thermoscientific

43iQ
Instruction Manual

Sulfur Dioxide Analyzer

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Thermo Fisher
SCIENTIFIC

Contents

Chapter 1
Introduction

The Thermo Scientific™ 43iQ Sulfur Dioxide (SO$_2$) utilizes pulsed fluorescence technology to measure the amount of sulphur dioxide in the air.

The pulsing of the UV source lamp serves to increase the optical intensity whereby a greater UV energy throughput and lower detectable SO$_2$ concentration are realized.

Reflective bandpass filters, as compared to commonly used transmission filters, are less subject to photochemical degradation and more selective in wavelength isolation. This results in both increased detection specificity and long term stability.

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.
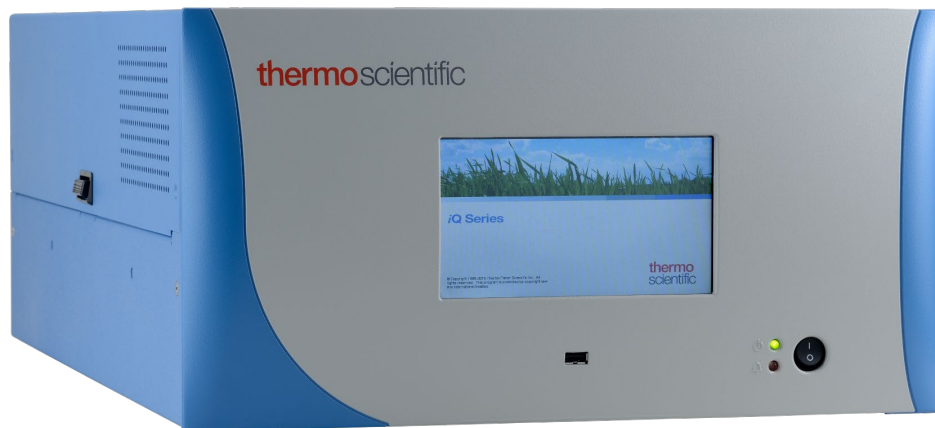
Figure 1–1. 43iQ Front

43iQ Principle of Operation

The 43iQ operates on the principle that SO_2 molecules absorb ultraviolet (UV) light and become excited at one wavelength, then decay to a lower energy state emitting UV light at a different wavelength. Specifically,

$$SO_2 + h\upsilon_1 \rightarrow SO_2* \rightarrow SO_2 + h\upsilon_2$$

The sample is drawn into the 43iQ through the SAMPLE bulkhead, as shown in . The sample flows through a hydrocarbon "kicker," which removes hydrocarbons from the sample by forcing the hydrocarbon molecules to permeate through the tube wall. The SO_2 molecules pass through the hydrocarbon "kicker" unaffected.

The sample then flows into the fluorescence chamber, where pulsating UV light excites the SO_2 molecules. The condensing lens focuses the pulsating UV light into the mirror assembly. The mirror assembly contains four selective mirrors that reflect only the wavelengths which excite SO_2 molecules.

As the excited SO_2 molecules decay to lower energy states they emit UV light that is proportional to the SO_2 concentration. The bandpass filter allows only the wavelengths emitted by the excited SO_2 molecules to reach the photomultiplier tube (PMT). The PMT detects the UV light emission from the decaying SO_2 molecules. The photodetector, located at the back of the fluorescence chamber, continuously monitors the pulsating UV light source and is connected to a circuit that compensates for fluctuations in the UV light.

As the sample leaves the optical chamber, it passes through a flow sensor, a capillary, and the "shell" side of the hydrocarbon kicker. The sample then flows to the pump and is exhausted out the EXHAUST bulkhead of the analyzer. The 43iQ outputs the SO_2 concentration to the front panel display and the analog outputs, and also makes the data available over the serial or Ethernet connection.
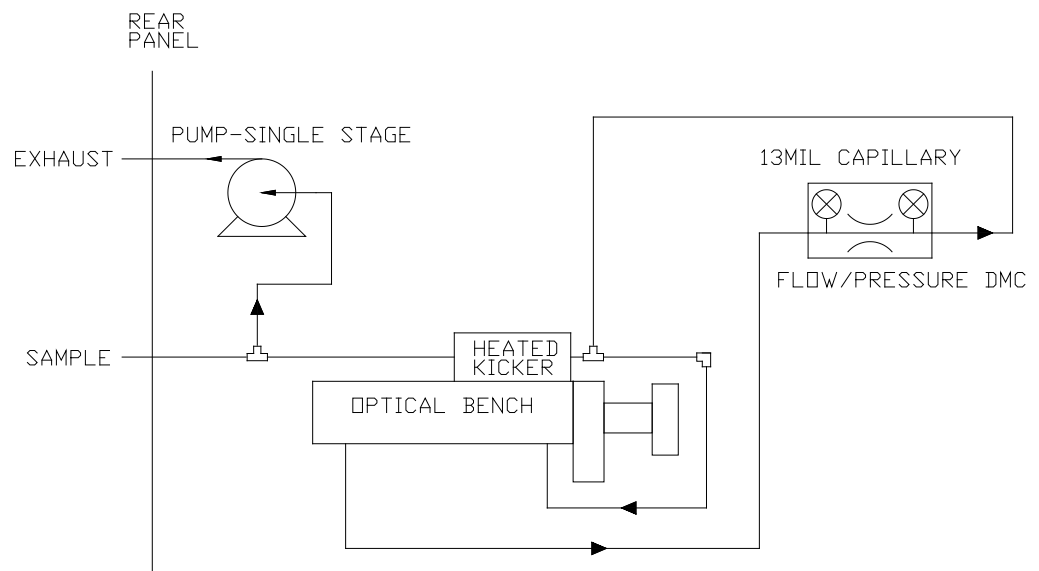
Figure 1–2. 43iQ Flow Schematic
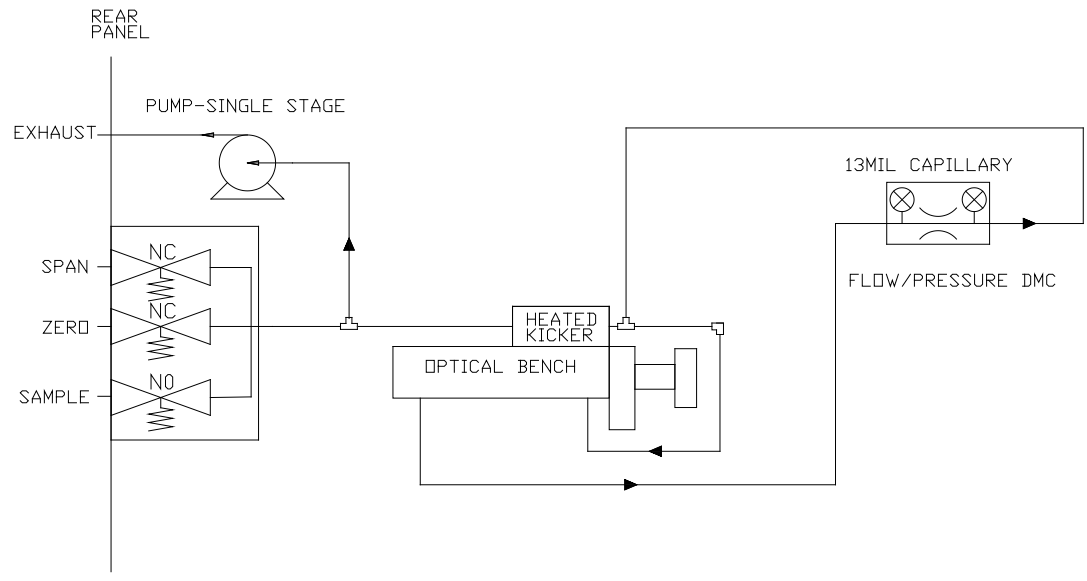
Figure 1–3. 43iQ Flow Schematic with Zero Span

Specifications

Table 1–1 lists the specifications for the 43iQ.

Table 1–1. 43iQ Specifications

Range	0–10 ppm
	0–25 mg/m^3
Extended Ranges	0–100 ppm
	0–250 mg/m^3
Zero Noise	1.0 ppb RMS (10 second averaging time)
	0.5 ppb RMS (60 second averaging time)
	0.25 ppb RMS (300 second averaging time)
Detection Limit	2 ppb (10 second averaging time)
	1 ppb (60 second averaging time)
	0.25 ppb (300 second averaging time)
Zero Drift	<0.5 ppb (24 hour)
Span Drift	±0.5% full-scale (24 hour)
Response Time	60 sec (10 second averaging time)
	110 sec (60 second averaging time)
	320 sec (300 second averaging time)
Linearity	±1% full-scale
Flow Rate	0.5 lpm (standard)
	1.0 lpm (optional)
Interferences (EPA levels)	Less than lower detectable limit except for the following:
	NO < 3 ppb, M-Xylene < 1ppb, H_2O < 3% of reading
Operating Temperature Range	0–45 °C
Power Requirements	100–240 VAC 50/60 Hz
	275 watts
Physical Dimensions	24 in (D) x 16.75 in (W) x 8.72 in (H) [609 mm (D) 425.45 mm (W) x 221.48 mm (H)]
Weight	37.1 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, EPA, UKCA

Table 1–2. 43iQ Optional Permeation Oven Specifications

Temperature Control	Three user selectable set points: 30, 35, 45 °C
Temperature Stability	± 0.1 °C
Warm-up Time	1 hour (permeation device can take 24 to 48 hours to stabilize)
Carrier Gas Flow	≈ 700 scc/min
Chamber size	Accepts permeation tubes up to 9 cm in total length; 1 cm in diameter
Physical Dimensions	Contained inside the 43iQ
Power Requirements	24 VDC, 50 watts (in addition to the standard 43iQ)
Weight	Approximately five pounds (in addition to standard 43iQ)

Dimensions
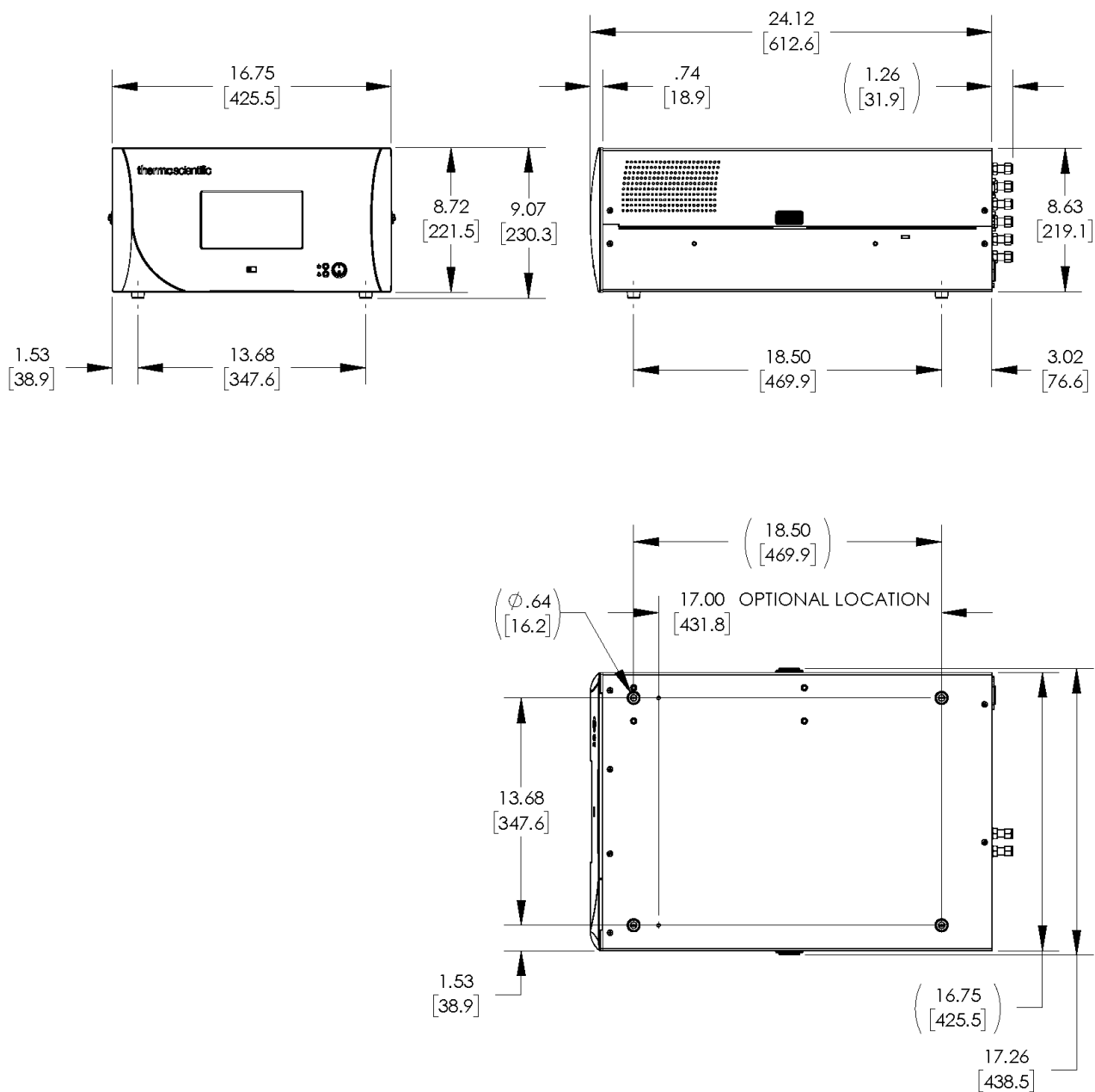
Figure 1–4. Bench Mount Assembly (dimensions in inches [mm])
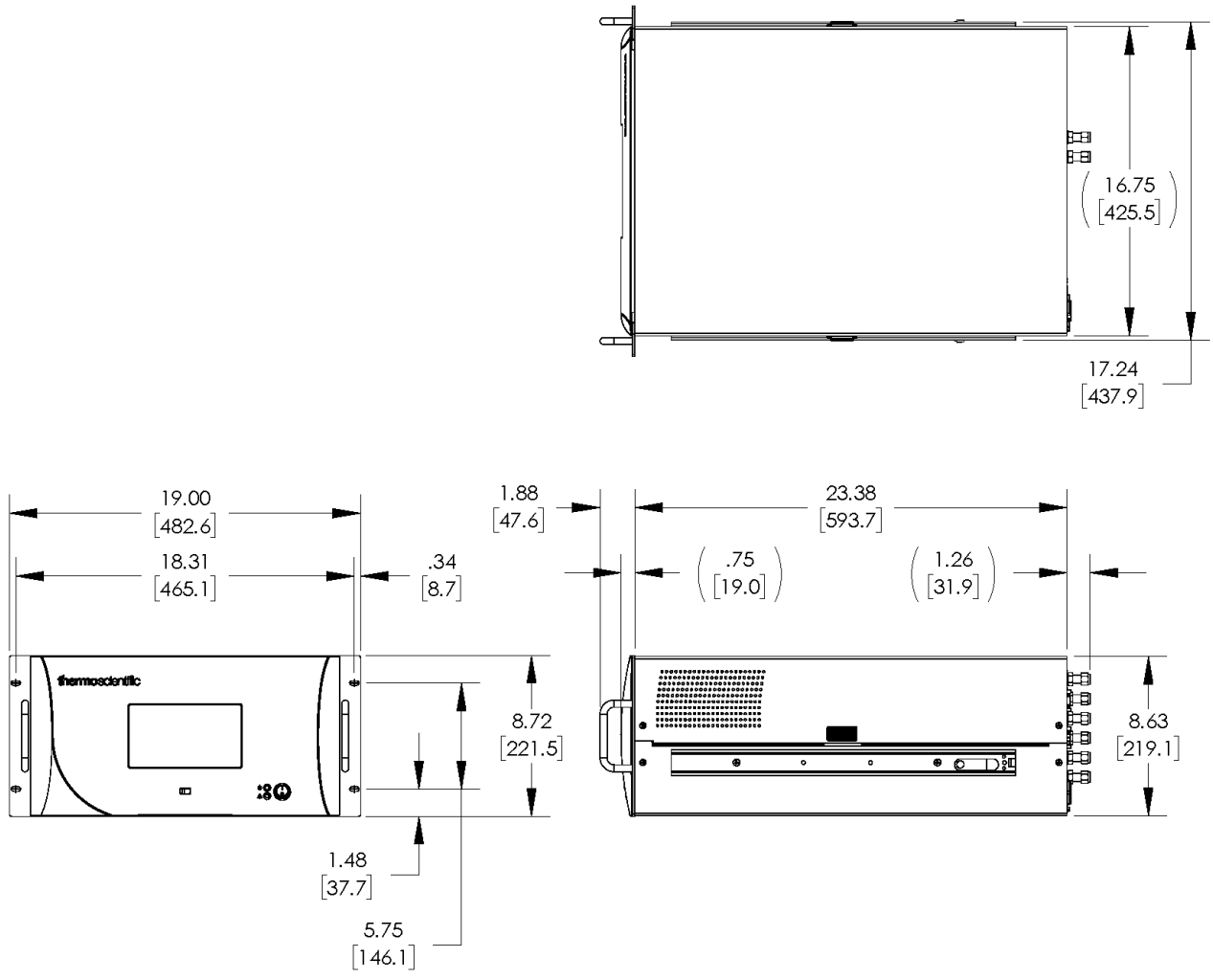
Figure 1–5. Rack Mount Assembly (dimensions in inches [mm])
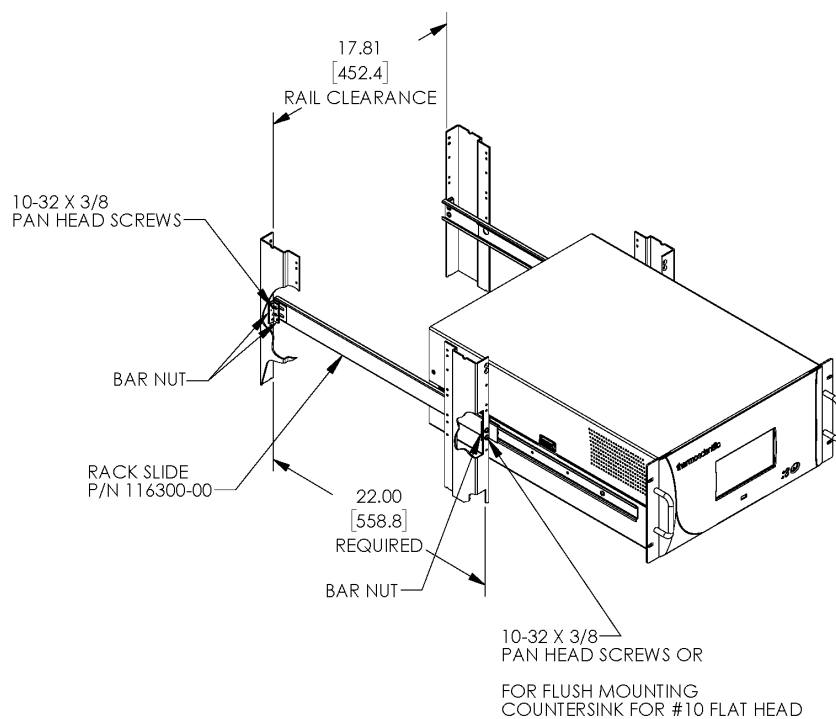
Figure 1–6. Rack Mount Requirements
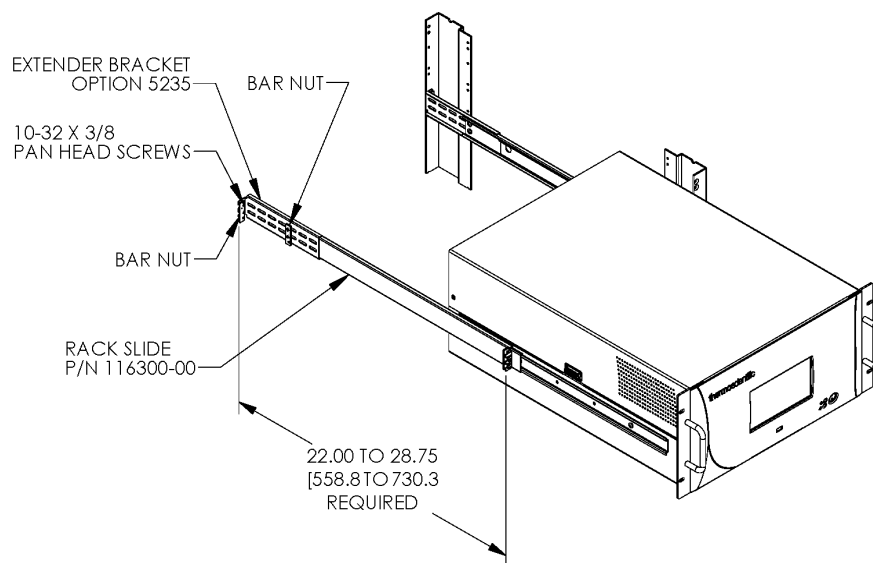
Figure 1–7. Rack Requirements Part 2

Chapter 2
Installation and Setup

Installation and Setup describes how to unpack, setup, and start-up the instrument. The installation should always be followed by instrument calibration as described in the "Calibration" chapter of this manual.

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

Unpacking and Inspection

The 43iQ 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
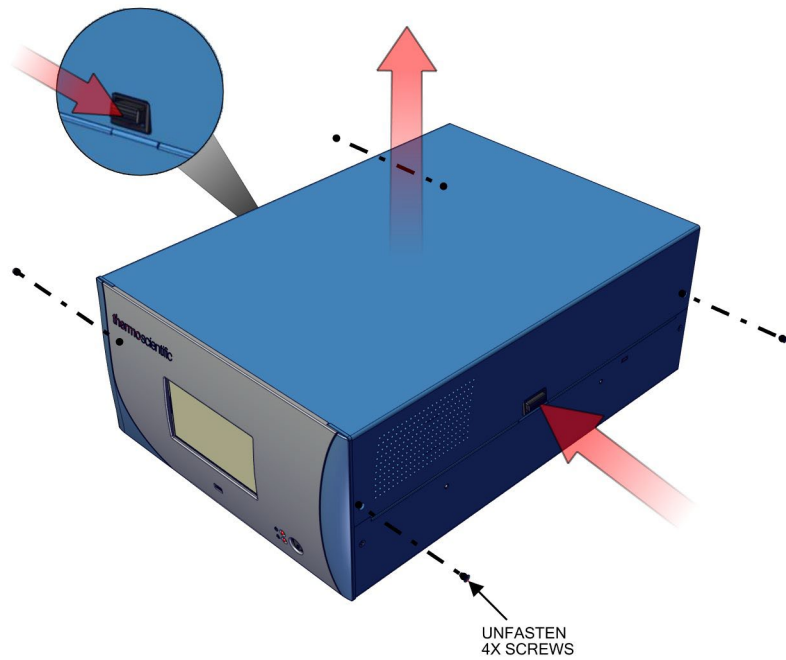
Figure 2–1. Removing the Cover

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.
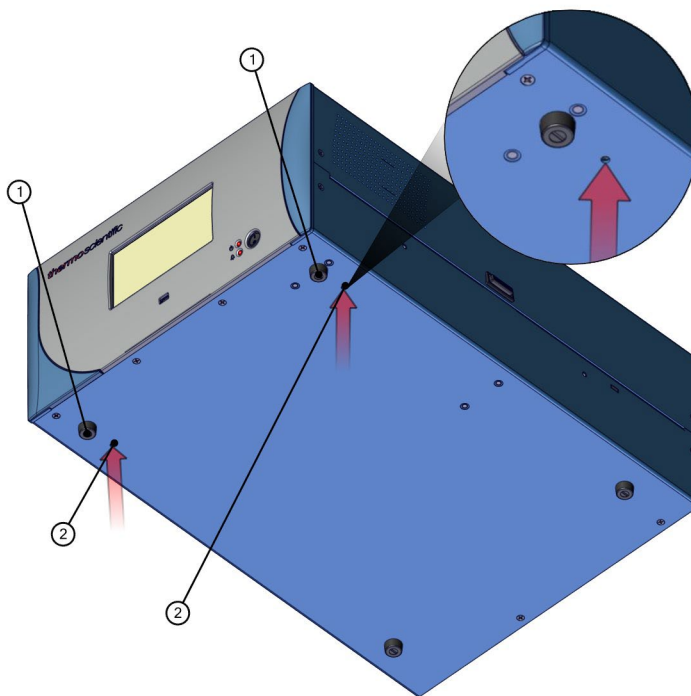
Figure 2–2. Installing Feet

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.
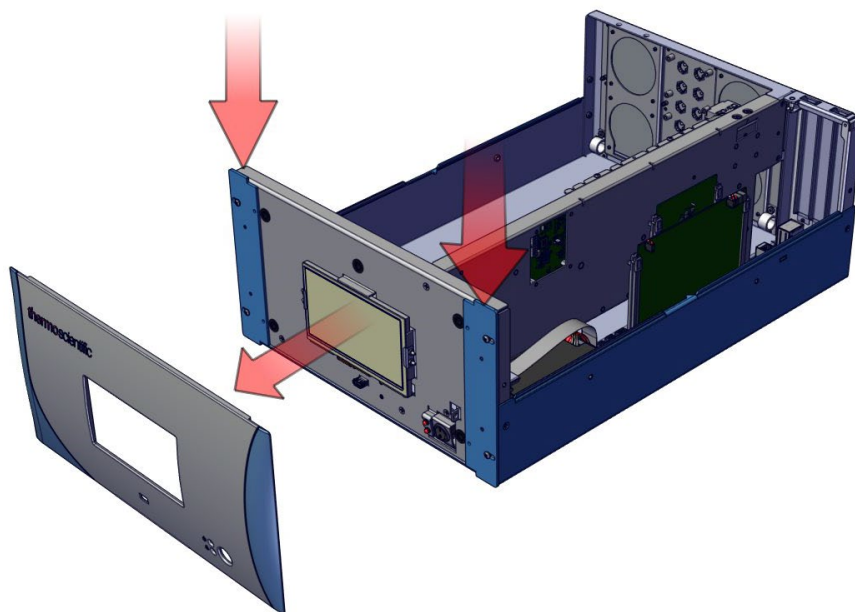
Figure 2–3. Removing the Front Panel

2. Unfasten the four 8-32 pan head screws.

3. Slide ears outwards.

4. Use the same four 8-32 pan head screws to secure it.

5. Install the handles with the four 8-32 flat head screws that came with the handle kit on the backside as shown.

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

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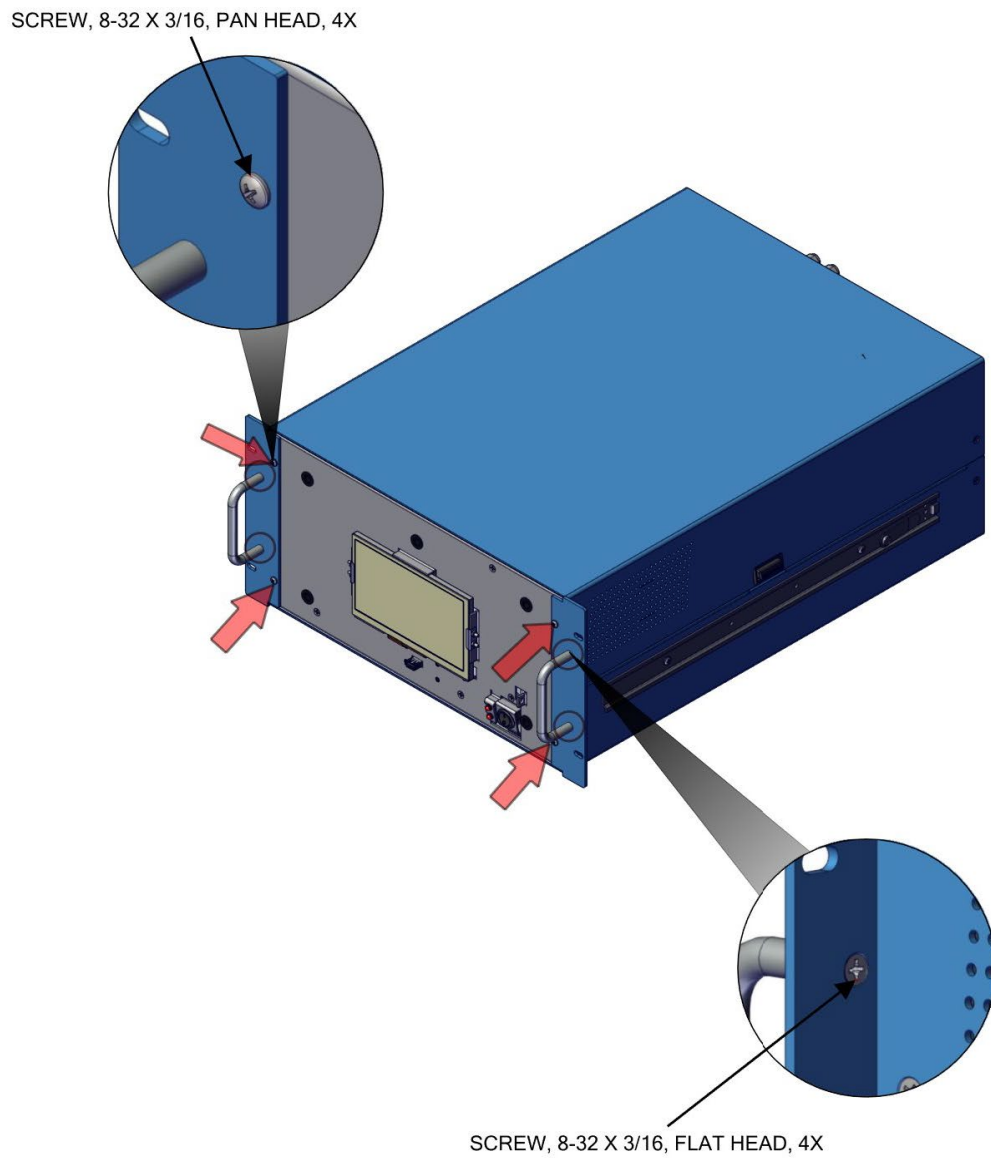
Figure 2–4. Installing Ears and Handles

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 9-23. ▲

Note If the sample may contain particulates larger than 5 microns, it should be filtered before introducing it to the instrument. Use a filter (such as PTFE) that does not interact with SO_2 in the sample. If a sample filter is used, all calibrations and span checks must be performed through the filter. The filter element should be replaced regularly to prevent the absorption of SO_2 by trapped material on the filter. ▲

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. 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 SO_2 and HC free air to the ZERO IN bulkhead, and connect a source of SO_2 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 3-82, and "Digital I/O" on page 3-83.

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

Note If instrument is equipped with an internal permeation oven, refer to Chapter 9, "Optional Equipment" for setup instructions. ▲

⚠ **WARNING** The 43iQ is supplied with a three-wire grounding cord. Under no circumstances should this grounding system be defeated. ▲
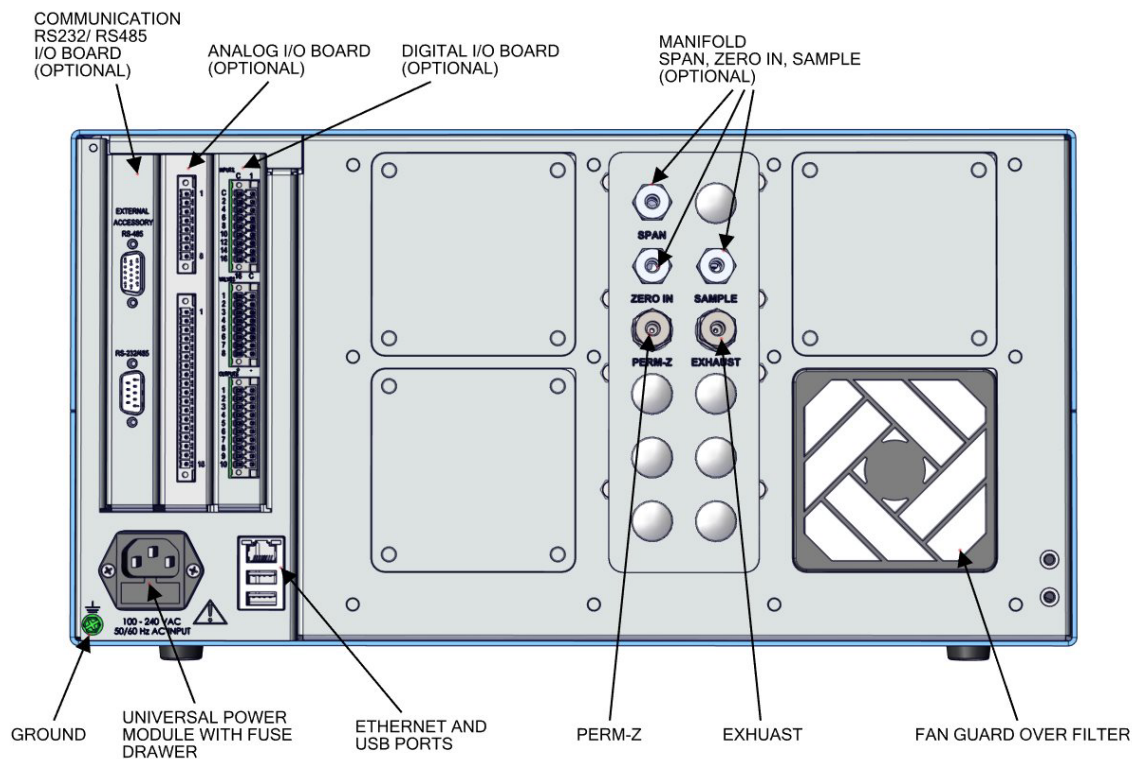
Figure 2–5. 43iQ Rear Panel
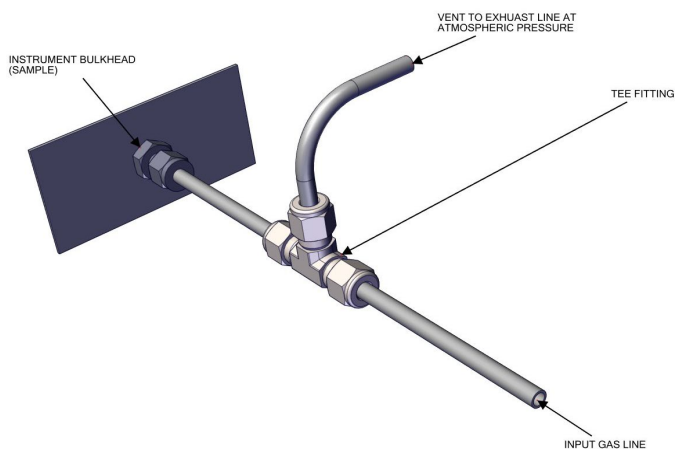
Figure 2–6. Atmospheric Dump Bypass Plumbing

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 calibration as described in the "Calibration" chapter.

LCD, TOUCH SCREEN   LED, POWER

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USB, PORT   LED, ALARM   SWITCH, POWER
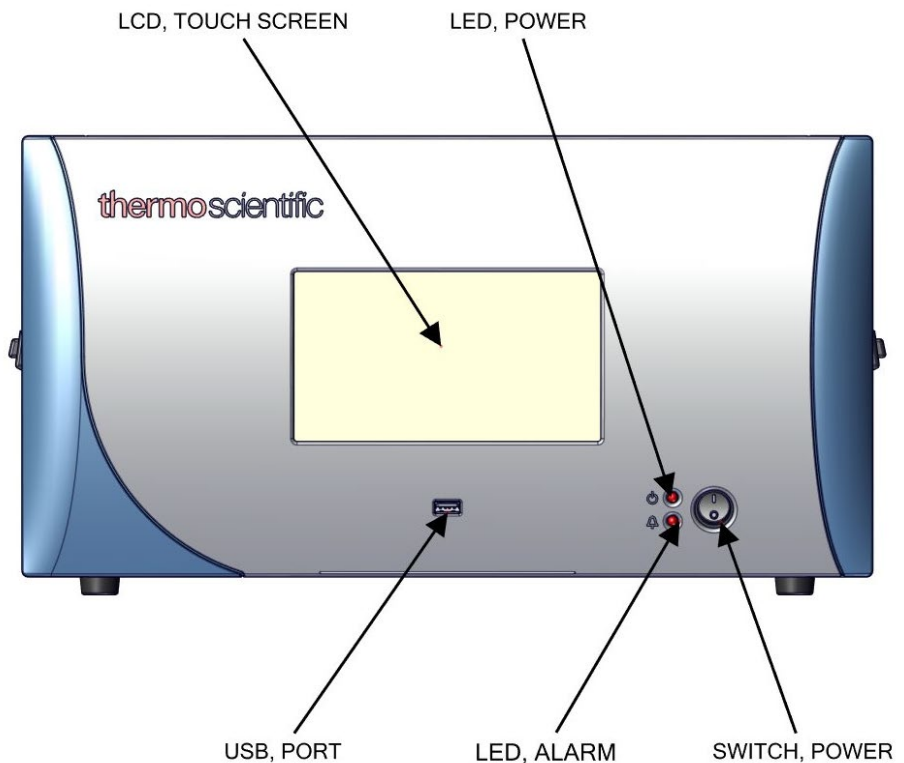
Figure 2–7. Front Panel and Touchscreen Display

Chapter 3
Operation

This chapter describes the functionality of the touchscreen user interface.

Instrument Display

The Instrument Display consists of a Title Bar, a User Interface, and a Status Bar. The Title Bar, located at the top, includes the Home button, instrument name, instrument gas mode, and Help button. The User Interface, located in the middle, is where the Home Screen and all other screens are accessed. The Home Screen has three Main Menu buttons, located on the left side, which include Calibration, Data, and Settings, while the user interface to the right of the buttons displays the chemical name, concentration value and unit. The Status Bar, located at the bottom, includes the Back button, Access Levels, Health Check, Favorites, Date and Time, and Contact Information.

Home Screen (single range mode)

Home Screen (dual or auto range mode)

Title Bar ⟶

User Interface ⟶

Status Bar ⟶

iQSeries:0

43iQ Analyzer   Sample

Calibration

Data   SO$_2$ Low   14.8 ppb

Settings

09/20/17
10:45:00   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 gas unit selection screen.

  - *Gas Mode button:* Displays current gas mode of the instrument. When pressed, brings you to the Gas Mode selection screen.

  - *Help button:* When pressed, brings you to the help screens.

- User Interface:

  - *Calibration button:* Allows the user to calibrate the instrument, setup automatic calibrations, and view calibration data.

  - *Data button:* Allows the user to view, graph, stream, and analyze data.

  - *Settings button:* Shows real-time status and alarms, also predictive diagnostics and maintenance history. Contains controls for operating the instrument, communications, and sets instrument options.

  - *Concentration*: When in single mode, displays SO_2 concentrations in big, bold characters, depending on operating mode. When in dual or auto mode, displays either high range or low range values based on the range setting.

- Status Bar:

  - *Back button:* When pressed, it displays the previous screen.

  - *Access Levels button:* Allows the user to set security access levels, and allows/restricts access to functionality depending on the selected access level.

  - *Health Check button:* Brings the user to the Health Check screen.

  - *Favorites button:* Allows user-selectable favorite buttons. To add to the favorites screen, user presses the desired screen button for 2 seconds. The user will be directed to the favorites screen where the user chooses the button position. To remove a favorite button from the favorites screen, press and hold button for 2 seconds.

  - *Clock:* Displays current date and time.

