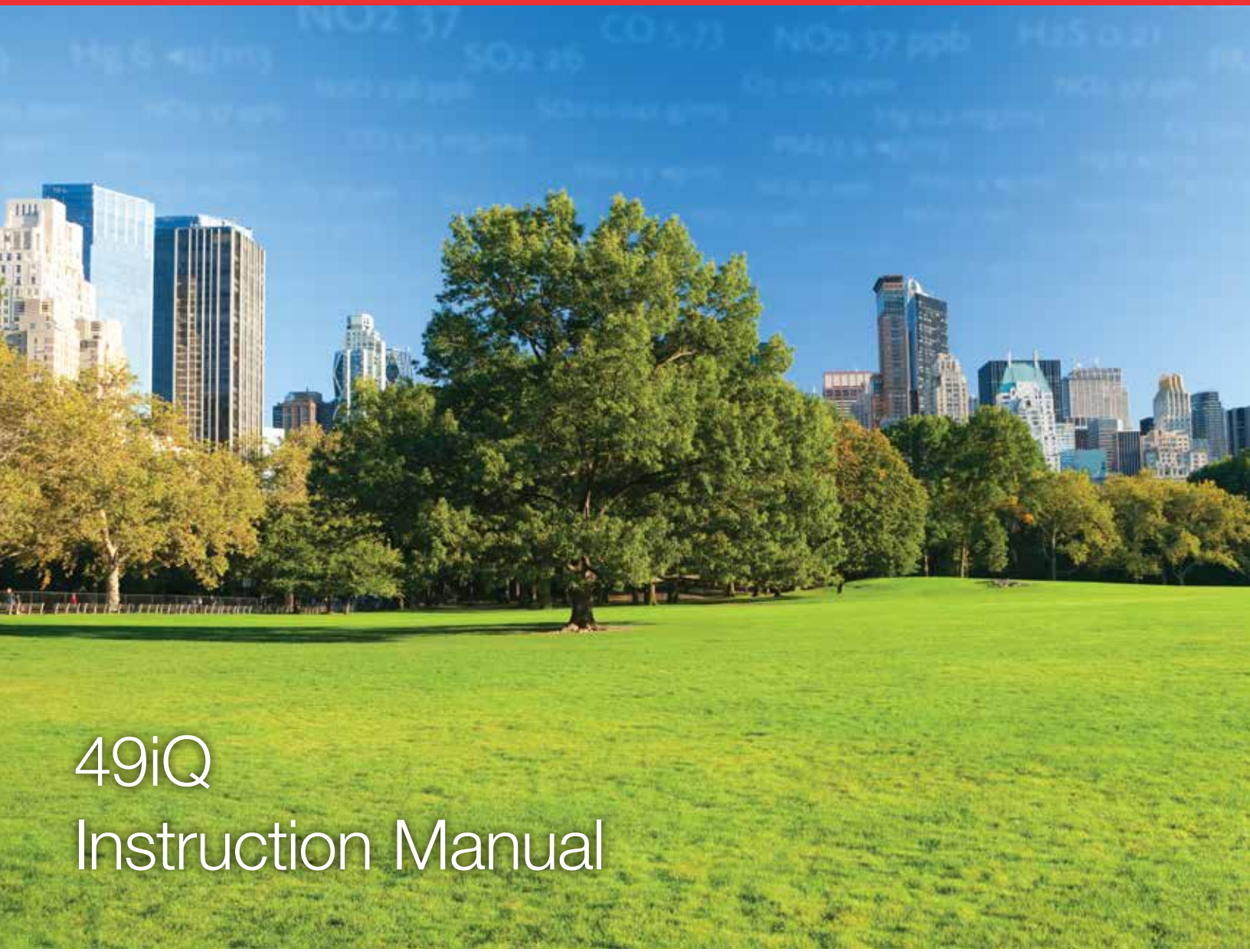
thermo scientific



49iQ
Instruction Manual

Ozone Analyzer

117433-00 • 5Feb2024

ThermoFisher
SCIENTIFIC

Contents

Chapter 4

Chapter 1
Introduction

The Thermo Scientific™ 49iQ Ozone (O_3) Analyzer utilizes UV Photometric technology to measure the amount of ozone in the air from ppb levels up to 200 ppm.

The 49iQ Analyzer is a dual cell photometer, the concept adopted by NIST for the national ozone standard. Because the instrument has both sample and reference flowing at the same time, a response time of 20 seconds can be achieved. Dual range, auto range, temperature correction and pressure correction are standard features.

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. 49iQ Front

Principle of Operation

The 49iQ operates on the principle that ozone (O_3) molecules absorb UV light at a wavelength of 254 nm. The degree to which the UV light is absorbed is directly related to the ozone concentration as described by the Beer-Lambert Law:

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

where:

K = molecular absorption coefficient, 308 cm^{-1} (at 0°C and 1 atmosphere)

L = length of cell, 38 cm

C = ozone concentration in parts per million (ppm)

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

I_o = UV light intensity of sample without ozone (reference gas)

The sample is drawn into the 49iQ through the *sample* bulkhead and is split into two gas streams, as shown in Figure 1–2. One gas stream flows through an ozone scrubber to become the reference gas (I_o). The reference gas then flows to the reference solenoid valve. The sample gas (I) flows directly to the sample solenoid valve. The solenoid valves alternate the reference and sample gas streams between cells A and B every 10 seconds. When cell A contains reference gas, cell B contains sample gas and vice versa.

The UV light intensities of each cell are measured by detectors A and B. When the solenoid valves switch the reference and sample gas streams to opposite cells, the light intensities are ignored for several seconds to allow the cells to be flushed. The 49iQ calculates the ozone concentration for each cell and outputs the average concentration to both the front panel display and the analog outputs, and also makes the data available over the serial or Ethernet connection.

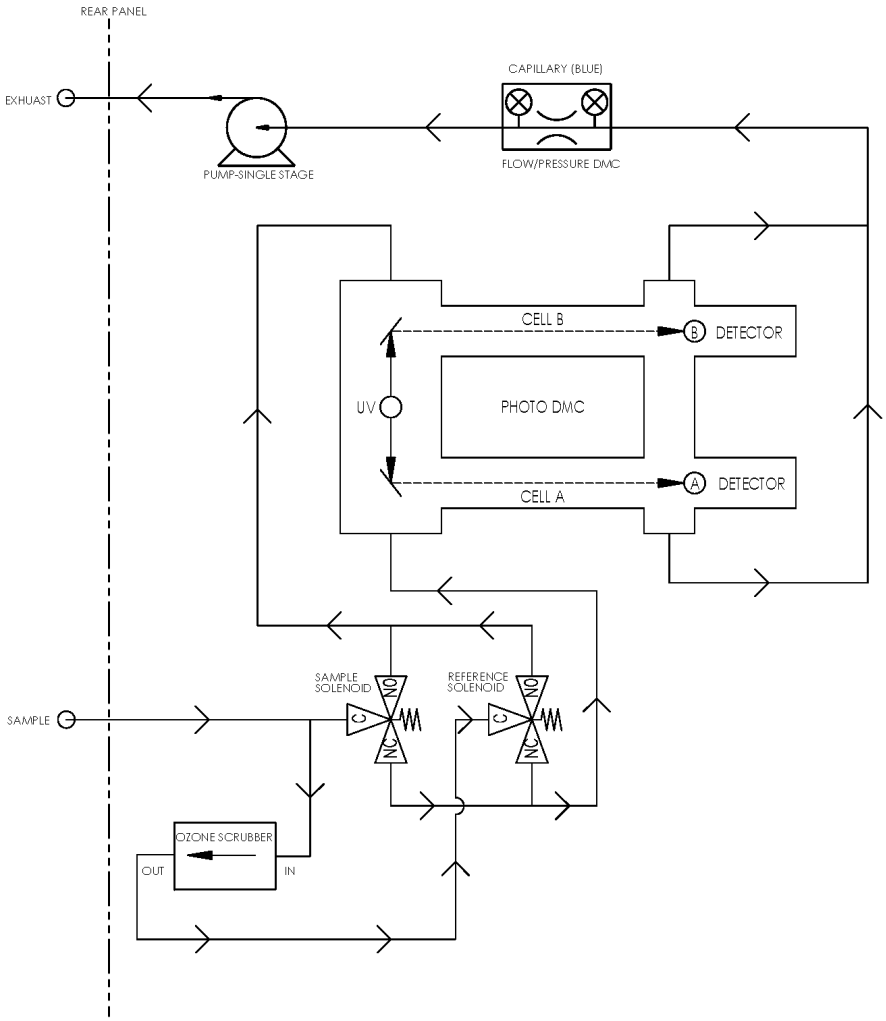


Figure 1–2. 49iQ Flow Diagram—No Sample/Cal Valve

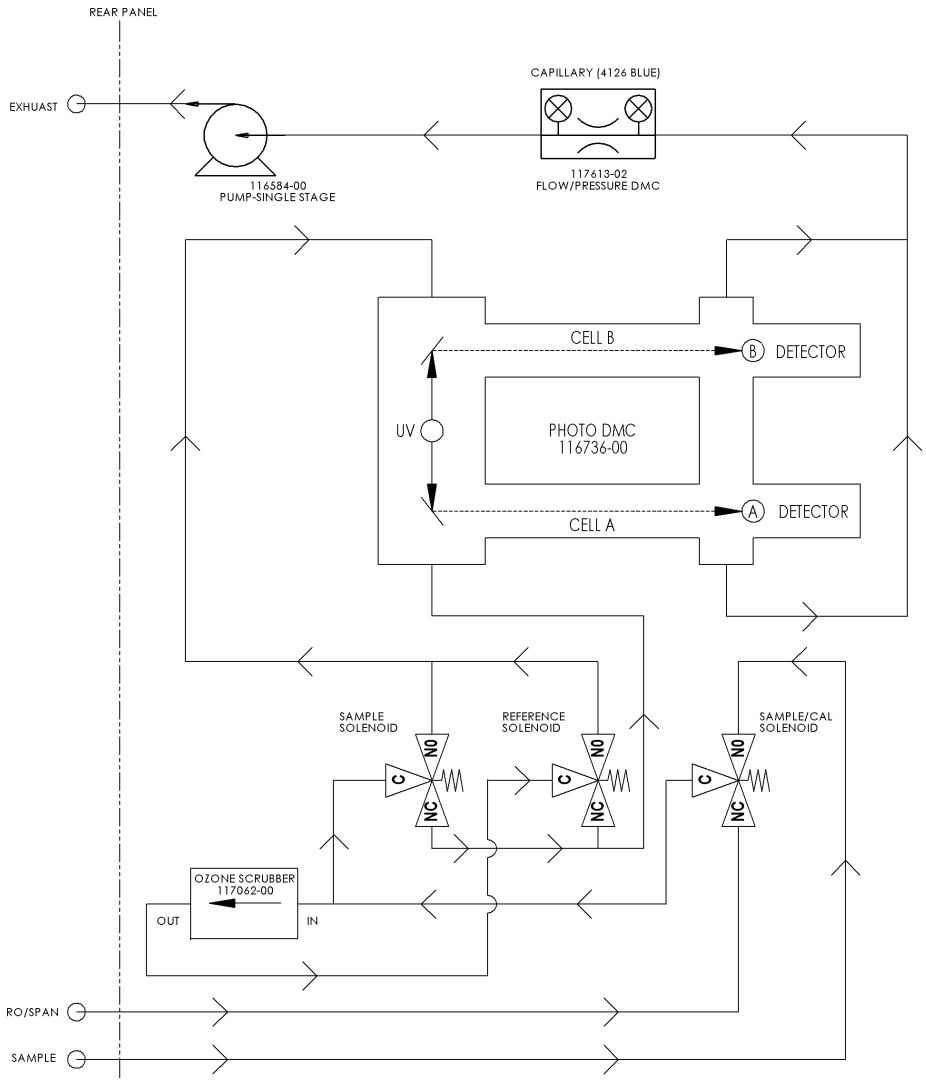


Figure 1–3. 49iQ Flow Diagram—Internal Sample/Cal Valve

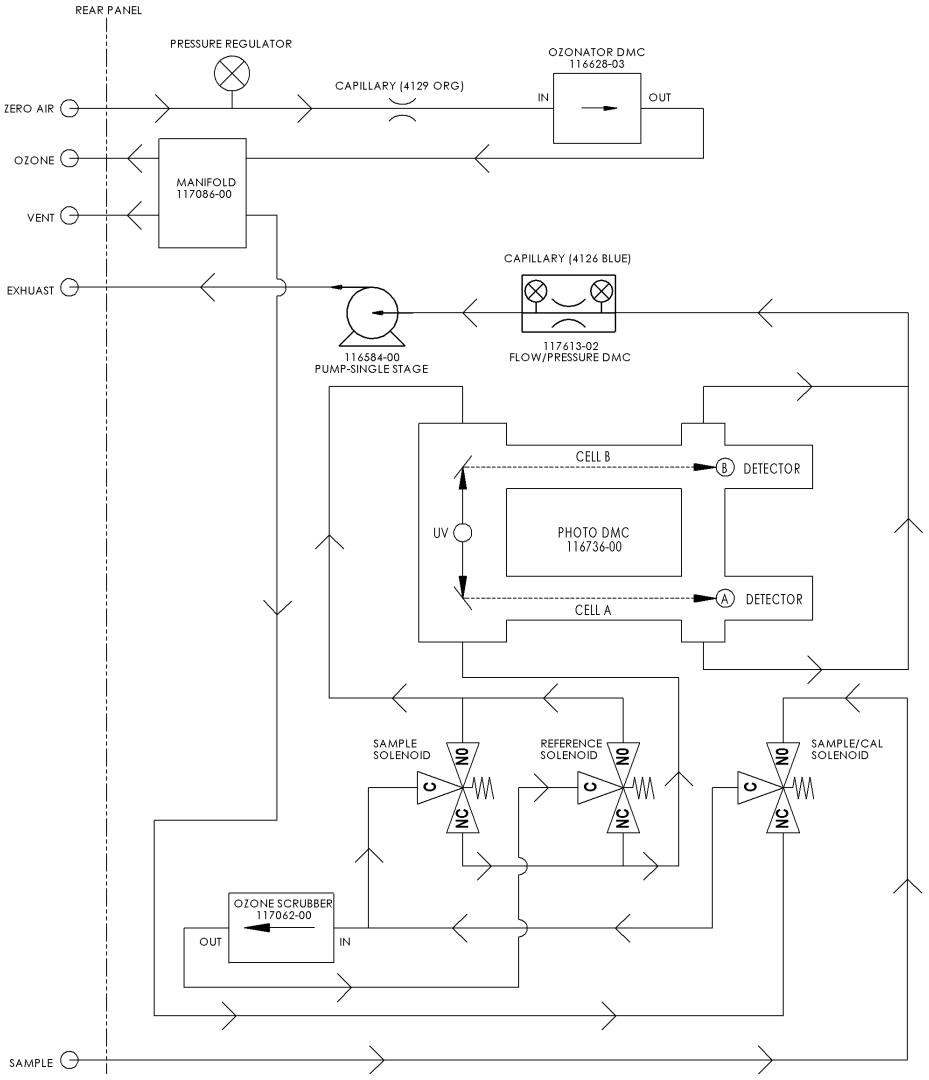


Figure 1–4. 49iQ Flow Diagram—Internal Ozonator, Manifold, Sample Cal Valve

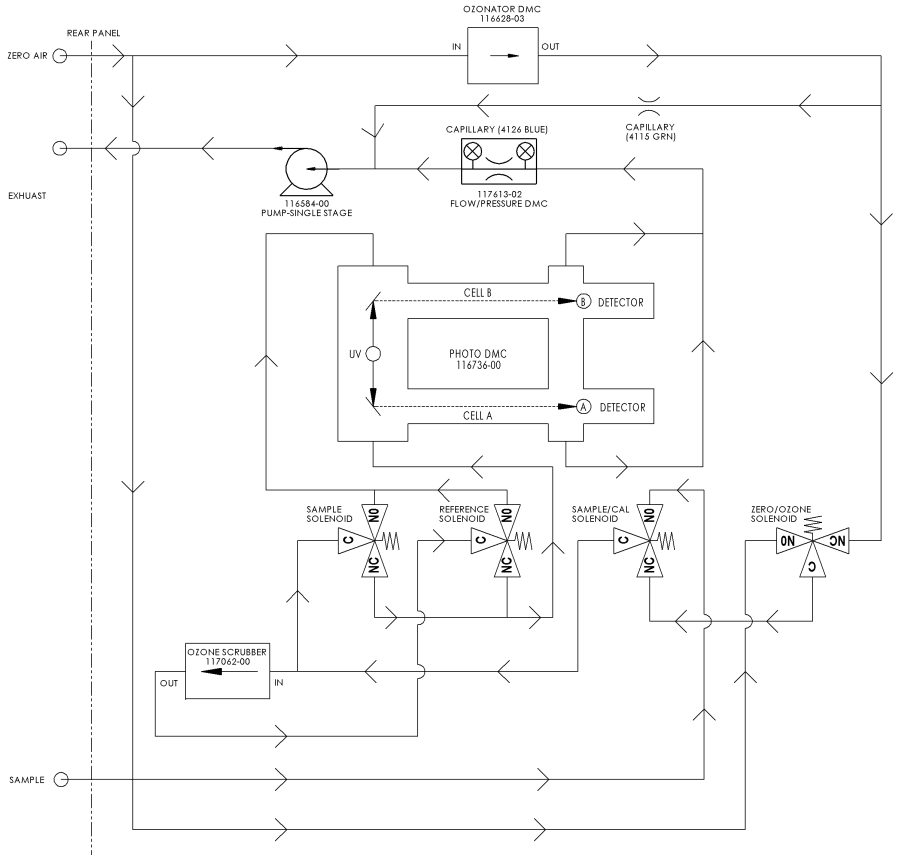


Figure 1–5. 49iQ Flow Diagram—Internal Ozonator, Sample/Cal & Zero/Ozone Valves

Specifications

Table 1–1 lists the specifications for the 49iQ.

Table 1–1. 49iQ Specifications

Range	0–200 ppm 0–400 mg/m^3
Zero Noise	0.25 ppb RMS (60 second averaging time)
Lower Detectable Limit	0.50 ppb
Zero Drift	<1.0 ppb (24 hour) <2.0 ppb (7 day)
Span Drift	<1% full-scale (1 month)
Response Time	20 seconds (10 second averaging time)
Linearity	±1% full-scale
Flow Rate	1.5 LPM nominal
Operating Temperature Range	0–45 °C
Power Requirements	100–240 VAC 50/60 Hz 200 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	31.67 lbs (std) 35.6 lbs (with ozonator)
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

Dimensions

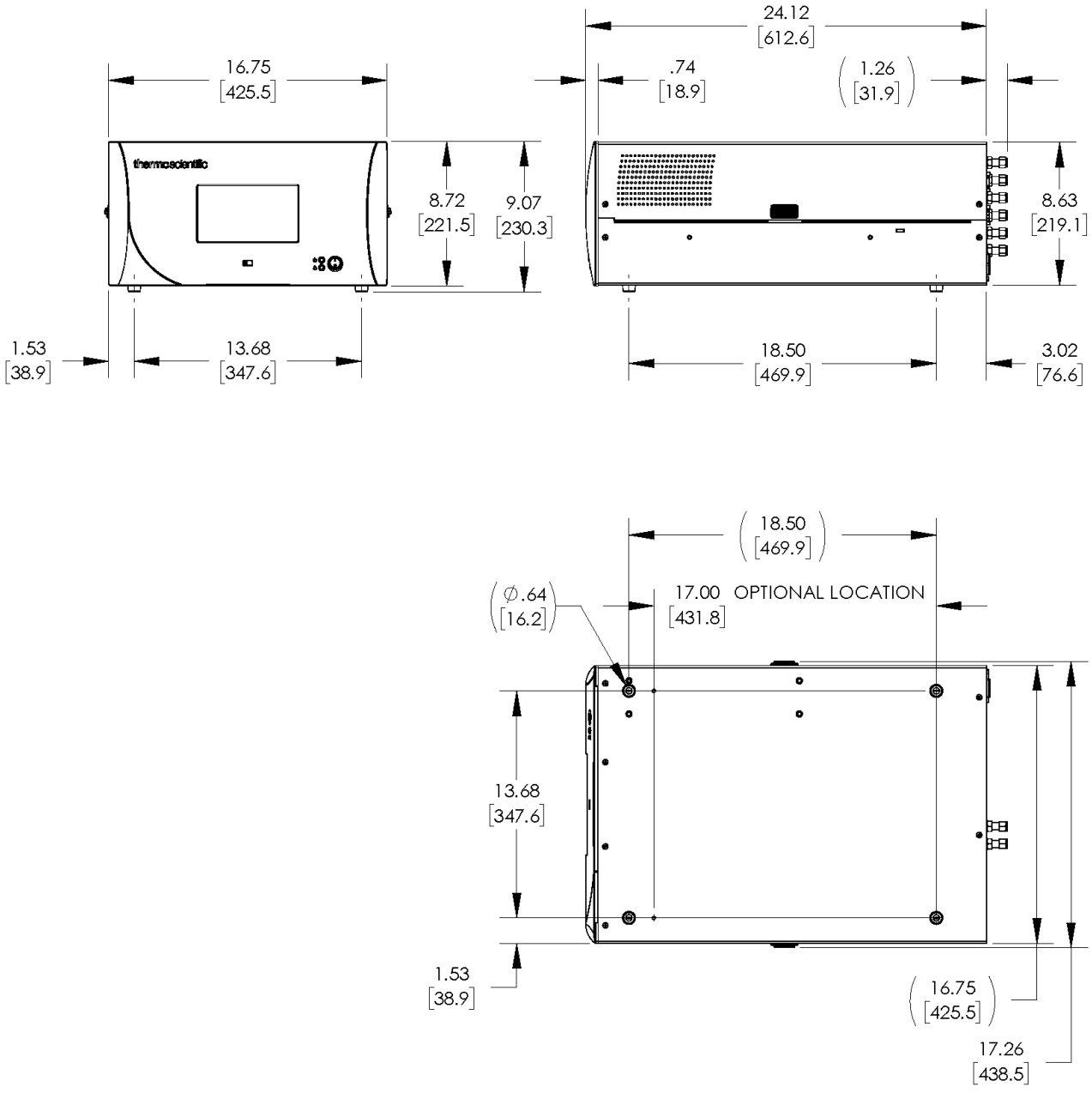


Figure 1–6. Bench Mount Assembly (dimensions in inches [mm])

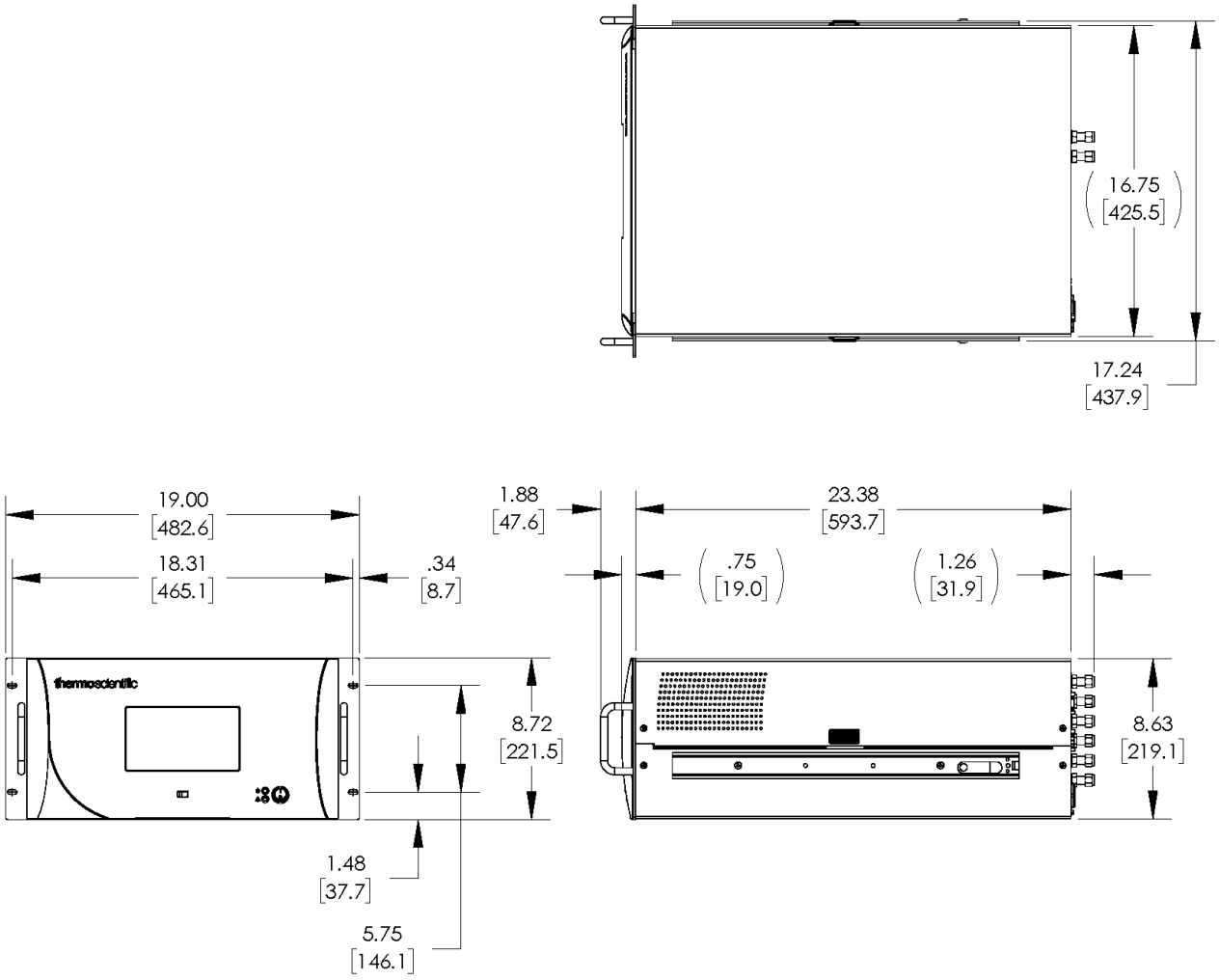


Figure 1–7. Rack Mount Assembly (dimensions in inches [mm])

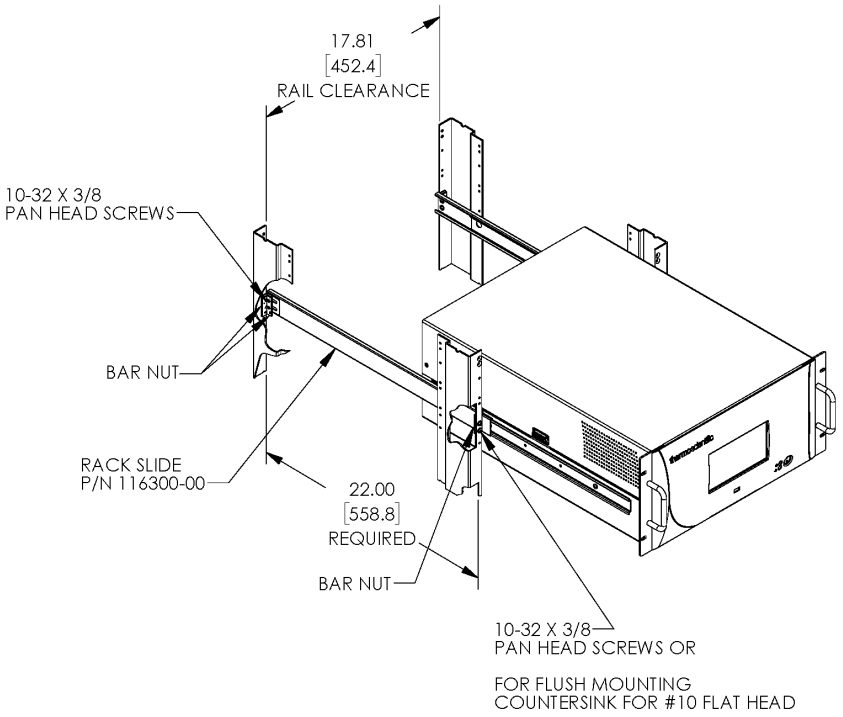


Figure 1–8. Rack Mount Requirements

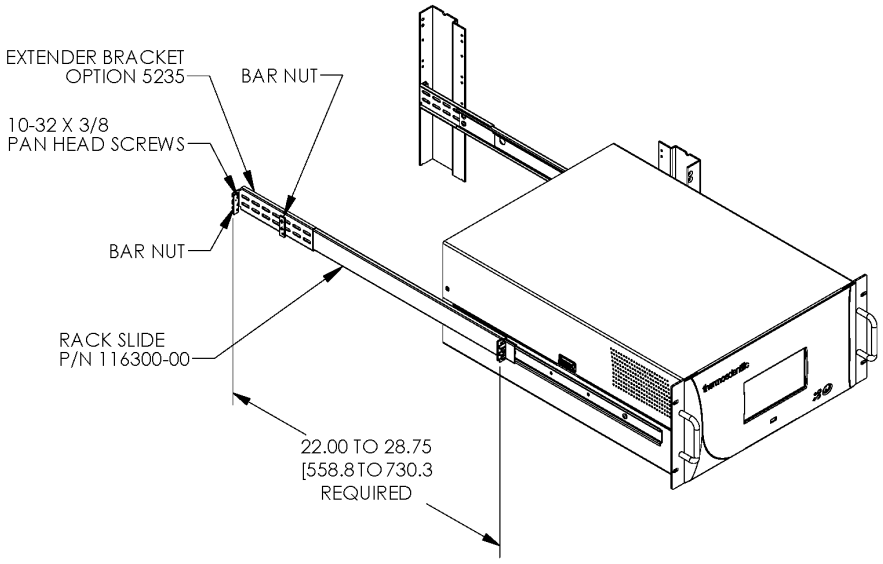


Figure 1–9. Rack Requirements Part 2

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 49iQ is shipped complete in one container. If there is obvious damage to the shipping container when you receive the instrument, notify the carrier immediately and hold for inspection. The carrier is responsible for any damage incurred during shipment.

Use the following procedure to unpack and inspect the instrument.

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

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

3. Check for possible damage during shipment.

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

5. Re-install the cover.

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

Cover Removing and Replacing

Use the following procedure to remove and replace the cover.

Equipment required:

Phillips screwdriver, #2

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

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

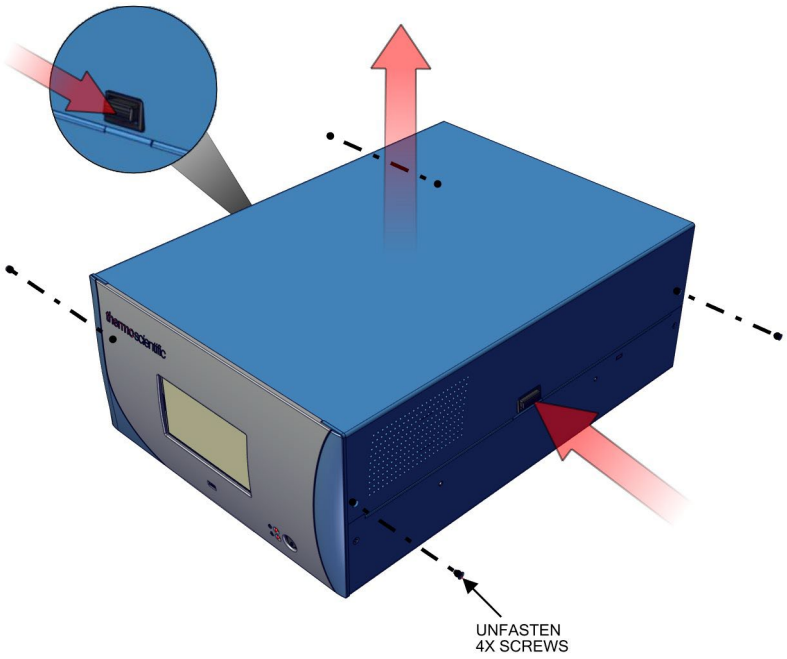


Figure 2–1. Removing the Cover

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

Mounting Options

The instrument can be installed in the following configurations:

- Bench Mount
- Rack Mount

Bench Mount

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

Equipment required:

Slot drive, 5/16-inch

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

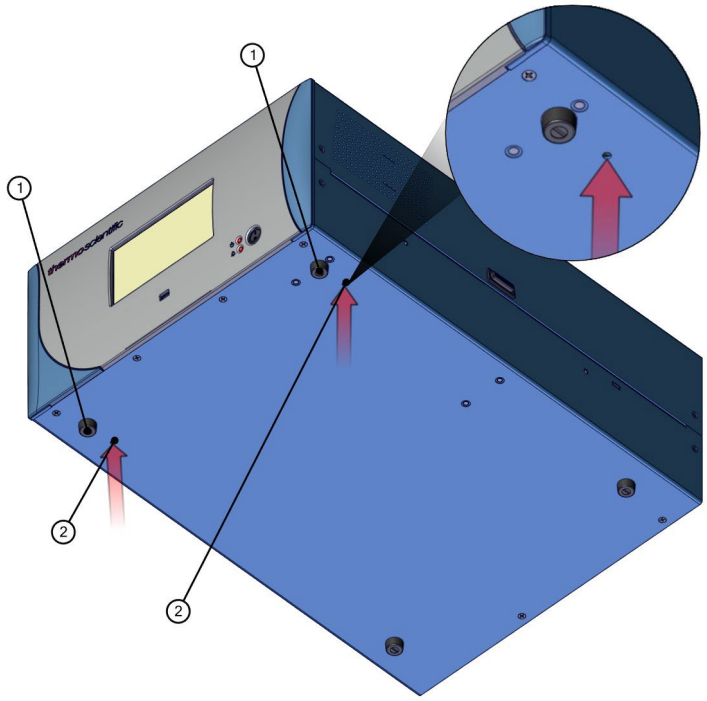


Figure 2–2. Installing Feet

Rack Mount

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

Equipment required:

Phillips drive, #2

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

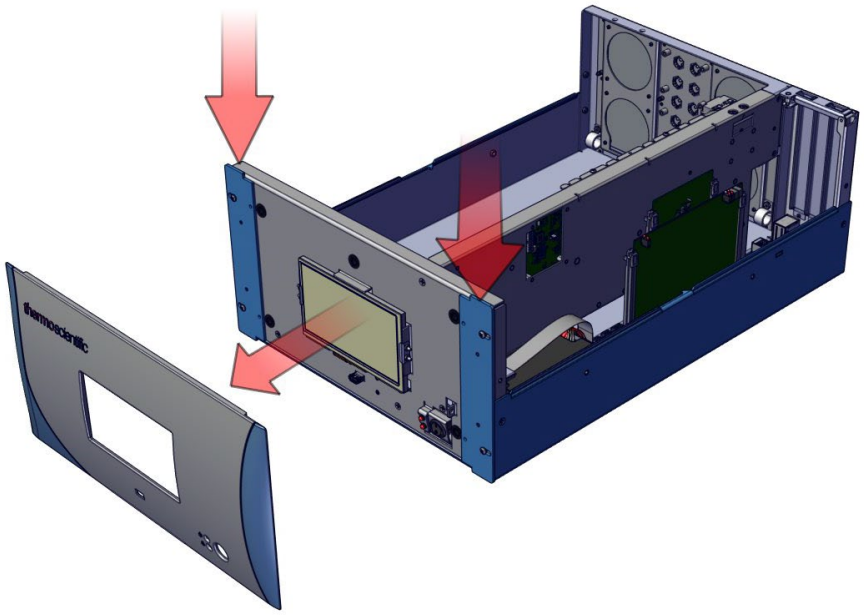


Figure 2–3. Removing the Front Panel

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

3. Slide ears outwards.

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

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

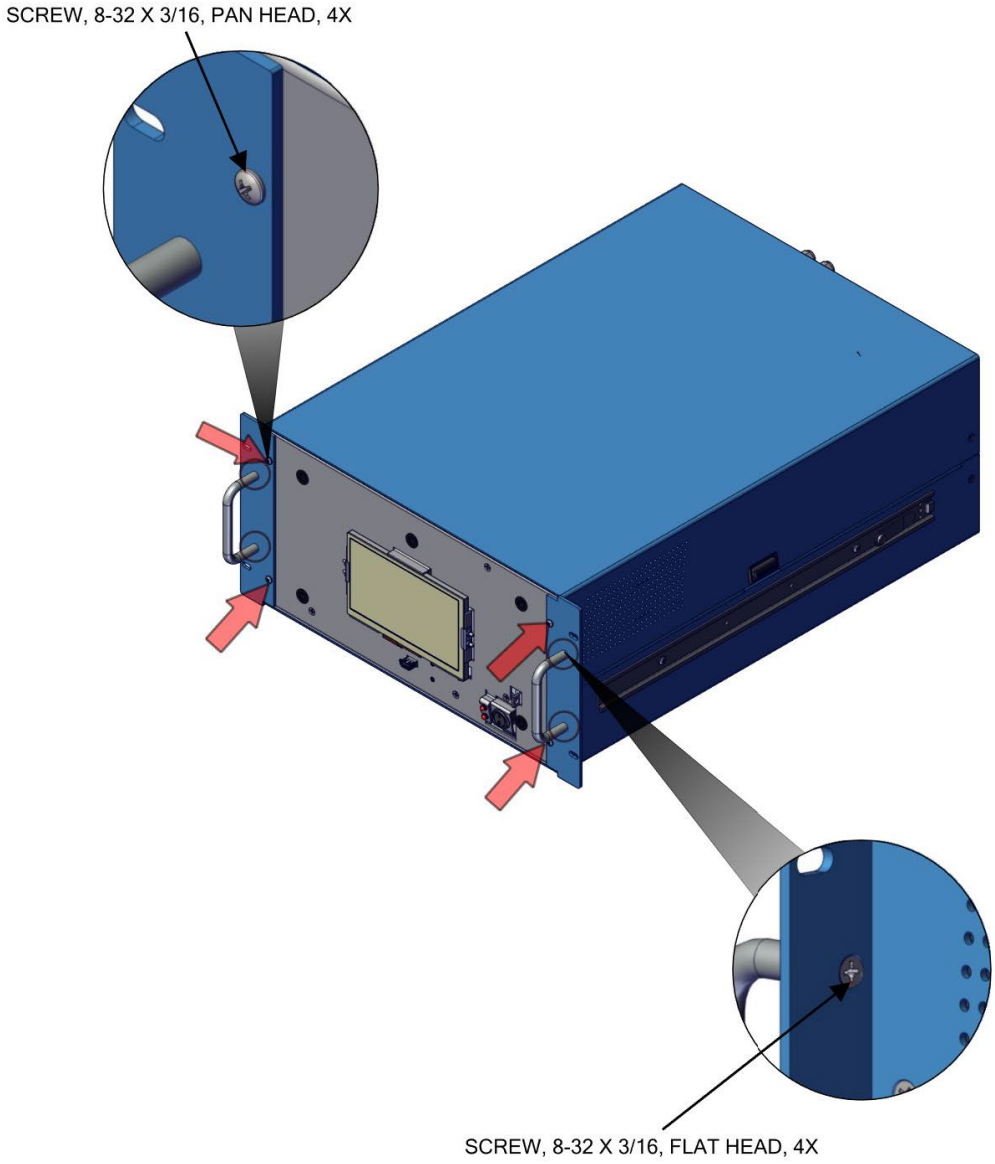


Figure 2–4. Installing Ears and Handles

Setup Procedure

Use the following procedure to setup the instrument:

1. Connect 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 9-17. ▲

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. 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 3-89 and "Digital I/O" on page 3-90.

