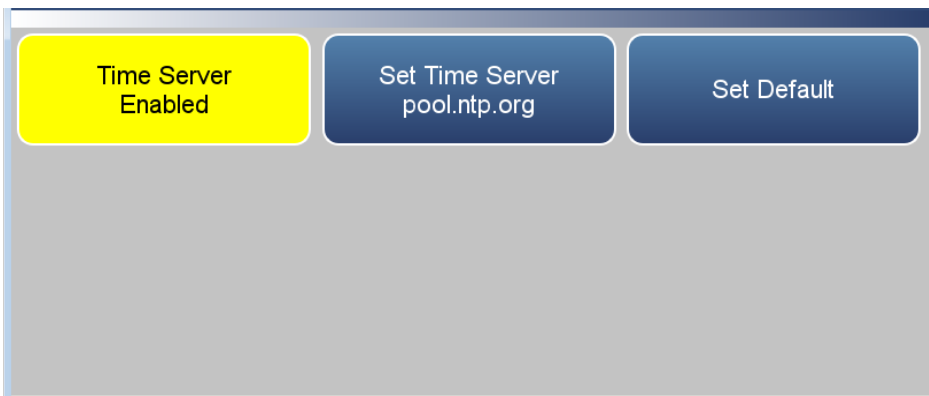
The Time Server screen contains the following information:

● *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

Instrument Serial Number

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

Home Screen>Settings>Instrument Settings>More>Instrument Serial Number
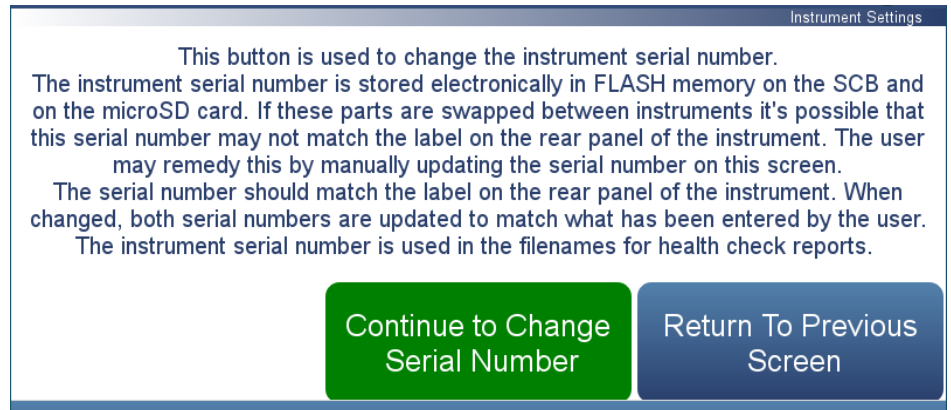
The Instrument Serial Number screen contains the following information:

● *Continue to Change Serial Number:* Proceeds to the keypad to enter serial number.

● *Return to Previous Screen:* Returns to the previous screen.

Configuration

The Configuration screen allows the user to enable optional features.

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
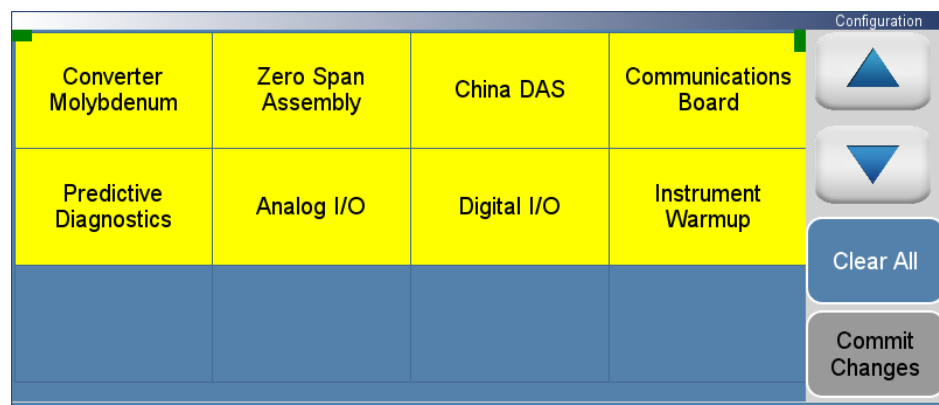
The Configuration screen contains the following information:

● *Converter Molybdenum:* Select if molybdenum converter is used.

● *Zero Span Assembly:* Enables zero/span valves.

● *Communications Board:* Enables RS-232 or RS-485 communication board.

● *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 Security 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 Instrument Password:* User can change instrument password.

- *Reset Instrument Password:* User can reset the instrument password.

Change Security to View Only Access

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

Home Screen>Settings>Security Access Levels>Change Security Access to View Only Access
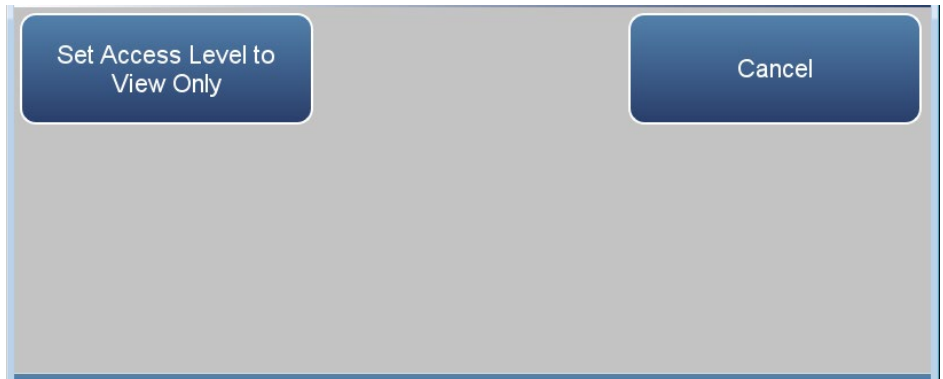
The Change Security to View Only Access screen contains the following information:

● *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

To Change the Security Access Password perform the following steps using the graphical user interface only (do not use an external USB keyboard):
1. Enter the Current Security Access Password
2. Enter the New Security Access Password
3. Confirm the New Security Access Password
4. Commit the New Security Access Password Change
Note: To clear the Full Access Password, follow the steps above using blank values for the New Password.

Continue	Cancel and Return to the Home Screen

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

Security Access Levels

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

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

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

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

3. Confirm the New Security Access Password and then press Continue.

| Confirm New Security Access Password | Continue | Cancel and Return to the Home Screen |

4. Commit the New Security Access Password Change

| Commit New Security Access Password Change | Cancel and Return to the Home Screen |
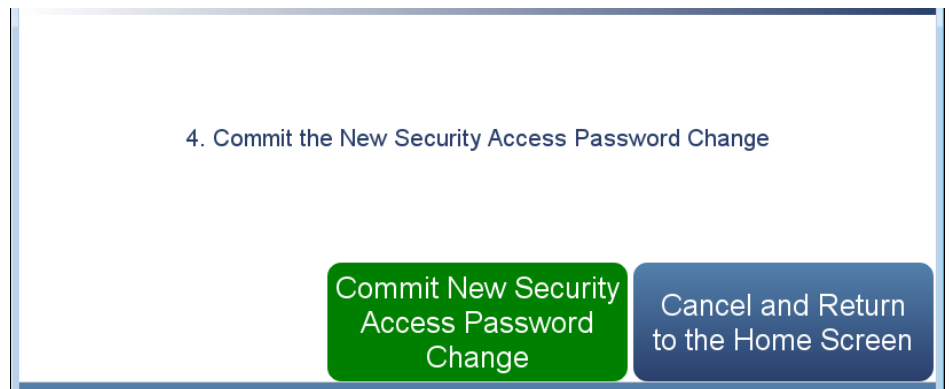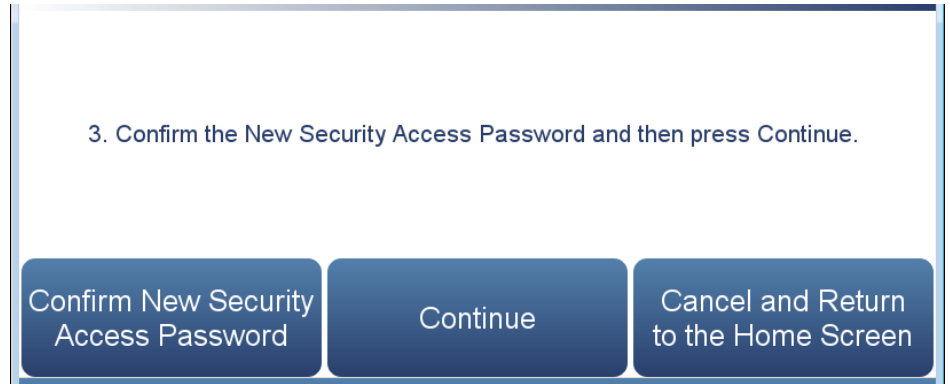
The Change Full Access Security Password screens contain the following information:

● *Enter Current Security Password:* User enters current security password.

● *Continue:* Proceeds to next screen.

● *Enter New Security Access Password:* User enters new security password.

● *Confirm New Security Access Password:* User confirms new security password for spelling confirmation.

● *Commit New Security Access Password Change:* Commits new security password.

● *Cancel and Return to the Home Screen:* Exits screen and returns to the Home Screen without changing password.

Change Instrument Password

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

Home Screen>Settings>Security Access Levels>Change Instrument Password
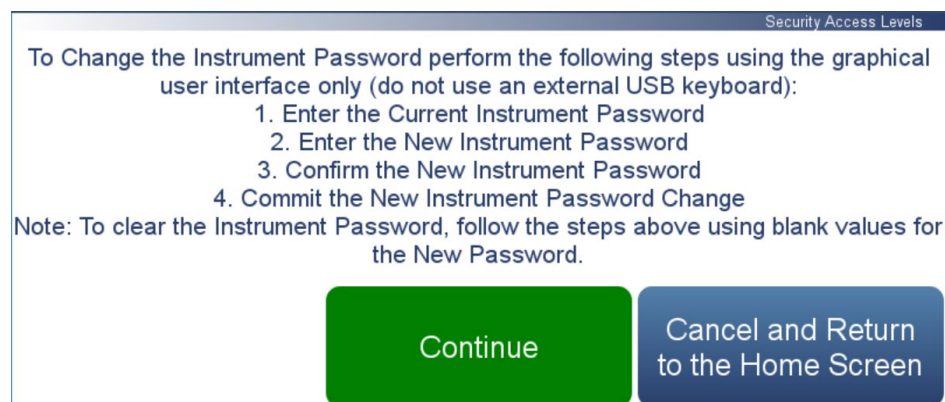
Home Screen>Settings>Security Access Levels>Change Instrument Password>Continue
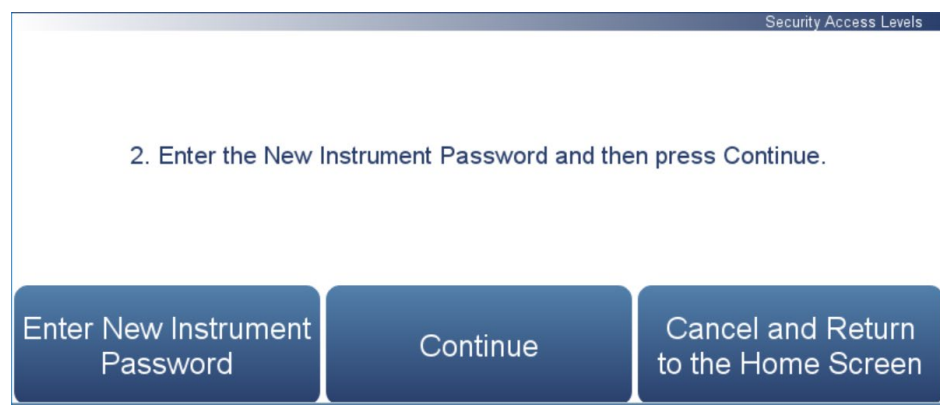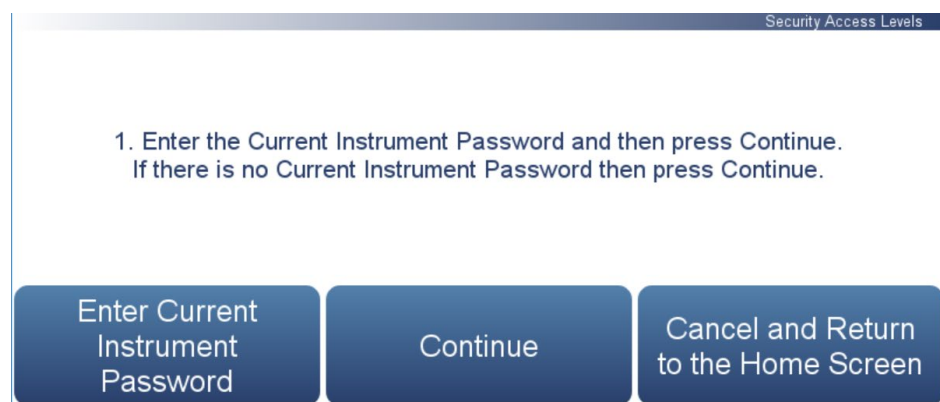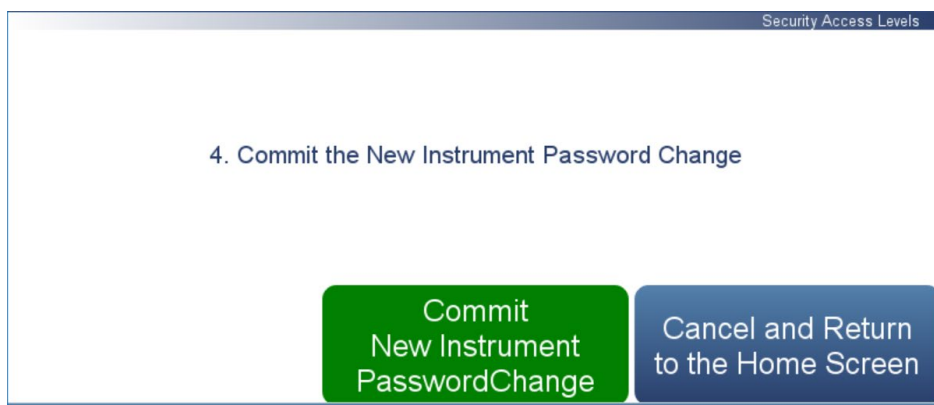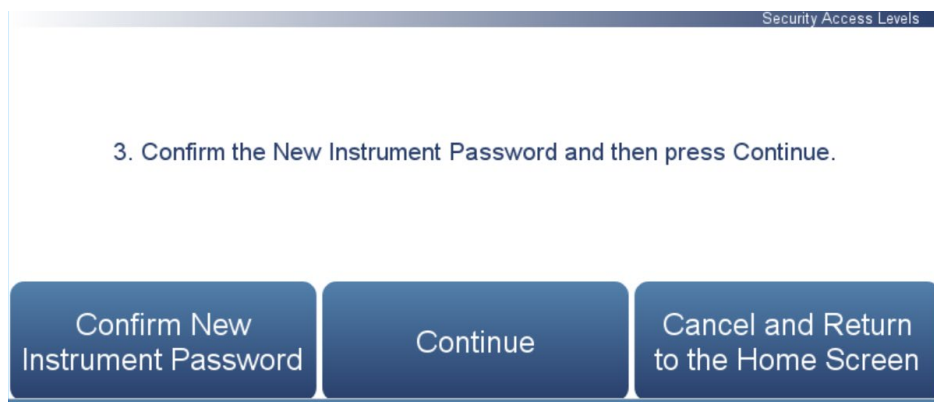
The Change Instrument Password screen contains the following information:

● *Enter Current Instrument Password:* User enters current instrument password.

● *Continue:* Proceeds to next screen.

● *Enter New Instrument Password:* User enters new instrument password.

● *Confirm New Instrument Password:* User confirms new instrument password for spelling confirmation.

● *Commit New Instrument Password Change:* Commits new instrument password.

● *Cancel and Return to the Home Screen:* Exits screen and returns to the Home Screen without changing password.

Reset Instrument Password

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

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

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

The Reset Instrument Password screen contains the following information:

● *Reset:* Allows the user to reset the instrument password.

● *Cancel and Return to the Home Screen:* Exits screen and returns to the Home Screen without changing password.

USB Drive

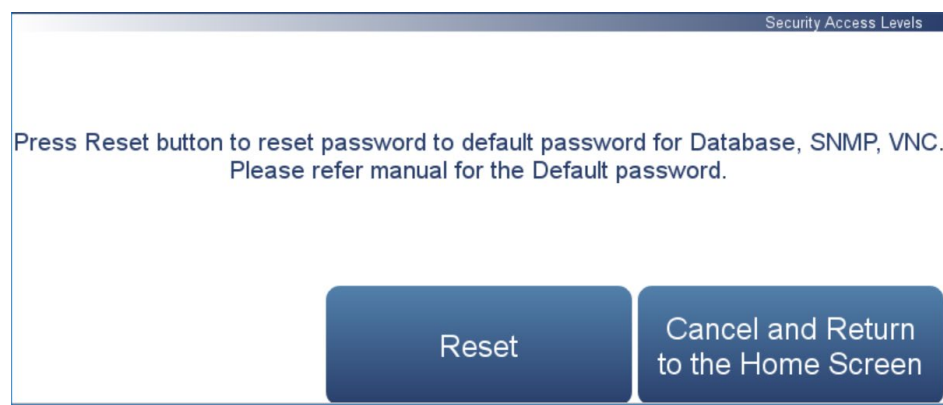The USB Drive screen allows the user to update firmware, download/upload information, change/reset the USB password, unmount USB drive, and restore configuration files.

Note The USB drive screen is only useable when a USB drive is inserted into the USB port. When a USB drive is inserted, the user is prompted to enter the password if a password has been set. ▲

Home Screen>Settings>USB Drive
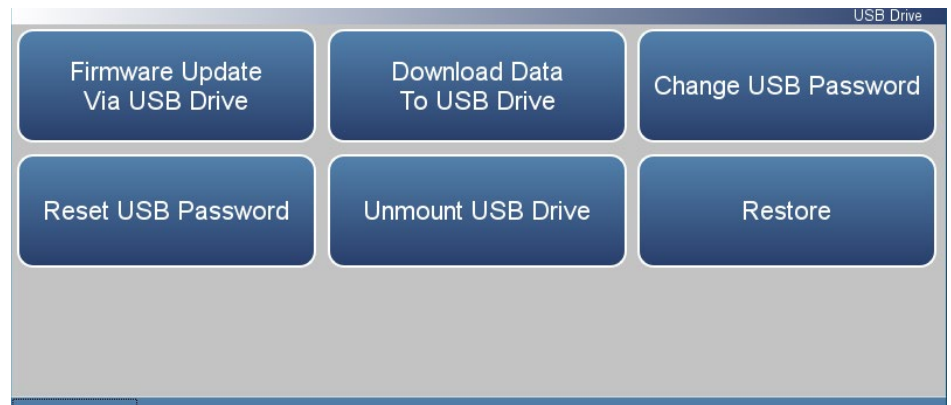
The USB Drive screen contains the following information:

●   *Firmware Update Via USB Drive:* If USB is mounted, user can update instrument firmware.

●   *Download Data To USB Drive:* User can download/upload information.

●   *Change USB Password:* User can change the USB password.

●   *Reset USB Password:* User can reset the USB password.

●   *Unmount USB Drive:* User can safely unmount the USB drive.

●   *Restore:* Allows the user to upload the configuration files from the USB to the instrument.

Firmware Update Via USB Drive

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

Home Screen>Settings>USB Drive>Firmware Update Via USB Drive
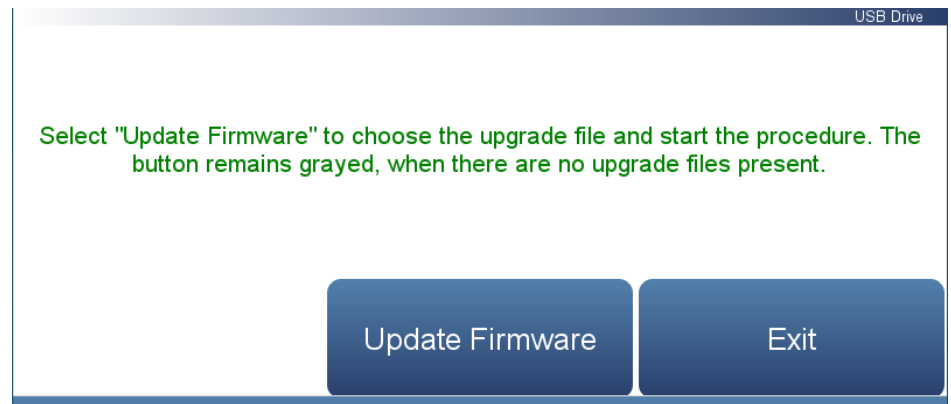
The Firmware Update Via USB Drive screen contains the following information:

● *Update Firmware:* User chooses firmware file from USB and updates instrument firmware. Instrument reboots when update is finished.

● *Exit:* User exits without updating firmware.

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

1. Copy the update*.zip file onto the USB FLASH drive using Windows Explorer or another means. The file must be copied into the root directory of the USB stick's file system otherwise it won't be recognized. Also, make sure the USB stick is formatted using the FAT or FAT32 file system.

2. Plug a USB flash drive into the data port on the front panel of the unit or into one of the USB ports on the side near the power cable. A pop-up box will appear, acknowledging that a flash drive has been detected. If a USB password has been previously set, you will be prompted to enter the USB password to continue. Press **Enter** to continue.

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

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

5. Press the **Update Firmware** button.
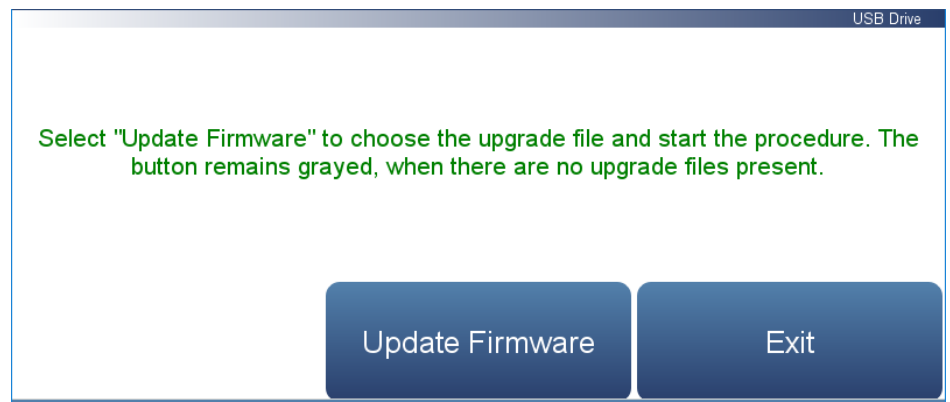
6. The on-screen instructions will prompt the user to select the firmware update file and display what it is doing at each step and some steps may take several minutes to complete.