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

Main Menus and Keypads

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

Calibration	Data	Settings

Calibration

Calibrate Background

Calibrate Span Coefficient

Zero/Span Schedule

Advanced Calibration
- Manual Calibration
  - Adjust Background
  - Adjust 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 Setting
- Gas Mode
- Gas Units
- Dilution Ratio
- Advanced Measurement
  - Optical Bench Settings
  - Flash Lamp
  - Optical Span Test
  - Extended Ranges
  - Compensation
  - Perm Oven Settings (Optional)
  - Pressure Calibration

Communications

Instrument Settings
- Display Setup
- Alarm Setpoints
- Language
- Clock
- 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.
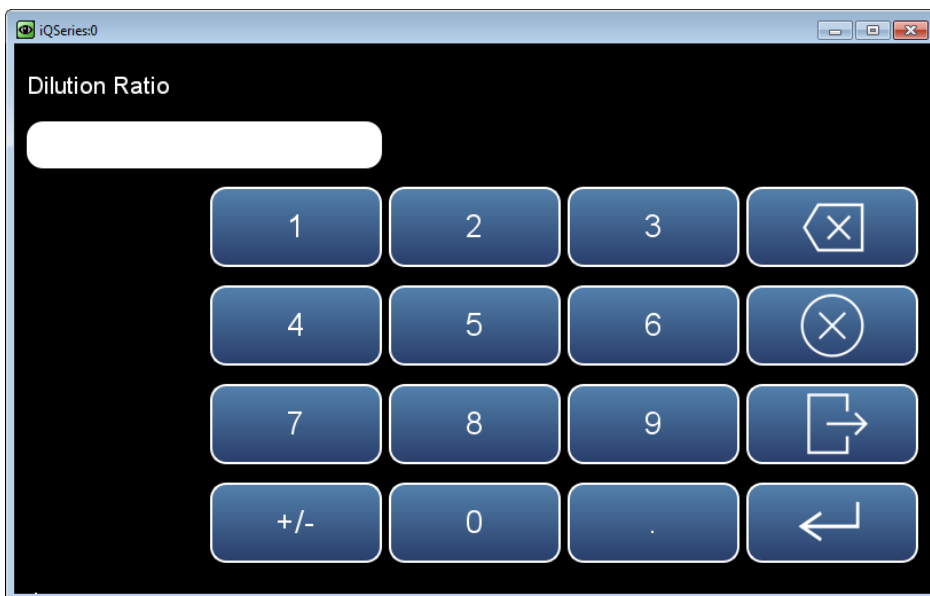
Alphanumeric Keypad   User enters a value into the box using the keypad. When the user needs to change an alphanumeric value, this keypad will automatically display. Initially, the box above the keypad will display the current value. Enter a new value using the keypad, and then select the **Enter** button 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.
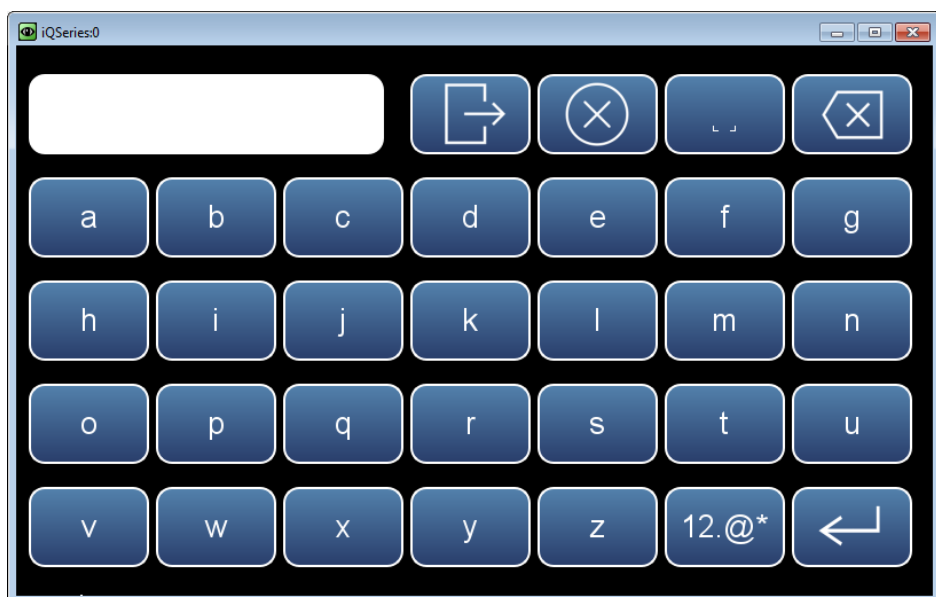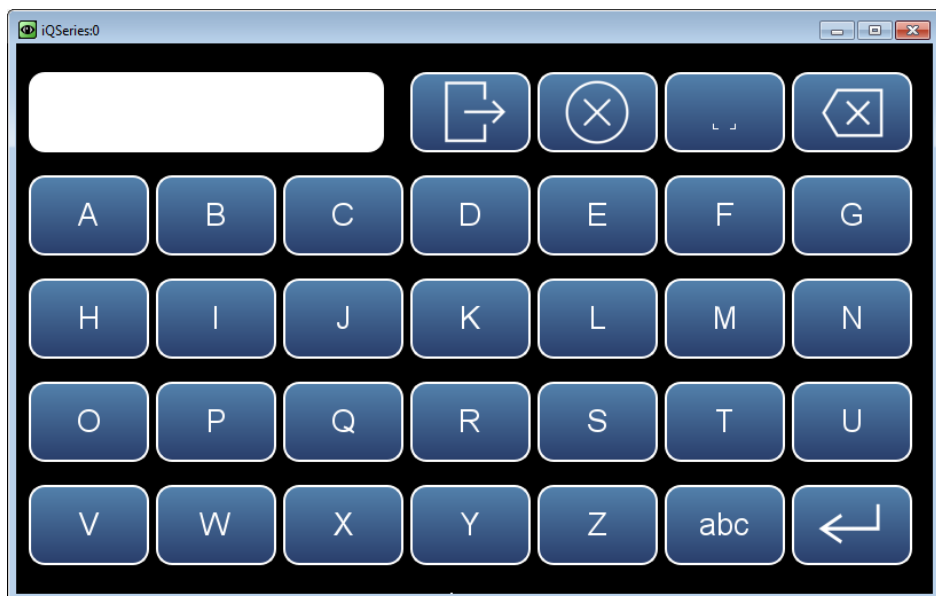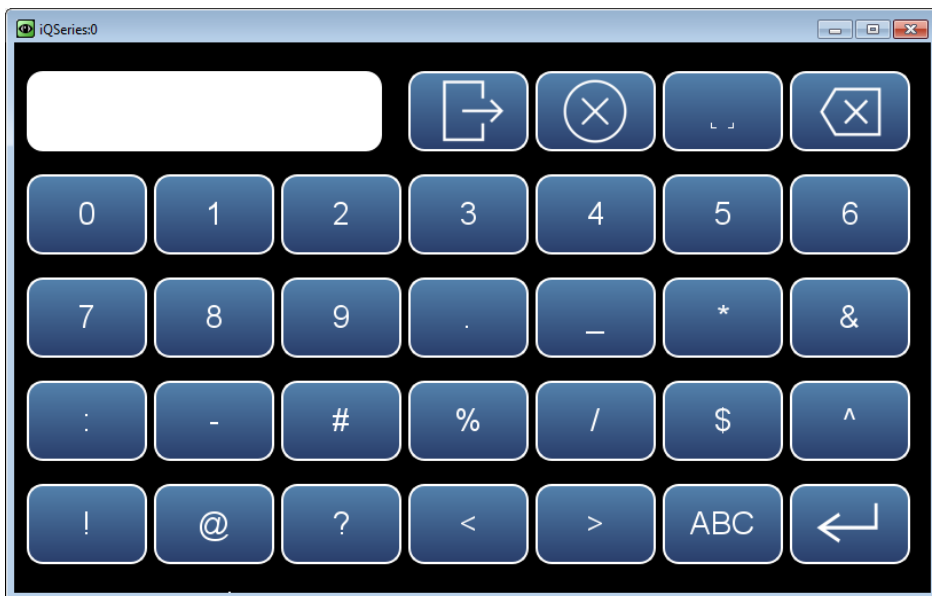
Calibration

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.

The following screens show the calibration screens in single range mode and dual or auto range mode. The dual and auto range modes have two SO_2 span factors (high and low). This allows each range to be calibrated separately. This is necessary if the two ranges used are not close to one another. For example, a low SO_2 range of .5 ppm and a high SO_2 range of 10 ppm. For more information about range modes, see "Range Mode Selection" on page 3-66.

Home Screen>Calibration (single range mode)
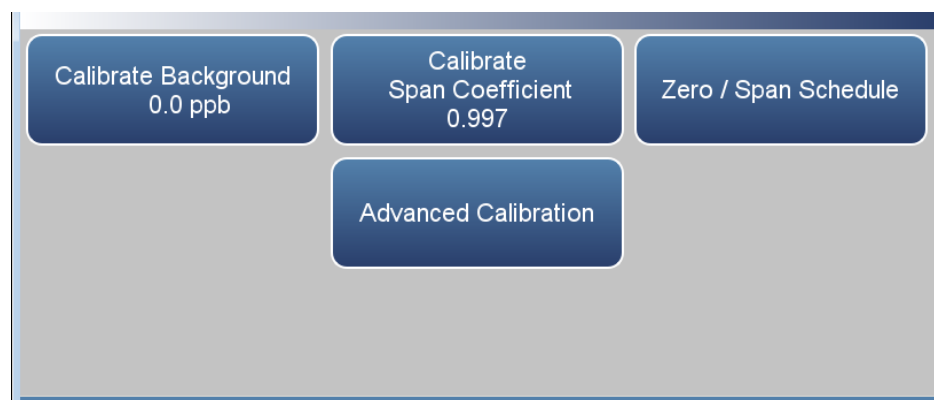
Calibrate Background 0.0 ppb	Calibrate Span Coefficient 0.997	Zero / Span Schedule
	Advanced Calibration	

Home Screen>Calibration (dual or auto range mode)

Calibrate Background 0.0 ppb	Calibrate High Range Span Coefficient 1.000	Calibrate Low Range Span Coefficient 0.997
Zero / Span Schedule		Advanced Calibration
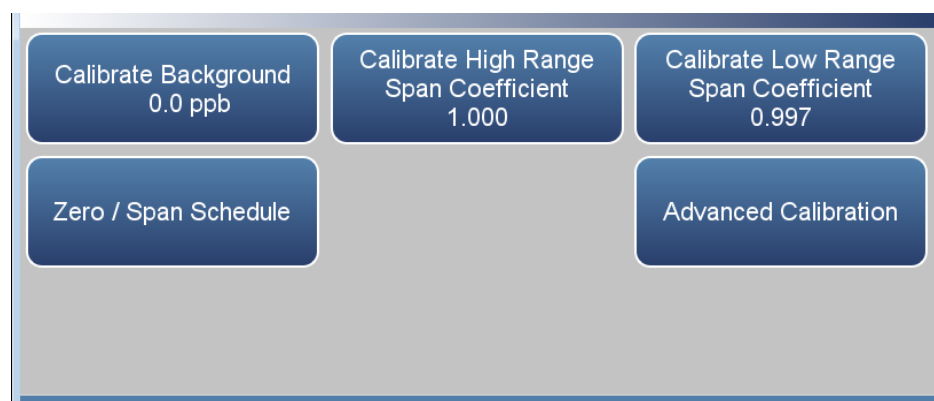
The Calibration screen contains the following information:

● *Calibrate Background:* Sets the SO_2 reading to zero.

● *Calibrate Span Coefficient:* Sets the span coefficient when in single range mode.

- *Calibrate High Range Span Coefficient:* Sets the high range span coefficient when in dual or auto range mode.

- *Calibrate Low Range Span Coefficient:* Sets the low range span coefficient when in dual or auto range mode.

- *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. 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 Background
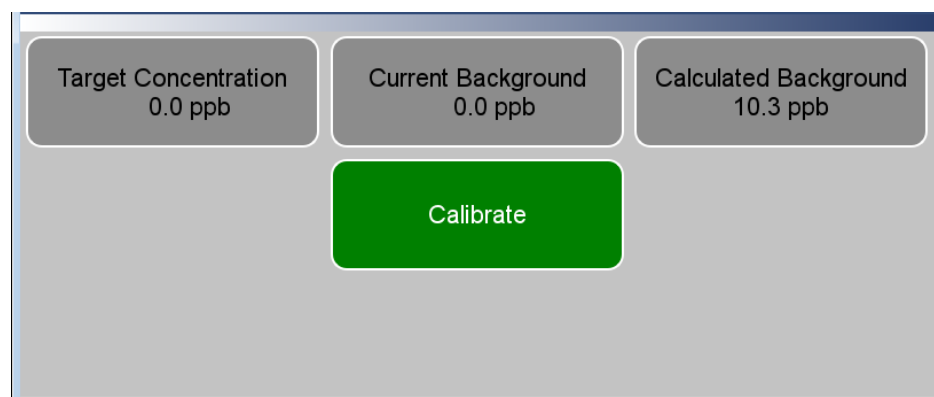
The Calibrate Background screen contains the following information:

● *Target Concentration:* Read only. Displays what the concentration value will become when the calibrate button is pressed.

● *Current Background:* Read only. Displays what the current user-set background is.

● *Calculated Background:* Read only. Displays what the current user-set background will become when the calibrate button is pressed.

● *Calibrate:* When pressed, updates the background value, setting the displayed concentration to zero.

Calibrate Span Coefficient

The Calibrate Span Coefficient screen is used to enter the span concentration and calibrate the SO_2 span coefficient. The SO_2 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 Range Span Coefficient and Calibrate Low Range 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)
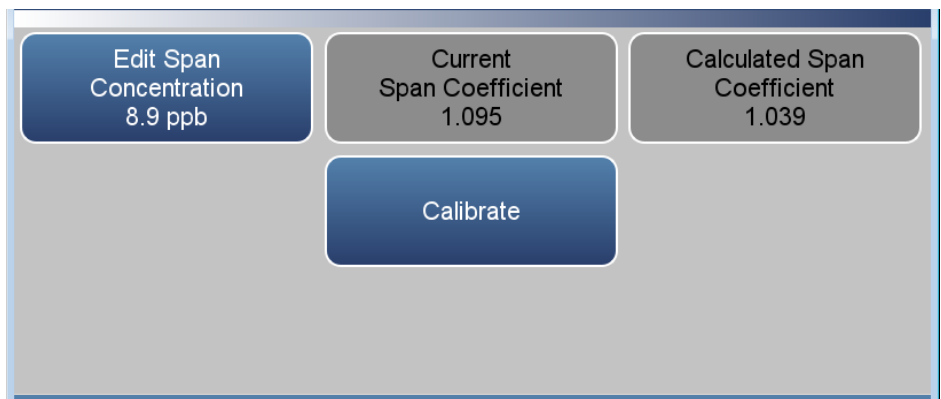
Home Screen>Calibration>Calibrate Span Coefficient (dual or auto range mode)
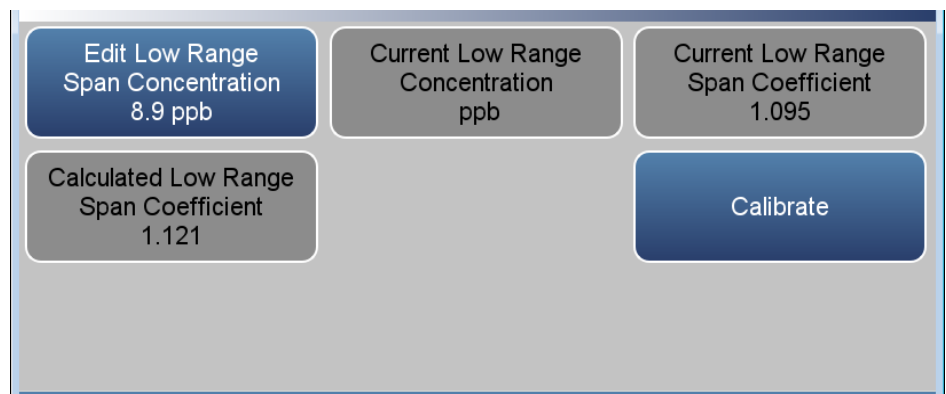
The Calibrate Span Coefficient screen contains the following information:

● *Edit Span Concentration:* User enters the span gas concentration when in single range mode.

● *Edit High Range Span Concentration:* User enters the high range span concentration when in dual or auto range mode.

● *Edit Low Range Span Concentration:* User enters the low range span concentration when in dual or auto range mode.

● *Current High Range Concentration:* Read only. Current high range concentration reading when in dual or auto range mode.

● *Current Low Range Concentration:* Read only. Current low concentration reading when in dual or auto range mode.

● *Current Span Coefficient:* Read only. Displays the current instrument span coefficient.

● *Current High Range Span Coefficient:* Read only. Displays the current instrument high range span coefficient.

● *Current Low Range Span Coefficient:* Read only. Displays the current instrument low range span coefficient.

● *Calculated Span Coefficient:* Read only. After the "Edit Span Concentration" value is entered, the new calculated span coefficient is displayed.

● *Calculated High Range Span Coefficient:* Read only. After the "Edit High Range Span Concentration" value is entered, the new calculated high range span coefficient is displayed.

● *Calculated Low Range Span Coefficient:* Read only. After the "Edit Low Range Span Concentration" value is entered, the new calculated low range 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

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
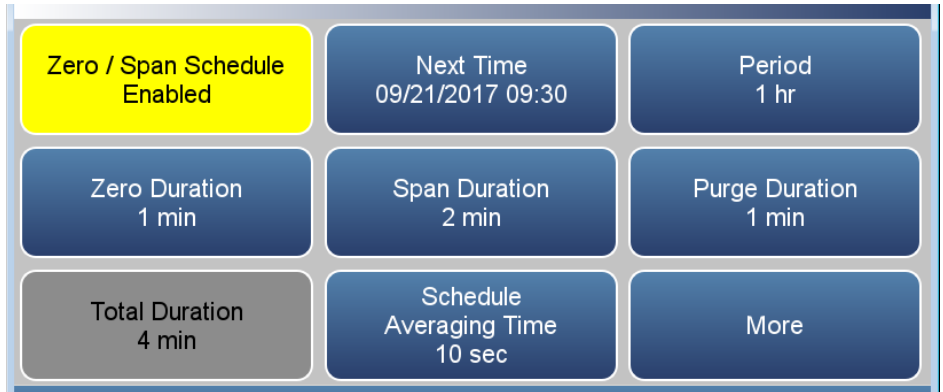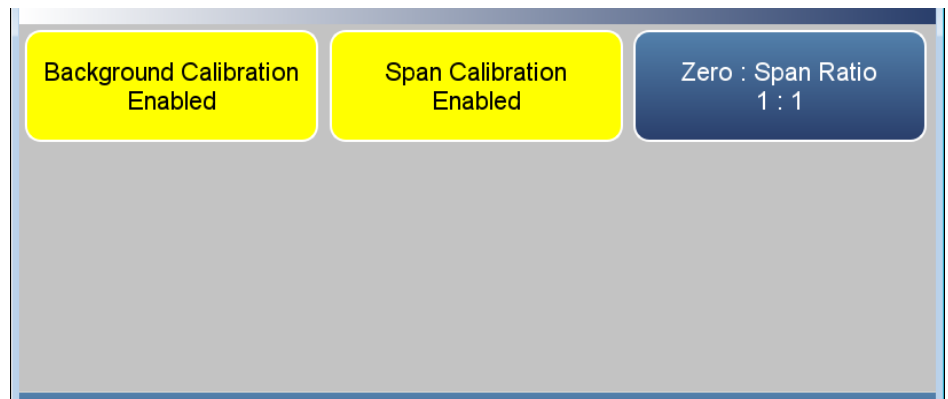
The Zero/Span Schedule contains the following information:

● *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
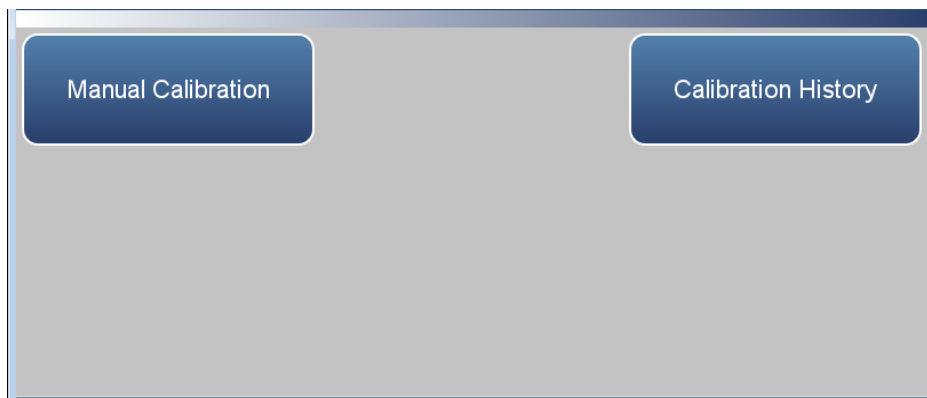
The Advanced screen contains the following information:

● *Manual Calibration:* The user manually calibrates 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.

The following screens show the manual calibration screens in single range mode and dual or auto range mode. In dual or auto range modes, "High Range" or "Low Range" buttons are displayed to indicate the calibration of the high or low coefficient.

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

Adjust Background 6.9 ppb	Adjust Span Coefficient 1.000	Reset Bkg to 0.000 and Span Coef to 1.000

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

Adjust Background 7.0 ppb	Adjust High Range Span Coefficient 1.000	Adjust Low Range Span Coefficient 1.000
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 when in single range mode.

● *Adjust High Range Span Coefficient:* Allows the user to manually adjust the high range span coefficient when in dual or auto range mode.

● *Adjust Low Range Span Coefficient:* Allows the user to manually adjust the low range span coefficient when in dual or auto range mode.

● *Reset Background to 0.000 and Span Coefficient to 1.000:* Resets all backgrounds and coefficients.

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

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

The Adjust Background screen contains the following information:

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

● *Adjusted Concentration:* Read only. Shows adjusted concentration based
on adjusted zero background.

● *Calibrate:* Calibrates zero background by saving the newly adjusted zero
background value.

Adjust Span Coefficient

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

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 Span Coefficient and Adjust Low Range Span Coefficient screens function the same way.

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

Adjust Span Coefficient
1.095

Adjusted Concentration
9.1 ppb

Calibrate

Home Screen>Calibration>Advanced Calibration>Manual Calibration>Adjust High Range Span Coefficient (dual or auto range mode)

Adjust High Range Span Coefficient
0.999

Adjusted High Range Concentration
7.9 ppb
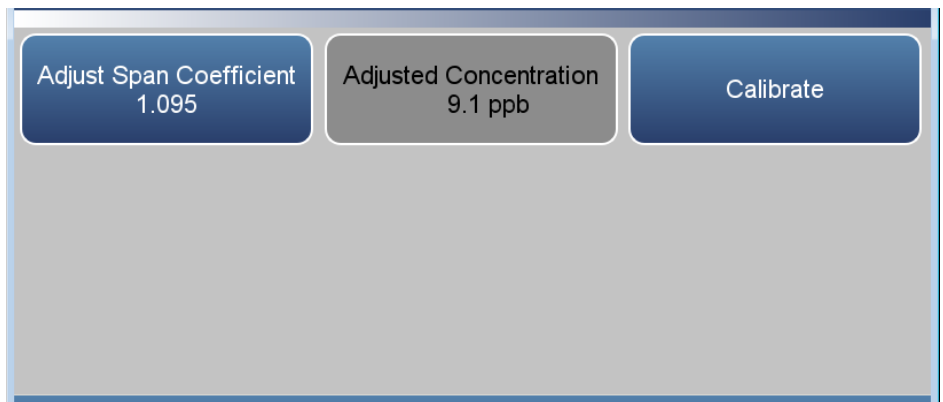
Calibrate

The Adjust Span Coefficient screen contains the following information:

● *Adjust Span Coefficient:* User manually adjusts span coefficient when in single range mode.

● *Adjusted Concentration:* Read only. Shows adjusted concentration based on adjusted span coefficient when in single range mode.

- *Adjust High Range Span Coefficient:* User manually adjusts high range span coefficient when in dual or auto range mode.

- *Adjusted High Range Concentration:* Read only. Shows adjusted high range concentration based on adjusted high range span coefficient when in dual or auto range mode.

- *Adjust Low Range Span Coefficient:* User manually adjusts low range span coefficient when in dual or auto range mode.

- *Adjusted High Range Concentration:* Read only. Shows adjusted low range concentration based on adjusted low range span coefficient 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... ▲

The Calibration History screen contains the following information:

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

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

● *Result:* Concentration result.

● *Target:* Concentration setpoint value.

● *Units:* Displays units for each item.

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

Data

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

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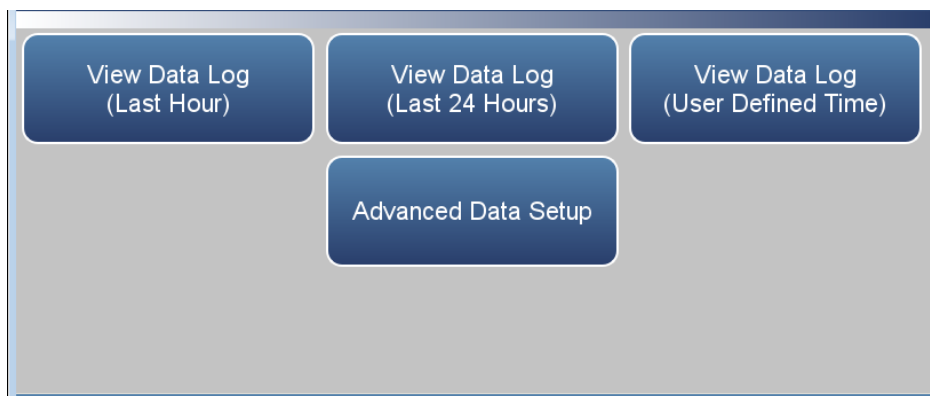
The Data screen contains the following information:

- *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 view the last hour worth of data in tabular and/or graphical form.

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

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

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

Time Stamp	Concentration (ppb or ug/m3)	Bench Pressure (mmHg)	Instrument Temperature (degC)	PMT High Voltage (Volts)	Flashe Voltage
	Graph	Graph	Graph	Graph	Graph
09/22/2017 08:15:00	17.8845	0	0	0	0
09/22/2017 08:14:00	17.7086	0	0	0	0
09/22/2017 08:13:00	17.8215	0	0	0	0
09/22/2017 08:12:00	17.8394	0	0	0	0
09/22/2017 08:11:00	17.8261	0	0	0	0
09/22/2017 08:10:00	17.8338	0	0	0	0
09/22/2017 08:09:00	17.9224	0	0	0	0
09/22/2017 08:08:00	17.8584	0	0	0	0

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

● *Graph:* Displays data graph for the column selected. The graph time axis is defined by the data set in the table.
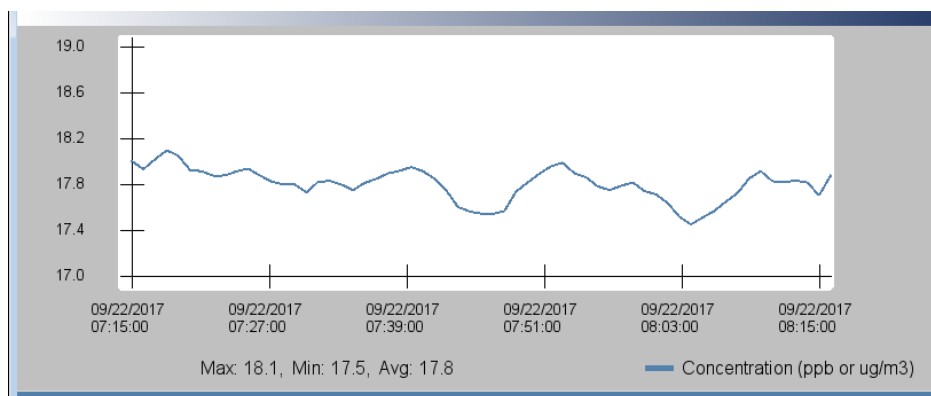
View Data Log (Last 24 Hours)

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

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

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

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

Time Stamp	Concentration (ppb or ug/m3)	Bench Pressure (mmHg)	Instrument Temperature (degC)	PMT High Voltage (Volts)	Flashe Voltage
	Graph	Graph	Graph	Graph	Graph
09/22/2017 08:16:00	17.9427	0	0	0	0
09/22/2017 08:15:00	17.8845	0	0	0	0
09/22/2017 08:14:00	17.7086	0	0	0	0
09/22/2017 08:13:00	17.8215	0	0	0	0
09/22/2017 08:12:00	17.8394	0	0	0	0
09/22/2017 08:11:00	17.8261	0	0	0	0
09/22/2017 08:10:00	17.8338	0	0	0	0
09/22/2017 08:09:00	17.9224	0	0	0	0

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

● *Graph:* Displays data graph for the column selected. The graph time axis is defined by the data set in the table.
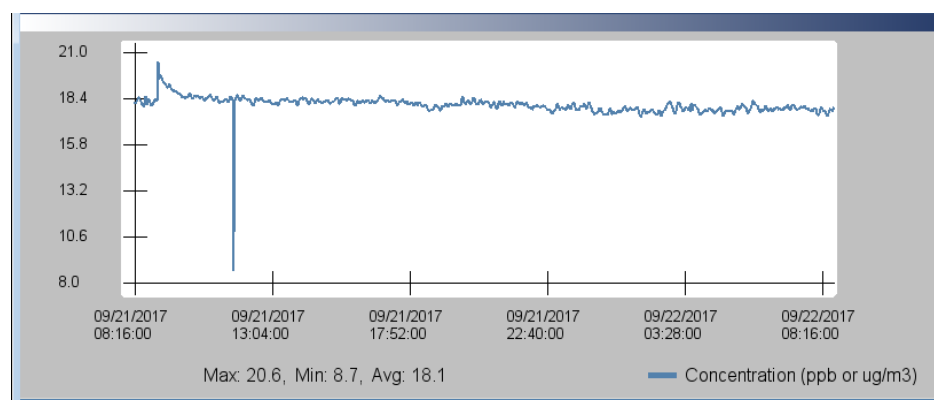
View Data Log (User Defined Time)

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

Home Screen>Data>View Data Log (User Defined Time)
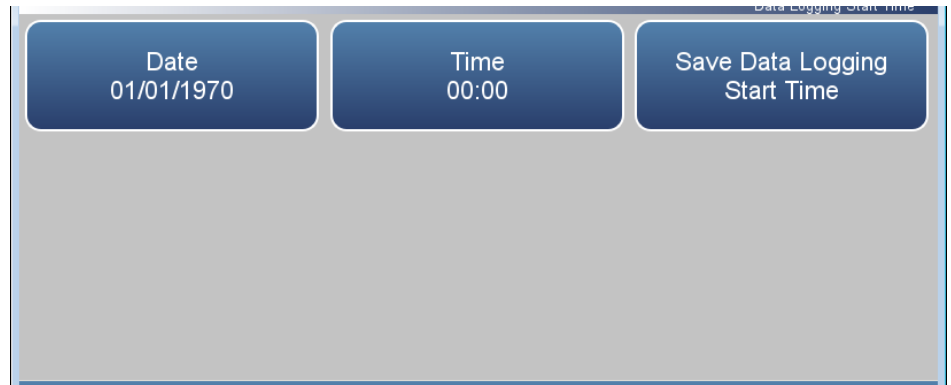
Home Screen>Data>View Data Log (User Defined Time)>Save Data Logging Start Time
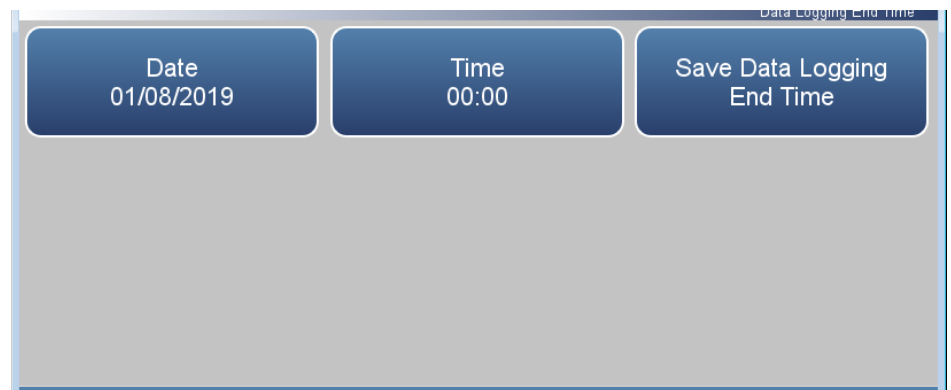
The View Data Log (User Defined Time) screen contains the following information:

● *Date:* Sets date of data logging start time.

● *Time:* Sets time of data logging start time.

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

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

● *Date:* Sets date of data logging end time.

● *Time:* Sets time of data logging end time.

● *Save Data Logging End Time:* Pressing the Save Data Logging End Time button saves the end time and follows directly to the data logging table.

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

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

Advanced Data Setup

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

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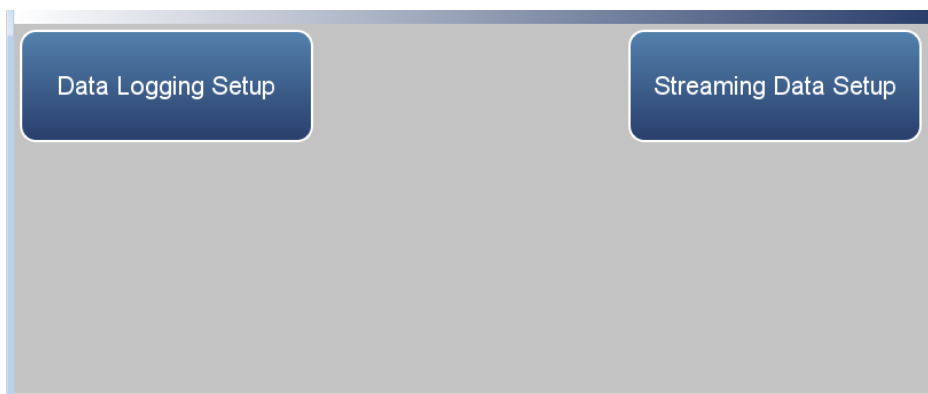
The Advanced Data Setup screen contains the following information:

● *Data Logging Setup:* User selects the parameters for collecting logged data.

● *Streaming Data Setup:* User selects the parameters for streaming data to a computer in real time.

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

Home Screen>Data>Advanced>Data Logging Setup
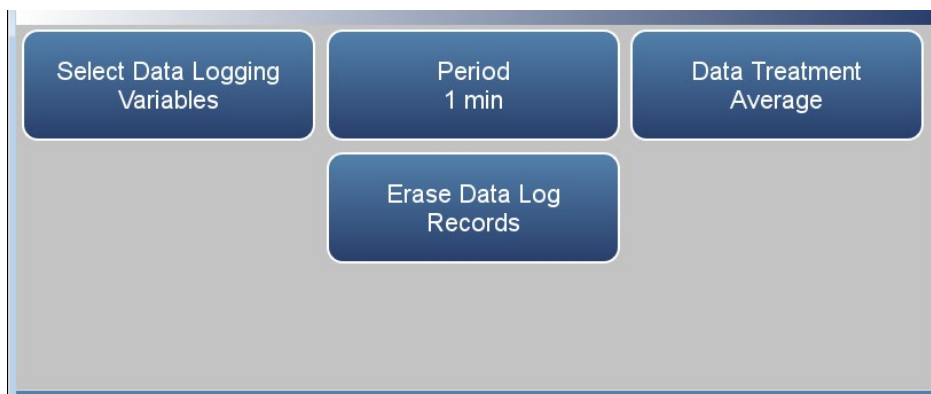
The Data Logging Setup screen contains the following information:

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

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

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

● *Erase Data Log Records*: Allows the user to erase all values in the data log and updates the data logging table.

Select Data Logging Variables

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

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

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

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

Home Screen>Data>Advanced>Streaming Data Setup
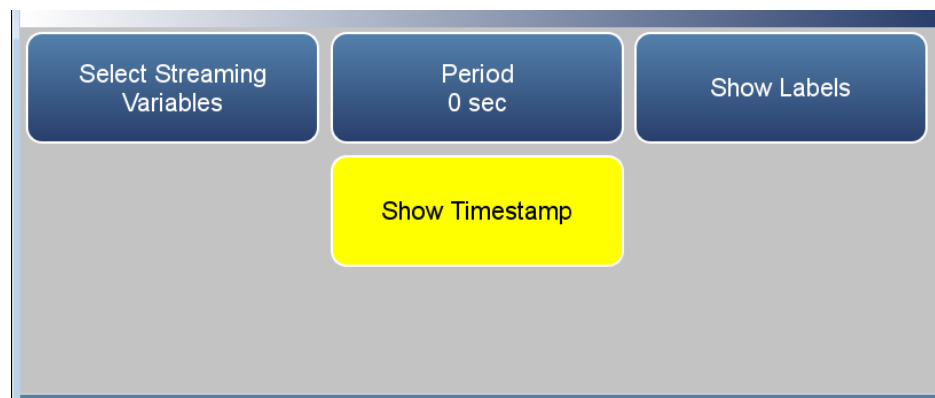
The Streaming Data Setup screen contains the following information:

- *Select Streaming Variables*: User selects which variables to stream.

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

- *Show Labels*: Toggles on/off. When on, shows variable labels to the left of the variable values.

- *Show Timestamp*: Toggles on/off. When on, shows timestamp at the beginning of each row of data.

Select Streaming Variables

The Select Streaming Variables screen allows the user to select which variables to track. Note: The Data logging and Streaming variable lists are **exclusive** from each other but contain the same variable selections. 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. More than one can be chosen.

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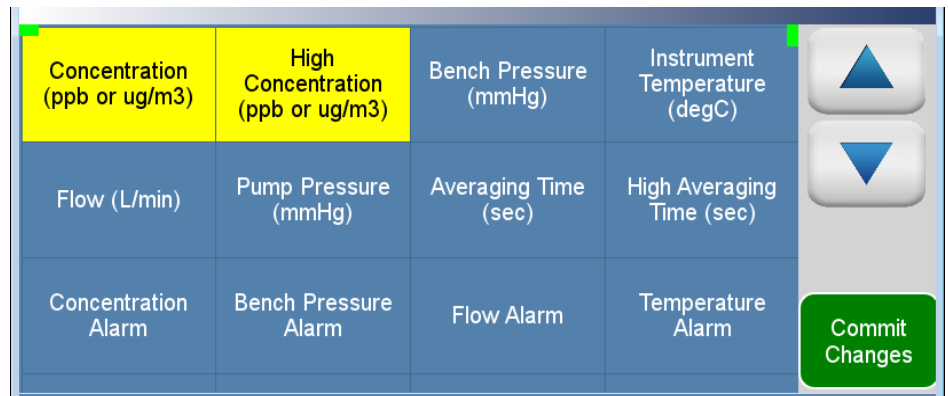
Settings

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

Home Screen>Settings

The Settings screen contains the following information:

- *Health Check:* View instrument status and alarms, predictive diagnostics, preventive maintenance alerts, maintenance history, email health check report files, and contact Thermo Fisher Scientific technical support.

- *Measurement Settings:* Allows the user to setup user preferences as related to the concentration readings.

- *Communications:* Allows the user to communicate with outside devices.

- *Instrument 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.

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 or condition in the module. ▲

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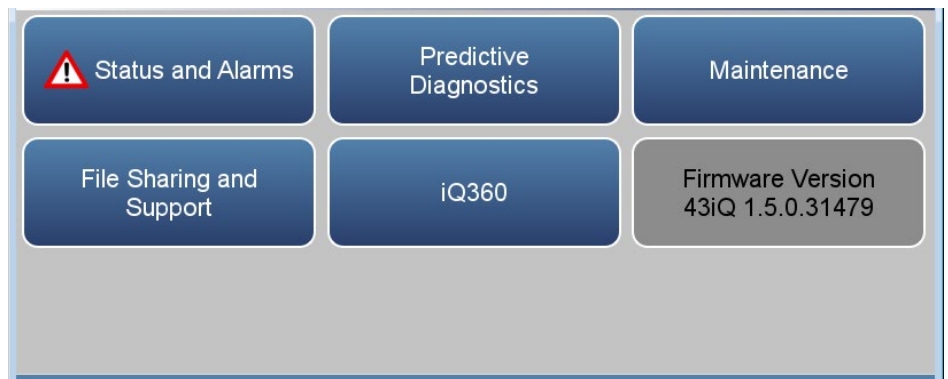
The Health Check screen contains the following information:

● *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

The Status and Alarms screen contains the following information:
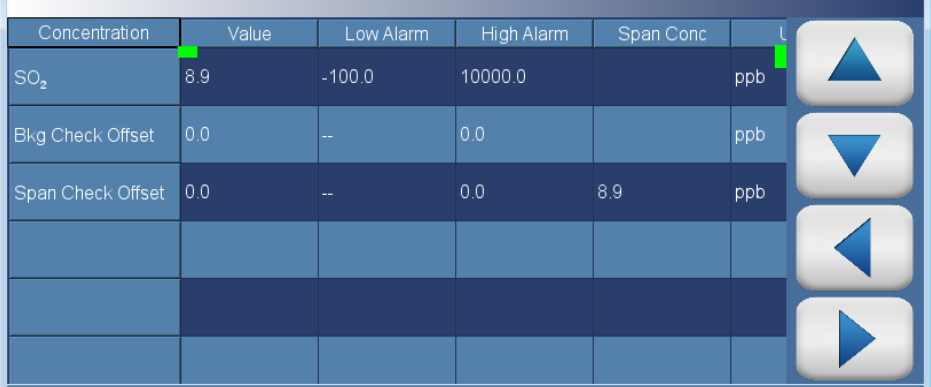
● *Concentration:* Displays SO₂ concentrations, alarms, and calibration pass/fail status.

● *SO₂ Bench:* Displays bench module alarms and faults.

● *Perm Oven:* Displays (optional) perm oven module alarms and faults.

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

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

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

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

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

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

Concentration　　The Concentration screen provides status and alarms for SO_2 concentration, background cal/checks, and span cal/checks. If the 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	Units	
SO₂	8.9	-100.0	10000.0		ppb	
Bkg Check Offset	0.0	--	0.0		ppb	
Span Check Offset	0.0	--	0.0	8.9	ppb	

The Concentration screen contains the following information:

- Across:

  - *Concentration:* This column lists items associated with the SO_2 concentration.

  - *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:

  - *SO₂:* SO_2 concentration.

  - *Bkg Check Offset:* Displays concentration based on the last attempted background calibration. High alarm shows user defined limit for acceptable background check offset.

● *Span Check Offset:* Displays 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. ▲

SO₂ Bench   The SO$_2$ Bench screen provides status and alarms related to the SO$_2$ bench 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>SO₂ Bench

SO₂ Bench	Value	Low Alarm	High Alarm	Units	
Chamber Temperature	45.0	44.0	46.0	⁰C	▲
Lamp Intensity	102.5	90.0	105.0	%	▼
Lamp Voltage	812.4	600.0	1400.0	V	◄
PMT Supply Voltage	-606.8			V	►
Bench Pressure	730.3			mmHg	
Flow	0.458			L/min	

The SO$_2$ Bench screen contains the following information:

● Across:

  ● *SO₂ Bench:* This column lists items associated with the SO$_2$ bench.

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

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

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

  ● *Units:* Displays units for each item.

● Down:

  ● *Chamber Temperature:* Displays the current chamber temperature. User can adjust low and high alarm limits.

  ● *Lamp Intensity:* Displays the current lamp intensity reading. User can adjust low and high alarm limits.

  ● *Lamp Voltage:* Displays the current lamp voltage. User can adjust low and high alarm limits.

  ● *PMT Supply Voltage:* Displays the current PMT supply voltage.

  ● *Bench Pressure:* Displays the current bench pressure reading.

  ● *Flow:* Displays the current sample flow reading.

- *Instrument Temp:* Displays the current instrument temperature 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.

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

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

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

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

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

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

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

Perm Oven	Value	Low Alarm	High Alarm	Units	
Perm Oven Temperature	0.00	29.90	30.10	ºC	
Board Communication	OK				
Power Supply	OK				
2.5 V Diagnostic	0.00	2.25	2.75	V	
3.0 V Diagnostic	0.00	2.70	3.30	V	
3.3 V Diagnostic	0.00	2.97	3.63	V	

The Perm Oven screen contains the following information:

● Across:

  ● *Perm Oven:* This column lists items associated with the perm oven.

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

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

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

  ● *Units:* Displays units for each item.

● Down:

  ● *Perm Oven Temperature:* Displays the current perm oven temperature. User can adjust low and high alarm limits.

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

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

  ● *2.5 V Diagnostics:* Displays current voltage readings. Alarm limits are not changeable.

- *3 V Diagnostics:* Displays current voltage readings. Alarm limits are not changeable.

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

- 5 V Diagnostics: Displays current voltage readings. Alarm limits are not changeable.

- *Heater Power Diagnostics:* Displays current heater 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	0.458	0.350	1.500	L/min	
Bench Pressure	730.3	600.0	800.0	mmHg	
Pump Pressure	112.49			mmHg	
Instrument Temperature	27.5	0.0	45.0	ºC	
Board Communication	OK				
Power Suppy	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 sample flow reading. User can adjust low and high alarm limits.
  - *Bench Pressure:* Displays the current bench pressure reading. User can adjust low and high alarm limits.
  - *Pump Pressure:* Displays the current pump 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 peripheral module. If an item being monitored goes outside the lower or higher alarm limit, an alarm is activated.

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

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

Peripherals Support	Value	Low Alarm	High Alarm	Units	
Module Temperature	28.7			ºC	
Sample Valve	128.906			mA	
Zero Valve	105.703			mA	
Span Valve	0.000			mA	
Instrument Error	OK				
Board Communication	OK				

The Peripherals Support screen contains the following information:

● Across:

  ● *Peripherals Support:* This column lists items associated with the peripherals support 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:

  ● *Module Temperature:* Displays the current module 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.

  ● *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 current voltage readings. Alarm limits are not changeable.

  - *24V Step Board 1:* Displays current voltage readings. Alarm limits are not changeable.

  - *5.0V Step Board 2:* Displays current voltage readings. Alarm limits are not changeable.

  - *24V Step Board 2:* Displays current voltage readings. Alarm limits are not changeable.

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>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.
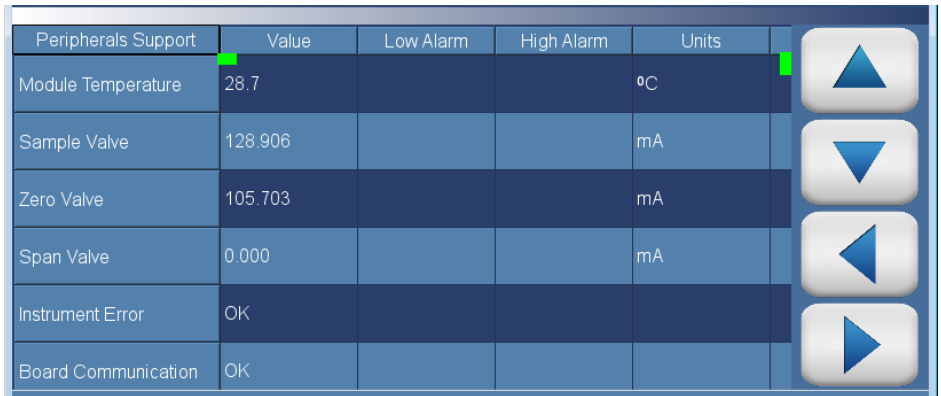
  ● *Test Mode:* Displays test mode on or off.