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

WARNING The 49iQ is supplied with a three-wire grounding cord. Under no circumstances should this grounding system be defeated. ▲

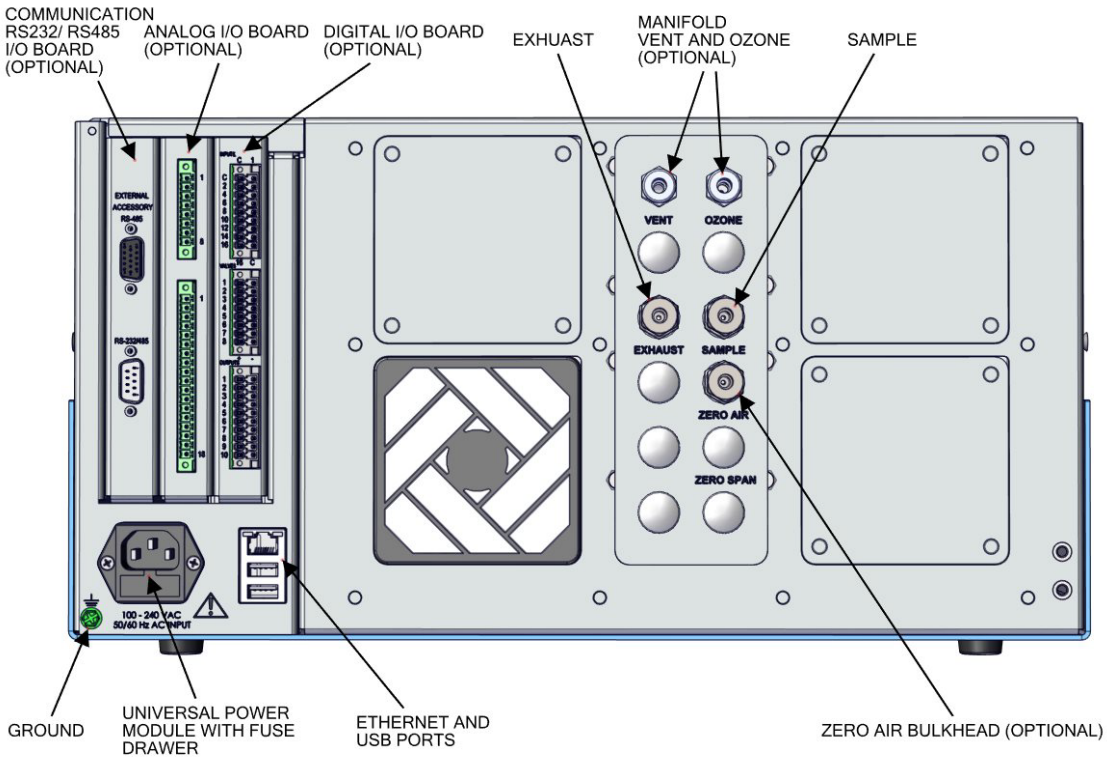


Figure 2–5. 49iQ Rear Panel

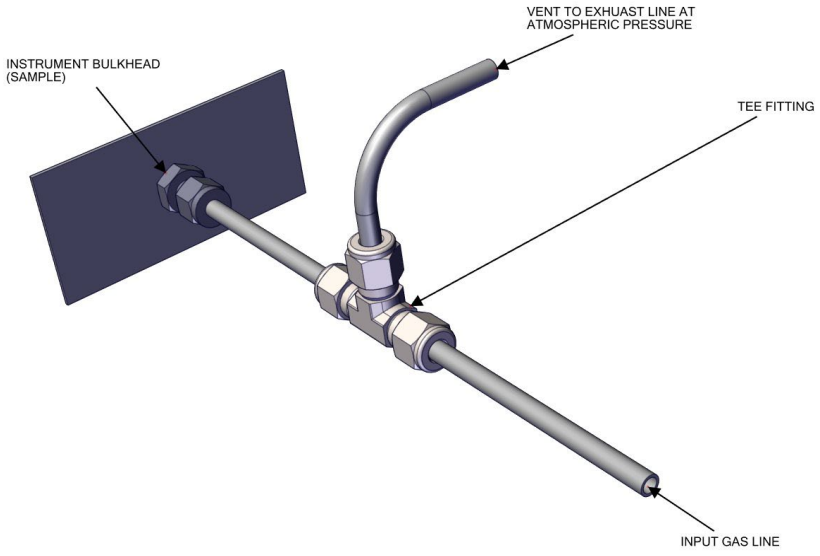


Figure 2–6. Atmospheric Dump Bypass Plumbing

Startup

Use the following procedure when starting the instrument.

1. Turn the power ON.

2. Allow 90–120 minutes for the instrument to stabilize. During the time that the instrument is warming up, the mode "warm up" is displayed on the gas mode button in the title bar, and the concentration calculation is turned off. To disable warm up, go to Settings>**Configuration**.

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

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

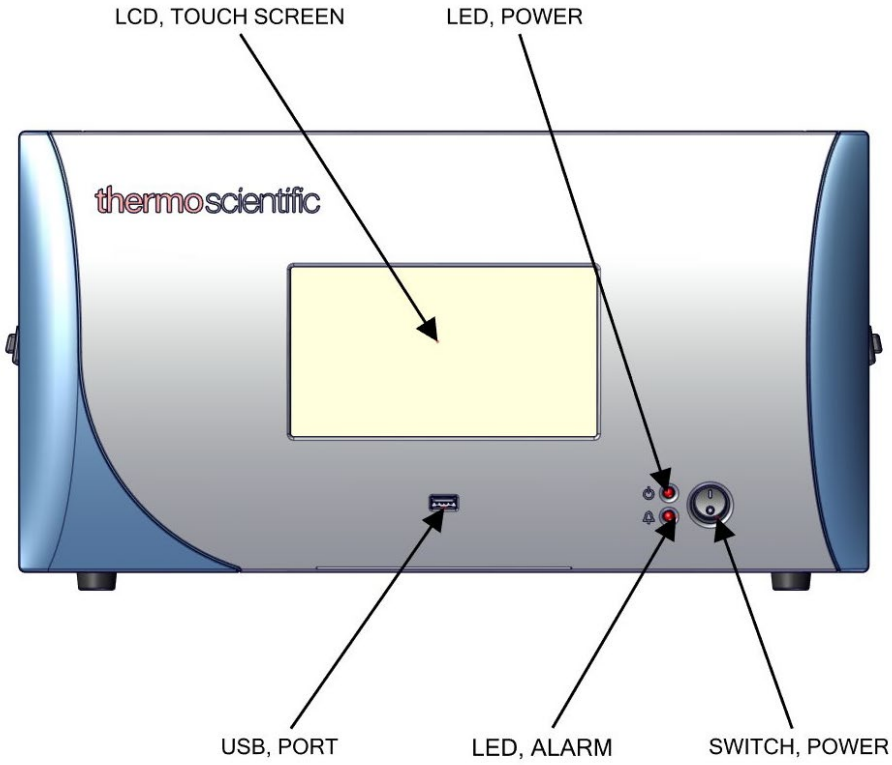


Figure 2–7. Front Panel and Touchscreen Display

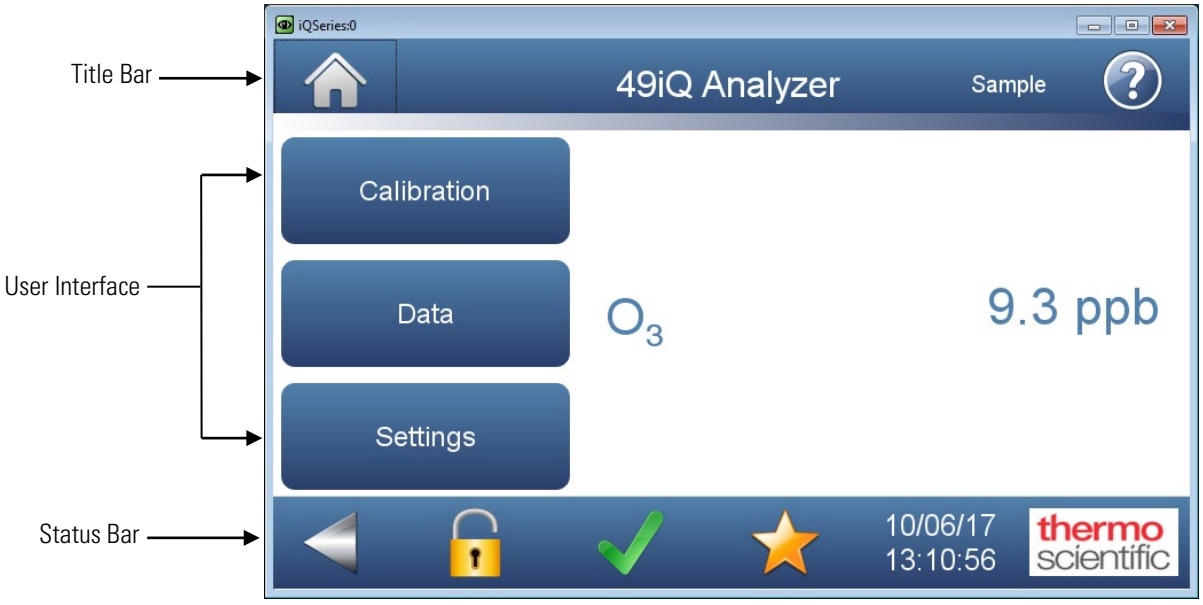
Chapter 3
Operation

This chapter describes the functionality of the touchscreen user interface.

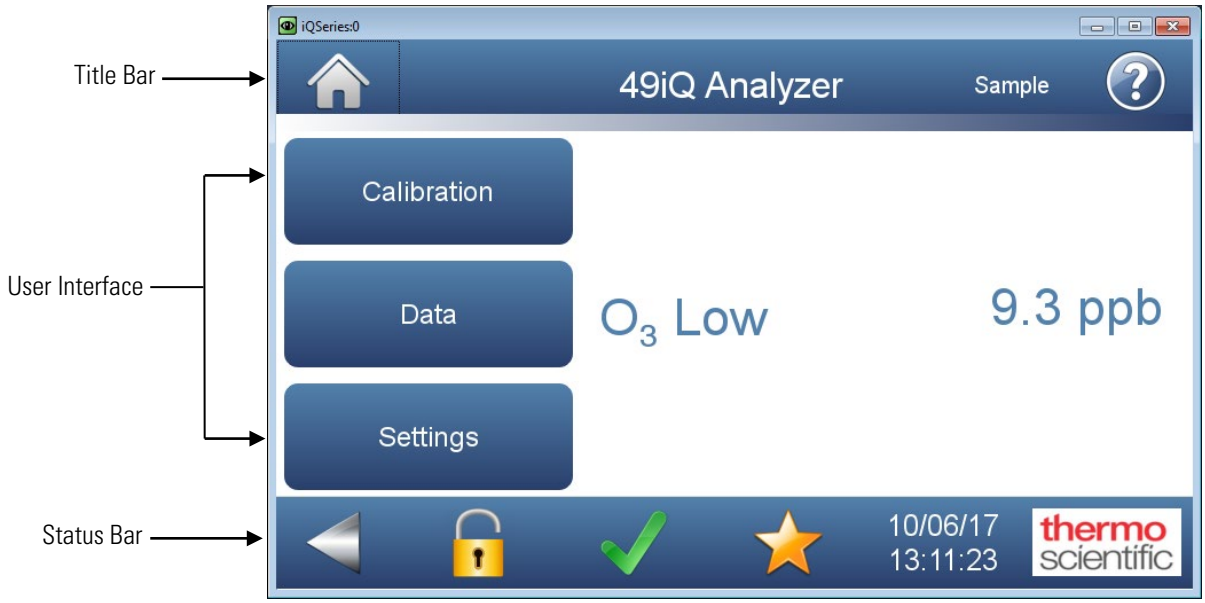
Instrument Display

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



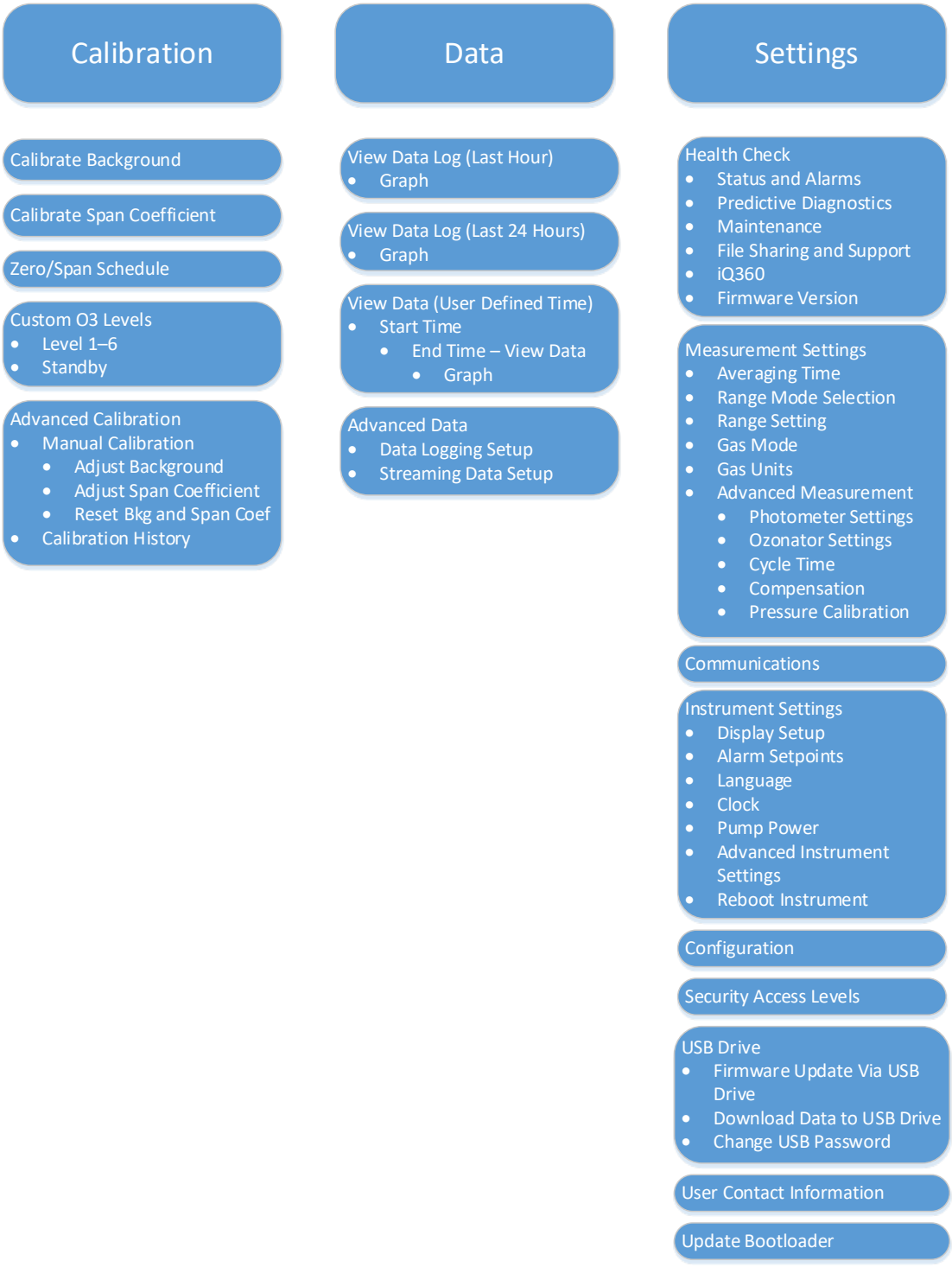
The Instrument Display contains the following information:

- 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, it 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 O_3 concentrations in big, bold characters, depending on operating mode. When in dual or auto mode, displays either high range or low range values based on the range setting.
- Status Bar:
  - *Back button:* When pressed, it displays the previous screen.
  - *Access Levels button:* Allows the user to set security access levels, and allows/restricts access to functionality depending on the selected access level.
  - *Health Check button:* Brings the user to the Health Check screen.
  - *Favorites button:* Allows user-selectable favorite buttons. To add to the favorites screen, user presses the desired screen button for 2 seconds. The user will be directed to the favorites screen where the user chooses the button position. To remove a favorite button from the favorites screen, press and hold button for 2 seconds.
  - *Clock:* Displays current date and time.

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

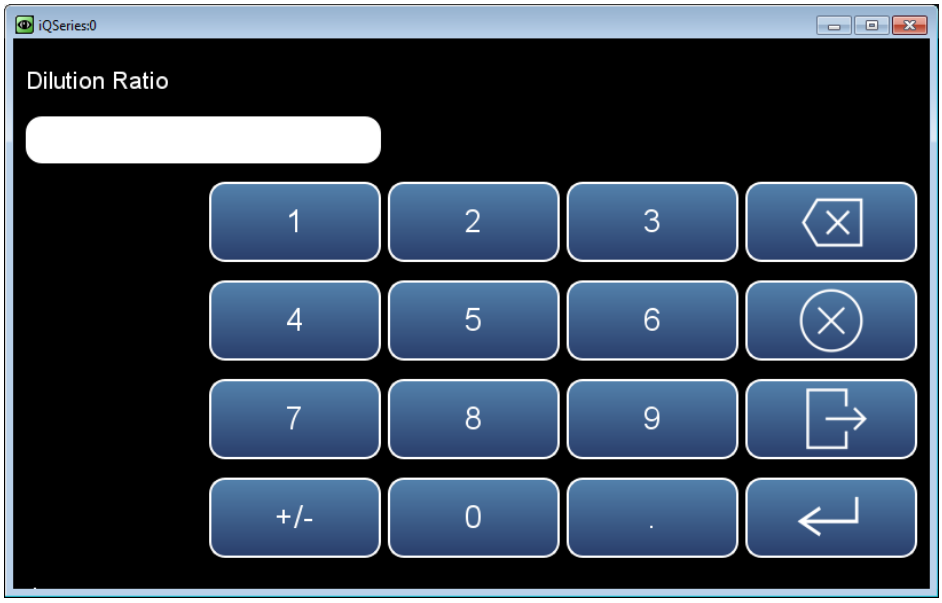
Main Menus and Keypads

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



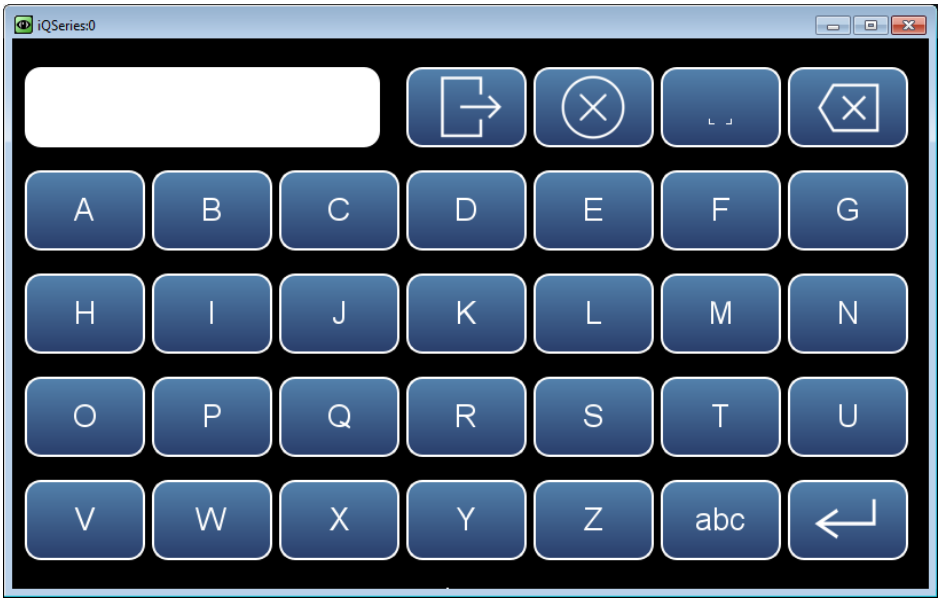
Numeric Keypad

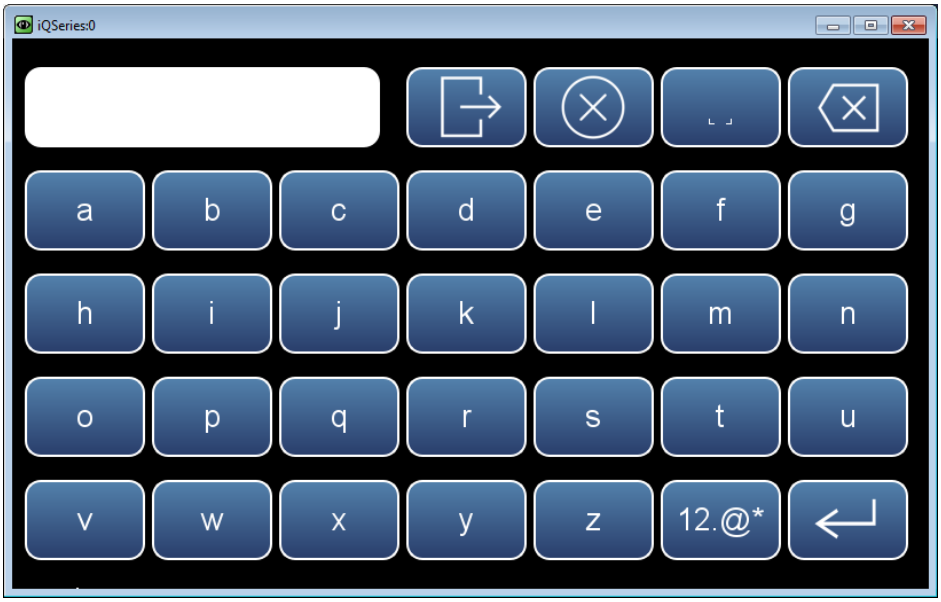
User enters a value into the box using the number keypad. When the user needs to change a value, such as for flow rates, temperatures or pressures, the keypad screen will automatically display. Initially, the box above the keypad will display the current value. Enter a new value using the keypad, and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

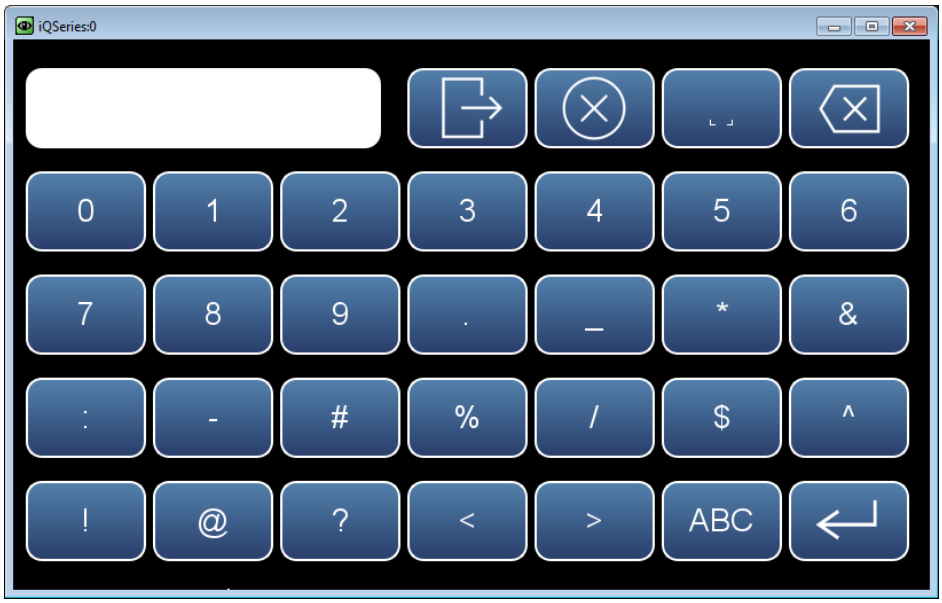


Alphanumeric Keypad

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





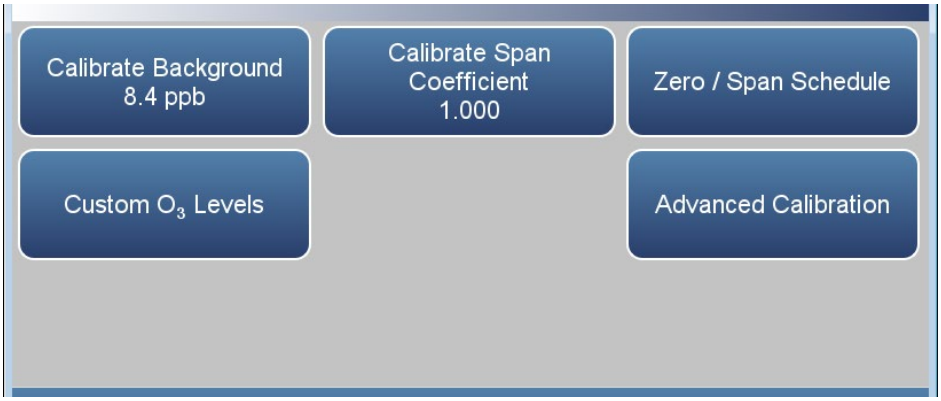

iQSeries:0
0
1
2
3
4
5
6
7
8
9
.
_
*
&
:
-
#
%
/
$
^
!
@
?
<
>
ABC

Calibration

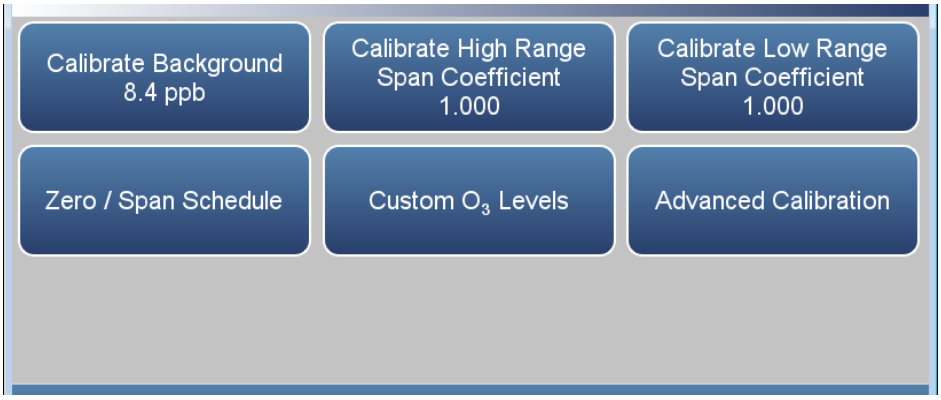
The Calibration menu allows the user to calibrate the system, setup automatic calibrations, and view calibration data. See Chapter 4 "Calibration" for further instructions on how to run a calibration.

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 O_3 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 O_3 range of 50 ppb and a high O_3 range of 20,000 ppb. For more information about range modes, see "Range Mode Selection" on page 3-72.

Home Screen>Calibration (single range mode)



Home Screen>Calibration (dual or auto range mode)



The Calibration menu contains the following information:

- *Calibrate Background:* Sets the O_3 reading to zero.
- *Calibrate Span Coefficient:* Sets the span coefficient when in single range mode.

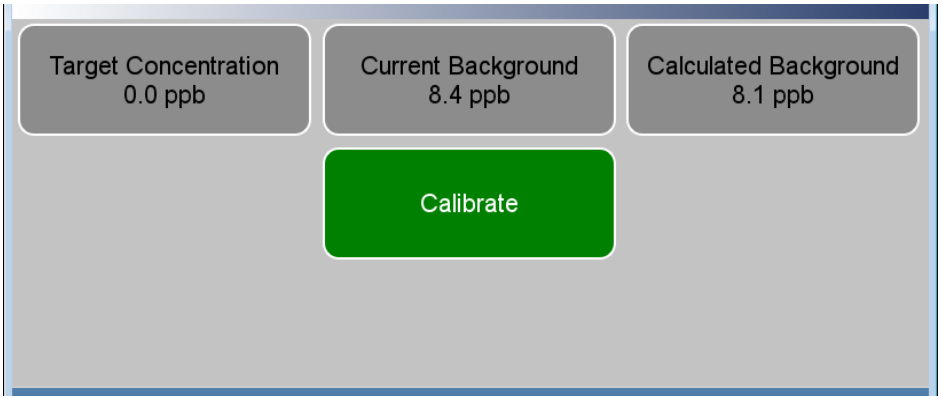
- *Calibrate High Range Span Coefficient:* Sets the high range span coefficient when in dual or auto range mode.
- *Calibrate Low Range Span Coefficient:* Sets the low range span coefficient when in dual or auto range mode.
- *Zero/Span Schedule:* Programs the instrument to perform fully automated zero and span checks or adjustments.
- *Custom O_3 Levels:* User sets concentration for O_3 levels and standby.
- *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 menu 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, making the concentration go to zero.

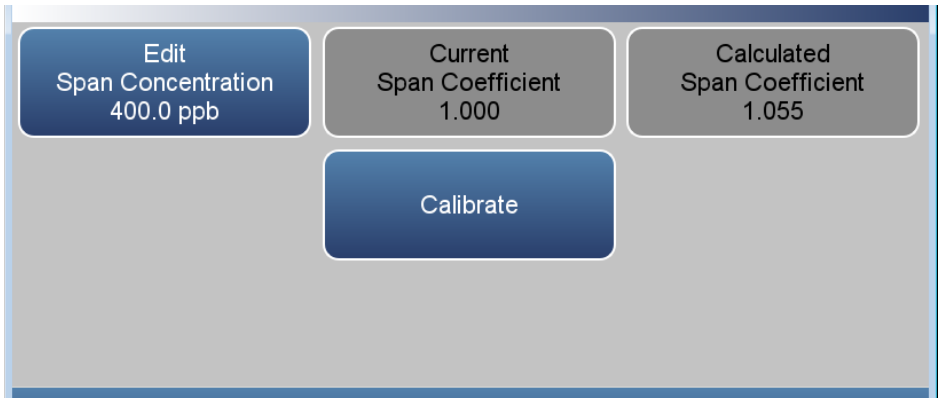
Calibrate Span Coefficient

The Calibrate Span Coefficient screen is used to enter the span concentration and calibrate the O_3 coefficient. The O_3 span coefficient is calculated, stored, and used to correct the current reading.

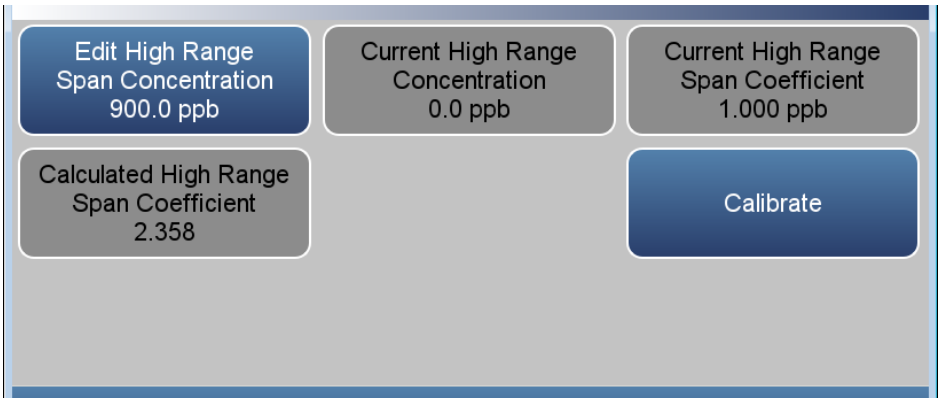
The following screens are shown in single range mode and dual or auto range mode. In dual or auto range modes, "High" or "Low" is displayed to indicate the calibration of the high or low coefficient. The Calibrate High Range Span Coefficient and Calibrate Low Range Span Coefficient screens function the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

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:

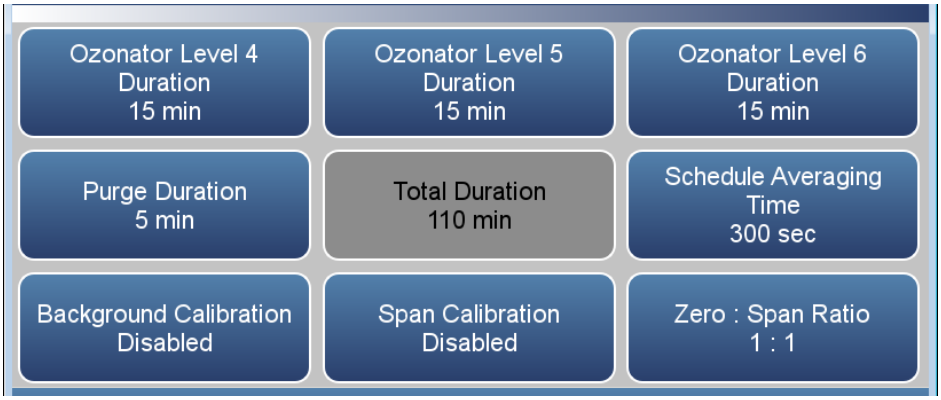
- *Edit Span Concentration:* User enters the span concentration when in single range mode.
- *Edit High Range Span Concentration:* User enters the high range span concentration when in dual or auto range mode.
- *Edit Low Range Span Concentration:* User enters the low range span concentration when in 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 range concentration reading when in dual or auto range mode.
- *Current Span Coefficient:* Read only. Displays what the current user-set span coefficient is when in single range mode.
- *Current High Range Span Coefficient:* Displays what the current user-set high range span coefficient is when in dual or auto range mode.
- *Current Low Range Span Coefficient:* Displays what the current user-set low range span coefficient is when in dual or auto range mode.
- *Calculated Span Coefficient:* Read only. After the "Edit Span Concentration" value is entered, the new calculated span coefficient is displayed when in single range mode.
- *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 when in dual or auto range mode.
- *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 when in dual or auto range mode.
- *Calibrate:* When pressed, updates the coefficient and the concentration should match the span concentration.

Zero/Span Schedule

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

Home Screen>Calibration>Zero/Span Schedule

Home Screen>Calibration>Zero/Span Schedule>More



The Zero/Span Schedule contains the following information:

- *Zero/Span Schedule:* Toggles zero/span schedule Enabled or Disabled.
- *Next Time:* Allows the user to view and set the initial date and time (24-hour format) of the zero/span schedule.
- *Period:* Defines the period or interval between zero/span checks or calibrations. If period = 0, the schedule runs continuously.
- *Zero Duration:* Sets how long zero air is sampled by the instrument.
- *Ozonator Level 1–6 Duration:* Sets the time duration for ozonator level 1–6.
- *Purge Duration:* Sets how long the purge period will be at the end of the schedule.

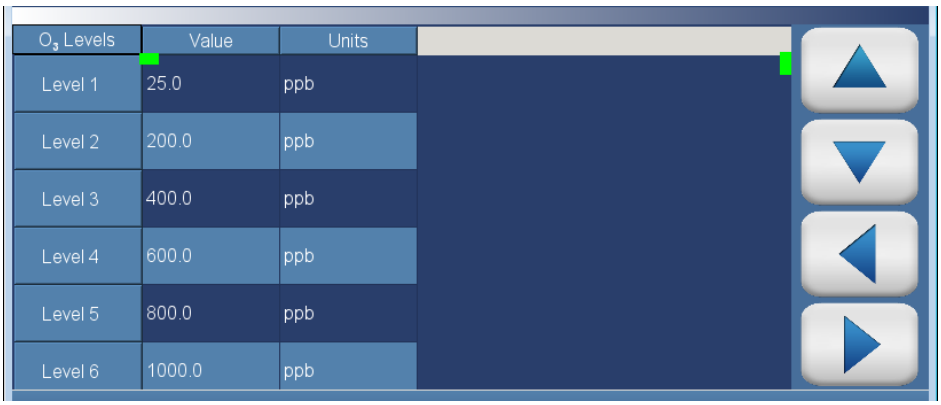
- *Total Duration:* Read only. Displays the total time duration of all scheduled events.
- *Schedule Averaging Time:* Allows the user to adjust the zero/span schedule averaging time. This averaging time only affects the zero/span schedule.
- *Background Calibration:* Toggles Enabled/Disabled. If enabled, 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 should read 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.

Custom O_3 Levels

The Custom O_3 Levels screen lists six custom levels: 1, 2, 3, 4, 5, and 6. Custom levels deal with ozonator control and configuration. A percentage of 100% results in the maximum amount of ozone production. A percentage of 0% results in no ozone production. The range of percentages, however, are not linear. This screen is only displayed if the ozonator option is installed.

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

Home Screen>Calibration>Custom O3 Levels



The Custom O_3 Levels screen contains the following information:

- Across:
  - *O_3 Levels:* This column lists items associated with the O_3 concentration.
  - *Value:* Displays the current value for each item.
  - *Units:* Displays units for each item.
- Down:
  - *Level 1–6:* Displays user-defined concentration levels.
  - *Standby:* Turns ozonator lamp to user defined setpoint when in zero or sample modes.

Advanced Calibration

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

Home Screen>Calibration>Advanced Calibration

The Advanced screen contains the following information:

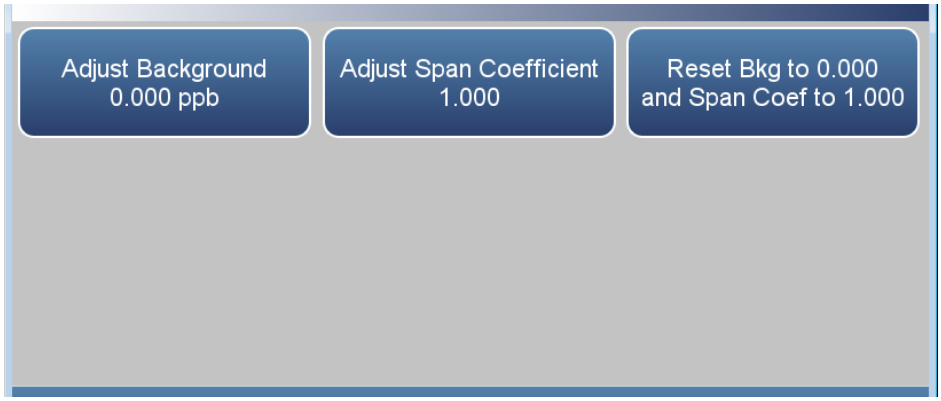
- *Manual Calibration:* The user manually adjusts the background or span coefficient.
- *Calibration History:* Lists all calibrations performed and calibration checks.

Manual Calibration

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

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)



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

The Manual Calibration screen contains the following information:

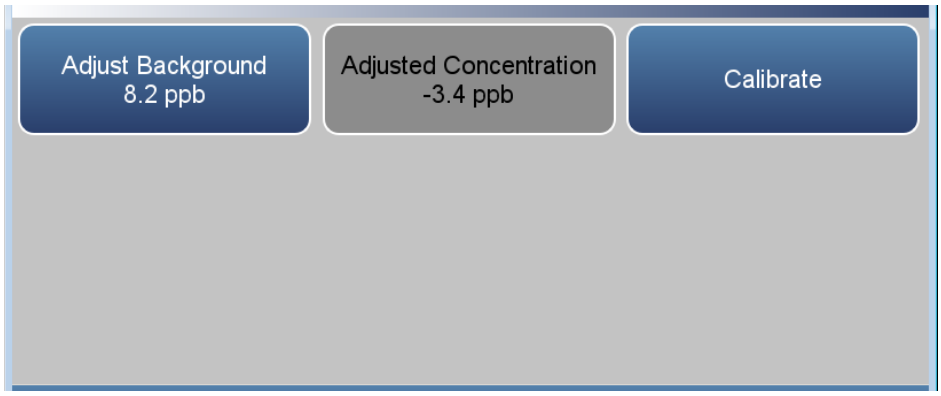
- *Adjust Background:* Allows the user to manually adjust the zero background.
- *Adjust Span Coefficient:* Allows the user to manually adjust the span coefficient when in single range mode.

- *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:

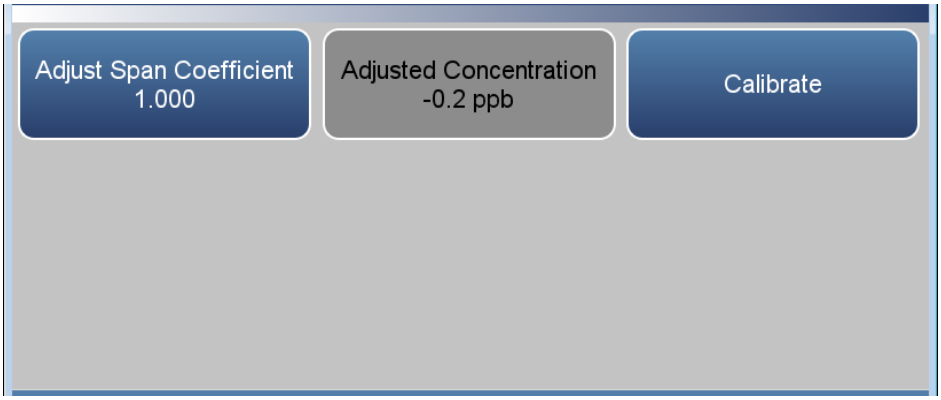
- *Adjust Background:* User manually adjusts zero background.
- *Adjusted Concentration:* Read only. Shows adjusted concentration based on adjusted zero background.
- *Calibrate:* Calibrates zero background by saving the newly adjusted zero.

Adjust Span Coefficient

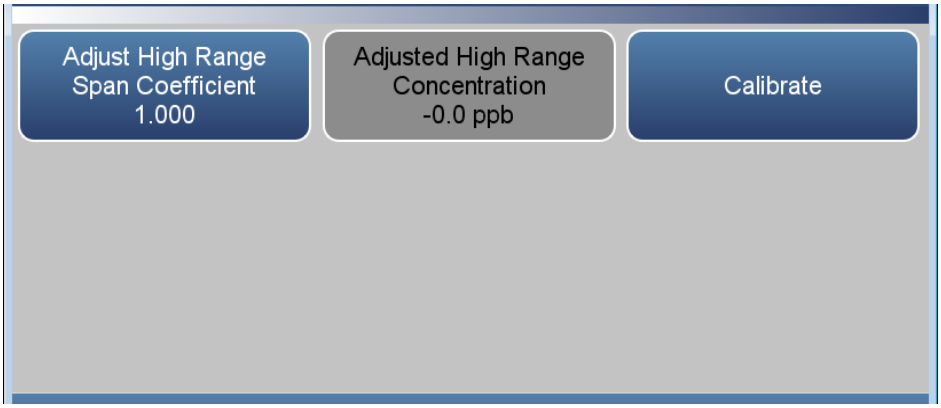
The Adjust Span Coefficient screen is used to manually adjust the span coefficient.

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)



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



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.