7. Press **Yes** to confirm and proceed with the firmware upgrade.

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

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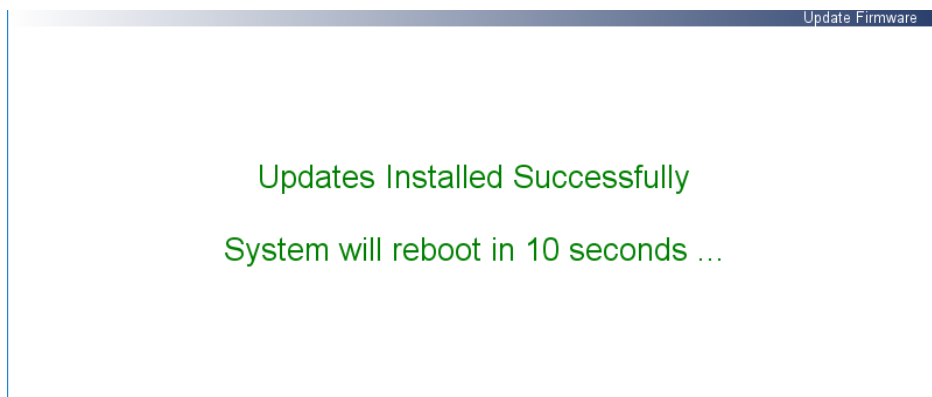
Download Data To USB Drive

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

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

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

- *Download Health Check Report:* Includes status and alarms, preventive maintenance, and maintenance history.

- *Download Entire Data Log:* Includes the entire data log (from data logging).

- *Download Service Log:* Includes a complete listing of data for all variables. This is set at the factory.

- *Download System Log:* Consists of system log text files, which include a listing of system errors.

- *Download Calibration History:* Includes the data in the calibration history screen.

- *Download Configuration Data Backup to USB:* Allows the user to download the configuration file from the instrument to the USB.

- *Upload Configuration Data Restore from USB:* Allows the user to upload the configuration files from the USB to the instrument.

- *Download All Data:* Downloads all reports, logs, histories, and backup information.

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

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


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

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

4. The Download Data to USB Drive screen will display. Select from various options to download.
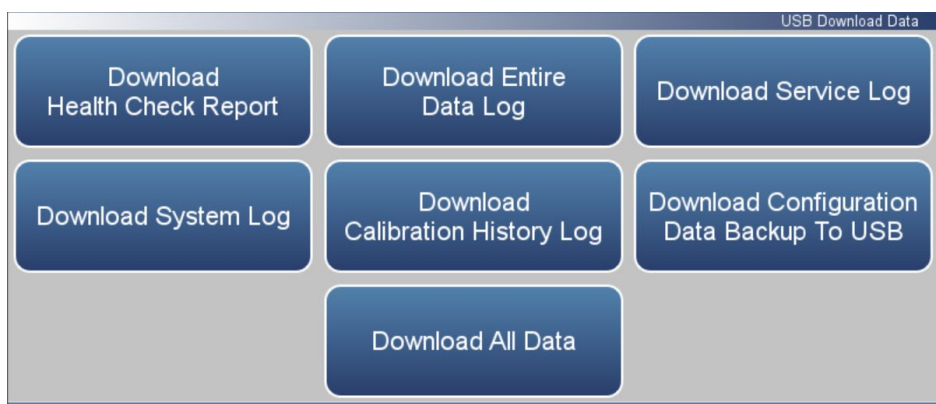
5. The instrument will display a "downloading data" message and begin transferring data to the USB drive.

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

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

Change USB Password

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

Home Screen>Settings>USB Drive>Change USB Password

To Change the USB Access Password perform the following steps using the graphical user interface only (do not use an external USB keyboard):
1. Enter the Current USB Access Password
2. Enter the New USB Access Password
3. Confirm the New USB Access Password
4. Commit the USB Access Password Change
Note: To clear the USB Password, follow the steps above using blank values for the New Password.

Continue   Cancel and Return to the Home Screen

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

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

Enter Current USB Password   Continue   Cancel and Return to the Home Screen

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

Enter New USB Password   Continue   Cancel and Return to the Home Screen

3. Confirm the New USB Access Password and then press Continue.

| Confirm New USB Password | Continue | Cancel and Return to the Home Screen |

4. Commit New USB Access Password Change

| Commit New USB Access Password Change | Cancel and Return to the Home Screen |
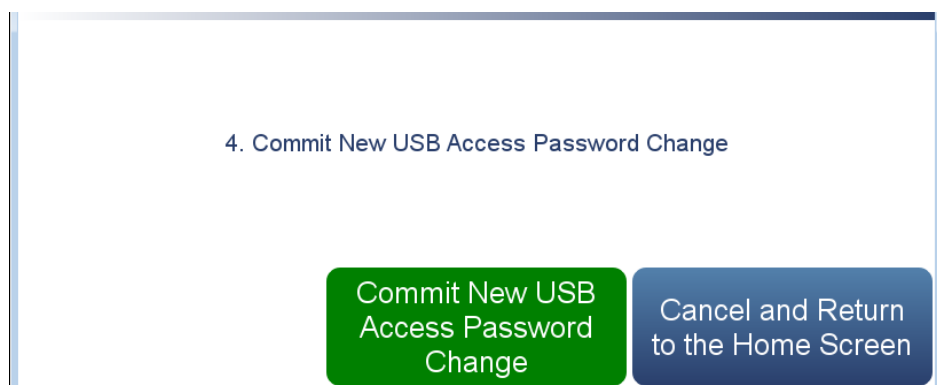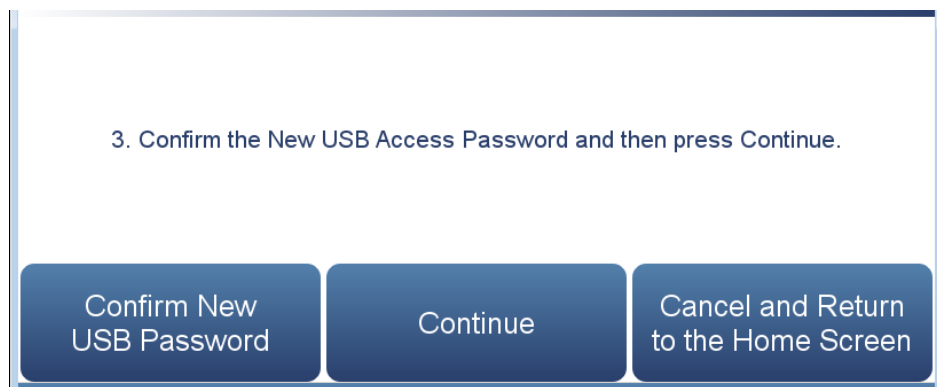
The Change USB Password screens contain the following information:

● *Enter Current USB Password:* User enters current USB password.

● *Continue:* Proceeds to next screen.

● *Enter New USB Password:* User enters new USB password.

● *Confirm New Security Access Password:* User confirms new security password for spelling confirmation.

● *Commit New USB Password Change:* Commits new USB password.

● *Cancel and Return to the Home Screen:* Exits screen and returns to the Home Screen without changing password.

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

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

Home Screen>Settings>Security Access Levels>Reset USB Password
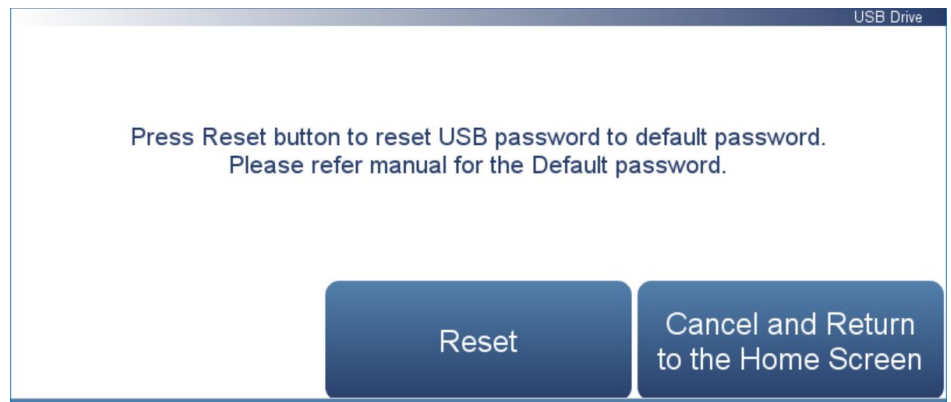
The Reset USB Password screen contains the following information:

● *Reset:* Allows the user to reset the USB password.

● *Cancel and Return to the Home Screen:* Exits screen and returns to the Home Screen without changing password.

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

Home Screen>Settings>Security Access Levels>Restore

The Restore screen contains the following information:

● *Restore Configuration Data:* Allows the user to restore the instrument configuration.

● *Restore Calibration History Data:* Allows the user to restore calibration history.

● *Restore Maintenance History From Health Check Data:* Allows the user to restore maintenance history.

User Contact Information

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

Home Screen>Settings>User Contact Information

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

The User Contact Information screen contains the following information:

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

Update Bootloader

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

Home Screen>Settings>Update Bootloader

Bootloader update is available. Pressing the "Reboot and Update" button will initiate the update and then reboot the instrument. This cannot be undone. Would you like to continue this operation?

Reboot and Update   Exit
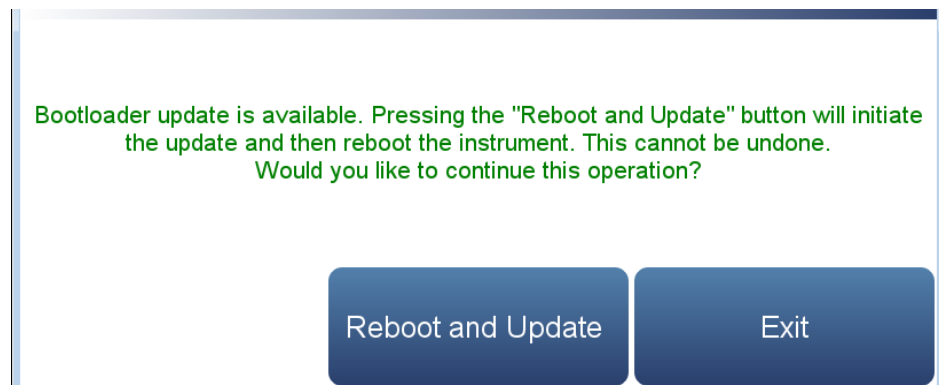
The Update Bootloader screen contains the following information:

● *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 42iQD 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 42iQD. 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:

$$NO + O_3 \rightarrow NO_2 + O_2$$
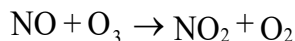
The quantitative nature of this reaction is such that when the NO concentration is known, the concentration of NO_2 can be determined. Ozone is added to excess NO in a dynamic calibration system, and the NO channel of the chemiluminescence NO-NO_2-NO_x analyzer is used as an indicator of changes in NO 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.
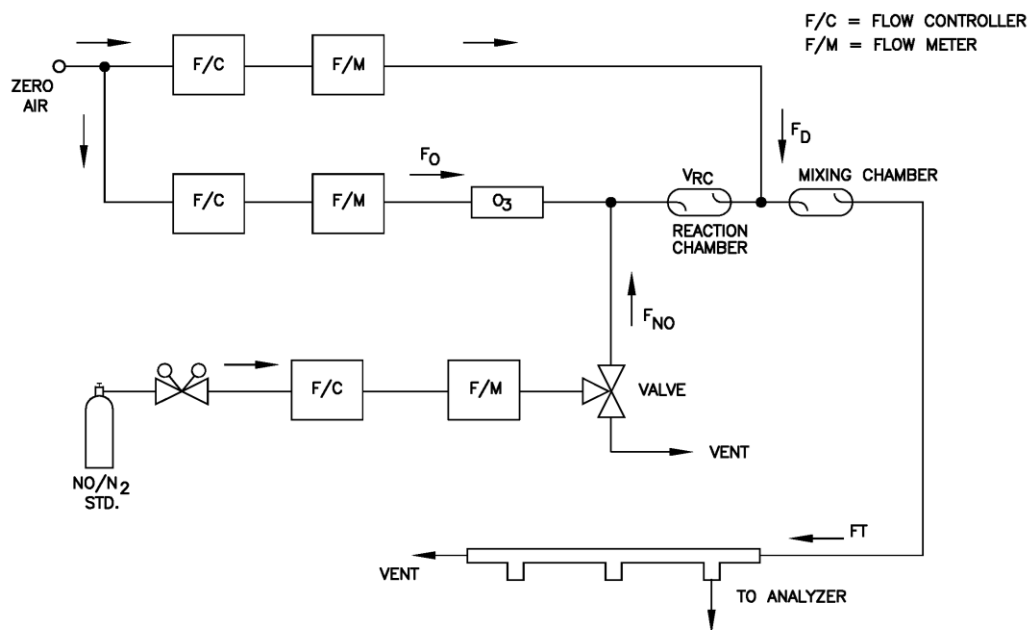
Figure 4–1. GPT System

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:

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

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

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

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:

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

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:

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

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 42iQD. 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. If the instrument is not in auto mode:

   a. From the Home screen choose **Settings>Measurement Settings>Range Mode Selection**.

   b. Select **Auto**.

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_x background to zero
- Calibrating the NO_x channel to the NO_x calibration gas

Set NOₓ Background to Zero

The NO_x background correction is 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 NOx Background" in the "Operation" chapter.

Use the following procedure to set the NO_x background to zero.

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 42iQD requires approximately 700 cc/min of sample flow, and a total GPT airflow of at least 1.5 liters/min is recommended.

   a. Allow the analyzer to sample zero air until the NO_x response stabilizes.

   b. After the response is stabilized, from the Home Screen, choose **Calibration>Calibrate Background>Calibrate NO_x Background**.

      The Target NO_x Concentration button will read 0.00. The Calculated NO_x Background button will display the background needed to make the current NO_x concentration go to 0.00.

   c. Press **Calibrate** to set the NO_x reading to zero and to save the new background.

   d. Record the stable zero air responses as Z_{NOX}.

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

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

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$_x$ Calibration Curves

Use the following procedures to prepare the NO$_x$ calibration curves.

1. Generate several additional NO$_x$ concentrations by decreasing F_{NO} or increasing F_D.

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

3. Record the NO$_x$ responses.

4. Plot the analyzer responses versus the respective calculated 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.

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. ▲

Alternative Calibration Procedure Using NO₂ Permeation Tube

Although it is recommended that a GPT system be used to calibrate the analyzer, the procedure described in the Code of Federal Regulations, Title 40, Part 50, Appendix F using a NO$_2$ permeation tube may be used as an alternative procedure for calibrating the instrument.

Commercial Precision Dilution Systems

Commercial precision dilution systems are available which reliably and accurately dilute a high concentration gas mixture to provide a reliable span gas. A high concentration of NO$_2$ in air is precisely diluted to the concentration range required.

The Thermo Scientific 146iQ Multi-gas Calibrator is one such system for precision dilution.

Permeation Tube System

Permeation tube systems which precisely maintain a set temperature to within ±0.1 °C and hold a zero air flow rate to within ±0.5% can be used for generation of span gas. The flow rate of the permeation system must be at least 0.5 LPM for proper operation.

A permeation tube system, shown in Figure 4–2 can be constructed. All connections between components in the system should be made with glass, PTFE, or other non-reactive material.

The air flow controllers should be capable of maintaining a constant air flow within ±2% of the required flow rate. Ensure all devices are properly calibrated and that all flows are corrected to 25 °C and 1 atm.
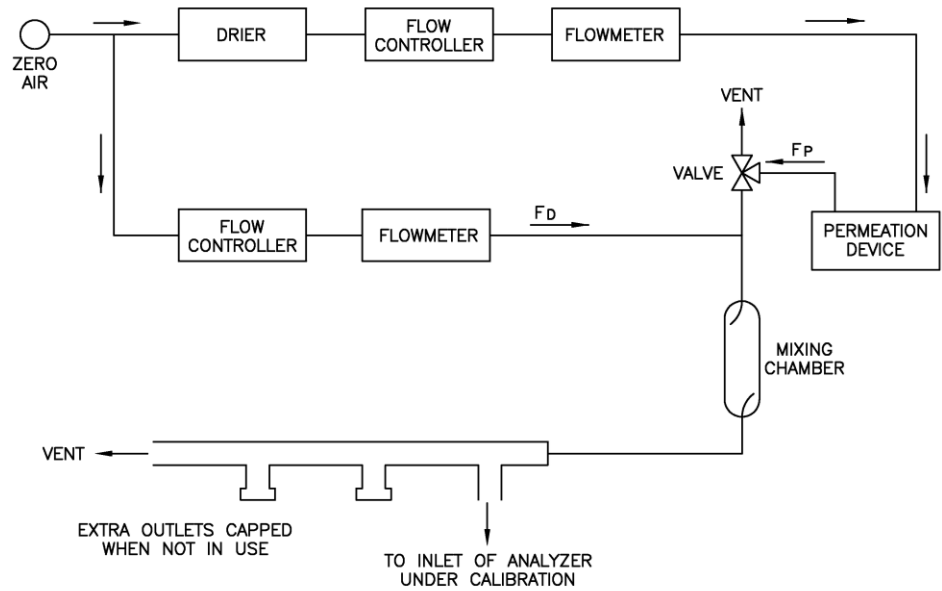
Figure 4–2. Permeation Tube System

The NO_2 output level is calculated from:

$$[NO_2]_{OUT} = \frac{P \, x \, K}{F_T}$$

Where:

$[NO_2]_{OUT}$ = NO_2 output concentration in ppm

P = permeation rate in µg/min

F_T = total flow rate of gas after mixing chamber (F_P + F_D) in liters/minute

K (NO_2) = 0.382 constant for NO_2 permeant

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$_x$ Background to Zero

Use the following procedure to set the NO$_x$ background to zero.

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$_x$ response stabilizes.

4. After the response is stabilized, from the Home Screen, choose **Calibration>Calibrate Backgrounds>Calibrate NO$_x$ Background**.

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

5. In the Calibrate Backgrounds screen, press **Calibrate** to set the NO_x reading to zero and to save the new background.

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 Calculated Low Range NO_x 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$_x$ 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 Calculated High Range NO_x 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.

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 42iQD 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_x channel, 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_x channel. 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_x value.

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_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 Background	Adjust Span Coefficient	Reset Bkg to 0.000 and Span Coef to 1.000

Adjust NO and NO_x Backgrounds

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 button labeled Adjust NO_x Background allows the user to change zero background. The second button called Adjusted NO_x Concentration shows

what the new NO$_x$ 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
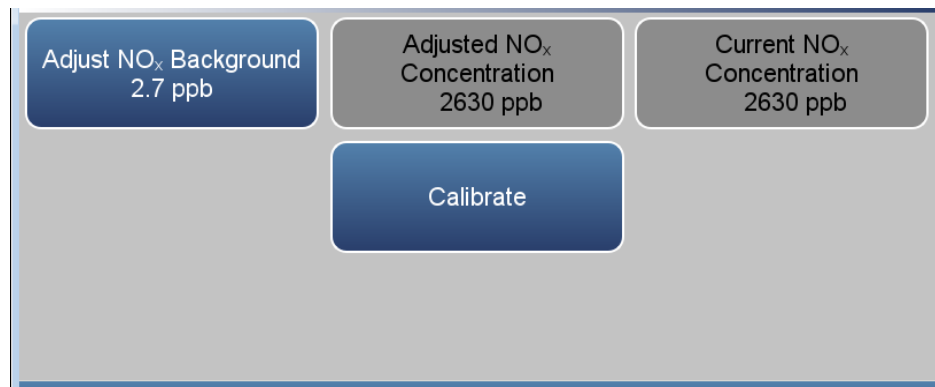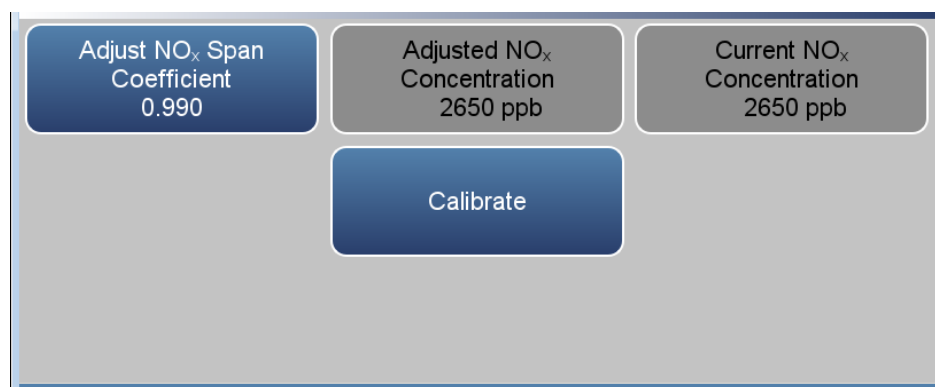

Adjust Span Coefficient

The span coefficient is used to correct the NO$_x$ reading. The NO$_x$ span coefficient normally has a value near 1.000.

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.

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

Home Screen> Calibration>Advanced Calibration>Manual Calibration>Adjust Coefficients>Adjust Low Range NO$_x$ Span Coefficient (dual or auto range mode)
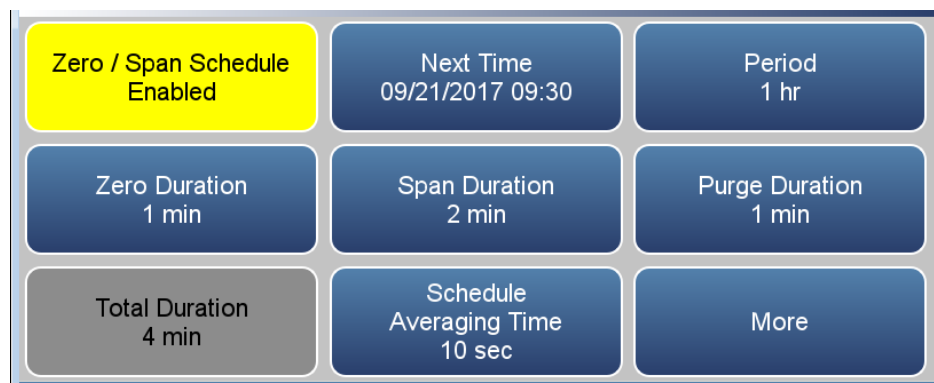
Adjust Low Range NO$_x$ Span Coefficient 0.990	Adjusted Low Range NO$_x$ Concentration 2650 ppb	Current Low Range NO$_x$ Concentration 2650 ppb
	Calibrate	
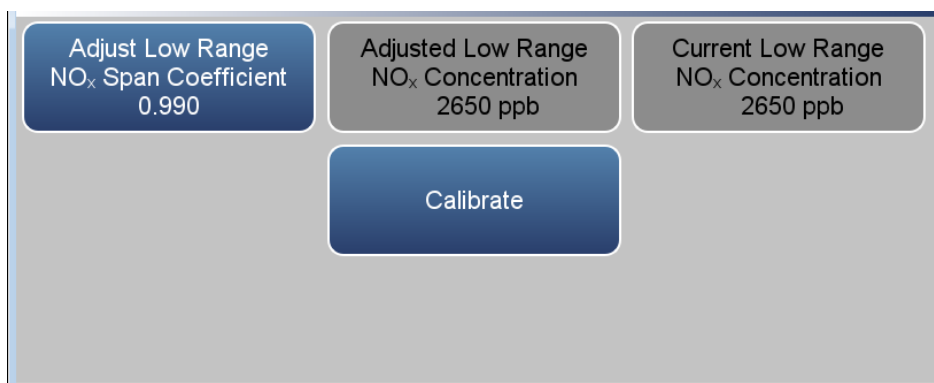
Reset Bkg to 0.000 and Span Coef to 1.000

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

Zero / Span Schedule Enabled	Next Time 09/21/2017 09:30	Period 1 hr
Zero Duration 1 min	Span Duration 2 min	Purge Duration 1 min
Total Duration 4 min	Schedule Averaging Time 10 sec	More

Home Screen>Calibration>Zero/Span Schedule>More

Background Calibration Enabled	Span Calibration Enabled	Zero : Span Ratio 1 : 1
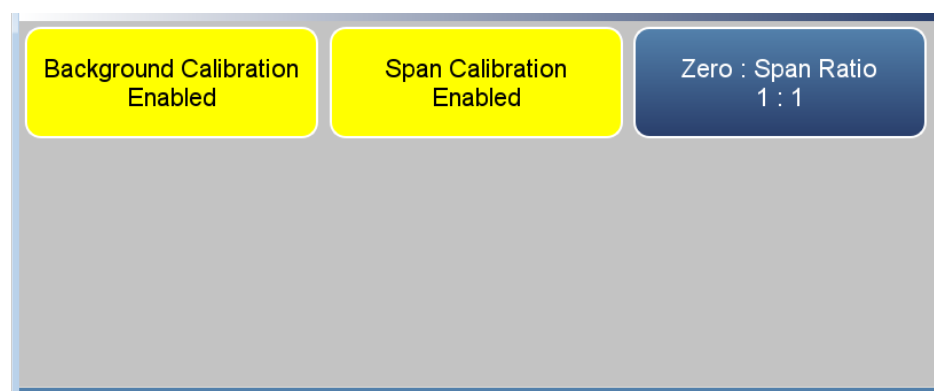
Next Time

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 7-26.