- *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>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>Serial Numbers

Instrument Common	SO₂ Bench 00001706CUU00345	Perm Oven
Flow and Pressure 00000FCN17130271	Peripherals Support 0000000000000000	Analog I/O
	Digital I/O	
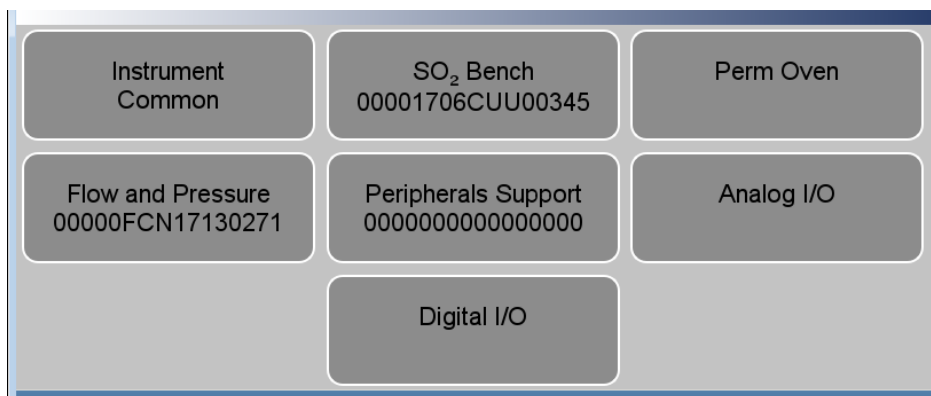
The Serial Numbers screen contains the following information:

- *Instrument:* Instrument serial number.
- *SO₂ Bench:* SO₂ bench serial number.
- *Perm Oven:* Optional perm oven 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 that allows the 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:

● Sample Pump

● Capillary

● Flow Path

● 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 related warning in the module. ▲

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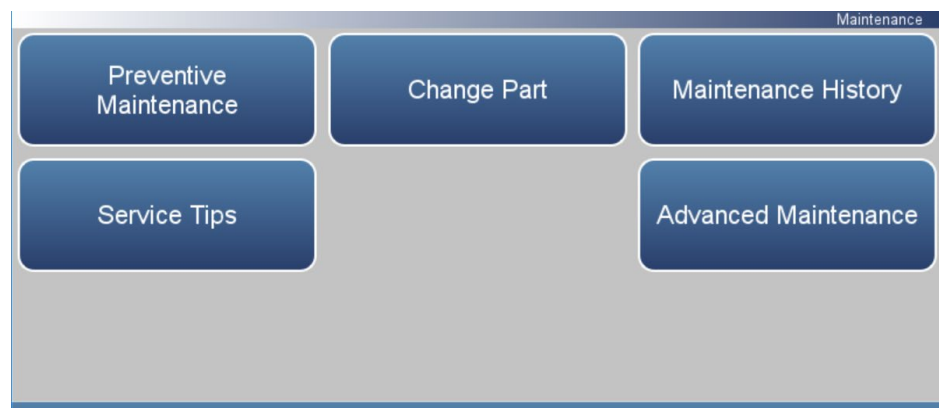
Home Screen>Settings>Health Check>Maintenance>Advanced Maintenance

The Maintenance screen contains the following information:

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

● *Change Part:* User logs component fix.

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

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

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

Preventive Maintenance

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

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

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

Component	Interval in Months	Months Left	Reset	Alert	
Optical Bench Module	48	47	Reset	Enabled	▲
UV Lamp	12	11	Reset	Enabled	▼
PMT	48	47	Reset	Enabled	◀
PMT Base Socket	48	47	Reset	Enabled	
Flash Intensity Assy	48	47	Reset	Enabled	▶
Mirrors	60	59	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 "Service Interval in Months" value.

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

● Down:

- *Optical Bench Module:* Service interval for optical bench module components.

  - *UV Lamp:* Service interval for UV lamp.

  - *PMT:* Service interval for PMT.

  - *PMT Base Socket:* Service interval for PMT base socket.

  - *Flash Intensity Assembly:* Service interval for flash intensity assembly.

  - *Mirrors:* Service interval for mirrors.

- *Permeation Tube:* Service interval for permeation tube.

- *Flow System:* Service interval for the flow system components.

  - *Capillaries:* Service interval for capillaries.

  - *Pump:* Service interval for pump.

- *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	07/17/2017	0	Reset All

The Maintenance History screen contains the following information:

● *Part:* Component that has been fixed.

● *Fix:* The type of maintenance.

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

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

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

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

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

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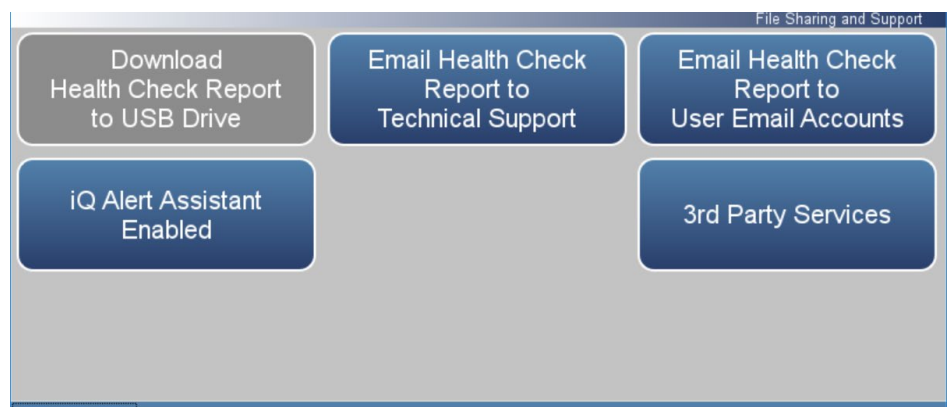
The File Sharing and Support screen contains the following information:

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

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

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

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

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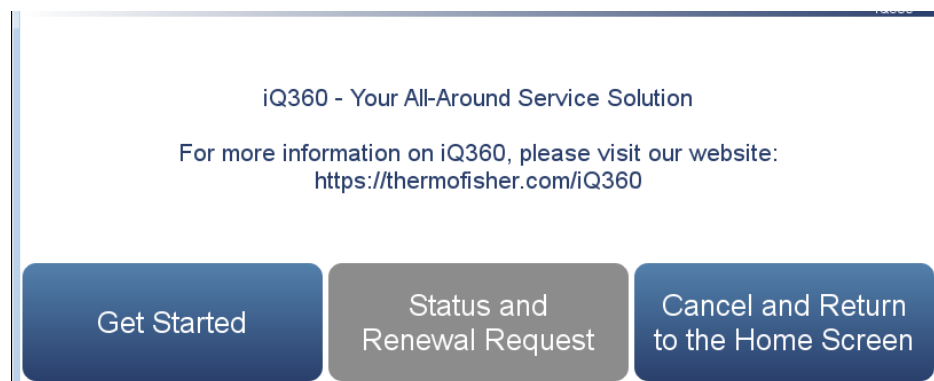
Home Screen>Settings>Health Check>iQ360 (Status and Renewal Request)
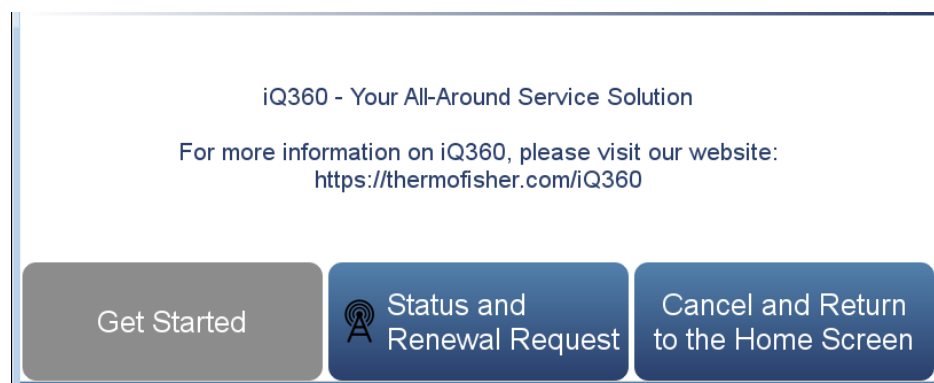
The iQ360 screen contains the following information:

● *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

iQ360 Subscription request email sent.
Contact Call Center at 508-520-0430 to Receive your iQ360
Access Code to Activate or Renew your Subscription.

| Resend Subscription E-mail | Enter Subscription Access Code | Exit and Return to the HomeScreen |
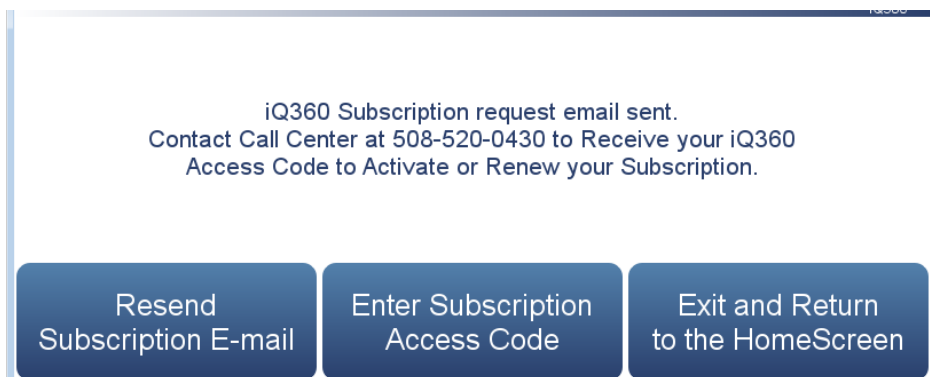
The Get Started screen contains the following information:

● *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.

The following screens show the measurement settings in single range mode and dual or auto range mode. In the dual and auto range modes, both the "High Range" or "Low Range " buttons averaging buttons will be available.

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

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

The Measurement Settings screen contains the following information:

- *Averaging Time:* Sets the averaging time for the SO_2 sample measurement when in single gas mode.

- *Range Mode Selection:* User can choose between the various range modes: single, dual, or auto. For more information, see "Range Mode Selection" on page 3-66

- *Range Setting:* Sets the concentration range for the analog outputs when in single range mode.

- *High Range Setting:* Sets the high range concentration range for the analog output when in dual or auto range mode.

- *Low Range Setting:* Sets the low range concentration for the analog output when in dual or auto range mode.

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

- *Gas Units:* Defines the units in which SO_2 concentration reading is expressed.

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

- *Advanced Measurement Settings:* Advanced settings affecting SO_2 readings.

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

Averaging Time defines the time period (1 to 300 seconds) during which SO_2 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 second if averaging time is greater than 1 second. An averaging time of 10 seconds, for example, means that the average concentration of the last 10 seconds will be displayed at each update. An averaging time of 300 seconds means that the moving average concentration of the last 300 seconds will be the output at each update (every 10 seconds). 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. The instrument 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)

Dynamic Filtering
Disabled

Averaging Time
300 seconds
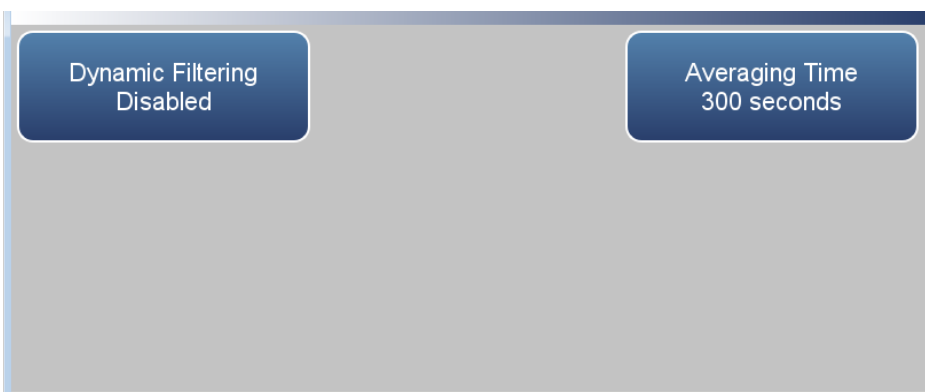
Home Screen>Settings>Measurement Settings>Averaging Time (dual or auto range mode)
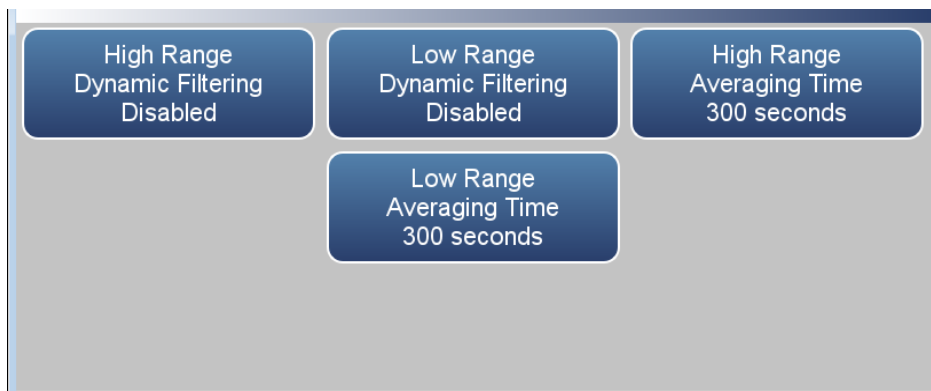
The Averaging Time screen contains the following information:

- *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 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 low 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
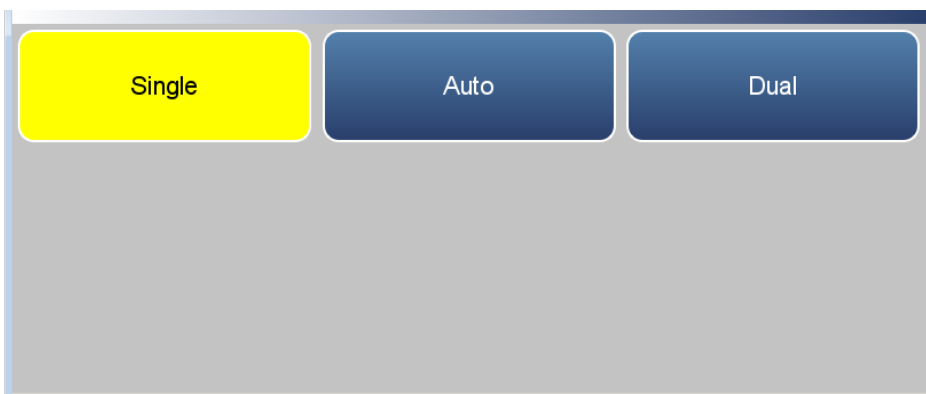
The Range Mode Selection screen contains the following information:

● *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 SO_2 analog output can be set to output concentrations from 0 to 50 ppb and the high SO_2 analog output set to output concentrations from 0 to 100 ppb.

In addition, each SO_2 analog output has a span coefficient 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 SO_2 range is set to 0–50 ppb and the high SO_2 range is set to 0–10000 ppb.

● *Auto:* The auto range mode switches the SO_2 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 concentration must drop to 95% of the low SO_2 range for the low range to become active.

In addition, each SO_2 range and analog output has a span coefficient 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 SO_2 range is set to 0–50 ppb and the high SO_2 range is set to 0–10000 ppb.
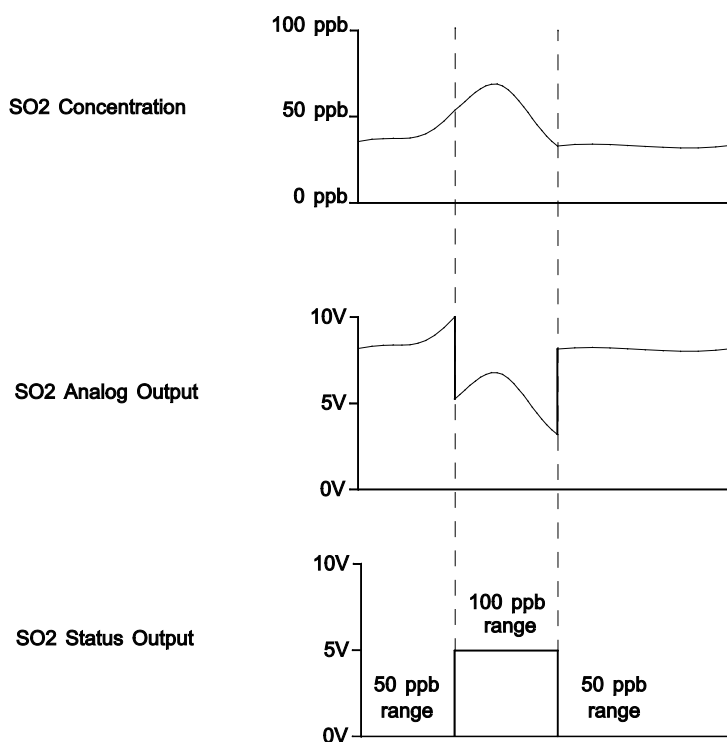
Range Setting   The Range Setting screen defines the concentration range of the analog outputs. For example, an SO_2 range of 0–50 ppb restricts the analog output to concentrations between 0 and 50 ppb.

The screen shows the current SO_2 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 3-66. Pressing Range Setting, High Range Setting or Low Range Setting, brings up a numeric keypad whereby the user can select a range.

Settable standard ranges according to unit selection include:

ppb	50–10000 ppb
ppm	0.05–10 ppm
%	5e-06–0.001 %
$\mu g/m^3$	200–25000 $\mu g/m^3$
mg/m^3	0.2–25 mg/m^3
g/m^3	0.0002–0.01 g/m^3

Settable extended ranges according to unit selection include:

ppb	50–100000 ppb
ppm	0.05–100 ppm
%	5e-06–0.01 %
$\mu g/m^3$	200–250000 $\mu g/m^3$
mg/m^3	0.2–250 mg/m^3
g/m^3	0.0002–0.25 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
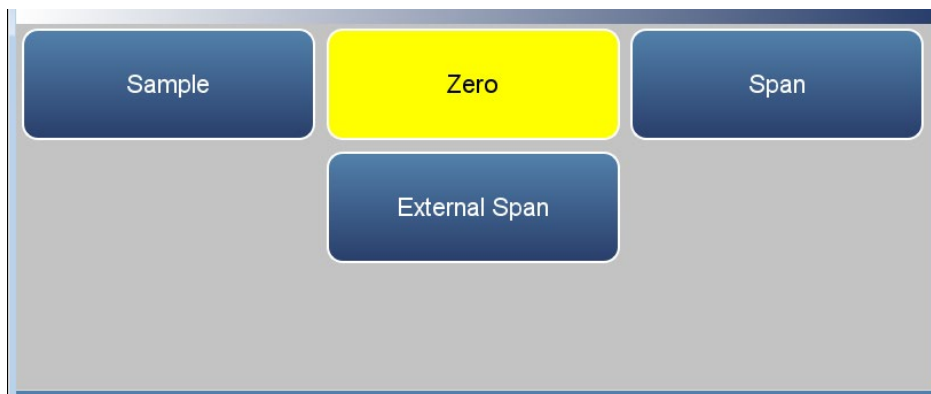
The Gas Mode screen contains the following information:

● *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.

● *External Span:* If optional perm oven is installed, allows the use of an external span source in addition to the internal permeation span.

Gas Units   The Gas Units screen defines how the SO_2 concentration reading is expressed. The $\mu g/m^3$, mg/m^3, and g/m^3 gas concentration modes are calculated using a standard pressure of 760 mmHg and a standard temperature of 0 °C. The temperature can be changed in the compensation screen.

Use the ▲ and ▼ buttons to select.

Home Screen>Settings>Measurement Settings>Gas Units
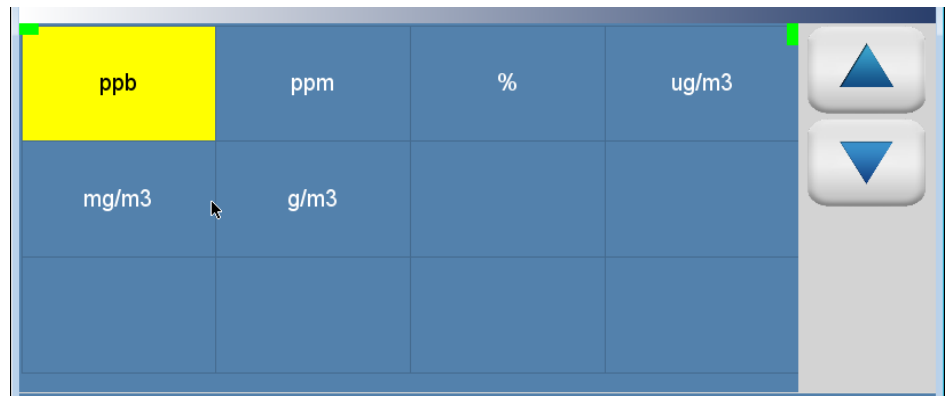
The Gas Units screen contains the following information:

● *ppb:* parts per billion.

● *ppm:* parts per million.

● *%:* percent.

● *µg/m3:* micrograms per meter cubed.

● *mg/m3:* milligrams per meter cubed.

● *g/m3:* grams per meter cubed.

Advanced Measurement Settings

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

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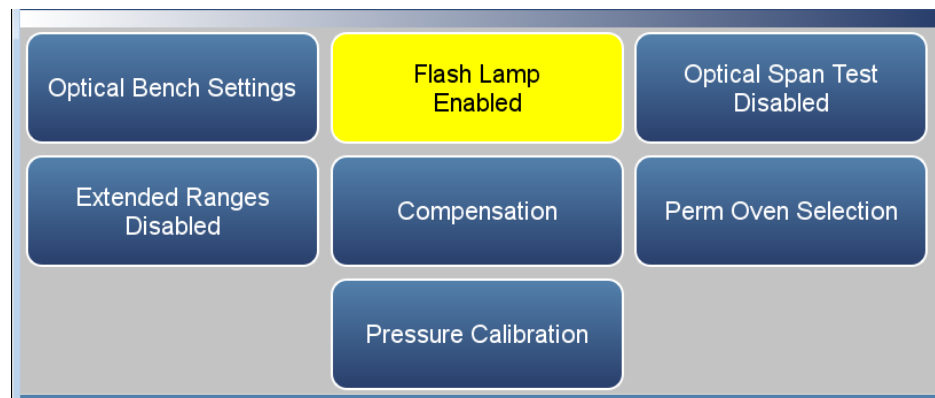
The Advanced Measurements Settings screen contains the following information:

● *Optical Bench Settings:* Calibrates detector gain, PMT supply, flash voltage, and initial flash reference.

● *Flash Lamp:* Enables/Disables flash lamp.

● *Optical Span Test:* Enables/Disables test LED and reads the LED SO_2 concentration.

● *Extended Ranges:* Enables/Disables extended ranges feature. When changing to extended range from standard range, the PMP voltage must be readjusted. For more information on readjusting the PMT voltage, go to Settings>Measurement Settings>Advanced Measurement Settings>Optical Bench Settings>**Continue to PMT Settings**.

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

● *Perm Oven Selection:* Allows the user to select the operating temperature of the perm oven.

● *Pressure Calibration:* Calibrates pressure.

Optical Bench Settings

The Optical Bench Settings screen allows the user to calibrate the optical bench. The calibration in this screen should be performed if the part associated with the optical bench has been changed/repaired or if the span coefficient is outside the limit of 0.5 to 2.0.

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>Optical Bench Settings

Auto Calibrations can take up to 10 minutes, please wait until the selected button on the concentration screen is no longer highlighted before proceeding. Moving to another screen or pressing 'Stop' in the middle of a calibration will prematurely end the calibration

| Continue To Detector Gain Settings Screen | Continue To PMT Settings Screen | Return To Previous Screen |
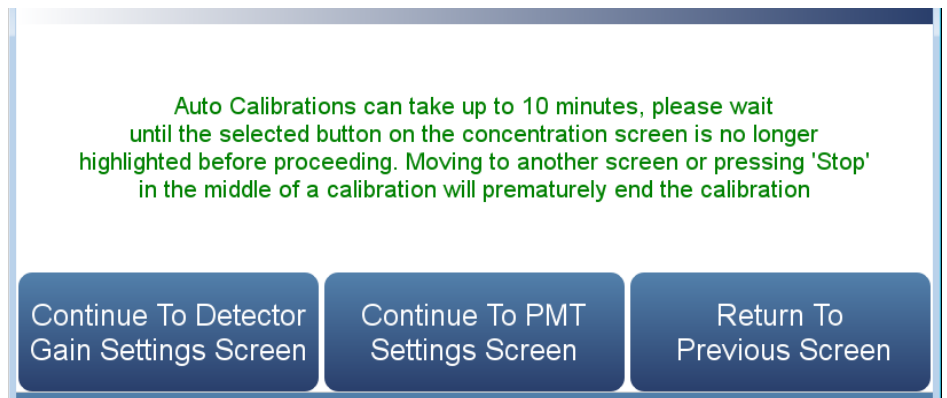
Home Screen>Settings>Measurement Settings>Advanced Measurement Settings>Optical Bench Settings>Continue To Detector Gain Settings Screen

Description	Detector Gain	Lamp Voltage	Lamp Intensity		
Manual Entry	39	0.0	0.0		
Auto Cal	Start				
End Cal	Stop				
Default Values	Default Gain				

The Detector Gain Settings screen contains the following information:

● Across:

  ● *Description:* Define the actions the user can do.

  ● *Detector Gain:* User can manually set or automatically calibrate the detector gain.

- *Lamp Voltage:* Displays the current lamp voltage.

- *Lamp Intensity:* Displays the current lamp intensity.

● Down:

  - *Manual Entry:* Shows current value. If pressed, user can manually set the detector gain value.

  - *Auto Cal:* When pressed, the detector's auto-calibration process is initiated. Please allow up to 5 minutes for calibration to complete. User can stop calibration by pressing the Stop button under Detector Gain.

  - *End Cal:* When pressed, the auto calibration is interrupted and the value does not change.

  - *Default Values:* When pressed, the default gain for the lamp intensity detector is restored.

Home Screen>Settings>Measurement Settings>Advanced Measurement Settings>Optical Bench Settings>Continue To PMT Settings Screen

Description	PMT Supply	Current PMT	Units		
Manual PMT Entry	-606.0	-606.8	V		
Target Concentration	0.0				
Calibration Concentration	3193.8				
Auto Calibration	Start				
End Calibration	Stop				
Default Values	Default PMT Supply				

The PMT Settings screen contains the following information:

● Across:

  - *Description:* Defines the actions the user can do.

  - *PMT Supply:* User can manually adjust the PMT supply value, read target and 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.

  - *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.

  - *End Calibration:* When pressed, the auto calibration is interrupted and the value does not change.

  - *Default Values:* When pressed, the default PMT voltage setting is restored.

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
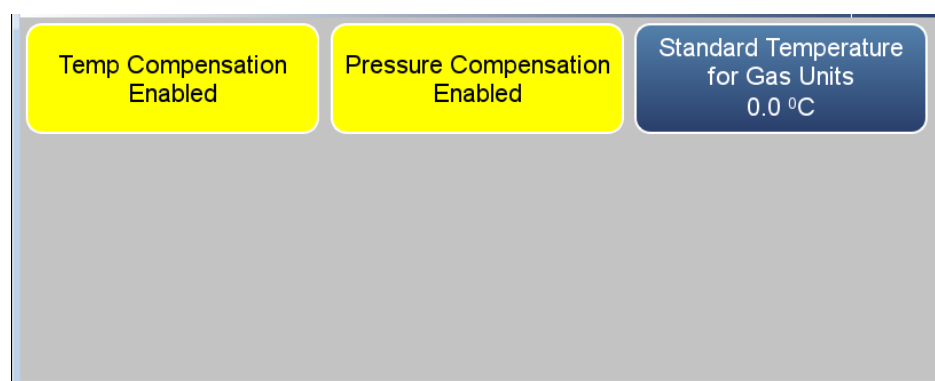
The Compensation screen contains the following information:
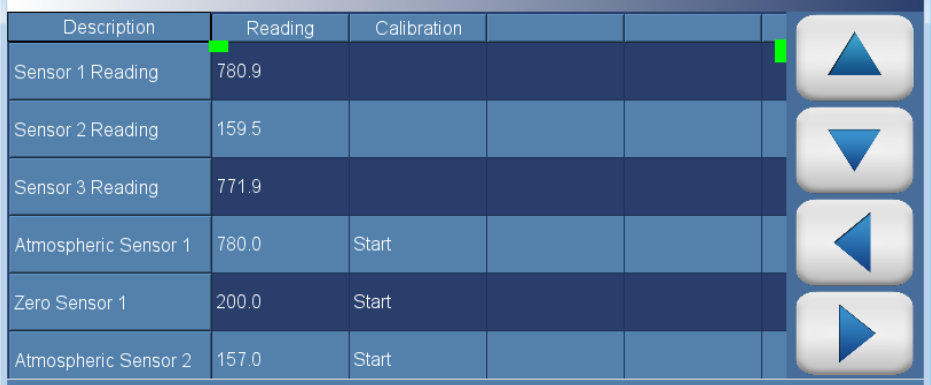
● *Temp Compensation:* Toggles temperature compensation enabled or disabled and provides compensation for any changes to the instrument's output signal due to internal instrument temperature variations. The effects of internal instrument temperature changes on the analyzer's subsystems and output have 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	780.9				
Sensor 2 Reading	159.5				
Sensor 3 Reading	771.9				
Atmospheric Sensor 1	780.0	Start			
Zero Sensor 1	200.0	Start			
Atmospheric Sensor 2	157.0	Start			

The Pressure Calibration screen contains the following information:

● Across:

  ● *Description:* Lists items in table.

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

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

● Down:

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

  ● *Atmospheric Sensor 1–3:* Under the column labeled reading, the user enters the current atmospheric pressure in mmHg units. Under the column labelled Calibration, the user presses the Start button to calibrate the high point of the sensor.

  ● *Zero Sensor 1–3:* User should put the pressure sensor under a strong vacuum. Under the column labeled reading, the user enters the pressure in mmHg. Under the column labeled Calibration, the user presses the Start button to calibrate the low point of the sensor.

  ● *Reset all values:* Resets values to default.

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

Home Screen>Settings>Communications

The Communications screen contains the following information:

● *Wired TCP/DHCP:* Settings for communicating with the instrument through wired Ethernet.

● *Serial RS-232/485:* Settings for communicating with the instrument through RS-232/485 protocol. This is only visible if selected in Settings>Configuration>Communications Board.

● *Analog I/O:* Settings for communicating with the instrument through analog I/O settings. This is only visible if selected in Settings>Configuration>Analog I/O.

● *Digital I/O:* Settings for communicating with the instrument through digital I/O settings. This is only visible if selected in Settings>Configuration>Digital I/O.

● *Email Server (SMTP):* Settings for communication with email.

● *Instrument ID:* Allows the user to edit the instrument identification number (ID). The ID is used to identify the instrument when using protocols to control the instrument or collect data. It may be necessary to edit the ID number if two or more of instruments of the same model are connected to one computer. Valid instrument ID numbers are from 0 to 127. The 43iQ 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.
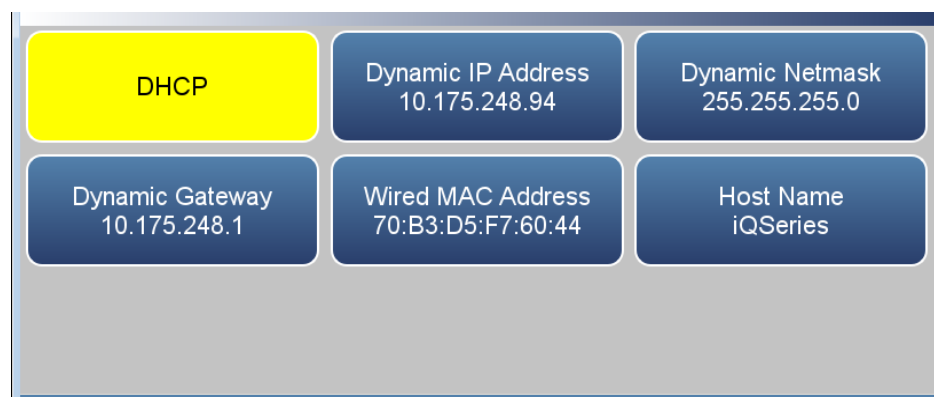
Note Refer to the "Bayern Hessen Protocol" section in the *Communications Manual* for a detailed description. ▲

● *Ethernet Protocol Selection:* Allows the user to enable Streaming, Modbus, or Bayern Hessen to utilize the mobile app and/or those communication protocols.
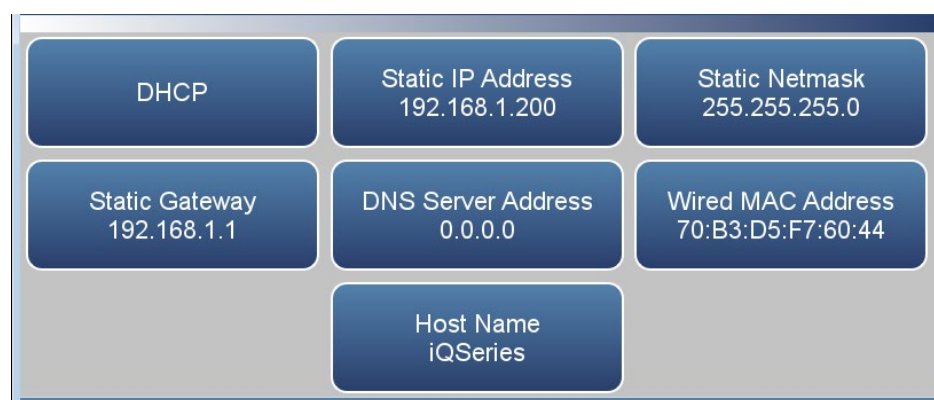
Wired TCP/DHCP The Wired TCP/DHCP screen allows the user to communicate with the instrument via wired TCP/IP settings.

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	Dynamic IP Address 10.175.248.94	Dynamic Netmask 255.255.255.0
Dynamic Gateway 10.175.248.1	Wired MAC Address 70:B3:D5:F7:60:44	Host Name iQSeries

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

| DHCP	Static IP Address 192.168.1.200	Static Netmask 255.255.255.0
Static Gateway 192.168.1.1	DNS Server Address 0.0.0.0	Wired MAC Address 70:B3:D5:F7:60:44
	Host Name iQSeries	

The Wired TCP/DHCP screen contains the following information:

● *DHCP:* Toggles DHCP enabled/disabled.

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

● *Dynamic Netmask:* Dynamic Netmask of instrument.

● *Dynamic Gateway:* Dynamic Gateway of instrument.

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

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

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

● *DNS Server Address:* DNS IP address of instrument. This is settable when DHCP is disabled.

● *Wired MAC Address:* Instrument MAC address.

● *Host Name:* Host name of instrument.

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

Home Screen>Settings>Communications>Serial RS-232/485
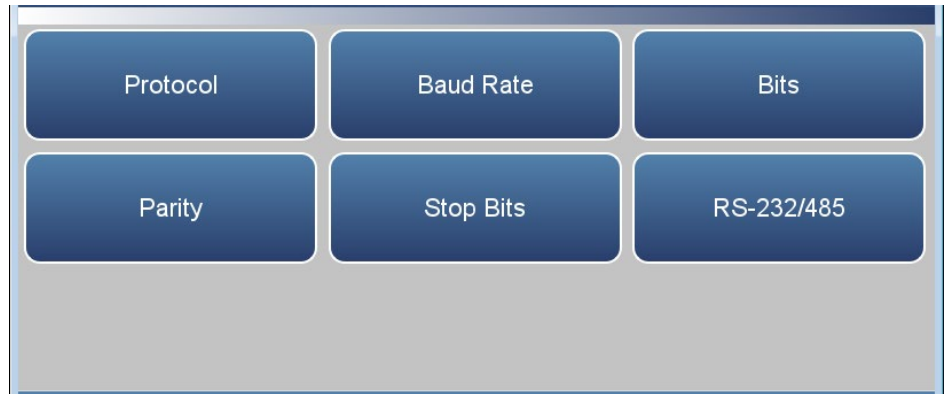
The Serial RS-232/485 screen contains the following information:

● *Protocol:* User selects Streaming, Modbus, or Bayern Hessen.

● *Baud Rate:* User selectable baud rates from 1200 to 115200.

● *Bits:* User selectable between 7 and 8.

● *Parity:* User selectable between None, Even, and Odd.

● *Stop Bits:* User selectable between 1 and 2.

● *RS 232/485:* User selectable between RS-232 and RS-485.

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

Home Screen>Settings>Communications>Analog I/O

Analog In	Analog Out (Voltage)	Analog Out (Current)
	Analog Out Under/Over Range Enabled	
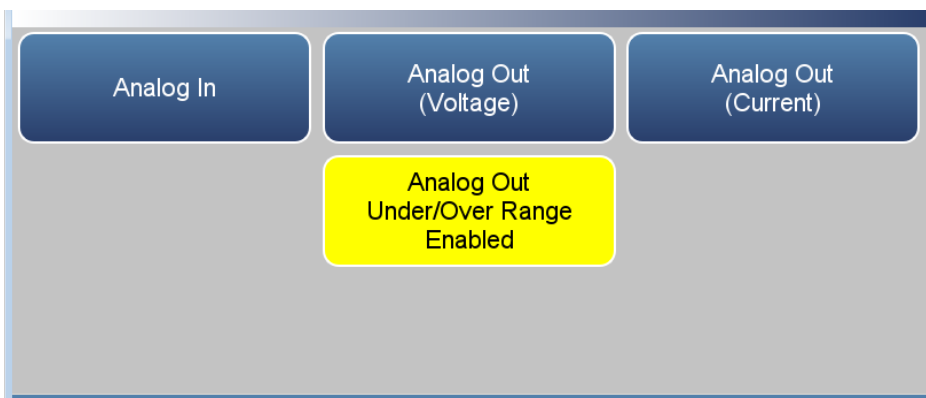
The Analog I/O screen contains the following information:

● *Analog In:* Allows the user to view and calibrate voltage inputs from external devices.

● *Analog Out (Voltage):* Allows the user to view voltage outputs from external devices.

● *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.

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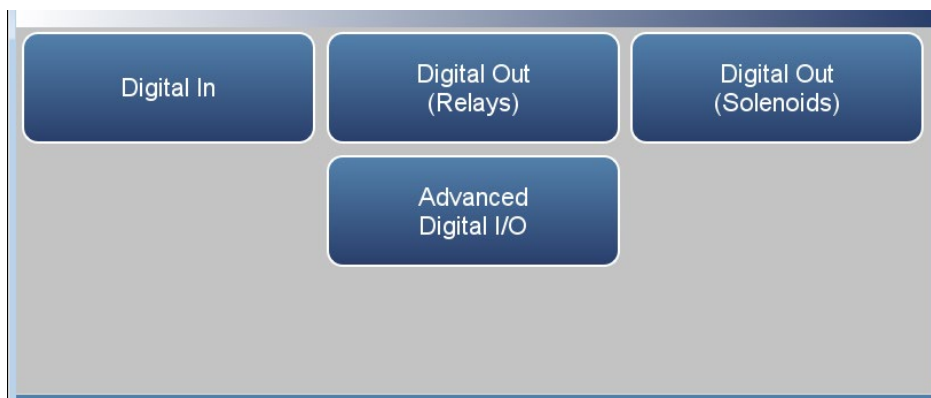
**Home Screen>Settings>Communications>Digital I/O**

The Digital I/O screen contains the following information:

● *Digital In:* Allows the user to view digital inputs from external devices.

● *Digital Out (Relays):* Allows the user to view relay outputs.

● *Digital Out (Solenoids):* Allows the user to view solenoid outputs.

● *Advanced Digital I/O:* Allows user to test the digital out relays and solenoids.

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

Home Screen>Settings>Communications>Email Server (SMTP)
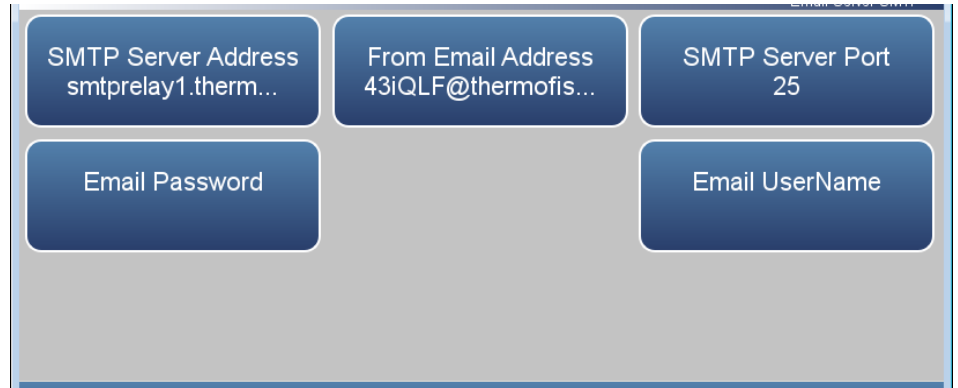
The Email Server (SMTP) screen contains the following information:

● *SMTP Server Address:* Address of the user's email server.

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

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

● *Email Password:* Password for SMTP server.

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

Bayern Hessen Settings   The Bayern Hessen Settings screen allows the user to select 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 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:

● Streaming

● Modbus

● Bayern Hessen

Instrument Settings

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

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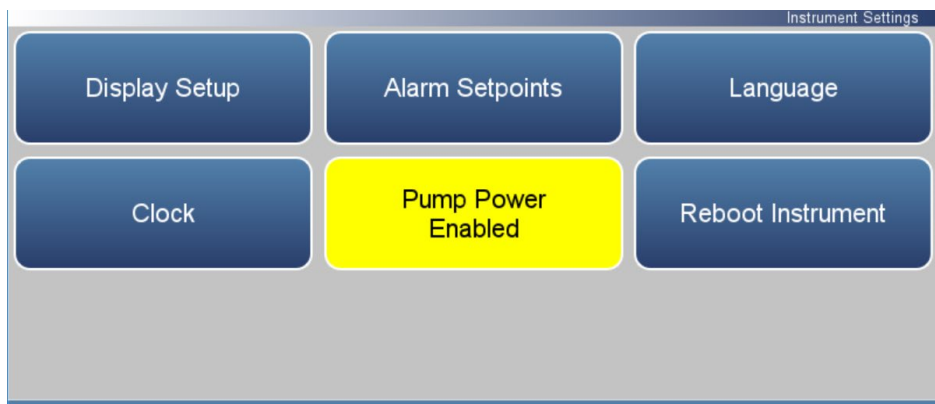
The Instrument Settings screen contains the following information:

● *Display Setup:* Sets touch screen display settings.

● *Alarm Setpoints:* View and set all available alarm minimum and maximum values.