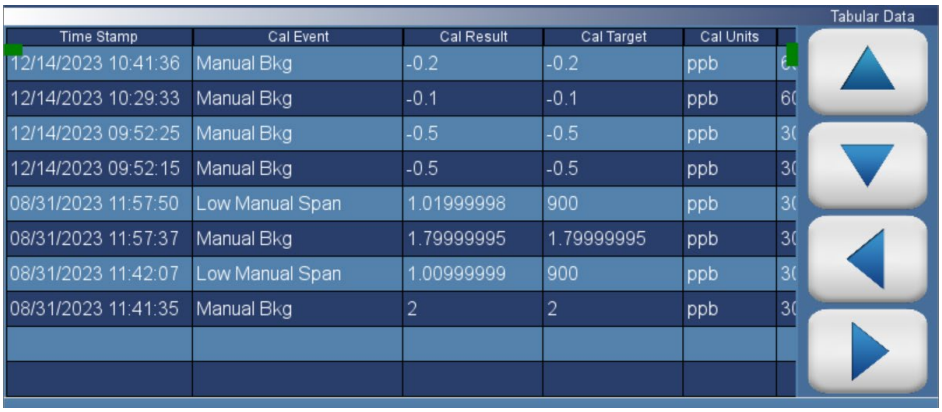
Calibration History

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... ▲



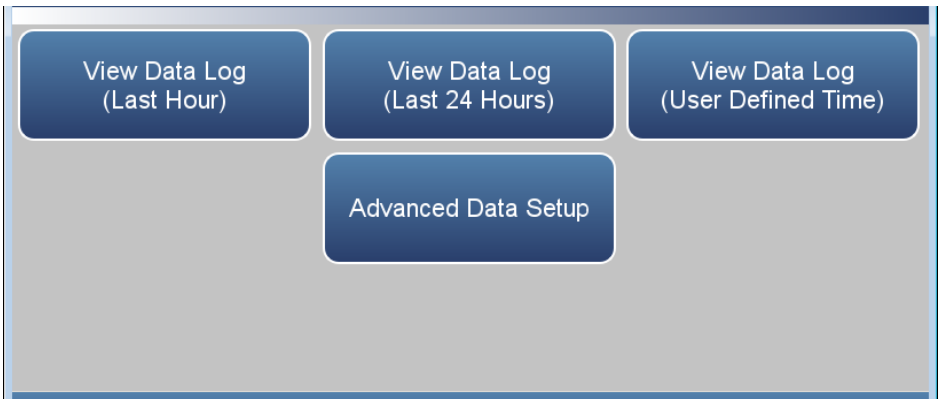
The Calibration History screen contains the following information:

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

Data

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

Home Screen>Data



The Data screen contains the following information:

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

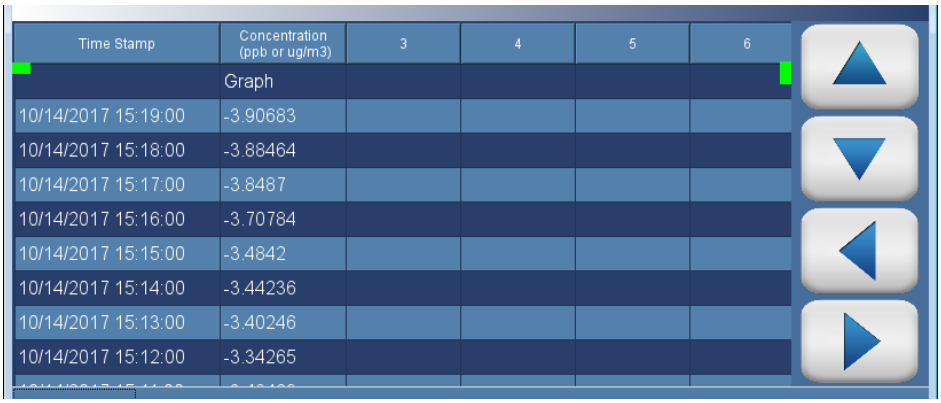
View Data Log (Last Hour)

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

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

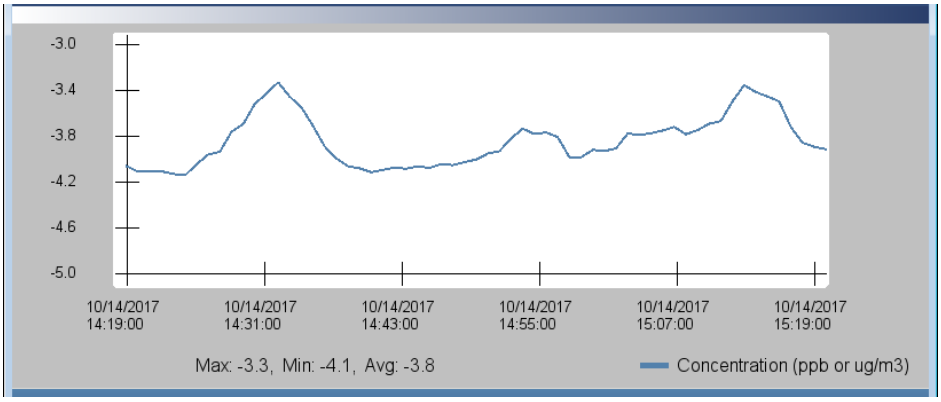
Home Screen>Data>View Data Log (Last Hour)

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



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

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



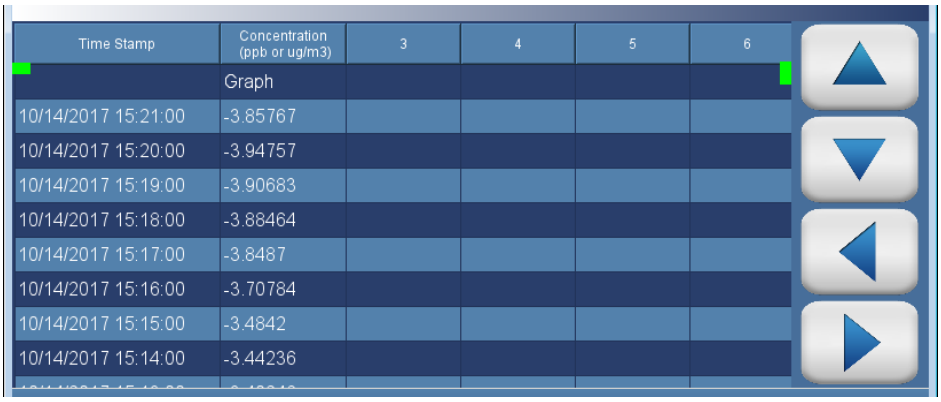
View Data Log (Last 24 Hours)

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

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

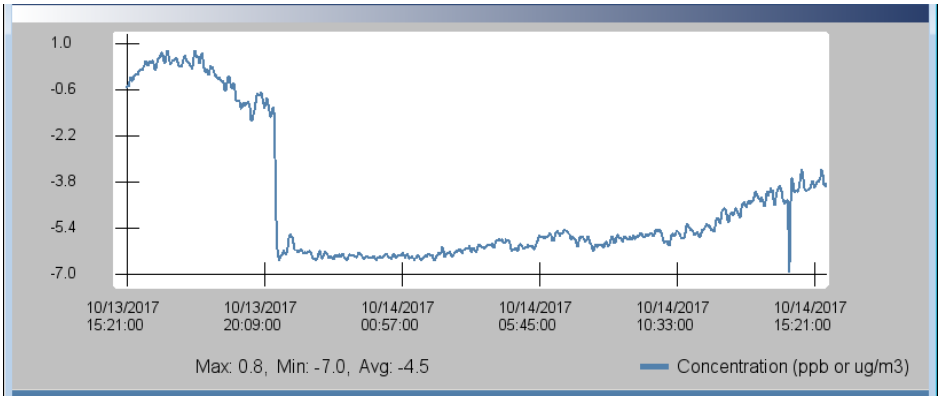
Home Screen>Data>View Data Log (Last 24 Hours)

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



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

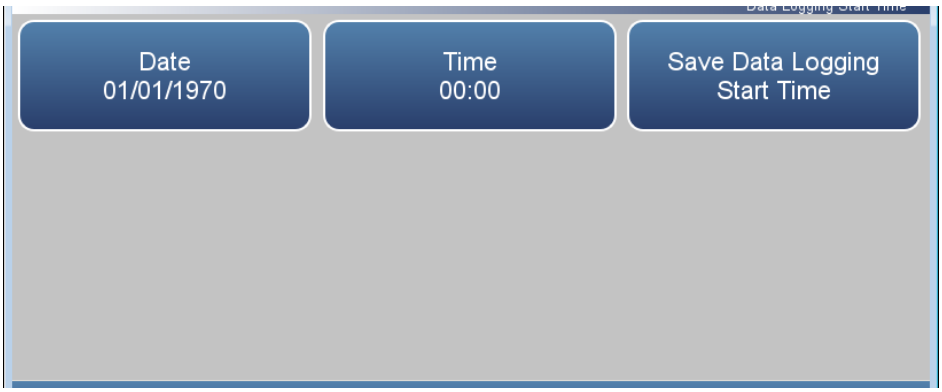
- *Graph:* Displays data graph for the column selected. The graph time axis is defined by the data set in the table.



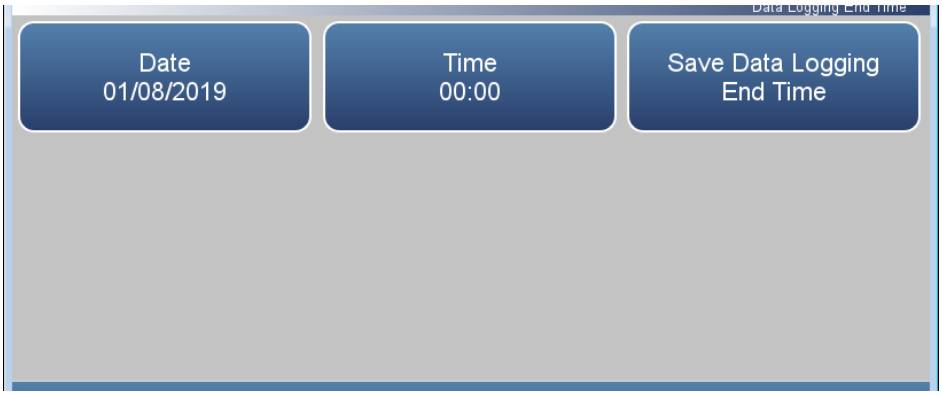
View Data Log (User Defined Time)

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

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



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



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

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

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

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

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

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

Advanced Data Setup

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

Home Screen>Data>Advanced Data Setup

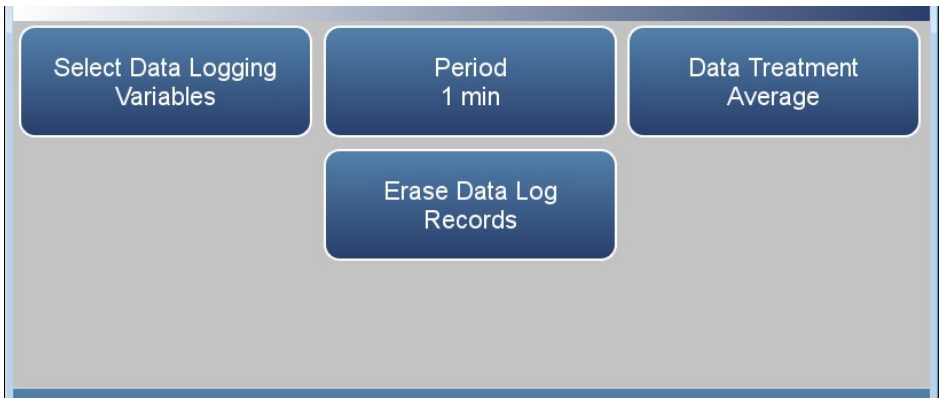
The Advanced Data Setup screen contains the following information:

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

Data Logging Setup

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

Home Screen>Data>Advanced>Data Logging Setup



The Data Logging Setup screen contains the following information:

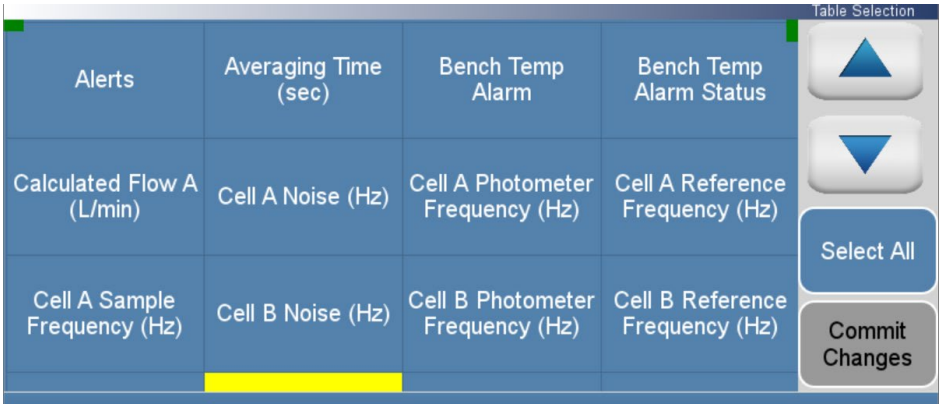
- *Select Data Logging Variables*: User selects instrument variables to log.
- *Period*: User selects how often data is collected by setting the duration between logged data.
- *Data Treatment*: Toggles between Average, Current, Minimum and Maximum. When set to average, the average value during the period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

Select Data Logging Variables

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

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

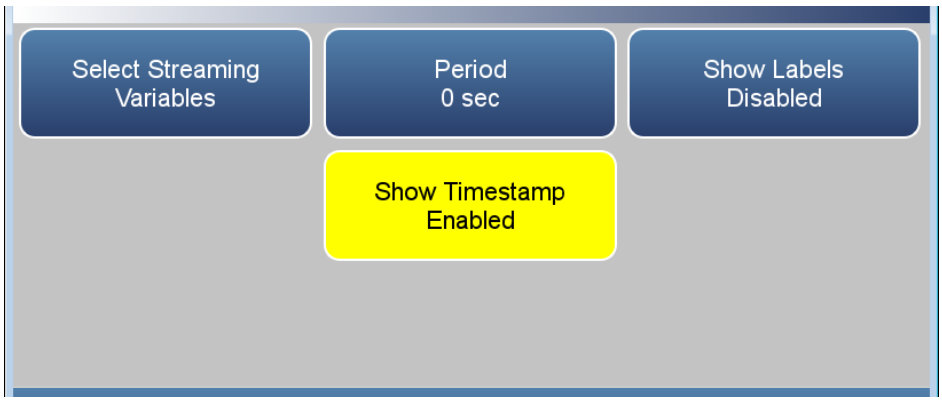
Home Screen>Data>Advanced>Data Logging Setup>Select Data Logging Variables



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:

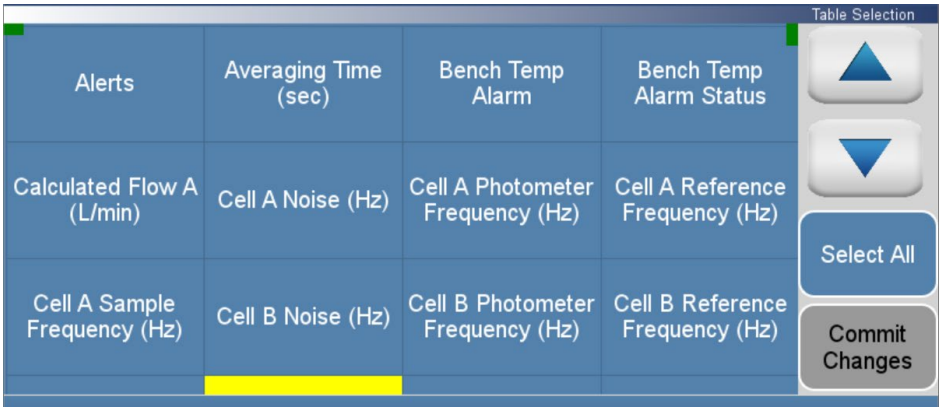
- *Select Streaming Variables*: User selects which variables to stream.
- *Period*: Sets the time between streamed data.
- *Show Labels*: Toggles enabled/disabled. When enabled, shows variable labels to the right of the variable values.
- *Show Timestamp*: Toggles enabled/disabled. When enabled, shows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

Select Streaming Variables

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

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

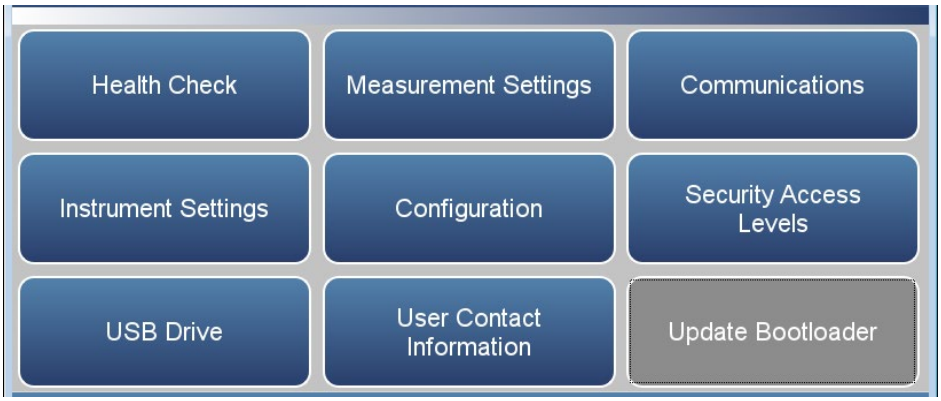
Home Screen>Data>Advanced>Streaming Data Setup>Select Streaming Variables



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.

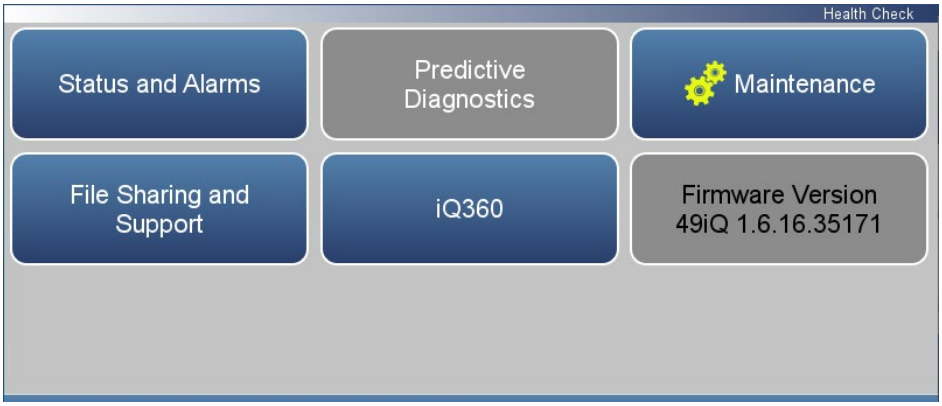
Health Check

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 in the module. ▲

Home Screen>Settings>Health Check



The Health Check screen contains the following information:

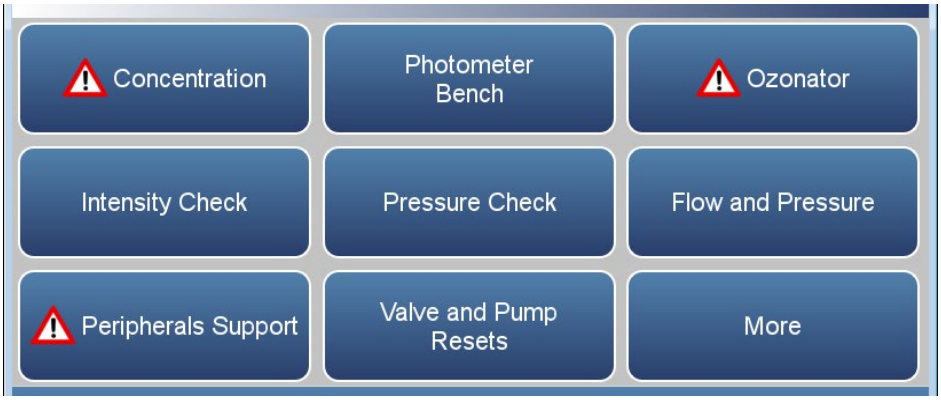
- *Status and Alarms:* Allows the user to view the status and alarm menus. Menus are broken down according to modules where the user can view instrument readings, setpoints and alarms.
- *Predictive Diagnostics:* Smart module diagnostics, which shows possible future issues.
- *Maintenance History:* Allows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

Status and Alarms

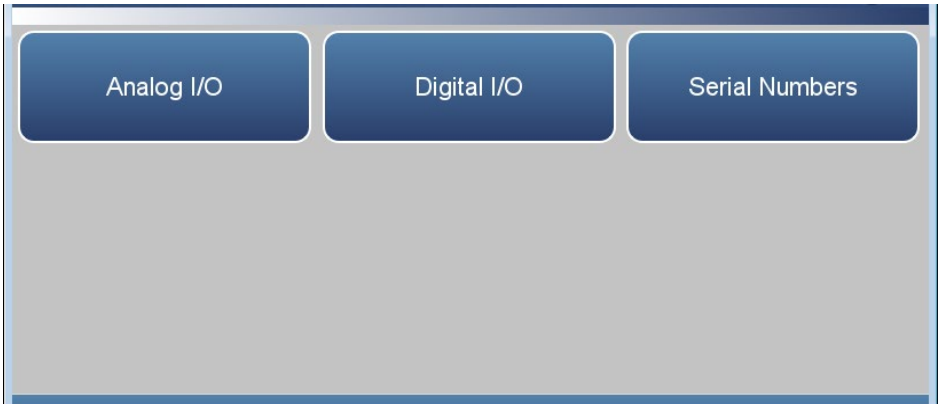
The Status and Alarms screen provides information with respect to module alarms. In each screen, instrument readings, setpoints, and low/high alarm values are displayed. If applicable, setpoints and alarms are also settable from the Settings>Instrument Settings screen.

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

Home Screen>Settings>Health Check>Status and Alarms



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



The Status and Alarms menu contains the following information:

- *Concentration:* Displays O_3 concentration and alarms.
- *Photometer Bench:* Displays photometer bench alarms and faults.
- *Ozonator:* Displays ozonator alarms and faults.
- *Intensity Check:* Displays intensity check alarms and faults.
- *Pressure Check:* Displays pressure check alarms and faults.

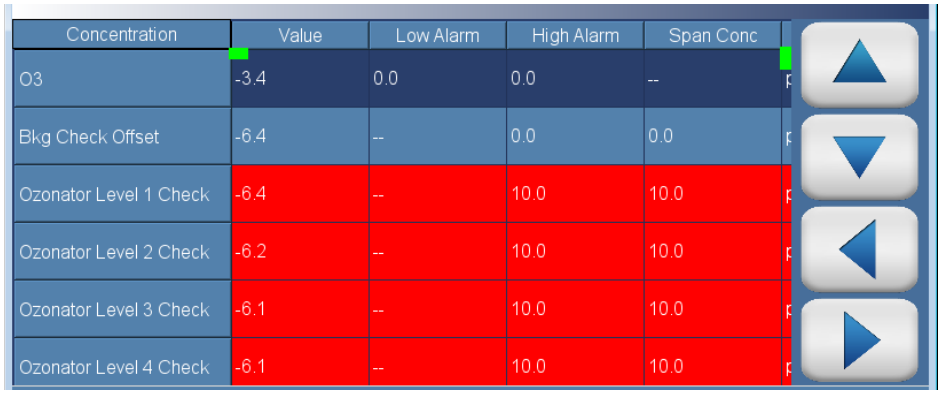
- *Flow and Pressure:* Displays flow and pressure alarms and faults.
- *Peripherals Support:* Displays peripherals support alarms and faults.
- *Valve and Pump Resets:* User can reset valve and pump power.
- *Analog I/O:* Displays analog input/output alarms and faults.
- *Digital I/O:* Displays digital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

Concentration

The Concentration screen provides status and alarms for O_3 concentration background cal/checks, and ozonator levels 1–6 checks. If an item being monitored goes outside the lower or higher alarm limit, an alarm is activated.

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

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



The Concentration screen contains the following information:

- Across:
  - *Concentration:* This column lists items associated with the CO and O_2 (if applicable) concentrations.
  - *Value:* Displays the current value for each item.
  - *Low Alarm:* Displays low alarm status for each item.
  - *High Alarm:* Displays high alarm status for each item.
  - *Span Conc:* Span concentration used in the span calibration or span check.
  - *Units:* Displays units for each item.
- Down:
  - *O_3:* O_3 concentration.
  - *Bkg Check Offset:* Displays concentration based on the last attempted background calibration. High alarm shows user defined limit for acceptable background check offset.

- *Ozonator Level-6 Check:* 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.

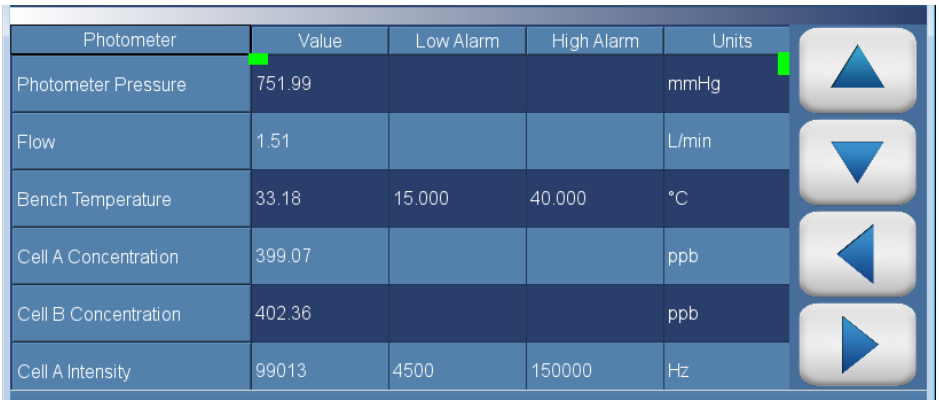
Note If both the low alarm and high alarms are set to zero, then no alarm will show. ▲

Photometer Bench

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

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

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



The Photometer Bench screen contains the following information:

- Across:
  - *Photometer:* This column lists items associated with the photometer.
  - *Value:* Displays the current value for each item.
  - *Low Alarm:* Displays low alarm status for each item.
  - *High Alarm:* Displays high alarm status for each item.
  - *Units:* Displays units for each item.
- Down:
  - *Photometer Pressure:* Displays the current photometer pressure reading.
  - *Flow:* Displays the current sample flow reading.
  - *Bench Temperature:* Displays the current bench temperature reading. User can adjust low and high alarm limits.
  - *Cell A Concentration:* Displays the current concentration in cell A. Alarm limits are not changeable.
  - *Cell B Concentration:* Displays the current concentration in cell B. Alarm limits are not changeable.

- *Cell A Intensity:* Displays the current intensity in cell A.
- *Cell B Intensity:* Displays the current intensity in cell B.
- *Lamp Temperature:* Displays the current lamp temperature. User can adjust low and high alarm limits.
- *Lamp Temp Sensor Short:* Displays OK/Fail for lamp temperature sensor short.
- *Lamp Temp Sensor Open:* Displays OK/Fail for lamp temperature sensor open.
- *Lamp Current:* Displays the current lamp Current. User can adjust low and high alarm limits.
- *Lamp Connection:* Displays OK/Fail for lamp connection.
- *Lamp Short:* Displays OK/Fail for lamp short.
- *Lamp Heater Current:* Displays the current lamp heater current.
- *Bench Temp Sensor Short:* Displays OK/Fail for bench temperature sensor short.
- *Bench Temp Sensor Open:* Displays OK/Fail for bench temperature sensor open.
- *Board Communication Failure:* 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.
    - *2.5 V Ref. Diagnostics:* Displays current voltage readings. Alarm limits are not changeable.
    - *3.3 Volts:* Displays current voltage readings. Alarm limits are not changeable.
    - *5.0 V Diagnostics:* Displays current voltage readings. Alarm limits are not changeable.
    - *Lamp Power:* Displays current lamp power readings. Alarm limits are not changeable.
    - *15 Volts:* Displays current voltage readings. Alarm limits are not changeable.
    - *-15 Volts:* Displays current voltage readings. Alarm limits are not changeable.

- *24.0 Volts:* Displays current voltage readings. Alarm limits are not changeable.

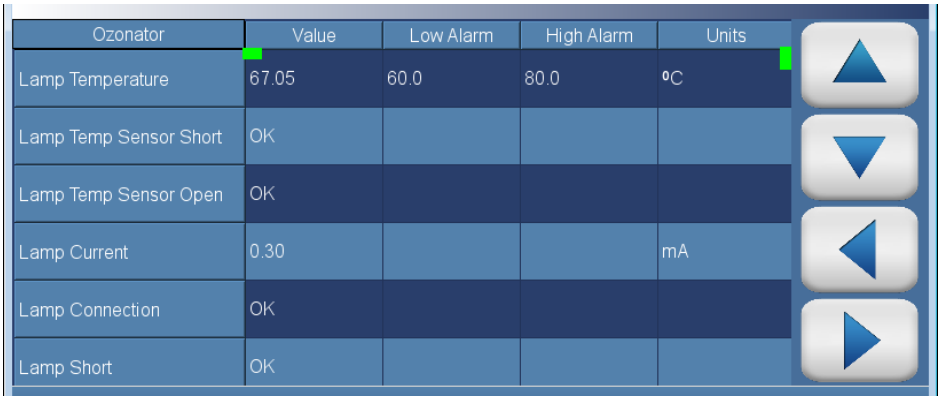
Note If both the low alarm and high alarms are set to zero, then no alarm will show. ▲

Ozonator

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

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

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



The Ozonator screen contains the following information:

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

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

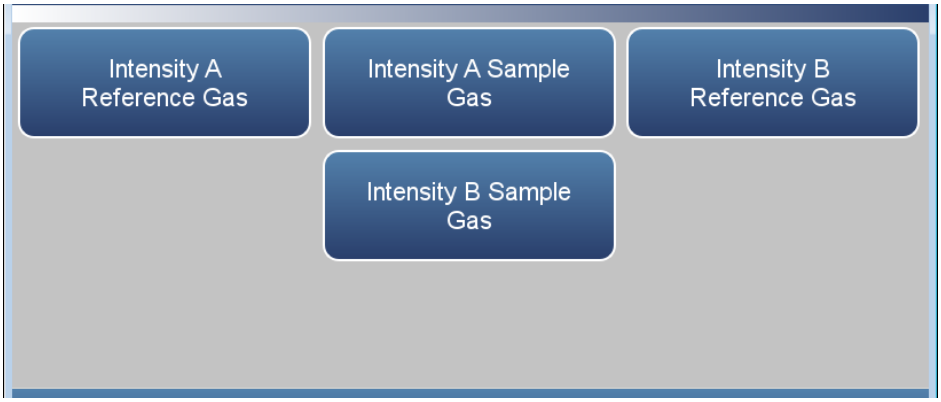
Note If both the low alarm and high alarms are set to zero, then no alarm will show. ▲

Intensity Check

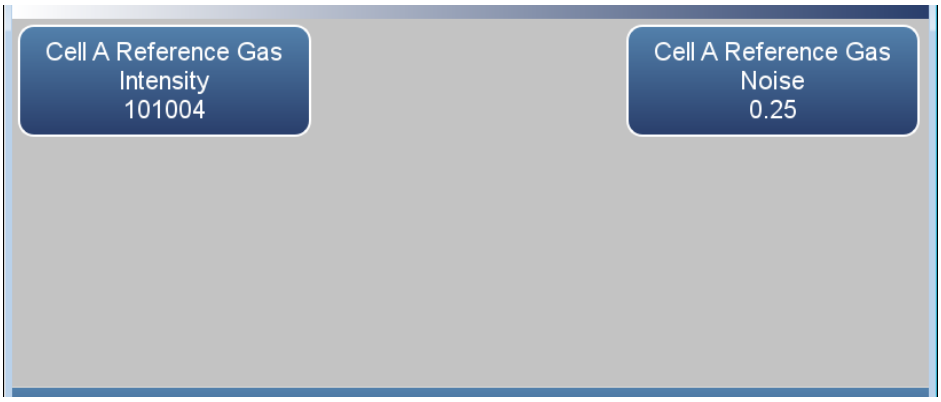
The Intensity Check screen is used to display the flow of reference or sample gas through either Cell A or Cell B. This enables the intensity and noise reading of the detector to be determined with either reference or sample gas flow. Selecting any either of these will disturb the analog outputs. The intensity check is visible only if the photometer option is installed.

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

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



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



The Intensity Check screen contains the following information:

- *Intensity A Reference Gas:* Displays reference gas.
- *Intensity A Sample Gas:* Displays sample gas.
- *Intensity B Reference Gas:* Displays reference gas.

- *Intensity B Sample Gas:* Displays sample gas.
- *Cell A Reference Gas Intensity:* Read only.
- *Cell A Reference Gas Noise:* Read only.
- *Cell B Reference Gas Intensity:* Read only.
- *Cell B Reference Gas Noise:* Read only.

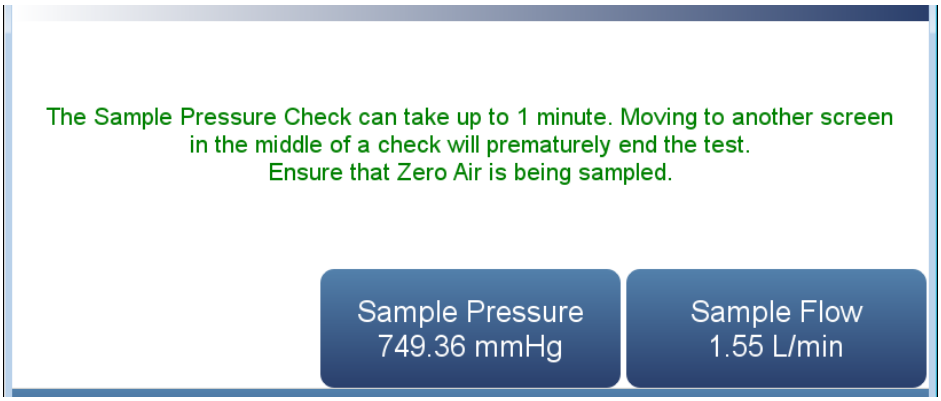
Pressure Check

The Pressure Check screen is used to manually control the flow of reference or sample gas through Cell B. This enables the pressure reading of Cell B, with either sample or reference gas, to be determined. Pump pressure is used to test the pump. Selecting any either of these will disturb the analog outputs.

All pressure check screens function the same way. Therefore, the following example of the Sample Pressure screen applies to all screens as well.

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

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



The Pressure Check screen contains the following information:

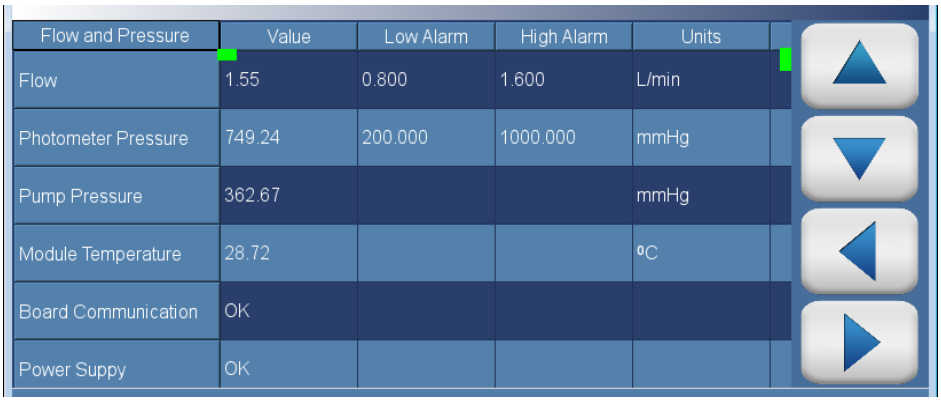
- *Sample Pressure:* Read only. Displays the pressure of the sample gas in Cell B.
- *Reference Pressure:* Read only. Displays the pressure of the reference gas in Cell B.
- *Pump Pressure:* Read only. Is used to test the pump.

Flow and Pressure

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

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

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



The Flow and Pressure screen contains the following information:

- Across:
  - *Flow and Pressure:* This column lists items associated with the flow and pressure module.
  - *Value:* Displays the current value for each item.
  - *Low Alarm:* Displays low alarm status for each item.
  - *High Alarm:* Displays high alarm status for each item.
  - *Units:* Displays units for each item.
- Down:
  - *Flow:* Displays the current sample flow reading. User can adjust low and high alarm limits.
  - *Photometer Pressure:* Displays the current photometer pressure reading. User can adjust low and high alarm limits.
  - *Pump Pressure:* Displays the current pump pressure reading.
  - *Module Temperature:* Displays the current instrument temperature reading.

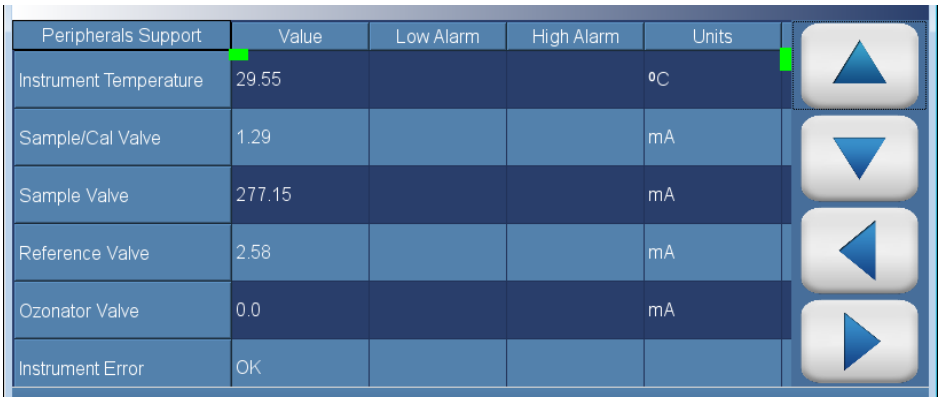
- *Board Communication:* Displays OK/Fail for board communication status.
- *Power Supply:* Displays OK/Fail of power supplies. Power supply goes red if any voltages are outside their limits. No voltage rows ever get highlighted.
    - *2.5V Diagnostic:* Displays current voltage readings. Alarm limits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



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:
  - *Instrument Temperature:* Displays the current instrument temperature of the module.
  - *Sample/Cal Valve:* Displays whether or not the sample/cal valve is activated.
  - *Sample Valve:* Displays whether or not the sample valve is activated.
  - *Reference Valve:* Displays whether or not the reference valve is activated.

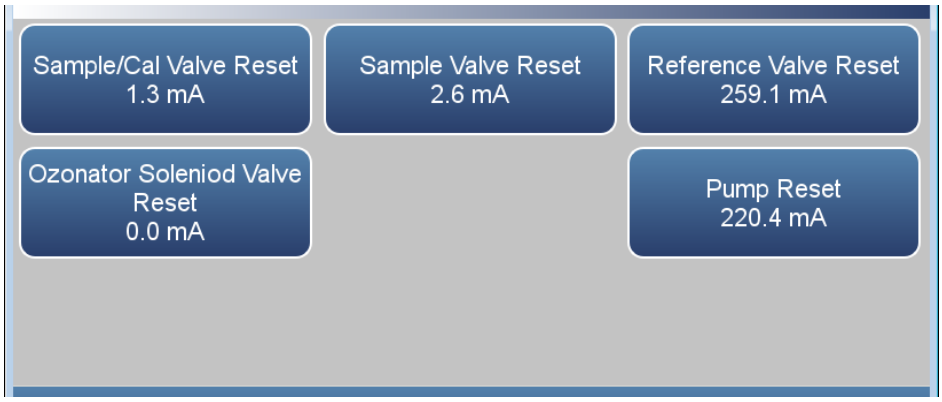
- *Ozonator Valve:* Displays whether or not the ozonator valve is activated.
- *Instrument Error:* Displays OK/Fail for PCP, datalogging, streaming, serial server, and Modbus protocols.
- *Board Communication:* Displays OK/Fail for board communication status.
- *Power Supply:* Displays OK/Fail of power 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.
- *5V Step Board 1:* Displays current voltage readings. Alarm limits are not changeable.
- *24V Step Board 1:* Displays current voltage readings. Alarm limits are not changeable.
- *5V Step Board 2:* Displays current voltage readings. Alarm limits are not changeable.
- *24V Step Board 2:* Displays current voltage readings. Alarm limits are not changeable.

Valve and Pump Resets

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

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

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



The Valve and Pump Resets screen contains the following information:

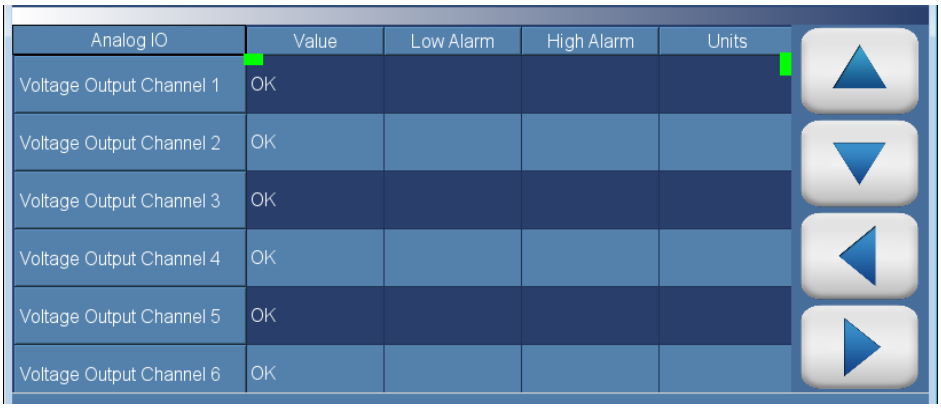
- *Sample/Cal Valve Reset:* Resets sample/cal valve.
- *Sample Valve Reset:* Resets sample valve.
- *Reference Valve Reset:* Resets reference valve.
- *Ozonator Solenoid Valve Reset:* Resets ozonator solenoid valve.
- *Pump Reset:* Resets pump.