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).
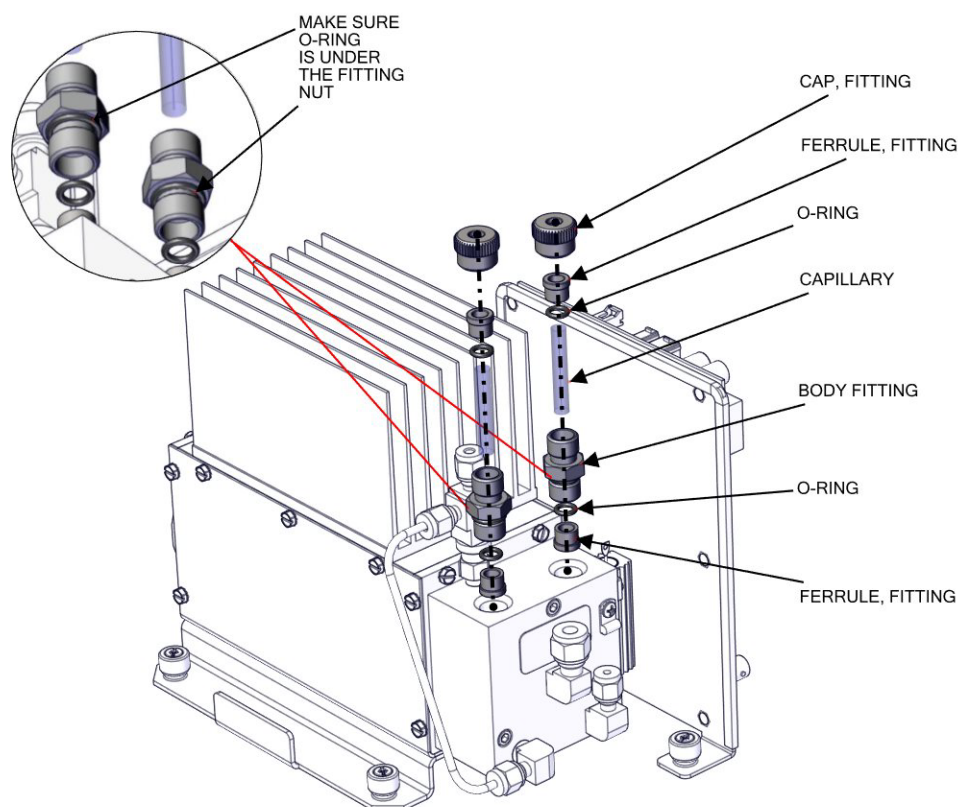
Figure 5–1. Inspecting and Replacing the Capillaries

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

Phillips screwdriver, #1

Marking pencil or marker

Allen wrench, 2.5 mm
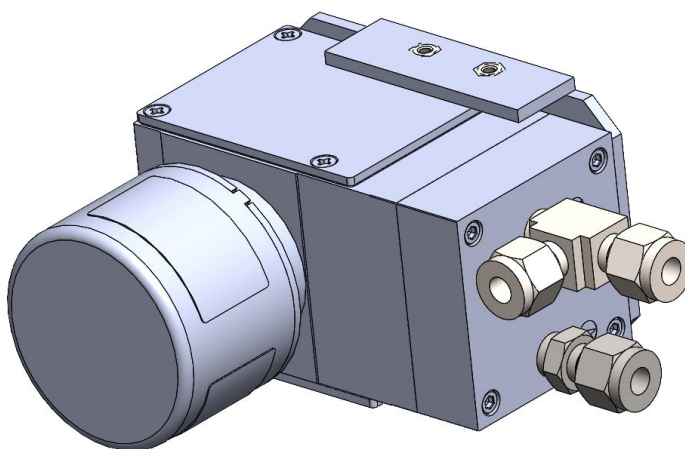
Figure 5–2. Pump

Disassembly:

Note Parts removed must be replaced exactly as found. If repairing multiple pumps, take care not to mix parts. ▲

1. Turn instrument OFF, unplug the power cord, and remove the cover. Make a sketch of the position of any tubes and fittings for ease of re-assembly later.

2. Mark the position of the pump headplate, intermediate plate and compressor housing relative to each other by drawing a line on the edges with a pencil or marker to insure proper re-assembly.

3. One of the aluminum compressor housing covers must be removed to gain access to the inside of the compressor housing. Remove the four

screws and then remove the cover. Re-use any gasketing. Remove any debris that may have accumulated in the bottom of the compressor housing.

4. Remove the four screws with the 2.5 mm allen wrench and remove the headplate. Note the positioning of the valveplate relative to the valve ports on the headplate and intermediate plate. Lift off the valveplate.

5. Remove the intermediate plate.

6. Check that all parts are free from dirt and clean as necessary. **Do not** scratch the parts.

7. Removal of the old diaphragm: Rotate the fan so that the diaphragm is positioned at the top dead center. This will help unseat the edge of the diaphragm. If required, push up from underneath the diaphragm or use a **non-metallic** tool to pry up the diaphragm from the housing groove. Do not scratch the head components. Unscrew the old diaphragm by turning it counterclockwise using both hands. Lift up and grip the edges of the diaphragm at 10 and 4 o'clock. High initial force may be required to break the diaphragm loose. **Do not use tools!** (Note: - Take care not to lose any shim rings positioned between the diaphragm and connecting rod, as the exact number of shim rings must be used during re-assembly.) While unscrewing the diaphragm with one hand, use your other hand to secure the shim rings onto the diaphragm stud. Lift the diaphragm, and shim rings from the pump. The compressor housing cover must be removed (See step 3) to gain access to and secure the shim rings onto the stud. Note: the quantity and thickness of shim rings will vary from pump to pump.

8. It is not necessary to remove the diaphragm ring (040) from the compressor housing groove but if it falls out it must be put back in place.

Assembly with new diaphragm and valveplate:

1. Place the shim rings removed in step 7 above onto the threaded stud of the new diaphragm. Carefully screw the new diaphragm into the connecting rod. It is helpful to hold the connecting rod at a slight angle until the threads are started. Spin the diaphragm on until it is snug. Lift and grip the edges of the diaphragm at 7 and 2 o'clock and tighten firmly using both hands. DO NOT use tools!

(TIP: If the pump is loose and not mounted, position and hold the pump with the motor shaft vertical when starting the threaded diaphragm stud into the connecting rod. This helps to prevent the small parts from falling off the stud.)

2. Turn the fan until the diaphragm is as far down as it will go (bottom point of the stroke). With the diaphragm centered over the compressor housing, firmly seat the diaphragm edge into the compressor housing groove.

3. Place the clean intermediate plate onto the compressor housing using the reference mark made earlier to insure the correct orientation. Then place the new valveplate on top of the intermediate plate.

4. Place the clean headplate (010) on top of the intermediate plate using the reference mark made earlier to insure the correct orientation. Tighten the four head screws snugly in a diagonal pattern and then tighten to a maximum torque of 6-7 inch-lbs. Turn the fan by hand to confirm that the pump turns freely.

5. Replace the compressor housing cover and gasket. Install the four cover screws. Do not over-tighten.

6. If the fittings are removed from the headplate: Remove any old PTFE tape from all fittings. Carefully apply two layers of PTFE tape around any fittings before reinstalling into the pump head. Install the fittings as previously sketched in step 1 above. Do not apply tape beyond threads, as excess tape may tear off and lodge in the valves. Do not substitute any other type of tape. Do not over-tighen metal fittings.

7. Install the tubing and their connection fittings as previously sketched in "Disassembly" step 1 above.
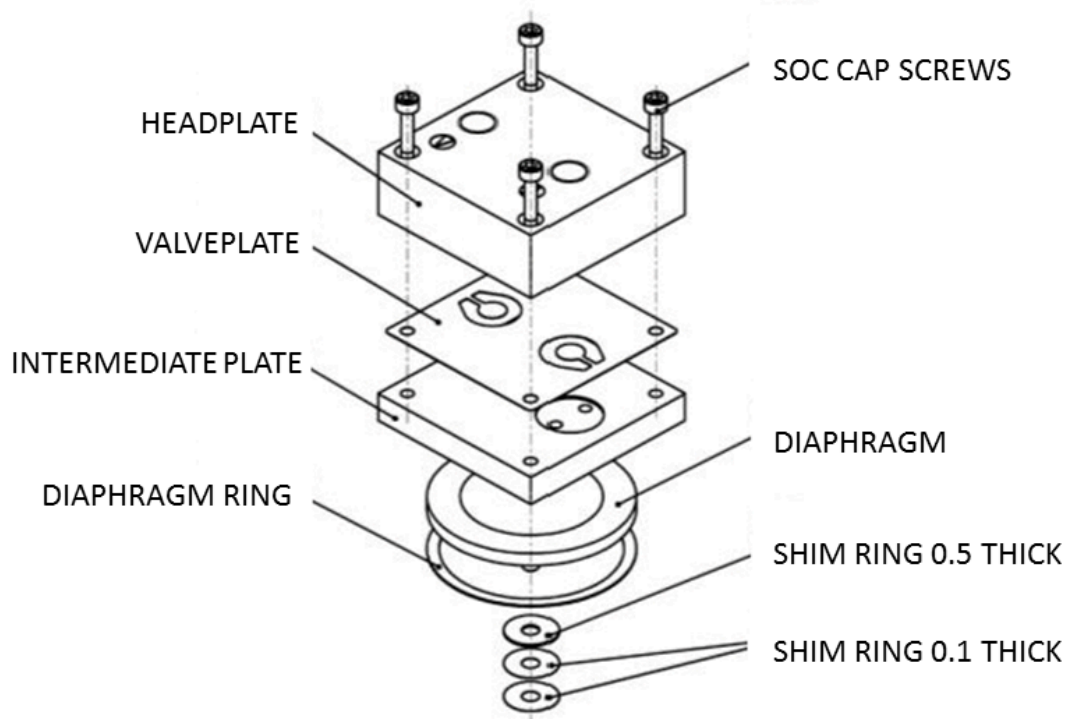
Figure 5–3. Pump Rebuilding

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)

Tee fitting

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. Disconnect the two connections from the pump inlet tee.

5. Join the two lines disconnected from the pump inlet and the vacuum tester tool to a tee fitting.

6. Squeeze trigger until gauge reads to pull in 10 in Hg.

7. Observe vacuum gauge for stable reading for 10 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" 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 42iQD 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. 42iQD 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	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 approximately 325 °C.
	Low line voltage	Check to see if line voltage is within specifications.
	Molybdenum consumed	Replace Molybdenum converter cartridge.
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	Molybdenum converter should be hot to the touch. If not, the heater may have failed. Check that converter temperature set point is approximately 325 °C.
Alarm – Pressure	High pressure indication	Check plumbing for leaks.
		Check the pump for a tear in the diaphragm.
		Replace if needed.

Problem	Possible Cause	Action
		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.
		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$_x$ 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.

Problem	Possible Cause	Action
Alarm – 5V/24V Step Board	Cable connection	Check the cable connections to that Step POL board.
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.

Problem	Possible Cause	Action
	Defective DMC board	Replace DMC board as needed.
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 42iQD 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. ▲
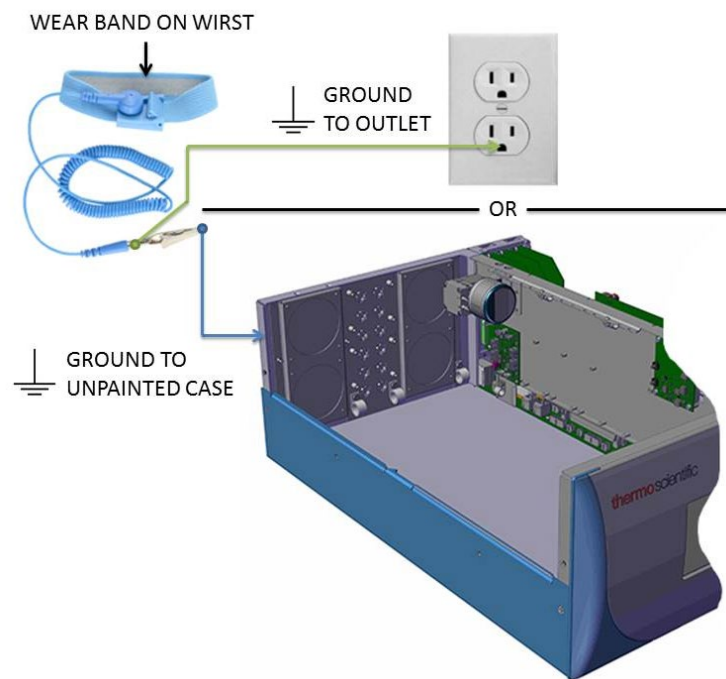
Figure 7–1. Properly Grounded Antistatic Wrist Strap

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:

http://www.thermofisher.com

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

Replacement Parts List

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

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

Refer to Figure 7–2 and Figure 7–3 to identify the component location.
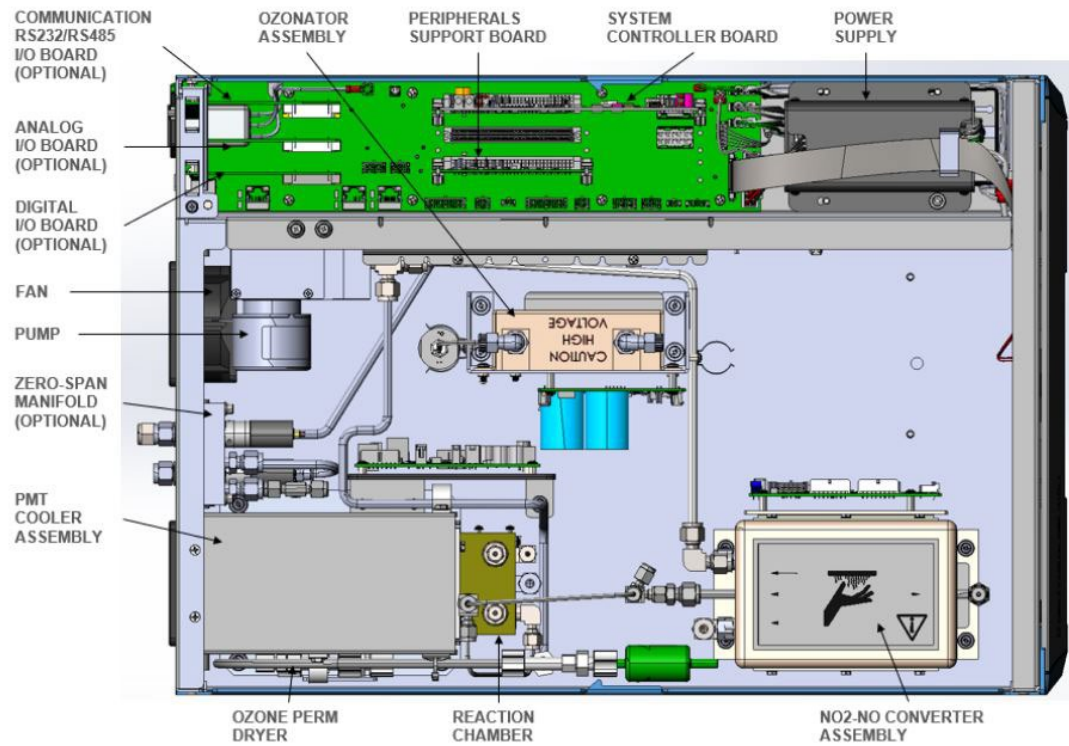
Figure 7–2. 42iQD Component Layout Top View
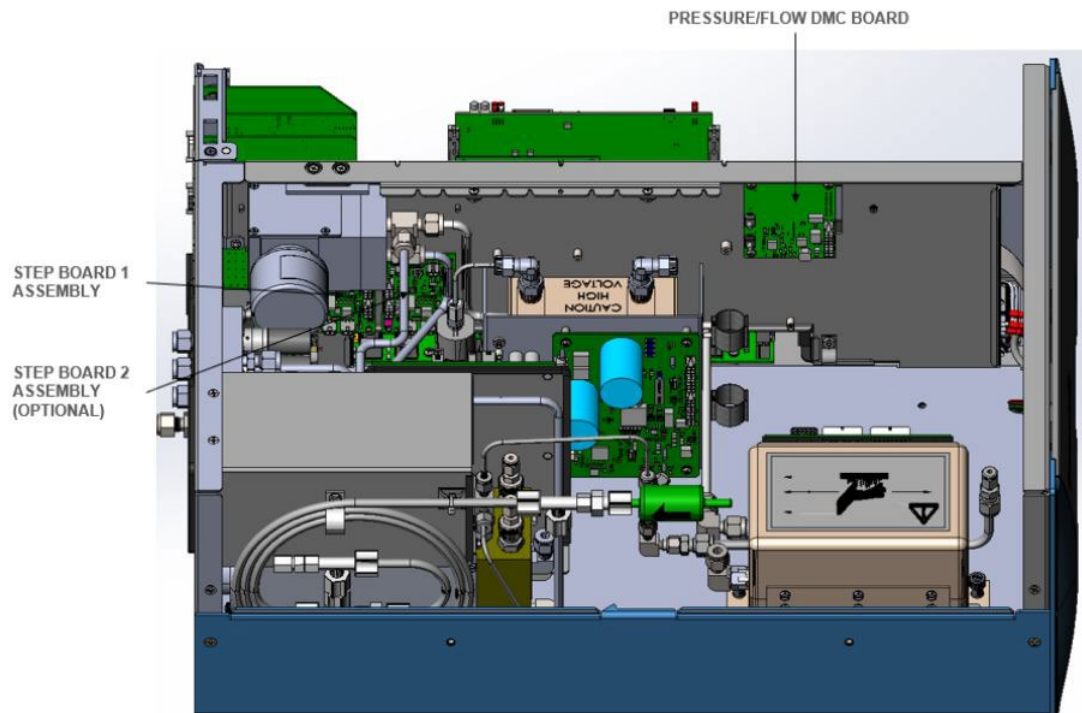
Figure 7–3. 42iQD Component Layout Side View

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.

PULL FUSE TRAY OUT AND REPLACE FUSES
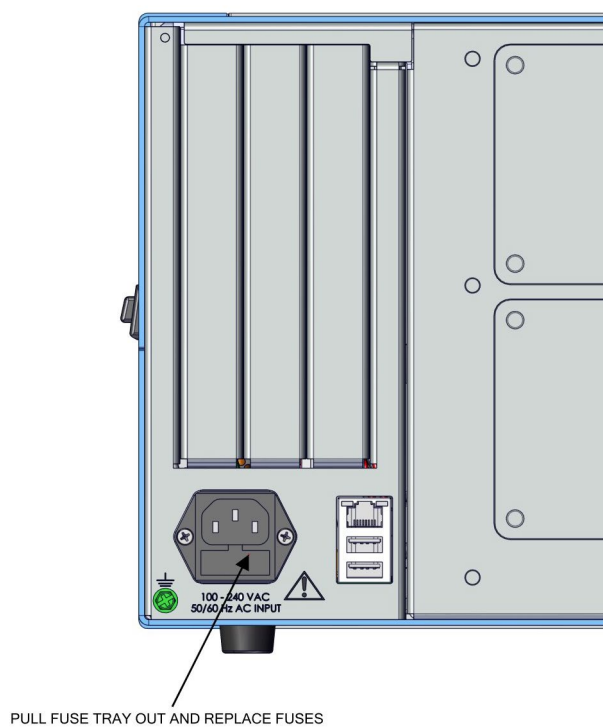
Figure 7–4. Replacing the Fuses

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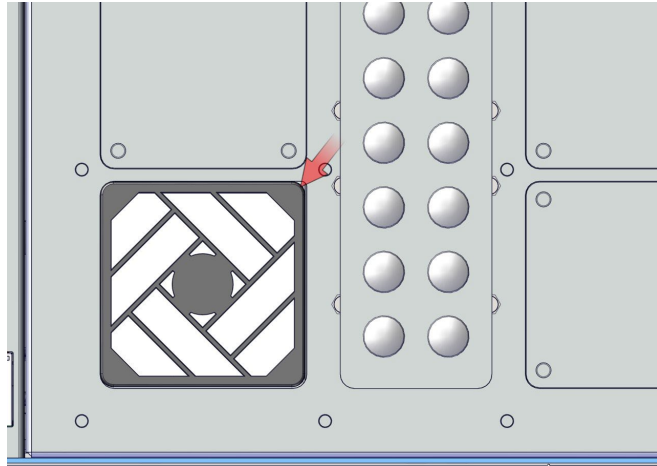
Figure 7–5. Start with Top Right Corner of Fan Cover

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

FAN FILTER
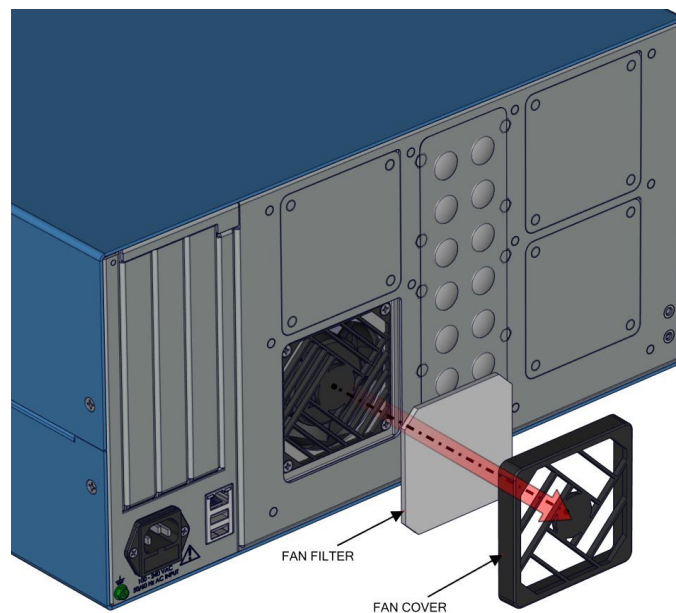
FAN COVER

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.
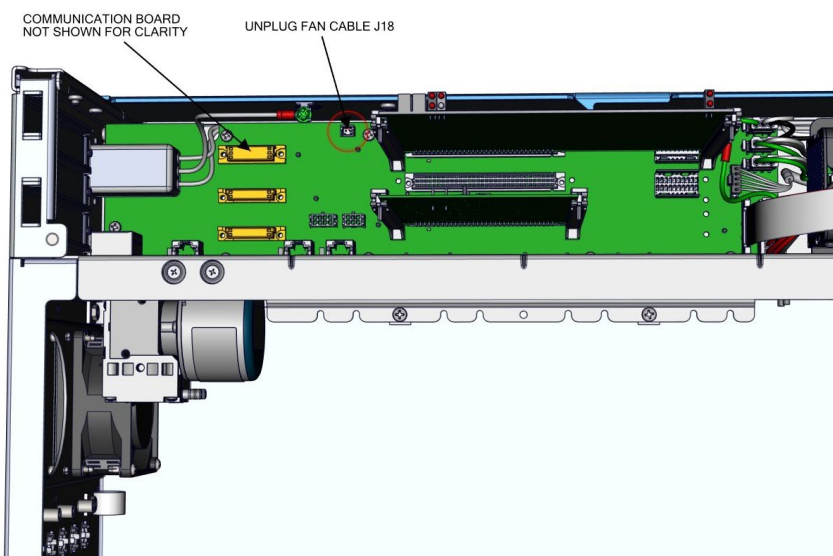
Figure 7–7. Unplugging the Fan Cable

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.
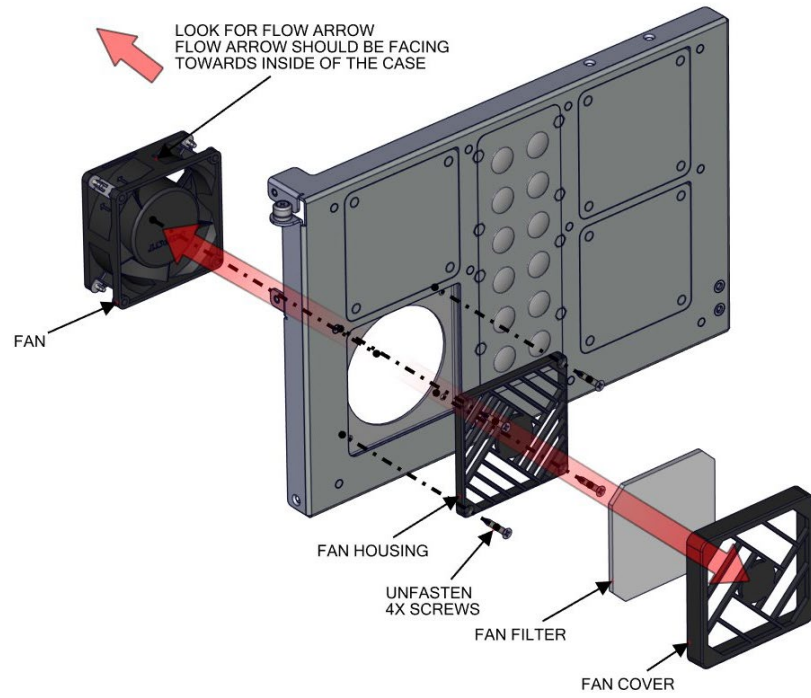
Figure 7–8. Replacing the Fan

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).