● *Language:* Sets language.

● *Clock:* Sets date and time.

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

● *Reboot Instrument:* Reboots the instrument.

Display Setup

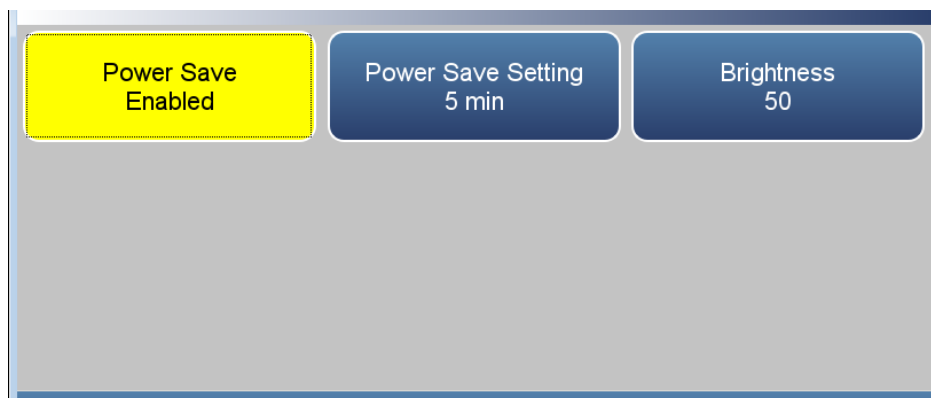The Display Setup allows the user to change the brightness of the display and choose power save option.

Home Screen>Settings>Instrument Settings>Display Setup

Power Save Enabled	Power Save Setting 5 min	Brightness 50

The Display Setup screen contains the following information:

● *Power Save:* Minutes before screen times out. Toggles enable/disable.

● *Power Save Setting:* Option whereby the user can display a black screen after a set amount of inactivity.

● *Brightness:* Sets the brightness of the display.

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

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 3-35. ▲

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

Home Screen>Settings>Instrument Settings>Alarm Setpoints

Variable	Value	Low Alarm	High Alarm	Units
SO2 Concentration	3200	0.0	0.0	ppb
Bkg Check Offset	0.0	--	0.0	ppb
Span Check Offset	0.0	--	0.0	ppb
Chamber Temperature	44.9	44.0	46.0	ºC
Lamp Intensity	0.0	90.0	105.0	%
Lamp Voltage	0.0	600.0	1400.0	V

The Alarm Setpoints screen contains the following information:

● Across:

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

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

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

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

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

● Down:

  ● *SO2 Concentration:* SO_2 concentration alarm.

  ● *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.

- *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.

- *Chamber Temperature:* Chamber temperature alarm.

- *Lamp Intensity:* Lamp intensity alarm.

- *Lamp Voltage:* Lamp voltage alarm.

- *Instrument Temperature:* Instrument temperature alarm.

- *Bench Pressure:* Bench pressure alarm.

- *Flow:* Flow pressure alarm.

- *Perm Oven Temperature:* Perm oven temperature alarm.

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

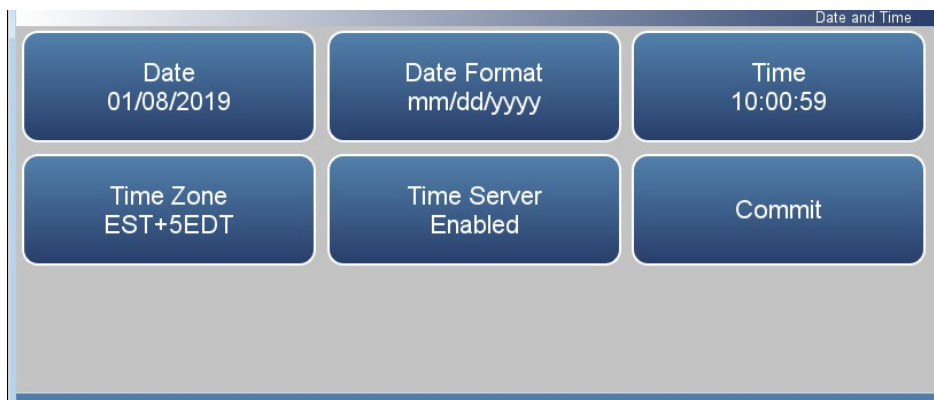**Home Screen>Settings>Instrument Settings>Language**

The Language screen contains the following information:

● English

● Chinese

● Spanish

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
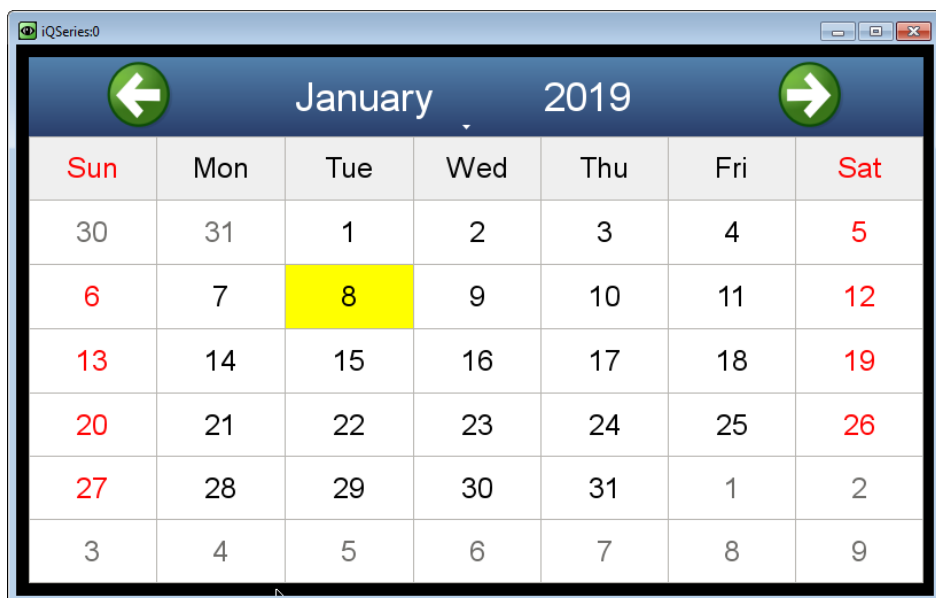

The Clock screen contains the following information:

●   *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.

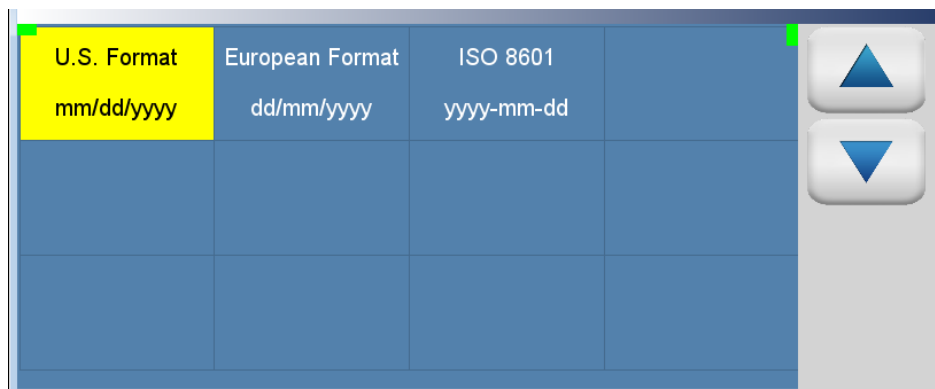**Home Screen>Settings>Instrument Settings>Clock>Date**

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
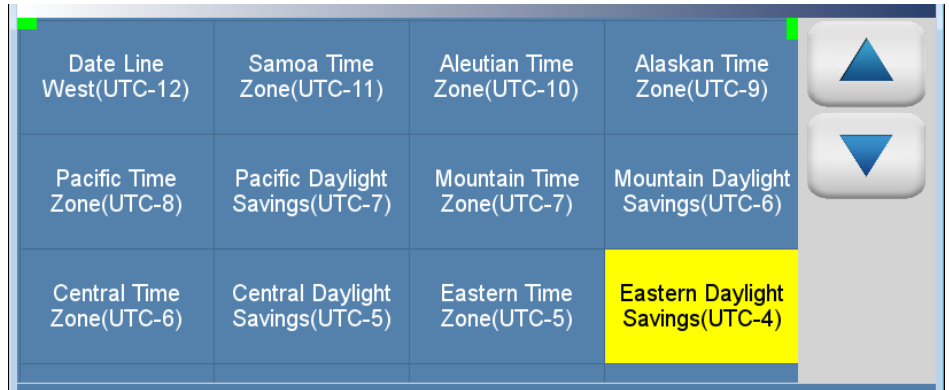
The Time Zone screen contains the following information:

- 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

| Time Server Enabled | Set Time Server pool.ntp.org | Set Default |

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.

Configuration

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

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

Home Screen>Settings>Configuration
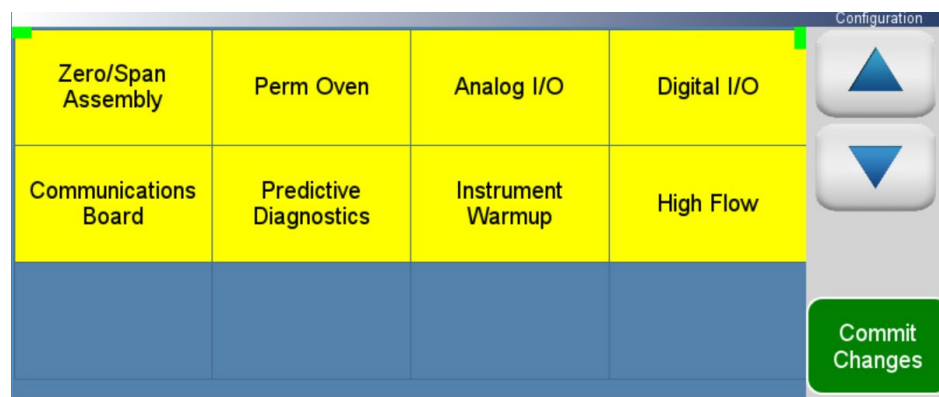
The Configuration screen contains the following information:

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

- *Perm Oven:* Enables permeation oven option.

- *Analog I/O:* Enables analog I/O option.

- *Digital I/O:* Enables digital I/O option.

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

- *Predictive Diagnostics:* Enables predictive diagnostics.

- *Instrument Warmup:* Enables instrument warm up option.

- *High Flow:* Switches between standard and high flow options.

Security Access Levels

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

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

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

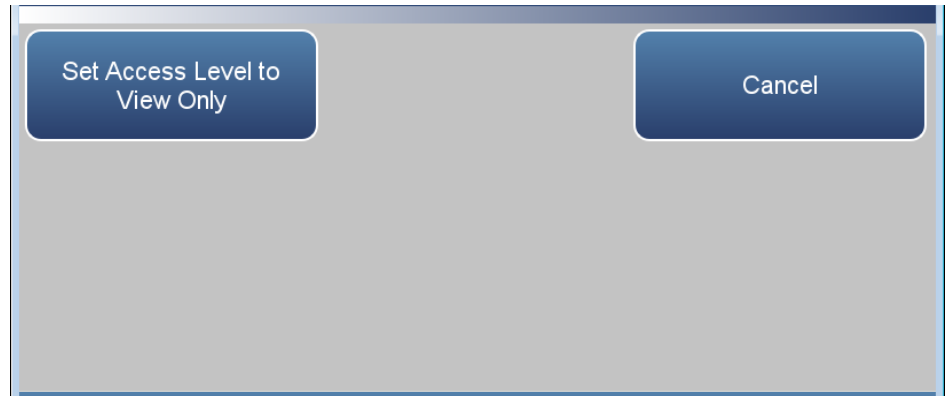The Security Access Levels screen contains the following information:

● *Current Security Access Full Access:* Read only. User will be able to change all values. Password is needed for full access.

● *Current Security Access View Only:* Read only. User won't be able to change any values. Password is not needed for view only.

● *Change Security Access to View Only:* User can switch to view only mode. Password not needed to change settings to view only access.

● *Change Security Access to Full Access:* User can switch to full access mode. Password is needed to change settings to full access.

- *Change Full Access Security Password:* Full access password can have a blank value or user selected password.

- *Change 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
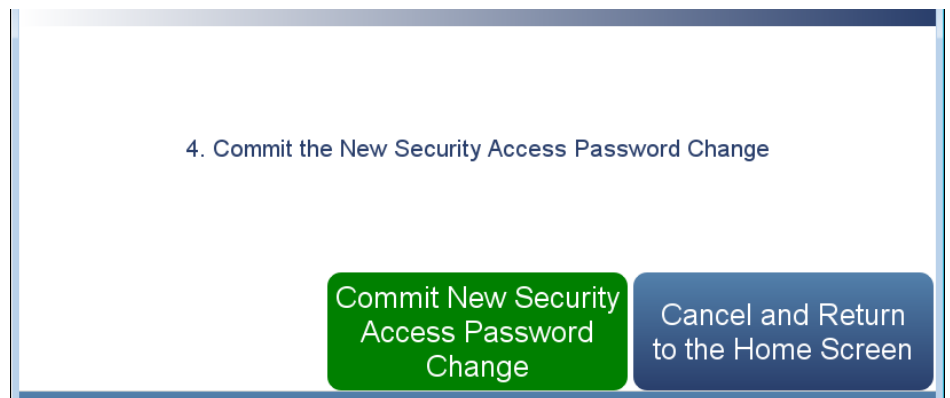
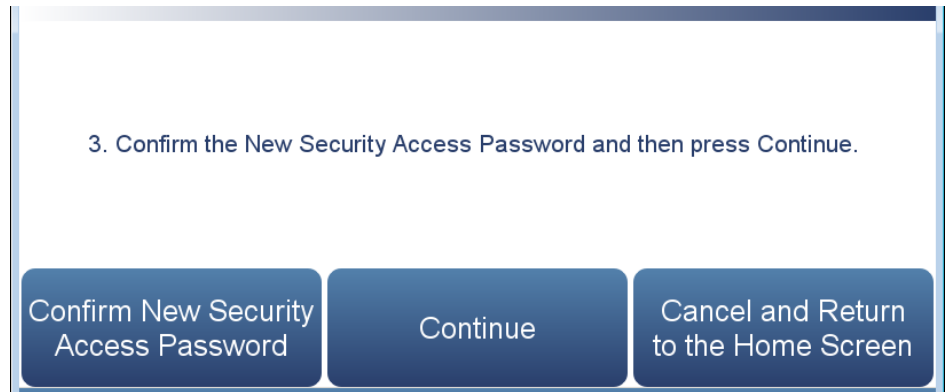Security Access Levels

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

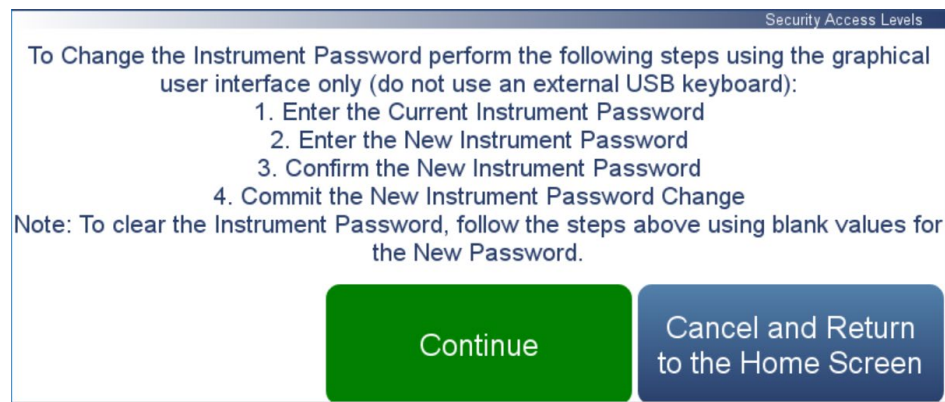| Commit New Security Access Password Change | Cancel and Return to the Home Screen |

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.

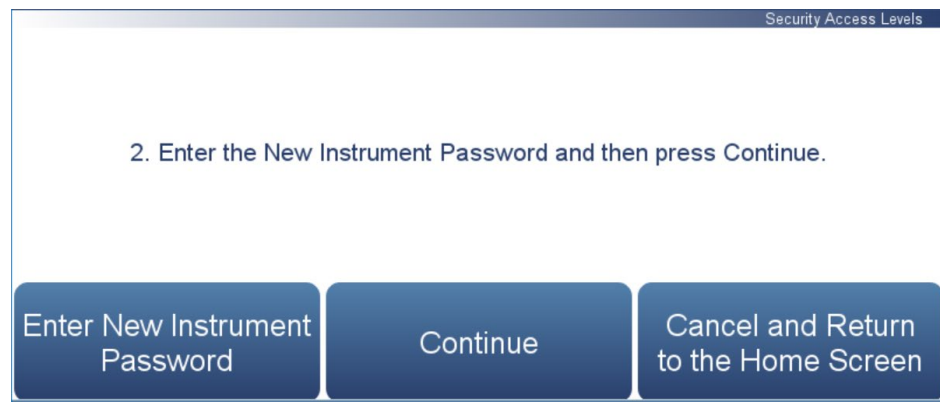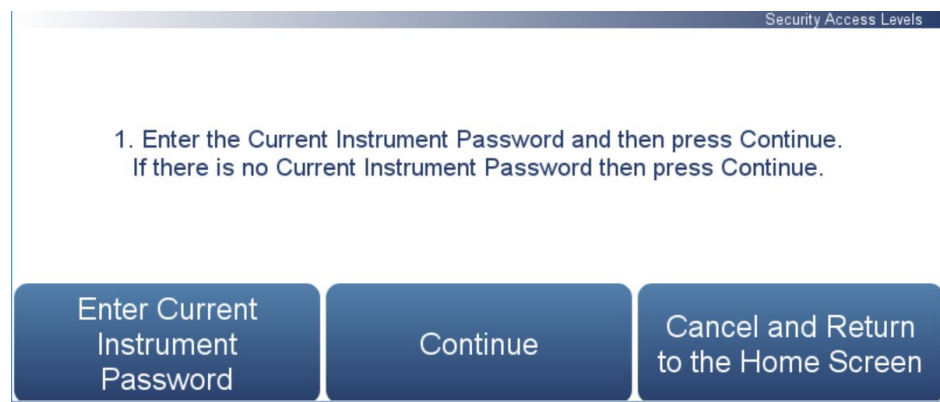● *Cancel and Return to the Home Screen:* Exits screen and returns to the Home Screen without changing password.
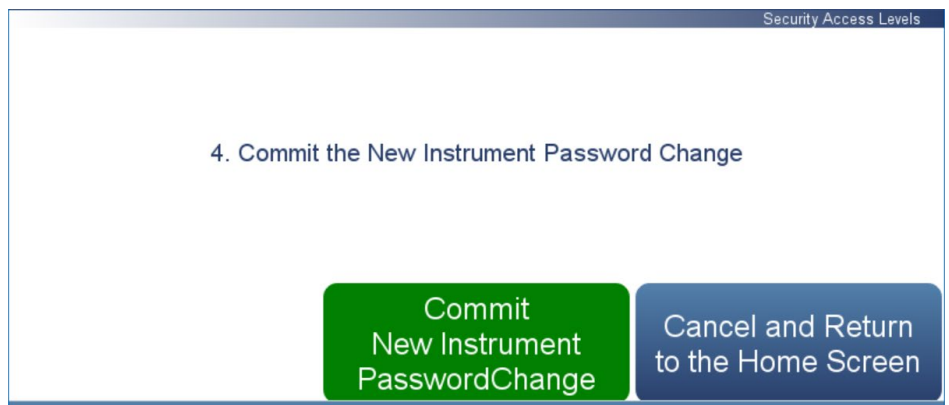
Change Instrument Password

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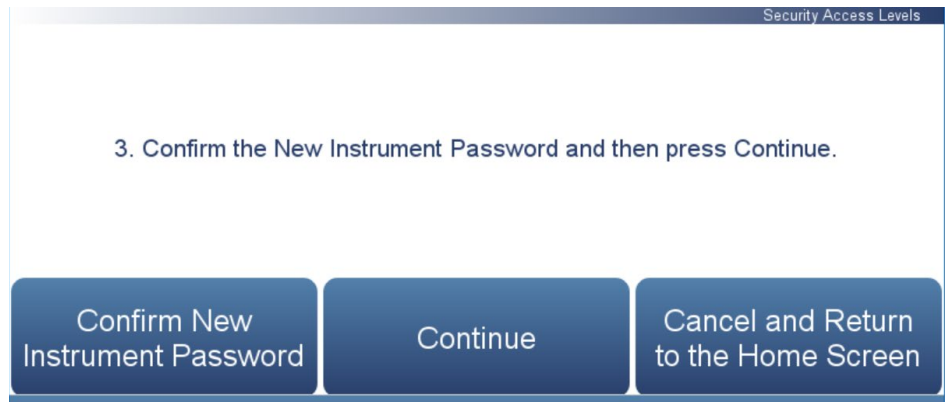
The Reset Instrument Password screen allows the user to reset the instrument password for Database, SNMP, and VNC.

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.

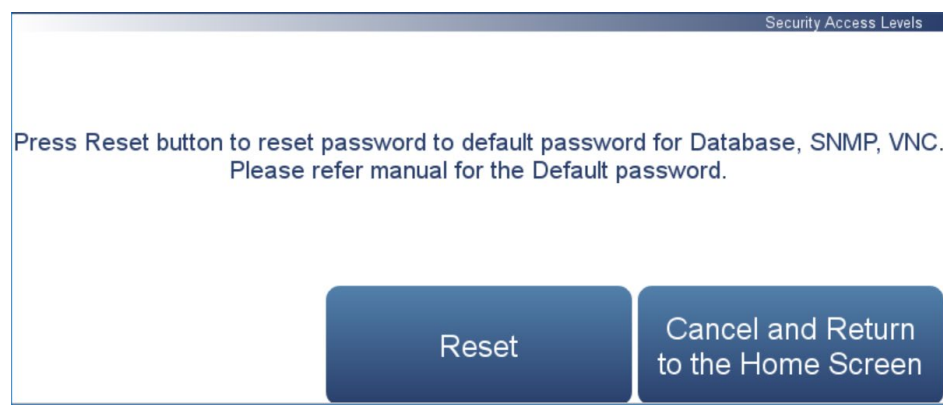● *Cancel and Return to the Home Screen:* Exits screen and returns to the Home Screen without changing password.

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

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

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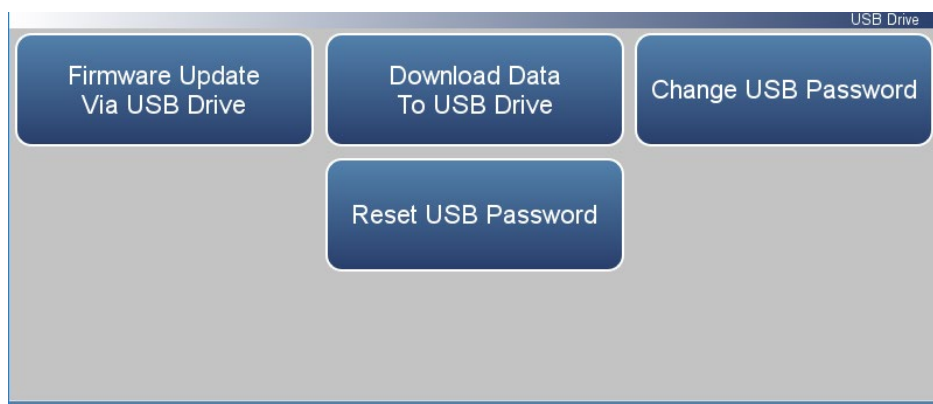
The USB Drive screen contains the following information:

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

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

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

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

Firmware Update Via USB Drive

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

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

New firmware update is available.
Would you like to update?

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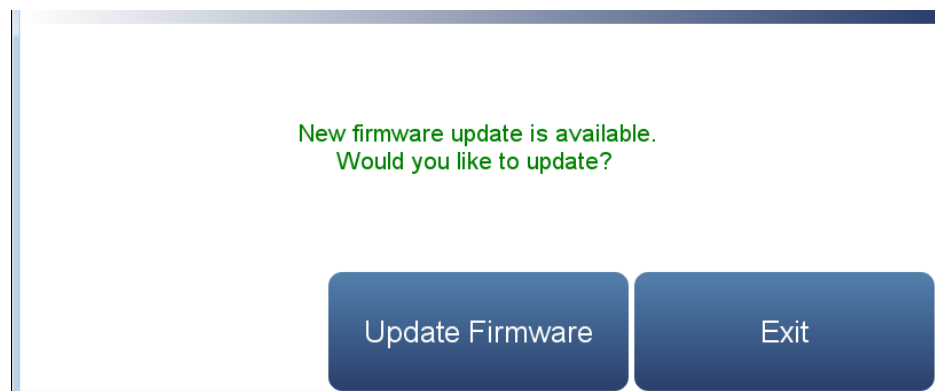
The Firmware Update Via USB Drive screen contains the following information:

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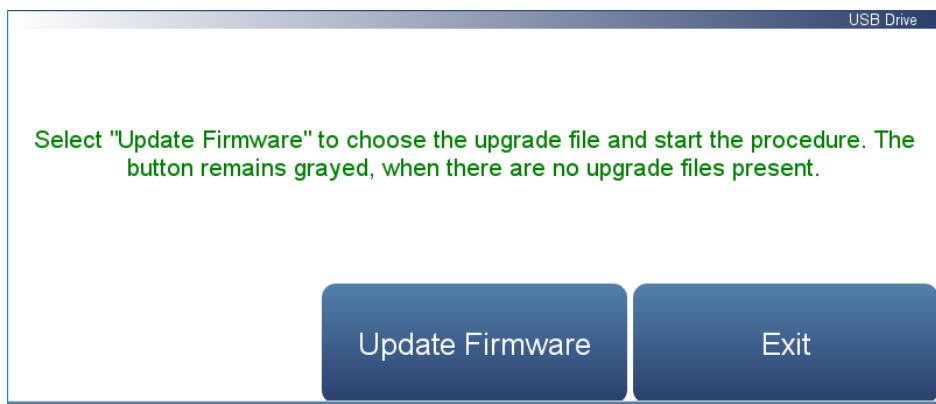
6. The on-screen instructions will prompt the user to select the firmware update file and display what it is doing at each step and some steps may take several minutes to complete.

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.
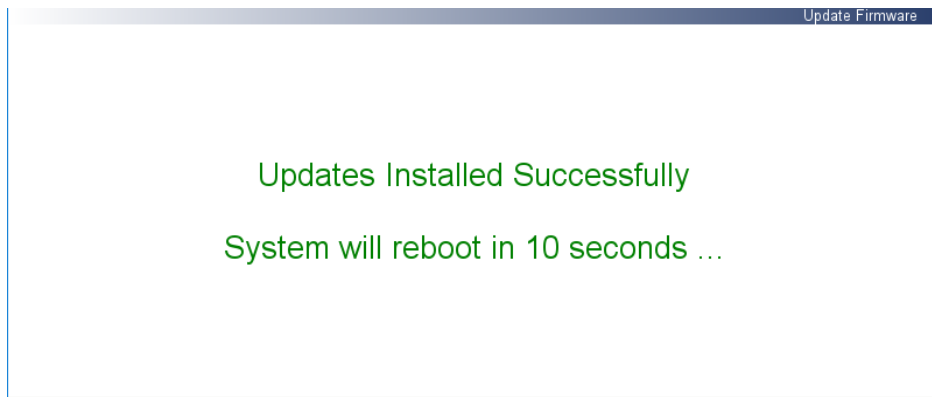
Download Data To USB Drive

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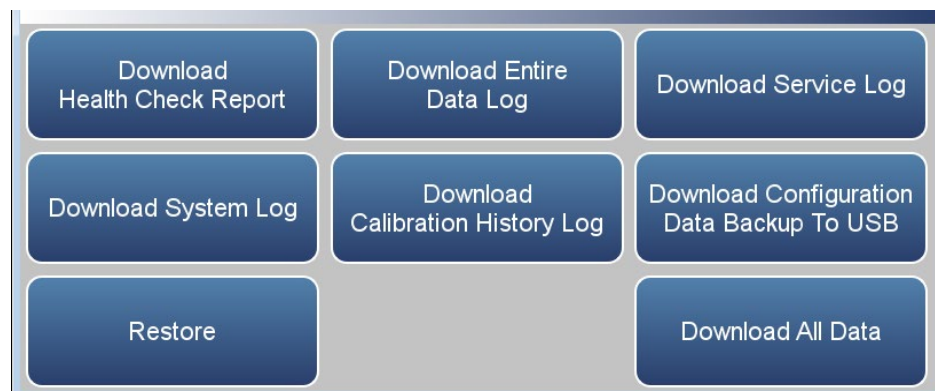
The Download Data to USB Drive screen contains the following information:

● *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.

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

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

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

1. Plug a 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**.

USB Drive

| Firmware Update Via USB Drive | Download Data To USB Drive | Change USB Password |

| Reset USB Password |

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

| Download Health Check Report | Download Entire Data Log | Download Service Log |

| Download System Log | Download Calibration History Log | Download Configuration Data Backup To USB |

| Restore | | Download All Data |
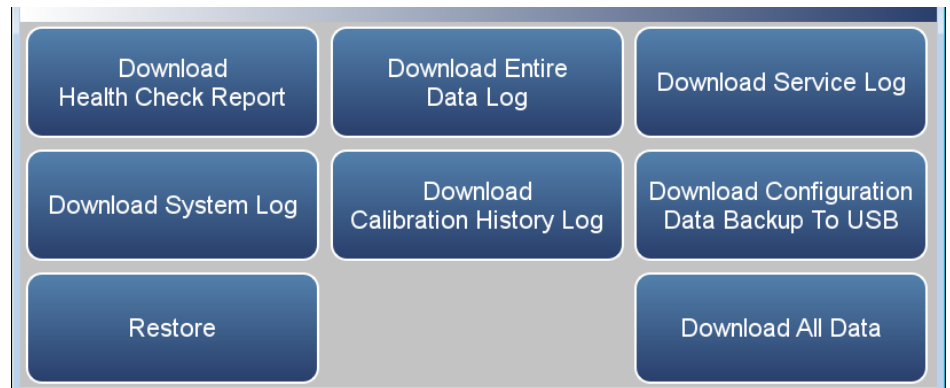
5. The instrument will display a "downloading data" message and begin transferring data to the USB drive.

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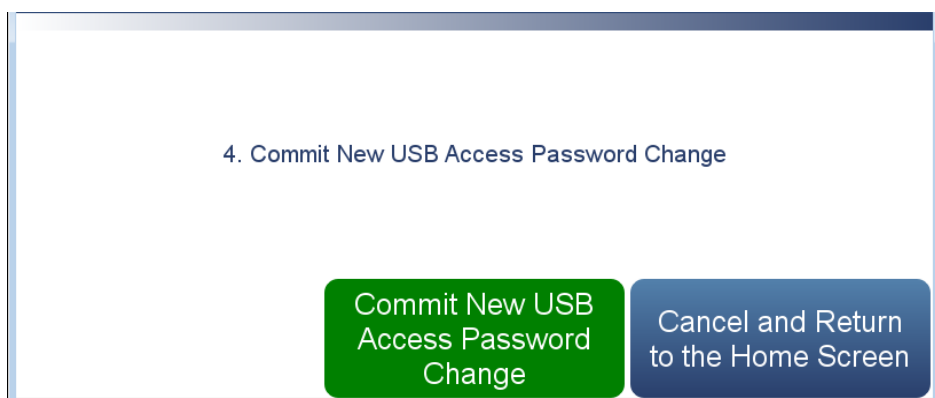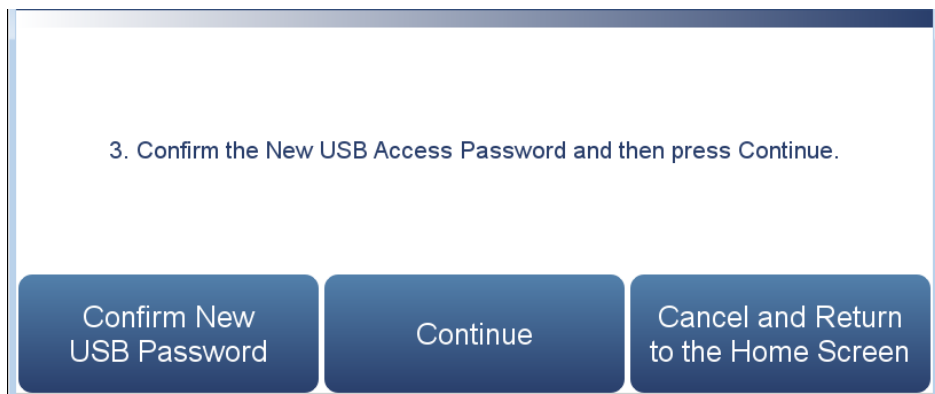> **Enter Current USB Password**   **Continue**   **Cancel and Return to the Home Screen**

> 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

USB Drive

Press Reset button to reset USB password to default password.
Please refer manual for the Default password.

Reset

Cancel and Return to the Home Screen
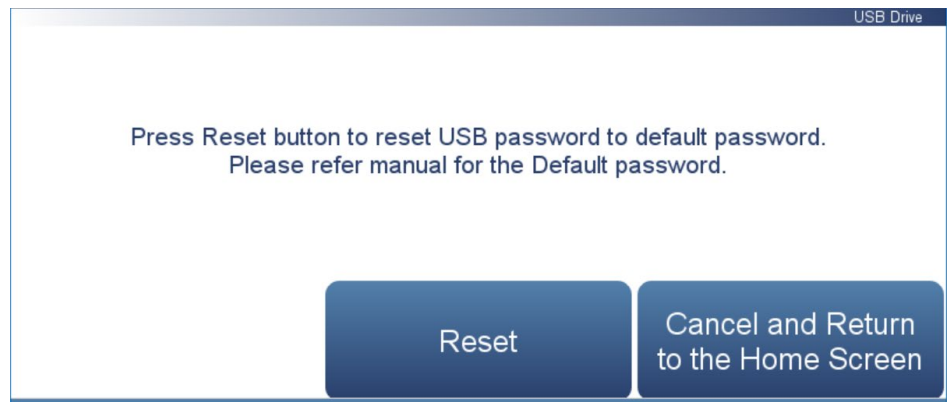
The Reset USB Password screen contains the following information:

● *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.

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		
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
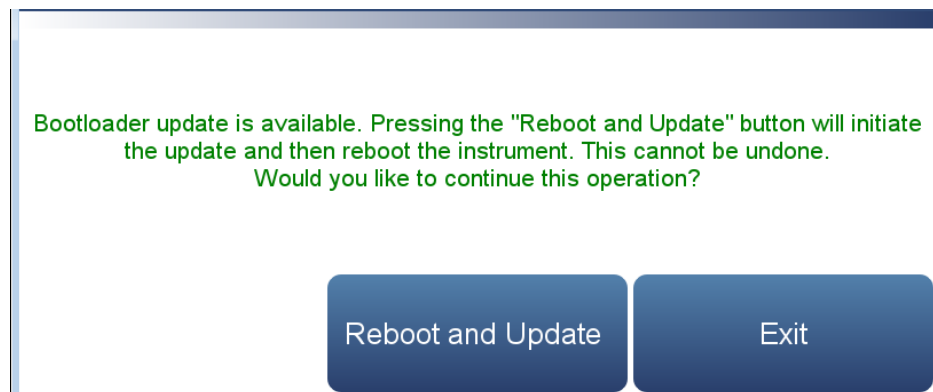
The Update Bootloader screen contains the following information:

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

Chapter 4
Calibration

This chapter describes the procedures for calibrating the analyzer and describes the required equipment.

The 43iQ 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 30 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.

Equipment Required

The following equipment is required to calibrate the instrument:

- Zero air
- Calibration gas

Note In order to reduce the possibility of interferences during calibration, all zero gas supplied to the instrument during calibrations should use air as the zero gas and not nitrogen. The same recommendation also applies to span gases supplied, where the calibration gas is supplied with a known SO_2 concentration with the balance of gas as air and not nitrogen. ▲

Zero Air Generation

An SO$_2$-free (< 0.0005 ppb) air supply is required for the proper calibration and checkout of the instrument. There are several methods that are acceptable to generate this zero air.

Commercial Heatless Air Dryers

Commercial heatless air dryers filled with a mixed bed of activated charcoal and a 13X molecular sieve have been found effective in removing SO$_2$ from compressed air. The use of this type of zero gas system is recommended when minimum maintenance is of prime importance. This system requires a source of compressed air. Refer to the manufacturer's recommendations for installation of such a system.

Absorbing Column

An absorbing column packed with activated charcoal is acceptable for scrubbing SO$_2$ from ambient air. Ambient air is forced through a laboratory gas absorption column packed with the charcoal and the SO$_2$ is removed to acceptable levels (<0.0005 ppb). The charcoal should be changed at a minimum of every six months. It may be necessary to change the charcoal more frequently depending on local conditions.

SO$_2$ Concentration Standard

A cylinder of SO$_2$ in air containing an appropriate concentration of SO$_2$ suitable for the selected operating range of the analyzer under calibration is necessary. The assay of the cylinder must be traceable either to a National Institute of Standards and Technology (NIST) SO$_2$ in Air Standard Reference Material (SRM) or an NIST/EPA approved gas manufacturer's Certified Reference Material (CRM).

A recommended protocol for certifying SO$_2$ gas cylinders against a SO$_2$, SRM or CRM is given in the *Quality Assurance Handbook*[1]. The SO$_2$ gas cylinder should be recertified on a regular basis determined by the local quality control program.

Calibration Gas Generation

A calibration gas system capable of providing accurate levels of SO$_2$ calibration gas between zero and 80% of the full-scale range is required. The calibration system must provide a flow rate of at least 0.5 LPM for an instrument with the standard flow (instruments with higher flow rates will require a higher minimum calibration system flow rate). All calibration gas should be derived from local or working standards (such as cylinders of compressed gas or permeation devices) that are certified as traceable to an NIST primary standard.

Cylinder Gas Dilution

A cylinder gas dilution system, shown in Figure 4–1, can be constructed. All connections between components in the system should be made with glass, SS, PTFE or other non-reactive material.

The air flow controller should be capable of maintaining a constant air flow within ±2% of the required flow rate. The SO_2 flow controller should be capable of maintaining constant SO_2 flows within ±2% of the required flow rate. Ensure both flow controllers are properly calibrated. The pressure regulator for the standard SO_2 cylinder must have a non-reactive diaphragm and internal parts and a suitable delivery pressure.

External Flow Meter(s) and Controller(s)

In order to obtain an accurate dilution ratio in the dilution method used for calibration, the flow rates must be regulated to 1%, and be measured to an accuracy of at least 2%. The meter and controller can be two separate devices, or combined in one device. The user's manual for the meter should be consulted for calibration information.

Additional information on the calibration of flow devices can be found in the *Quality Assurance Handbook*[1]. It should be noted that all flows should be corrected to 25 °C and 760 mmHg, and that care should be exercised in correcting for water vapor content.
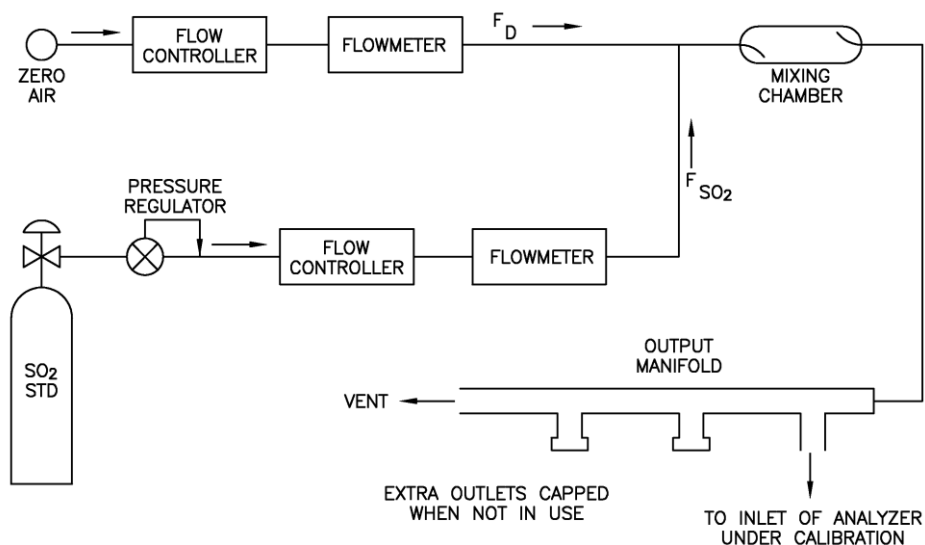

Figure 4–1. Cylinder Gas Dilution System

The exact SO_2 concentration is calculated from:

$$[SO_2]_{OUT} = \frac{[SO_2]_{STD} \, x \, F_{SO_2}}{F_D + F_{SO_2}}$$

Where:

$[SO_2]_{OUT}$ = diluted SO_2 concentration at the output manifold, ppm

$[SO_2]_{STD}$ = concentration of the undiluted SO_2 standard, ppm

F_{SO2} = flow rate of the SO_2 standard corrected to 25 °C and 760 mm Hg

F_D = flow rate of the dilution air corrected to 25 °C and 760 mm Hg

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 (50 ppm) of SO_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.
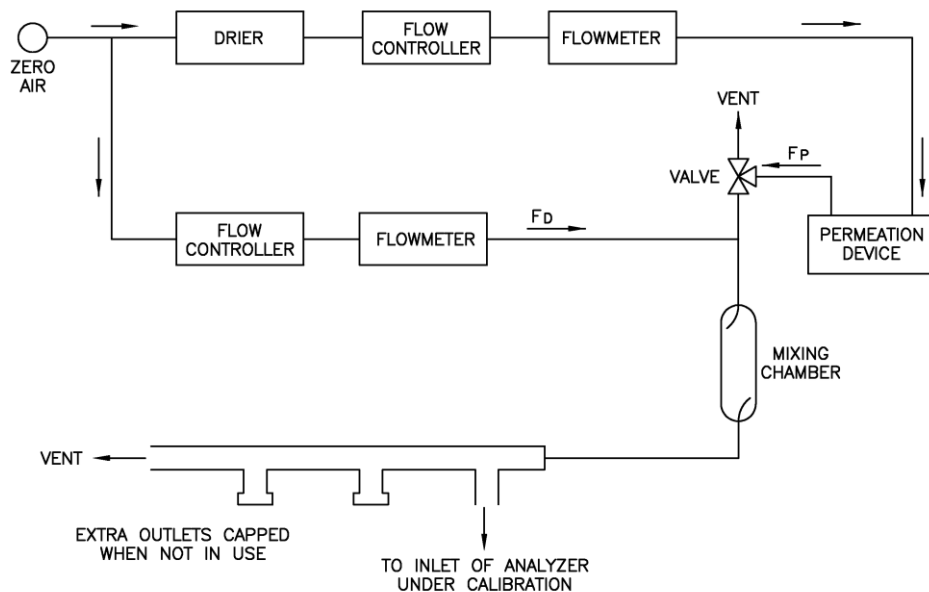
Figure 4–2. Permeation Tube System

The SO$_2$ output level is calculated from:

$$[SO_2]_{OUT} = \frac{P \times K}{F_T}$$

Where:

[SO$_2$]$_{OUT}$ = SO$_2$ 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 (SO$_2$) = 0.382 constant for SO$_2$ permeant

Commercial Permeation Systems

Commercial permeation systems, such as the Thermo Scientific 146iQ Multigas Calibration System, are available for this requirement. Refer to the instrument instruction manual for more information.