Analog I/O

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

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

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



The Analog I/O screen contains the following information:

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

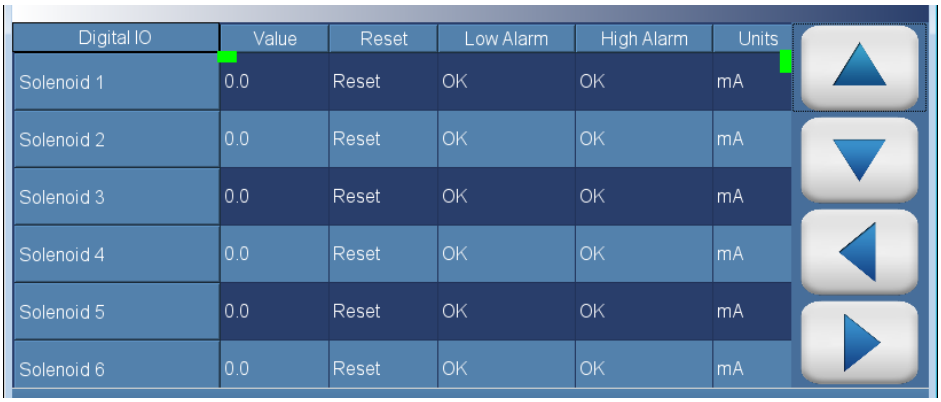
- *Board Communication:* Displays OK/Fail for board communication status.
- *Power Supply:* Displays OK/Fail of power supplies. Power supply goes red if any voltages are outside their limits. No voltage rows ever get highlighted.
    - *3.3V Diagnostic:* Displays current voltage readings. Alarm limits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

Digital I/O

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

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

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



The Digital I/O screen contains the following information:

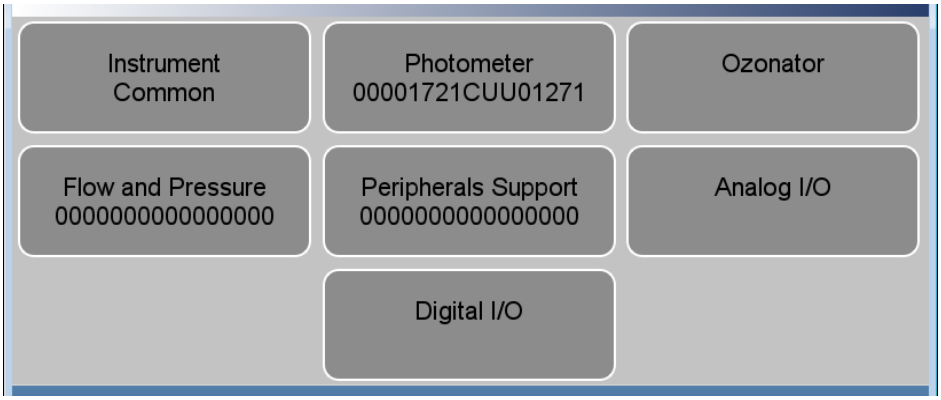
- Across:
  - *Digital IO:* This column lists items associated with the digital I/O.
  - *Value:* Displays the current value for each item.
  - *Reset:* Resets item.
  - *Low Alarm:* Displays low alarm status for each item.
  - *High Alarm:* Displays high alarm status for each item.
  - *Units:* Displays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

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

Serial Numbers

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

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



The Serial Numbers screen contains the following information:

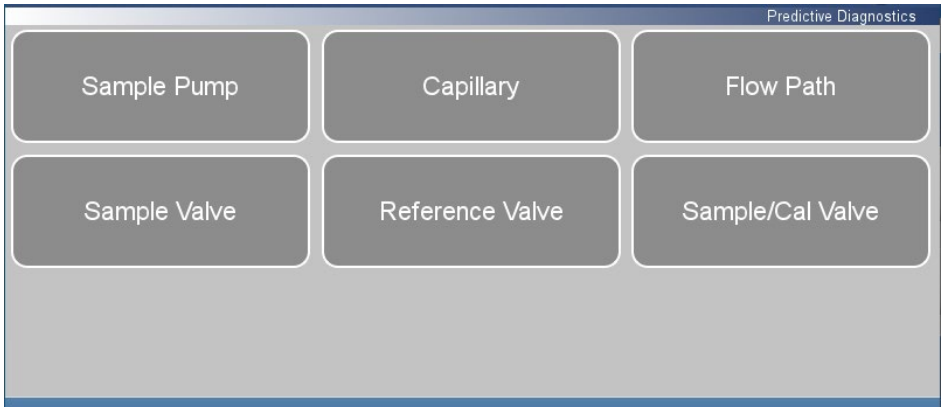
- *Instrument:* Instrument serial number.
- *Photometer:* Photometer serial number.
- *Ozonator:* Ozonator serial number.
- *Flow and Pressure:* Flow and pressure serial number.
- *Peripherals Support:* Peripherals support serial number.
- *Analog I/O:* Analog I/O serial number.
- *Digital I/O:* Digital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

Predictive Diagnostics

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

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

Home Screen>Settings>Health Check>Predictive Diagnostics



The Predictive Diagnostics screen contains the following information:

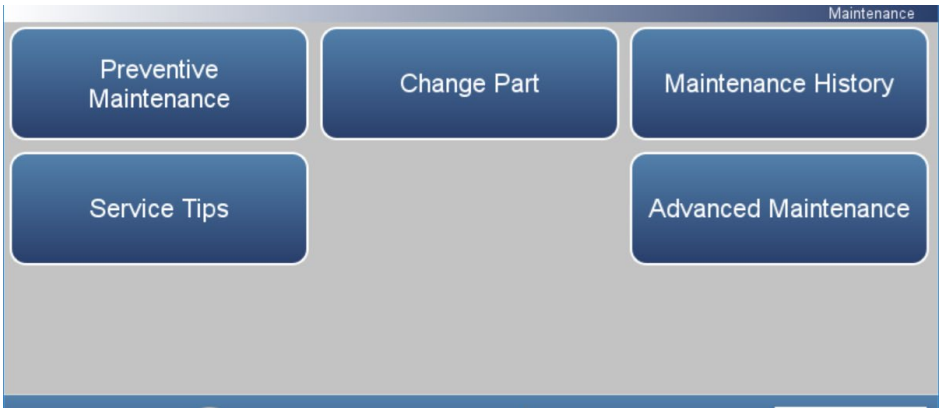
- Sample Pump
- Capillary
- Flow Path
- Sample Valve
- Reference Valve
- Sample/Cal Valve (optional)
- Ozone Valve (optional)

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:

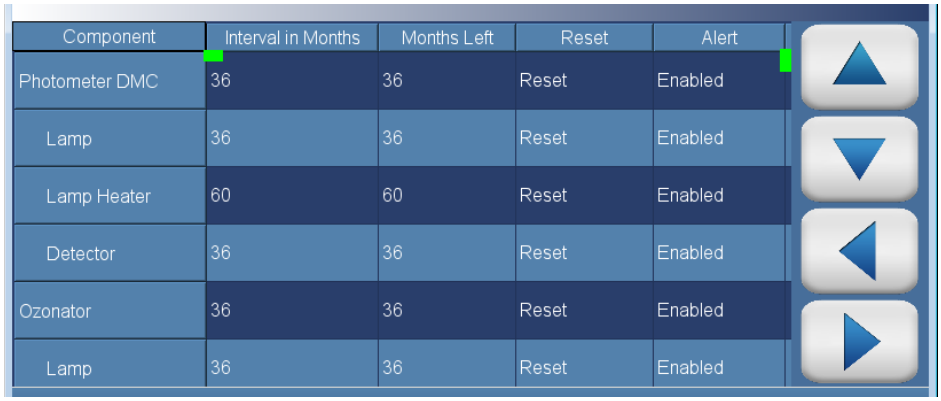
- *Preventive Maintenance:* Shows suggested service interval and time left for component replacement.
- *Change Part:* User logs component fix.
- *Maintenance History:* Shows the log of all recorded component fixes.
- *Service Tips:* Provides video and procedural service tips.
- *Advanced Maintenance:*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



The Preventive Maintenance screen contains the following information:

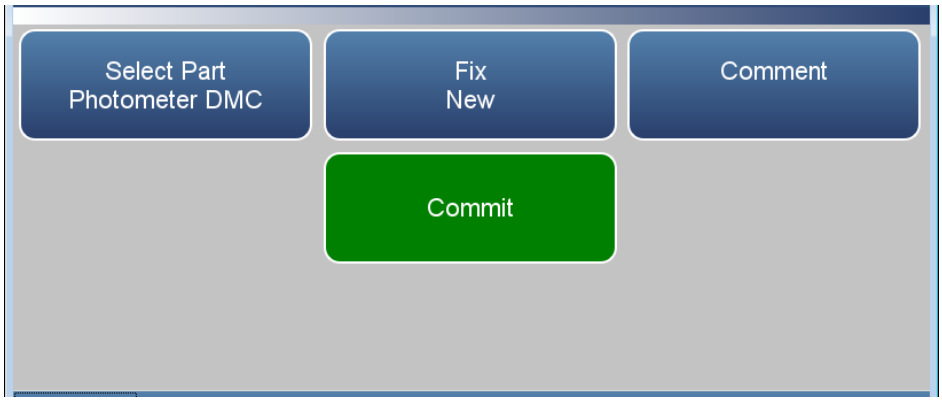
- Across:
  - *Component:* Device to be routinely serviced or replaced.
  - *Interval in Months:* Expected period of time before a component needs to be checked and/or serviced.
  - *Months Left:* Count down timer in months. Remaining time since the beginning of the service interval. When the value is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

    - *Lamp:* Service interval for lamp.
    - *Lamp Heater:* Service interval for lamp heater.
    - *Detector:* Service interval for detector.
- *Ozonator:* Service interval for ozonator.
    - *Lamp:* Service interval for lamp.
    - *Lamp Heater:* Service interval for lamp heater.
- *Flow System:* Service interval for the flow system components.
    - *Pump:* Service interval for pump.
    - *Capillaries:* Service interval for capillaries.
    - *Ozone Scrubber:* Service interval for ozone scrubber.
- *DC Power Supply:* Service interval for DC power supply.
- *Fan Filter:* Service interval for fan filter.
- *System Components:* Service interval for system components.
    - *Purafil:* Service interval for purafil.
    - *Charcoal:* Service interval for charcoal.
    - *Dri-Rite:* Service interval for dri-rite.

Change Part

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

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



The Change Part screen contains the following information:

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

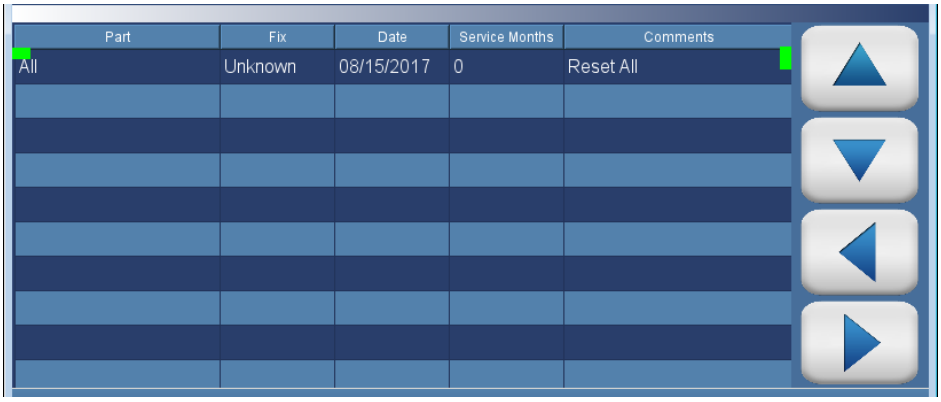
Maintenance History

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

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

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

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



The Maintenance History screen contains the following information:

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

File Sharing and Support

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

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

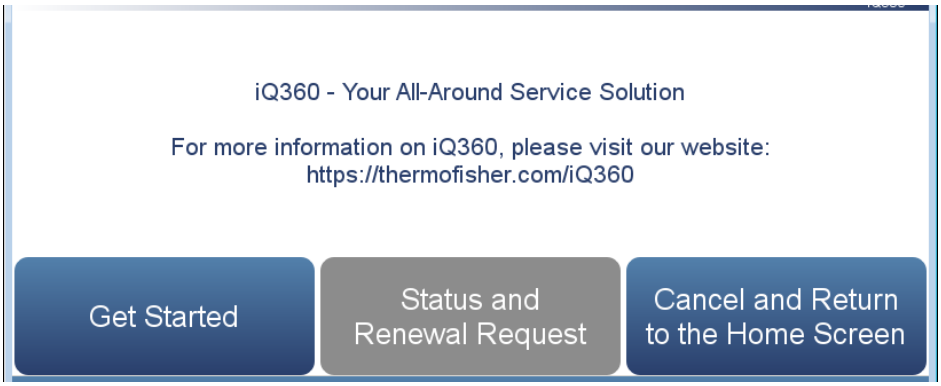
Home Screen>Settings>Health Check>File Sharing and Support

The File Sharing and Support screen contains the following information:

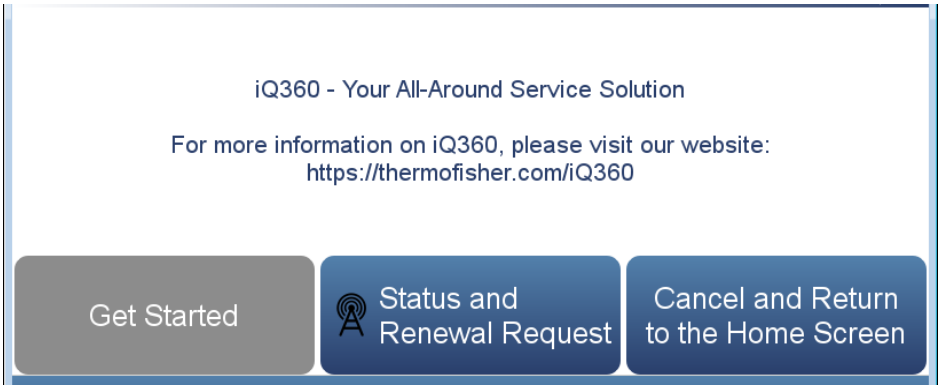
- *Download Health Check Report to USB Drive:* Sends the health report to USB drive.
- *Email Health Check Report File to Technical Support:* Sends the health report file to technical support and the customer email addresses via email.
- *Email Health Check Report to Personal Account:* Sends the health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

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

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



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



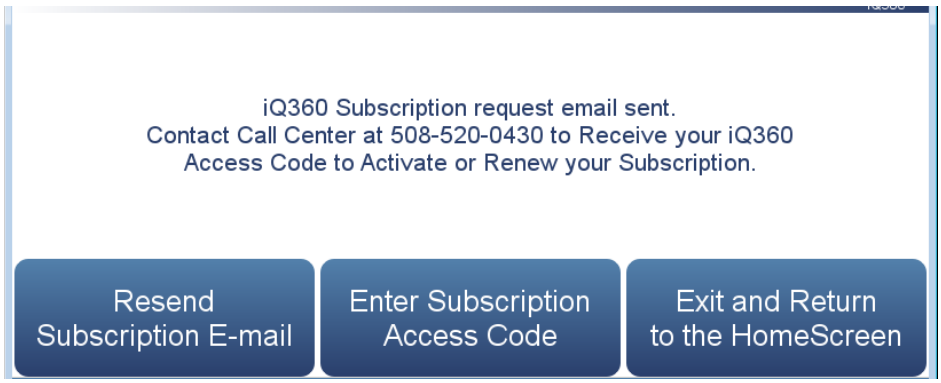
The iQ360 screen contains the following information:

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

Get Started

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

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



The Get Started screen contains the following information:

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

Status and Renewal Request

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

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

The Status and Renewal Request screen contains the following information:

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

Measurement Settings

The Measurement Settings menu 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 Setting menu contains the following information:

- *Averaging Time:* Sets the averaging time for the O_3 sample measurement.
- *Range Mode Selection:* User can choose between the various range modes: single, dual, or auto. For more information, see "Range Mode Selection" on page 3-72
- *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 O_3 concentration reading is expressed.
- *Dilution Ratio:* Serves as a multiplier when dilution gas is utilized.
- *Advanced Measurement Settings:* Advanced settings affecting O_3 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 O_3 measurements are taken. The average concentration of the readings are calculated for that time period. The front panel display and analog outputs are updated every 10 seconds for averaging times between 10 and 300 seconds. For averaging times of 1, 2, and 5 seconds, the front panel display and analog outputs are updated every second. An averaging time of 10 seconds, for example, means that the average concentration of the last 10 seconds will be displayed every 10 seconds. An averaging time of 300 seconds means that the moving average concentration of the last 300 seconds will be output at each update. Therefore, the lower the averaging time the faster the front panel display and analog outputs respond to concentration changes. Longer averaging times are typically used to smooth output data.

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

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

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

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

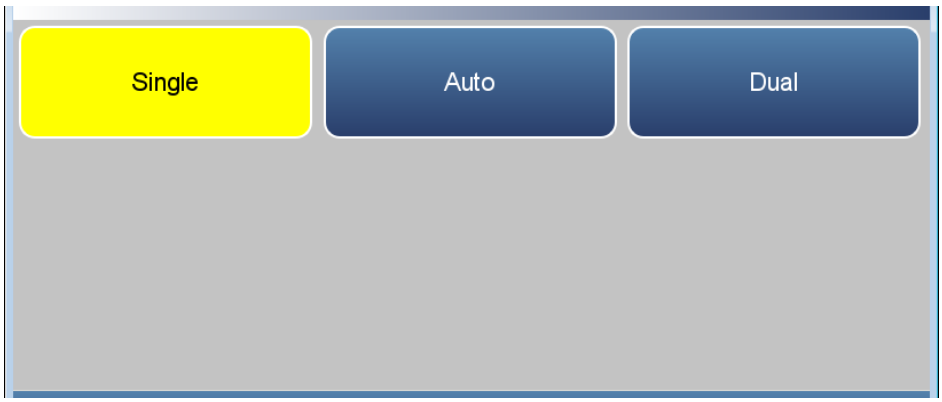
The Averaging Time screen contains the following information:

- *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 O_3 analog output can be set to output concentrations from 0 to 50 ppb and the high O_3 analog output set to output concentrations from 0 to 200 ppb.

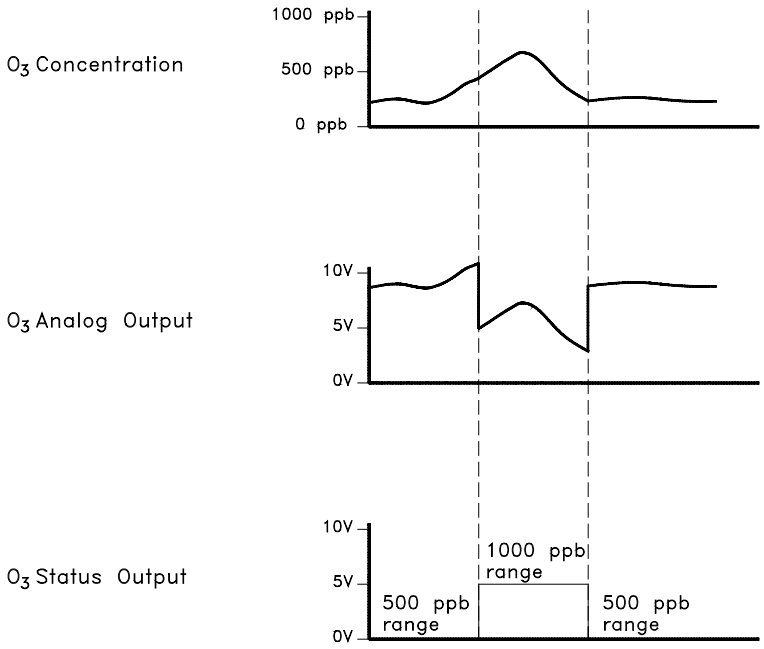
  In addition, each O_3 analog output has a span coefficient so that each range can be calibrated separately. This is especially necessary if the two ranges are not close to one another. For example, the low O_3 range is set to 0–50 ppb and the high O_3 range is set to 0–1,000 ppb.
- *Auto:* The auto range mode switches the O_3 analog outputs between high and low range settings, depending on the concentration level. The high and low ranges are defined in the Range Settings menu.

  For example, suppose the low range is set to 500 ppb and the high range is set to 1,000 ppb. Sample concentrations below 500 ppb are output based on low range selection and sample concentrations above 500 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 85% of the low O_3 range for the low range to become active.

In addition, each O_3 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 O_3 range is set to 0–50 ppb and the high O_3 range is set to 0–20,000 ppb.



Range Setting

The Range Setting screen defines the concentration range of the analog outputs. For example, an O_3 range of 0–500 ppb restricts the analog output to concentrations between 0 and 500 ppb.

The screen shows the current O_3 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 3-72. Pressing Range Setting, High Range Setting or Low Range Setting, brings up a numeric keypad whereby the user can select a range.

Settable ranges according to unit selection include:

ppb	50–200,000 ppb
ppm	0.05–200 ppm
%	0.000005–0.02 %
µg/m^3	100–400,000 µg/m^3
mg/m^3	0.1–400 mg/m^3
g/m^3	$1.0x10^{-10}$–$4.0x10^{-7}$ 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:

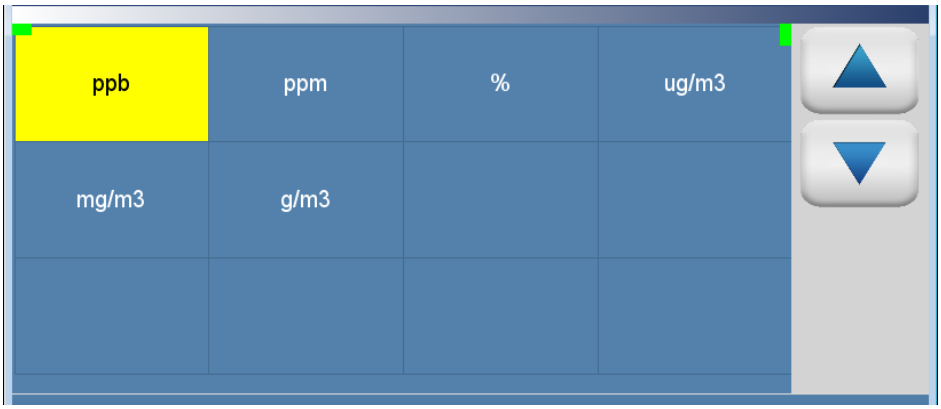
- *Sample:* Sets the instrument to measure sample gas.
- *Zero:* Used when calibrating the background of the instrument. When pressed, sets the instrument to zero mode.
- *Level 1–6:* Sets the instrument to user-defined concentration levels.

Gas Units

The Gas Units screen defines how the O_3 concentration reading is expressed. The µg/m³, mg/m³, and g/m³ gas concentration modes are calculated using a standard pressure of 760 mmHg and a standard temperature of 0 °C. The temperature can be changed in the compensation screen.

Use the ▲ and ▼ buttons to select.

Home Screen>Settings>Measurement Settings>Gas Units



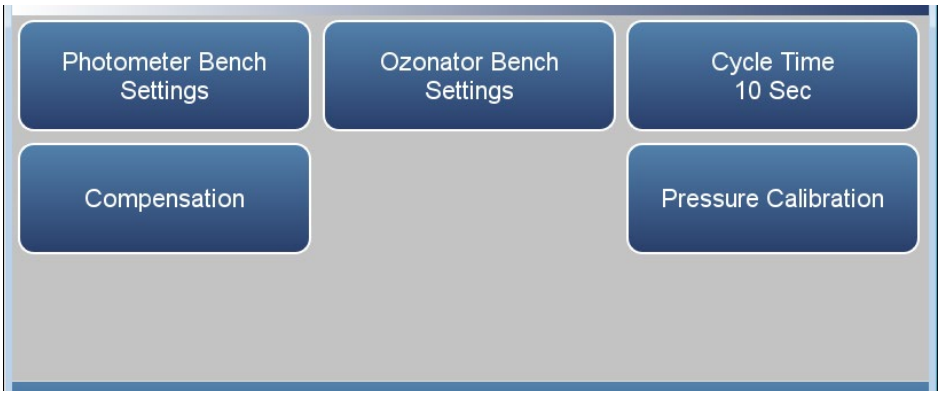
The Gas Units screen contains the following information:

- *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 menu allows the user to calibrate the detector gain, select compensations, and calibrate pressure.

Home Screen>Settings>Measurement Settings>Advanced Measurement Settings



The Advanced Measurements Settings menu contains the following information:

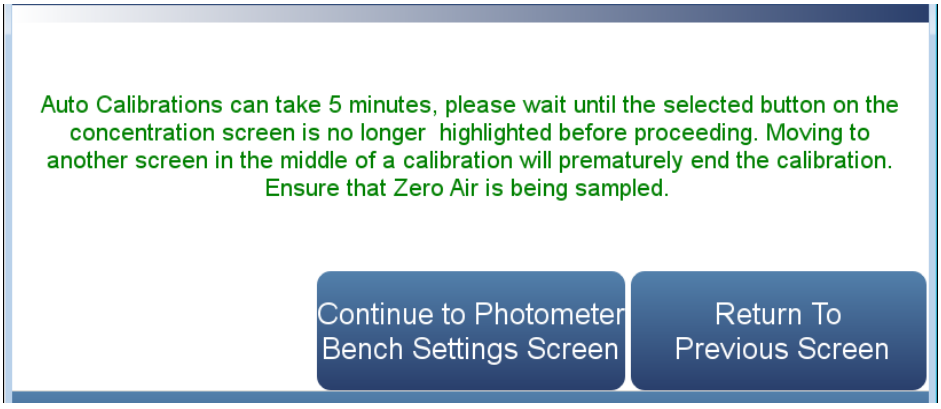
- *Photometer Bench Settings:* User can set the detector gain. This can be done manually or automatically.
- *Ozonator Bench Settings:* User can run automated calibration for lamp power to concentration.
- *Cycle Time:* Toggles cycle time to either 4 seconds or 10 seconds.
- *Compensation:* Allows the user to compensate for changes in temperature and pressure concentration.
- *Pressure Calibration:* Calibrates pressure.

Photometer Bench Settings

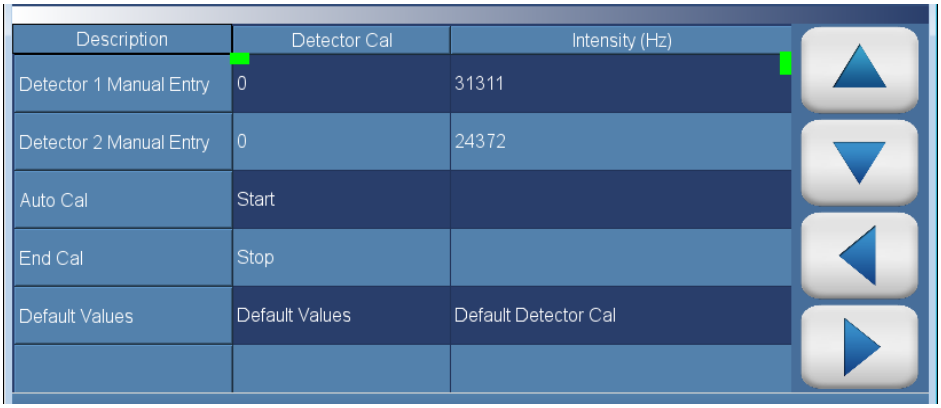
The Photometer Bench Settings screen allows the user to manually or automatically set detector 1 and 2.

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>Photometer Bench Settings



Home Screen>Settings>Measurement Settings>Advanced Measurement Settings>Photometer Bench Settings>Continue to Photometer Bench Settings Screen



The Photometer Bench Settings screen contains the following information:

- Across:
  - *Description:* Defines the actions the user can do.
  - *Detector Cal:* User can manually set or automatically calibrate detector 1 and 2.
  - *Intensity (Hz):* Displays the current intensity in Hz.

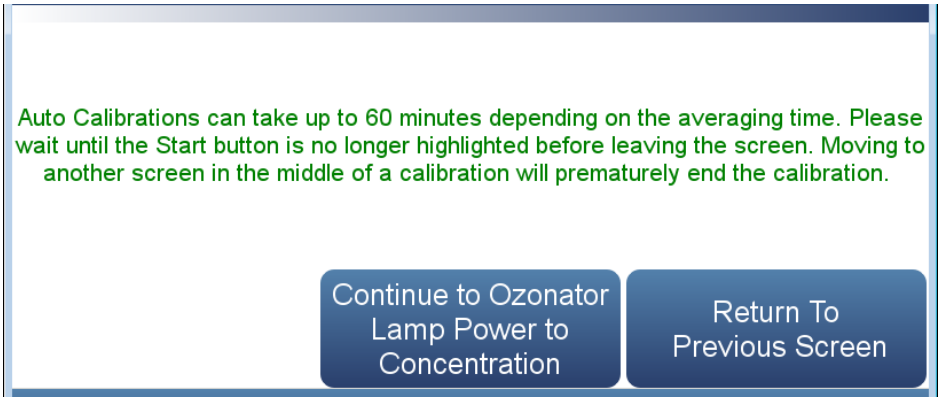
- Down:
  - *Detector 1 Manual Entry:* Shows current values for detector 1. If detector cal cell is pressed, user can manually set the detector 1 cal value.
  - *Detector 2 Manual Entry:* Shows current values for detector 2. If detector cal cell is pressed, user can manually set the detector 2 cal value.
  - *Auto Cal:* When Start is pressed, the auto-calibration process is initiated. Please allow up to 5 minutes for calibration to complete. User can stop calibration by pressing the Stop button.
  - *End Cal:* When Stop is pressed, the auto calibration is interrupted and the value does not change.
  - *Default Values:* When pressed, the default values are saved.

Ozonator Bench Settings

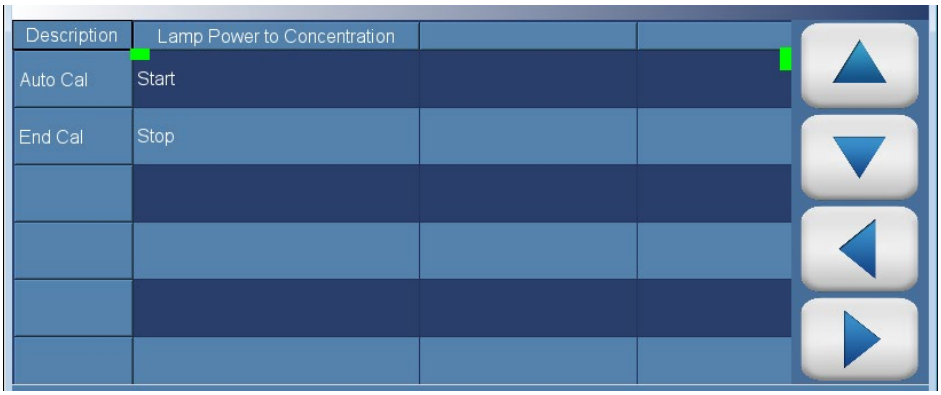
The Ozonator Bench Settings screen allows the user to run automated calibrations for the ozonator lamp.

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>Ozonator Bench Settings



Home Screen>Settings>Measurement Settings>Advanced Measurement Settings>Ozonator Bench Settings>Continue to Ozonator Lamp Power to Concentration



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

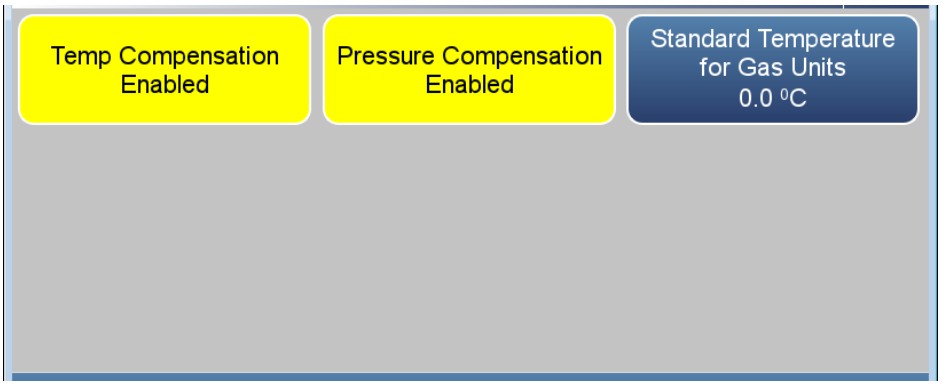
- Across:
  - *Description:* Lists items in table.
  - *Lamp Power to Concentration:* User can initiate calibration by pressing Start, and end calibration prematurely by pressing Stop.

- Down:
  - *Auto Cal:* When Start is pressed, the auto-calibration process is initiated. Please allow up to 60 minutes for calibration to complete. User can stop calibration by pressing the Stop button.
  - *End Cal:* When Stop is pressed, the auto calibration is interrupted and the value does not change.

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:

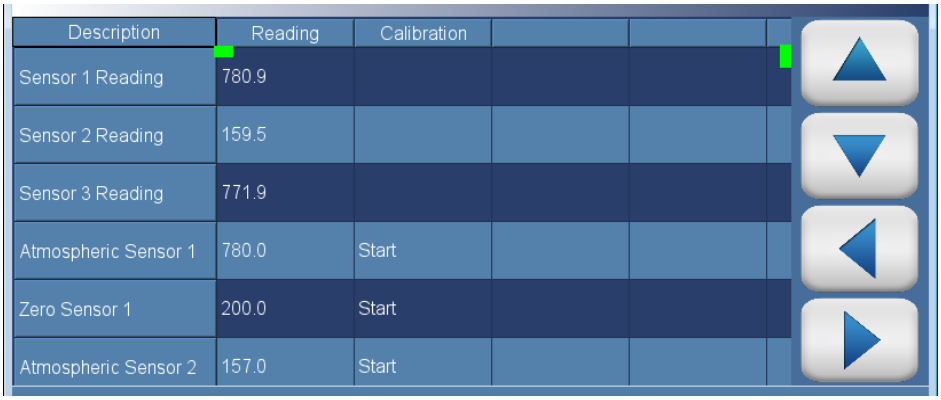
- *Temp Compensation:* Toggles temperature compensation enabled or disabled and provides compensation for any changes to the instrument's output signal due to internal instrument temperature variations. The effects of internal instrument temperature changes on the analyzer's subsystems and output have 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 µg/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



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 49iQ has a default instrument ID of 1.
- *Bayern Hessen Settings:* User selects the registers (measured values) that the instrument should respond with, in response to a valid data query (DA) command.

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

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

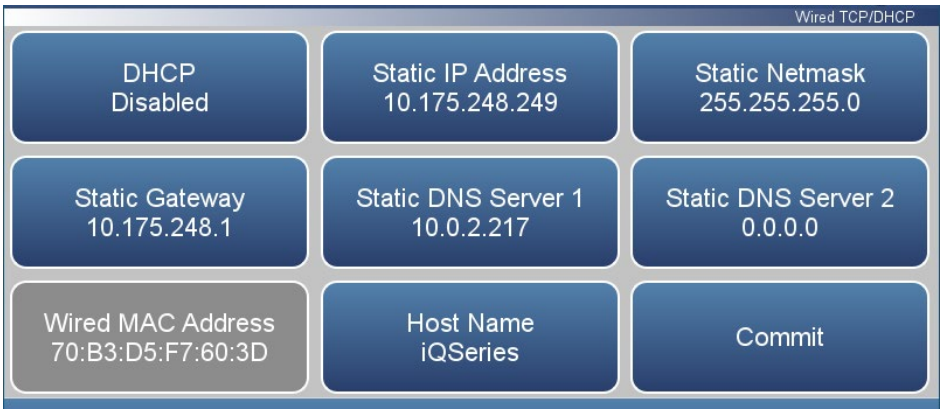
Wired TCP/DHCP

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

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

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

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



The Wired TCP/DHCP screen contains the following information:

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

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

Serial RS-232/485

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

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

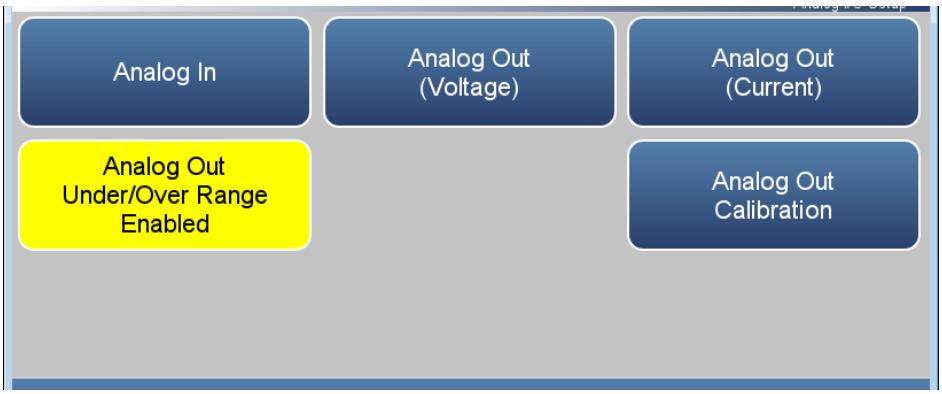
The Serial RS-232/485 screen contains the following information:

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

Analog I/O

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

Home Screen>Settings>Communications>Analog I/O



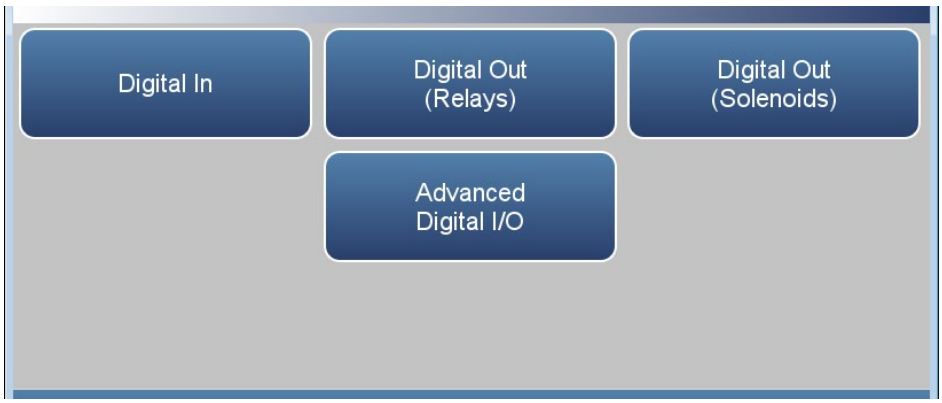
The Analog I/O screen contains the following information:

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

Digital I/O

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

Home Screen>Settings>Communications>Digital I/O



The Digital I/O screen contains the following information:

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

Email Server (SMTP)

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

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

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

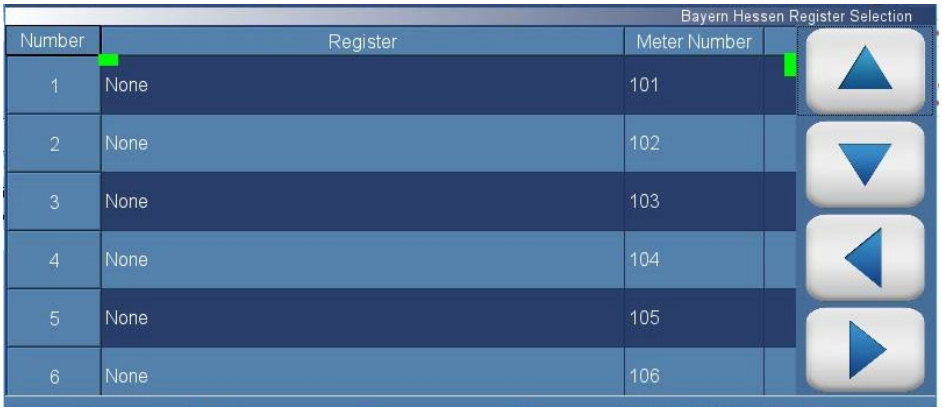
- *SMTP Server Address:* Address of the user's email server.
- *From Email Address:* The email address that goes in the From field in emails.
- *SMTP Server Port:* Server port of user's email server.
- *Email Password:* Password for SMTP server.
- *Email UserName:* User name that is authorized to send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

Bayern Hessen Settings

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

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

Home Screen>Settings>Communications>Bayern Hessen Settings



The Bayern Hessen Settings screen contains the following information:

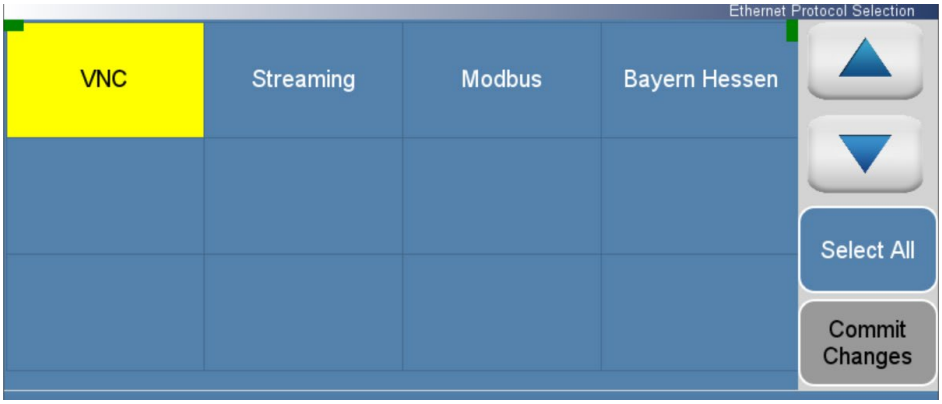
- Across:
  - *Number:* Lists up to 8 registers that can selected by the user.
  - *Register:* User selects the measured values to be logged.
  - *Meter Number:* Allows the user to choose the meter/register number (001 to 999) that will preface the measured value in the response to the 'DA' command.
- Down:
  - *1–8:* Displays the register number and the measured values to be logged in the respective register location, in response to a valid query (DA) command.