COMMUNICATION BOARD NOT SHOWN FOR CLARITY   UNPLUG FAN CABLE J18
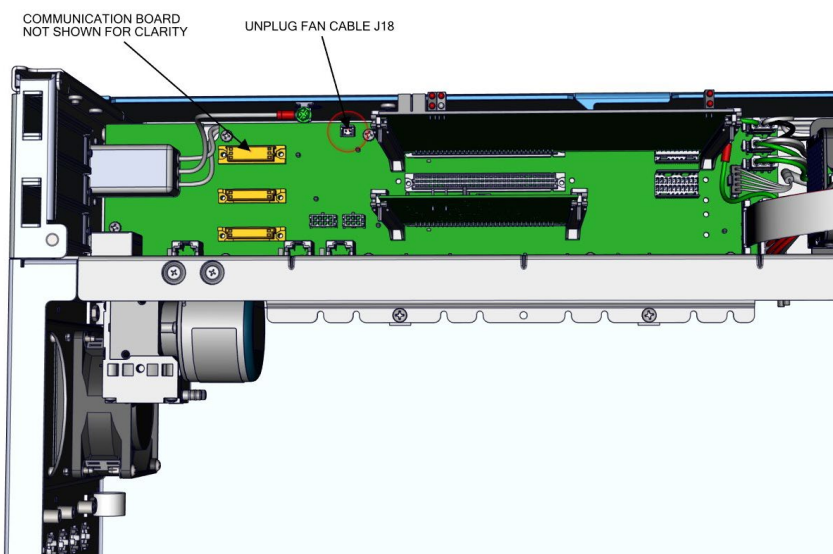
Figure 7–9. Unplugging the Fan Cable

3. Unplug DMC cable (Figure 7–10).

REFERENCE
DMC CABLE CONNECTS HERE
IF REMOVED

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).
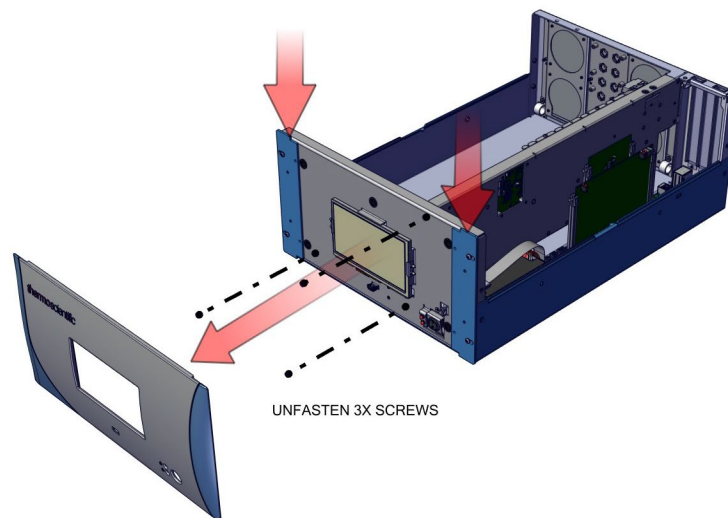
UNFASTEN 3X SCREWS

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.

SWING ARM OPEN

UNFASTEN
CAPTIVE HARDWARE
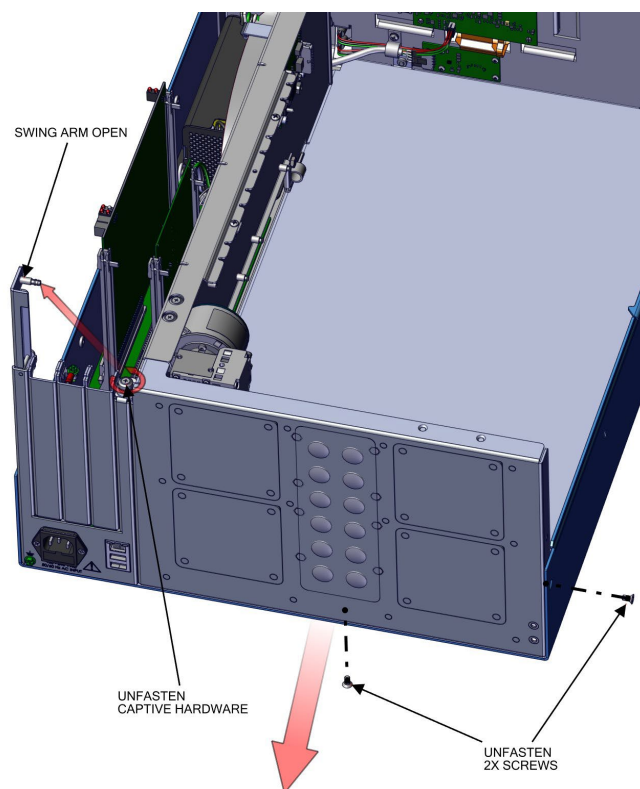
UNFASTEN
2X SCREWS

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).

REMOVE PANEL AND UNFASTEN 4X NUTS
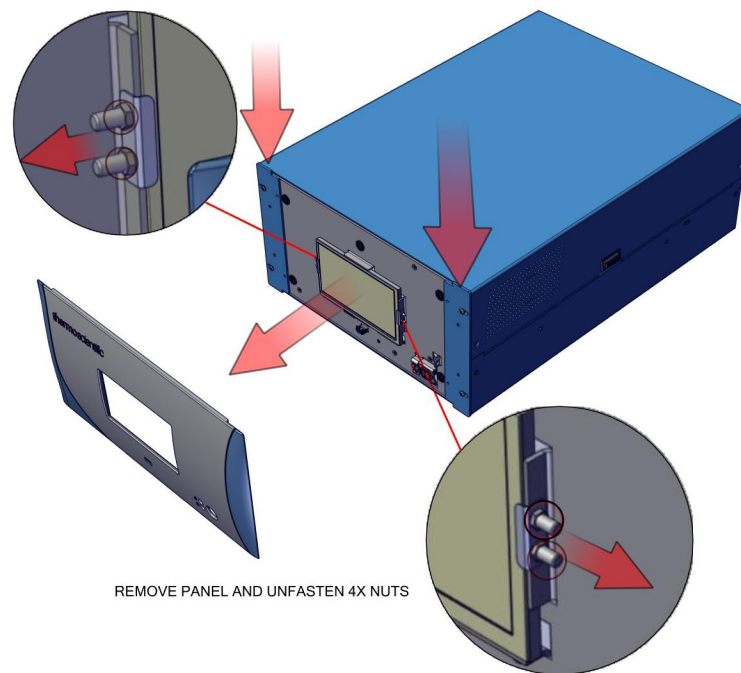
Figure 7–13. Replacing the LCD Module

4. Remove cover.

5. Unplug LCD cables from backside of board.

6. Pull board off the standoffs.

PULL BOARD OFF
THE STANDOFFS

UNPLUG LCD CABLES
FROM BACKSIDE OF BOARD
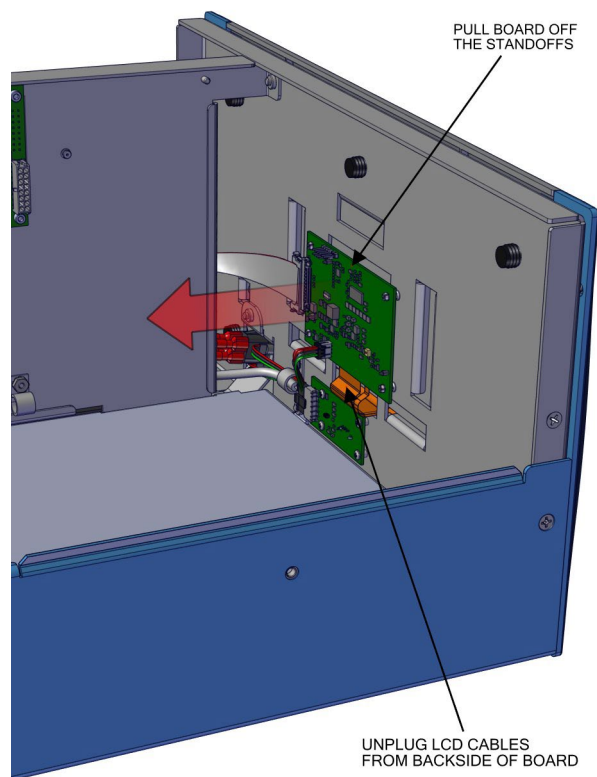
Figure 7–14. Remove Electrical Cables from LCD

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.
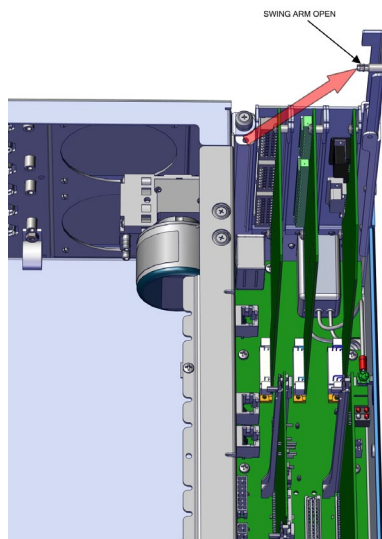
Figure 7–15. I/O Replacement, Arm

3. Pull board upwards.
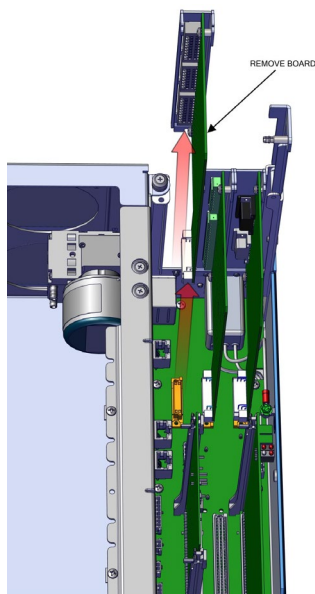
Figure 7–16. I/O Replacement, Remove Board

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

5. Insert board downwards.
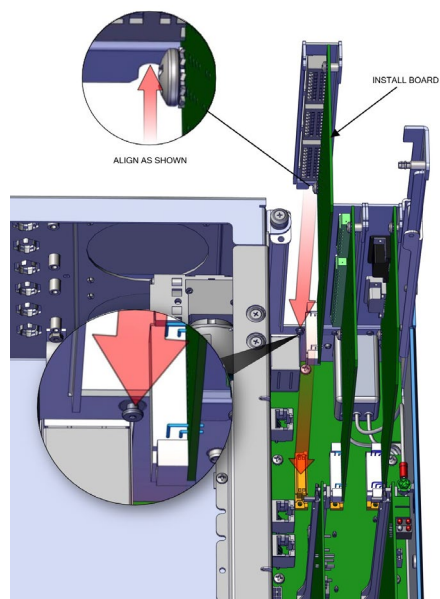
Figure 7–17. I/O Replacement, Install

6. Close arm. Make sure expansion bracket aligns to the inside of the rectangular cutouts.
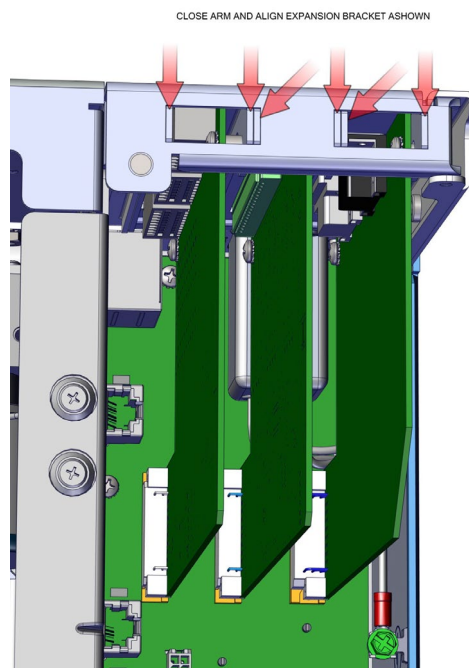
Figure 7–18. I/O Replacement, Close Arm Alignment

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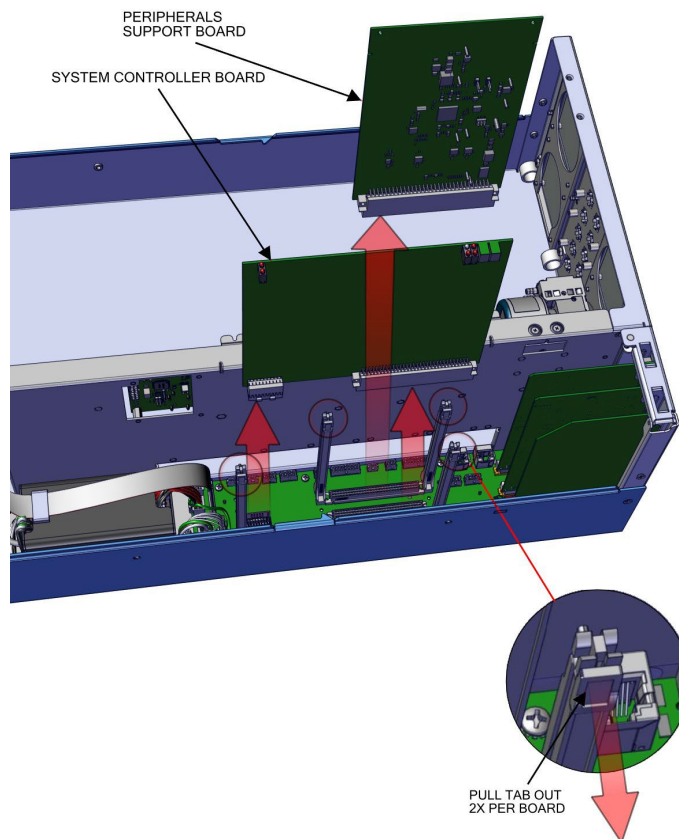
Figure 7–19. Replacing the Peripherals Support or System Controller Board

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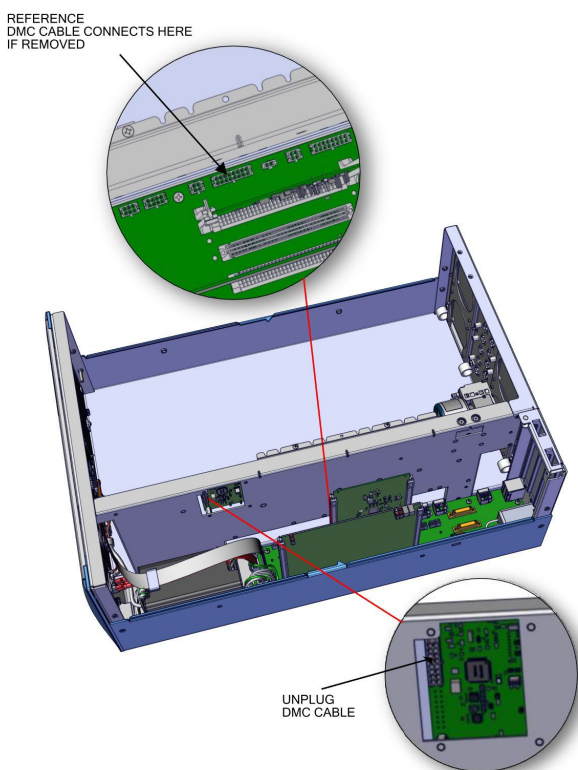
Figure 7–20. Flow Pressure Board, Disconnect DMC Cable

3. Disconnect plumbing.

4. Using 7/16 hex drive, unfasten four #6-32 socket cap head screws.
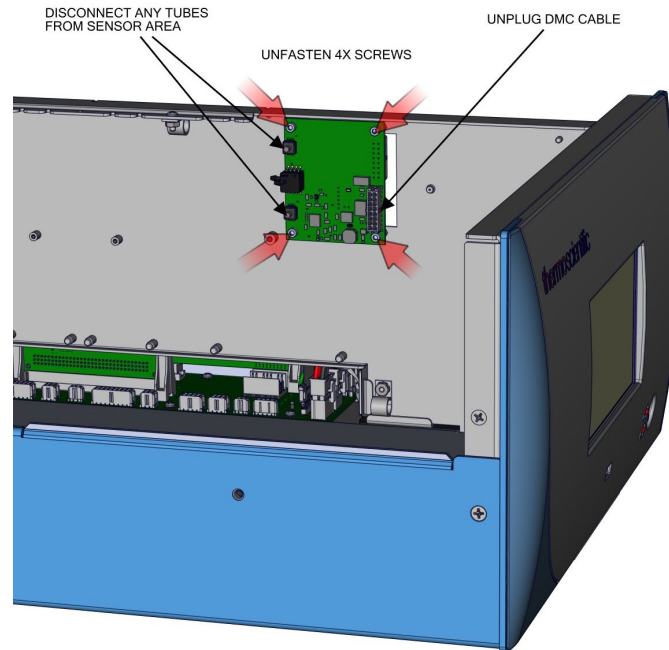
Figure 7–21. Flow Pressure Board, Screws

5. Replace board and reassemble in reverse order.

Pump Replacement

Use the following procedure to replace the pump.