In addition to the 146iQ and other commercial permeation systems, the 43iQ can also be configured with an optional permeation oven to supply calibration gas for the instrument. The operation of the internal permeation oven is described in Chapter 9, "Optional Equipment".

Calibration

Regulations typically require zero/span calibration when the instrument is newly installed, moved, repaired, interrupted for more than a few days, or when span or zero shift by more than 15%.

All gas must be supplied to the instrument at atmospheric pressure. It may be necessary to employ an atmospheric bypass plumbing arrangement to accomplish this. Refer to Figure 2–6 in the "Installation and Setup" chapter for an example of an atmospheric bypass plumbing arrangement.

If a filter is used, all gas must enter the instrument through the filter.

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. ▲

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. ▲

Use the following procedure to perform a zero/span calibration.

1. If the instrument is equipped with the optional zero/span and sample valves, connect the zero and span gas to the rear panel bulkheads labeled ZERO IN and SPAN, otherwise connect a source of vented zero air to the SAMPLE bulkhead. The top right of the title bar indicates which mode is active: ZERO, SPAN, or SAMPLE.

Note Do not use nitrogen for zero air. ▲

2. To ensure that the zero air is being measured at atmospheric pressure, check that the zero air flow reported by the analyzer is approximately 0.5 LPM. Actual zero air flow should be 0.8 LPM or more, with the excess flowing out the atmospheric bypass.

   a. From the Home screen choose **Settings>Health Check>Status and Alarms>Flow and Pressure**.

   b. Make sure that the reported sample flow is less than the actual zero air flow.

3. Monitor the zero air reading and wait for the reading to stabilize.

4. From the Home Screen, press Calibration>**Calibrate Background**.

   The Target Concentration button will read 0.00. The Calculated Background button will display the background needed to make the current SO_2 concentration go to 0.00.

5. Press **Calibrate** to set the SO_2 reading to zero and to save the new background.

6. Connect a source of calibration gas to the SAMPLE bulkhead. The calibration gas concentration should be approximately 80% of the full-scale range.

7. To ensure that the calibration gas is being measured at atmospheric pressure, check that the sample flow in the analyzer is approximately 0.5 LPM. Actual sample air flow should be 0.8 LPM or more, with the excess flowing out the atmospheric bypass.

8. Sample the vented calibration gas and wait for the instrument reading to stabilize.

9. From the Home Screen, choose Calibration>**Calibrate Span Coefficient**.

   The user sets the span concentration by pressing the Edit Span Concentration button. The Calculated 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 coefficient and calibrate the instrument.

10. Enter the SO_2 calibration gas concentration using the pushbuttons, and then press **Calibrate** to calibrate the instrument to the SO_2 calibration gas.

Note The minimum and maximum analog output configuration values should be set to the default settings (minimum 0%; maximum 100%). ▲

Calibration in Dual/Auto Range Mode

Regulations typically require zero/span calibration when the instrument is newly installed, moved, repaired, interrupted for more than a few days, or when span or zero shift by more than 15%.

All gas must be supplied to the instrument at atmospheric pressure. It may be necessary to employ an atmospheric bypass plumbing arrangement to accomplish this. Refer to Figure 2–6 in the "Installation and Setup" chapter for an example of an atmospheric bypass plumbing arrangement.

If a filter is used, all gas must enter the instrument through the filter.

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. ▲

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. ▲

Use the following procedure to perform a zero/span calibration.

1. If the instrument is equipped with the optional zero/span and sample valves, connect the zero and span gas to the rear panel bulkheads labeled ZERO IN and SPAN, otherwise connect a source of vented zero air to the SAMPLE bulkhead. The top right of the title bar indicates which mode is active: Zero, Span, or Sample.

Note Do not use nitrogen for zero air. ▲

2. To ensure that the zero air is being measured at atmospheric pressure, check that the zero air flow reported by the analyzer is approximately 0.5 LPM. Actual zero air flow should be 0.8 LPM or more, with the excess flowing out the atmospheric bypass.

   a. From the Home screen choose **Settings>Health Check>Status and Alarms>Flow and Pressure**.

   b. Make sure that the reported sample flow is less than the actual zero air flow.

3. Monitor the zero air reading and wait for the reading to stabilize.

4. From the Home Screen, choose **Calibration>Calibrate Background**.

   The Target Concentration button will read 0.000. The Calculated Background button will display the background needed to make the current SO_2 concentration go to zero.

5. Press **Calibrate** to set the SO_2 reading to zero and to save the new background.

6. Connect a source of calibration gas to the SAMPLE bulkhead. The calibration gas concentration should be approximately 80% of the high full-scale range.

7. To ensure that the calibration gas is being measured at atmospheric pressure, check that the sample flow in the analyzer is approximately 0.5 LPM. Actual sample air flow should be 0.8 LPM or more, with the excess flowing out the atmospheric bypass.

8. Sample the vented calibration gas and wait for the instrument reading to stabilize.

9. From the Home Screen, choose **Calibration>Calibrate High Range Span Coefficient**.

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

10. Enter the SO_2 calibration gas concentration using the pushbuttons, and then press **Calibrate** to calibrate the instrument to the high SO_2 calibration gas.

Note The minimum and maximum analog output configuration values should be set to the default settings (minimum 0%; maximum 100%). ▲

11. Connect a source of calibration gas to the SAMPLE bulkhead. The calibration gas concentration should be approximately 80% of the low full-scale range.

12. From the Home Screen, choose **Calibration>Calibrate Low Range Span Coefficient**.

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

13. Enter the SO_2 calibration gas concentration using the pushbuttons, and then press **Calibrate** to calibrate the instrument to the low range SO_2 calibration gas.

Zero and Span Check

The zero and span check procedure is normally performed any time a quick check of the accuracy of the instrument is required. Normally, zero and span are checked daily. As experience is gained with the instrument, the frequency of these checks can be adjusted accordingly.

The span gas concentration used in the span check should be between 70% and 90% of the full-scale range. The zero and span drift should be measured and recorded prior to making any adjustments.

All gas must be supplied to the instrument at atmospheric pressure. It will be necessary to employ an atmospheric bypass plumbing arrangement to accomplish this.

If a filter is used, all gas must enter the instrument through the filter.

Use the following procedure to check the zero/span.

1. If the instrument is equipped with the optional zero/span and sample valves, connect the zero and span gas to the rear panel bulkheads labeled ZERO IN and SPAN, otherwise connect a source of vented zero air to the SAMPLE bulkhead.

Note Do not use nitrogen for zero air. ▲

2. To ensure that the zero air is being measured at atmospheric pressure, check that the zero air flow reported by the analyzer is approximately 0.5 LPM. Actual zero air flow should be 0.8 LPM or more, with the excess flowing out the atmospheric bypass.

   a. From the Home screen choose **Settings>Health Check>Status and Alarms>Flow and Pressure**.

b. Make sure that the reported sample flow is less than the actual zero air flow.

3. Monitor the zero air reading and wait for the reading to stabilize.

4. Record the measured SO_2 value as the zero drift since the last adjustment. If the zero has changed by more than ±0.015 ppm, it is recommended that a new calibration be performed.

5. Connect a source of vented span gas to the SAMPLE bulkhead. The span gas should be approximately 80% of the full-scale range.

6. To ensure that the span gas is being measured at atmospheric pressure check that the flow is approximately 0.5 LPM or more, with the excess flowing out the atmospheric bypass.

7. Sample the vented calibration gas and wait for the instrument reading to stabilize.

8. Record the difference between the measured SO_2 value and the actual SO_2 span concentration used. This is the span drift since the last adjustment. If the calibration has changed by more than ±10%, a new calibration should be performed.

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 SO_2 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 (single range mode)

| Adjust Background 6.9 ppb | Adjust Span Coefficient 1.000 | Reset Bkg to 0.000 and Span Coef to 1.000 |

Adjust Background

The SO_2 background is the amount of signal read by the analyzer while sampling zero air.

The Adjust Background screen is 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 Background allows the user to change zero background. The second button called Adjusted Concentration shows what the new SO_2 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 Background

| Adjust Background 0.0 ppb | Adjusted Concentration 9.1 ppb | Calibrate |

Adjust Span Coefficient

The span coefficient is used to correct the SO_2 readings and normally has a value near 1.000 with minimum/maximum limits of 0.500 and 2.000 respectively.

The user can manually change the span coefficient by entering a value in the Adjust Span Concentration button. The second button called Adjusted

Concentration shows what the new SO_2 concentration would be based on the adjusted span coefficient. Press the Calibrate button to save the adjusted span coefficient value.

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

Adjust Span Coefficient 1.095	Adjusted Concentration 9.1 ppb	Calibrate

Home Screen>Calibration>Advanced Calibration>Manual Calibration>Adjust High Range Span Coefficient (dual or auto range mode)
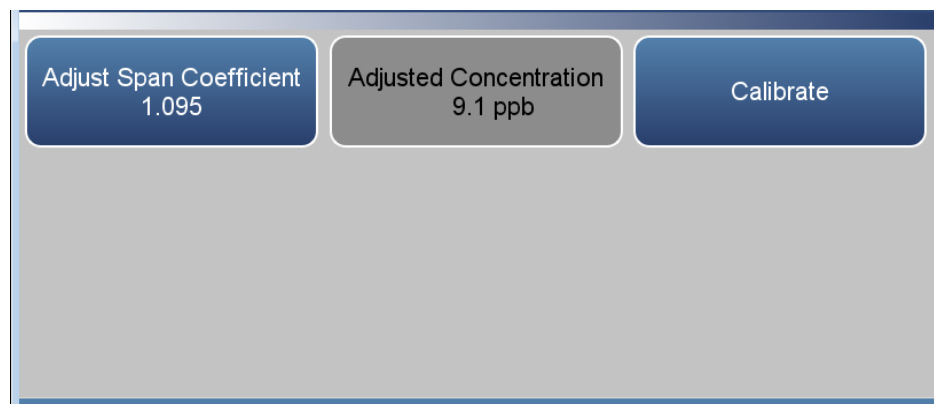
Adjust High Range Span Coefficient 0.999	Adjusted High Range Concentration 7.9 ppb	Calibrate
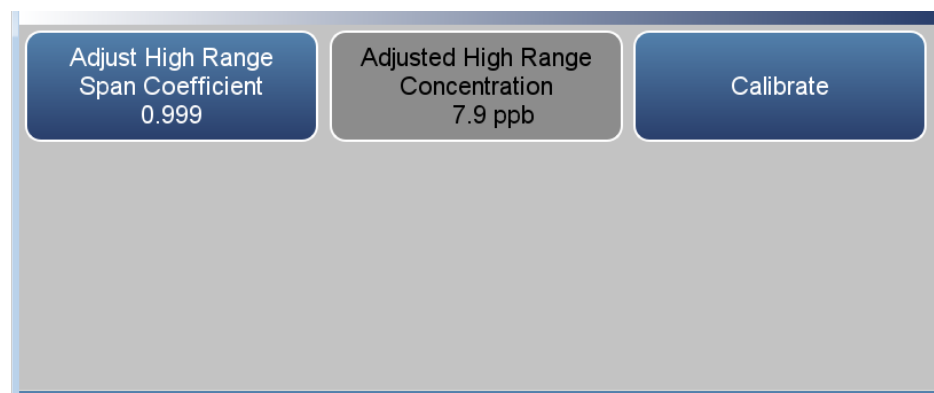
Reset Bkg to 0.000 and Span Coef to 1.000

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 calibration or calibration checks.

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
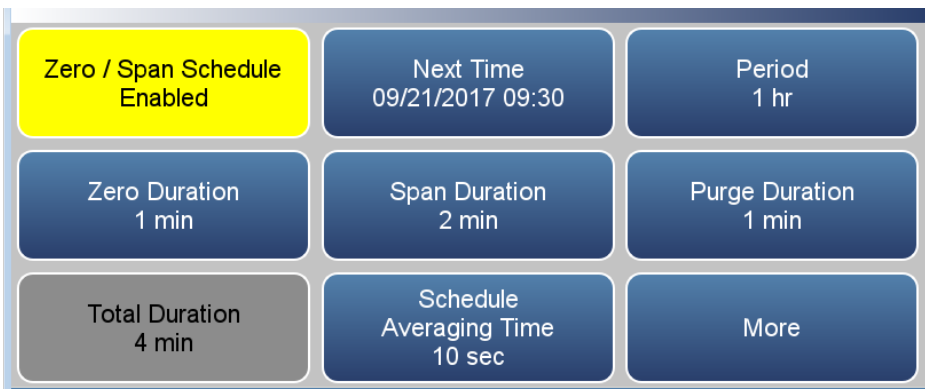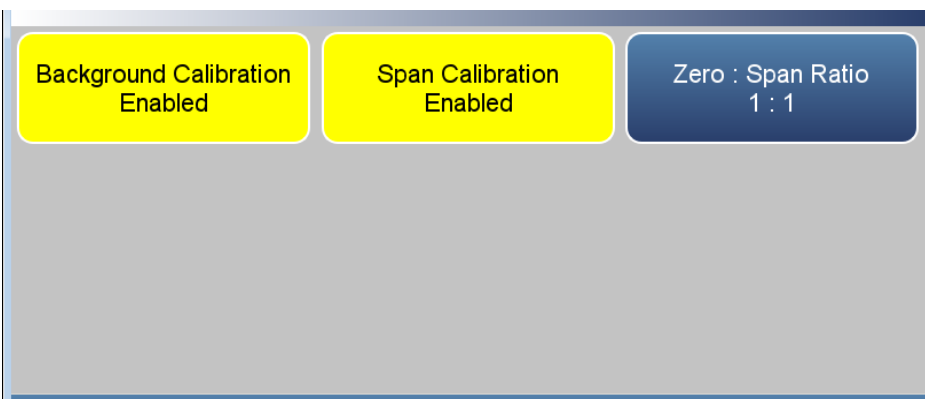
Next Time

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.

References

1. Section 12 of EPA *Quality Assurance Handbook for Air Pollution Measurement Systems*, Volume II, available at www.epa.gov.

   Section 12 also provides information on "Calibration of Primary and Secondary Standards for Flow Measurements".

   Specific information on certification of concentration standards is given in EPA *Traceability Protocol for Assay and Certification of Gaseous Calibration Standards*, available at www.epa.gov.

Chapter 5
Maintenance

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

Safety Precautions

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

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

Fan Filter Inspection and Cleaning

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

1. Remove the fan guard from the fan and remove the filter.

2. Flush the filter with warm water and let dry (a clean, oil-free purge will help the drying process) or blow the filter clean with compressed air.

3. Re-install the filter and fan guard.

Pump Rebuilding

Use the following procedure to rebuild the pump.

Equipment required:

>Pump rebuild kit (qty. 1)

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

>Pencil or marker
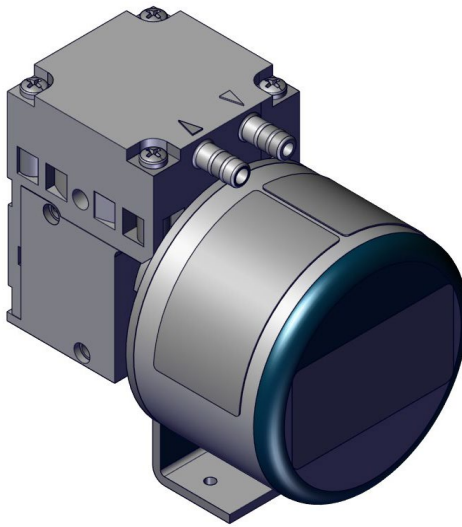
Figure 5–1. Single Stage Pump

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

2. Mark the position of head parts relative to each other by drawing a line with a pencil. This helps avoid incorrect assembly later.

3. Undo the four screws in the head.

4. Lift the head plate and the intermediate plate off the housing.

5. Hold the pump with one hand, so that the diaphragm is pointing downwards. Lift the diaphragm by the opposing side edges, grasp it and unscrew it in the counter-clockwise direction.

6. Remove connection rod disc and diaphragm spacers from the threaded pin of the diaphragm.

7. Push the connection rod disc and the diaphragm spacers in this order onto the threaded pin of the new diaphragm.

8. Move the connecting rod to the upper point.

9. Screw the new diaphragm with connection rod disc and spacers clockwise onto the connection rod and tighten hand-tight.

10. Place the intermediate plate on housing, in the position indicated by the drawing line.

11. Place the new valve plate on the intermediate plate.

12. Place the head plate on the intermediate plate, in the position indicated by the drawing line; gently tighten the four screws, evenly and diagonally (if a torque screwdriver is available: torque about 0.30 Nm).

13. Let the pump run.
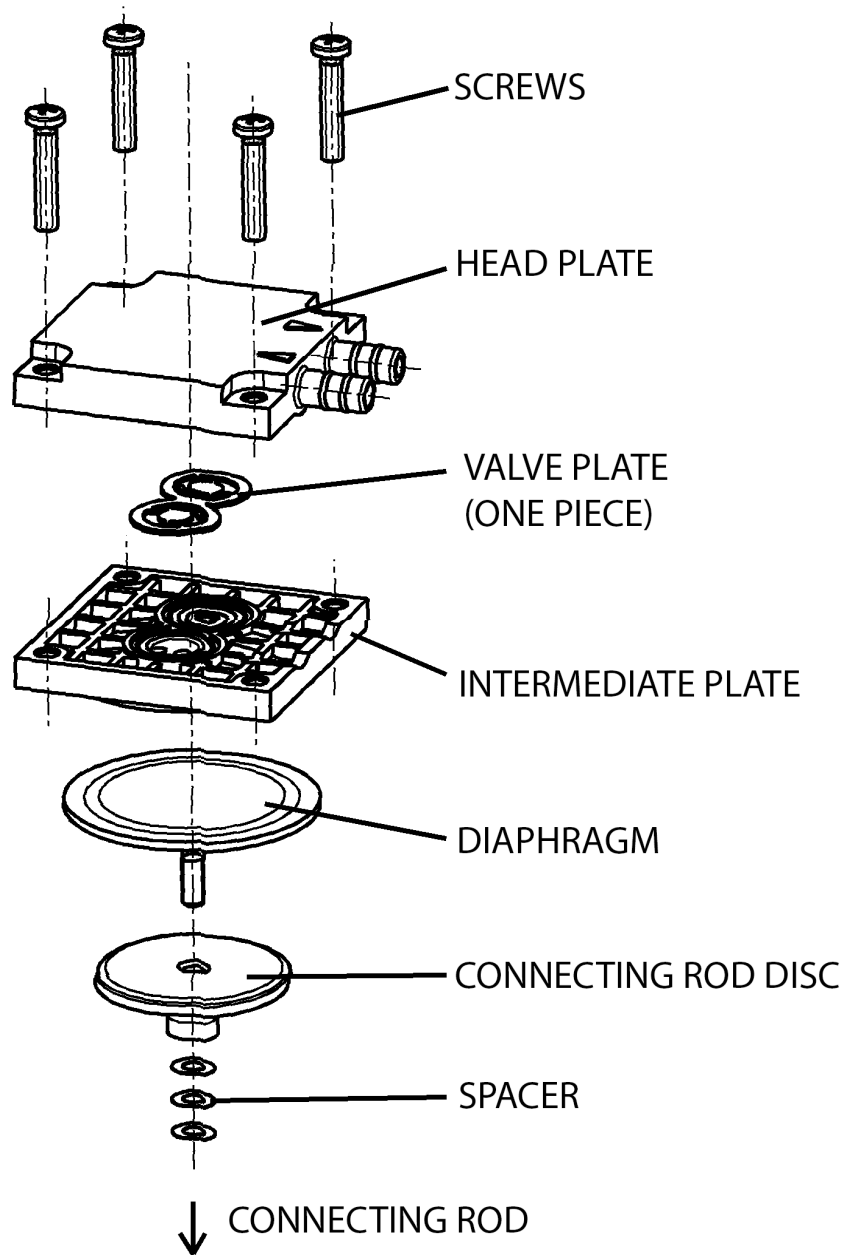
Figure 5–2. Pump Rebuilding

Leak Test

Use the following procedure to perform a leak test.

Equipment Required:

Cap

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

1. Turn instrument OFF, unplug the power cord.

2. Block the SAMPLE bulkhead on the rear panel with a leak-tight cap.

3. Connect the vacuum tester tool to the EXHAUST bulkhead on the rear panel.

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

5. Observe vacuum gauge for stable reading for 5 minutes. If reading remains at 10 in Hg, no leak is present.

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

Lamp Voltage Check

The instrument is equipped with a lamp voltage control circuit, which automatically corrects for degradation of the flash lamp. However, after several years of use, the lamp may have degraded to the point that is being driven with the maximum voltage that the power supply can deliver.

There are two methods available that allows the operator to check the lamp voltage. The first is via the Measurements Settings>Advanced Measurement Settings>Optical Bench Settings>**Continue to Detector Gain Settings** Screen. The current Lamp Voltage and Lamp Intensity are displayed.

The second method is via Settings>Health Check>Status and Alarms>**SO2 Bench** screen. The current Lamp Voltage and Lamp Intensity are displayed along with the upper and lower alarm limits.

For detailed information about this screen, refer to the "Operation" chapter. For more information about replacing the lamp or adjusting the lamp voltage control circuit, see the "Servicing" chapter.

Lamp Voltage Adjustment

The auto calibration of the detector will automatically adjust the lamp voltage to 800 volts (±5 Volts). This is done so by adjusting the gain on the detector to optimize the illumination of the lamp.

Use the following procedure to adjust the lamp voltage.

1. From the Home screen choose Settings>Measurement Settings>Advanced Measurement Settings>Optical Bench Settings>**Continue To Detector Gain Settings Screen**.

2. Under the Detector Gain – Auto Cal, Press "Start" to initiate the auto calibration sequence.

Description	Detector Gain	Lamp Voltage	Lamp Intensity		
Manual Entry	39	0.4	0.0		
Auto Cal	Start				
End Cal	Stop				
Default Values	Default Gain				

3. To manually adjust the detector gain, touch the numeral value under the detector gain. Then change the Manual Entry Detector Gain to your set value and save.

usfrk-nitro:0

Manual Entry Detector Gain

41   counts

1	2	3	⌫
4	5	6	⊗
7	8	9	↪
+/-	0	.	↵

Chapter 6
Troubleshooting

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

Safety Precautions

Read the safety precautions in Appendix A, "Safety" before performing any actions listed in this chapter.

Troubleshooting Guide

Table 6–1 provides general troubleshooting information for the common platform and indicates the checks that you should perform if you experience an instrument problem. It also lists 43iQ 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. 43iQ 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	Unseated or missing Micro SD card	Power off, re-seat Micro SD or install if missing.

Problem	Possible Cause	Action
on front panel are on)		
	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.
Cannot zero instrument or there is a high background signal when sampling zero air. (Zero air should produce a reading equivalent to less than 15 ppb SO_2.)	Zero air system is faulty, needs new SO_2 scrubbers or requires maintenance.	Test against an ultra-zero cylinder from a reputable scientific gas supplier or check effect of a new chromatography grade activated charcoal scrubber installed at the instrument inlet.
	Zero air flow rate is inadequate	Check by-pass or atmospheric pressure vent to verify that the zero air system is providing more flow than the instrument is drawing.
	Instrument is not drawing in zero air	Check the sample flow and pressure in the Settings>Health Check>Status and Alarms>Flow and Pressure screen.
		Use an independent flow meter to check flows at the sample inlet and exhaust bulkheads (they should match).
		Perform a leak test as described on page 5-5.
	Span gas containing SO_2, NO or hydrocarbon is contaminating system	Verify that span gases connected to the calibration system are shut off and leak-tight.
	Internal or external lines, filters and other sample handling equipment are contaminated or dirty	Replace inlet filter (if installed) and as much as possible.

Problem	Possible Cause	Action
	Hydrocarbon kicker has failed	Replace the hydrocarbon kicker.
	High scattered light	Toggle the "Flash Lamp" off in the Settings>Measurement Settings>Advanced Settings>Flash Lamp screen. If the previously high signal drops to zero or less when the flash lamp is off, the problem may be caused by scattered light from dust in the optical bench. If so, carefully clean the bench.
Instrument appears to zero, but there is weak or no response to span gas	Span cylinder empty	Check the source pressure.
	Calibration system failure	Check solenoids or other hardware to be sure that span gas is being delivered.
	Flow rate of the diluted span mix is adequate	Check by-pass or atmospheric vent to verify that the zero air system is providing more flow than the instrument draws.
	Instrument is not drawing in span gas	Check the sample flow and pressure in the Settings>Health Check>Status and Alarms>Flow and Pressure screen.
		Use an independent flow meter to check flows at the sample inlet and exhaust bulkheads (they should match).
		Perform a leak test as described on page 5-5.
	SO_2 is being absorbed by tubing, filters or dirt in the calibration system	Replace any lines made of vinyl or plastics with fresh PTFE or stainless steel. Replace PTFE filter membranes that look dirty. Remove any filters that are not PTFE membranes.
	Flash lamp has failed	Listen for the rapid clicking of the flash lamp. Check the flash lamp voltage and intensity.
	PMT has failed	Check the PMT voltage and run the optical span test. A good optical span test indicates that the PMT is OK and that the problem is more likely the lamp. Adjust PMT voltage if

Problem	Possible Cause	Action
		needed.
Zero or Span will not stabilize	Flow rate of the diluted span mix is inadequate	Check the by-pass or atmospheric pressure vent to verify that the zero air system is providing more flow than the instrument is drawing.
	Instrument is not drawing in span gas	Check the sample flow and pressure in the Settings>Health Check>Status and Alarms>Flow and Pressure screen.
		Use an independent flow meter to check flows at the sample inlet and exhaust bulkheads (they should match).
		Perform a leak test as described on page 5-5.
	SO_2 is being absorbed and released by dirt in tubing or filters of the calibration system or contamination inside the instrument	Replace any lines made of vinyl or plastics with fresh PTFE or stainless steel. Replace PTFE filter membranes that look dirty. Remove any filters that are not PTFE membranes.
	Averaging time is not correct	Check the "Averaging Time" in the Settings>Measurement Settings screen. If too high, the unit will be slow to stabilize. If too low, the signal may appear to be noisy.
	Flasher lamp	Replace with known-good lamp to see if the lamp is the problem.
Reduced response or no response to sample gas with alarm(s) indicated	Undefined electronic failure or pump failure	Check the status and alarms screen to localize fault.
		Check the response to known span gas.
		Run an optical span test.
	Instrument is not drawing in sample as expected	Check the sample flow and pressure in the Settings>Health Check>Status and Alarms>Flow and Pressure screen.
		Use an independent flow meter to check flows at the sample inlet and exhaust bulkheads (they should match).

Problem	Possible Cause	Action
		Perform a leak test as described on page 5-5.
Reduced response or no response to sample gas with no alarm(s) indicated	Instrument is not properly calibrated	Verify the SO_2 background and SO_2 coefficient are set appropriately in the Calibration screen.
	Instrument is not drawing in sample as expected	Check sample flow and pressure readings in the Settings>Health Check>Status and Alarms>Flow and Pressure screen.
		Use an independent flow meter to check flows at the sample inlet and exhaust bulkheads (they should match).
		Perform a leak test as described on page 5-5.
		Check the external plumbing for leaks or other problems.
		Check all external plumbing and the source of the sample to verify that the SO_2 is not being absorbed by the sampling system. Lines carrying SO_2 must be made from clean PTFE or stainless steel.
	Detection circuit failure	Run the optical span text to verify PMT and associated electronics.
	PMT failure	Check the PMT voltage. Adjust if needed.
	Flash lamp failure	Check the lamp voltage. Perform a detector Autocal. If outside of spec, replace the detector.
Span calibration coefficient outside acceptable limits of 0.5–2.0.	Bad span gas	Verify quality of span gas.
	System leak	Perform a leak test as described on page 5-5.
	Insufficient calibrator flow	Verify calibrator is providing a flow of at least 0.8 LPM.
Excessive noise or spikes on analog outputs	Defective or low sensitivity	Check PMT voltage and run an optical span test. Replace PMT with known-good unit if

Problem	Possible Cause	Action
		possible.
	Noise pick-up by recorder or data logger	Check analog cable shielding and replace.
		Try to localize source of noise by comparing analog signal to data collected through RS-232 or Ethernet.
Poor linearity	Problem with calibrator	Verify accuracy of the calibration system with an independent flow meter.
	Hydrocarbon kicker	Replace kicker if older than 3 years.
	Leak in sample probe line	Check for variable dilution.
Excessive response time	Averaging time is not set correctly	Check the "Averaging Time" in the Settings>Measurement Settings screen.
	Instrument is not drawing in sample at the expected flow rate	Check sample flow and pressure readings in the Settings>Health Check>Status and Alarms>Flow and Pressure screen.
		Use an independent flow meter to check flows at the sample inlet and exhaust bulkheads (they should match).
		Perform a leak test as described on page 5-5.
	SO_2 is being absorbed and released by dirt in tubing or filters of the calibration system or contamination inside the instrument	Replace any lines made of vinyl or plastics with fresh PTFE or stainless steel.
		Replace PTFE filter membranes that look dirty.
		Remove any filters that are not PTFE membranes.
	Contaminated bench	Contact technical support for additional information and options.
Analog signal doesn't match expected value	Software has not been configured	Verify that the selected analog output has been properly configured to match the data system.
	Analog output goes above	By default, a 5% over and

Problem	Possible Cause	Action
	full-scale value or below zero	under range on the analog outputs is provided. If this is not desirable due to system restrictions, it may be turned off in the Settings>Communications>Analog I/O screen.
	Recorder is drawing down output	Verify that the recorder or data logger input impedance meets minimum requirements.
Flow meter fluctuations	Dirty pump diaphragm	Clean or replace pump diaphragm.
	Capillary blocked	Clean or replace capillary.
	Clogged PTFE line	Inspect all sample lines.
Alarm – Chamber Temperature	Heater failed	Replace heaters as needed.
	Defective PCB	Replace PCB.
Alarm – Perm Gas Temp	Incorrect Perm oven set temperature or alarm setting	Check that the alarm settings match the set temperature.
	Perm oven heater thermistor or gas thermistor error	Replace thermistor.
	Perm oven failure	Replace the Perm oven.
Alarm – Pressure	High pressure indication	Check plumbing for leaks.
		Check the pump for a tear in the diaphragm. Replace if needed.
		Check that 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.
		Perform a leak test as decribed on page 5-5.
	Flow high	When delivering zero air or gas to the instrument, use an

Problem	Possible Cause	Action
		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 – Intensity	Low – Lamp is failing	Check that the lamp and trigger pack are securely fastened.
		Replace lamp.
Alarm – Lamp voltage	Low voltage (<750v)	Replace lamp power supply.
	High voltage (>1200v)	Replace flash lamp.
Alarm – SO$_2$ Conc.	Concentration has exceeded range limit	Check to ensure range corresponds with expected value. If not, select proper range.
	Concentration low	Check user-defined low set point. Be sure the minimum trigger is set as desired.
Alarm – Board Communication	Cable connection	Check that DMC cable is connected properly. Reseat if needed.
	Defective DMC PCB	Replace DMC board.
Alarm – Power Supply	Cable connection	Check that DMC cable is connected properly. Reseat if needed.
	Defective component	Check for other alarms, as it is possible that another component of that DMC is drawing too much current.
	Defective DMC PCB	Replace DMC board.
Alarm – Module Temperature	Cable connection	Check that DMC cable is connected properly. Reseat if needed.
	Other alarm	Make sure the instrument temperature is not too high or in alarm.
	Defective DMC PCB	Replace DMC board.
Alarm – 5V/24V Step Board	Cable connection	Check the cable connections to that Step POL board.

Problem	Possible Cause	Action
Alarm – 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 – Analog I/O	Defective PCB	Replace Analog board.
Alarm – Digital I/O	Defective PCB	Replace Digital board.
Alarm – Auto Bkg Cal/Check	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 – Auto Span Cal/Check	Incorrect high alarm limit	Verify the high limit is correct via Settings>Status and Alarms>Concentrations screen.
	Instrument span calibration failed	Recalibrate the instrument.

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 43iQ 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. ▲
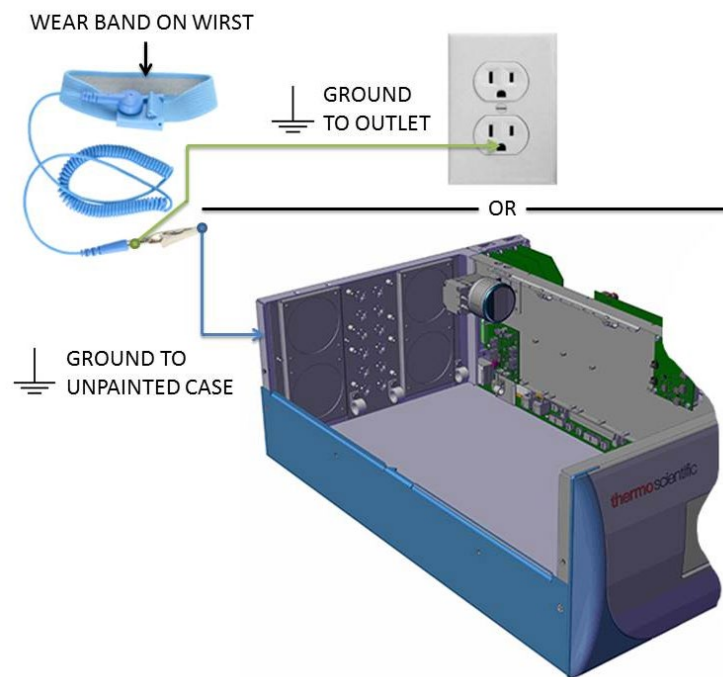
Figure 7–1. Properly Grounded Antistatic Wrist Strap

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.
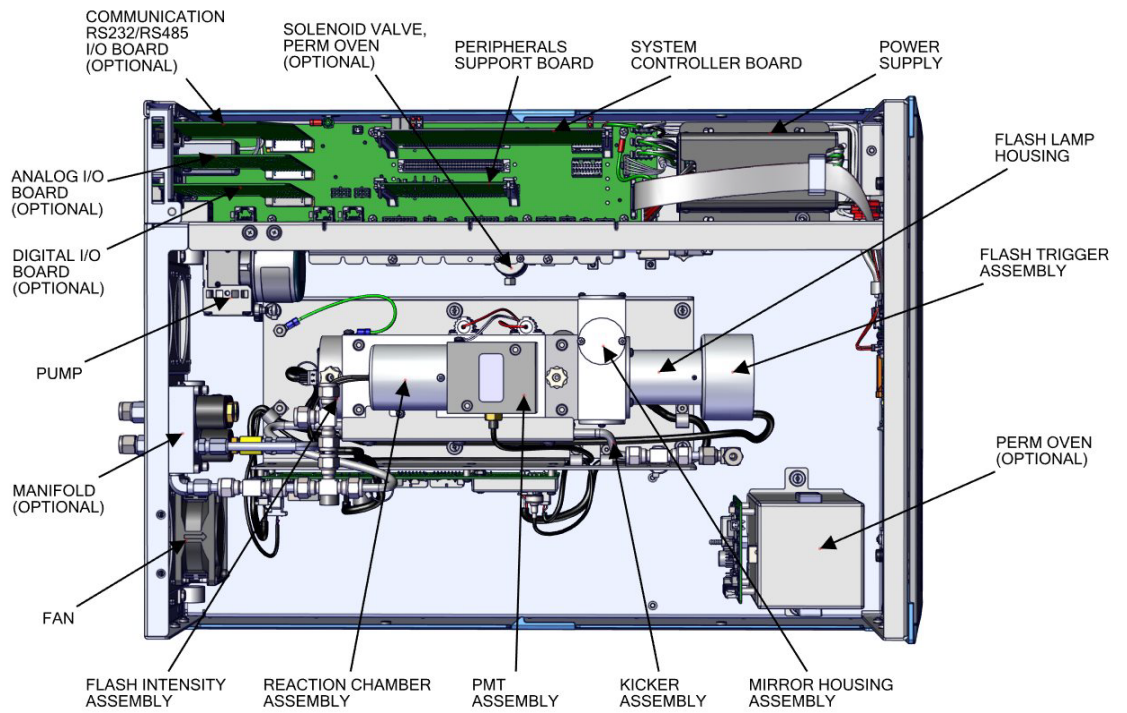
Figure 7–2. 43iQ Component Layout Top View
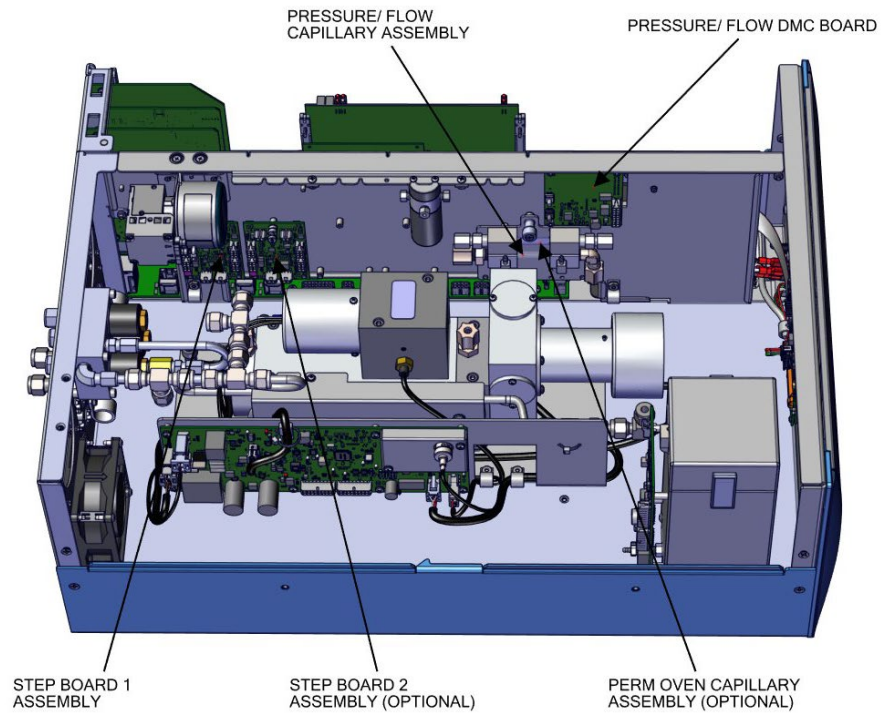
Figure 7–3. 43iQ Component Layout Side View

Fuse Replacement

Use the following procedure to replace the fuses.

4. Turn instrument OFF and unplug the power cord.

5. Remove fuse drawer, located on the AC power connector.

6. If either fuse is blown, replace both fuses.

7. Insert fuse drawer and reconnect power cord.

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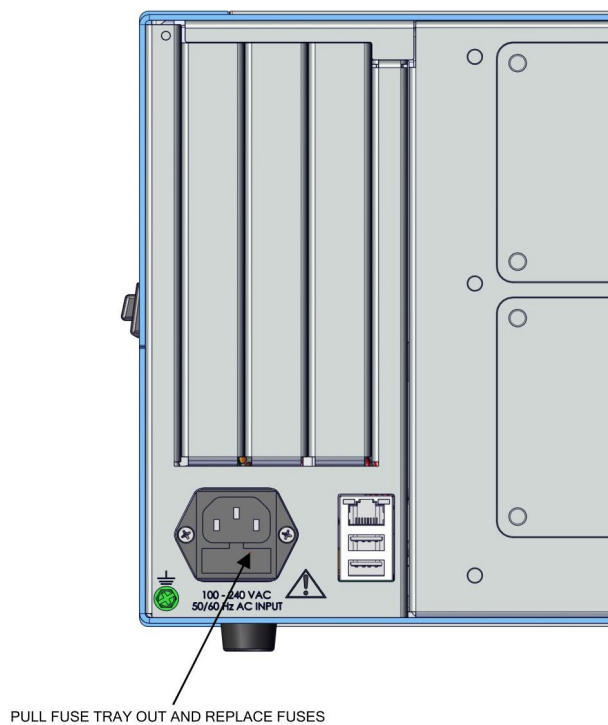
Figure 7–4. Replacing the Fuses

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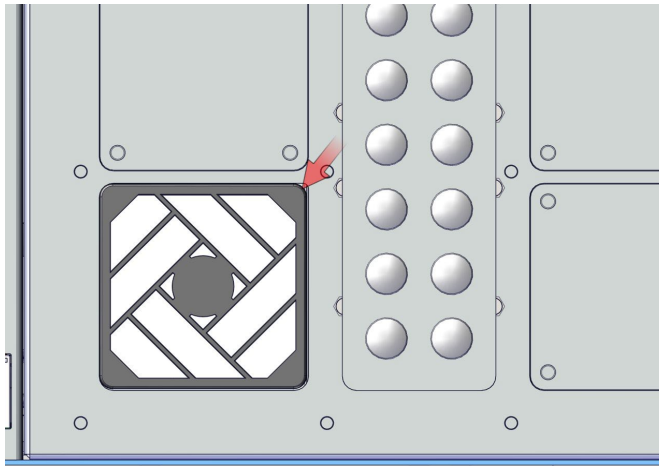
Figure 7–5. Start with Top Right Corner of Fan Cover

3. Replace filter and snap fan cover back in place.
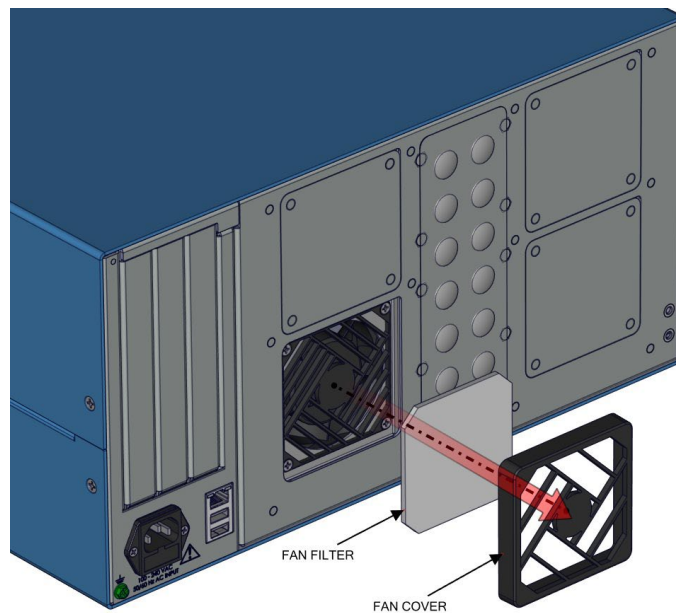
Figure 7–6. Removing the Fan Cover

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.