Ethernet Protocol Selection

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

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

Home Screen>Settings>Communications>Ethernet Protocol Selection



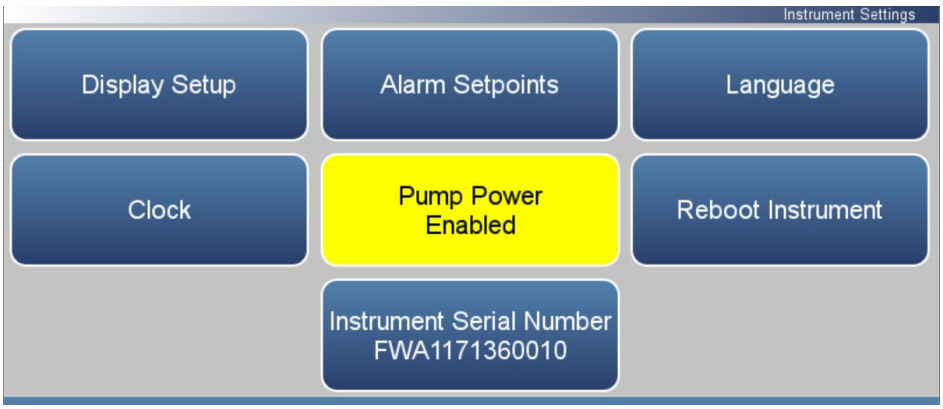
The Ethernet Protocol Selection screen contains the following information:

- VNC
- Streaming
- Modbus
- Bayern Hessen

Instrument Settings

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

Home Screen>Settings>Instrument Settings



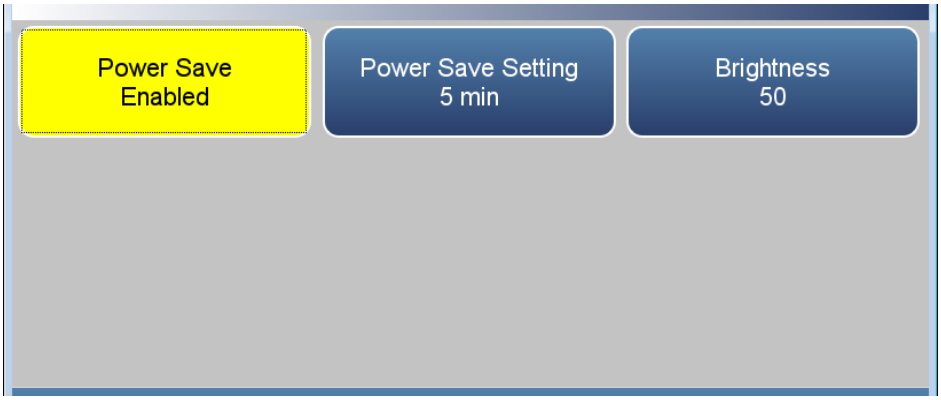
The Instrument Settings screen contains the following information:

- *Display Setup:* Sets touchscreen display settings.
- *Alarm Setpoints:* View and set all available alarm setpoints.
- *Language:* Sets language.
- *Clock:* Sets date and time.
- *Pump Power:* Manually enables/disables the pump.
- *Reboot Instrument:* Reboots the instrument.
- *Instrument Serial Number:* Allows the user to change the instrument serial number.

Display Setup

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

Home Screen>Settings>Instrument Settings>Display Setup



The Display Setup screen contains the following information:

- *Power Save:* Minutes before screen times out. Toggles enabled/disabled.
- *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.

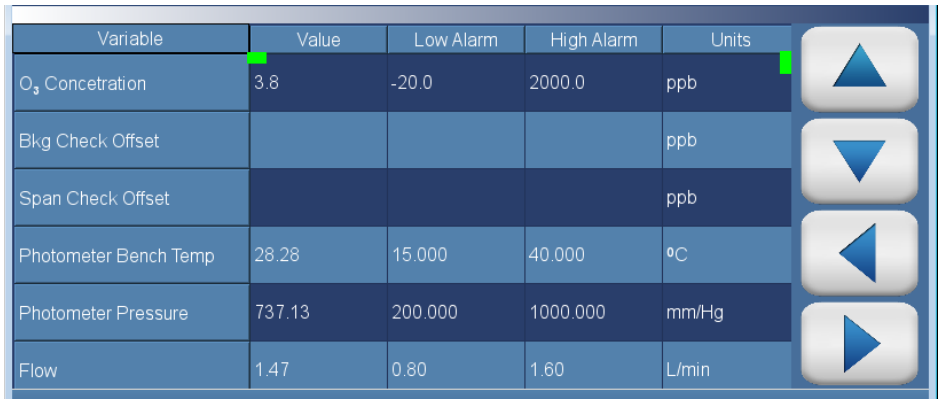
Alarm Setpoints

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

Note User cannot set alarm limits outside of the acceptable range. The minimum and maximum alarm limit can also be set by pressing on the corresponding buttons located in the Settings>Health Check>Status and Alarms screen. See "Status and Alarms" on page 3-36. ▲

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

Home Screen>Settings>Instrument Settings>Alarm Setpoints



The Alarm Setpoints screen contains the following information:

- Across:
  - *Variable:* Lists the items that have settable alarm limits.
  - *Value:* Displays the current value for each item.
  - *Low Alarm:* User sets low alarm for item.
  - *High Alarm:* User sets high alarm for item.
  - *Units:* Units for each item (not settable).
- Down:
  - *O_3:* O_3 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.
- *Photometer Bench Temp:* Photometer bench temperature alarm.
- *Photometer Pressure:* Photometer temperature alarm.
- *Flow:* Flow pressure alarm.
- *Cell A Intensity:* Cell A intensity alarm.
- *Cell B Intensity:* Cell B intensity alarm.
- *Photometer Lamp Temp:* Photometer lamp temperature alarm.
- *Photometer Lamp Current:* Photometer lamp current alarm.

Language

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

Home Screen>Settings>Instrument Settings>Language

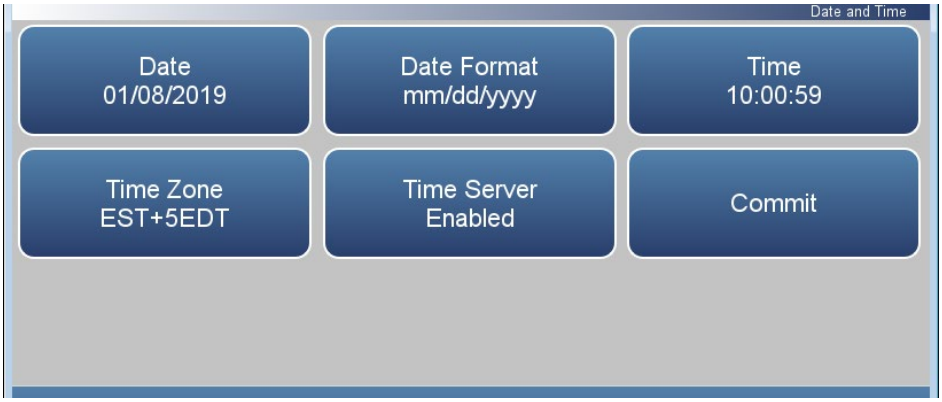
The Language screen contains the following information:

- English
- Chinese

Clock

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

Home Screen>Settings>Instrument Settings>Clock



The Clock screen contains the following information:

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

Date The Date screen allows the user to choose date.

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

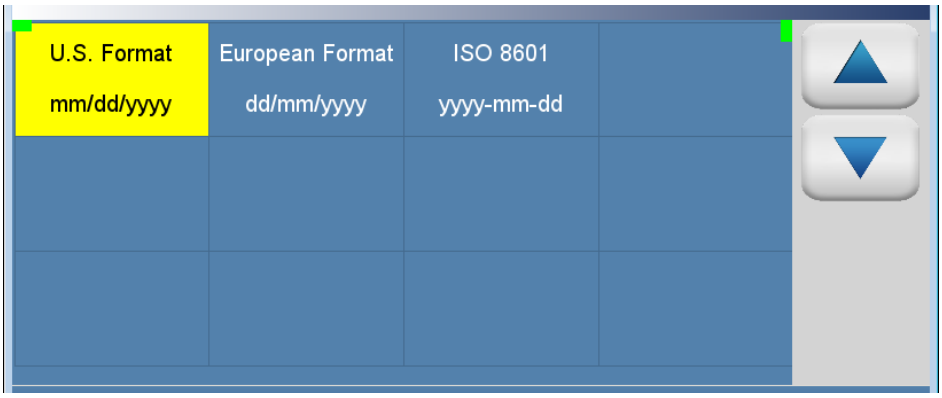
Home Screen>Settings>Instrument Settings>Clock>Date

Date Format

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

Use the ▲ and ▼ buttons to select.

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



The Date Format screen contains the following information:

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

Time

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

Use the ▲ and ▼ buttons to select.

Home Screen>Settings>Instrument Settings>Clock>Time

The Time screen contains the following information:

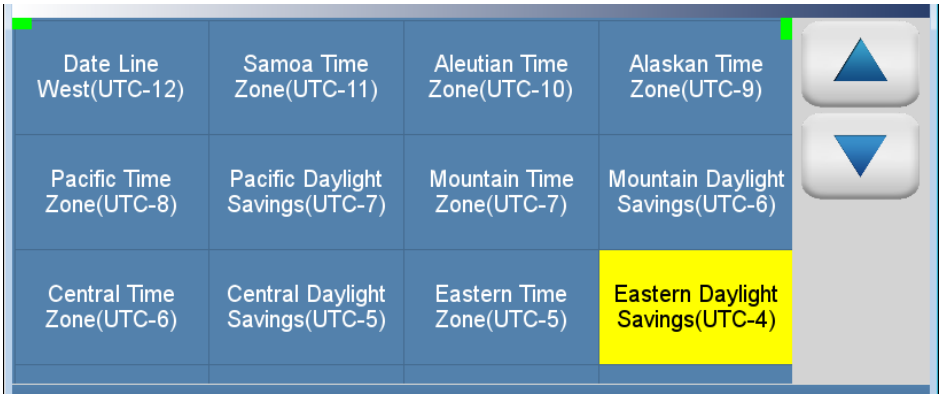
- Hours
- Minutes
- Seconds

Time Zone

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

Use the ▲ and ▼ buttons to select.

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



The Time Zone screen contains the following information:

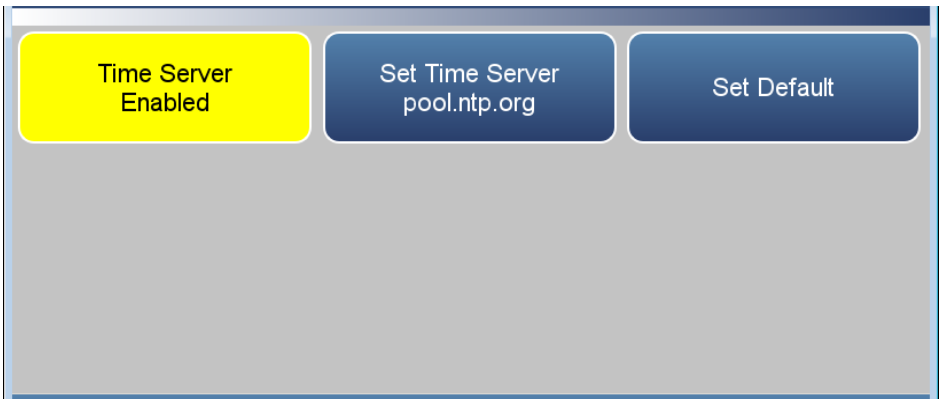
- Date Line West(UTC-12)
- Samoa Time Zone(UTC-11)
- Aleutian Time Zone(UTC-10)
- Alaskan Time Zone(UTC-9)
- Pacific Time Zone(UTC-8)
- Pacific Daylight Savings(UTC-7)
- Mountain Time Zone(UTC-7)
- Mountain Daylight Savings(UTC-6)
- Central Time Zone(UTC-6)
- Central Daylight Savings((UTC-5)
- Eastern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

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

Time Server

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

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



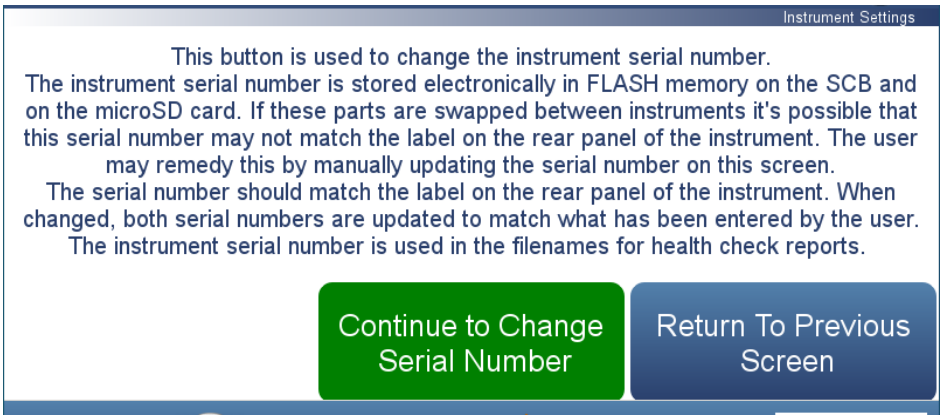
The Time Server screen contains the following information:

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

Instrument Serial Number

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

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



The Instrument Serial Number screen contains the following information:

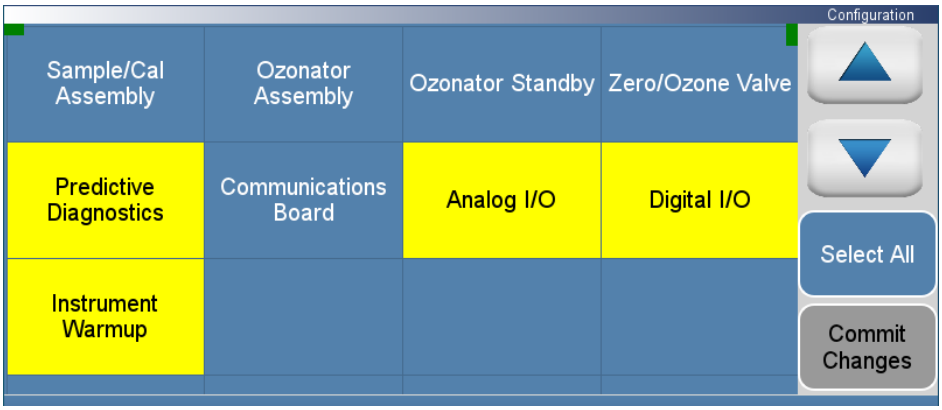
- *Continue to Change Serial Number:* Proceeds to the keypad to enter serial number.
- *Return to Previous Screen:* Returns to the previous screen.

Configuration

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

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

Home Screen>Settings>Configuration



The Configuration screen contains the following information:

- *Sample/Cal Assembly:* Enables sample/cal assembly option.
- *Ozonator Assembly:* Enables ozonator assembly option.
- *Ozonator Standby:* Enables standby.
- *Zero/Ozone Valve:* Enables zero air source option.
- *Predictive Diagnostics:* Enables predictive diagnostics option.
- *Communications Board:* Enables RS-232 or RS-485 communication board option.
- *Analog I/O:* Enables analog I/O option.
- *Digital I/O:* Enables digital I/O option.
- *Instrument Warmup:* Enables instrument warm up option.

Security Access Levels

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

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

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

The Security Access Levels screen contains the following information:

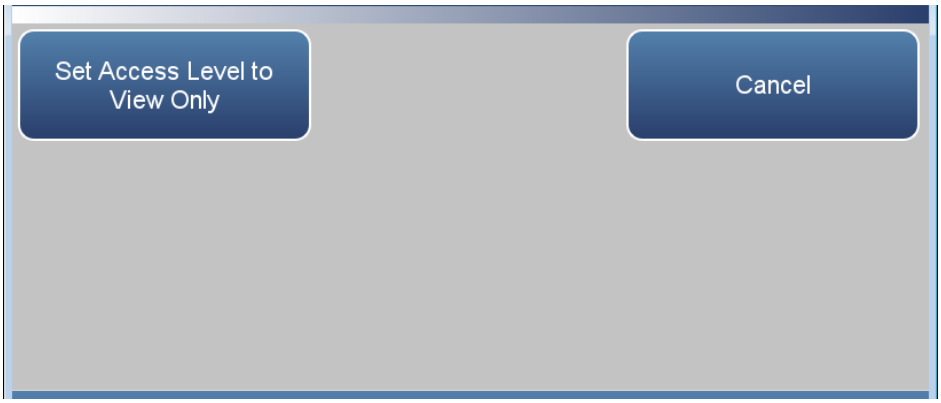
- *Current Security Access Full Access:* Read only. User will be able to change all values. Password is needed for full access.
- *Current Security Access View Only:* Read only. User won't be able to change any values. Password is not needed for view only.
- *Change Security Access to View Only:* User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

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

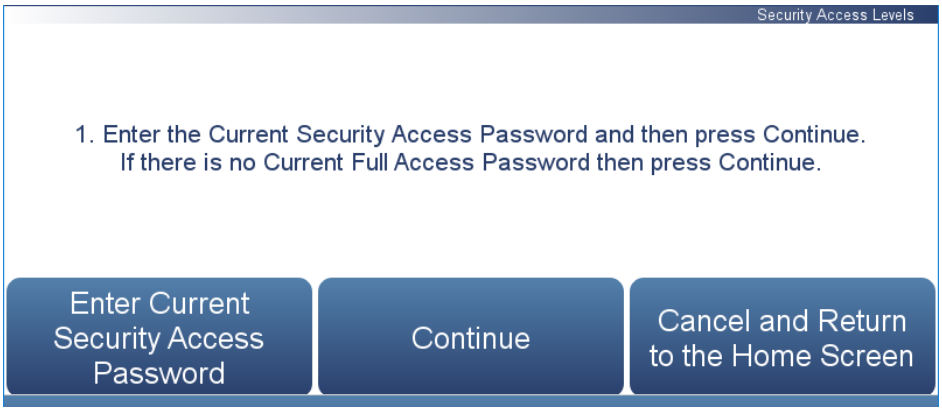
Note To change security access from view only access to full access, a keypad will be displayed where the user can enter full access password. ▲

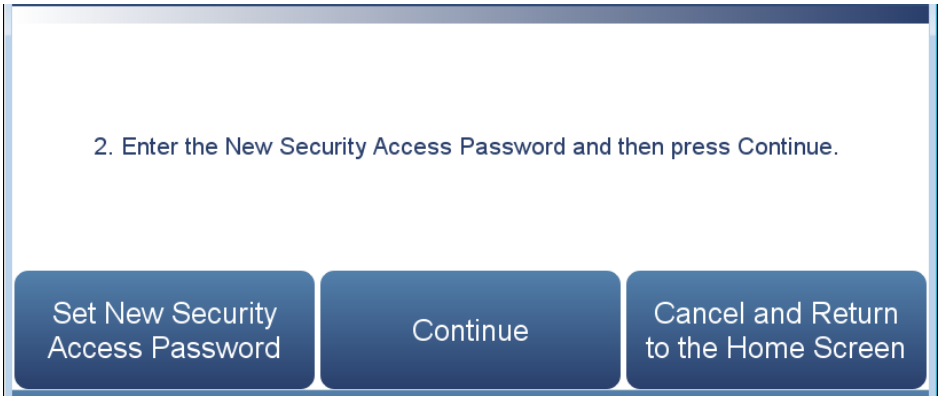
Change Full Access Security Password

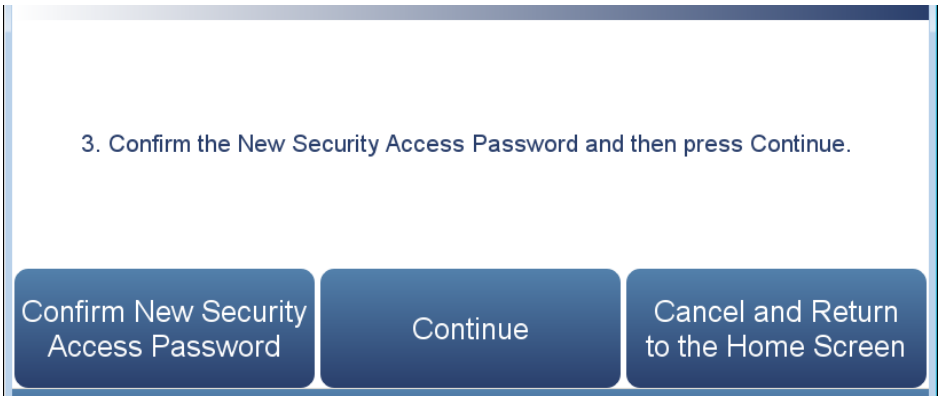
The Change Full Access Security Password screen allows the user to set a new password for allowing full access.

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

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







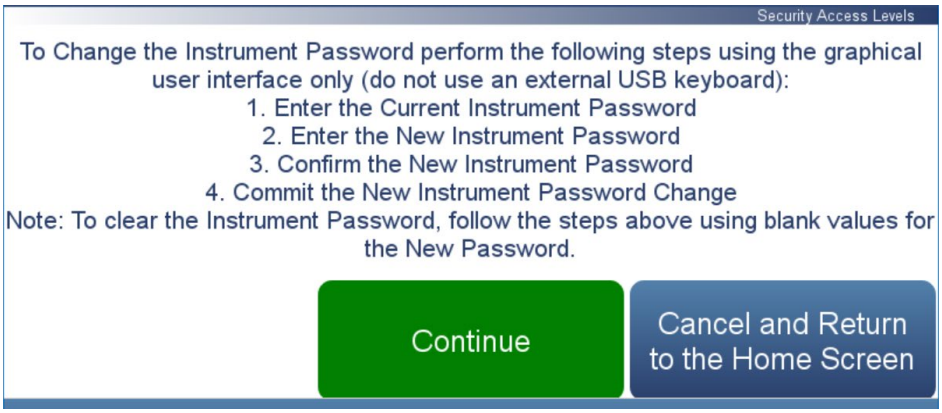
The Change Full Access Security Password screens contain the following information:

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

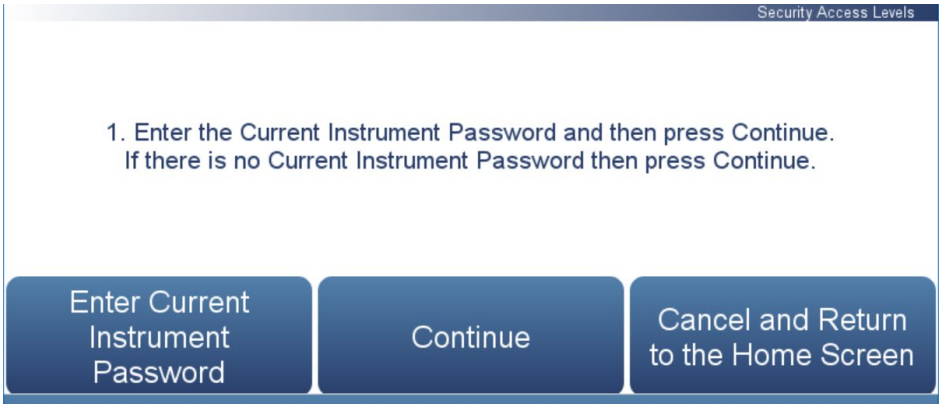
Change Instrument Password

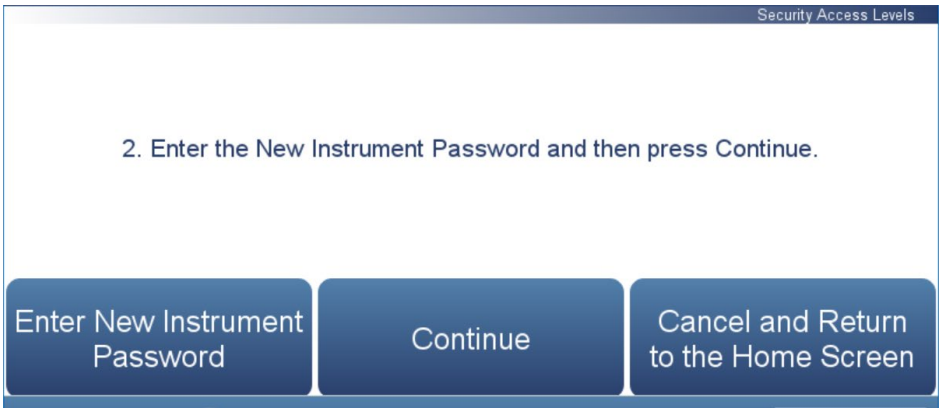
The Change Instrument Password screen allows the user to change the instrument password.

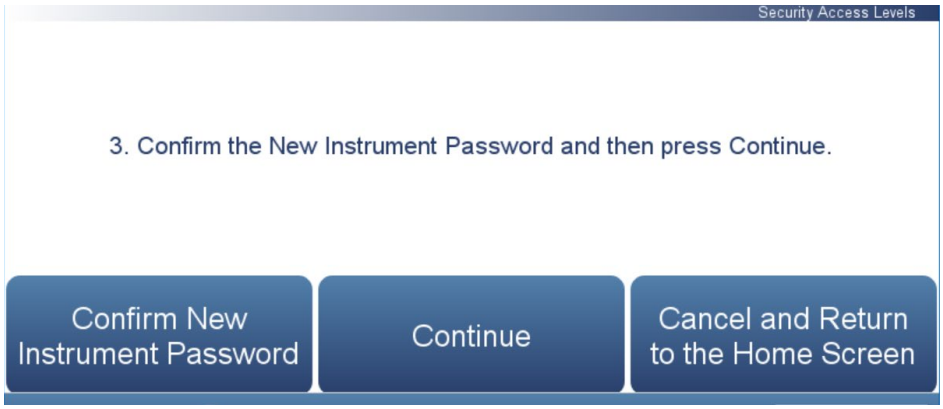
Home Screen>Settings>Security Access Levels>Change Instrument Password

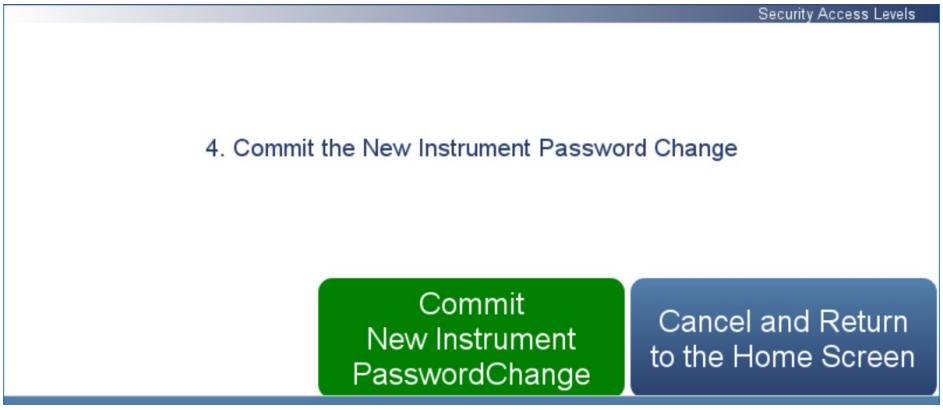


Home Screen>Settings>Security Access Levels>Change Instrument Password>Continue









The Change Instrument Password screen contains the following information:

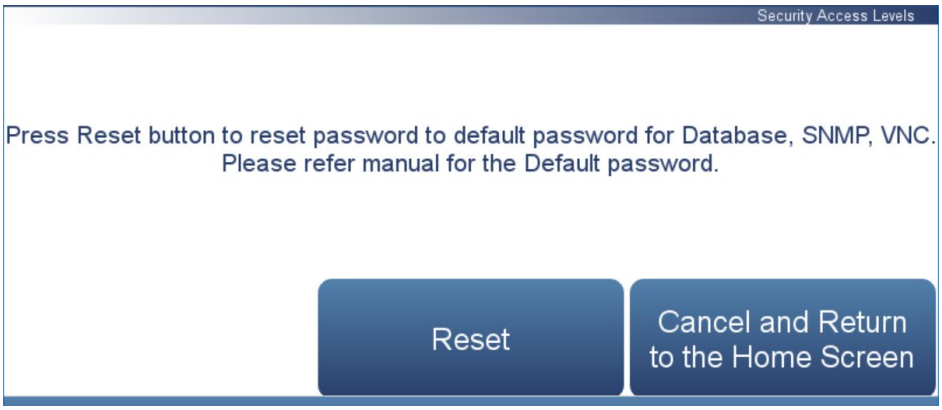
- *Enter Current Instrument Password:* User enters current instrument password.
- *Continue:* Proceeds to next screen.
- *Enter New Instrument Password:* User enters new instrument password.
- *Confirm New Instrument Password:* User confirms new instrument password for spelling confirmation.
- *Commit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

Reset Instrument Password

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

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

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



The Reset Instrument Password screen contains the following information:

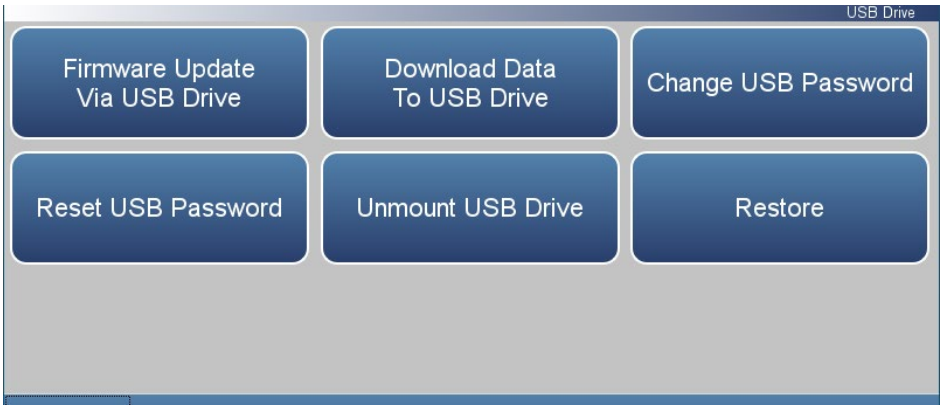
- *Reset:* Allows the user to reset the instrument password.
- *Cancel and Return to the Home Screen:* Exits screen and returns to the Home Screen without changing password.

USB Drive

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

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

Home Screen>Settings>USB Drive



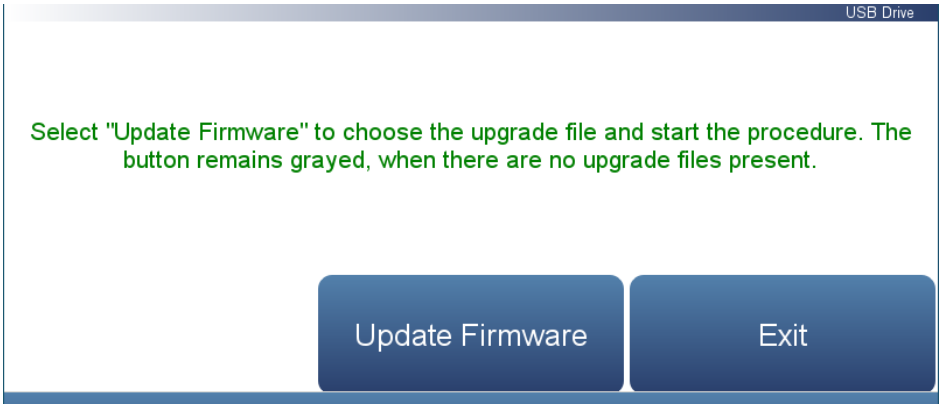
The USB Drive screen contains the following information:

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

Firmware Update Via USB Drive

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

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



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

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

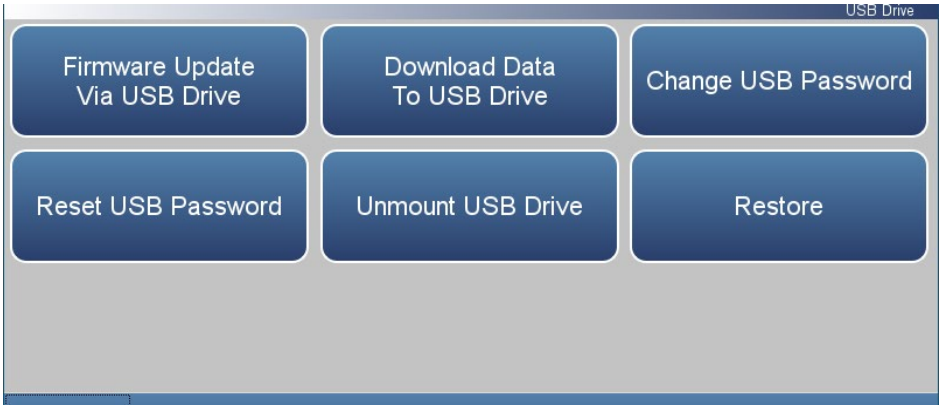
Use the following procedure to update firmware using the USB connection.

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

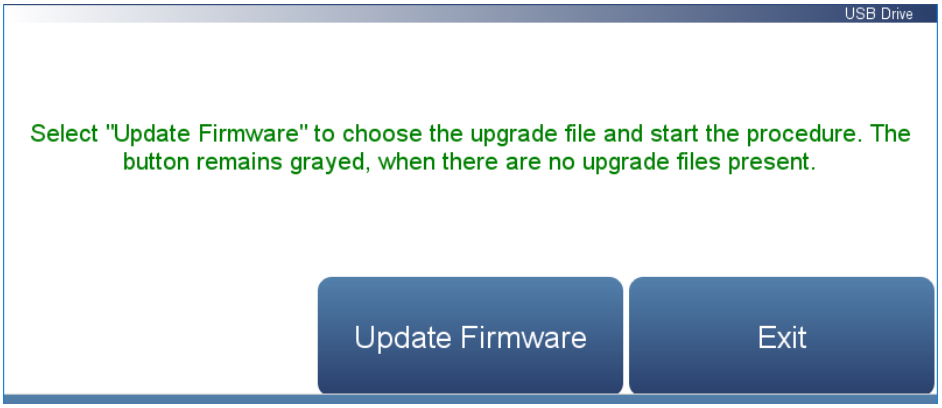
2. Plug a USB flash drive into the data port on the front panel of the unit or into one of the USB ports on the side near the power cable. A pop-up box will appear, acknowledging that a flash drive has been detected. If a USB password has been previously set, you will be prompted to enter the USB password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

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

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



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

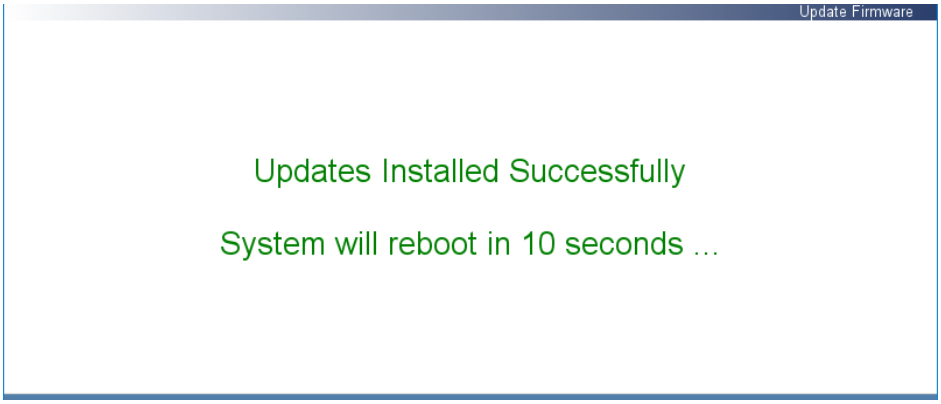


6. The on-screen instructions will prompt the user to select the firmware update file and display what it is doing at each step and some steps may take several minutes to complete.

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

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

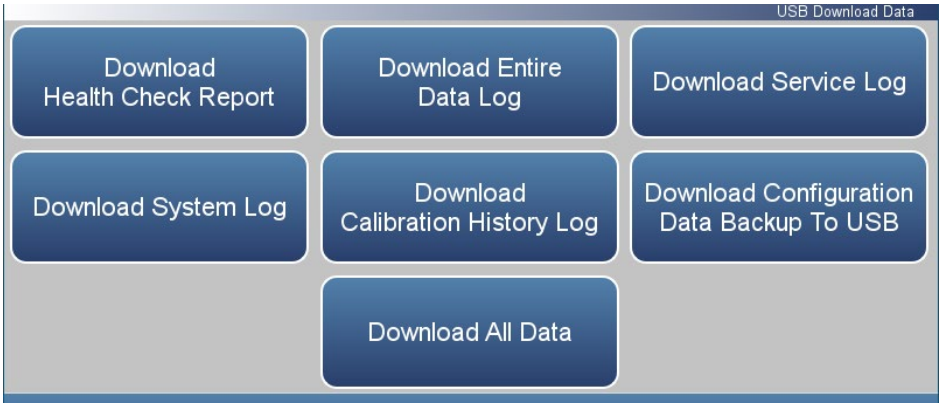
8. The instrument should reboot automatically and should have the new firmware installed. To check that the firmware was installed, go to the **Settings>Health Check** screen and view the Firmware Version button.



Download Data To USB Drive

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

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



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

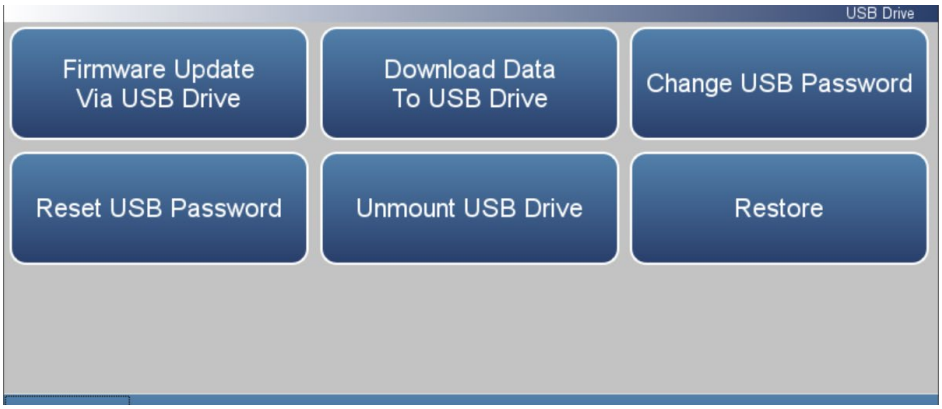
- *Download Health Check Report:* Includes status and alarms, preventive maintenance, and maintenance history.
- *Download Entire Data Log:* Includes the entire data log (from data logging).
- *Download Service Log:* Includes a complete listing of data for all variables. This is set at the factory.
-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

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

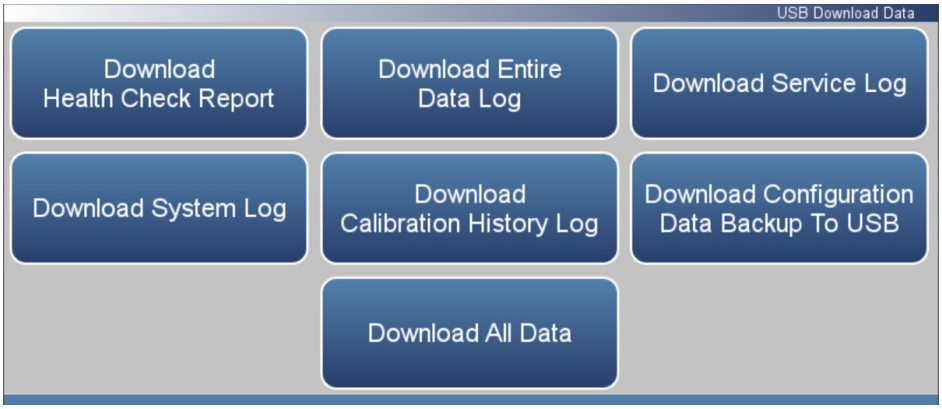
1. Plug a USB flash drive into the USB connection on the front of the instrument. If a USB password has been previously set, you will be prompted to enter the USB password to continue. Press **Enter** to continue.