Equipment required:

Phillips drive, #1 and #2

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

2. Unplug pump cable from Step POL board J7.

3. Disconnect tubing from pump.

4. Unfasten two captive hardware.

5. Slide pump right until keyway meets opening.
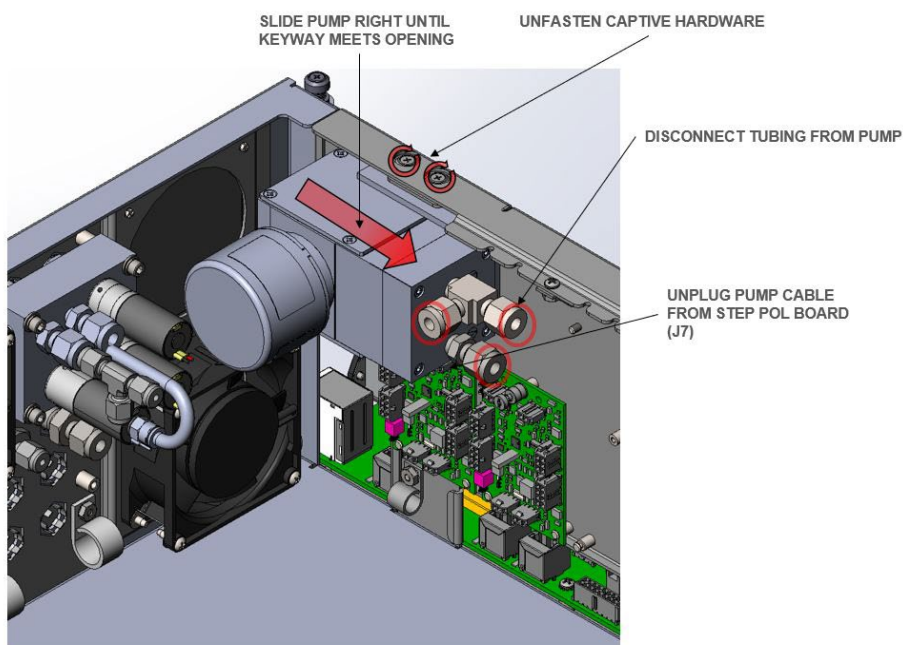
Figure 7–22. Remove Pump, Disconnect and Unfasten

6. Pull pump outwards.

Note When installing pump, make sure the pump keyway opening goes over the keyway. ▲
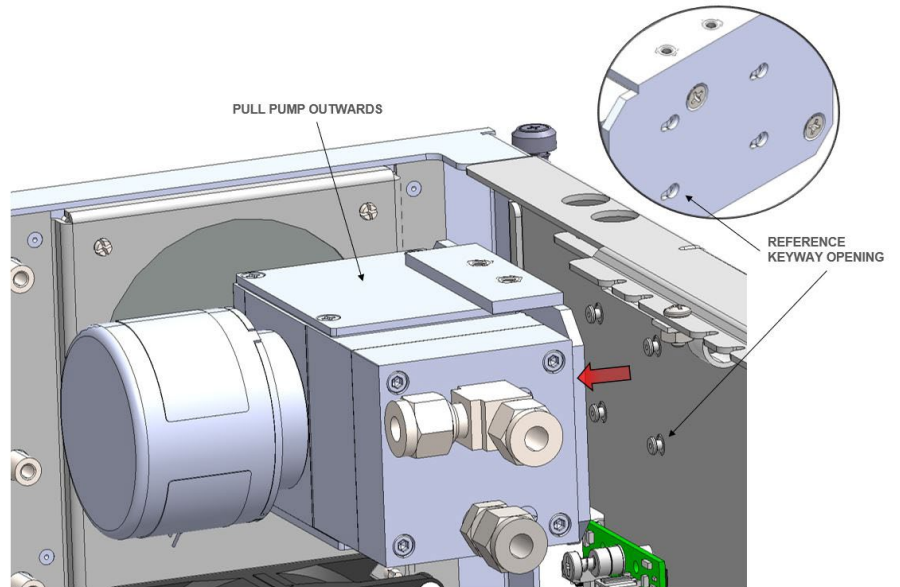
Figure 7–23. Pump Removal, Keyway

7. Remove two screws.
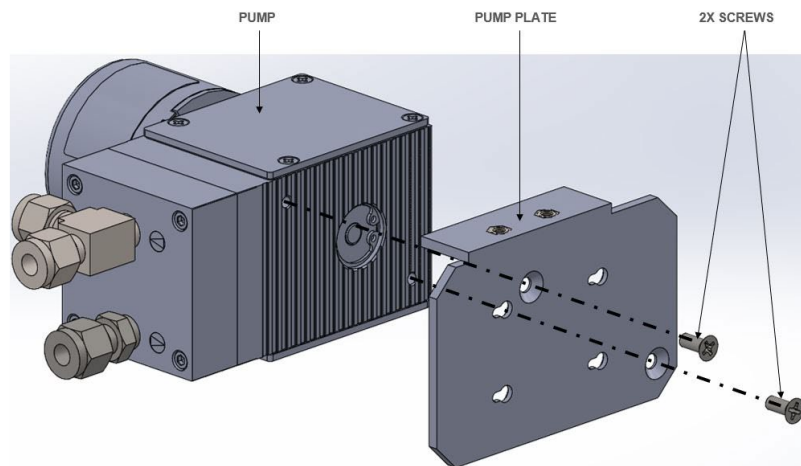
Figure 7–24. Pump replacing, Unfasten Screws

8. Replace pump and reassemble in reverse order.

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.
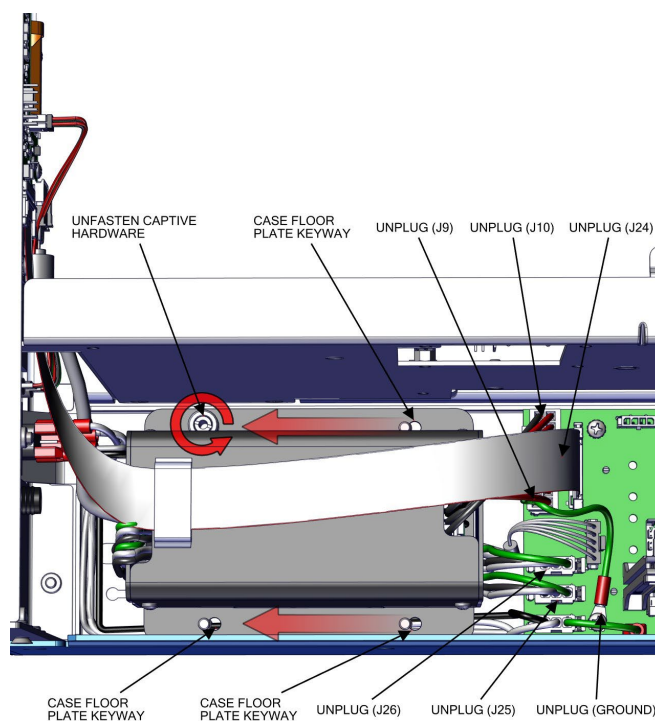
Figure 7–25. Removing Power Supply

5. Pull power supply up.

6. Replace power supply and reassemble in reverse order.
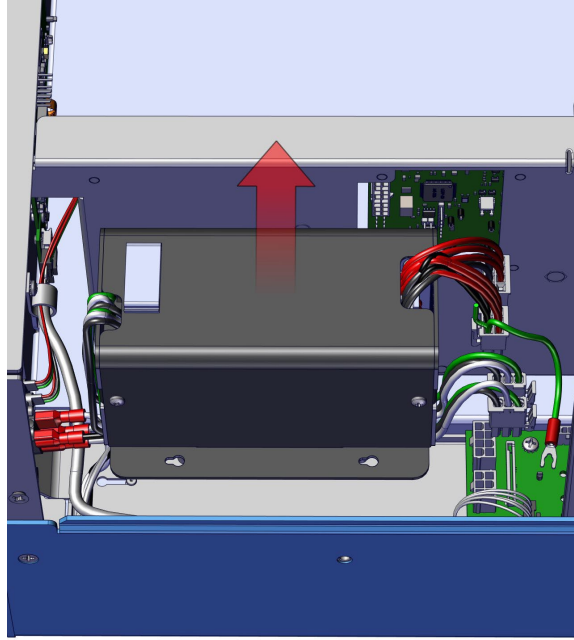
Figure 7–26. Replacing Power Supply

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.

UNPLUG STEP POL POWER CABLE J4

UNFASTEN CAPTIVE HARDWARE

UNPLUG PUMP CABLE J7 (LOAD CD)

UNPLUG STEP POL SIGNAL CABLE J2
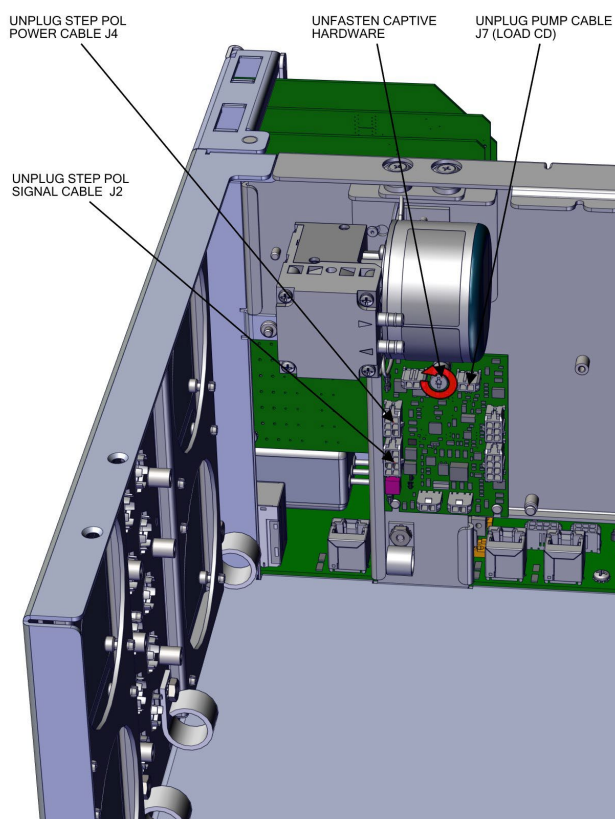
Figure 7–27. Unplug and Unfasten Step POL Board
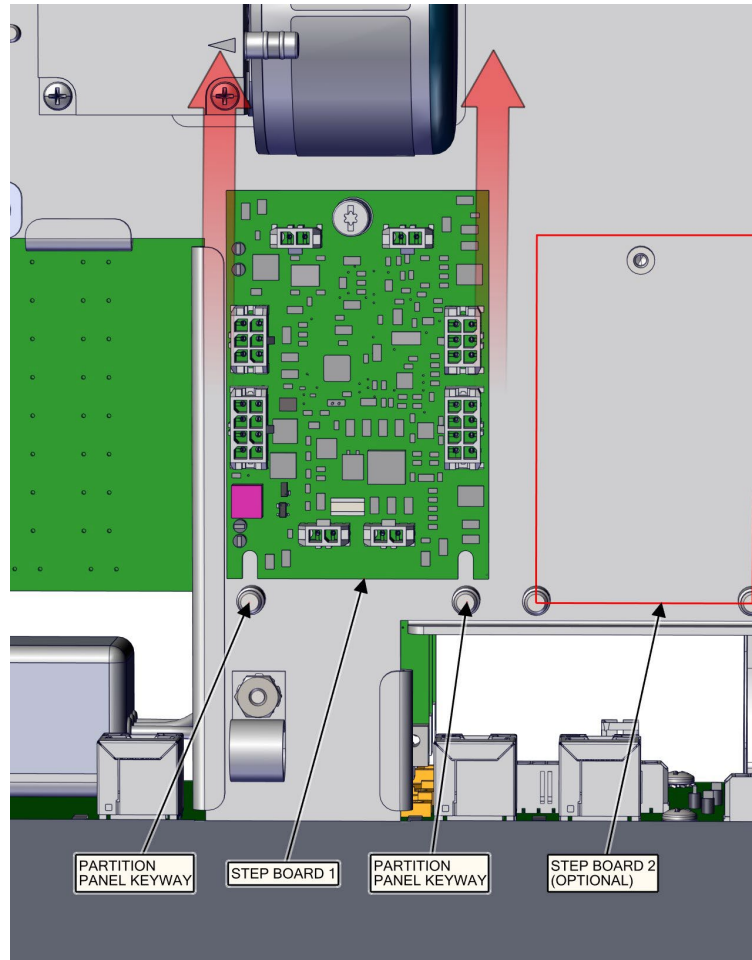
Figure 7–28. Clear Partition Keyway Step POL Board

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

7. If replacing step board 1, make sure switch 1 and 2 are pointed away from ON (Figure 7–29). If replacing optional step board 2, make sure switch 1 is pointed towards ON and switch 2 is pointed away from ON (Figure 7–29).

8. Replace Step POL board and reassemble in reverse order.
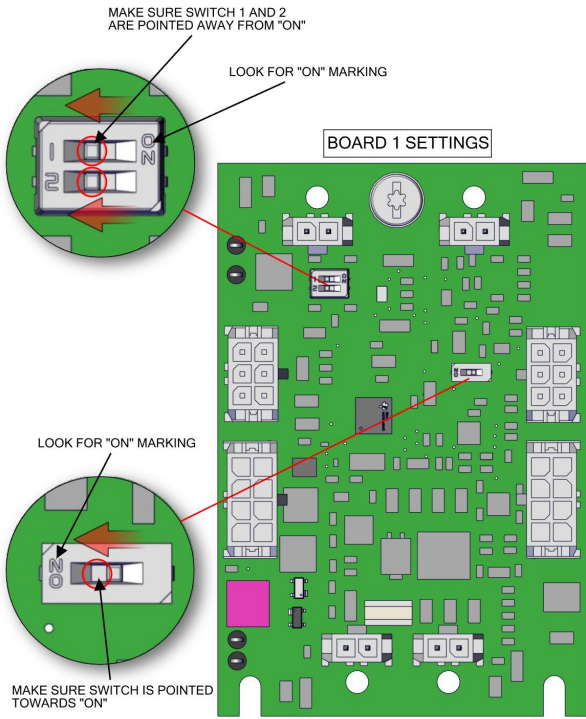
Figure 7–29. Step POL Board 1 Switch Settings
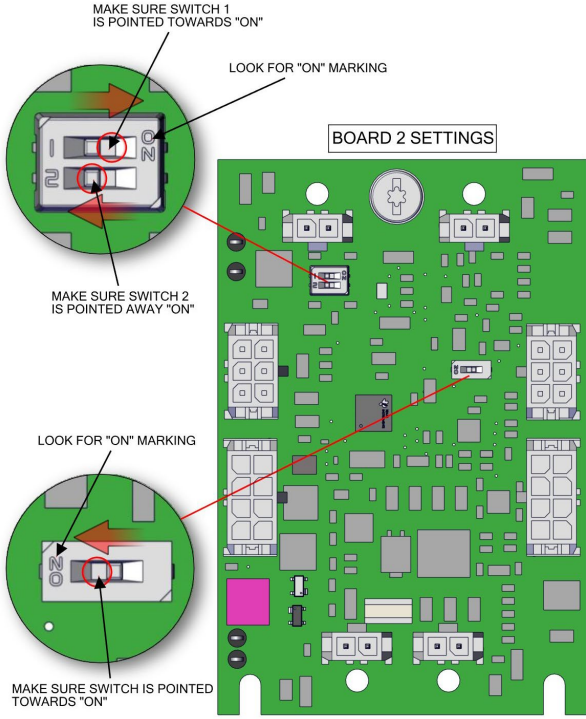
Figure 7–30. Step POL Board 2 Switch Settings

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.
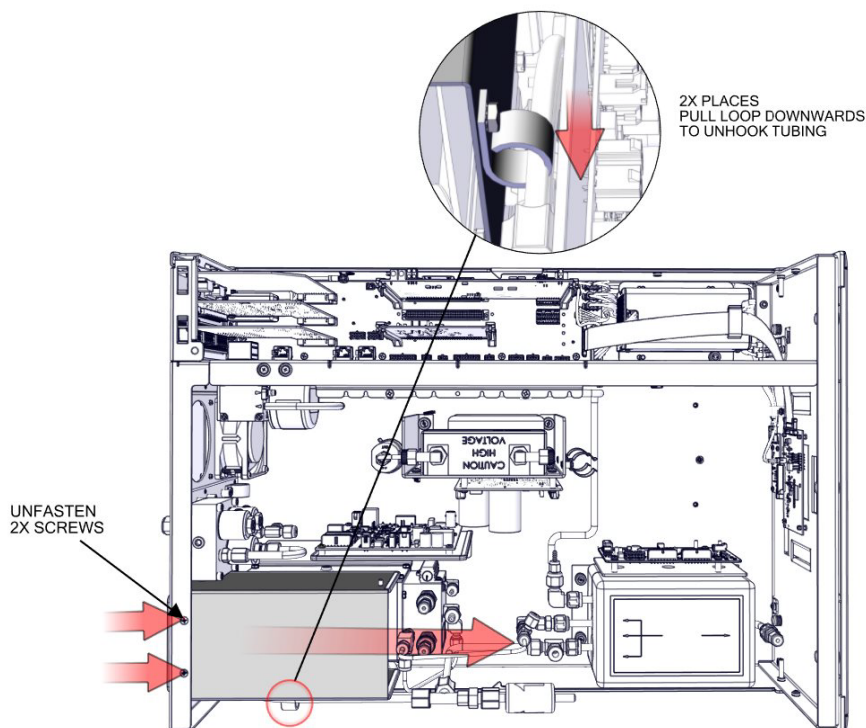
Figure 7–31. Remove PMT Cooler Shroud

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.

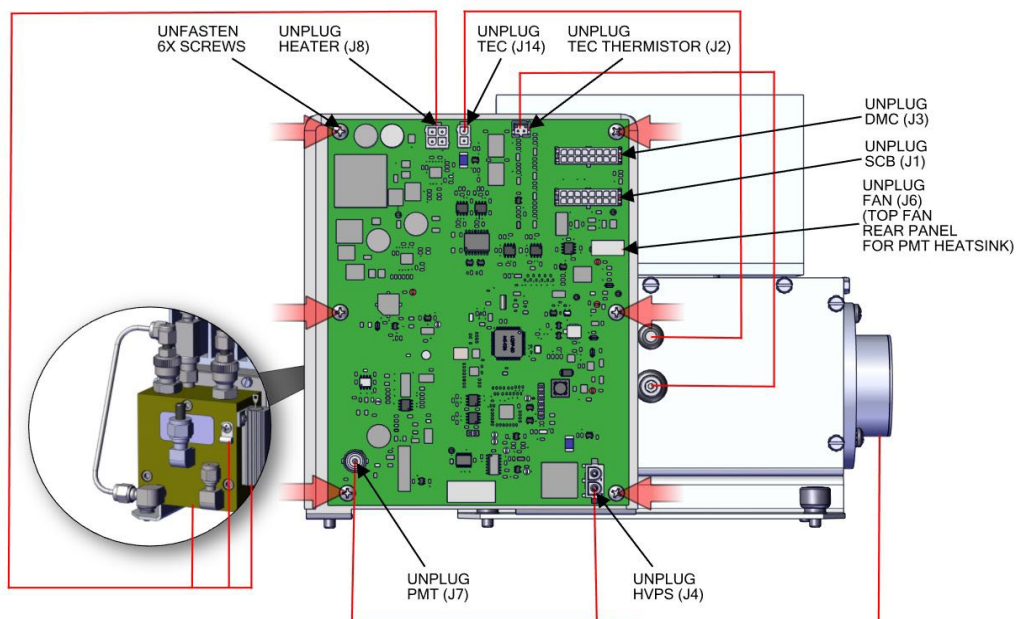8. Pull PMT cooler upwards.

Figure 7–32. 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 7–33. 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.
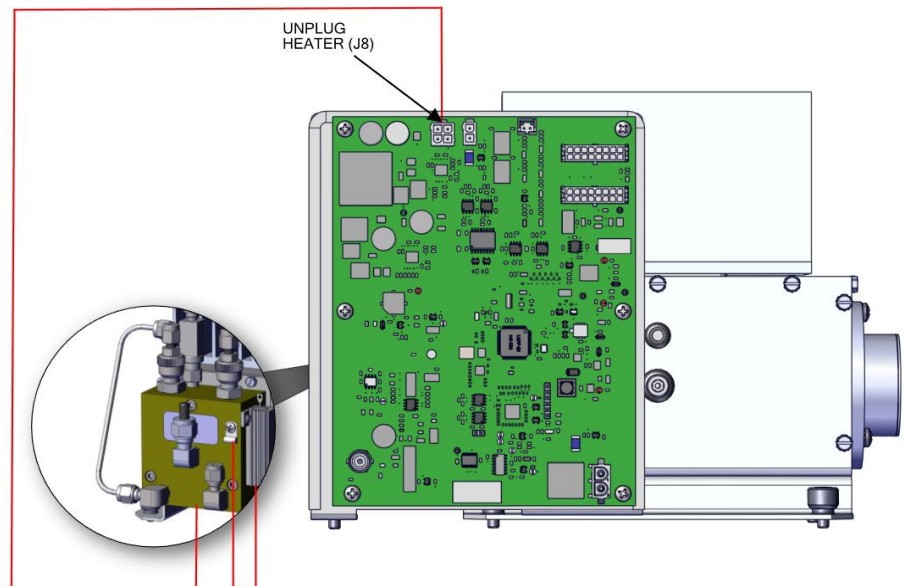
Figure 7–34. Photo Reaction Chamber Cleaning, Electrical

4. Disconnect plumbing as shown.

5. Using a 9/64-inch hex drive, unfasten three #8-32 socket cap head screws.
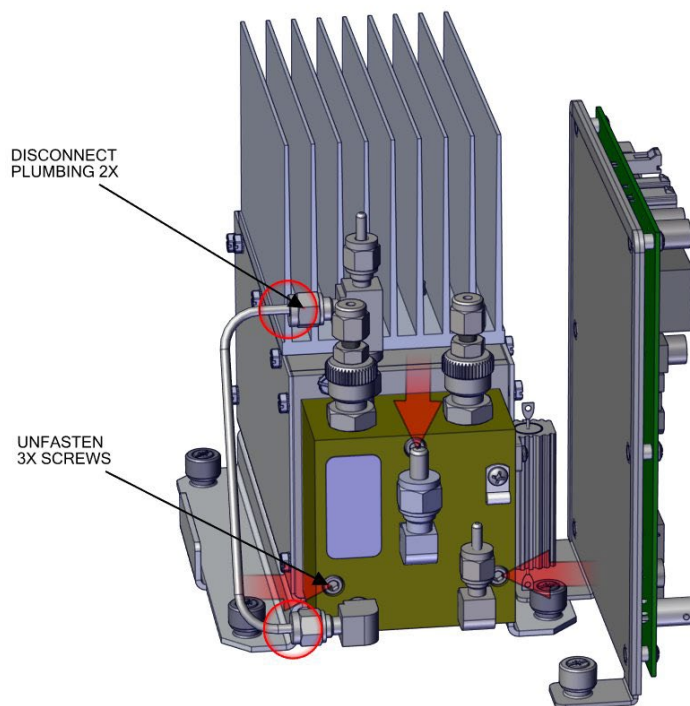
Figure 7–35. Photo Reaction Chamber Cleaning, Hardware

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 7–34 and Figure 7–41.
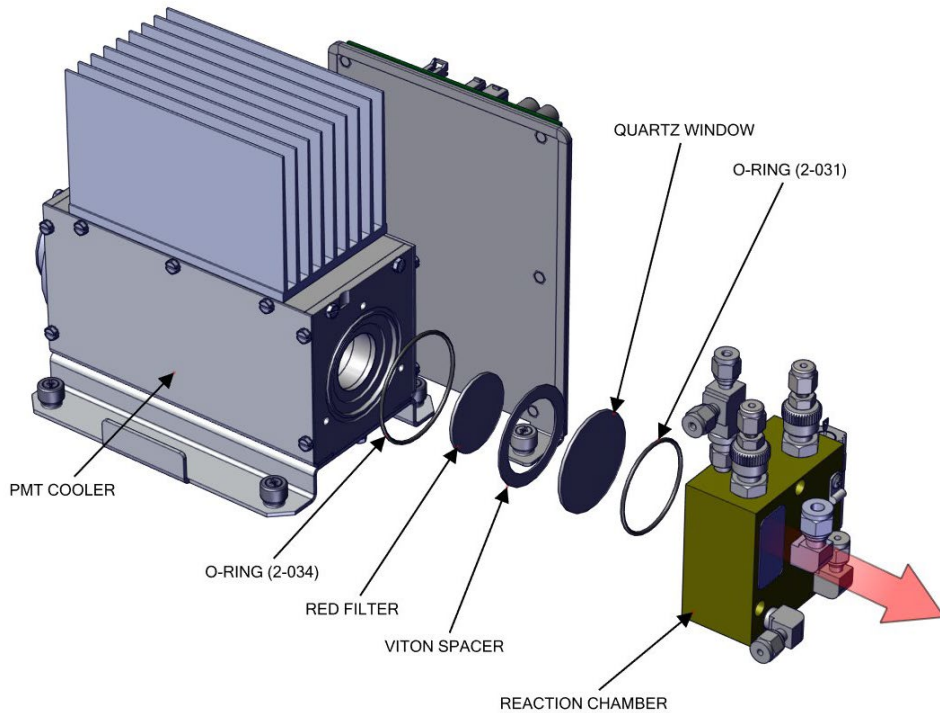
Figure 7–36. Photo Reaction Chamber Cleaning, Window

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).