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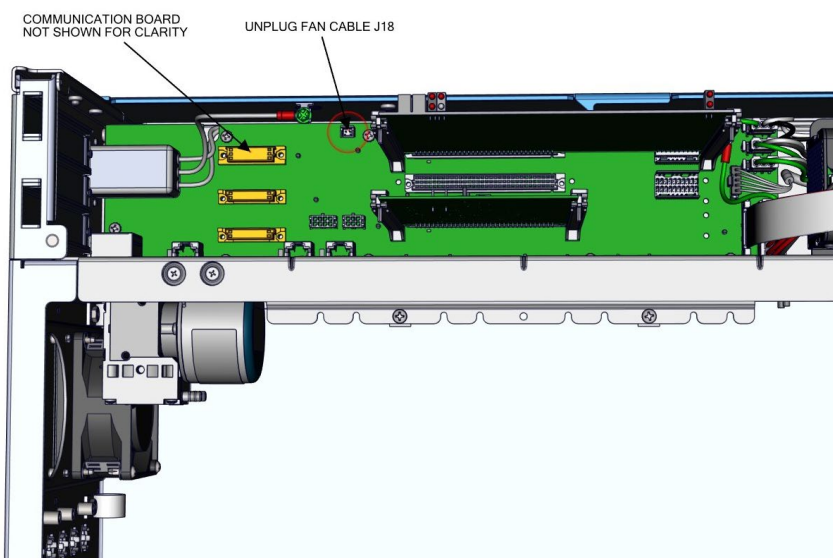
Figure 7–7. Unplugging the Fan Cable

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.

LOOK FOR FLOW ARROW
FLOW ARROW SHOULD BE FACING
TOWARDS INSIDE OF THE CASE

FAN

FAN HOUSING

UNFASTEN
4X SCREWS

FAN FILTER

FAN COVER
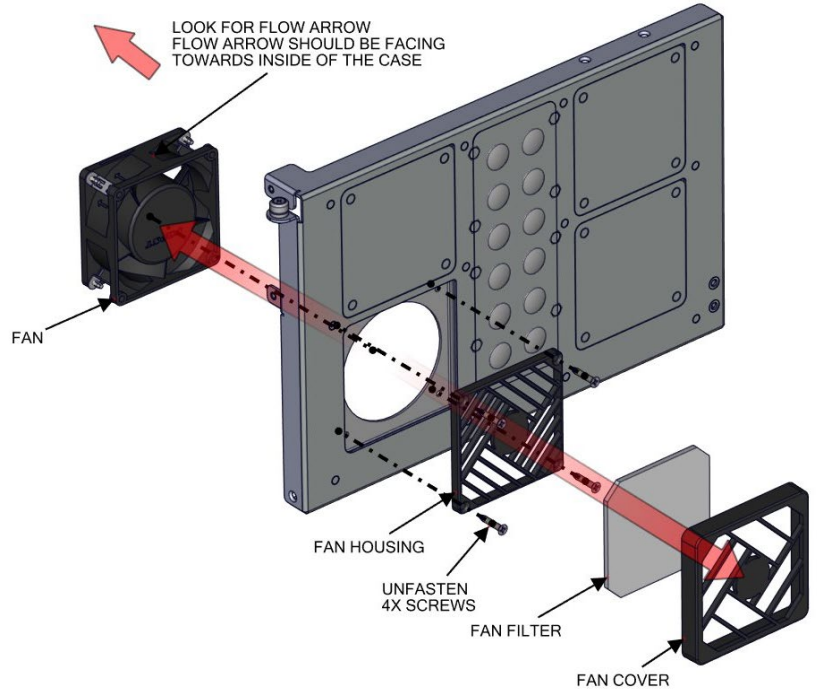
Figure 7–8. Replacing the Fan

Measurement Side Removal and Replacing

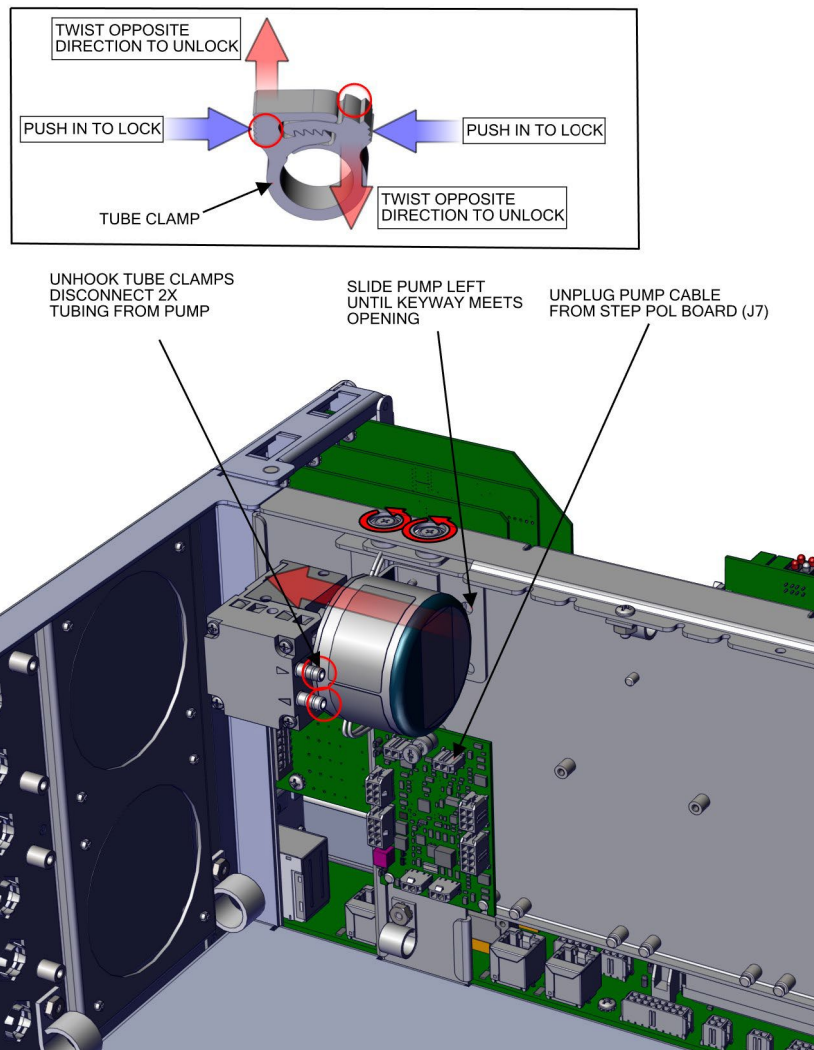Use the following procedure to remove and replace the measurement side if necessary.

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
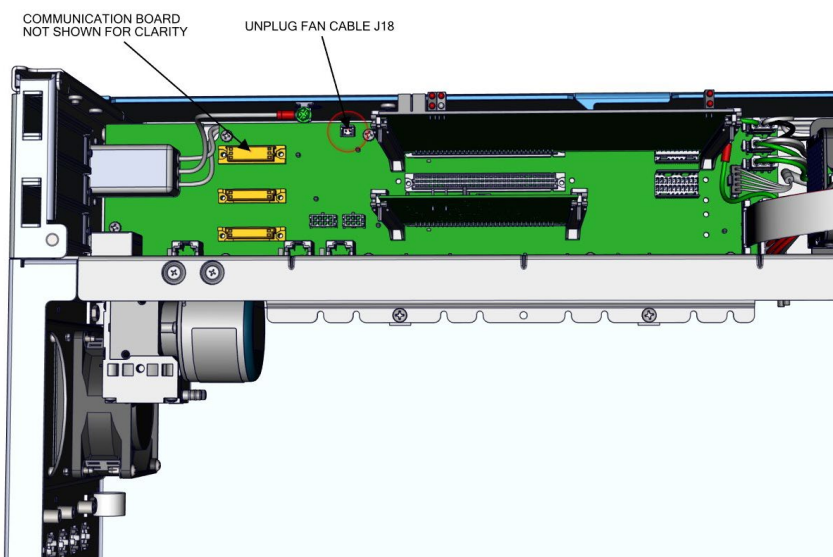
Figure 7–9. Unplugging the Fan Cable

3. Unplug DMC cable (Figure 7–10).
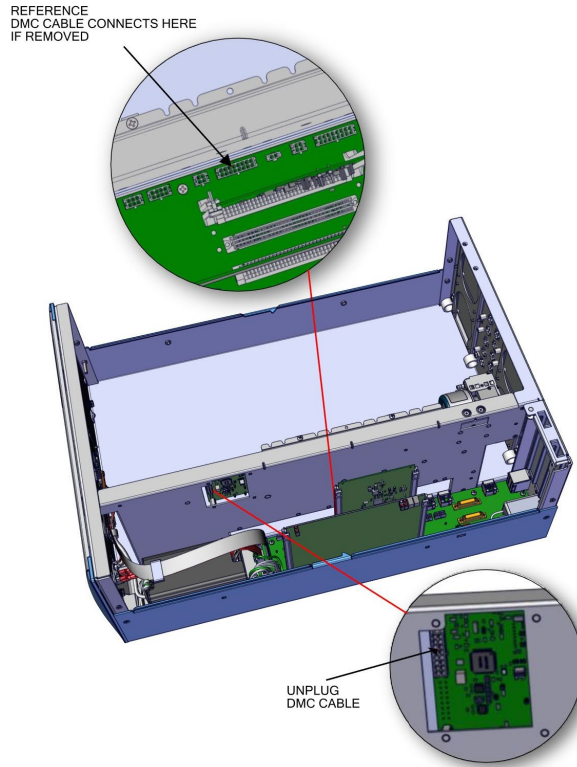
Figure 7–10. Unplugging the DMC Cable

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

5. Remove three 8-32 flat head screws (Figure 7–11).
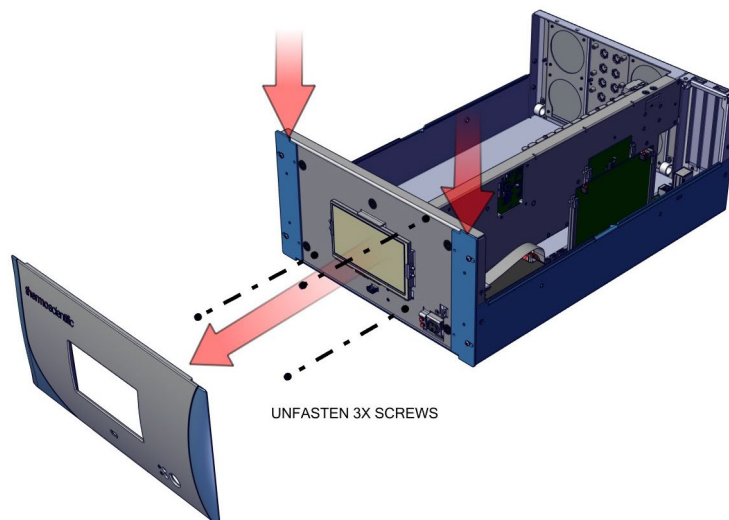
Figure 7–11. Unfasten Hardware Front for Measurement Side Removal

6. Swing arm open.

7. Unfasten captive hardware.

8. Remove two 8-32 flat head screws.

9. Pull measurement side out.

10. Replace in reverse order.
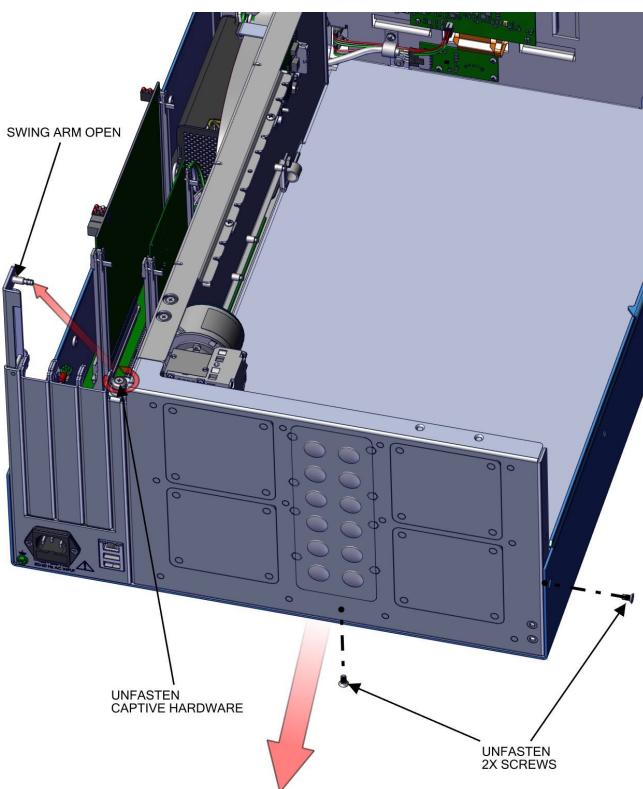
Figure 7–12. Unfasten Hardware Rear for Measurement Side Removal

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
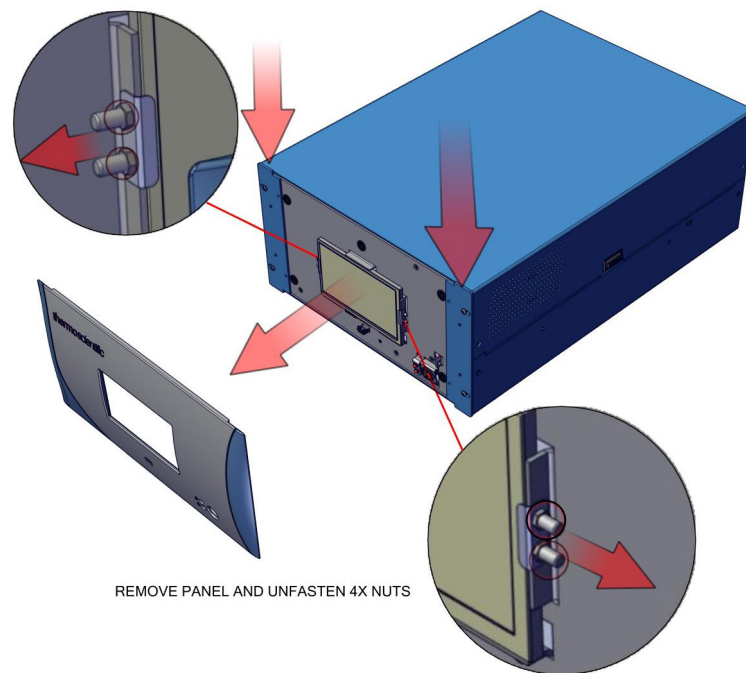
Figure 7–13. Replacing the LCD Module

4. Remove cover.

5. Unplug LCD cables from backside of board.

6. Pull board off the standoffs.
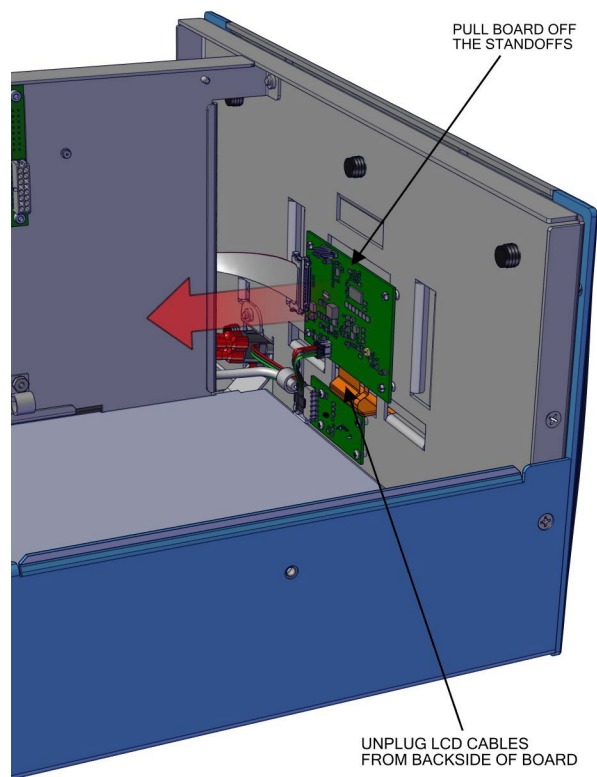
Figure 7–14. Remove Electrical Cables from LCD

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.
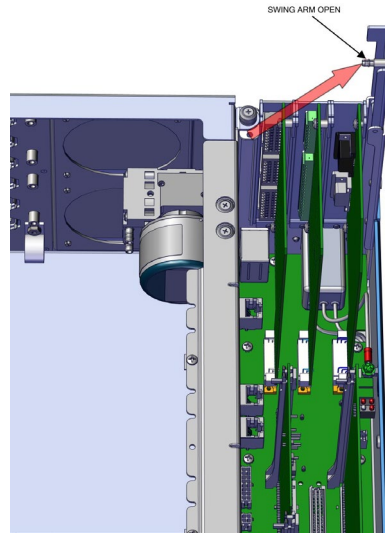
Figure 7–15. I/O Replacement, Arm

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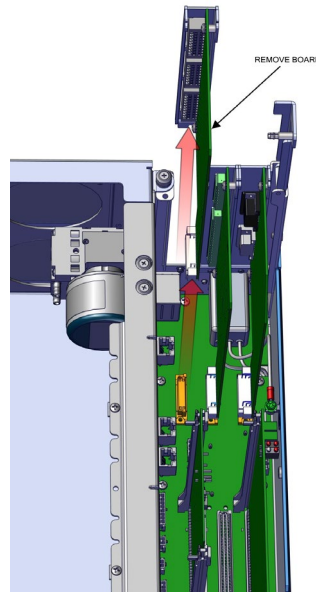
Figure 7–16. I/O Replacement, Remove Board

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

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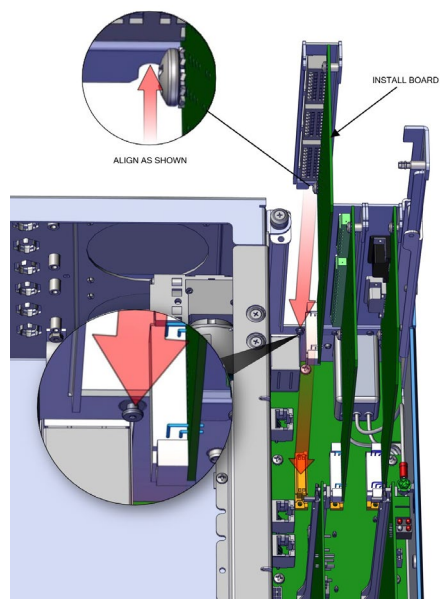
Figure 7–17. I/O Replacement, Install

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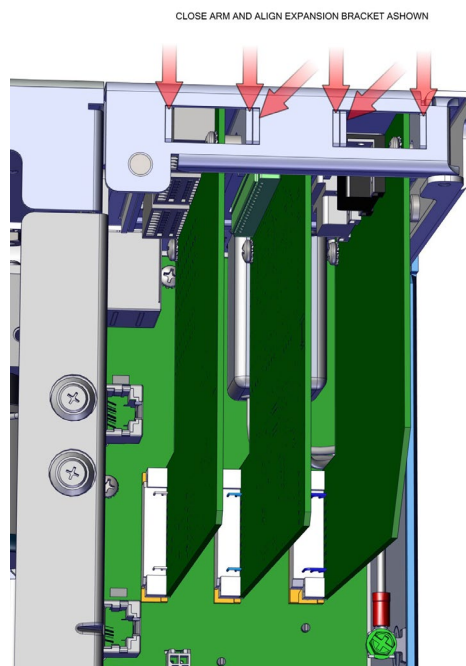
Figure 7–18. I/O Replacement, Close Arm Alignment

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.
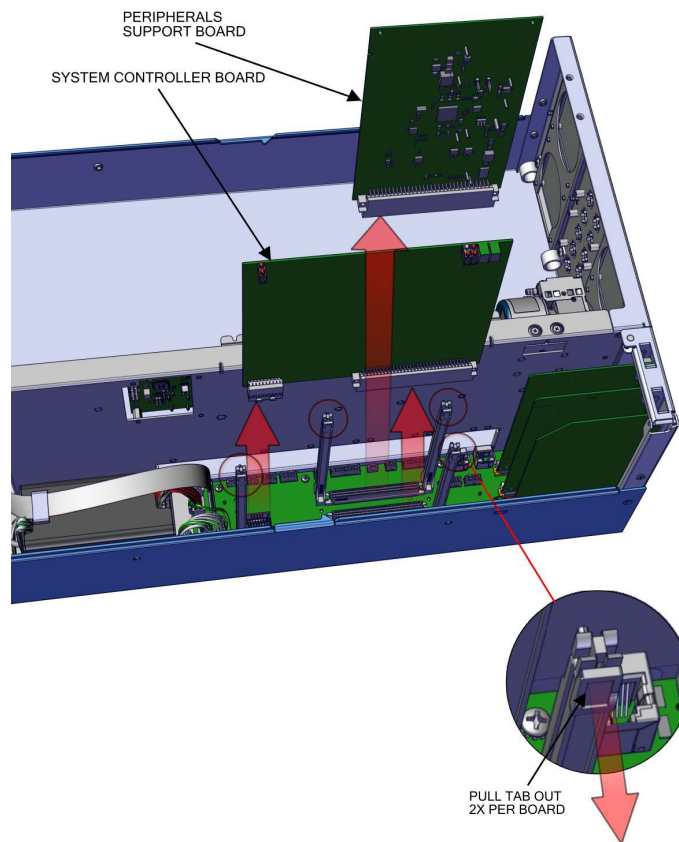
Figure 7–19. Replacing the Peripherals Support Board

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.

REFERENCE
DMC CABLE CONNECTS HERE
IF REMOVED

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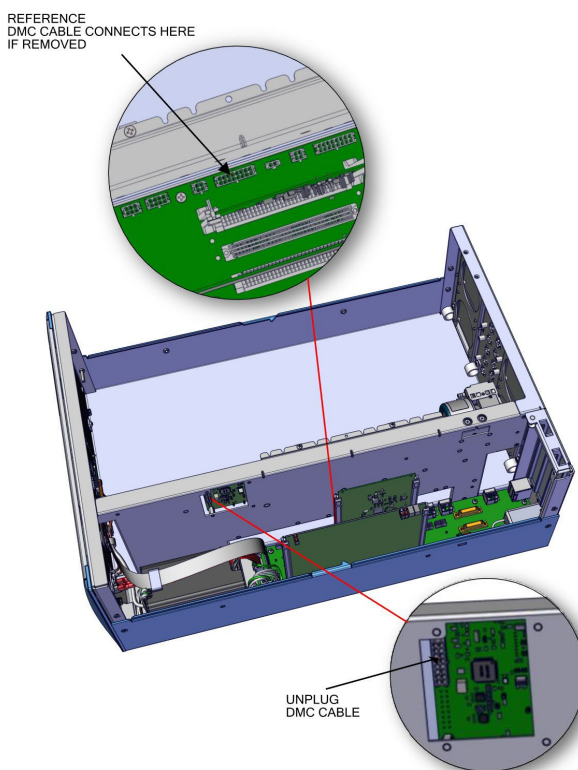
Figure 7–20. Flow Pressure Board, Disconnect DMC Cable

3. Disconnect plumbing.

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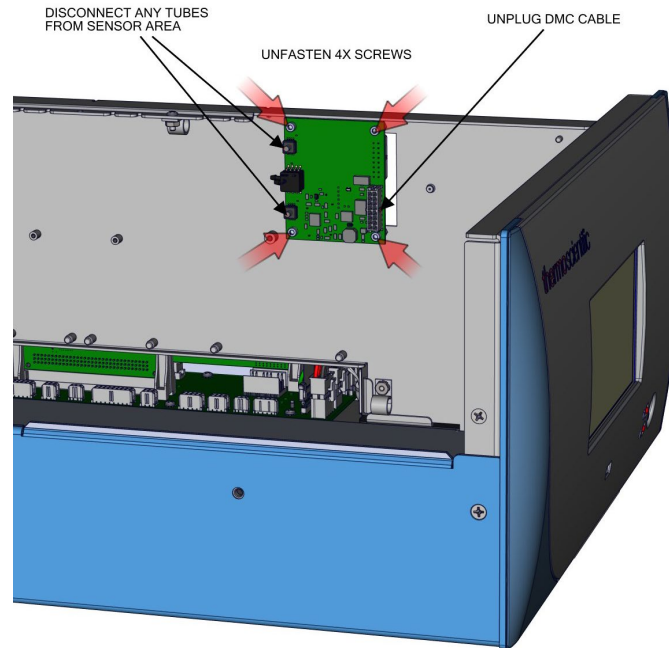
Figure 7–21. Flow Pressure Board, Screws

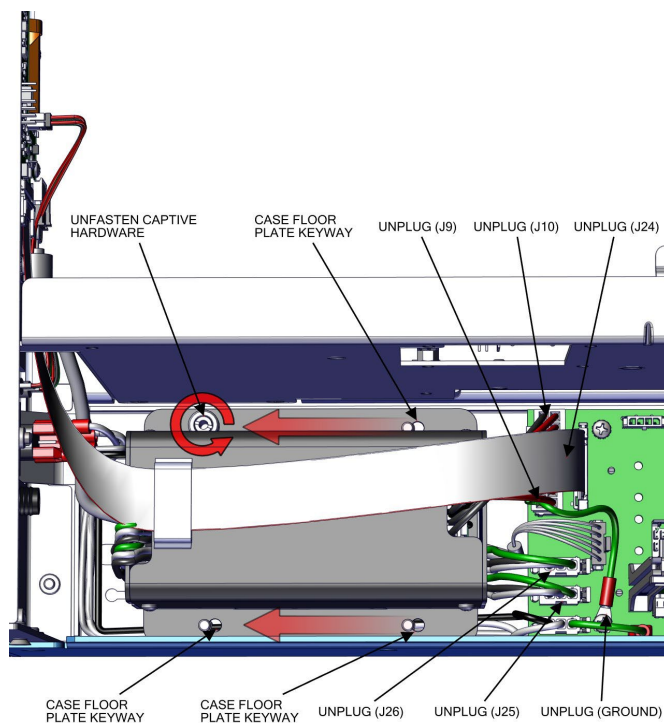5. Replace board and reassemble in reverse order.

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. Twist opposite direction to unlock tube clamps.

Note Push in tube clamp to lock. ▲

4. Disconnect tubing from pump.

5. Unfasten two captive hardware.

6. Slide pump left until keyway meets opening.

Figure 7–22. Remove Pump, Disconnect and Unfasten

7. Pull pump outwards.

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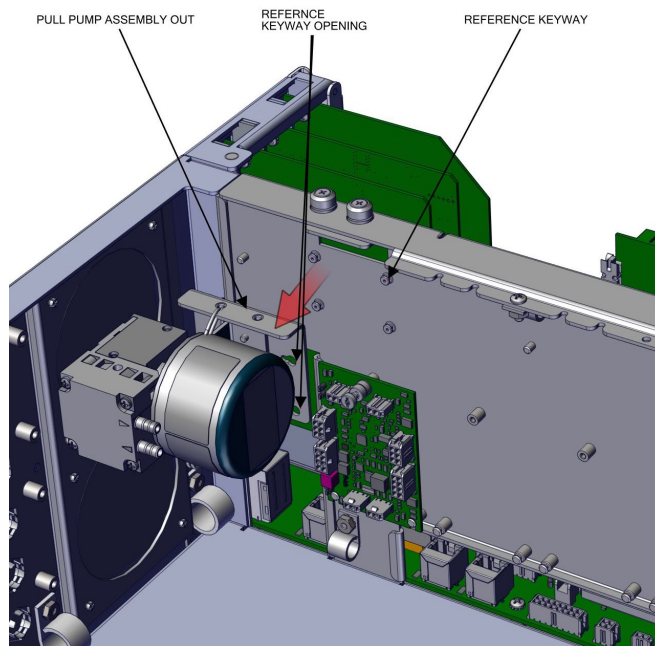
Figure 7–23. Pump Removal, Keyway

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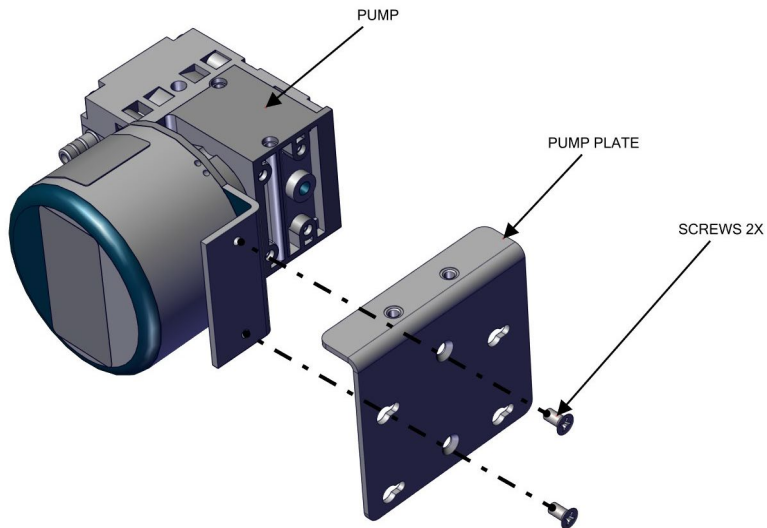
Figure 7–24. Pump replacing, Unfasten Screws

9. Replace pump and reassemble in reverse order.

Capillary Cleaning and/or Replacement

Use the following procedure to clean or replace the capillary.

Equipment required:

Phillips drive, #2

Hex drive, 7/64

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

2. Disconnect the plumbing.

3. Unfasten captive hardware.
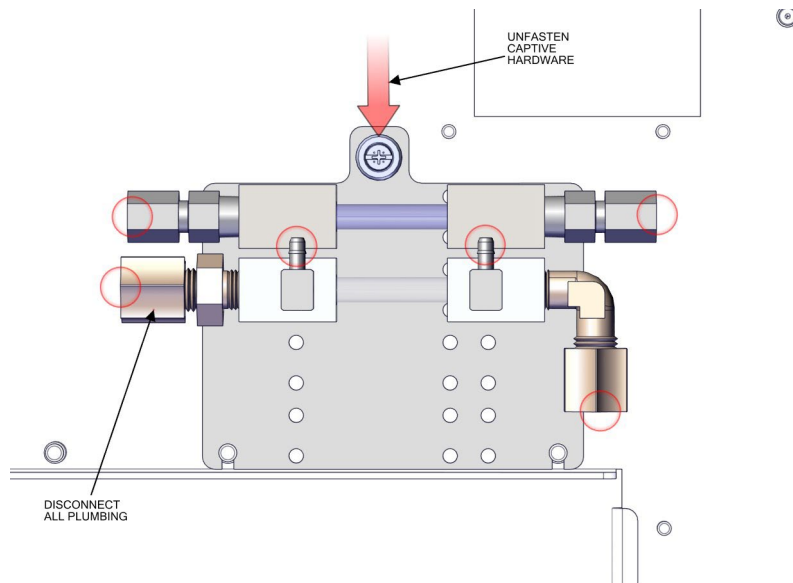
Figure 7–25. Remove Capillary, Disconnect and Unfasten

4. Slide capillary plate upwards clearing the partition panel keyway.
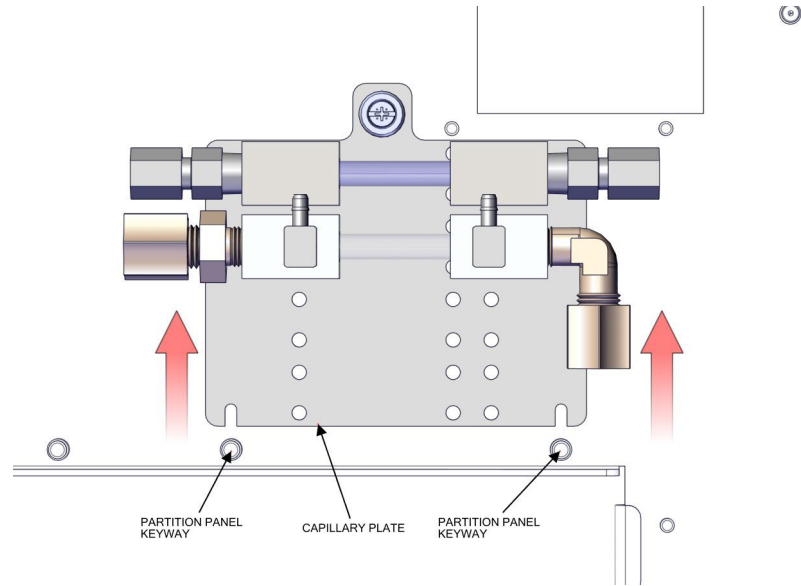
Figure 7–26. Capillary Plate, Keyway

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

6. Pull apart the capillary blocks.
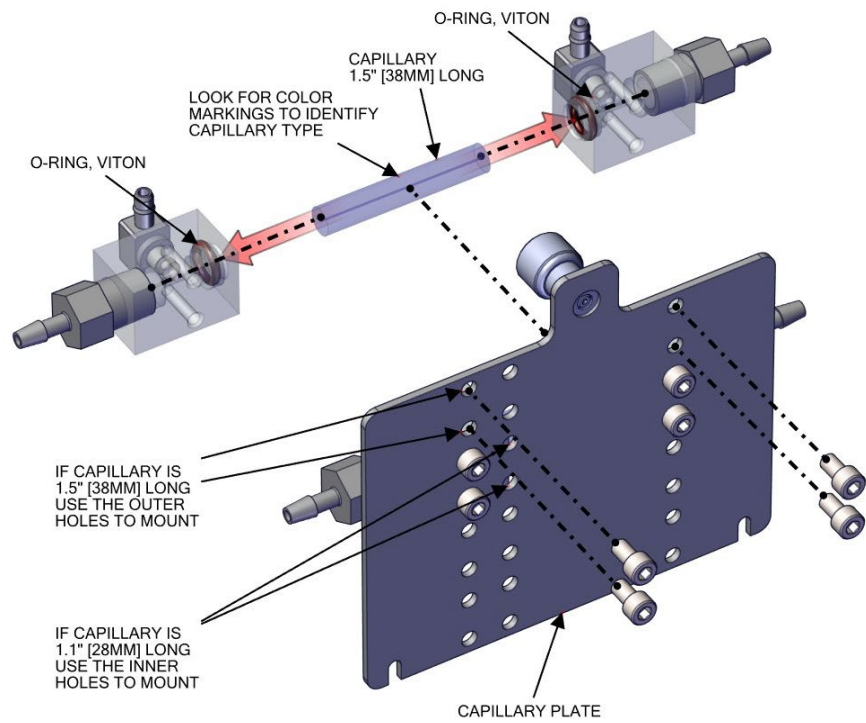
Figure 7–27. Capillary and O-Ring Replace

7. Replace capillary and reassemble in reverse order.

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

Capillary O-Ring Replacement

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

Equipment required:

O-ring pick tool

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

Note Be careful in not damaging the o-ring walls during this process. Refer to Figure 7–27. ▲

# Power Supply Replacement

Use the following procedure to replace the power supply.

Equipment required:

Phillips drive, #2

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

2. Unplug all electrical shown J9, J10, J24, J25, J26, and ground.

3. Unfasten captive hardware.

4. Slide power supply left, clearing three case floor plate keyways.

Figure 7–28. Removing Power Supply

5. Pull power supply up.

6. Replace power supply and reassemble in reverse order.
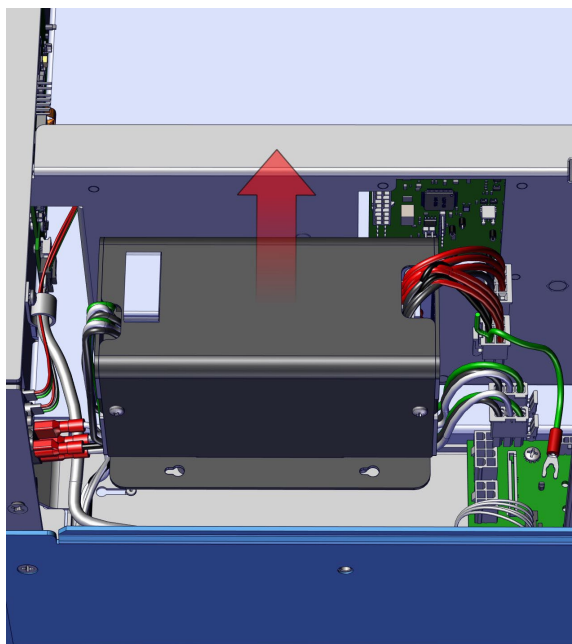
Figure 7–29. Replacing Power Supply

Step POL Board Replacement

Use the following procedure to replace the Step POL Board.

Equipment required:

Torque screwdriver, T15 or Slot screwdriver, 3/16

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

2. Unplug step pol power cable J4.

3. Unplug step pol signal cable J2.

4. Unplug pump cable J7.

5. Unfasten captive hardware.
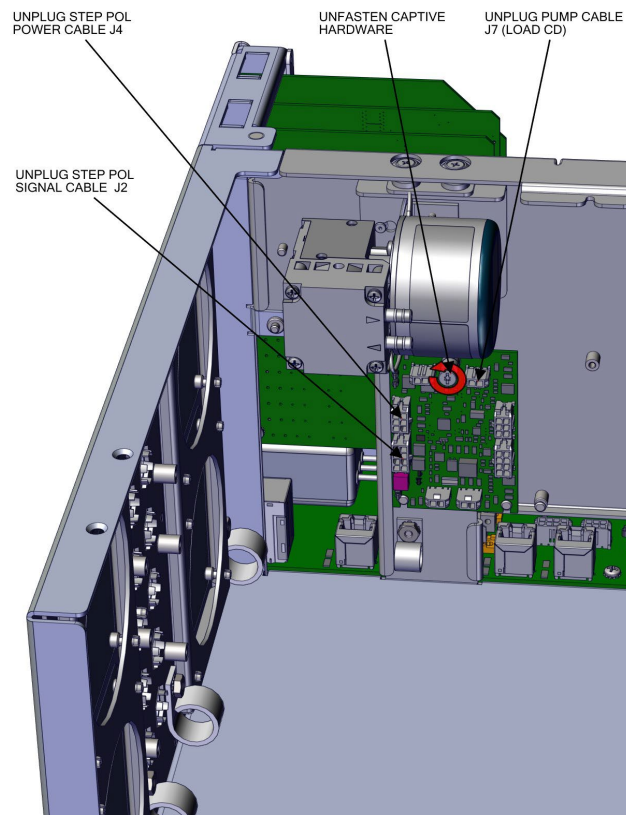
Figure 7–30. Unplug and Unfasten Step POL Board
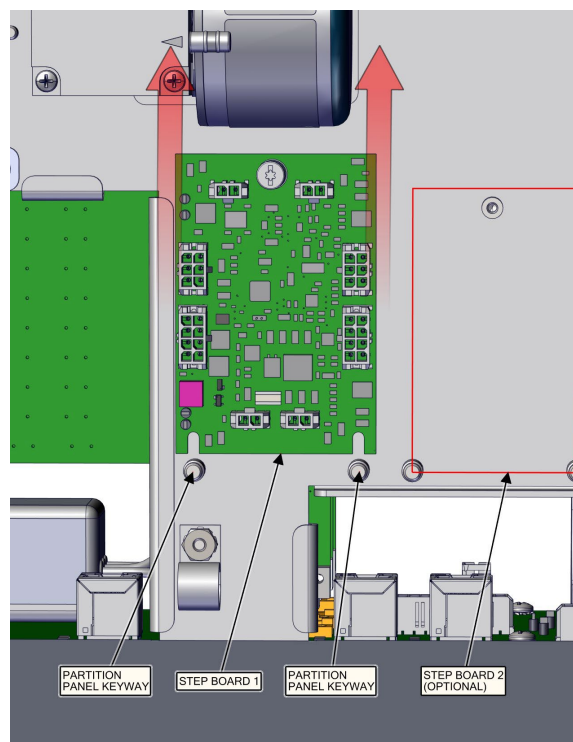
Figure 7–31. Clear Partition Keyway Step POL Board

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

7. If replacing step board 1, make sure switch 1 and 2 are pointed away from ON (Figure 7–32). If replacing optional step board 2, make sure switch 1 is pointed towards ON and switch 2 is pointed away from ON (Figure 7–33).

8. Replace step pol board and reassemble in reverse order.
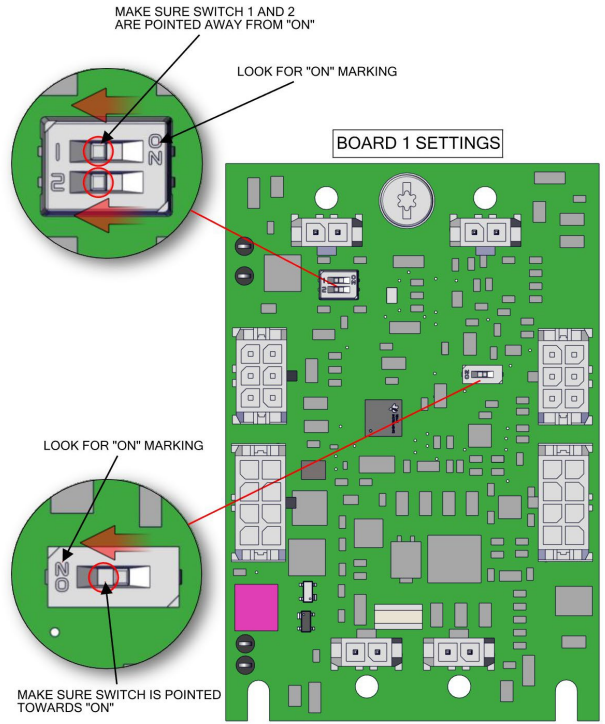
Figure 7–32. Step POL Board 1 Switch Settings
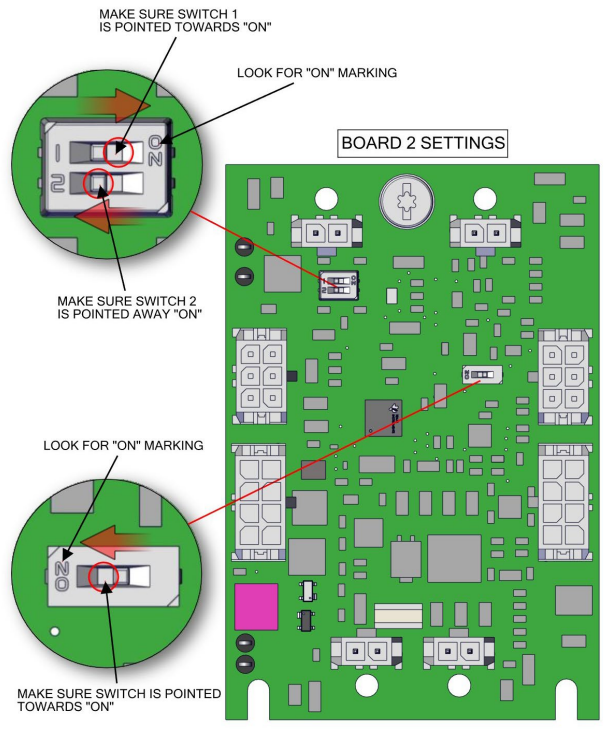
Figure 7–33. Optional Step POL Board 2 Switch Settings

DMC Optical Bench Removal

Use the following to remove the DMC optical bench from the instrument.

- Optical Bench Assembly Removal
- PMT Replacement
- Flasher Pack Replacement
- Flasher Pack Lamp Replacement
- Photo Lamp Detector Board Replacement
- Kicker Assembly Replacement

Optical Bench Assembly Removal

Use the following procedure to remove the optical bench assembly.