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

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



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



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

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

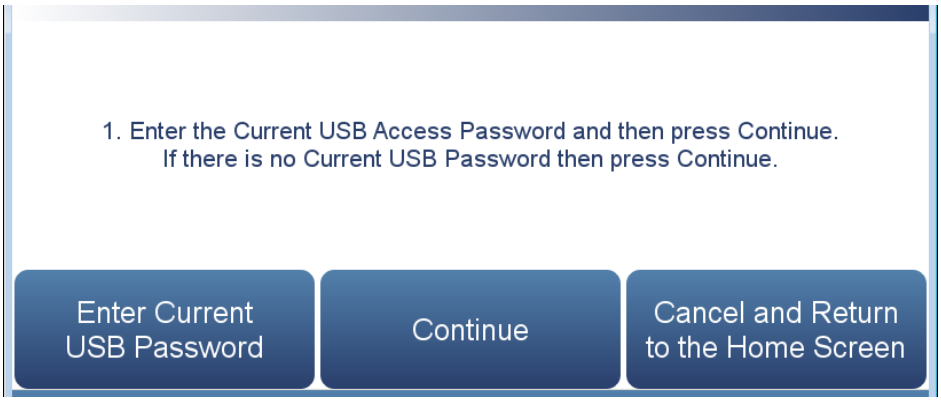
6. When the data download is complete, the instrument will display a “Success!” message and display the file name as it is stored on the USB flash drive. (The file name format is the instrument serial number, name of download, followed by a date/time stamp.) Remove the USB flash drive and select the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

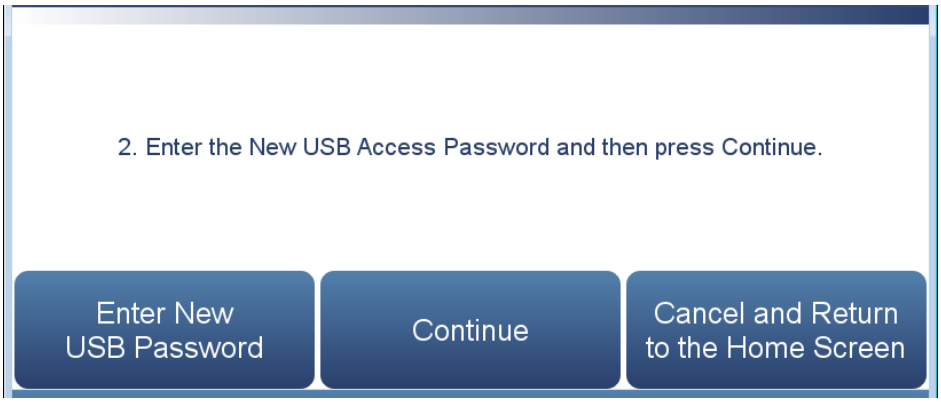
Change USB Password

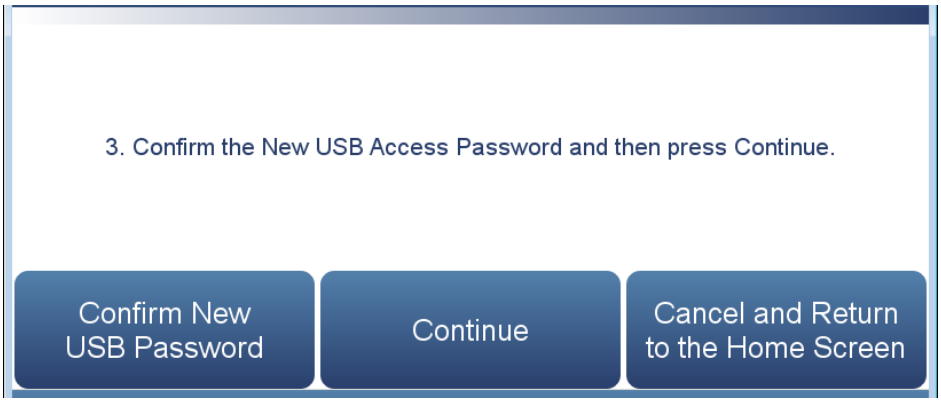
The Change USB Password screen allows the user to set a new password for accessing USB.

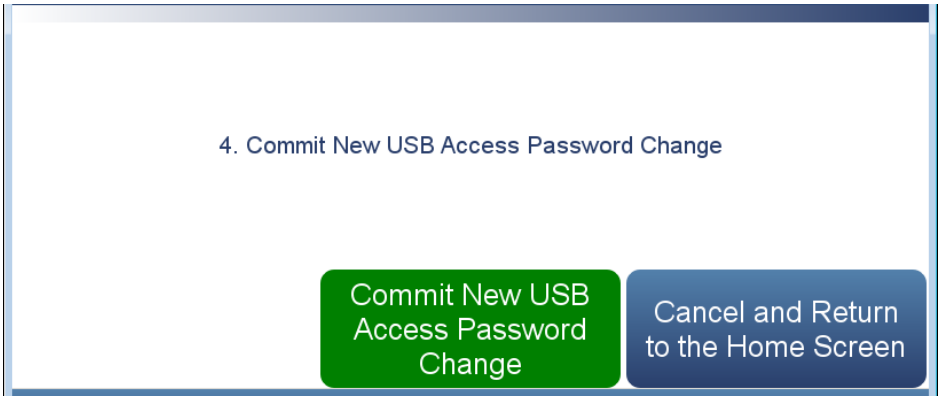
Home Screen>Settings>USB Drive>Change USB Password

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









The Change USB Password screens contain the following information:

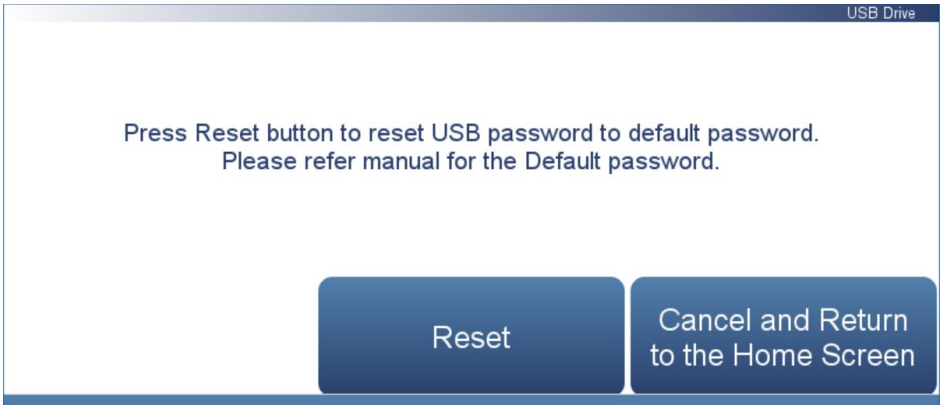
- *Enter Current USB Password:* User enters current USB password.
- *Continue:* Proceeds to next screen.
- *Enter New USB Password:* User enters new USB password.
- *Confirm New Security Access Password:* User confirms new security password for spelling confirmation.
- *Commit New USB Password Change:*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

Reset USB Password

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

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

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



The Reset USB Password screen contains the following information:

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

Restore

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

Home Screen>Settings>Security Access Levels>Restore

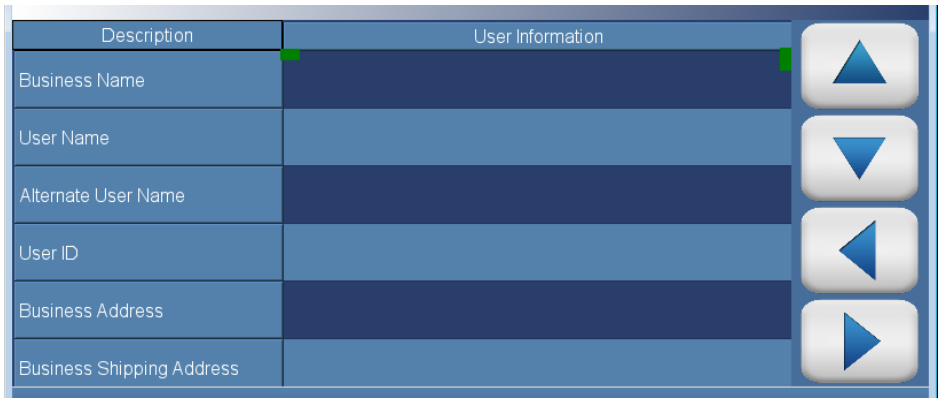
The Restore screen contains the following information:

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

User Contact Information

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

Home Screen>Settings>User Contact Information



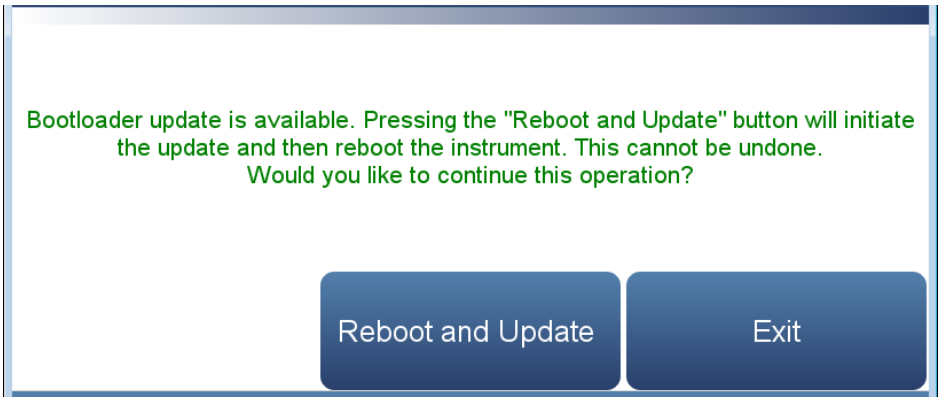
The User Contact Information screen contains the following information:

- 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 how to perform a multipoint calibration of the photometric ozone analyzer. It is based upon the current EPA approved procedure using a UV photometer as a calibration standard. The information described here should be adequate to perform the calibration. However, for more information refer to the Code of Federal Regulations (Title 40, Part 50, Appendix D) and the EPA's "Technical Assistance Document for the Calibration of Ambient Ozone Monitors."

Equipment Required

The following equipment is required to calibrate the instrument:

- Zero air generator
- Calibration photometer system

Zero Air Generator

Zero air can be obtained either from compressed cylinders or from scrubbed ambient air. If cylinder air is used, it should be actual and not synthetic. If ambient air is used, the following compounds must be removed: ozone, nitric oxide, nitrogen dioxide, sulfur dioxide, and hydrocarbons. The following scheme is recommended by the EPA in its technical assistance document:

1. Irradiate the air with an ozone generating UV lamp to convert nitric oxide to nitrogen dioxide. Alternatively, pass air through Purafil® which oxidizes nitric oxide to nitrogen dioxide and scrubs nitrogen dioxide.

2. Pass air through a large column of activated charcoal to remove residual nitrogen dioxide, ozone, sulfur dioxide, hydrocarbons, and so on.

3. Pass air through a molecular sieve.

4. Pass air through a final particulate filter to remove particulates which originate in scrubbing columns.

Note An important requirement for the calibration photometer operation is that the zero air used to reference the photometer come from the same source as the zero air used in the ozonator. This is to effectively cancel impurities present in the zero air source. ▲

Calibration Photometer System

A UV photometer calibration system which includes an ozone generator, an output port or manifold, a photometer, and a source of zero air is required. The Thermo Scientific 49iQ Ozone Photometric Primary Standard satisfies the calibration photometer system requirement in a single convenient package. In addition, the 49iQ can be modified to operate as a calibration photometer by removing the ozone scrubber and plumbing zero air into the common port of the ozone-free solenoid valve, as shown in Figure 4–1. If the 49iQ is modified to operate as a calibration photometer, it must be dedicated for calibration and not be used for monitoring ozone at any time.

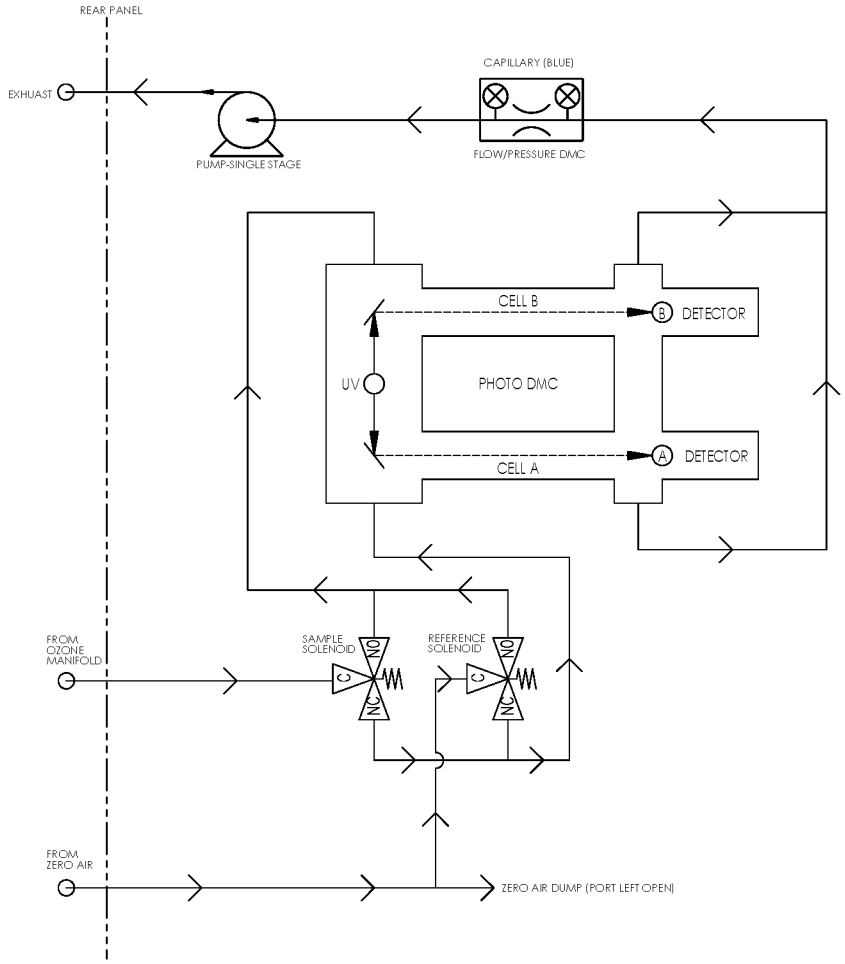


Figure 4–1. 49iQ Connected as Calibrator

Instrument Preparation

Use the following procedure to prepare the instrument prior to calibration.

1. Turn the instrument ON.
2. Allow the instrument to stabilize for a minimum of one hour.
3. Perform the service checks in the "Maintenance" chapter.
4. Connect the 49iQ to the ozone manifold. If a PTFE particulate filter is being used, it must be installed prior to calibration.

Calibration Photometer System Preparation

As indicated in the EPA Technical Assistance Document there are several tests that should be performed prior to the use of an ozone UV photometer as a calibrator to ensure the accuracy of the measurements. These tests include:

- System check
- Ozone loss test
- Linearity check
- Intercomparability

System Check

A step-by-step checkout procedure to verify proper operation of a 49iQ Primary Standard (or a 49iQ modified as described earlier) is as follows:

1. Turn the calibration photometer ON.
2. Turn the ozonator ON.
3. Allow the calibration photometer and ozonator to stabilize for one hour.
4. Perform the service checks in the "Maintenance" chapter.

Ozone Loss Test

If the calibration photometer passes the leak test in the "Maintenance" chapter, it is highly unlikely that the system is destroying ozone. If desired, a rigorous test is as follows (this check follows the EPA's Technical

Assistance Document with the appropriate change for a time-shared, dual cell system).

1. Calibrate an ozone analyzer using the calibration photometer. Assume the photometer is correct.

2. Generate a stable level of ozone and with the calibrated ozone analyzer measure and note reading as R_m.

3. Unplug the pump of the calibration photometer from the AC power source and plug the exhaust line and zero-air inlet line.

4. Connect the calibrated ozone analyzer to the access port on the inlet of Cell A.

5. From the Home Screen, press Settings>Health Check>Status and Alarms>**Intensity Check**. From the Intensity Check menu, press **Intensity B Reference Gas**. Wait for a steady reading and record the intensity as $R(a)_{input}$. Press the ◀ button to return to the Intensity Check screen.

6. Connect the calibrated ozone analyzer to the access port on the inlet of cell B. From the Intensity Check menu, press **Intensity A Reference Gas**. Wait for a steady reading and record the intensity as $R(b)_{input}$.

7. Replace access fittings used in steps 4 and 6 above and make sure they are leak tight.

8. Connect the calibrated ozone analyzer to the access port on the outlet of absorption cell of Cell A.

9. From the Home Screen, press Settings>Health Check>Status and Alarms>**Intensity Check**. From the Intensity Check menu, press **Intensity B Reference Gas**. Wait for a steady reading and record the intensity as $R(a)_{out}$.

10. Connect the calibrated ozone analyzer to the access port on the outlet of absorption cell of Cell B. From the Home Screen, press Settings>Health Check>Status and Alarms>**Intensity Check**. From the Intensity Check menu, press **Intensity A Reference Gas.** Wait for a steady reading and record the intensity as $R(b)_{out}$.

11. Replace access fittings used in steps 8 and 10, and make sure they are leak tight.

12. Compute percent of ozone loss from the following equation:

    Percent of Ozone Loss =

$$\frac{R_m - 1/4[R(a)_{input} + R(a)_{out} + R(b)_{input} + R(b)_{out}]}{R_m} \times 100\%$$

If the ozone loss is greater than 2%, check that the absorption cells and PTFE tubing have not become contaminated by dirt. See "Optical Bench Cleaning" in the "Maintenance" chapter for more information. If the cells and PTFE tubing are clean, recondition the optical bench by setting the ozone generator for maximum ozone and adjust the pressure regulator for minimum dump flow (about 1/2 liter per minute). Let the calibration photometer run overnight sampling the high level of ozone. Then repeat ozone loss test.

Linearity Check

Since the 49iQ is inherently linear over the range of interest (0-1 ppm), a linearity test is an effective overall test that the instrument is operating properly. The checks above should identify whether any causes of non-linearity are present. The possible causes of non-linearity are:

- Dirty or contaminated cell, lines, or manifold
- Inadequate conditioning of system
- Leaks in system
- Contamination in zero air
- Non-linear detectors in photometer
- Faulty electronics

To demonstrate linearity, generate a concentration of ozone near the upper range limit of the calibration photometer and accurately dilute the ozonated air with zero air. To do this test accurately, two calibrated flow meters and a mixing chamber are needed: one flow meter to measure the flow into the ozonator, and the other to measure the flow of the dilutant zero air. The percent of non-linearity is calculated as follows:

$$R = \frac{F_o}{F_o + F_d}$$

$$E = \frac{A_1 - \frac{A_2}{R}}{A_1} \times 100\%$$

where:

F_o = Ozonator flow

F_d = Dilutant zero air flow

E = Linearity error, in percent

A_1 = Assay of original concentration

A_2 = Assay of diluted concentration

R = Dilution ratio

Note The inherent linearity accuracy of the 49iQ Primary Standard (or a 49iQ modified as described earlier) is greater than the accuracy measurements of the mass flow meters. ▲

Use the following procedure to check the calculations are complete and accurate:

1. With the ozone generator in the manual mode, i.e., gain set to zero, adjust ozone level to generate a level in excess of 0.5 ppm. Wait until ozone concentration is stable.

2. From the Home Screen, press Settings>Health Check>Status and Alarms>**Intensity Check**. From the Intensity Check menu, select **Intensity A Reference Gas.** Wait for stable frequency reading and note as Io(A). Press the ◀ button to return to the Intensity Check screen.

3. From the Intensity Check screen, select Intensity A Sample Gas. Wait for stable frequency reading, note as I(A). Press the ◀ button to return to the Intensity Check screen.

4. From the Intensity Check screen, select Intensity B Reference Gas. Wait for stable frequency reading, note as Io(B).

5. From the Home Screen, press Settings>Health Check>Status and Alarms>**Photometer Bench** to get the current pressure reading and current instrument temperature reading.

6. Compute C(A) and C(B) from the following equation.

$$C = \left(\frac{10^6}{(308)37.84} \right) \left(\frac{760(273+T)}{273P} \right) \ln \left(\frac{I_o}{I} \right)$$

This value should agree with the value noted in the Home Screen. Note that the concentration determined in this manner does not correct for lamp fluctuation and thus will be noisier than the concentration determined in the Home Screen.

Intercomparability Test

To perform an intercomparability test of a 49iQ Primary Standard, it may be necessary to have the 49iQ Primary Standard sample ozone from a source other than the one contained in the instrument. Use the following procedure to accomplish this.

1. Set gas mode to zero.

2. At the PTFE distribution manifold, disconnect the line from the ozonator to the manifold and cap fitting.

3. Cap bulkhead labeled VENT.

4. Connect PTFE line from bulkhead labeled OZONE to manifold of ozone source being utilized for intercomparability study.

5. Make sure the same zero air is feeding both the 49iQ Primary Standard and the second photometer being used in study.

6. If it is desired to hold usage of zero air to a minimum, adjust the pressure regulator feeding the ozonator to zero pressure.

7. Perform intercomparability test.

8. After completion of test, reconnect ozonator and leak check following the "Leak Test" procedure in the "Maintenance" chapter.

Note If an ozone analyzer is available in addition to the two ozone photometers being checked for intercomparability, an easier intercomparability check is to calibrate the ozone analyzer against each photometer individually and then compare the two ozone calibration curves. ▲

If a calibration photometer other than a 49iQ Primary Standard or modified 49iQ is being used, follow the checkout procedure given in the Manual for the calibration photometer, or follow the procedure in the Technical Assistance Document.

Calibration Procedure

To generate data of the highest confidence, it is recommended that a multipoint calibration be performed:

- every three months
- any time any major disassembly of components is performed

Connect the Instrument

Connect the 49iQ to the manifold on the output of the ozonator, as shown in Figure 4–2. If an optional sample line filter is used, the calibration must be performed through this filter. Ensure that the flow rate into the output manifold is greater than the total flow required by the calibration photometer, analyzer, and any other flow demand connected to the manifold.

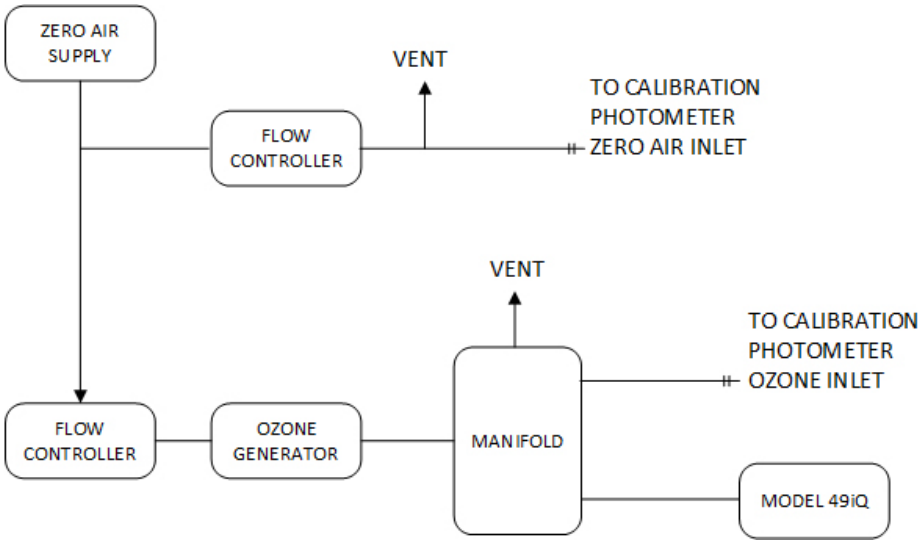


Figure 4–2. Calibration Flow Schematic

Zero Adjust

Use the following procedure to adjust zero.

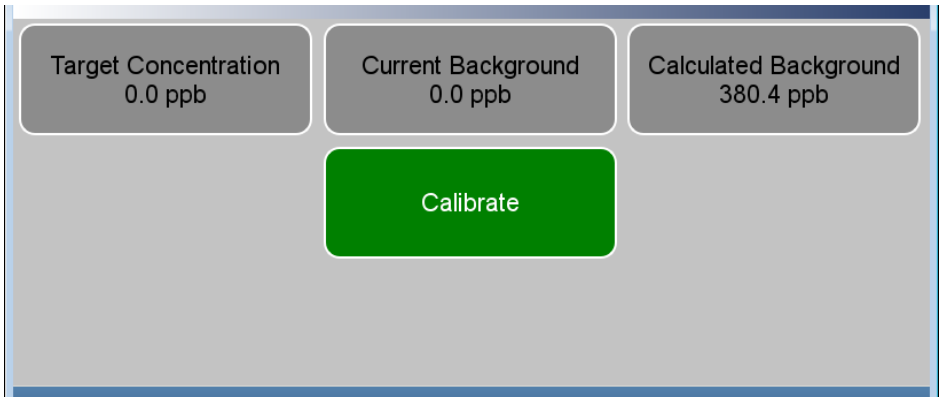
1. Allow sufficient time for the instrument and the calibration photometer to warm up and stabilize.

2. With the zero air supply ON, but the ozonator OFF, allow the instrument to sample zero air until a stable response is obtained.

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

   The Target Concentration button will read 0.000. The Calculated Background button will display the background needed to make the current O_3 concentration go to 0.000.

4. In the Calibrate Background screen, press **Calibrate** to set the O_3 reading to zero and to save the new background.



Span Adjust

Use the following procedure to adjust span.

1. Generate an ozone concentration standard of approximately 80% of the upper range limit (URL) of the ozone analyzer (such as, 0.4 or 0.8 ppm for the 0.5 and 1.0 ppm ranges respectively).

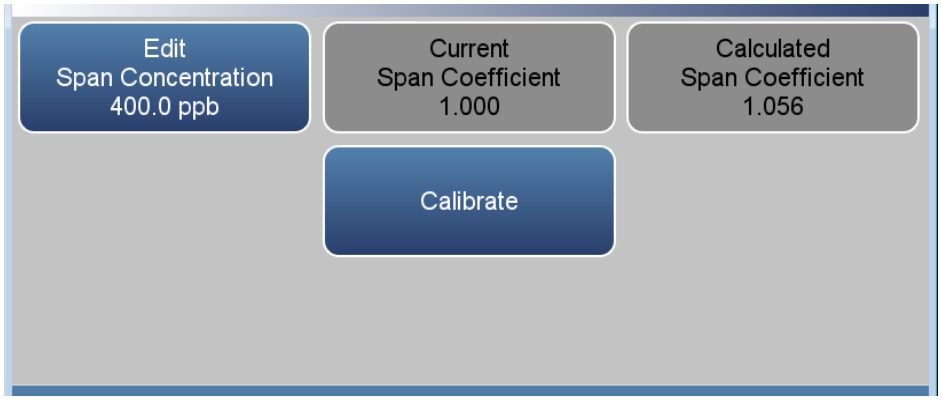
2. Allow the instrument to sample this ozone concentration standard until a stable response is obtained.

3. 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 bet set to if the Calibrate button is pressed. Pressing the Calibrate button will save the new coefficient and calibrate the instrument.

4. Enter the O_3 calibration gas concentration using the pushbuttons, and then press the **Calibrate** button to calibrate the O_3 reading to the O_3 calibration gas.

5. Record the ozone concentration as determined by the calibration photometer and the corresponding analyzer response.



Additional Concentration Standards

1. Generate several other ozone concentration standards (at least five others are recommended) over the scale range of the instrument.

2. For each ozone concentration standard, record the ozone concentration as determined by the calibration photometer and record the corresponding analyzer response.

   If a 49iQ Primary Standard is being used as the calibration photometer, use the ozone concentration as determined by the photometer and not the value of the ozone level number.

Calibration Curve

Use the following procedure to plot the calibration curve.

1. Plot the 49iQ responses versus the corresponding ozone concentrations.

2. Connect the experimental points by using a straight line, preferably determined by linear regression techniques.

   Points that lie more than ±4% from this line are an indication of an error in determining the calibration curve. The error may be due to a malfunction of the calibration photometer, or a malfunction of the analyzer being calibrated. The most likely malfunctions in both the analyzer and calibration photometer which can give non-linear results are leaks, a malfunctioning ozone scrubber, a dirty solenoid, or dirt in the optical system. The calibration curve is used to reduce subsequent ambient data.

   Note To generate data of the highest confidence, it is recommended that a multipoint calibration be performed every three months, any time major disassembly of components is performed, or any time the zero or span checks give results outside the limits described in "Periodic Zero and Span Checks" that follow. ▲

Periodic Zero and Span Checks

In order to achieve data of the highest confidence, it is suggested that periodic zero air and span checks be performed. These checks can be performed by:

1. Periodically challenging the instrument with zero air. The output of the zero air supply should be greater than the flow demand of the instrument. In addition, an atmospheric dump bypass should be utilized to ensure that the zero air gas flow is being delivered at atmospheric pressure. Record the response in percent of scale as A_O. Compute the zero drift from the following equation:

$$\text{Zero Drift \%} = A_O - Z$$

where:

Z = Recorder response with zero air, % scale

2. Periodically challenging the instrument with an ozone level of approximately 80% URL from a previously calibrated stable ozone generator. The output flow from this generator should be greater than the flow demand of the instrument. In addition, an atmospheric dump bypass should be used to ensure the span gas flow is being delivered at atmospheric pressure. Record the analyzer response in % of scale as A80. Compute the span error from the following equation.

$$\text{RecorderResponse (\%Scale)} = \frac{(O_3)_{out}}{\text{URL}} \times 100 + Z$$

where:

A_{80} = Recorder response with 80% URL

Z = Recorder response with zero air, % scale

$[O_3]$out = Generated span concentration, ppm.

URL = Upper range limit

3. A zero drift in excess of ±4% of fullscale, or a span drift in excess of ±6% of fullscale is an indication of a malfunction either of the zero air supply, ozone source, recorder, or analyzer. Since the 49iQ is a ratio instrument and thus does not have an electronic span or zero drift, it is not recommended that any zero adjustment or span adjustment be performed as the result of a zero or span check. If values are obtained

outside of the limits of ±4% for zero and ±6% for span drift, the multipoint calibration above is indicated to isolate the problem.

For detailed guidance in setting up a quality assurance program, refer to the *Code of Federal Regulations and the EPA Handbook on Quality Assurance*.

Internal Ozonator Adjustment

The internal ozonator has been designed to satisfy the current EPA regulations on biweekly precision and span checks. Before this option can be used for precision or span checks, it must be certified as a transfer standard. For detailed information on qualification and certification of an ozone generating transfer standard, refer to the EPA Technical Assistance Document on Transfer Standards.

For more information about the internal ozonator, see the "Optional Equipment" chapter.

Use the following chapter to adjust the internal ozonator.

1. Connect a transfer standard or primary standard to the ozone OUT bulkhead fitting of the instrument (see Figure 4–3).

   The transfer standard or primary sample will be used to read the O_3 generated by the internal ozonator.

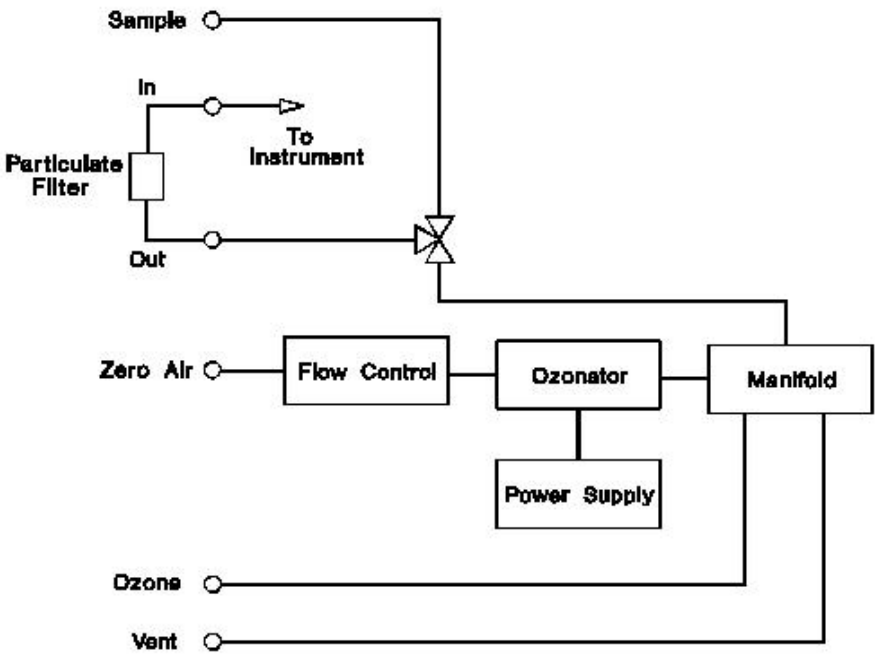


Figure 4–3. Ozonator Flow Scheme

2. From the Home Screen, press Calibration>**Custom O_3 Levels**.

3. Adjust Level 1 for the desired level (typically 80% URL).

4. Allow this value to stabilize.

5. Record the value as $[O_3]_{80}$ to be used in the span error equation of Step 2 in the "Periodic Zero and Span Checks" section described previously. Note Level 1 setting.

6. Adjust Level 2 for the desired level (typically 90 ppb).

7. Allow this value to stabilize.

8. Record the Level 2 value as $[O_3]_{20}$ to be used in the following error equation:

$$\% \text{ Error} = \frac{[(A_{20} - Z)\frac{URL}{100}] - [O_3]_{20}}{[O_3]_{20}} \times 100$$

Where:

A_{20} = Recorder response with precision level, % scale

Z = Recorder response with zero air, % scale

URL = Upper range limit

Note The expected stability of the instrument section is greater then the expected stability of the internal ozonator. ▲

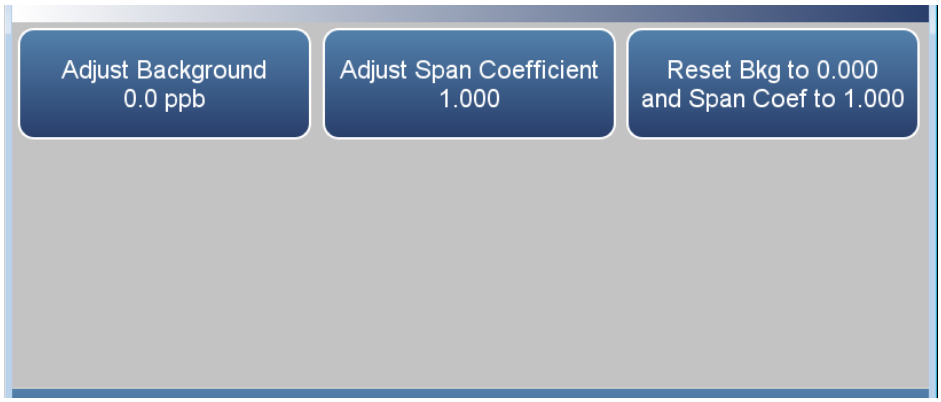
Manual Calibration

The Manual Calibration screen allows the user to view and manually adjust the zero background and span coefficient. These are used to correct the O_3 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 as the (single range) Adjust Span Coefficient screen.

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

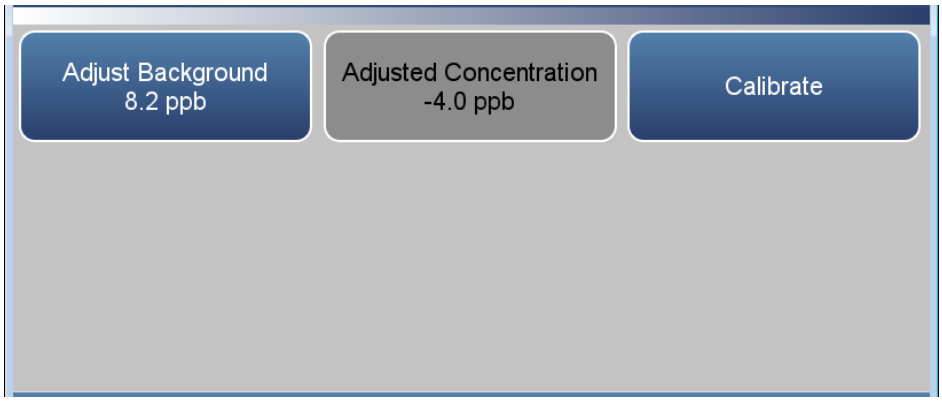


Adjust Background

The O_3 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 shows the current background and the Adjusted Concentration shows what the new O_3 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

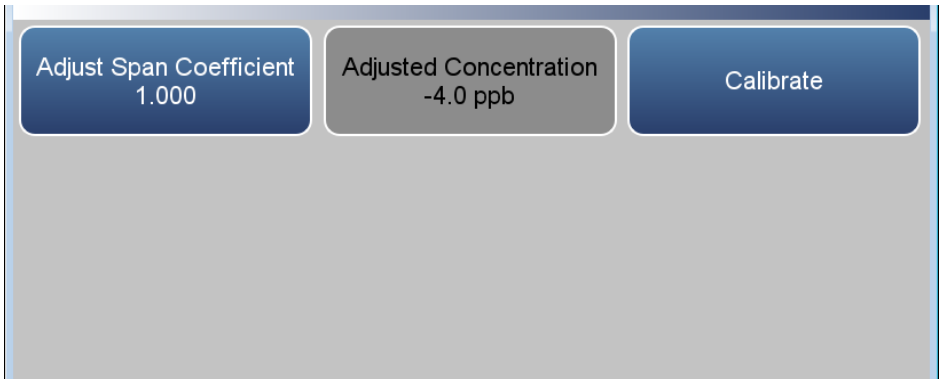


Adjust Span Coefficient

The span coefficients are used to correct the O_3 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 Coef button. The second button called Adjusted Concentration shows what the new concentration would be based on the adjusted span coefficient. Press the Calibrate button to save the adjusted span coefficient value.

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



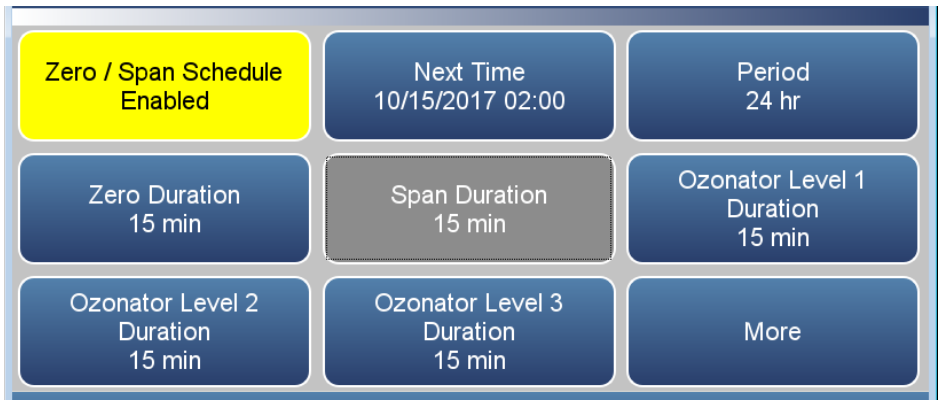
Reset Bkg to 0.000 and Span Coef to 1.000

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.

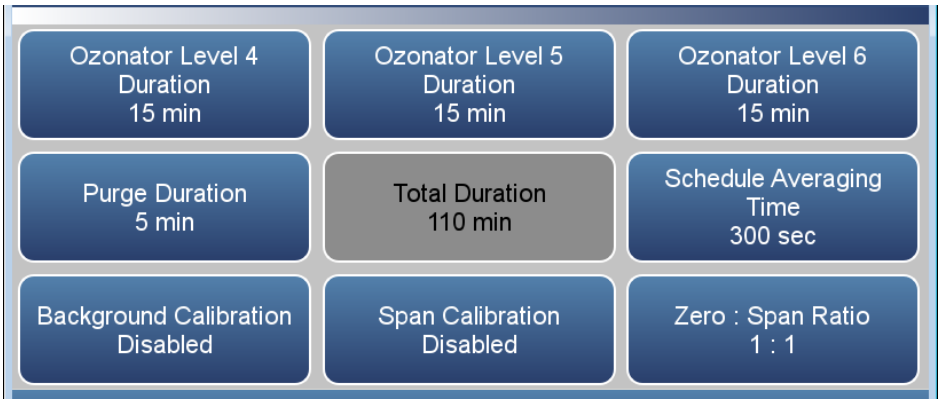
Zero/Span Schedule

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



Home Screen>Calibration>Zero/Span Schedule>More



Next Time

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

Period

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

Zero/Span/Purge Duration Minutes

The Zero Duration button defines how long zero air is sampled by the instrument. The Span (Ozonator Level 1–6) and Purge Duration buttons look and function the same way as the zero duration button. The span duration buttons are 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 10–300 seconds.

Background

Background is a toggle button that changes between Check Only and Calibrate Enabled. If Background is set to Calibrate Enabled, then a zero adjustment is made.