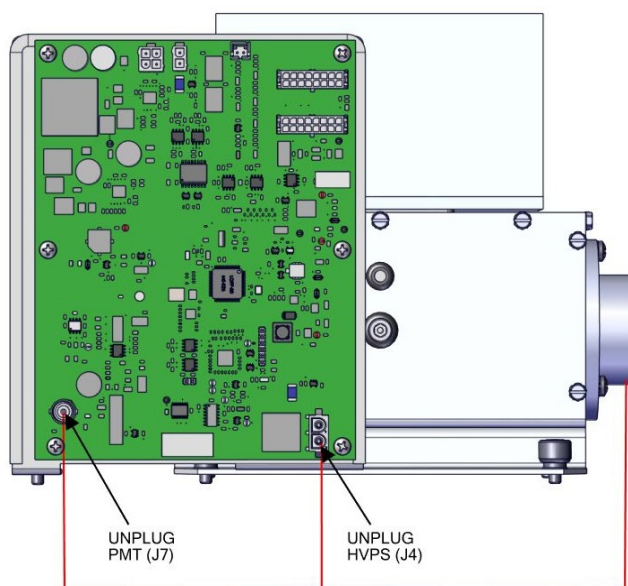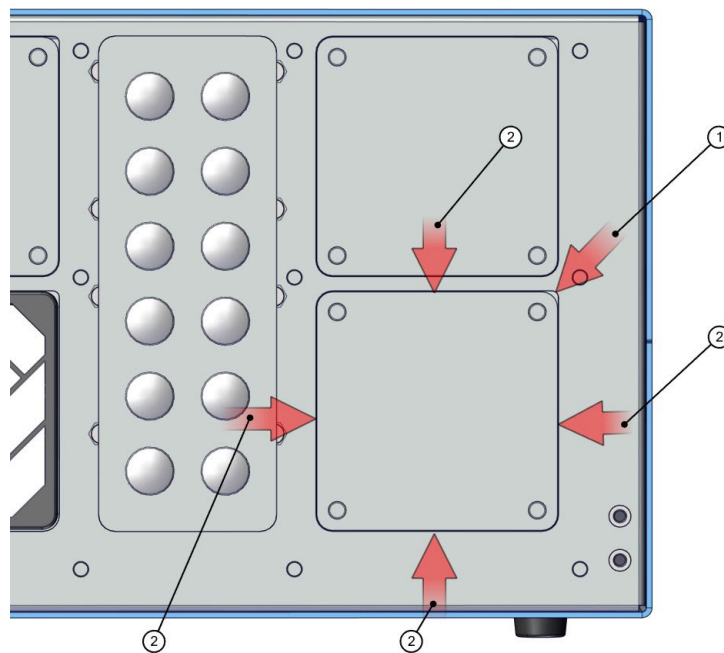2. Unplug electrical connections PMT (J7) and HVPS (J4).

Figure 7–37. PMT Tube Replace-Elec-Pt1

3. Using a flat head screwdriver, wedge out of top right corner starting point, labeled 1 (Figure 7–38).

4. Continue to wedge out the four midpoints of the plate to remove the snap on access panel, labeled 2 (Figure 7–39).
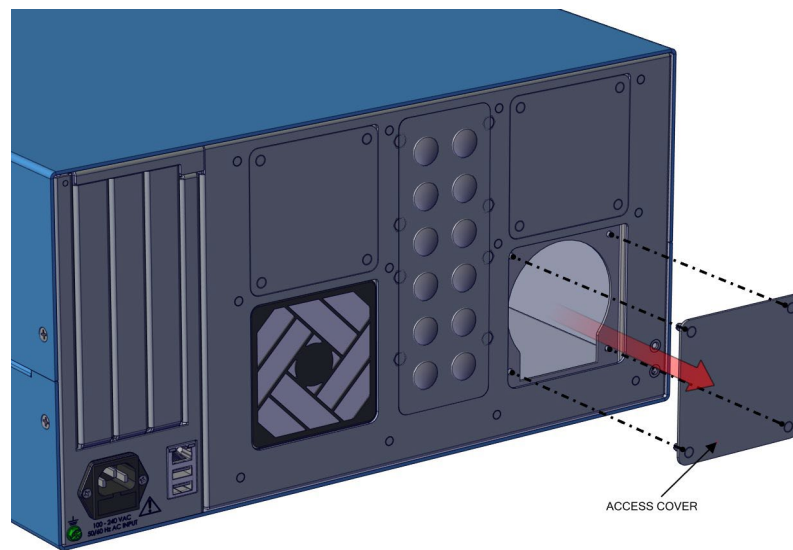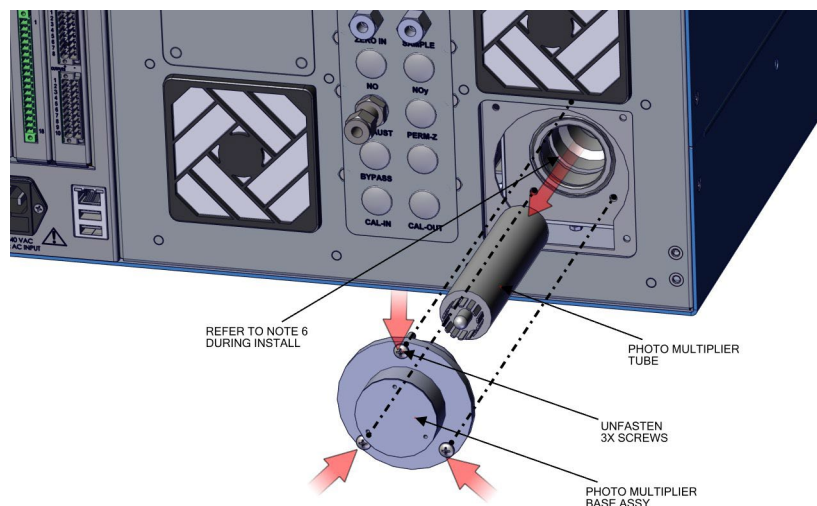
Figure 7–38. Removing the Access Panel, Starting Point

5. Pull access cover out.

ACCESS COVER

Figure 7–39. Access Cover

Figure 7–40. 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 3-77.

DMC Converter Replacement

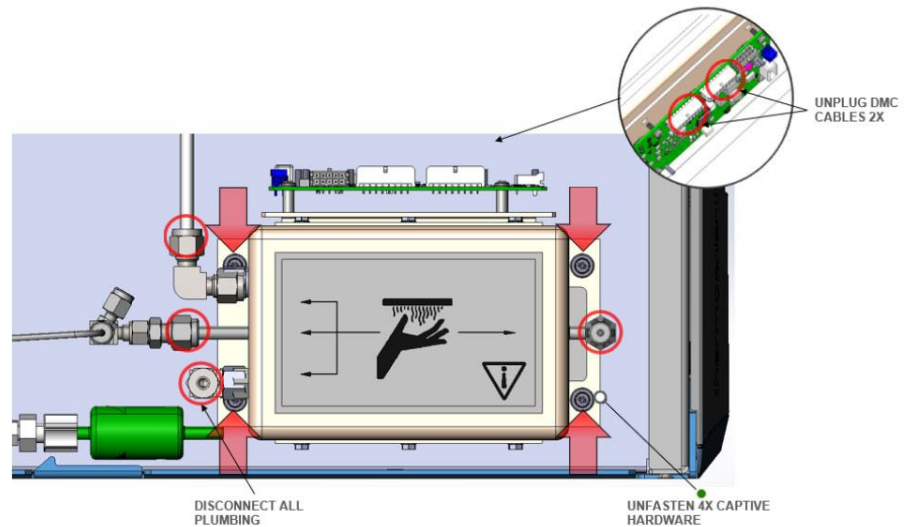Use the following procedure to replace the converter.

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 8X.

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

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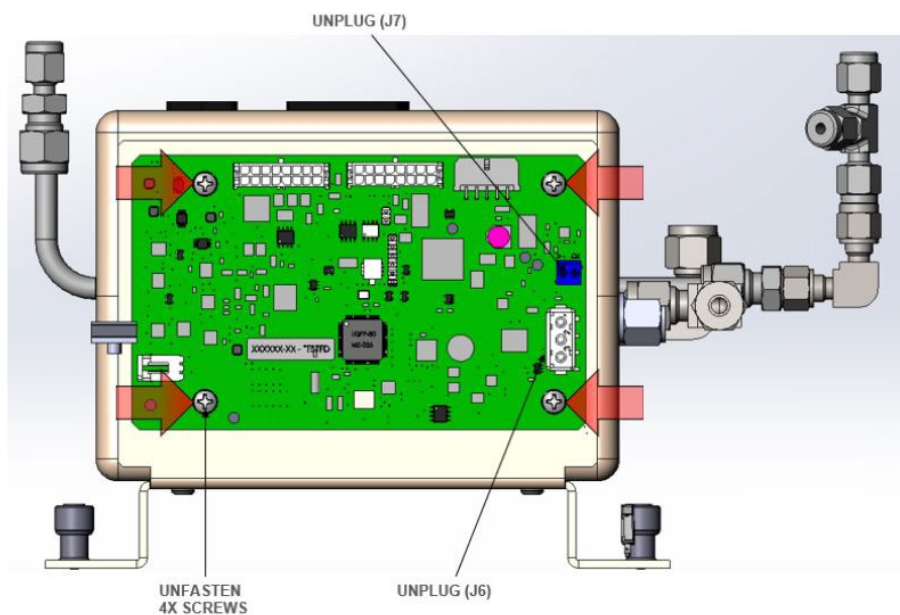

Figure 7–41. Converter DMC Assembly Remove

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 7–42. Converter Assembly Remove bd

5. Pull converter assembly board outwards.

6. Replace converter assembly board and assemble in reverse order.
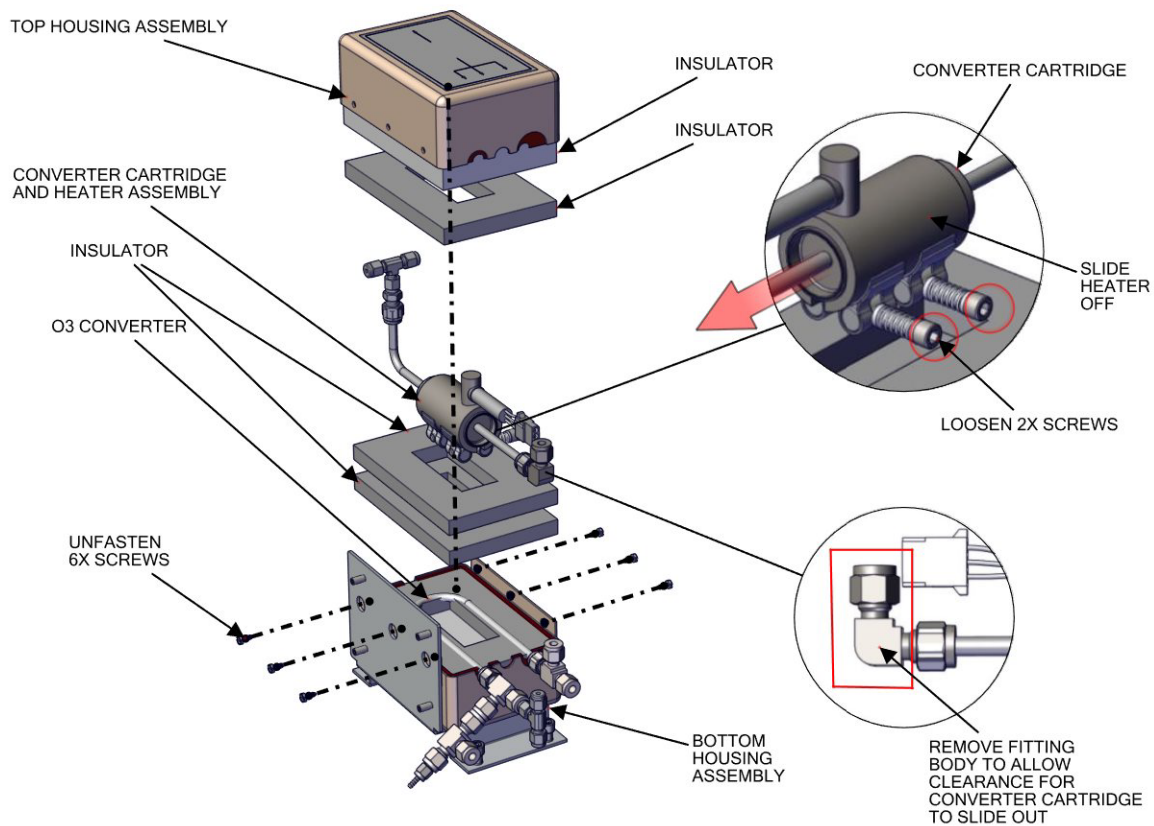
Converter Cartridge Heater Replacement

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.

TOP HOUSING ASSEMBLY

INSULATOR

CONVERTER CARTRIDGE

INSULATOR

CONVERTER CARTRIDGE
AND HEATER ASSEMBLY

SLIDE
HEATER
OFF

INSULATOR

O3 CONVERTER

LOOSEN 2X SCREWS

UNFASTEN
6X SCREWS

BOTTOM
HOUSING
ASSEMBLY

REMOVE FITTING
BODY TO ALLOW
CLEARANCE FOR
CONVERTER CARTRIDGE
TO SLIDE OUT

Figure 7–43. Converter Assembly Replace Heater

DMC Ozonator

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

- Removing the ozonator and transformer

- Replacing the ozonator and transformer board

- Replacing the flow switch

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).

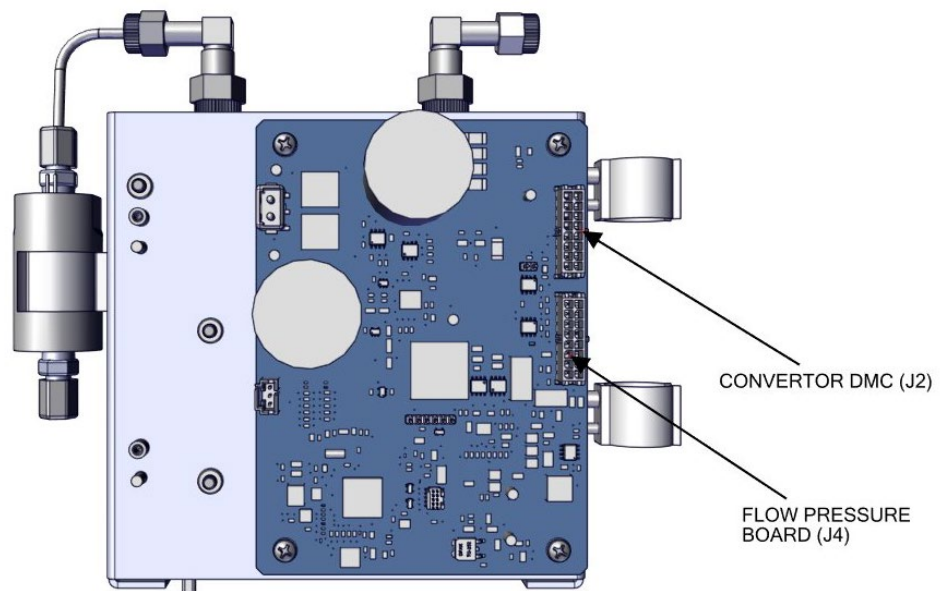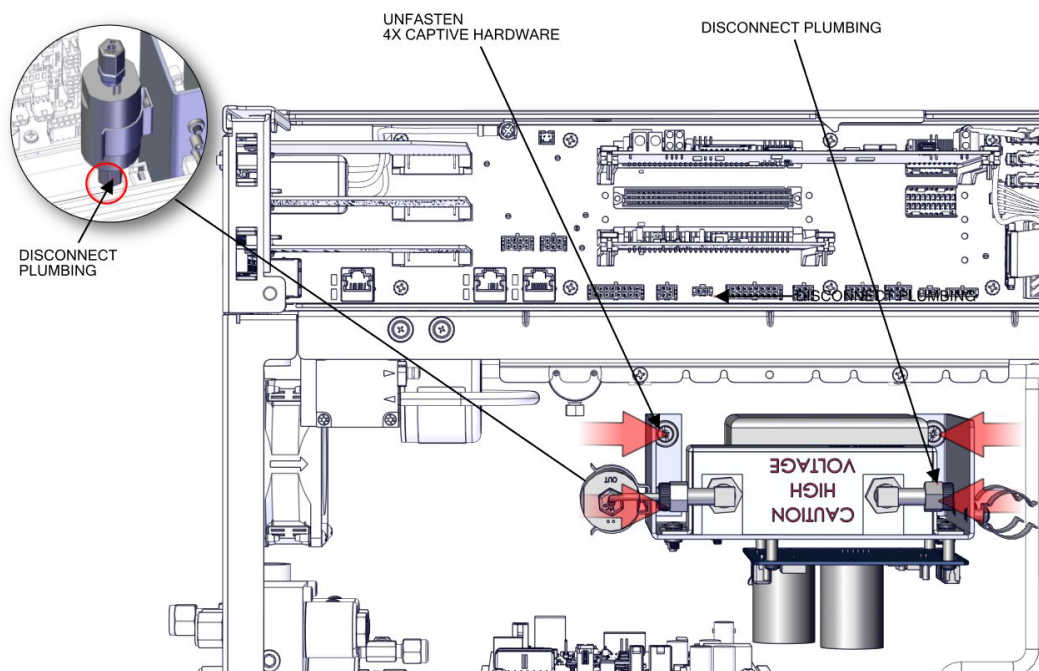2. Unplug converter DMC (J2) and flow pressure board (J4).

Figure 7–44. HVPS, Electrical

3. Disconnect plumbing.

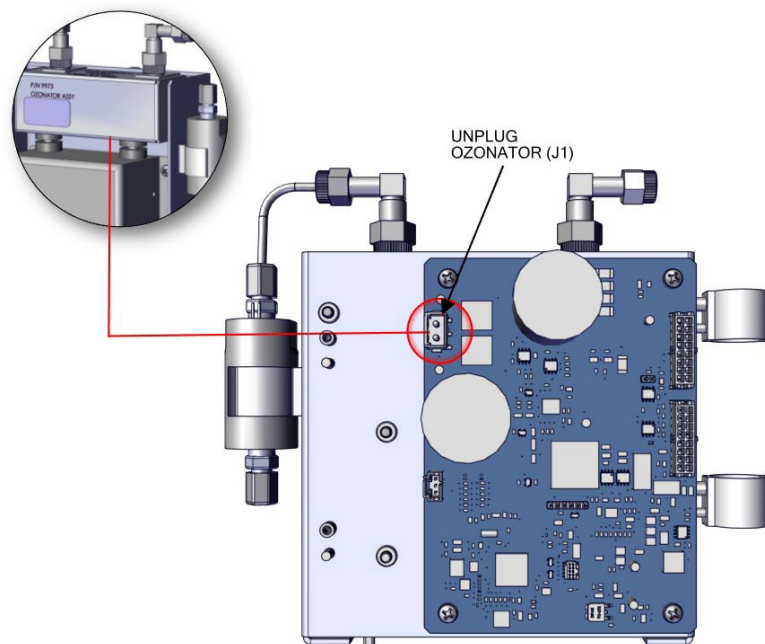4. Using a #2 Phillips drive, unfasten captive hardware 4X.

Figure 7–45. 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.
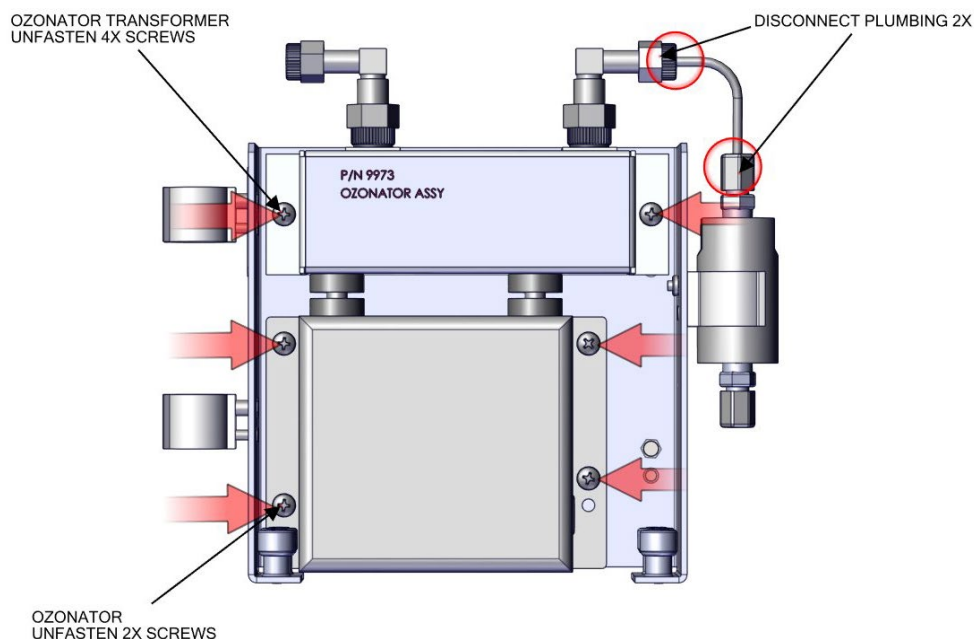
Figure 7–46. Replace Ozonator

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.

OZONATOR TRANSFORMER
UNFASTEN 4X SCREWS

DISCONNECT PLUMBING 2X

P/N 9973
OZONATOR ASSY

OZONATOR
UNFASTEN 2X SCREWS

Figure 7–47. 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.
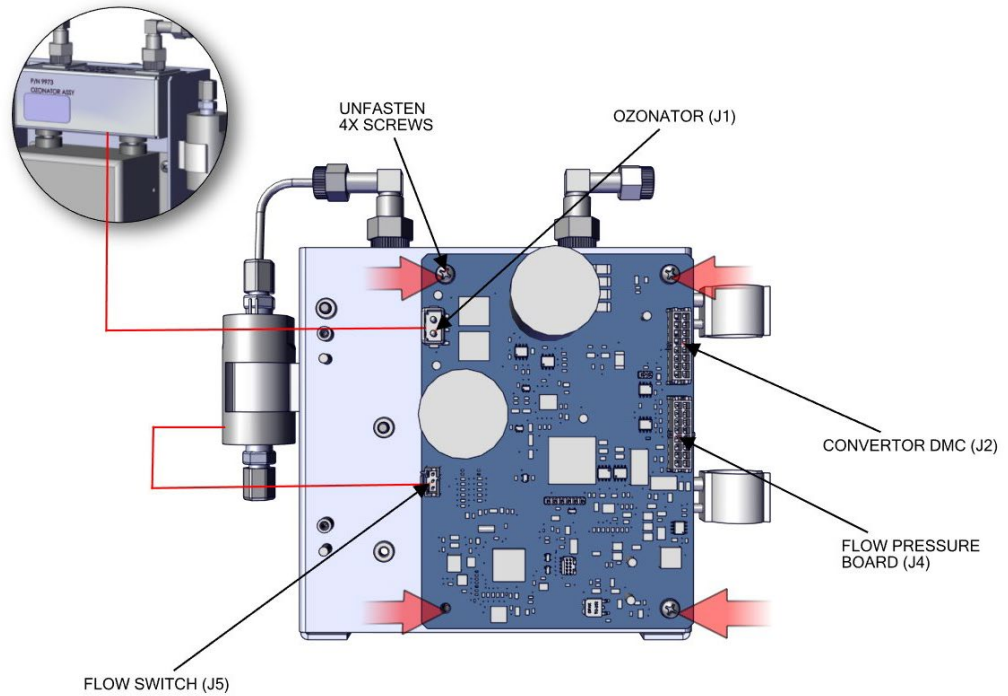
Figure 7–48. HPVS Remove Bd

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.