Equipment required:

Phillips drive, #2

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

2. Unplug two DMC cables.

3. Disconnect all plumbing.

4. Unfasten six captive hardware.

UNFASTEN 6X
CAPTIVE HARDWARE

DISCONNECT ALL
PLUMBING

UNPLUG DMC CABLES 2X
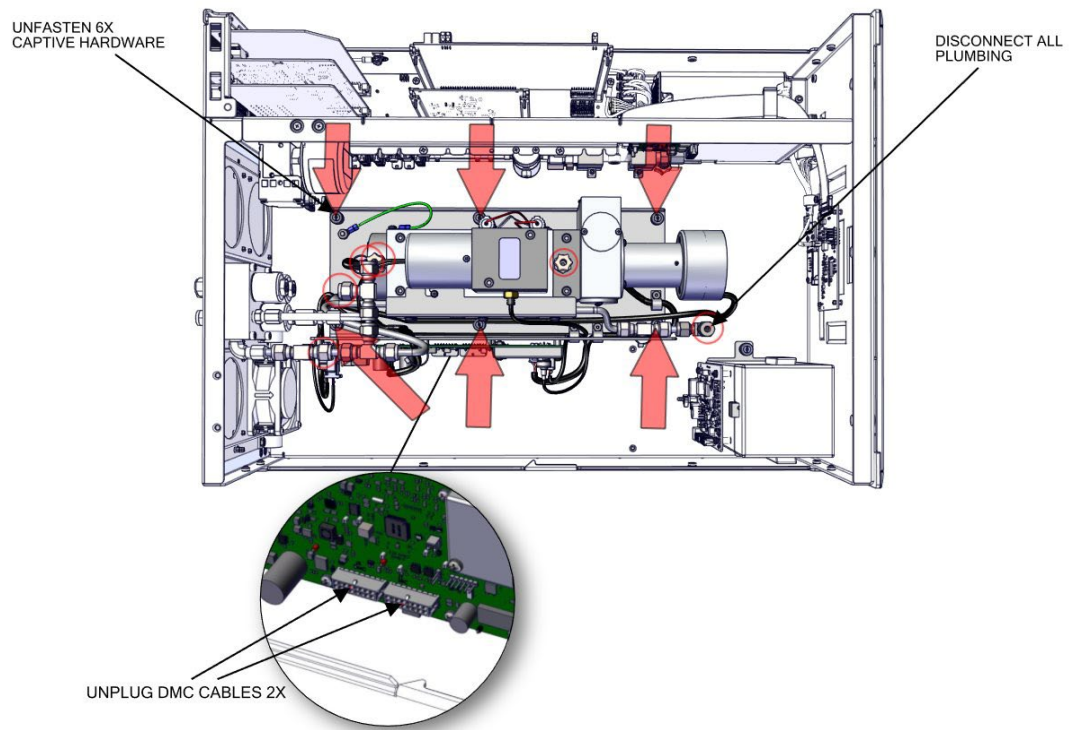
Figure 7–34. Removing the DMC Optical Bench Removal from Instrument

Optical Bench Assembly Removal

Use the following to remove the optical bench assembly.

Equipment required:

Hex nut drive, 3/8 and 5/32 and hex drive, 5/32

1. Unplug all electrical as shown (Figure 7–35).
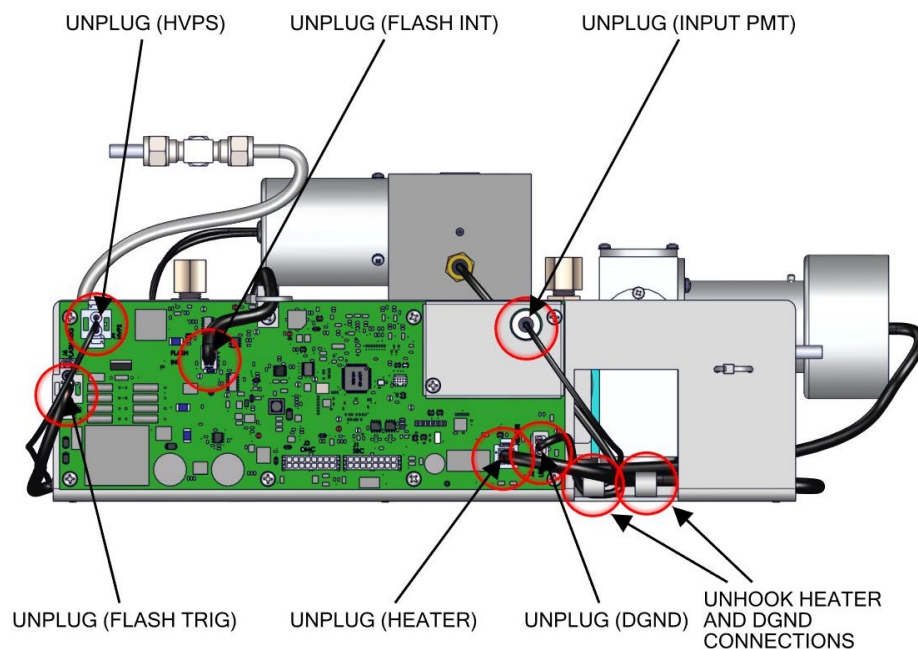
Figure 7–35. Removing the Optical Bench Assembly

2. Using 3/8 hex nut drive, unfasten nut.

3. Using 5/32 hex drive, unfasten two #10-32 socket cap head screws.

4. Pull optical bench assembly upwards (Figure 7–36).

UNFASTEN 4X SCREWS

OPTICAL BENCH
ASSEMBLY

UNFASTEN
1X NUT
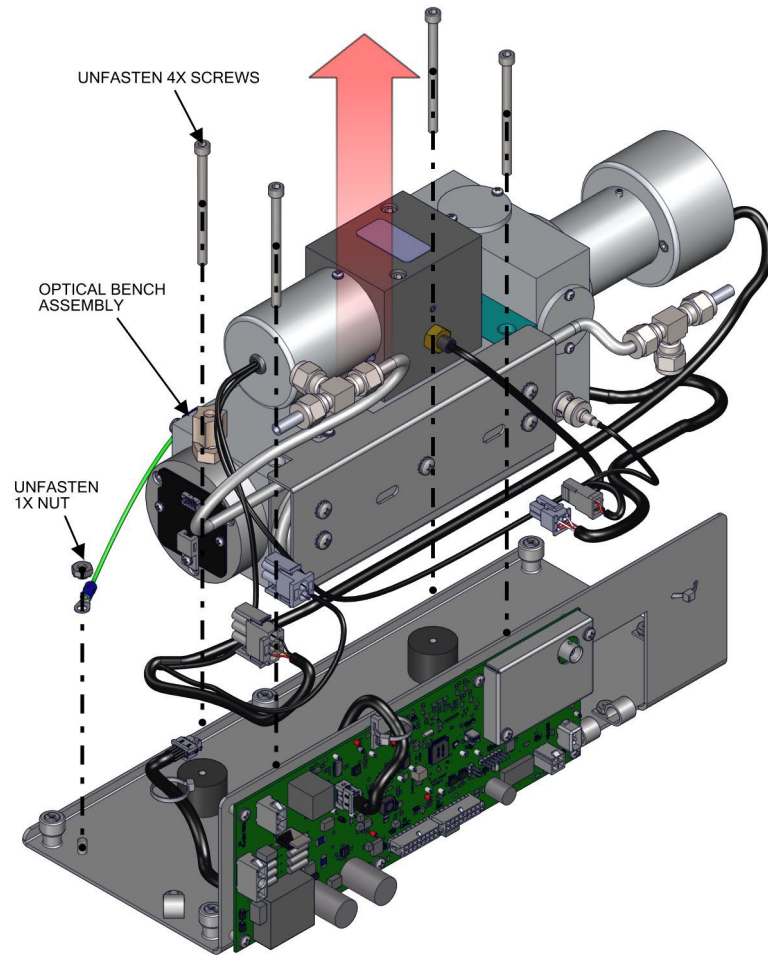
Figure 7–36. Removing the Optical Bench Assembly pt 2

Photomultiplier Tube (PMT) Replacement

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

Equipment required:

Hex drive, 5/32

Phillips drive, #1 and #2

Lint-free gloves

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

2. Unplug all electrical as shown (Figure 7–37).

3. Using 5/32 hex drive, unfasten two #10-32 socket cap head screws.

4. Pull photomultiplier housing upwards.
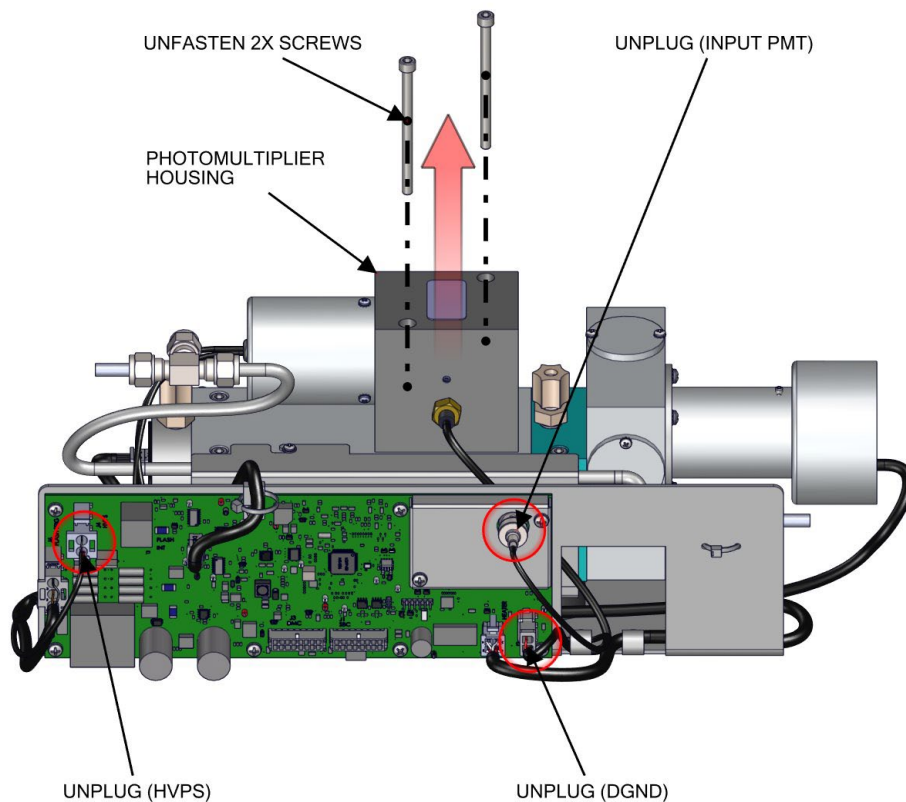
Figure 7–37. Removing the PMT Assembly

5. Using #1 Phillips drive, unfasten three #4-40 pan head screws.
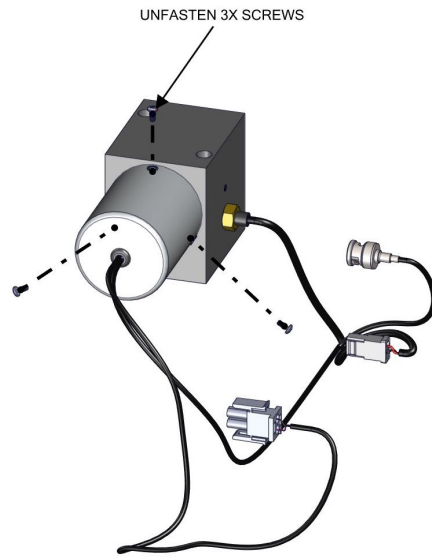
Figure 7–38. Removing the PMT Cover

6. Slide cover and grommet back.

Note Wear lint-free gloves to unplug PMT from base. ▲

7. Using #2 Phillips drive, unfasten two #6-32 pan head screws.

8. Replace PMT as needed and assemble in reverse order.
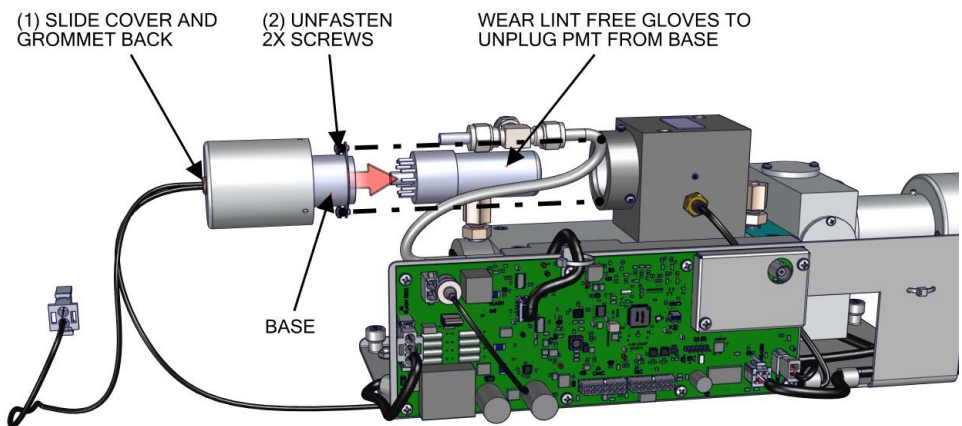
Figure 7–39. Replacing the PMT

Flasher Pack Replacement

Use the following procedure to replace the flasher pack.

Equipment required:

Hex drive, 1/16

1. Unplug flash trig from board.

2. Loosen 6-32 set screw until the flasher pack/lamp can be eased out of housing.
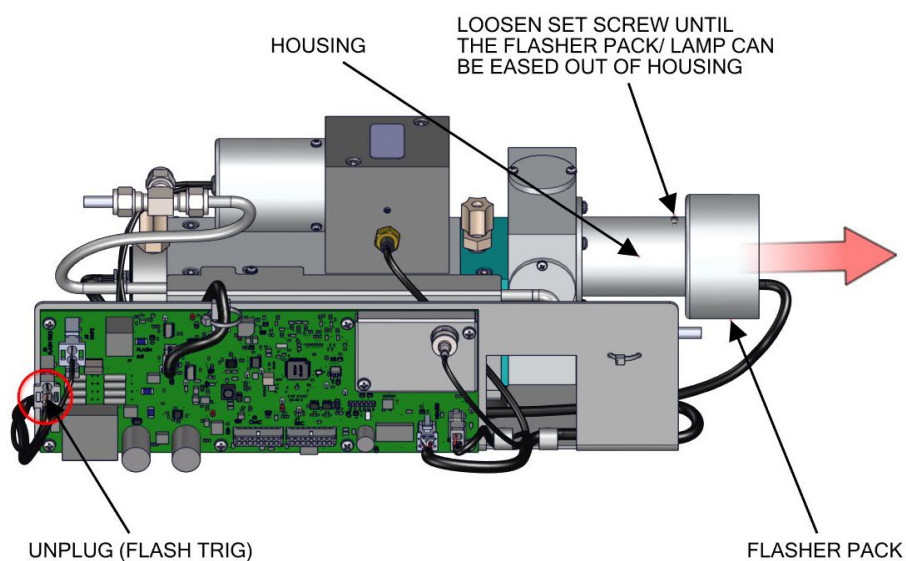
Figure 7–40. Removing and Replacing the Flasher Pack

Flasher Pack Lamp Replacement

Use the following procedure to replace and flasher pack lamp.

Equipment required:

Lint-free gloves

1. Wearing lint-free gloves unplug the lamp from the flasher pack.

WEARING LINT FREE
GLOVES UNPLUG THE LAMP
FROM FLASHER PACK
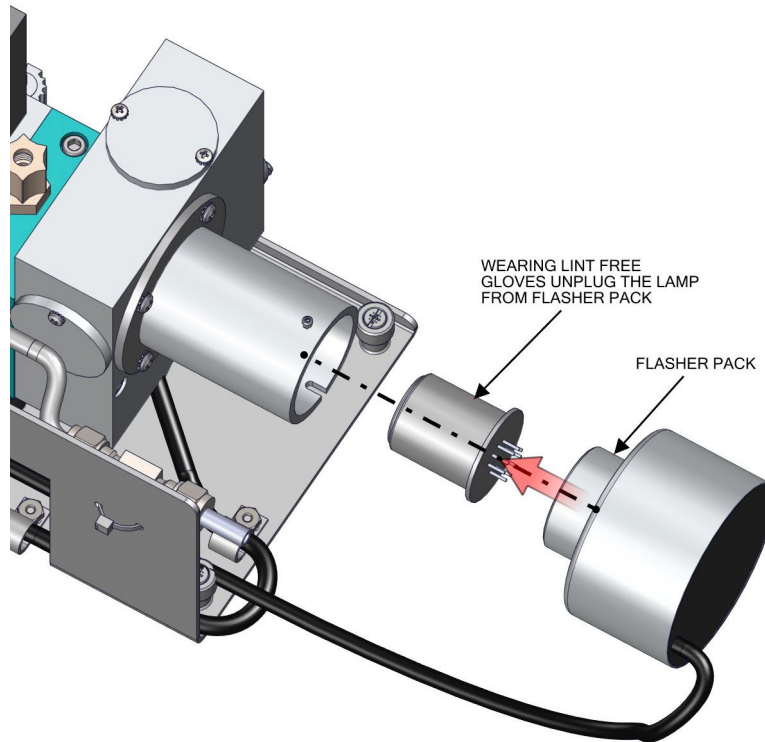
FLASHER PACK

Figure 7–41. Replacing the Flasher Pack Lamp

2. Replace flasher pack lamp and assemble in reverse order.

Photo Lamp Detector Board Replacement

Use the following procedure to remove and replace the photo lamp detector board.

Equipment required:

Phillips drive, #1 and #2

1. Unplug cable.

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

UNPLUG CABLE   UNFASTEN 3X SCREWS
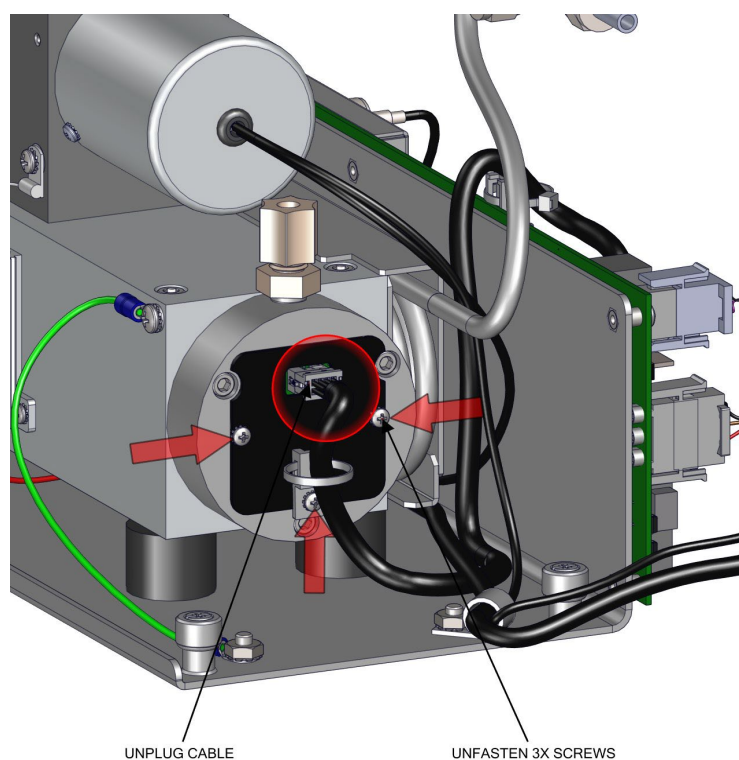
Figure 7–42. Replacing the Photo Lamp Detector Board pt 1

3. Pull detector cover outwards.

4. Using #1 Phillips drive, unfasten four #4-40 pan head screws.

5. Pull photo lamp detector board outwards.

6. Replace lamp detector board and assemble in reverse order.

UNFASTEN
3X SCREWS

PHOTO LAMP
DETECTOR BOARD
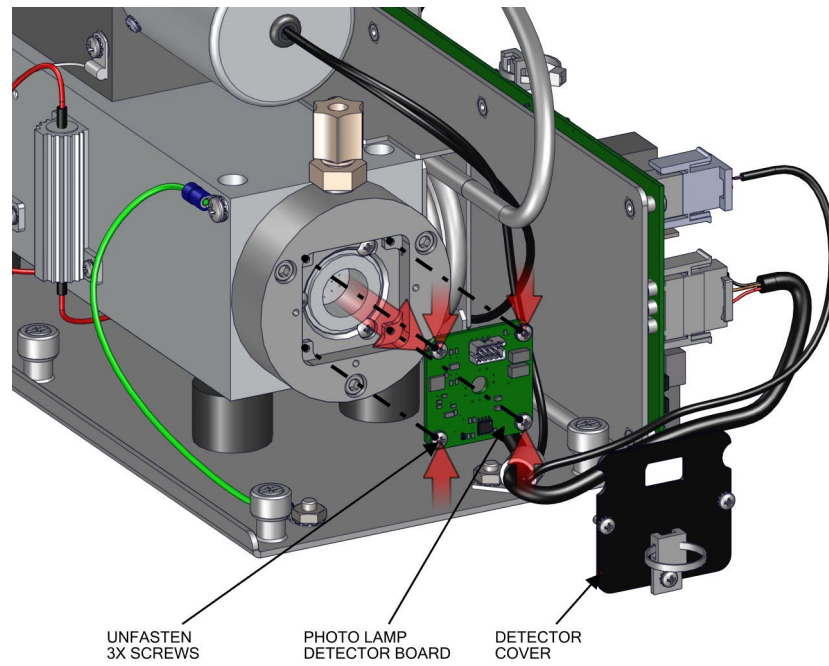
DETECTOR
COVER

Figure 7–43. Replacing the Photo Lamp Detector board pt 2

Kicker Assembly Replacement

Use the following procedure to replace the kicker assembly (Figure 7–44).

Equipment required:

Phillips drive, #1

1. Disconnect plumbing as shown.

2. Loosen 4-40 screw. Slide kicker assembly towards opening of keyway.

⚠ **Equipment Damage** Do not loosen or tighten this side of fitting as the internal tubing will twist blocking flow. These fittings are covered by silicone tape as a reminder. ▲

3. Once kicker assembly clears the keyway, pull outwards towards the board and up.

Figure 7–44. Removing and Replacing the Kicker Assembly

4. Replace the kicker assembly and assemble in reverse order.

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.
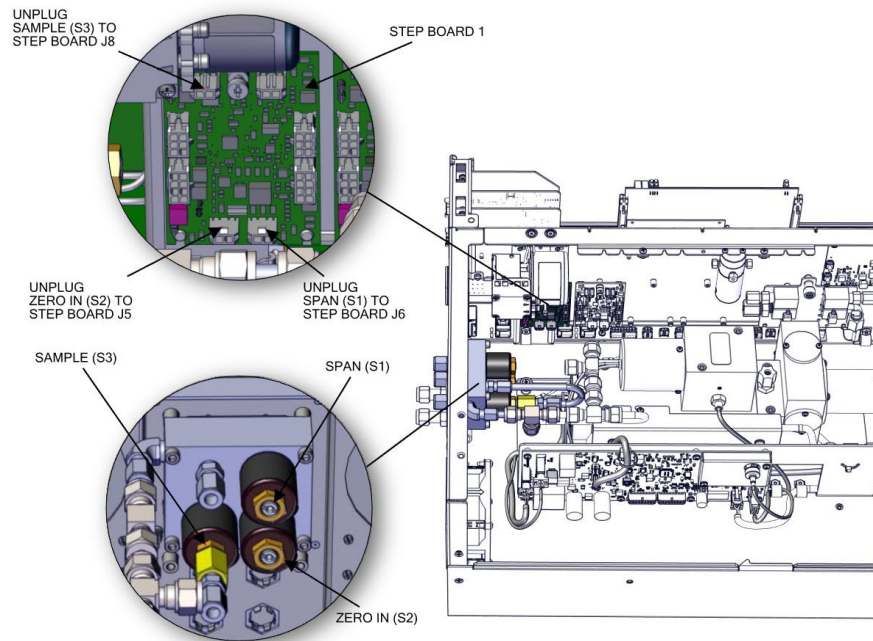
Figure 7–45. Replacing the Manifold pt 1

3. Unfasten three nuts. Remove the nuts, front and back ferrules as shown from span, zero in, sample back panel (Figure 7–46).
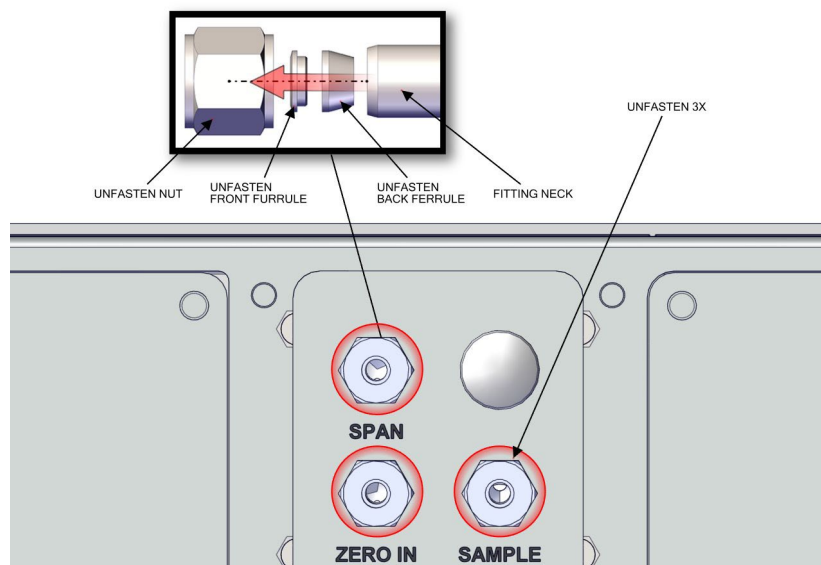
Figure 7–46. Replacing the Manifold pt 2

4. Unfasten fitting nut and slide tee fitting assembly off.

5. Unfasten four #8-32 screws.
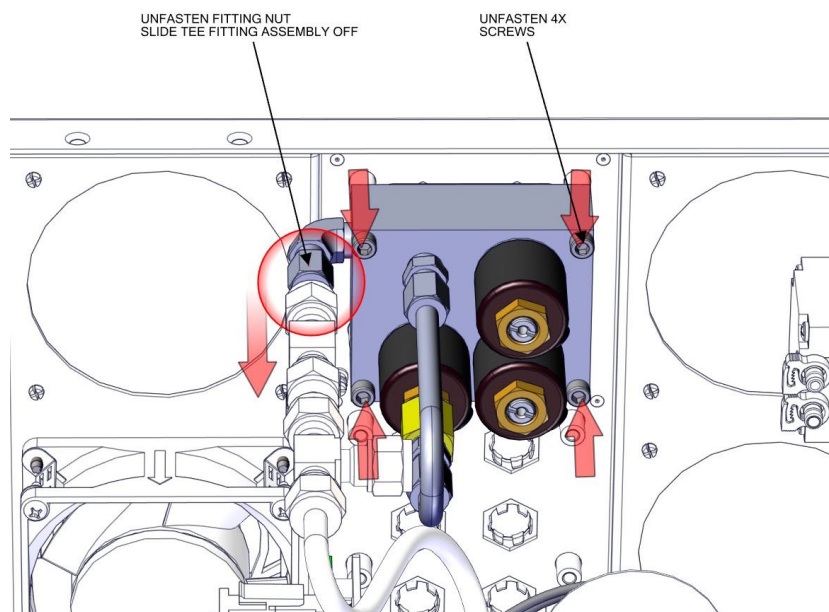
Figure 7–47. Replacing the Manifold pt 3

6. Replace the manifold and assemble in reverse order.

Optional DMC Permeation Oven Solenoid Valve Replacement

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

Equipment required:

Phillips drive, #1

⚠CAUTION

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

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

2. Unplug perm valve J7 from step pol board 2.
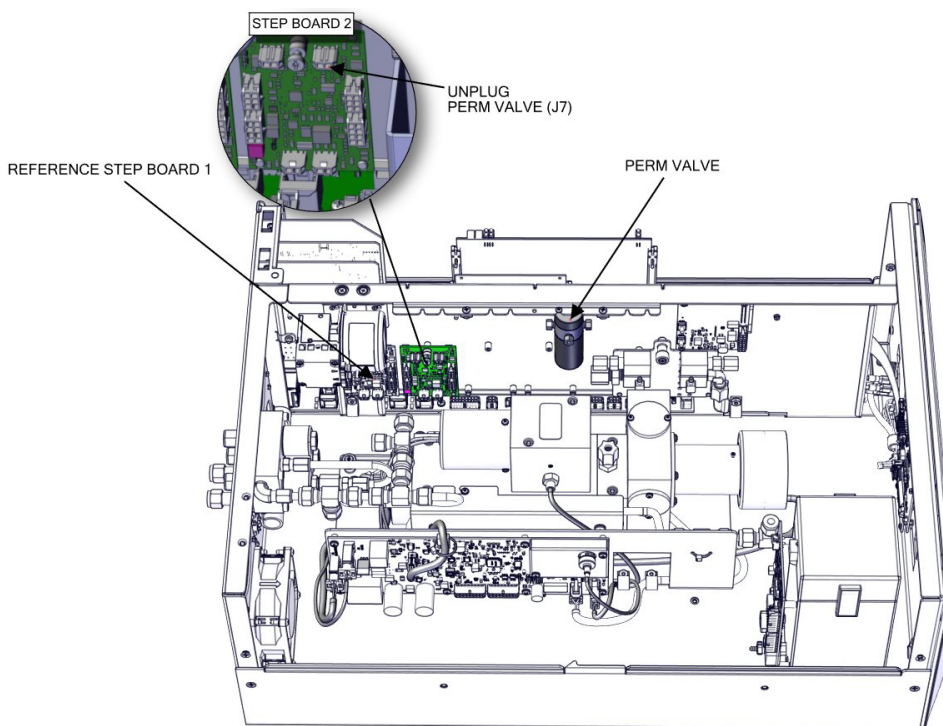
Figure 7–48. Removing and Replacing the Solenoid Valve pt 1

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

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

DO NOT DISCONNECT THE PLUMBING FROM THE VALVE END
DISCONNECT FROM THE ATTACHING END ONLY
THIS WILL PREVENT DAMAGING AND LEAKS FROM THE VALVE END

LOOSEN 2X SCREW
SLIDE OPTIONAL
PERM VALVE OUT
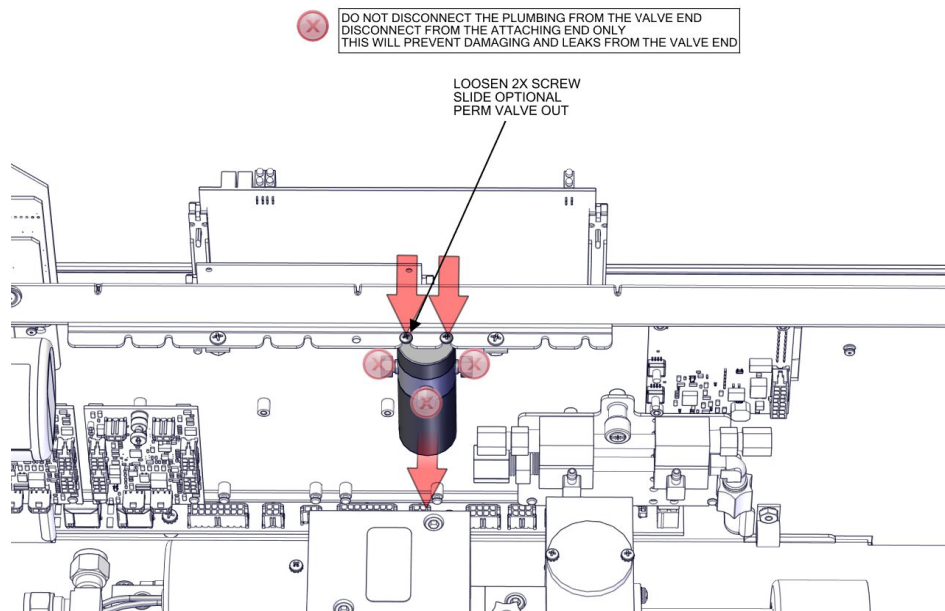
Figure 7–49. Removing and Replacing the Solenoid Valve pt 2

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

Permeation Oven Replacement

Use the following procedure to replace the permeation oven.

Equipment required:

Phillips drive, #2

Tube release tool (optional)

⚠CAUTION

CAUTION Allow oven to cool down prior to servicing. ▲

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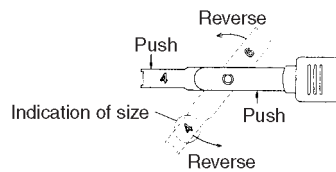
2. Unplug DMC cables as shown.

3. Disconnect plumbing.

UNPLUG DMC CABLES

DISCONNECT PLUMBING
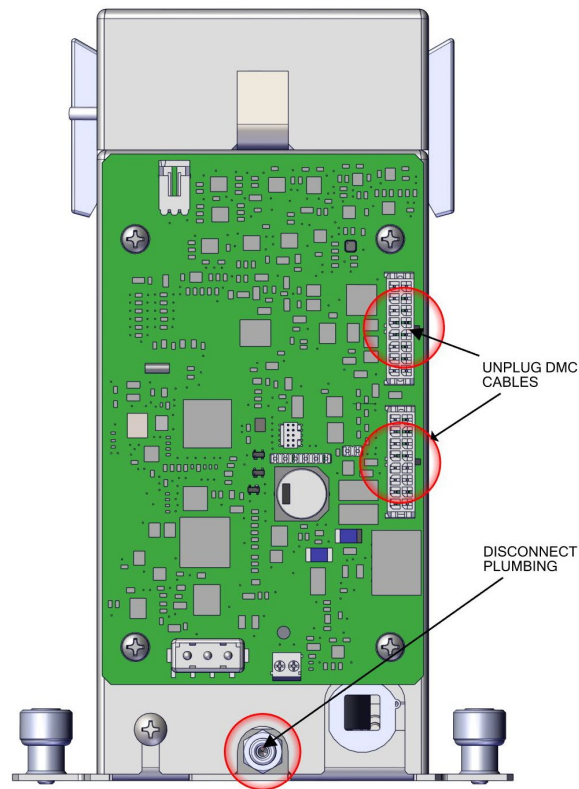
Figure 7–50. Perm Oven pt 1

4. Push in fitting head evenly with fingers towards fitting body.
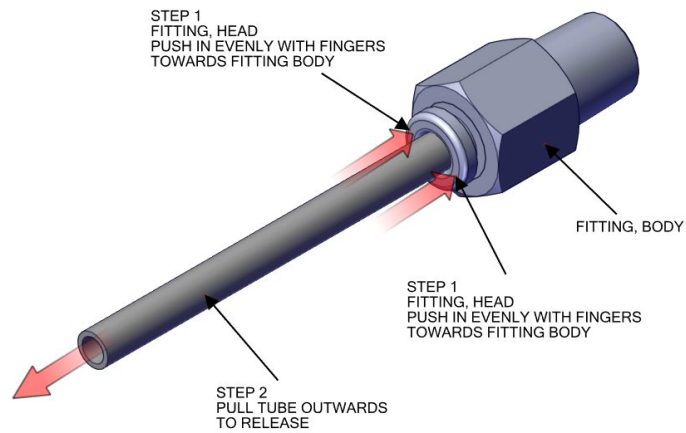
Figure 7–51. Finger Push and Release Tubing

5. Pull tube outwards to release. If using the tool provided:

   a. Adjust tool size to 1/4 tube as indicated on the back side.

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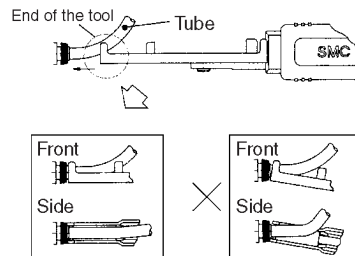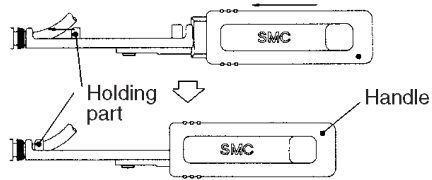

   c. After inserting, grasp handle tightly and insert the end of the tubing to the stroke end.

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

   d. After inserting end of tube, relax your grip on the tool. Returning force of spring releases the tube.
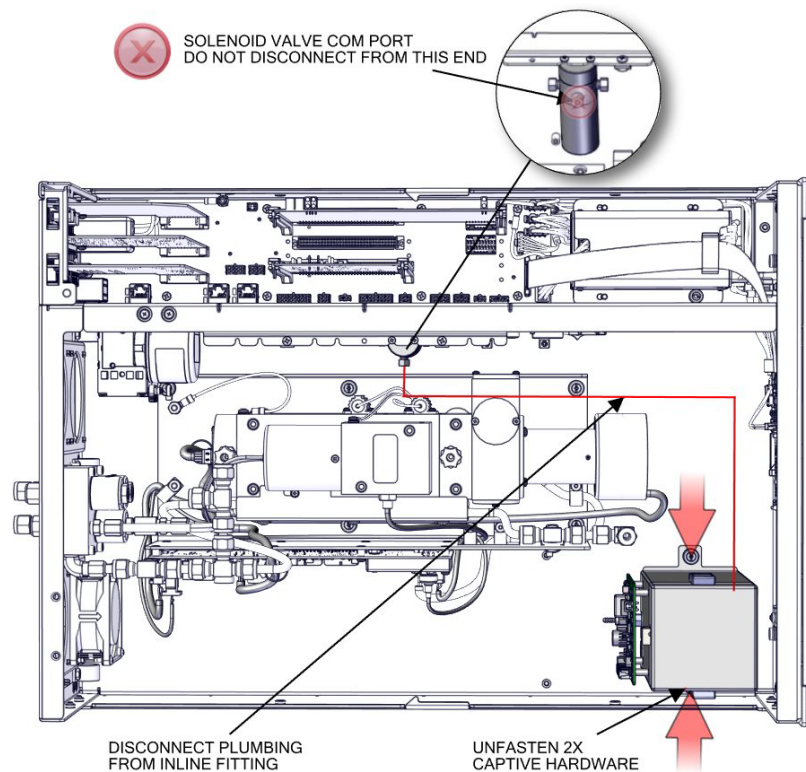
Push both sides at once to release. Reverse and fix at the same position as before. Applicable tube size is indicated on the back side.

6. Disconnect plumbing from inline fitting.

Note Do not disconnect from valve end. ▲

7. Unfasten two captive hardware.

Figure 7–52. Perm Oven Replacement pt 2

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

Permeation Oven Board Replacement

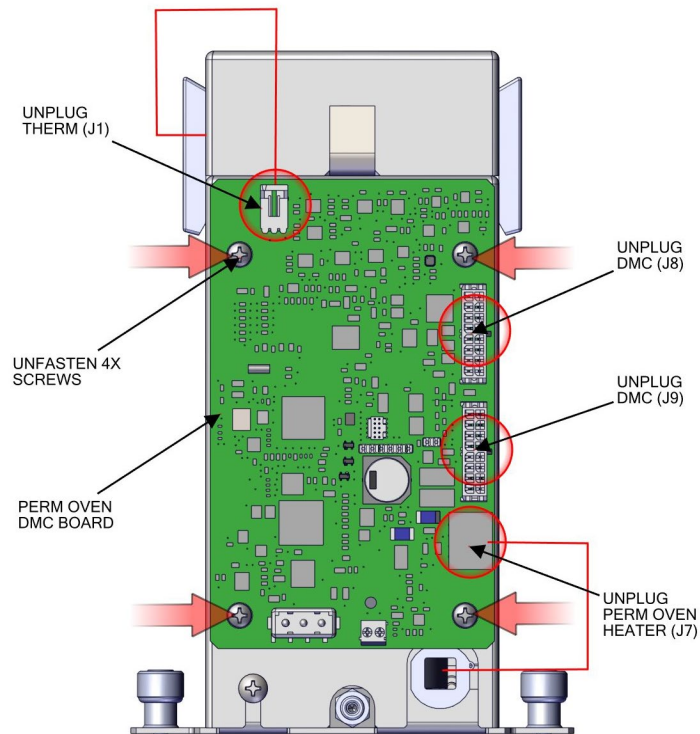Use the following procedure to replace the permeation oven board.

Equipment required:

Phillips drive, #2

⚠CAUTION

CAUTION Allow oven to cool down prior to servicing. ▲

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

2. Unplug all electrical J1, J7, J8, J9 as shown.

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

Figure 7–53. Replacing the Permeation Oven Board

4. Replace permeation board and assemble in reverse order.

Chapter 8
System Description

The 43iQ 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 43iQ system components include:

- Optical Bench DMC

    - Heated hydrocarbon kicker

    - Optical Bench hardware with bandpass filters and mirrors

    - Flash lamp trigger assembly

    - Photomultiplier tube (PMT)

    - Photodetector

    - Optical bench DMC board

- Permeation Oven (optional)

- Common Electronics

    - Power Supply

    - System controller board

    - Backplane board

    - Front panel

    - I/O (optional)

- Peripherals Support System

    - Fan (on rear panel)

    - Step POL board

    - Sample pump

    - Solenoid valve panel (optional)

- Flow Pressure DMC with flow restricting capillary

- Firmware

Optical Bench DMC

The Optical Bench DMC contains the key components of the optical measurement that eventually results in SO_2 concentration. In the reaction chamber pulsating light from the flash lamp excites the SO_2 molecules. A condenser lens collects and focuses light from fluorescing SO_2 molecules onto the PMT assembly.

Heated Hydrocarbon Kicker

The heated hydrocarbon kicker removes hydrocarbons from the gas stream while leaving the SO_2 concentration unaffected. It operates on a selective permeation principle using differential pressure to force hydrocarbon molecules to pass through the tube wall. The differential pressure is created across the tube wall as sample gas passes through a capillary tube which reduces its pressure. The sample gas is then fed to the shell side of the hydrocarbon kicker. The heated kicker operates at the same temperature as the optical bench and requires no additional power.

Optical Bench Hardware

The optics section provides the light source for the fluorescence reaction and optimizes the reaction with a system of lenses and mirrors. It includes a flash lamp, condensing lens, bandpass mirror assembly and light baffle.

Condensing Lens

The condensing lens focuses light from the flash lamp into the mirror assembly.

Mirror Assembly

A set of four mirrors selectively reflects only those wavelengths used in exciting SO_2 molecules. This reflective filtering causes the radiation reaching the detection chamber to be more intense and more stable throughout the lifetime of the instrument.

Light Baffle

The circular baffle helps keep stray light from entering the detection volume.

Bandpass Filter

The bandpass filter restricts the light reaching the photomultiplier tube to the SO_2 fluorescence wavelengths.

Flash Lamp Trigger Assembly

The flash lamp trigger assembly pulses the UV flash lamp at a rate of 10 times per second for improved signal-to-noise ratio and long term stability.

The lamp is operated in the pulsed mode for six major reasons:

- Long life
- High optical intensity – improved signal to noise ratio
- Small size
- Low power requirements – less than 1 watt
- Long-term stability
- Chopped signal processing – no dark current drift

Flash Lamp

The flash lamp provides the ultraviolet light source that causes the fluorescence reaction in the SO_2 molecules.

Flash Trigger Board

The flash trigger board is located in the base of the flash lamp assembly. It receives high voltage and the trigger signal from the measurement interface board and uses a small transformer to produce a short, high-voltage pulse to fire the flash lamp.

Flash Intensity Assembly

The flash intensity assembly is located in the fluorescence chamber and continuously monitors the pulsating UV flash lamp. This photodetector is connected to a circuit that automatically compensates for fluctuations in flash lamp output.