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

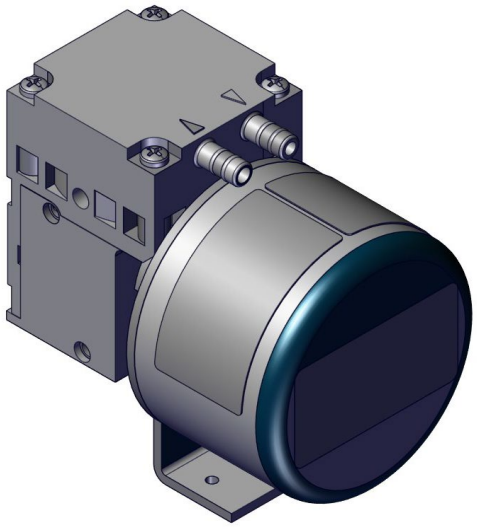


Figure 5–1. Single Stage Pump

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.

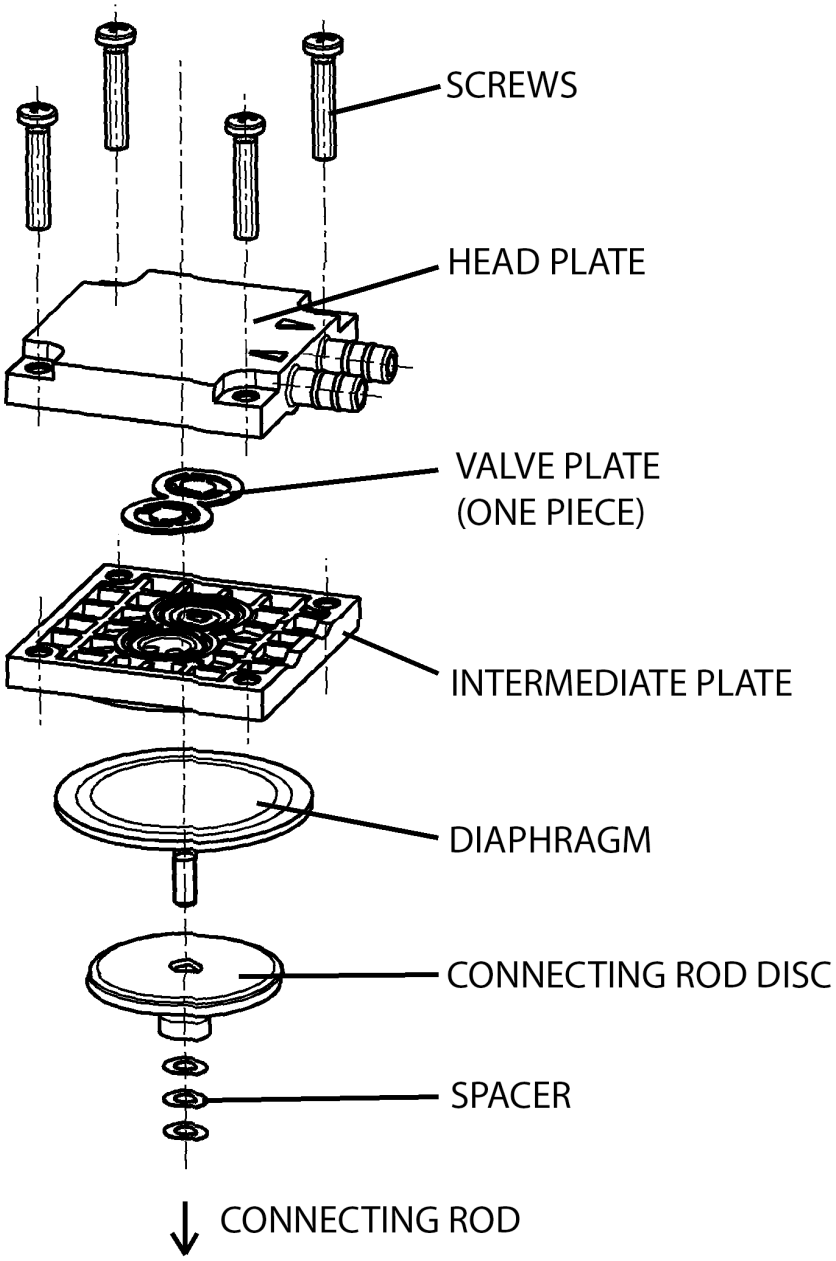


Figure 5–2. Pump Rebuilding

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. ▲

Optical Bench Cleaning

Use the following procedure to clean the mirrors.

Equipment required:

Hex drive, 7/64

1. Unfasten nuts with hands. No tool required.

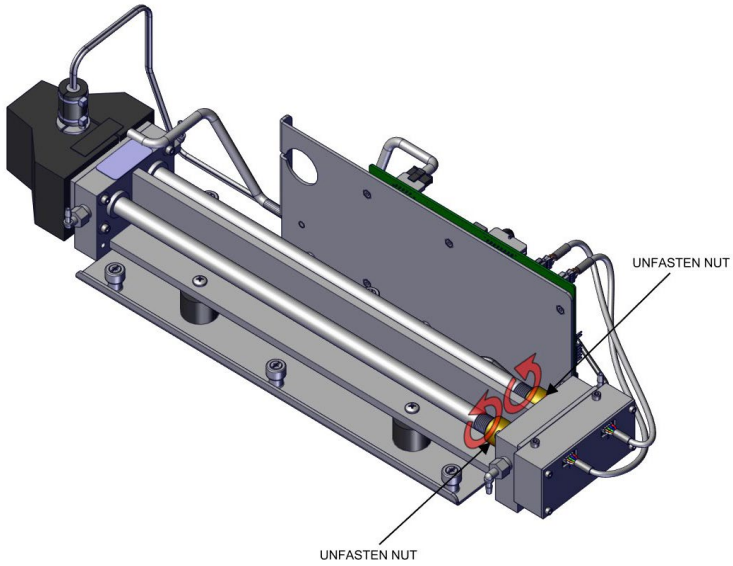


Figure 5–3. Absorption Cleaning Removing Nuts

2. Pull up then pull out the absorption tube.

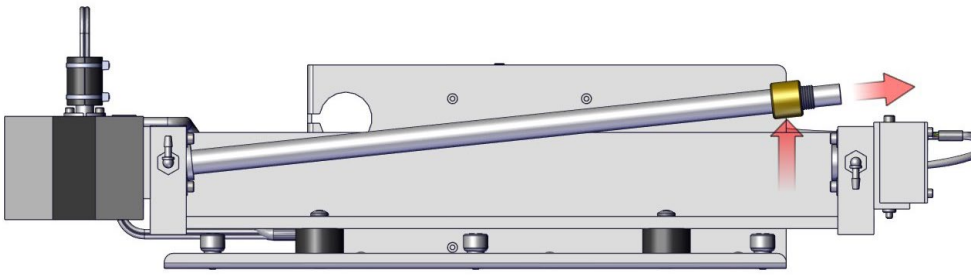


Figure 5–4. Absorption Tube Removal

3. Push a piece of lens paper down the tube using a 1/4-inch piece of PTFE tubing so as not to damage the tube. Use a cotton swab to clean the window surfaces through the holes that the tube fits into.

Note Both absorption tubes are identical, so they can be replaced in either position. Replacement of absorption cells is opposite to that of removal. Since the 49iQ is a ratio instrument, and cleaning the absorption tubes does not affect the calibration, it is not necessary to recalibrate the instrument every time the cells are cleaned. ▲

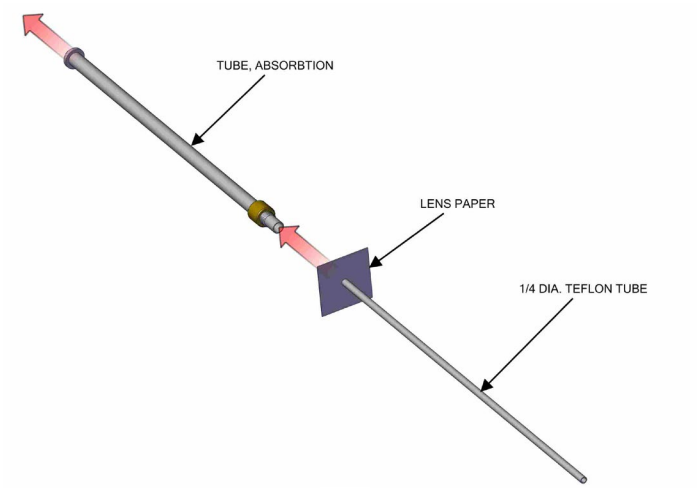


Figure 5–5. Absorption cleaning pt 3 clean tube

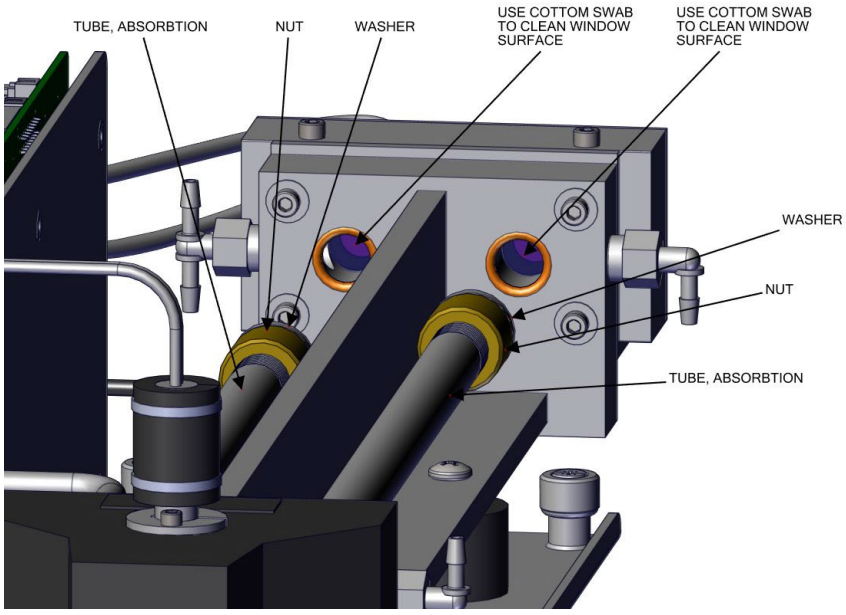


Figure 5–6. Absorption cleaning pt 4 clean window

4. Re-install the instrument cover.

Note If windows are severely contaminated, they are best cleaned by removing windows from the bench. The windows on the detector side can be removed by removing the detector block and carefully removing the windows. The windows on the source side can be removed by removing the source block to gain access to the windows. It is recommended that the instrument be recalibrated if the optical bench has been completely disassembled. Always leak check the system after any component removal. ▲

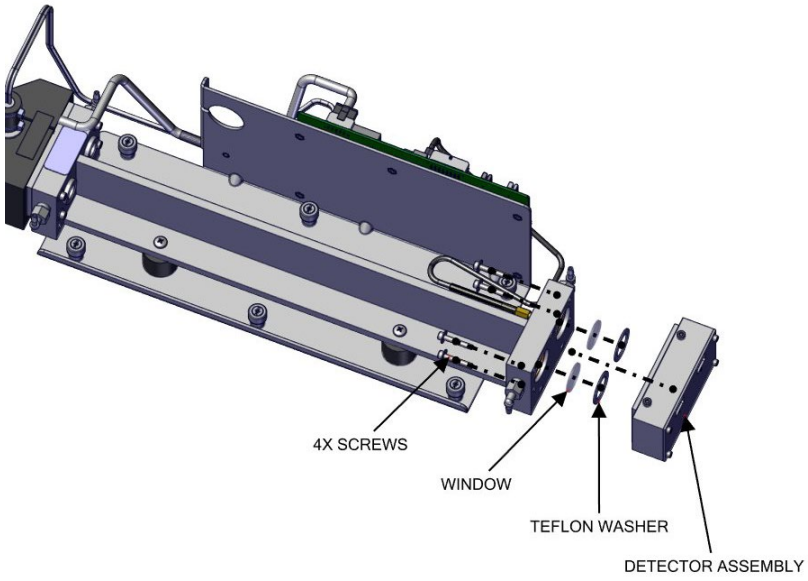


Figure 5–7. Absorption cleaning pt 5 full window clean option

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 49iQ 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. 49iQ Troubleshooting Guide

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

Problem	Possible Cause	Action
	Micro SD Card Programming	If Micro SD card was just replaced, re-install the old one. If the problem is fixed, request a replacement Micro SD card.
Instrument temperature out of range	Fan failure	Replace fan if not operating properly.
	Dirty fan filter	Clean or replace filter.
	Overheating PCBA	Locate defective PCBA reporting the error and replace if needed.
Voltage levels out of range	Poor PCBA or cable connection	Locate PCBA where out of range voltage level is being detected and inspect connections. Replace PCBA if damaged.
Solenoid current out of range (option)	Sticking or damaged solenoid	Reset solenoid via Settings>Health Check>Status and Alarms>Valve and Pump Resets screen. If damaged, replace solenoid valve block.
Pump current out of range	Damaged or dirty pump	Reset pump via Settings>Health Check>Status and Alarms>Valve and Pump Resets. Inspect and refurbish pump. If pump motor is damaged, replace pump.
Out of range pressure high – upstream flow	Too much positive pressure in sample line	Regulate line to lower pressure, or install flow bypass near rear panel.
Out of range pressure low – upstream flow	Ineffective pump	Evaluate for refit/replacement of pump.
	Internal leak	Inspect lines downstream of flow capillary. Replace tubing if needed.
	Stuck solenoid valve (zero/span gas valve option only)	Reset valve via Settings>Health Check>Status and Alarms>Valve and Pump Resets. Replace manifold valve block if necessary.
Bench temperature out of range	Thermistor disconnected or shorted	Check to ensure range corresponds with expected value. If not, select proper range.
	High: Excessive high temperature in instrument, duty cycle of temperature control at zero	Check external temperature (must be under 45 °C); check rear panel fan for operation, replace if necessary.
	Low: Excessive low temperature in instrument, ineffective or disconnected heater, duty cycle temperature at 100%	Check external temperature (must be above 0 °C); check heater connection for disconnect or crimps.

Problem	Possible Cause	Action
Flow, pressure or vacuum are too low, or: pump produces no flow	Diaphragm or valve plates are worn or dirt in the head	Rebuild or replace pump.
	Connections or lines are blocked	Let the pump run for a few minutes pumping air.
	An external valve is closed or a filter blocked	Remove the external filter or valve to see if the flow comes back into spec.
	There is a leak at a connector, in a line or in the pump head	Find and repair leak.
	Liquid (condensate) has collected in the pump head	Clean and dry. Pump may need replacement.
	Pump cable not seated	Verify the pump cable is properly seated into the Step POL board.
	The cross-section of pneumatic lines, or connected components are too small or they are restricted	The pump is not designed for this condition.
Alarm – board communication failure	Internal cables not connected properly	Verify cables to DMC PCB are seated properly. Replace DMC PCB if necessary.
Alarm – power supply	Internal cables not connected properly	Verify cables to DMC PCB are seated properly. Replace DMC PCB if necessary.
Cell A or B frequency (Photometer)	Light adjustment	Readjust Lamp setting from the "Photometer Bench Settings" menu.
	Defective detector	Interchange detectors at Photometer DMC PCB connectors to determine if detector is defective.
Cell A and B frequency (Ozone)	Lamp supply	
Cell A or B frequency low or zero	Light adjustment	Readjust lamp setting from the "Photometer Bench Settings" menu.
	One cell excessively contaminated	Clean cell.
	Defective detector	Interchange detectors at photometer DMC PCB connectors to determine if detector is defective.
Cell A and B frequency low or zero	Dirty cells	Clean cells.
	Light adjustment	

Problem	Possible Cause	Action
	Lamp	Remove one cell and look for blue light in hole of input block.
	Lamp heater	Check lamp temperature from the Status & Alarms>Photometer Bench screen.
	+/- 15V power supply	Check +/- 15V from the Status & Alarms>Photometer Bench screen.
Cell A or B noise excessive	Foreign material in one cell	Clean cell.
	Defective detector	Interchange detectors at photometer DMC PCB connectors to determine if detector is defective.
Cell A and B noise excessive	Foreign material in cells	Clean cells.
	Lamp failure	
	+/- 15V power supply	Check +/- 15V from the Status & Alarms>Photometer Bench screen.
Output signal noisy	Recorder	Replace or repair recorder.
	Sample is varying	Run instrument on stable ozone source. If quite, no malfunction.
	Foreign material in cell	Clean cell.
	Sticky solenoid valve	Replace with known-good solenoid valve.
Analyzer does not calibrate properly	Leak	Check all tubing connections for leak.
	Contaminated scrubber	Perform scrubber efficiency test. Replace if needed.
	Flow/Pressure out of calibration	Recalibrate flow/pressure in the operator's manual.
	Dirty system	Clean cells and flow components.
	Solenoid defective	Replace with known-good solenoid valve.
Slow response	Averaging time	Verify averaging time is set properly.
	Contaminated photometer	Clean bench and then condition system overnight.
Alarm – O_3 Lamp temp	Defective lamp heater	Replace ozonator, lamp driver board or lamp assembly.
Alarm –Lamp temp	Defective lamp heater	Replace bench lamp driver board or lamp assembly.
Alarm – Flow	Flow low	Check sample capillary for blockage. Replace as necessary.

Problem	Possible Cause	Action
		If using a sample particulate filter, make sure it is not blocked. Disconnect sample particulate filter from the sample bulkhead; if flow increases, replace filter.
Alarm – Cell A Intensity Alarm – Cell B Intensity	Pre-amp gain not set properly	Check gain adjustment.
	Defective photometer DMC PCB board	Replace photometer DMC PCB board.
Alarm – Zero Check (Option)	Instrument out of calibration	Recalibrate instrument.
		Check gas supply.
		Perform a manual calibration.
Alarm – O_3 Concentration	Concentration has exceeded range limit	Check to ensure range corresponds with expected value. If not, select proper range.
	Concentration low	Check user-defined low set point, set to zero.
Alarm – Lamp Heater Current (Photometer)	Defective heater	Replace heater as needed.
Alarm – Lamp Temp Sensor Short (Photometer)	Defective sensor	Replace sensor as needed.
Alarm – Lamp Temp Sensor Open (Photometer)	Defective sensor	Replace sensor as needed.
Alarm – Bench Temp Sensor Open (Photometer)	Defective sensor	Replace sensor as needed.
Alarm – Bench Temp Sensor Short (Photometer)	Defective sensor	Replace sensor as needed.
Alarm – Lamp Connection (Photometer)	Defective lamp	Replace lamp as needed.
Alarm – Lamp Short (Photometer)	Defective lamp	Replace lamp as needed.
Alarm – Lamp Heater Current (Ozone)	Defective heater	Replace heater as needed.

Problem	Possible Cause	Action
Alarm – Bench Temperature (Ozone)	Dirty fan filter	Clean fan filter as needed.
Alarm – Lamp Temp Sensor Short (Ozone)	Defective sensor	Replace sensor as needed.
Alarm – Lamp Temp Sensor Open (Ozone)	Defective sensor	Replace sensor as needed.
Alarm – Lamp Connection (Ozone)	Defective lamp	Replace lamp as needed.
	Defective DMC board	Replace DMC board as needed.
Alarm – Lamp Short (Ozone)	Defective lamp	Replace lamp as needed.
		Reseat if needed.
	Defective DMC PCB	Replace DMC board.

Chapter 7
Servicing

This chapter describes the periodic servicing procedures that should be performed on the instrument to ensure proper operation and explains how to replace the 49iQ 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. ▲

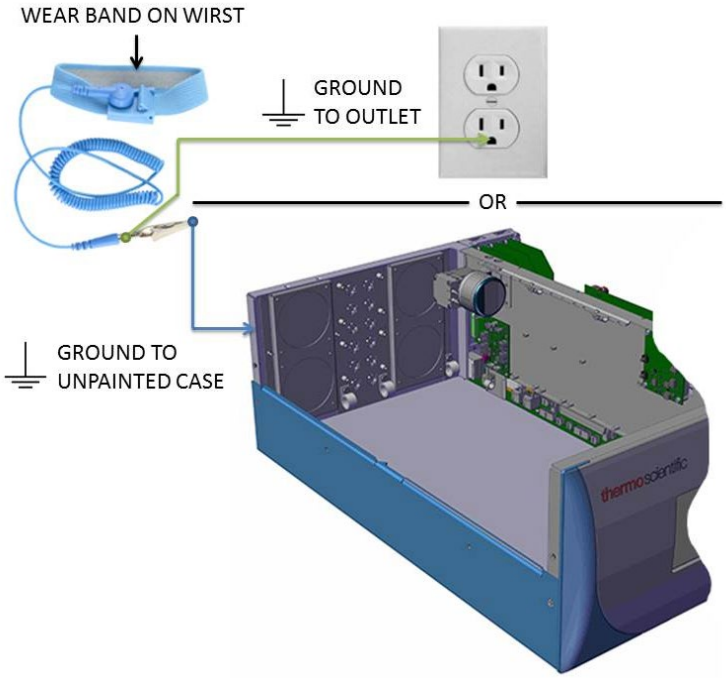


Figure 7–1. Properly Grounded Antistatic Wrist Strap

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.

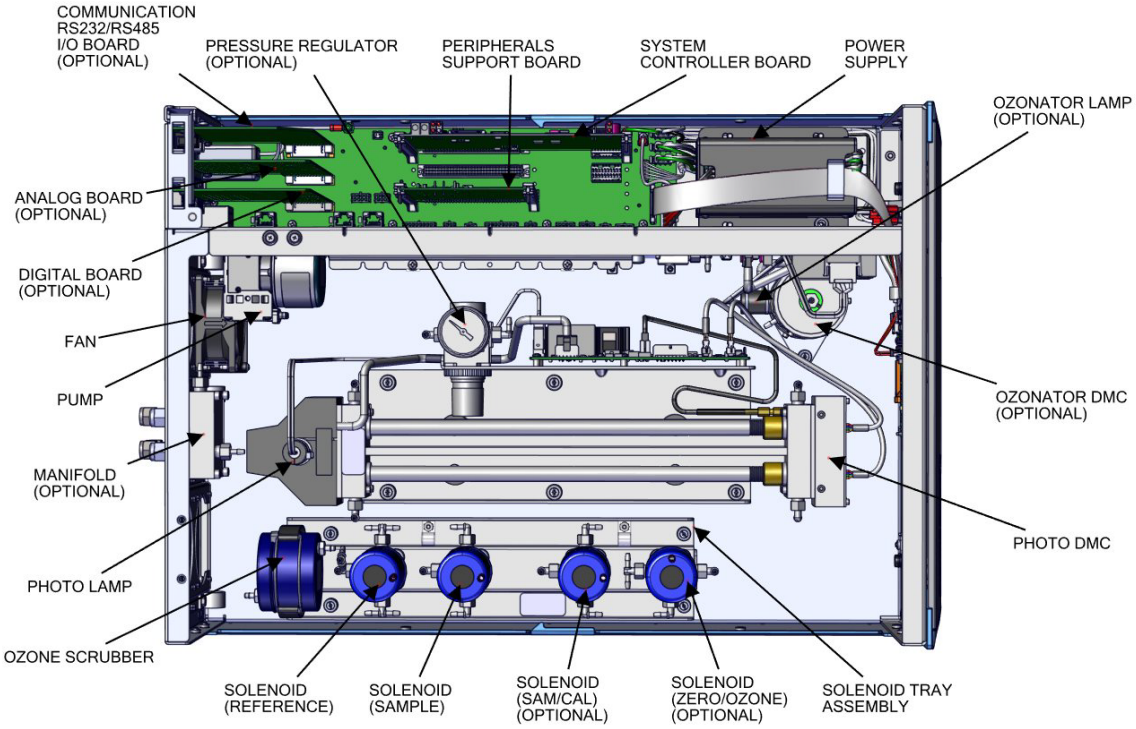


Figure 7–2. 49iQ Component Layout Top View

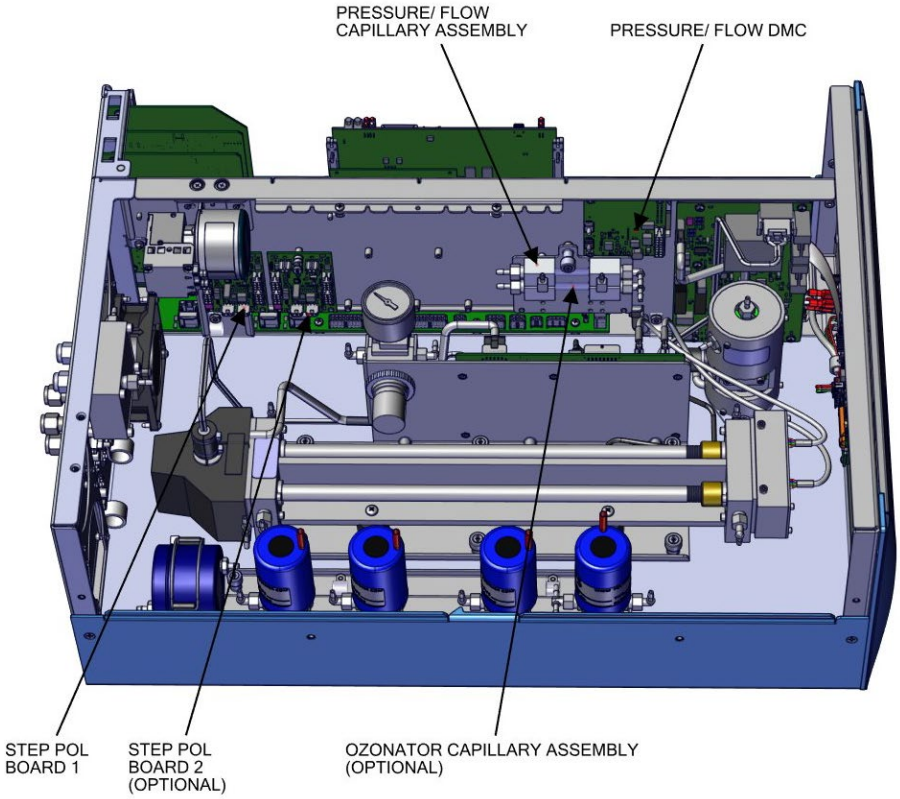


Figure 7–3. 49iQ Component Layout Side View

Fuse Replacement

Use the following procedure to replace the fuses.

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

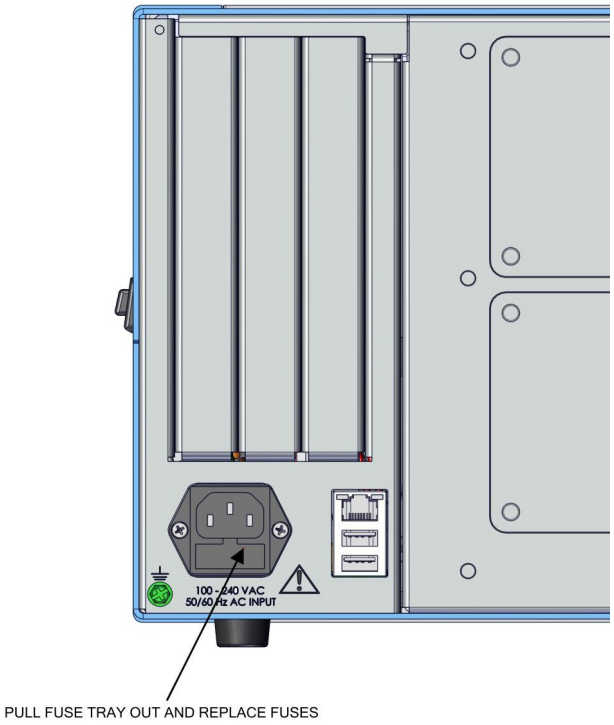


Figure 7–4. Replacing the Fuses

Filter Replacement

Use the following procedure to replace the filter.

1. Turn instrument OFF and unplug the power cord.

2. Starting with top right corner, pull out to remove fan cover.

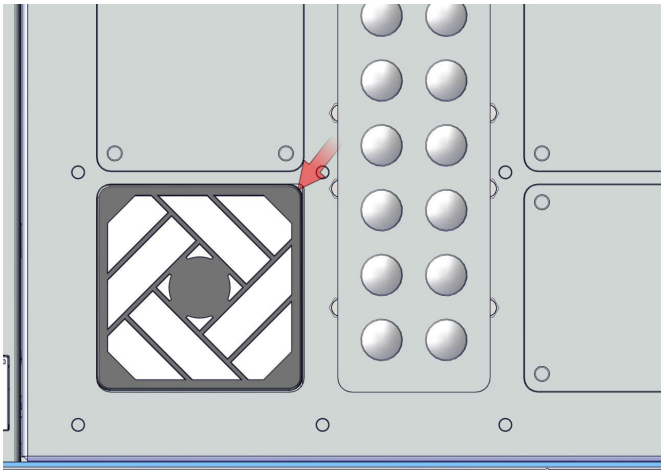


Figure 7–5. Start with Top Right Corner of Fan Cover

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

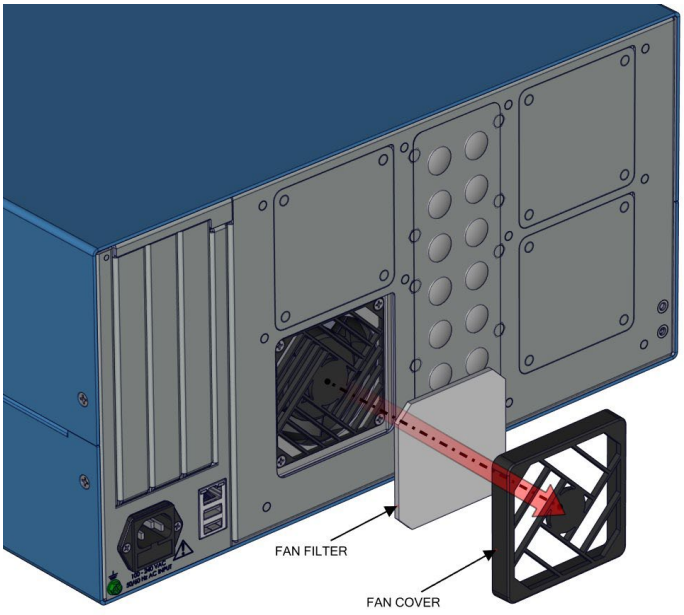


Figure 7–6. Removing the Fan Cover

Fan Replacement

Use the following procedure to replace the fan.

Equipment required:

Phillips drive, #2

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

2. Unplug the fan cable J18.

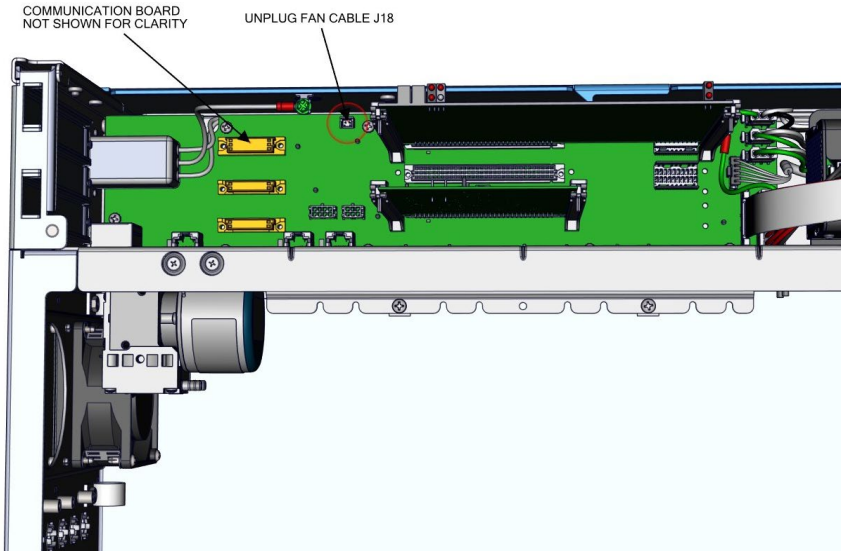


Figure 7–7. Unplugging the Fan Cable

3. Starting with top right corner, pull out to remove fan cover.

4. Unhook the four latches of the fan cover.

5. Unfasten the four 6-32 screws from the fan housing.

6. Replace fan and reassemble in reverse order.

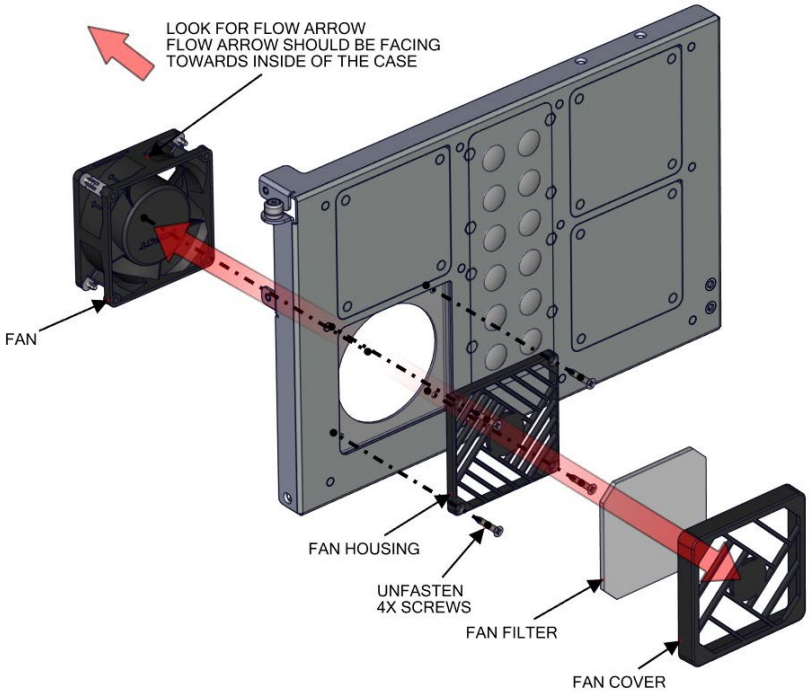


Figure 7–8. Replacing the Fan

Measurement Side Removal and Replacing

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

Equipment required:

Phillips drive, #2

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

2. Unplug the fan cable J18 (Figure 7–9).

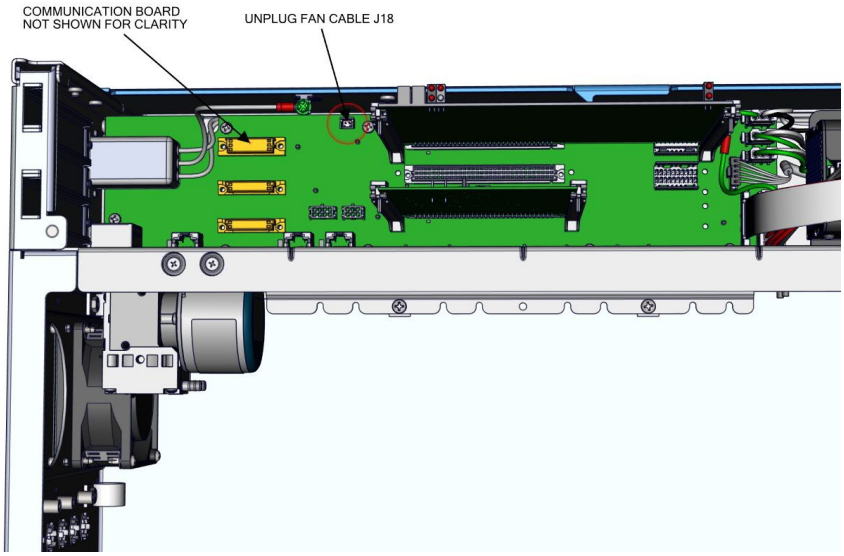


Figure 7–9. Unplugging the Fan Cable

3. Unplug DMC cable (Figure 7–10).

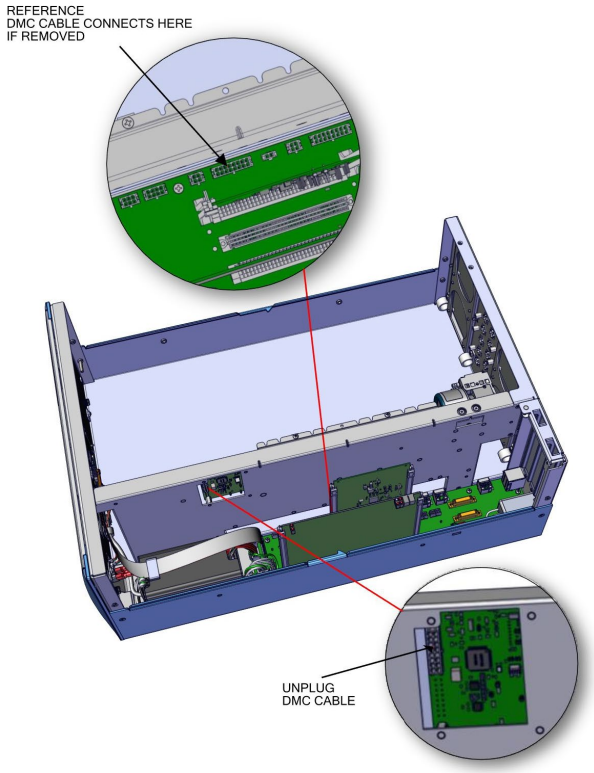


Figure 7–10. Unplugging the DMC Cable

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

5. Remove three 8-32 flat head screws (Figure 7–11).

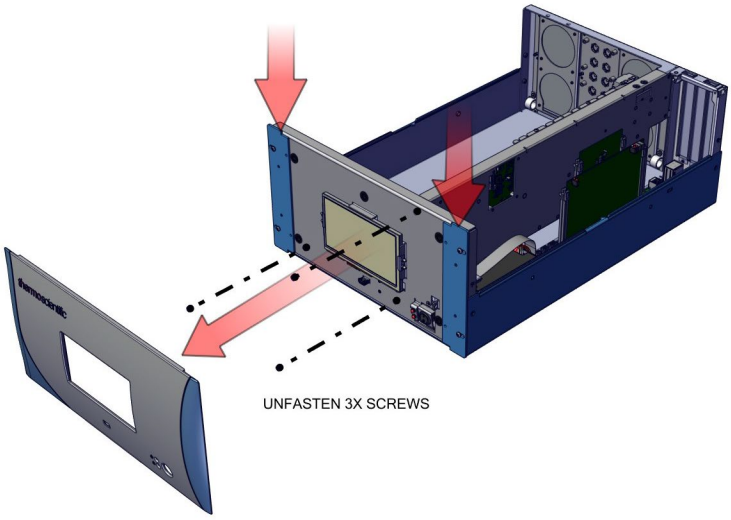


Figure 7–11. Unfasten Hardware Front for Measurement Side Removal

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.

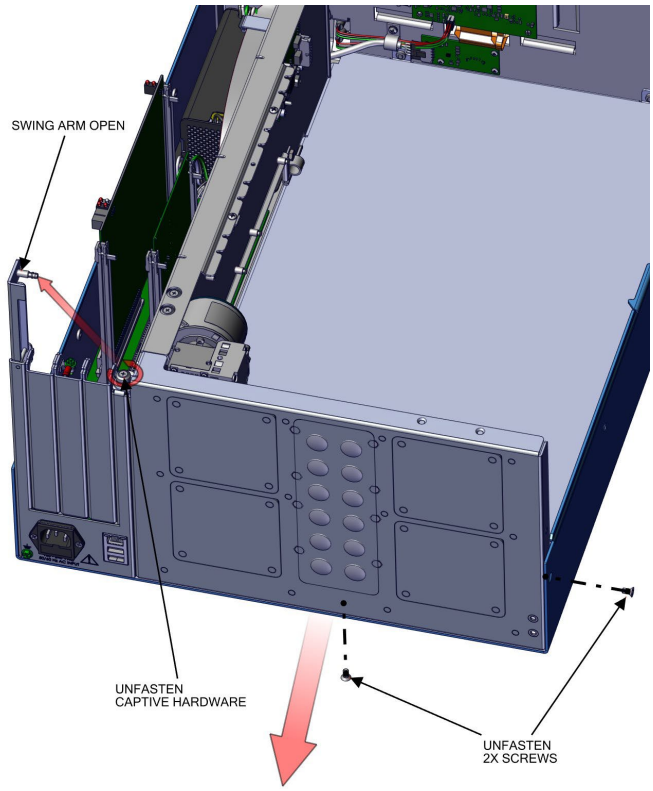


Figure 7–12. Unfasten Hardware Rear for Measurement Side Removal

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).