PULL FLOW SWITCH OFF
CLIP AFTER UNPLUGING
FROM BOARD

UNPLUG
FLOW SWITCH (J5)
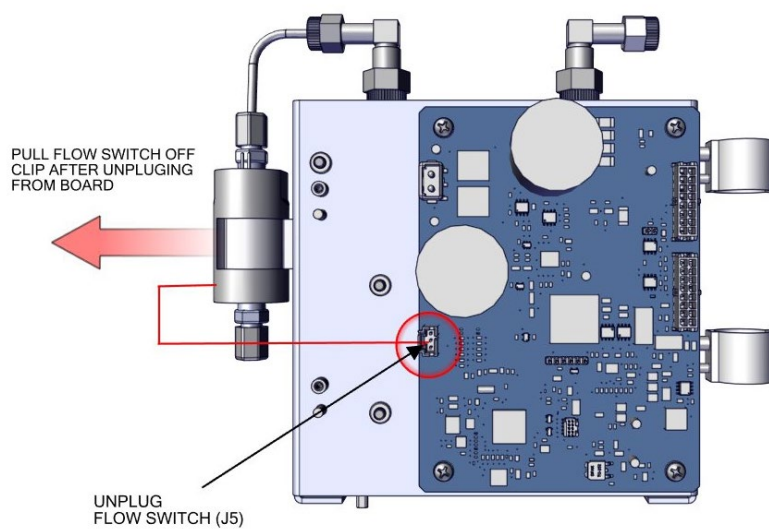
Figure 7–49. Flow Switch Remove
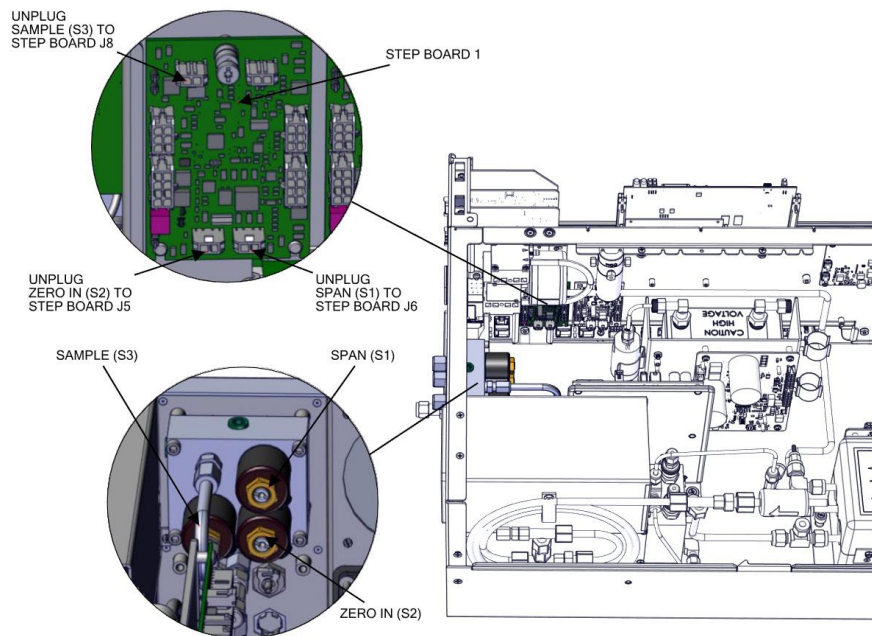
Optional Manifold Replacement

Use the following procedure to replace the manifold.
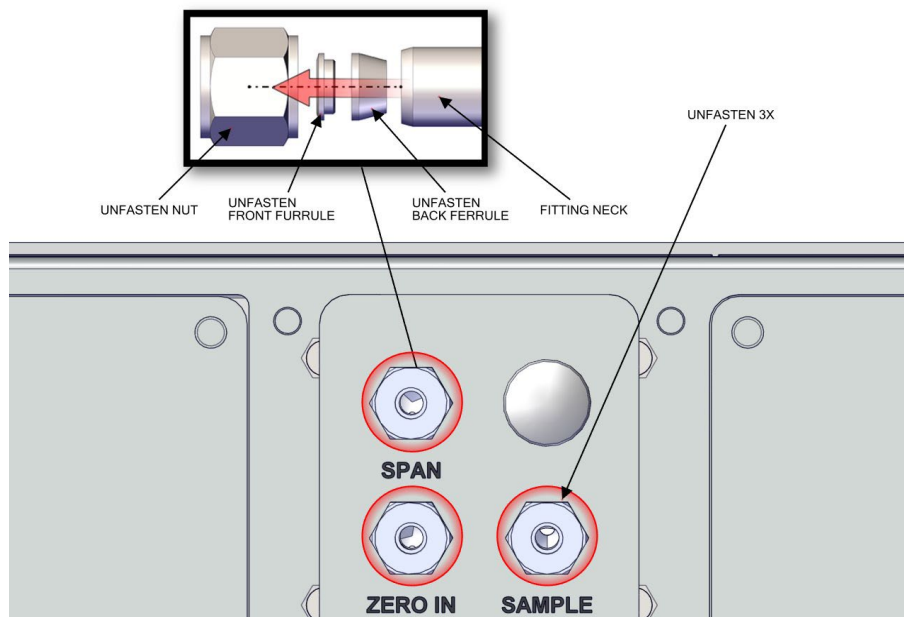
Equipment required:

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.

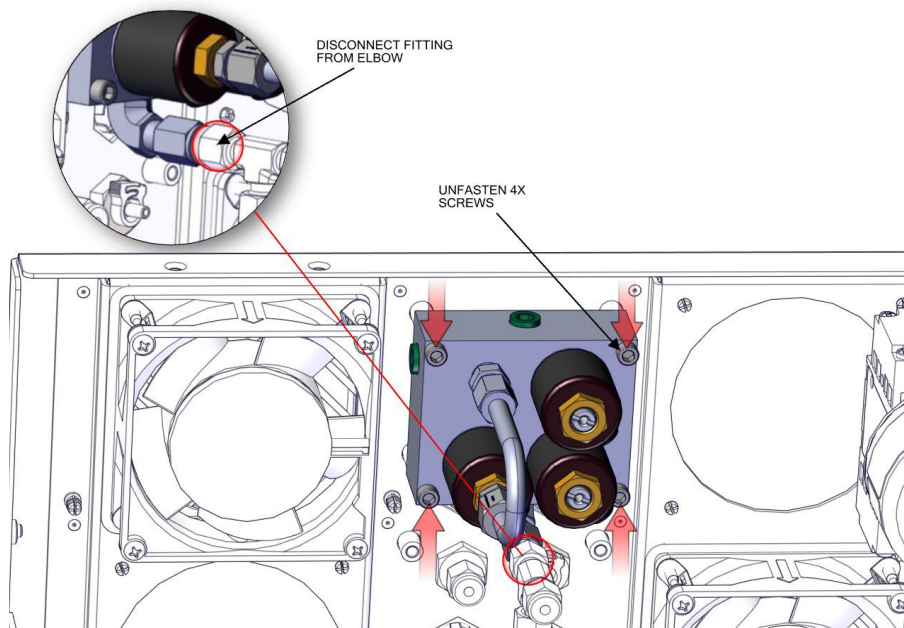**Figure 7–50.** Replacing the Manifold pt 1

3. Unfasten three nuts. Remove the nuts, front and back ferrules as shown from span, zero in, sample back panel (Figure 7–51).

Figure 7–51. Replacing the Manifold pt 2

4. Disconnect tubing.

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

Figure 7–52. Replacing the Manifold pt 3

6. Replace the manifold and assemble in reverse order.

Chapter 8
System Description

The 42iQD 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 42iQD system components include:

- Reaction Chamber DMC

    - Optical filter

    - Photomultiplier tube (PMT)

    - Photomultiplier tube cooler

- Ozonator DMC

    - Ozonator DMC board

    - Ozone flow switch

- Ozonator Permeation Dryer

- NO_2-to-NO converter DMC

    - Converter DMC board

- Common Electronics

    - Power supply

    - System Control board

    - Backplane board

    - Front panel

    - I/O (optional)

- Peripherals Support System

    - Fan (on rear panel)

    - Step POL board

    - Pump

- Solenoid valve panel (optional)
- Flow Pressure DMC with restricting capillary
- Firmware

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.

Ozonator 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.

NO₂-to-NO Converter

The NO_2-to-NO converter heats molybdenum to approximately 325 °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 42iQD, 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 42iQD, including options. The modular design of the instrument is conveyed in the architecture. Brief descriptions of the specific PCBAs follow.
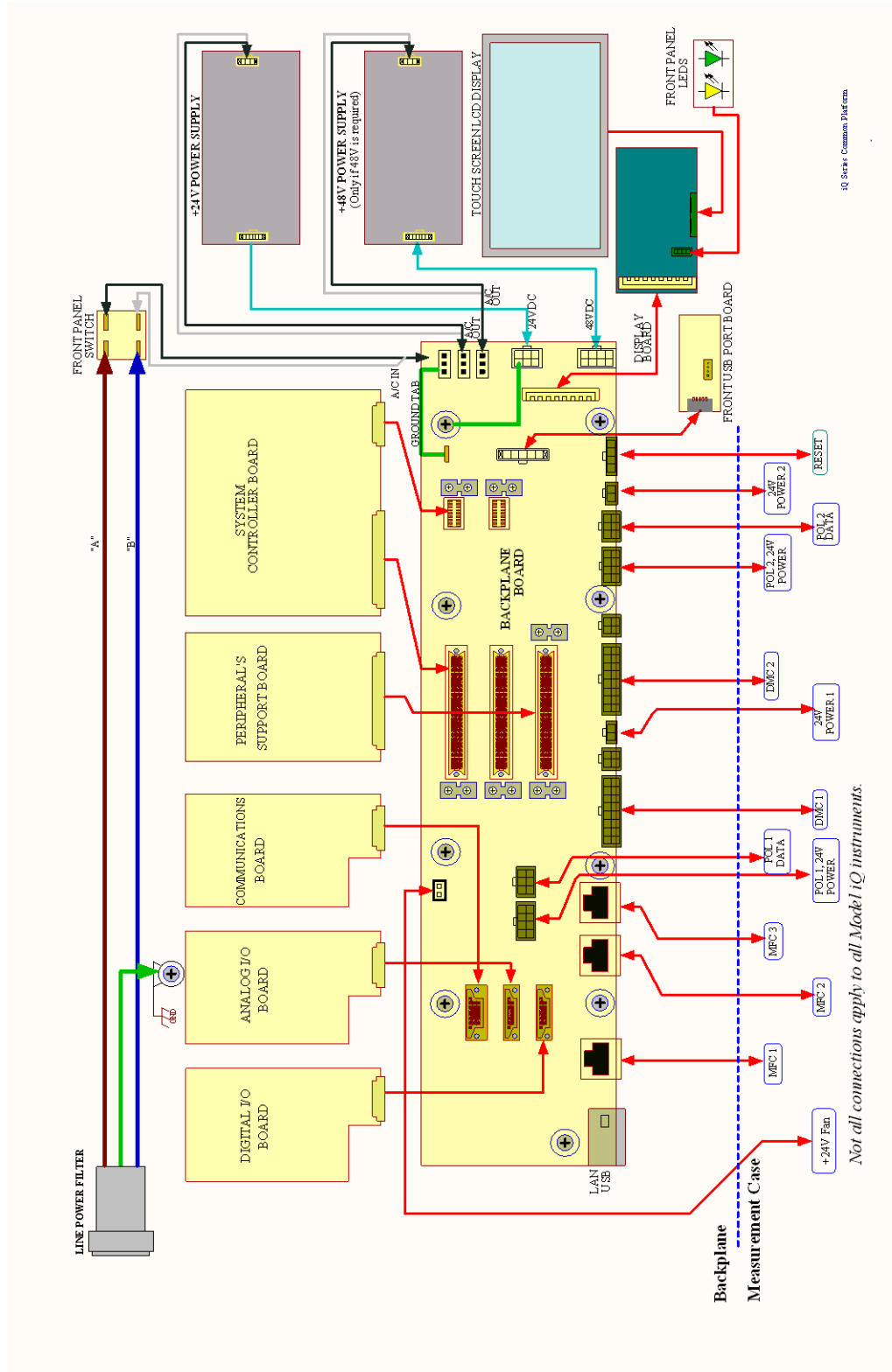
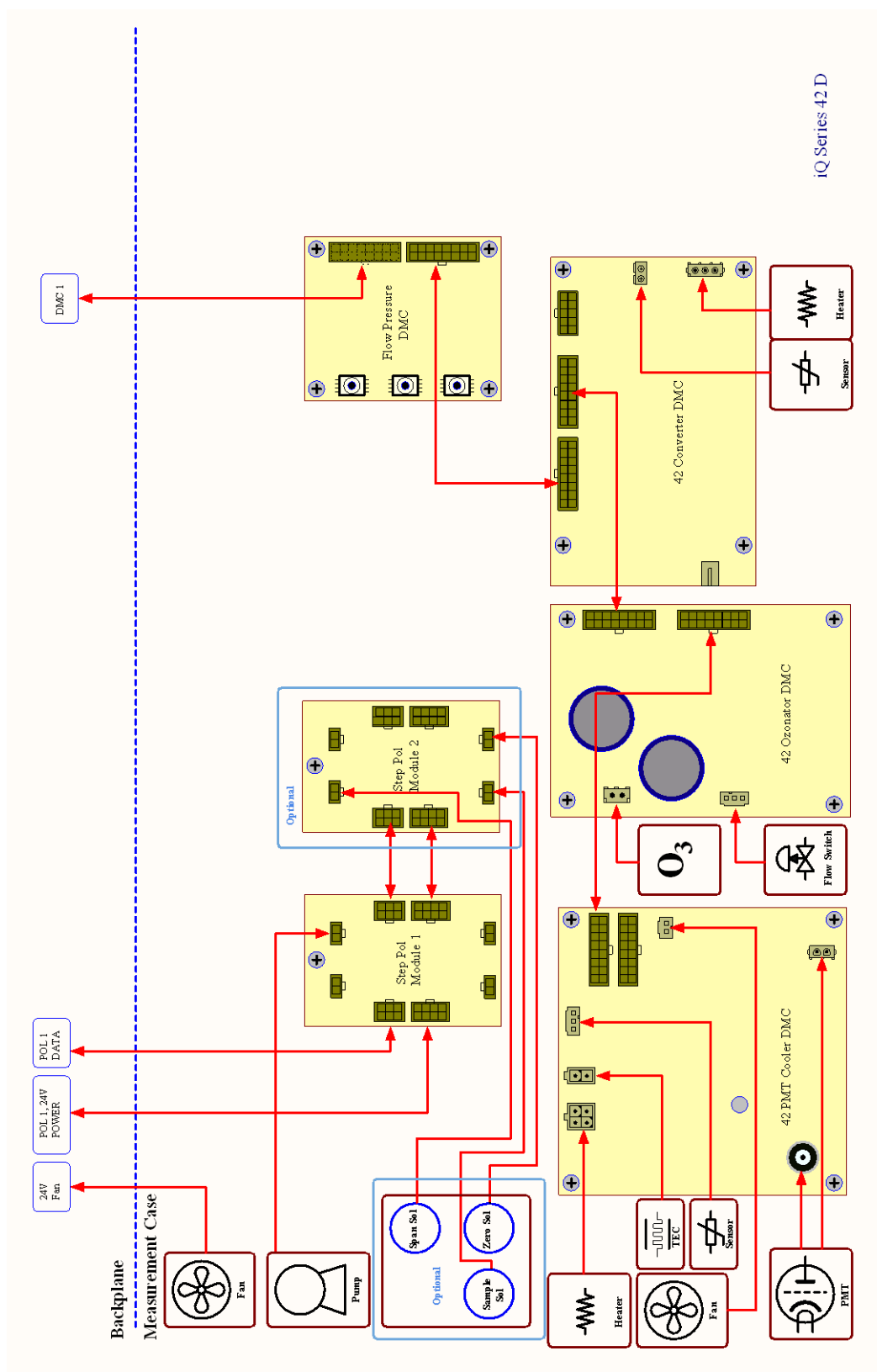**Figure 8–1.** Common System Interconnect Diagram

Figure 8–2. 42iQD 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 42iQD 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.

Pump

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

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 42iQD, microprocessors containing firmware are located as follows:

- Reaction Chamber/PMT DMC
- Ozonator DMC
- NO_2 Converter
- Flow/Pressure DMC
- Peripherals Support Board
- Optional I/O (Communications, Digital, and Analog)

The firmware contains the active controls for their application, as well as self-identification and configuration for "plug and play" style operation. Each are associated with specific registers of two types:

- Modbus registers that are communicated from each microprocessor to the System Controller Board (SCB) via internal RS-485
- SNMP registers that are maintained in the software and SCB for health and data processing computation

The Modbus communication system operates on 1 second intervals. Within those intervals, data treatment like integration (whether analog or digital) and servo control, are embedded in the module firmware. The SCB receives the 1 second updates for higher level "software" processing and control via SNMP registers, some of which is interfaced with the front panel Graphical User Interface (GUI).

In addition to the operating registers, the 42iQD stores a historical data log in a MySQL database. The memory is provided on the same micro SD card where the operating software resides, for which there is capability to store up to a year of data at 1 minute intervals. Chapter 3, "Operation" describes how this database is accessed and used including external memory downloads.

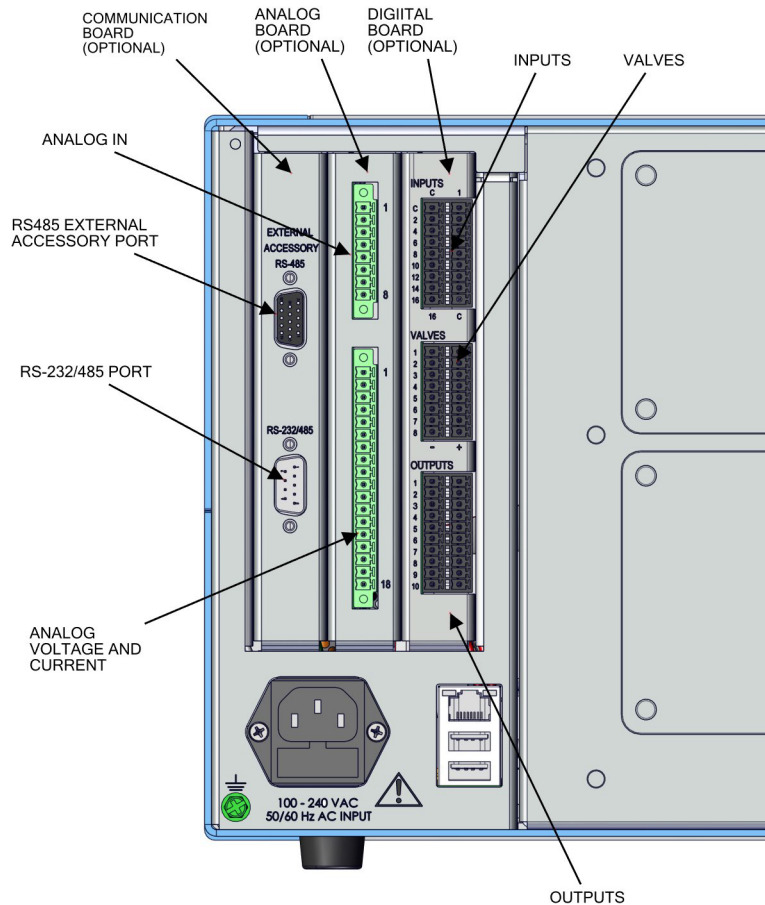# Chapter 9
Optional Equipment

The 42iQD 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

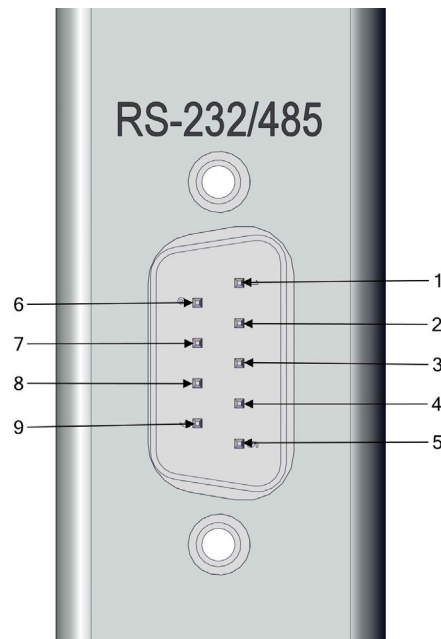**Figure 9–1.** I/O Expansion Replacement Boards

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.
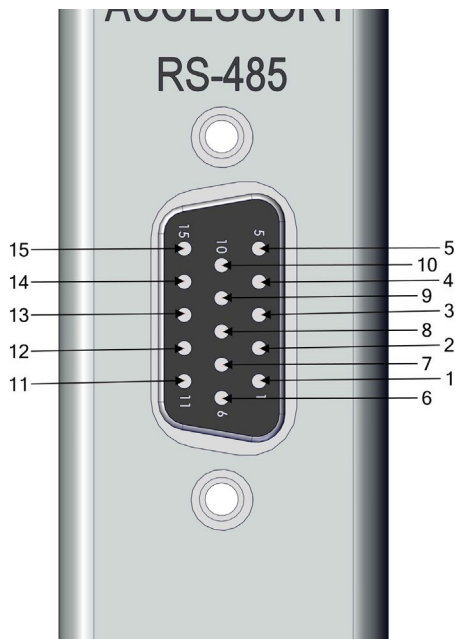

Figure 9–2. RS-232/RS-485 Port

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

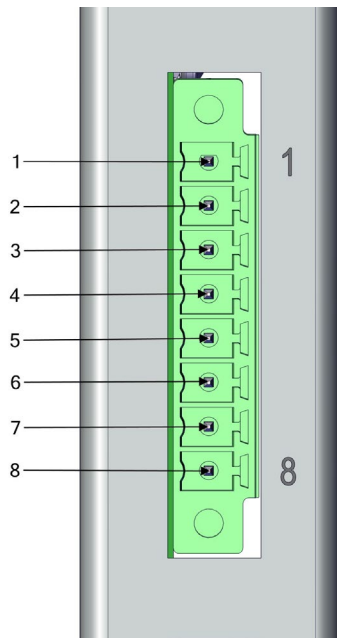| Terminal Number	Signal Name
1	EXT_RS485_RX_N
2	EXT_RS485_RX_P
3	+5V (Fused @0.4A)
4	+5V (Fused @0.4A)
5	+5V (Fused @0.4A)
6	GND
7	GND
8	GND
9	EXT_RS485_TX_N
10	EXT_RS485_TX_P
11	+24V (Fused @0.4A)
12	+24V (Fused @0.4A)
13	+24V (Fused @0.4A)
14	+24V (Fused @0.4A)
15	+24V (Fused @0.4A)

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.
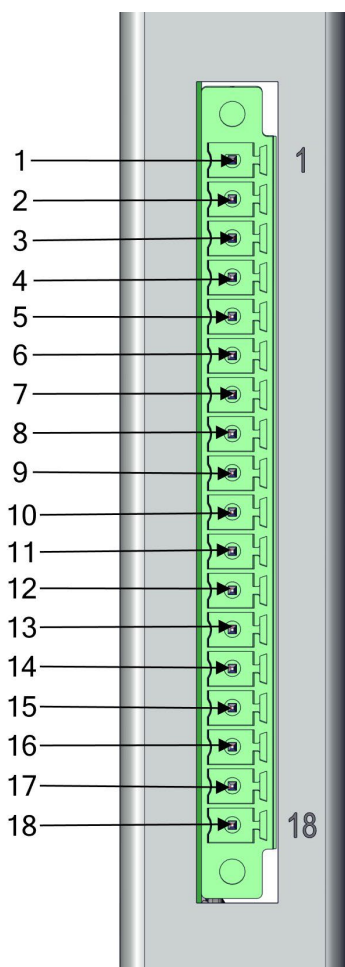