Photomultiplier Tube

The PMT power supply produces high voltage to operate the photomultiplier tube used in the measurement system. The output voltage is adjustable from approximately 600 to 1200 volts under software control. The PMT converts optical energy from the reaction to an electrical signal. This signal is sent to the input board which transmits it to the processor.

Optical Bench DMC Board

The optical bench DMC board accepts the current signal from the PMT and converts it to a voltage, which is scaled by a factor of approximately 1, 10, or 100 depending on the full-scale range of the SO_2 channel.

Bench Heater

The fluorescence chamber temperature is measured with a thermistor. The voltage across the thermistor is fed to the main processor for use in calculating and displaying the reaction chamber temperature. The voltage across the thermistor is also compared to a set-point voltage and used to control that the reaction chamber heaters to maintain a constant temperature.

Permeation Oven (Optional)

The 43iQ can be configured with an optional permeation oven for generating SO_2 span gas. The permeation oven is configured as a DMC module with self-contained temperature measurements and heater controls. For more information, see "Internal Permeation Span Source" as described in Chapter 9, "Optional Equipment".

Common Electronics

The common electronics contain the core computational and power routing hardware for the 43iQ, and is replicated throughout other iQ series products (Figure 8–1). It also contains the front panel display, the USB ports, the Ethernet port, and the optional I/O interfaces (RS-485, analog, and digital).

Figure 8–2 shows the PCBA interconnect structure for the 43iQ, including options. The modular design of the instrument is conveyed in the architecture. Brief descriptions of the specific PCBAs follow.
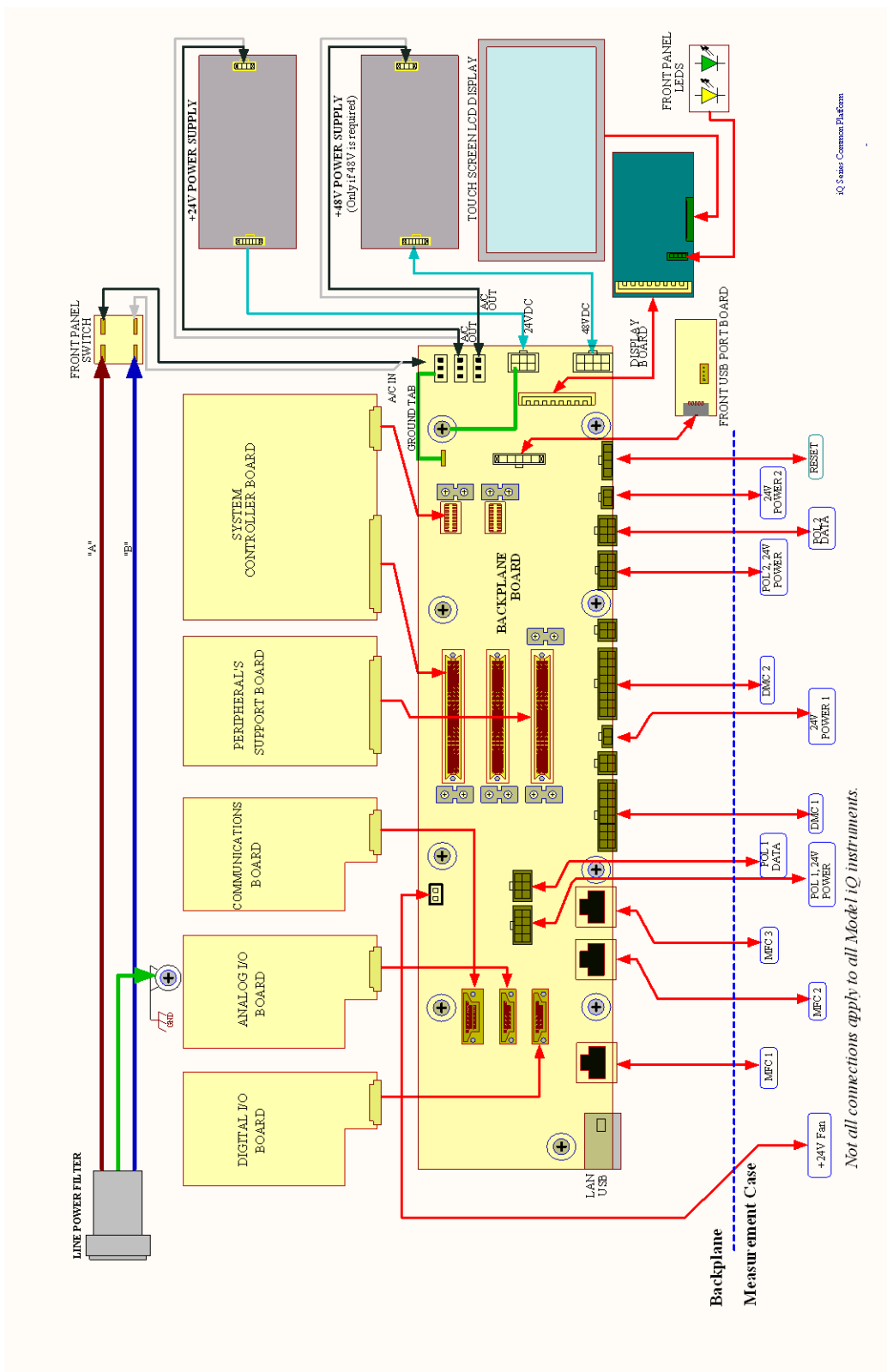
Figure 8–1. Common System Interconnect Diagram
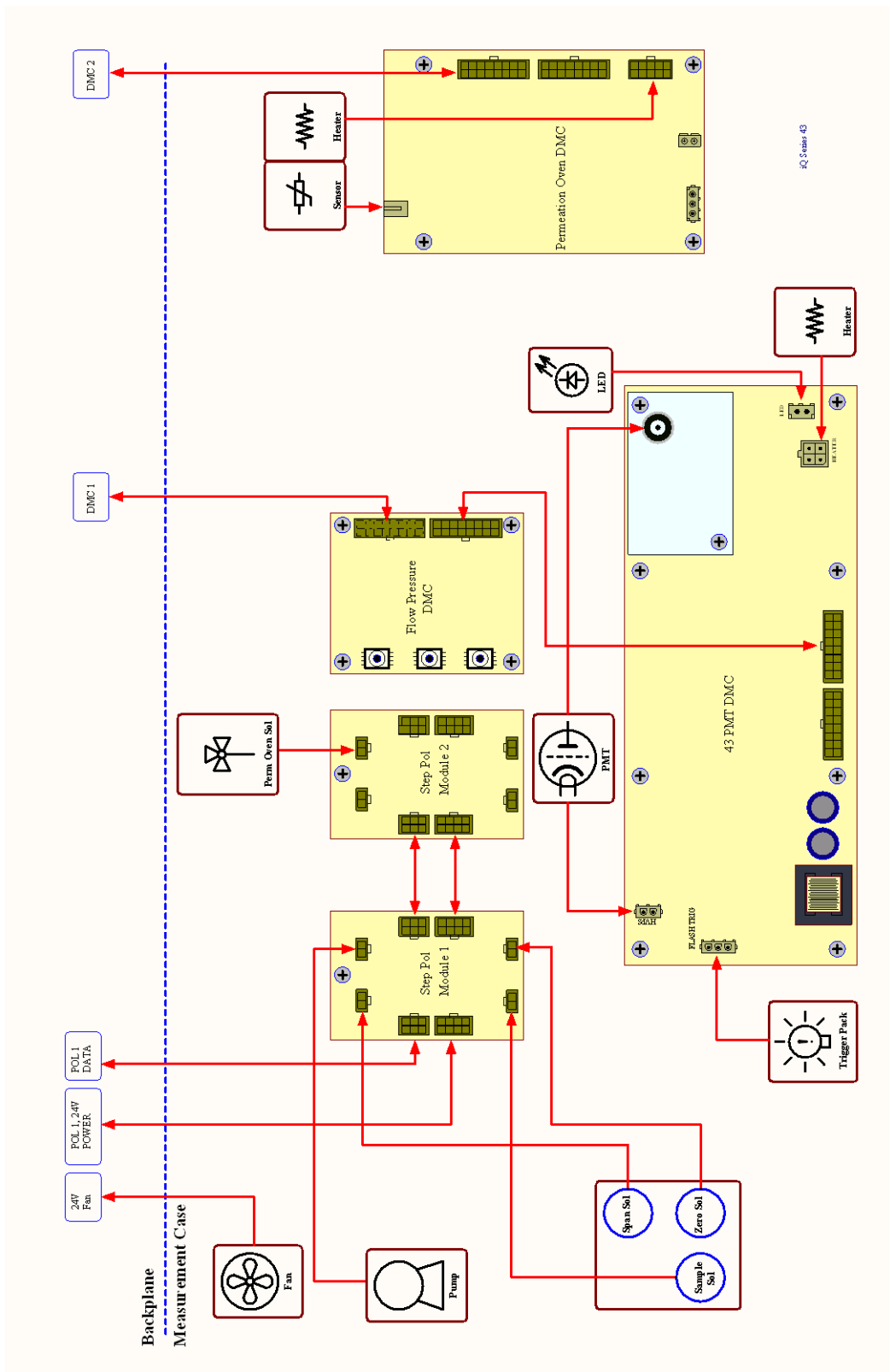
Figure 8–2. 43iQ System Interconnect Diagram

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 43iQ 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, 2 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 RS485 communication with and powering of DMCs and the Step POL Module. It additionally routes the front panel display and driver, external USB and Ethernet.

Peripherals Support System

The peripheral 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.

Sample Pump

Internal vacuum pump for generating air/sample through the instrument

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 is used measure instrument pressures that assure proper flow regulation and for sample pressure within the measurement bench for pressure corrections and compensation.

The DMC includes two pressure sensors that read 0-860 mmHg. These sensors are used with the coupled restricting capillary for flow control along with the downstream sample pump. The pressure differential determines the flow through the capillary. The upstream pressure is the measurement bench pressure, while the downstream pressure is at the pump inlet pressure.

Firmware

Like the hardware, the firmware is modular and located within microprocessors distributed throughout the instrument. In the 43iQ, microprocessors containing firmware are located as follows:

- Optical Bench DMC
- Flow/Pressure DMC
- Peripherals Support Board
- Optional I/O (Communications, Digital, and Analog)

- Optional Permeation Oven

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 43iQ 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.
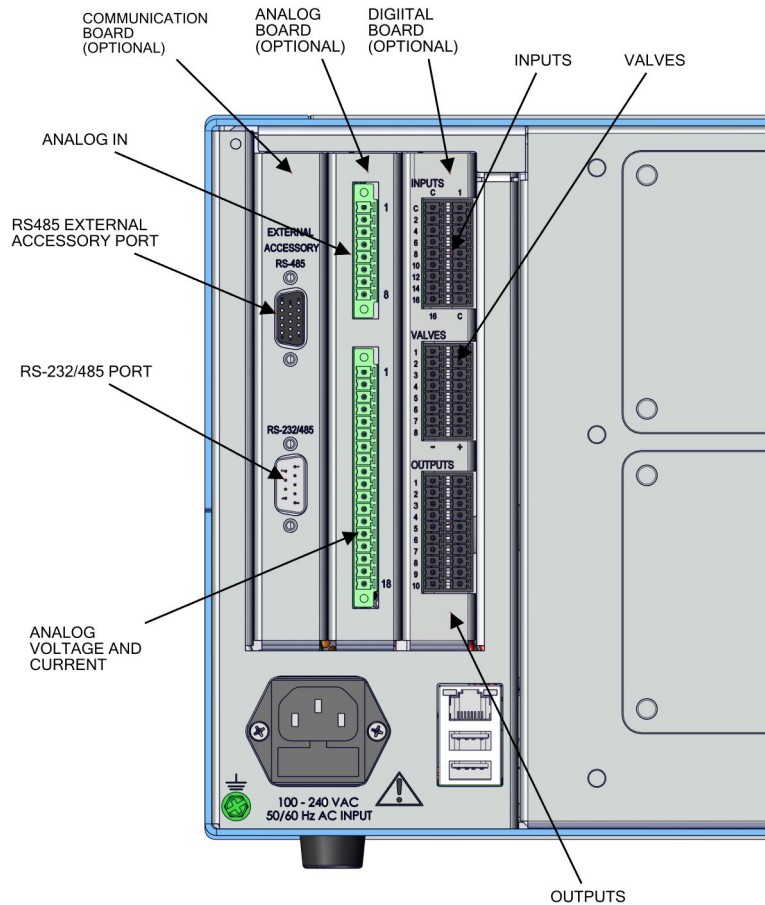
Chapter 9
Optional Equipment

The 43iQ 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

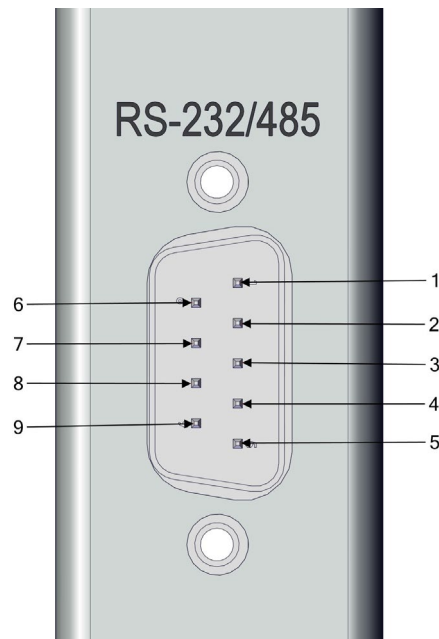**Figure 9–1.** I/O Expansion Replacement Boards

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.
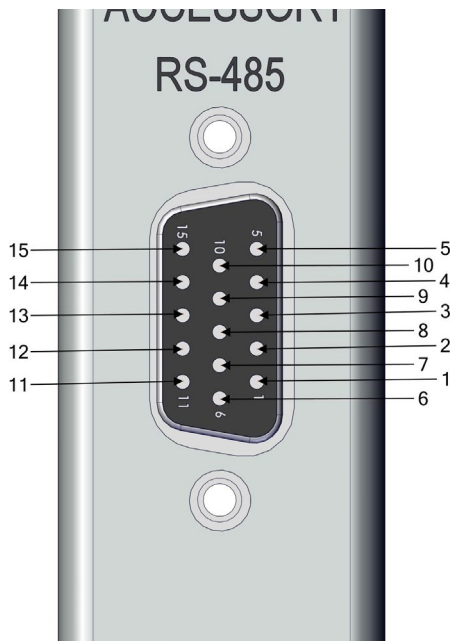
Figure 9–3. RS-485 External Accessory Port

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.
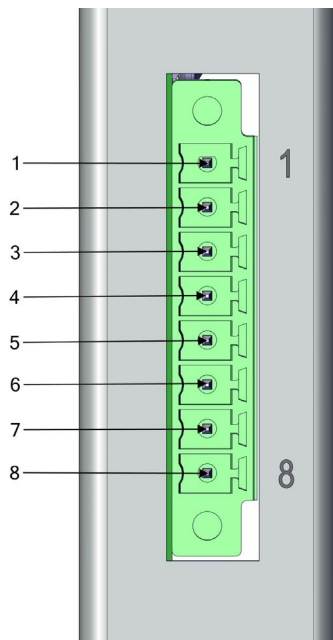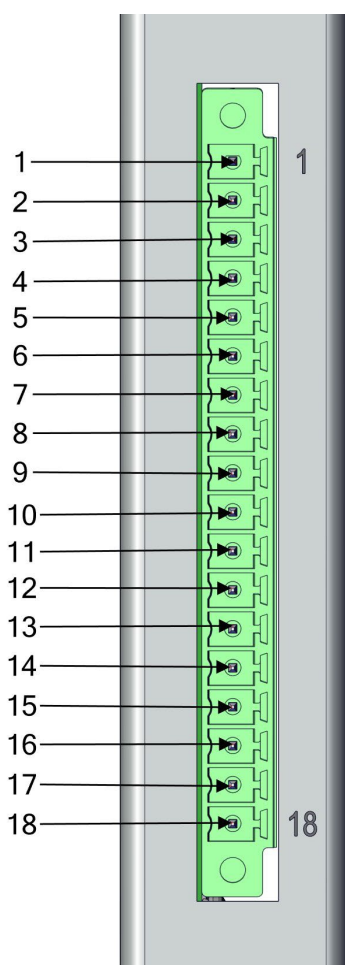

Figure 9–4. Analog Voltage Inputs

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.

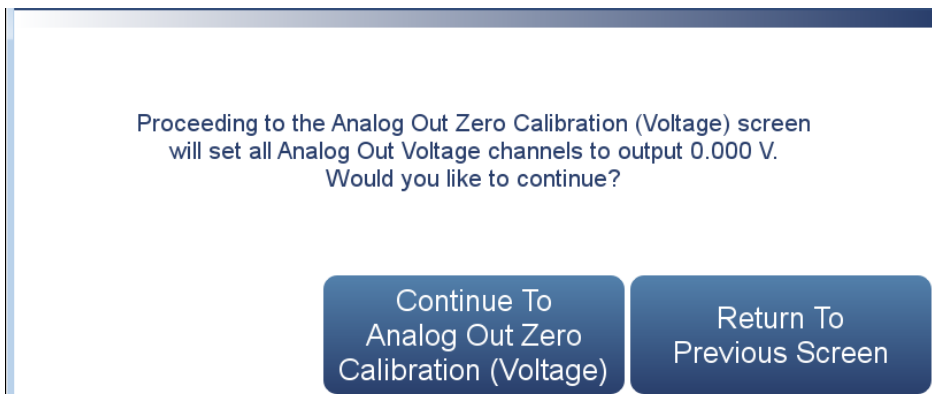**Note** This adjustment should only be performed by an instrument service technician. ▲

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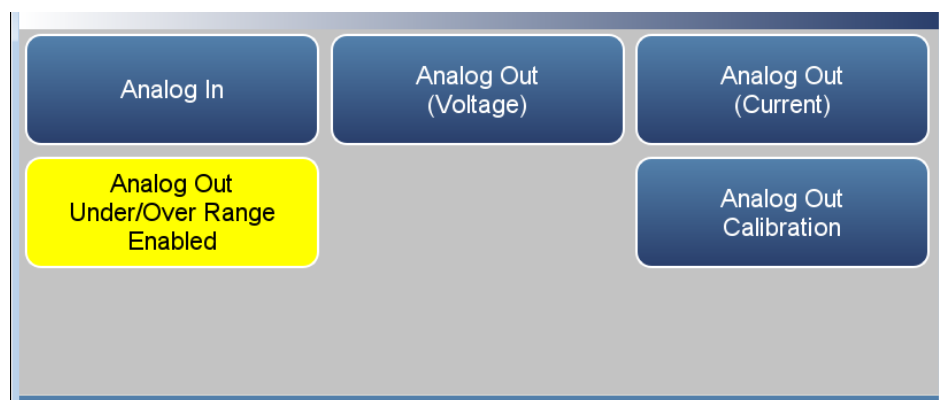
2. Depending on the output type being used, select either Analog Out Zero Calibration (Voltage) or Analog Out 4.000 mA Calibration (Current).
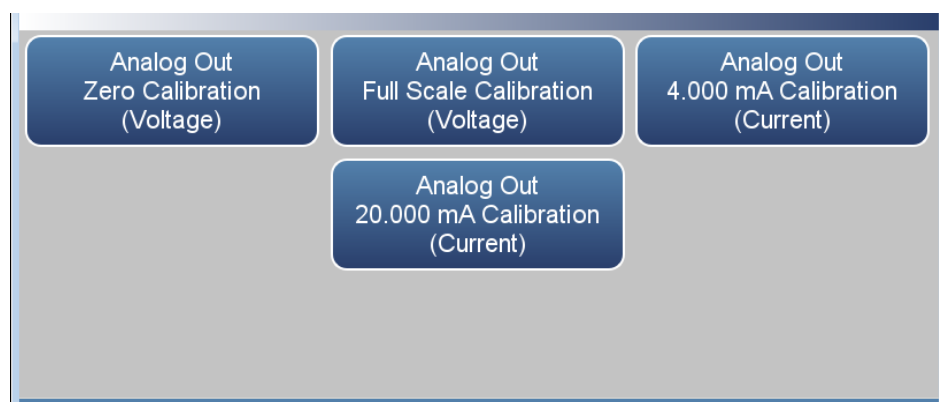
3. A confirmation screen is presented. Select Continue to proceed with the calibration or Return to Previous Screen.

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.

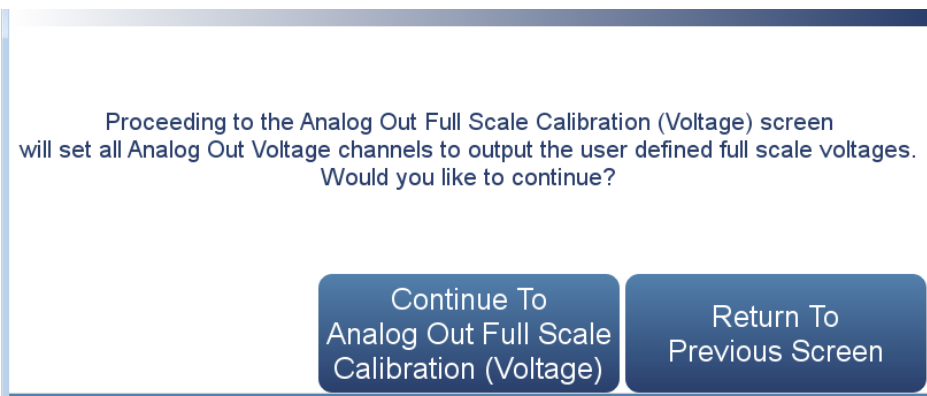**Note** This adjustment should only be performed by an instrument service technician. ▲

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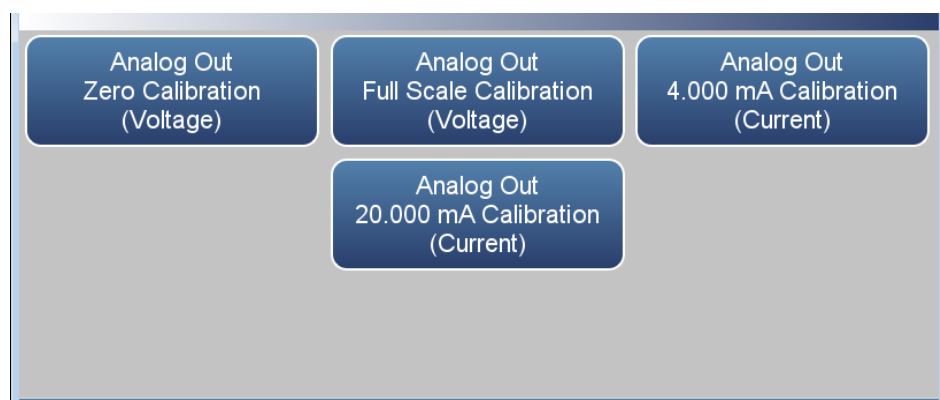
3. A confirmation screen is presented. Select Continue to proceed with the calibration or Return to Previous Screen.

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
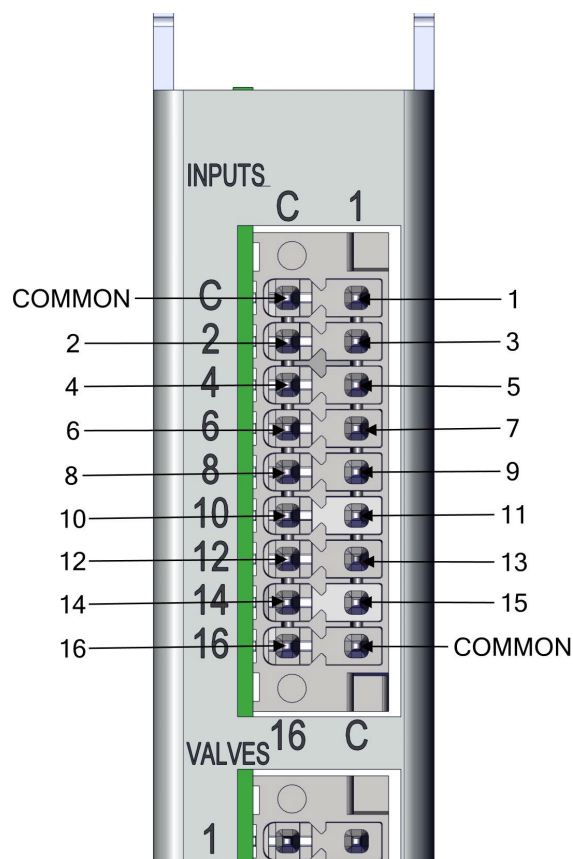- Absolute allowable input voltages: -0.5 to 5.5 V

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
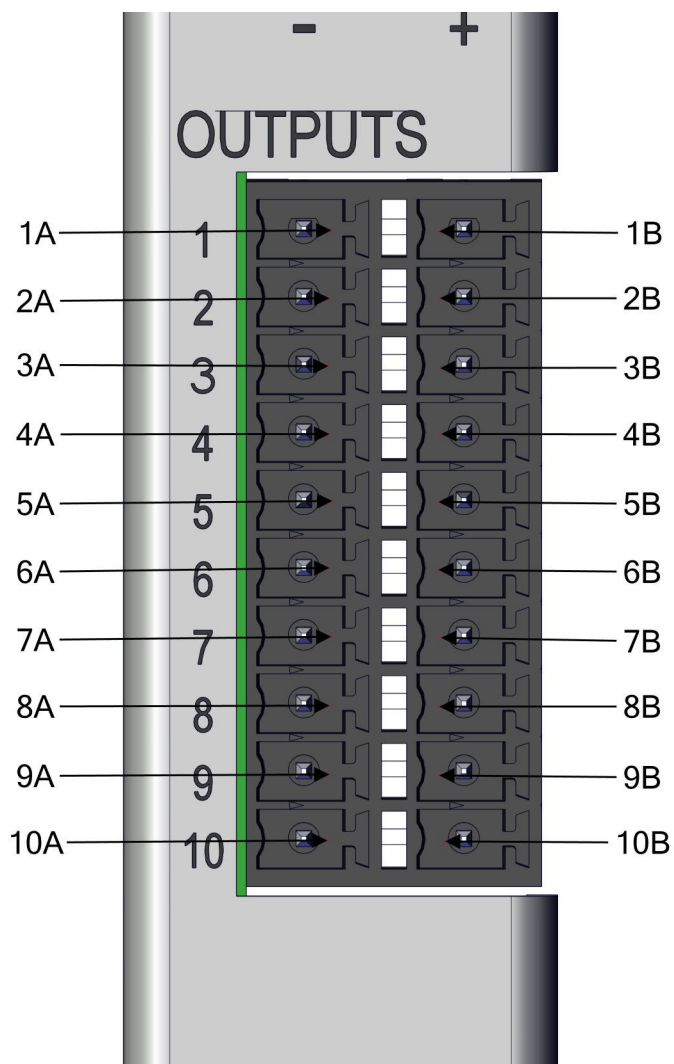
Figure 9–7. Digital Relay Switches

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

- Maximum Current: 300 mA

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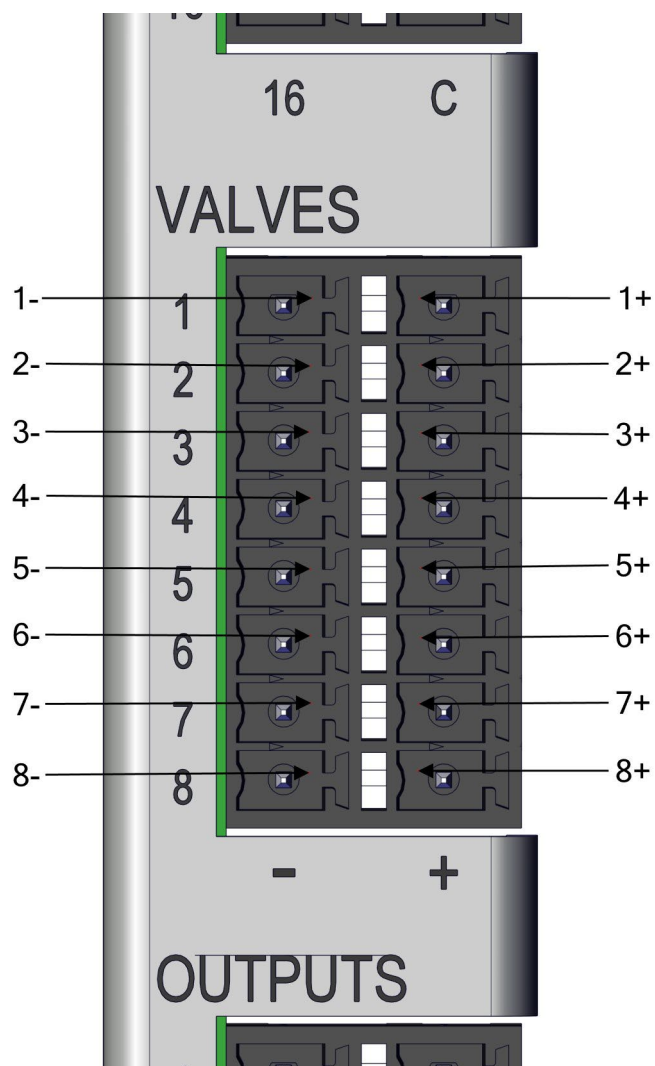
Figure 9–8. Valve Driver Outputs

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. 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.

Internal Permeation Span Source

The Internal Permeation Span Source option is designed to provide a simple span check. This option is intended as a quick, convenient check to be used between zero and span calibrations for determining instrument malfunction or drift. Because this option does not precisely control dilution gas flow, it should not be used as a basis for instrument zero and span adjustments, calibration updates or adjustment of ambient data.

Whenever there is an indication of possible instrument drift or malfunction, a full zero and calibration (Level 1) should be performed prior to corrective action. For further information on zero, span and calibration of air pollution monitors, refer to Section 2.0.9 of the US EPA's *Quality Assurance Handbook for Air Pollution Measurement Systems (Volume II)*.

Figure 9–9 shows how this option is integrated with the 43iQ components. During normal operation, the pump draws zero air through the permeation oven and out the instrument exhaust. When performing a single point span check, the sample valve is energized, closing the sample valve, and the Perm valve is energized, opening the perm valve. This directs the zero air/SO_2 gas mixture from the permeation oven gas through the heated hydrocarbon kicker and into the optical bench.
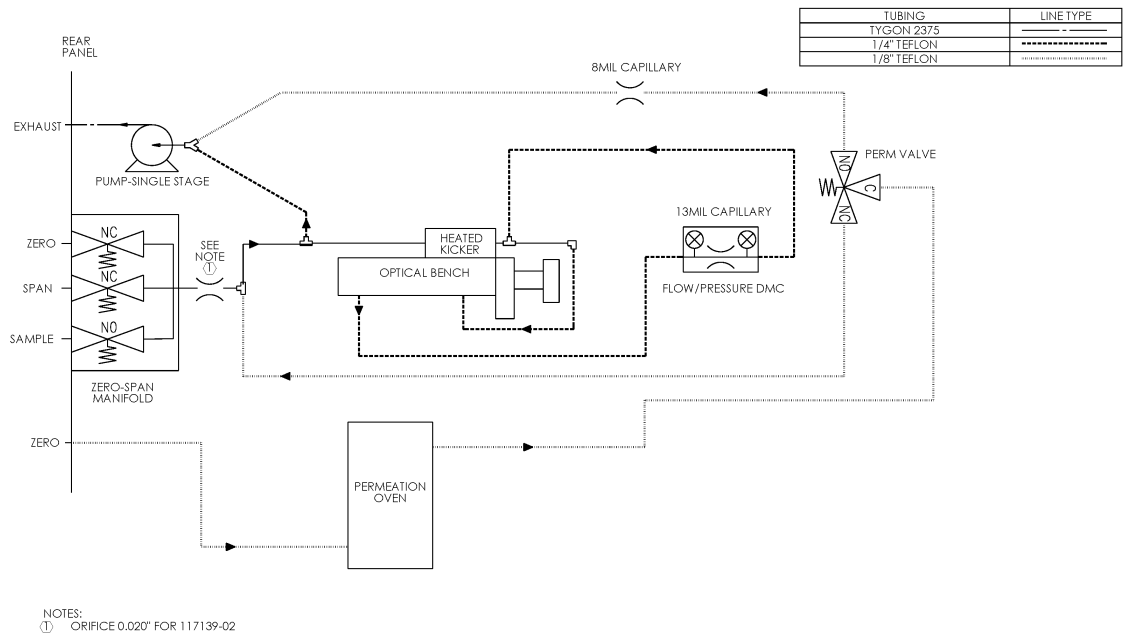
Figure 9–9. Internal Permeation Span Source Flow Diagram

Permeation Tube Installation

Use the following procedure to install the permeation tube.

⚠CAUTION

CAUTION Allow oven to cool down prior to servicing. ▲

1. Lift oven cover up.

2. Lift and unlatch two oven cover handles.
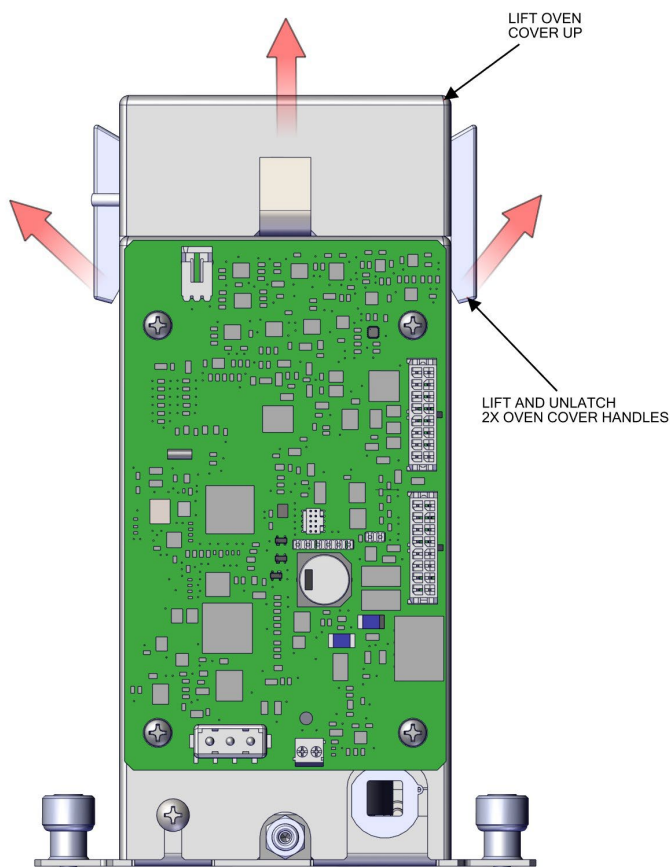
Figure 9–10. Installing Glass Tube pt 1

3. Unfasten nut. Loosen thumb screw 2X full counter clock rotation.

4. Loosening the thumb screw deflates the o-ring making it easier to pull the thermistor assembly out.

5. Pull thermistor assembly upwards.

REFERENCE
THERMISTOR WIRES

REFERENCE
TEFLON TUBE

UNFASTEN NUT
HOT SURFACE

LOOSENING THE THUMB SCREW
DEFLATES THE O-RING
MAKING IT EASIER TO
PULL THE THERMISTOR
ASSEMBLY OUT

HOT SURFACE
LOOSEN THUMB SCREW
2X FULL COUNTER CLOCK
ROTATION

THERMISTOR
ASSEMBLY

HOT SURFACE
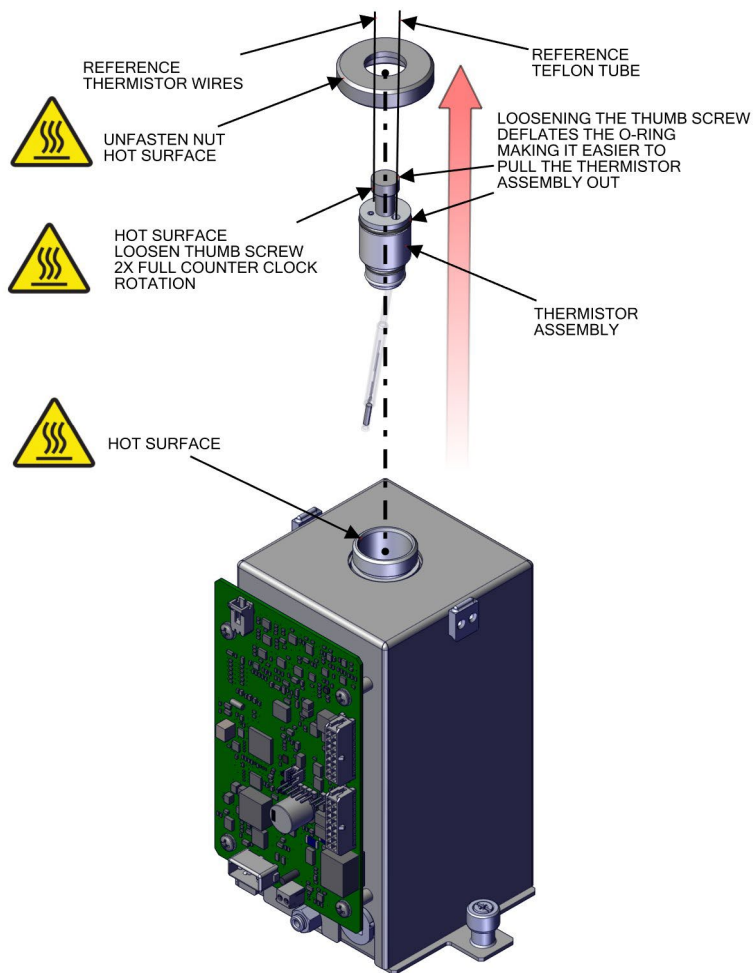
Figure 9–11. Installing Glass Tube pt 2

6. Push and gently twist tube dispersion glass upwards and seat into o-ring.

Note Make sure PTFE tube and thermistor is inside the dispersion glass. Keep glass clean by using kimwipes or similar material to handle glass. ▲

TEFLON TUBE

THERMISTOR
ASSEMBLY

MAKE SURE TEFLON
TUBE IS IN THE TUBE

MAKE SURE THE INNER
TUBE DIAMETER
SEATS INTO THIS
O-RING

MAKE SURE THERMISTOR
IS IN THE TUBE

TUBE DISPERSION GLASS
HANDLE WITH CARE
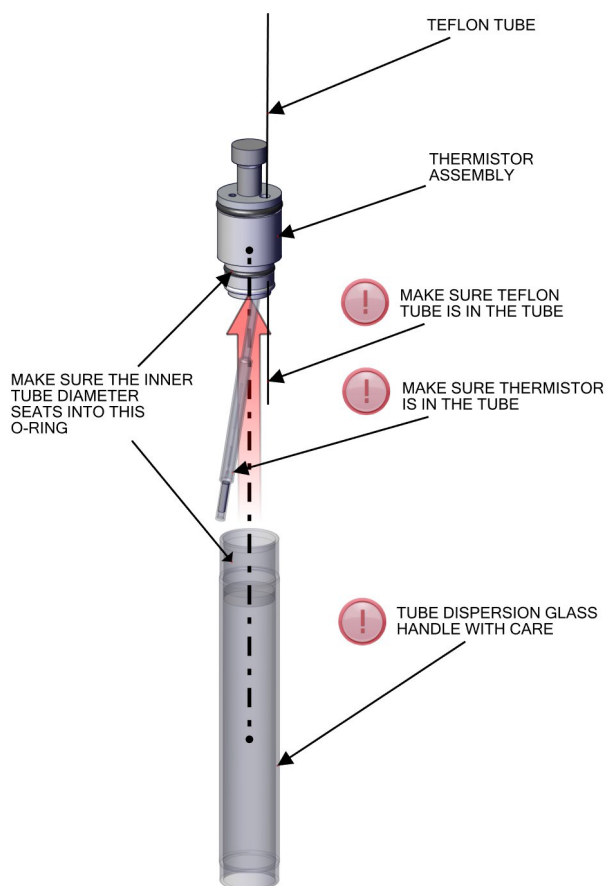
Figure 9–12. Installing Glass Tube pt 3

7. Insert thermistor assembly into oven tube. Make sure it bottoms out.

8. Tighten thumb screw to expand o-ring for complete seal.

9. Fasten nut.

(3) FASTEN NUT

(1) INSERT THERMISTOR ASSEMBLY
INTO OVEN TUBE.
MAKE SURE IT BOTTOMS OUT.

(2) TIGHTEN THUMB SCREW
TO EXPAND ORING
FOR COMPLETE SEAL
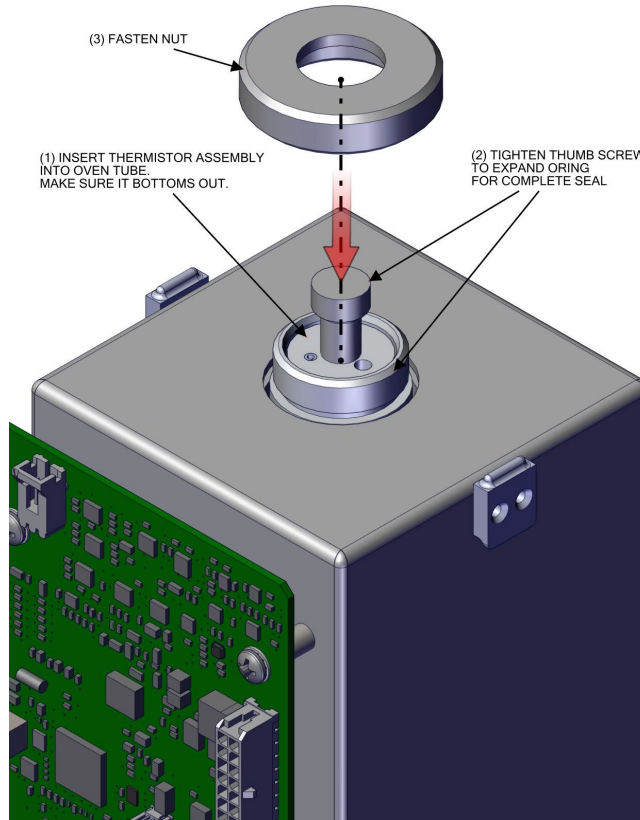
Figure 9–13. Installing Glass Tube pt 4

10. Latch oven cover handles.

Computation of Concentrations

The computation of SO_2 output level is shown in the following information. Note that is assumed that all devices are properly calibrated and that all flows are corrected to 25 °C and 1 atm.

Permeation Tube:

$$Output\ (ppm) = \frac{(R)\,(K)}{Q_o}$$

Where:

R = permeation rate in ng/min

Q_0 = flow rate of gas (scc/min) into the charcoal scrubber during span mode

K = constant for the specific permeant = 24.45 / MW

MW = molecular weight

PTFE Particulate Filter

A 5-10 micron pore size, two-inch diameter PTFE element is available for the 43iQ. 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.

High Flow Option

The 43iQ ships standard with a capillary to maintain the instrument flow rate at approximately 0.5 LPM. An optional capillary is available that will maintain the instrument flow at approximately 1.0 LPM. This increased flow may be desirable when a reduced instrument response time is desired.

To run the higher flow rate, replace the instrument capillary with a 0.02 size capillary. (Refer to "43iQ Measurement Case" in the *iQ Series Gas Analyzer Spare Parts Catalog* for part number.)

From the Home Screen, press Configuration>**High Flow** to enable the high flow option.

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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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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