Figure 9–4. Analog Voltage Inputs

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. ▲
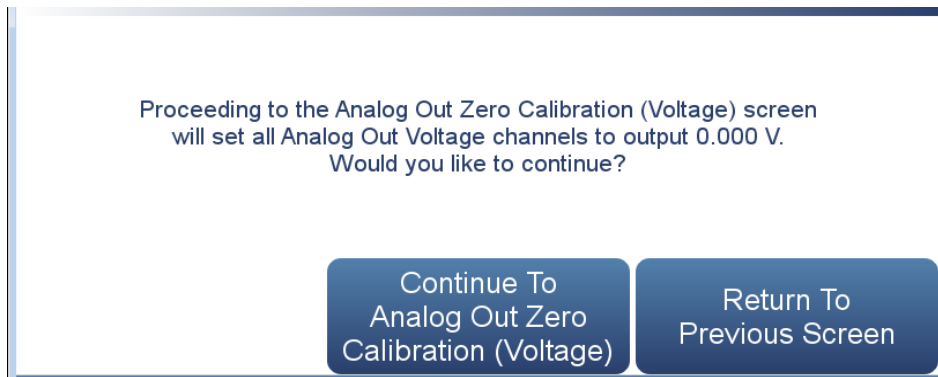
1. From the Home screen, choose **Settings>Communications>Analog I/O>Analog Out Calibration.**
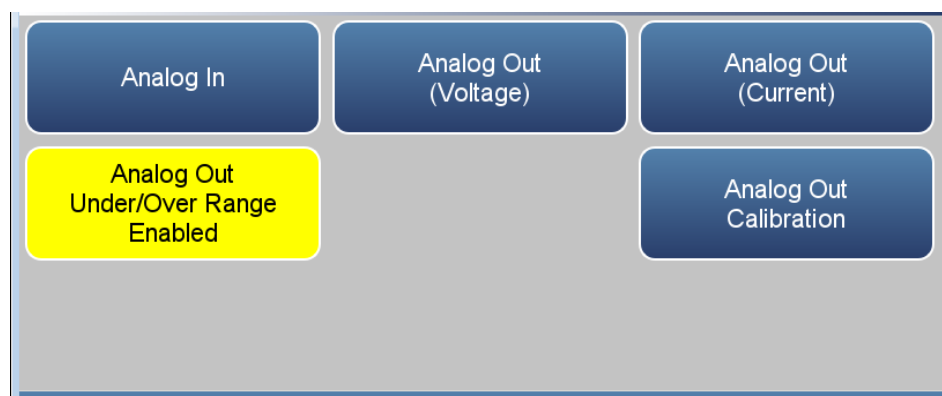
2. Depending on the output type being used, select either Analog Out Zero Calibration (Voltage) or Analog Out 4.000 mA Calibration (Current).
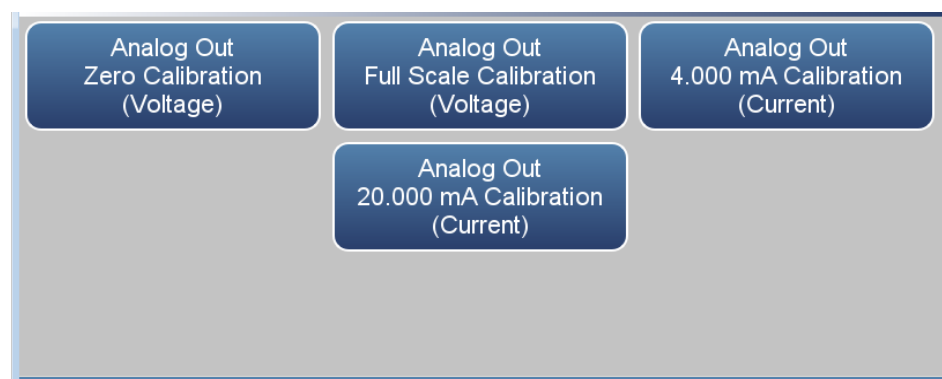
3. A confirmation screen is presented. Select Continue to proceed with the calibration or Return to Previous Screen.

Proceeding to the Analog Out Zero Calibration (Voltage) screen
will set all Analog Out Voltage channels to output 0.000 V.
Would you like to continue?

Continue To Analog Out Zero Calibration (Voltage) | Return To Previous Screen

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

Channel	Output (V)	Dec	Dec	Dec	Inc	Inc	Inc	Commit
1	0.000	↓↓↓	↓↓	↓	↑	↑↑	↑↑↑	Commit
2	0.000	↓↓↓	↓↓	↓	↑	↑↑	↑↑↑	Commit
3	0.000	↓↓↓	↓↓	↓	↑	↑↑	↑↑↑	Commit
4	0.000	↓↓↓	↓↓	↓	↑	↑↑	↑↑↑	Commit
5	0.000	↓↓↓	↓↓	↓	↑	↑↑	↑↑↑	Commit
6	0.000	↓↓↓	↓↓	↓	↑	↑↑	↑↑↑	Commit

● *Output (V):* Displays the actual output level at the terminal of the analog output board. For analog voltage, this value will default at zero. For analog current, this value will default at 4 mA.

● *Decrease ↓↓↓, Decrease ↓↓, and Decrease ↓:* Decreases the output by coarse, medium, or fine amounts.

● *Increase ↑, Increase ↑↑,* and *Increase ↑↑↑:* Increases the output by coarse, medium, or fine amounts.

● *Commit:* Accepts the changes to the analog output levels.

5. For the desired analog output channel, increase or decrease the output until the reading on the recording device indicates the proper value.

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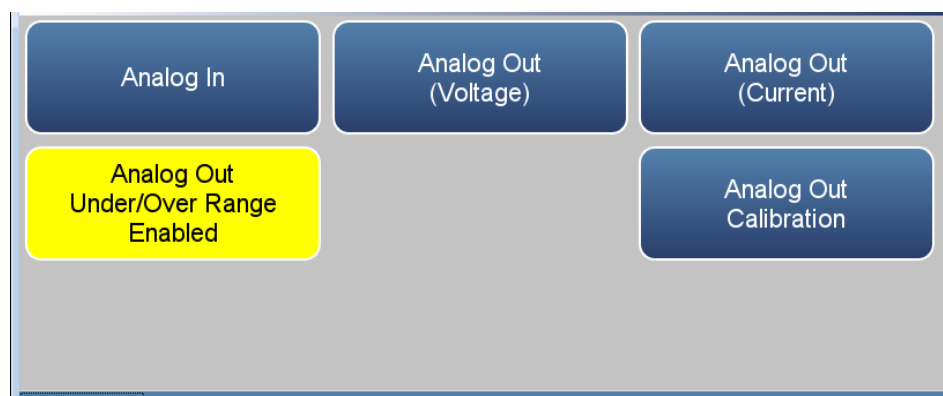
**Analog Output Full Scale Calibration**

Use the following procedure to calibrate the output channel to full scale. This analog output calibration procedure reflects the full scale calibration for analog output voltage for demonstration purposes. To calibrate the 20 mA current calibration, follow the same procedure, by selecting the 20 mA current calibration option.

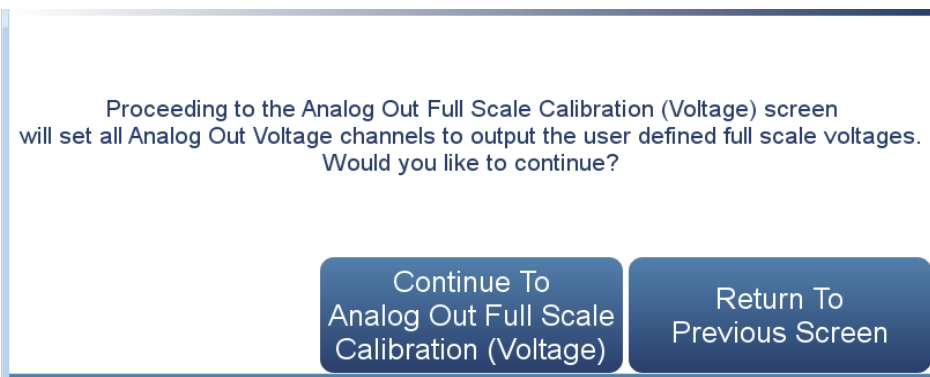**Note** This adjustment should only be performed by an instrument service technician. ▲

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

2. Depending on the output type being used, select either Analog Out Full Scale Calibration (Voltage) or Analog Out 20.000 mA Calibration (Current).
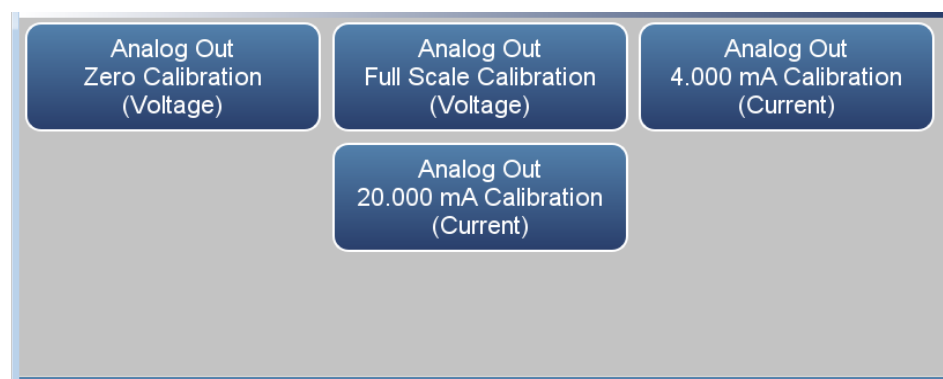
3. A confirmation screen is presented. Select Continue to proceed with the calibration or Return to Previous Screen.

Proceeding to the Analog Out Full Scale Calibration (Voltage) screen
will set all Analog Out Voltage channels to output the user defined full scale voltages.
Would you like to continue?

| Continue To Analog Out Full Scale Calibration (Voltage) | Return To Previous Screen |

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

Channel	Output (V)	Dec	Dec	Dec	Inc	Inc	Inc	Commit
1	10.000	↓↓↓	↓↓	↓	↑	↑↑	↑↑↑	Commit
2	1.000	↓↓↓	↓↓	↓	↑	↑↑	↑↑↑	Commit
3	1.000	↓↓↓	↓↓	↓	↑	↑↑	↑↑↑	Commit
4	1.000	↓↓↓	↓↓	↓	↑	↑↑	↑↑↑	Commit
5	1.000	↓↓↓	↓↓	↓	↑	↑↑	↑↑↑	Commit
6	10.000	↓↓↓	↓↓	↓	↑	↑↑	↑↑↑	Commit

● *Output (V):* Displays the actual output level at the terminal of the analog output board. For analog voltage, this value will default at the setting of the output channel, 1, 5, or 10 V. For analog current, this value will default at 20 mA.

● *Decrease ↓↓↓, Decrease ↓↓, and Decrease ↓:* Decreases the output by coarse, medium, or fine amounts.

● *Increase ↑, Increase ↑↑,* and *Increase ↑↑↑:* Increases the output by coarse, medium, or fine amounts.

● *Commit:* Accepts the changes to the analog output levels.

5. For the desired analog output channel, increase or decrease the output until the reading on the recording device indicates the proper value.

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

Digital I/O Board

The digital I/O board consists of:

- 16 Digital Inputs (18 pin connector)
- 10 Digital Relay Switches (20 pin connector)
- 8 Valve Driver Outputs (16 pin connector)

Digital Inputs

The digital inputs are TTL (3 V or 5 V) compatible and are pulled high within the instrument. The active state can be user defined in firmware.

- Logic Low Threshold: 0.8 V
- Logic High Threshold: 2.0 V
- Absolute allowable input voltages: -0.5 to 5.5 V
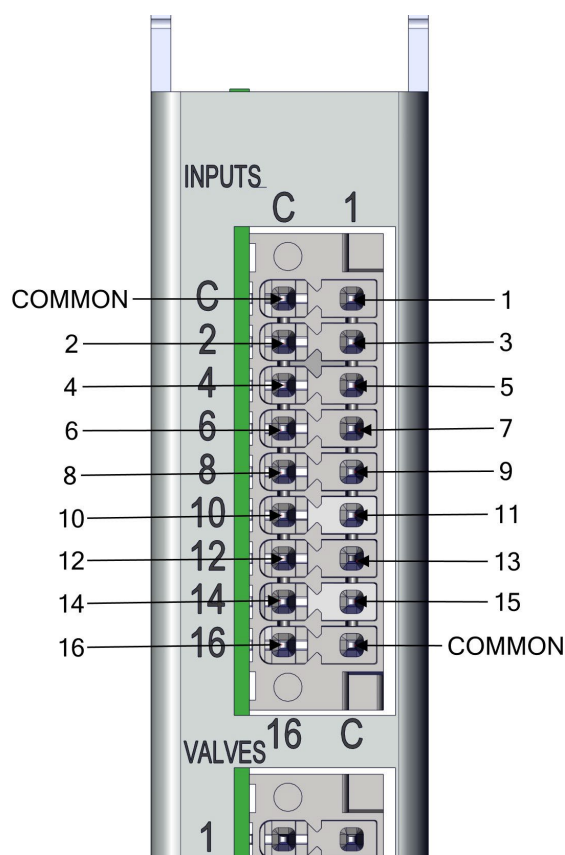
Figure 9–6. Digital Inputs

Table 9–5. Digital Inputs Terminal Assignment

Terminal Number	Signal Name
COMMON	
1	Digital In 1
2	Digital In 2
3	Digital In 3
4	Digital In 4
5	Digital In 5
6	Digital In 6
7	Digital In 7
8	Digital In 8
9	Digital In 9
10	Digital In 10
11	Digital In 11
12	Digital In 12
13	Digital In 13
14	Digital In 14
15	Digital In 15
16	Digital In 16
COMMON	

Digital Relay Switches   Table 9–6 lists the digital relay switches.

- Maximum Voltage: 300 VDC

- Maximum Current: 500 mA

- Fuse: 800 mA
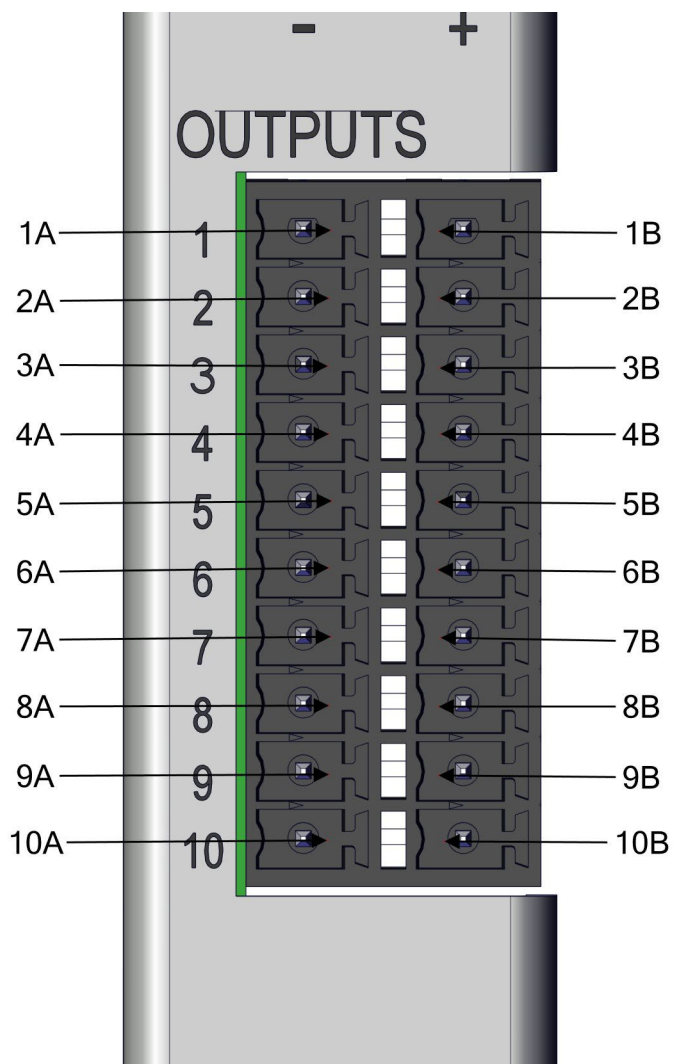
Figure 9–7. Digital Relay Switches

Table 9–6. Digital Relay Switch Assignment

Terminal Number	Signal Name
1A	Relay 1A
1B	Relay 1B
2A	Relay 2A
2B	Relay 2B
3A	Relay 3A
3B	Relay 3B
4A	Relay 4A
4B	Relay 4B
5A	Relay 5A
5B	Relay 5B
6A	Relay 6A
6B	Relay 6B
7A	Relay 7A
7B	Relay 7B
8A	Relay 8A
8B	Relay 8B
9A	Relay 9A
9B	Relay 9B
10A	Relay 10A
10B	Relay 10B

Valve Driver Outputs Table 9–7 lists the valve driver outputs.

- Actual Output Voltage: 22–24 VDC per channel, 2A total

- Maximum Current: 300 mA

- Both positive and negative outputs are protected from over voltage and over current by 500 mA fuses.
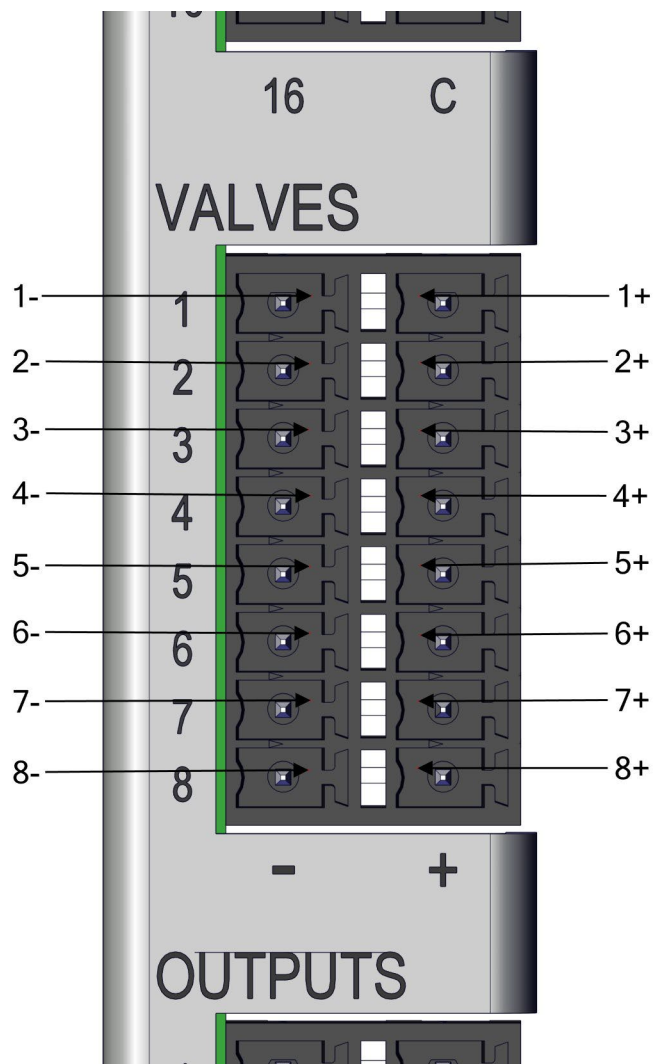
Figure 9–8. Valve Driver Outputs

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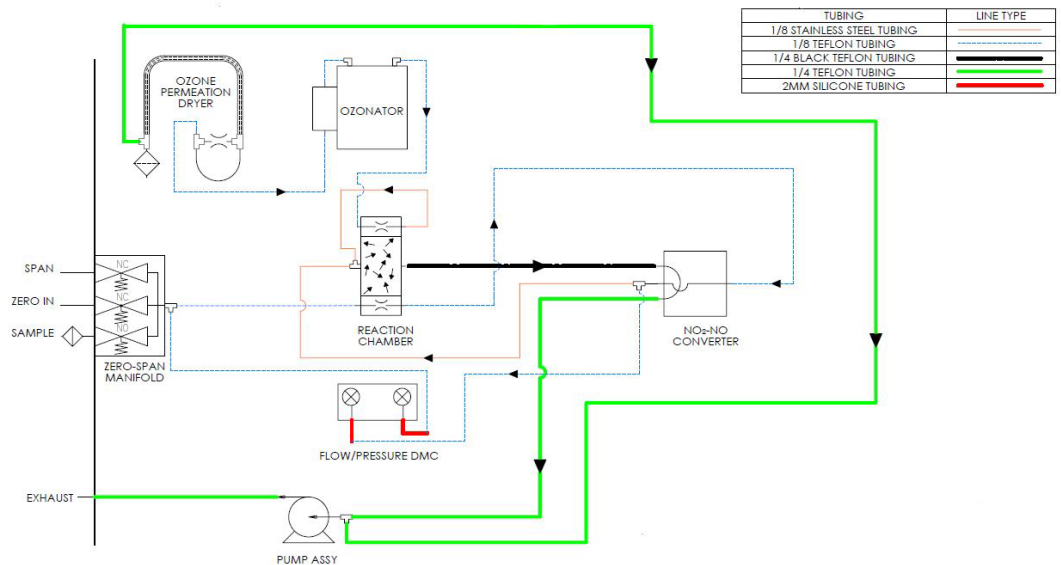
Figure 9–9. Flow Diagram, Zero/Span Option

PTFE Particulate Filter

A 5-10 micron pore size, two-inch diameter PTFE element is available for the 42iQD. 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 two (2) years from the date of shipment to Buyer for equipment and ninety (90) days for all other products (the "Warranty Period"). Seller agrees during the Warranty Period, to repair or replace, at Seller's option, defective Products so as to cause the same to operate in substantial conformance with said published specifications; provided that (a) Buyer shall promptly notify Seller in writing upon the discovery of any defect, which notice shall include the product model and serial number (if applicable) and details of the warranty claim; (b) after Seller's review, Seller will provide Buyer with service data and/or a Return Material Authorization ("RMA"), which may include biohazard decontamination procedures and other product-specific handling instructions; and (c) then, if applicable, Buyer may return the defective Products to Seller with all costs prepaid by Buyer. Replacement parts may be new or refurbished, at the election of Seller. All replaced parts shall become the property of Seller. Shipment to Buyer of repaired or replacement Products shall be made in accordance with the Delivery provisions of the Seller's Terms and Conditions of Sale. Consumables, including but not limited to lamps, fuses, batteries, bulbs and other such expendable items, are expressly excluded from the warranty under this warranty.

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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. ▲

Appendix B
Quick Reference

List of Figures

List of Tables

Appendix C
GNU Lesser General Public License

Version 2.1, February 1999

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For example, on rare occasions, there may be a special need to encourage the widest possible use of a certain library, so that it becomes a de-facto standard. To achieve this, non-free programs must be allowed to use the library. A more frequent case is that a free library does the same job as widely used non-free libraries. In this case, there is little to gain by limiting the free library to free software only, so we use the Lesser General Public License.

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If such an object file uses only numerical parameters, data structure layouts and accessors, and small macros and small inline functions (ten lines or less in length), then the use of the object file is unrestricted, regardless of whether it is legally a derivative work. (Executables containing this object code plus portions of the Library will still fall under Section 6.)

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