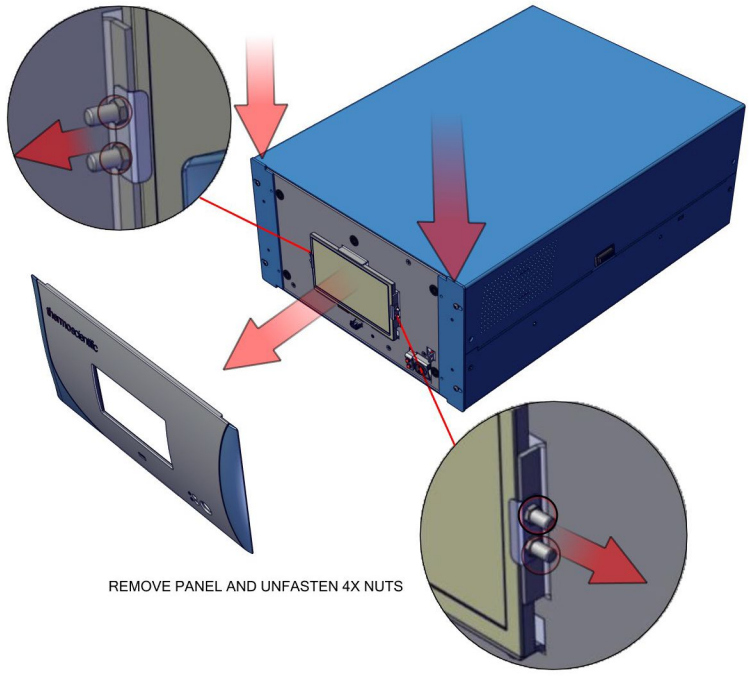


Figure 7–13. Replacing the LCD Module

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

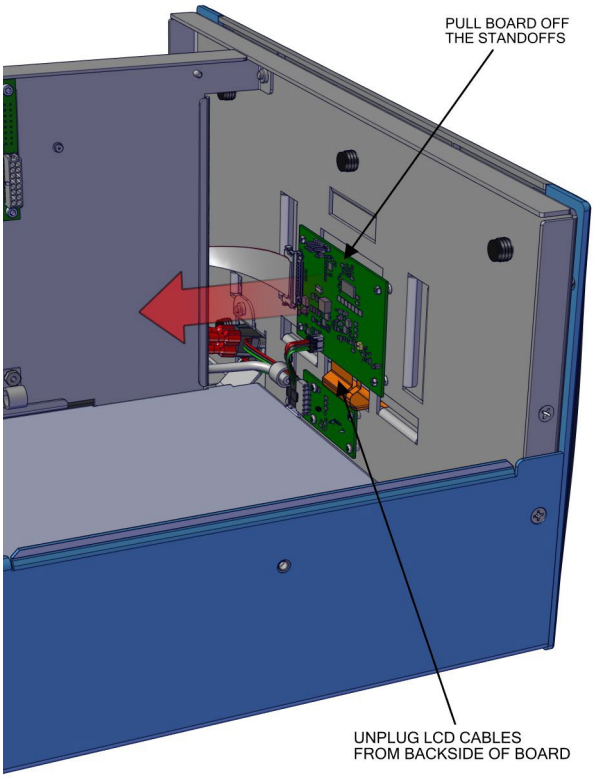


Figure 7–14. Remove Electrical Cables from LCD

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.

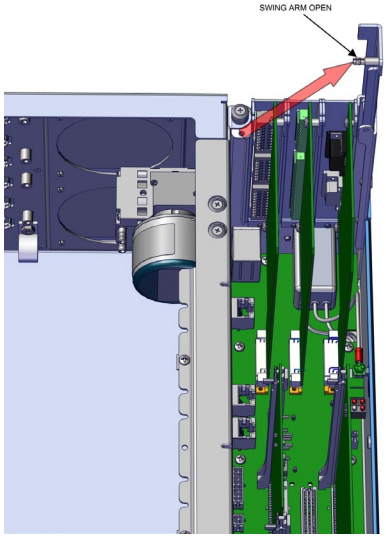


Figure 7–15. I/O Replacement, Arm

3. Pull board upwards.

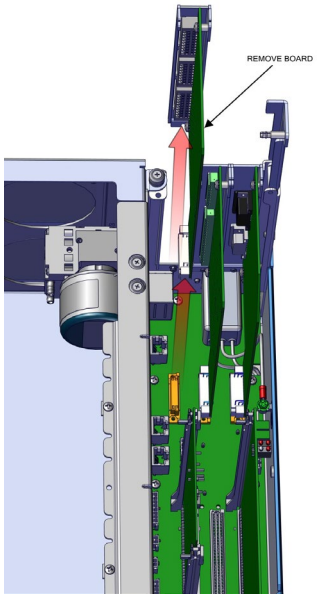


Figure 7–16. I/O Replacement, Remove Board

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

5. Insert board downwards.

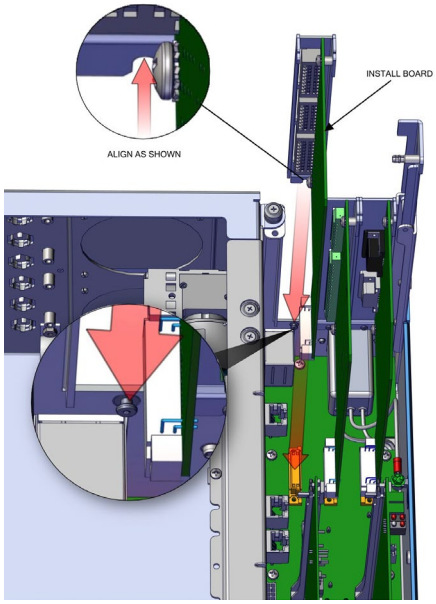


Figure 7–17. I/O Replacement, Install

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

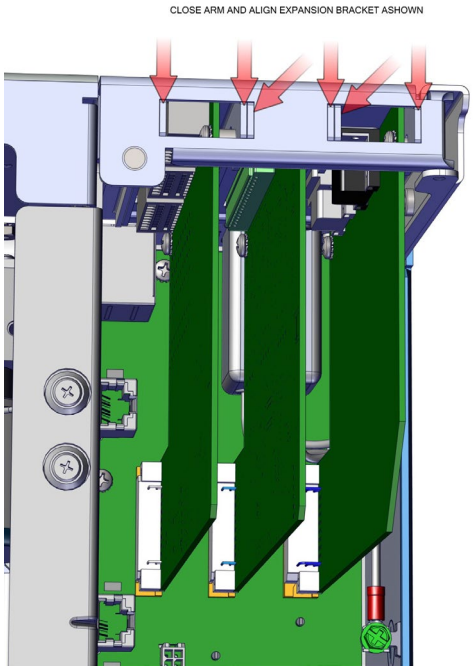


Figure 7–18. I/O Replacement, Close Arm Alignment

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.

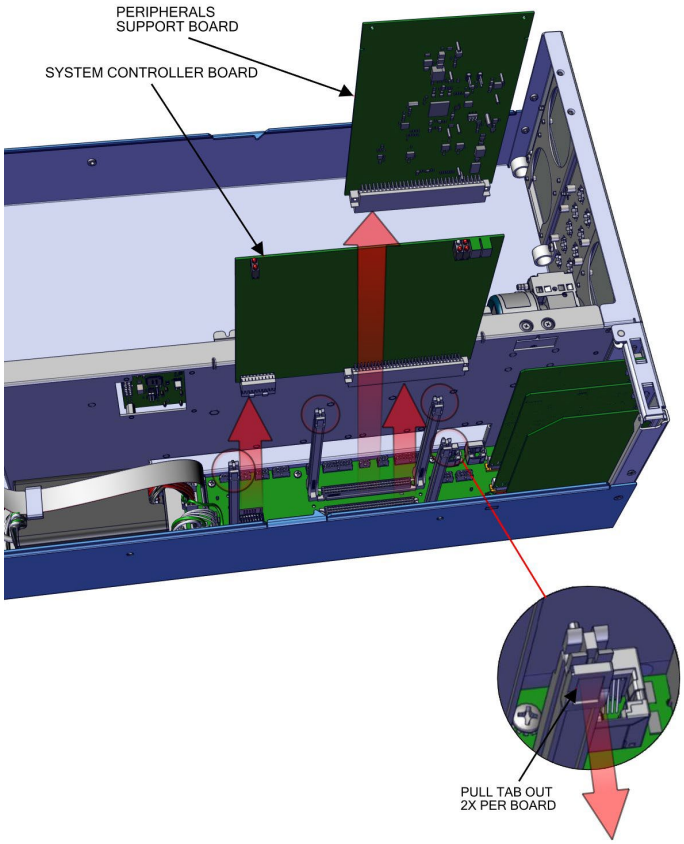


Figure 7–19. Replacing the Peripheral Support board

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.

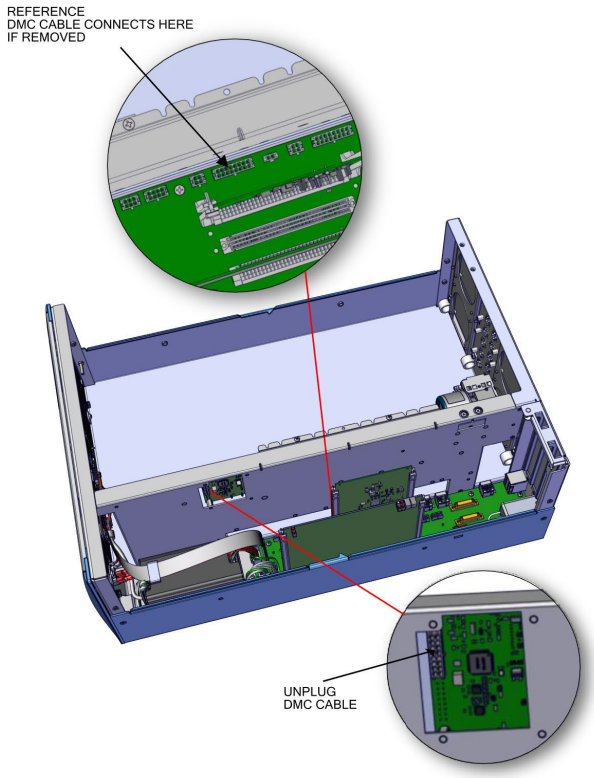


Figure 7–20. Flow Pressure Board, Disconnect DMC Cable

3. Disconnect plumbing.

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

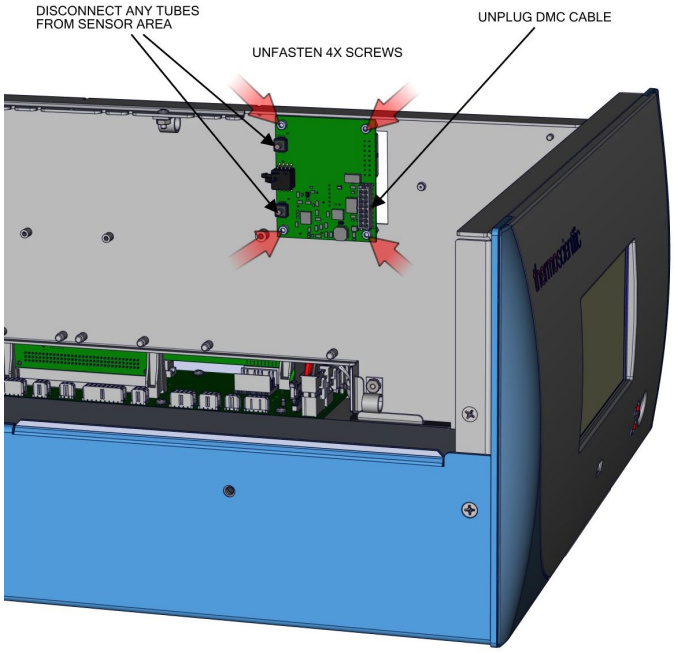


Figure 7–21. Flow Pressure Board, Screws

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.

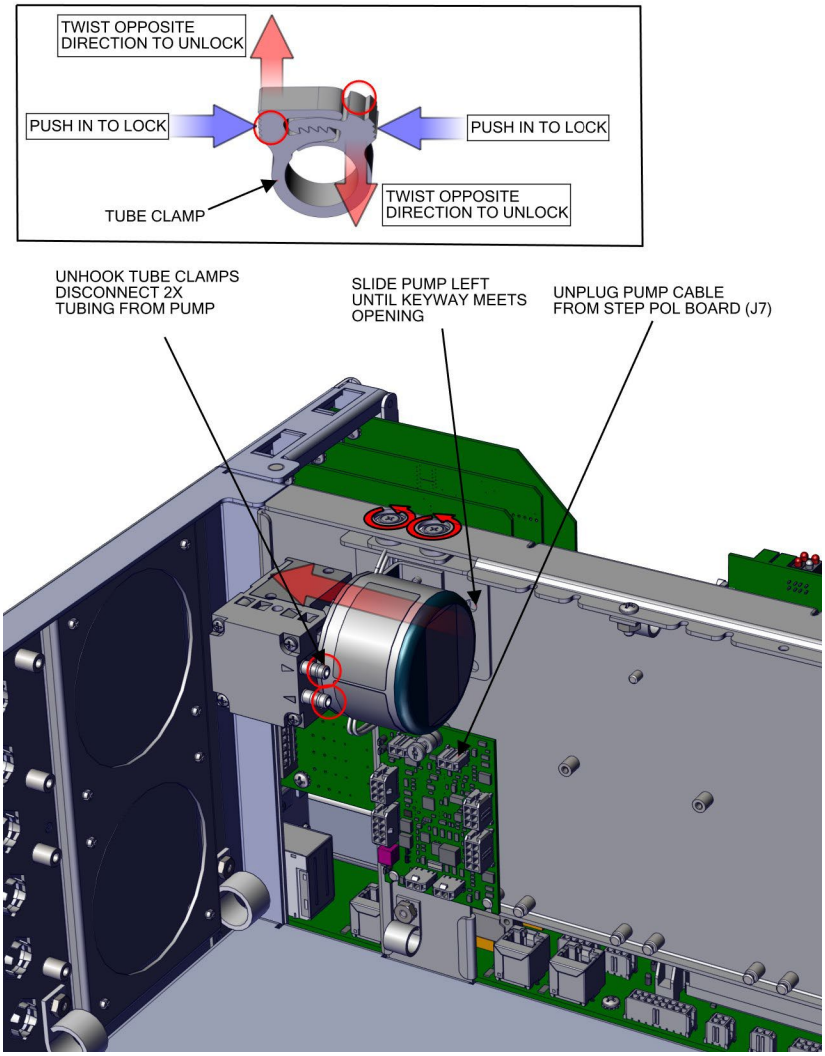


Figure 7–22. Remove Pump, Disconnect and Unfasten

7. Pull pump outwards.

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

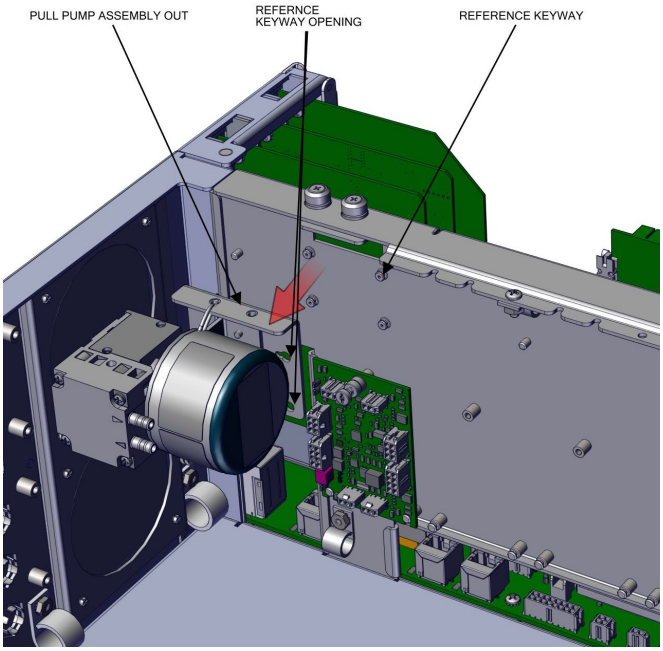


Figure 7–23. Pump Removal, Keyway

8. Remove two screws.

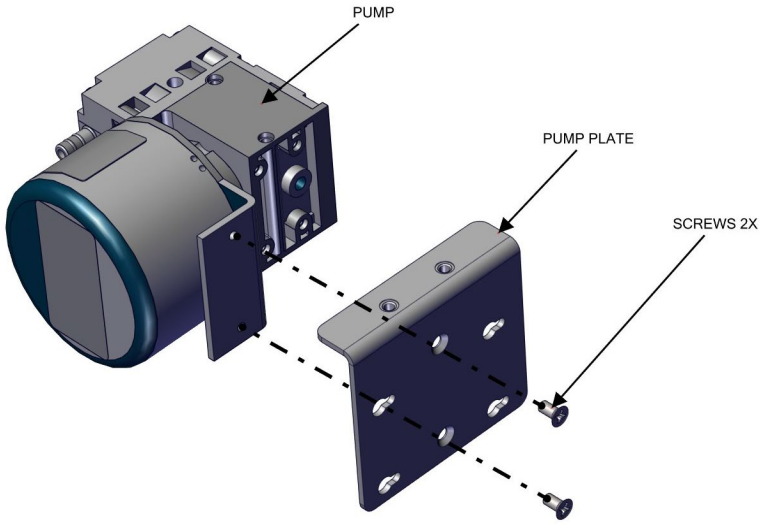


Figure 7–24. Pump replacing, Unfasten Screws

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. Using #2 Phillips drive, unfasten captive hardware.

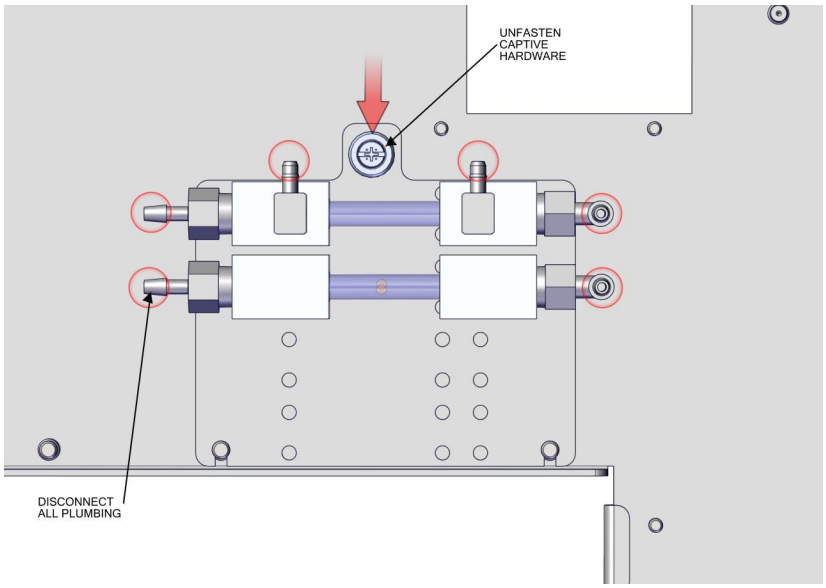


Figure 7–25. Remove Capillary, Disconnect and Unfasten

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

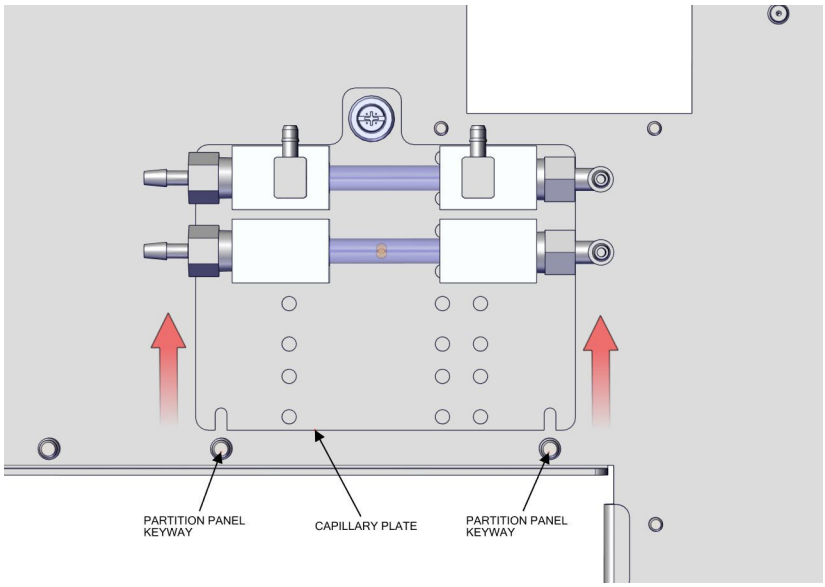


Figure 7–26. Capillary Plate, Keyway

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

6. Pull apart the capillary blocks.

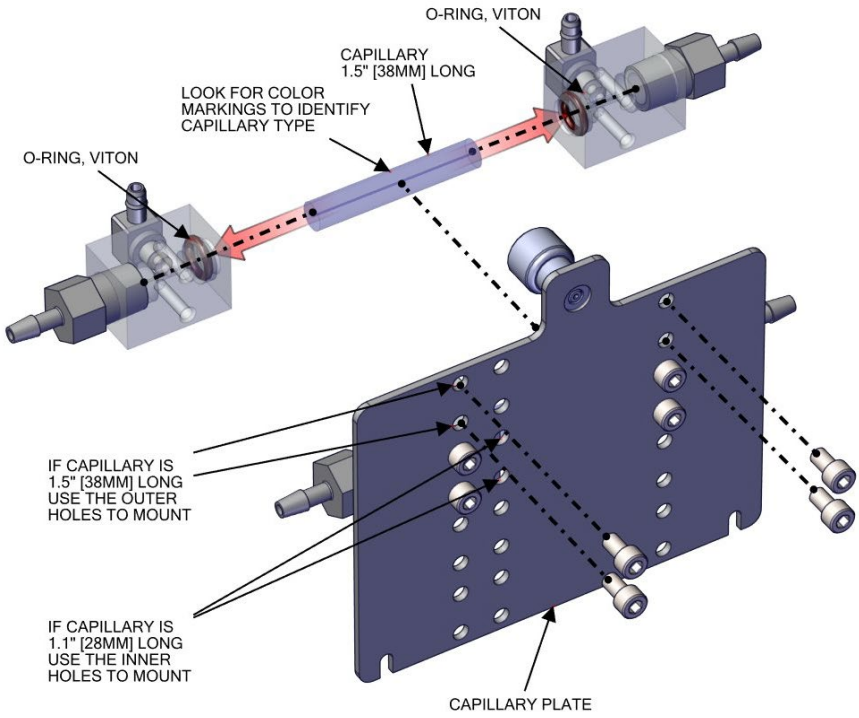


Figure 7–27. Capillary and O-Ring Replace

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.

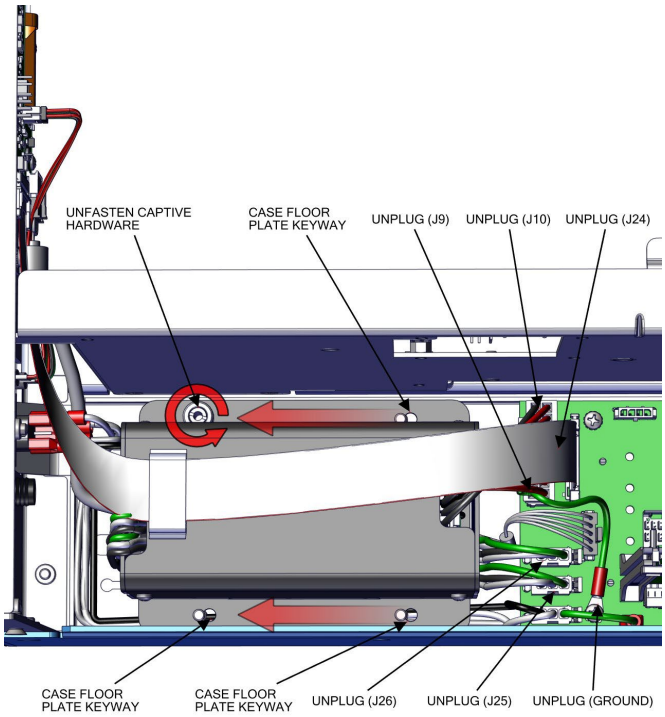


Figure 7–28. Removing Power Supply

5. Pull power supply up.

6. Replace power supply and reassemble in reverse order.

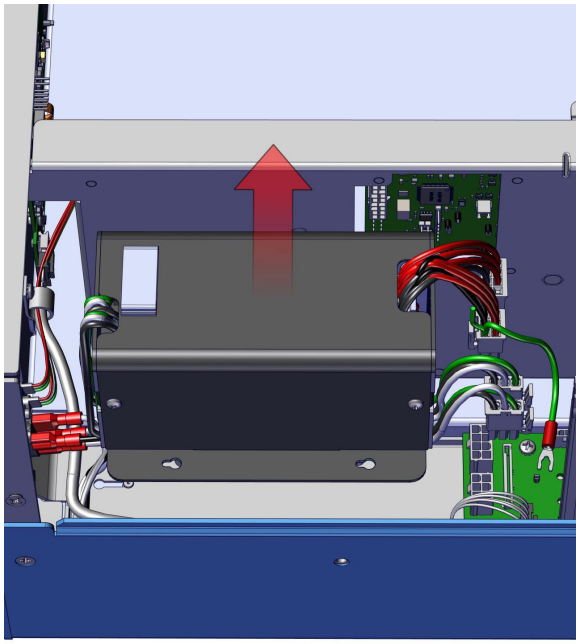


Figure 7–29. Replacing Power Supply

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.

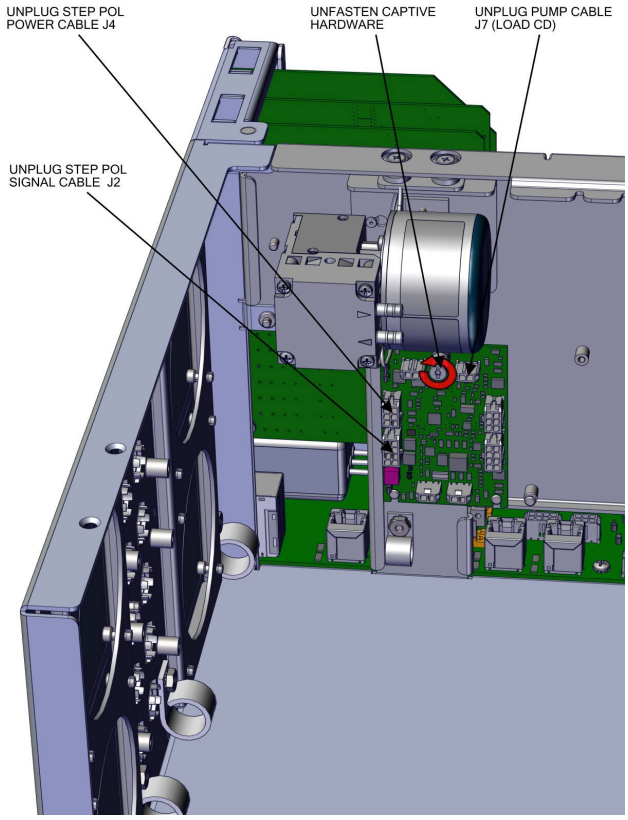


Figure 7–30. Unplug and Unfasten Step POL Board

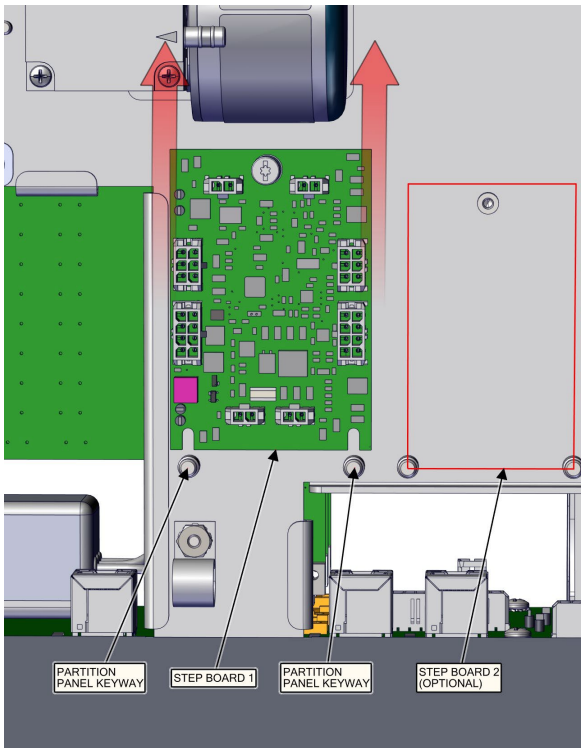


Figure 7–31. Clear Partition Keyway Step POL Board

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.

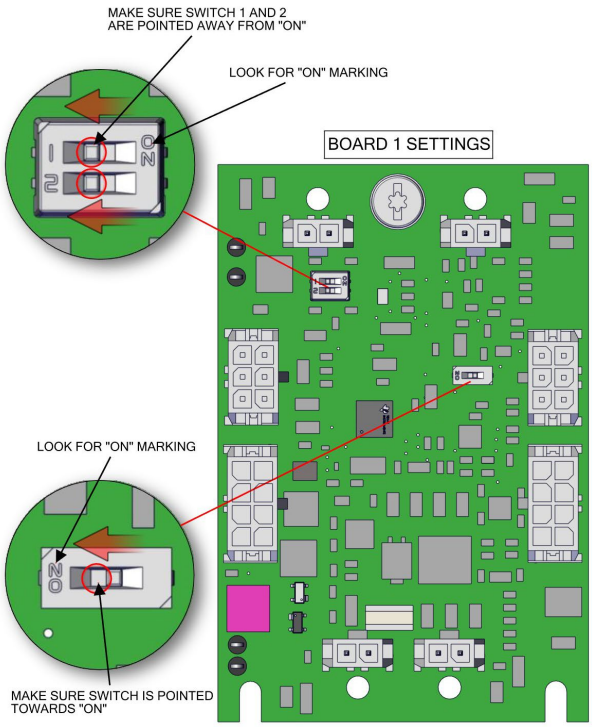


Figure 7–32. Step POL Board 1 Switch Settings

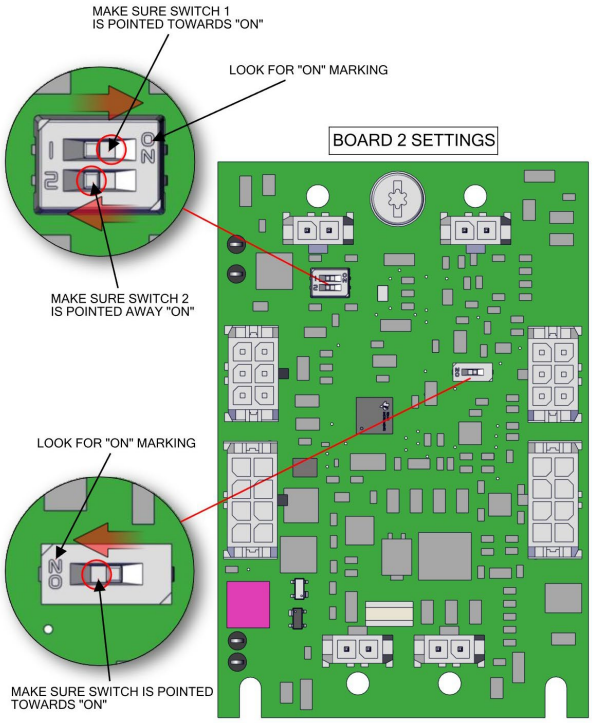


Figure 7–33. Optional Step POL Board 2 Switch Settings

49iQ Photometer DMC

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

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

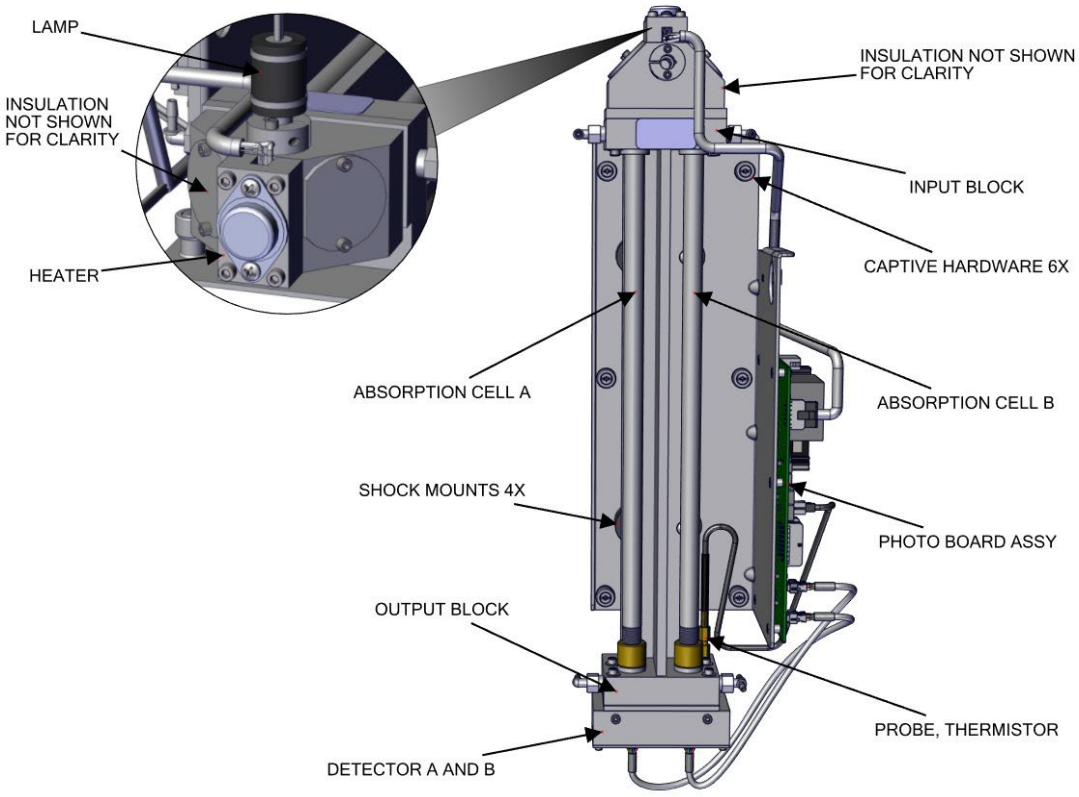


Figure 7–34. Photometer DMC Layout

Photometer Lamp Replacement

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

Equipment required:

Hex drive, 3/32

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

2. Disconnect lamp connector.

3. Unhook lamp cable from cable holder.

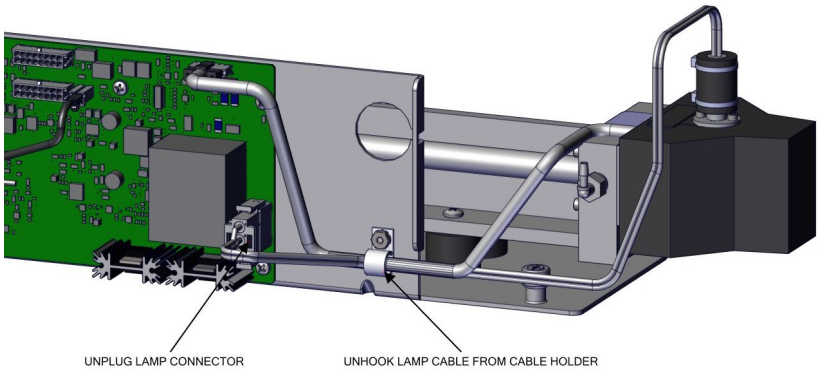


Figure 7–35. Lamp Removal pt 1

4. Unfasten Velcro strap.

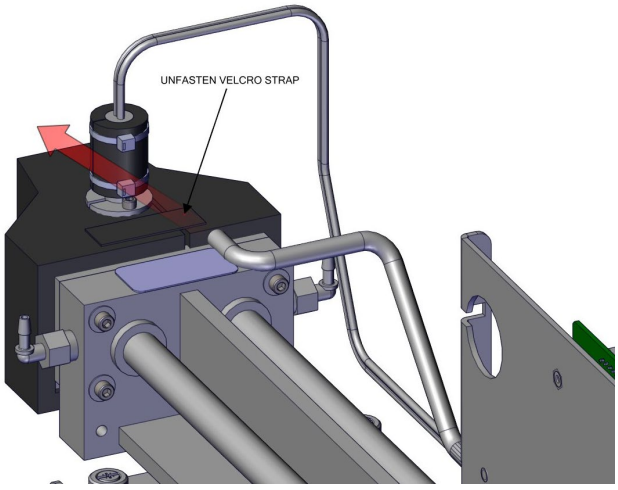


Figure 7–36. Lamp Removal pt 2

5. Peel insulation back enough to unfasten this screw.

6. Using a 3/32 hex drive, unfasten the #6-32 cap head screw.

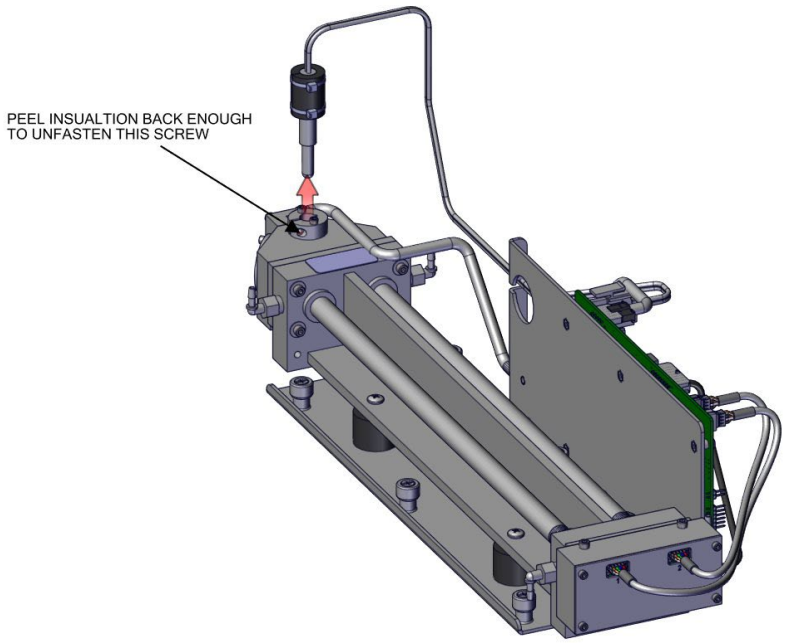


Figure 7–37. Lamp Removal pt 3

7. Rebuild/install assembly in reverse order.

Photometer DMC Removal

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

Equipment required:

Phillips drive, #2

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

2. Unplug DMC cable, top connector (photometer DMC board to pressure/flow board).

3. Unplug DMC cable, bottom connector (photometer DMC board to ozonator DMC board).

4. Disconnect 3X plumbing (Figure 7–38).

5. Using a #2 Phillips drive, unfasten 6X captive hardware.

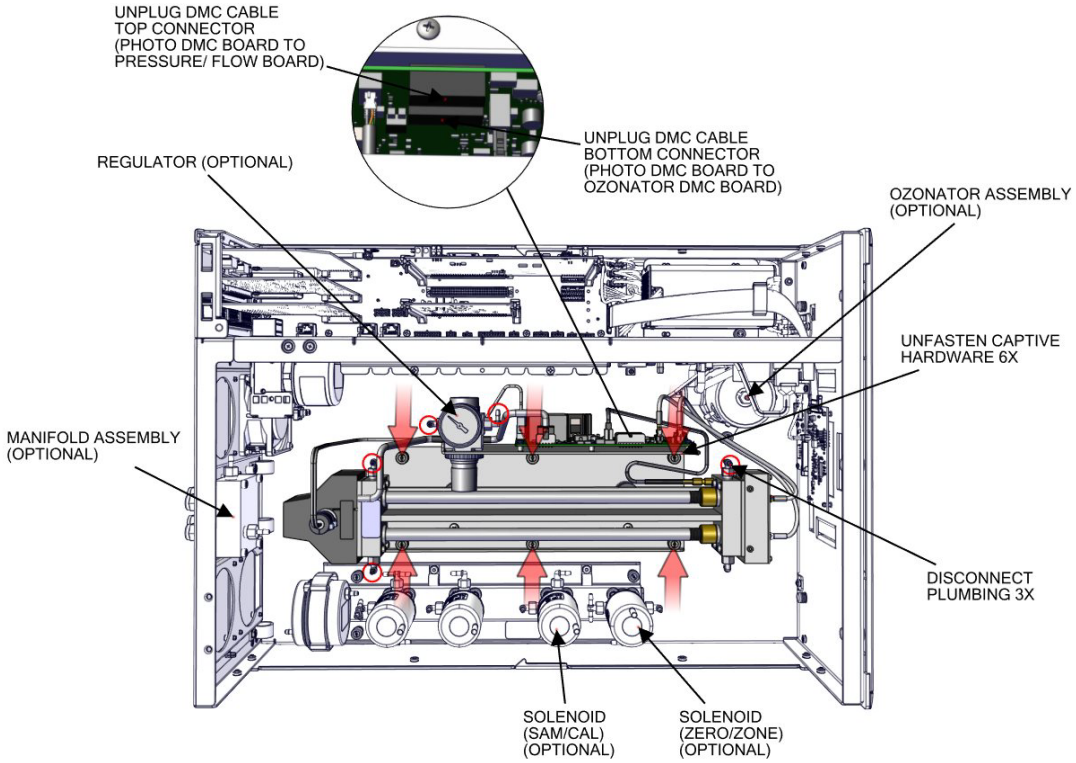


Figure 7–38. Photometer DMC Removal

Photometer DMC Board Replacement

Use the following procedure to replace the board.

Equipment required:

Phillips drive, #2

1. Unplug electrical, detector 1, detector 2, thermistor, and heater.

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

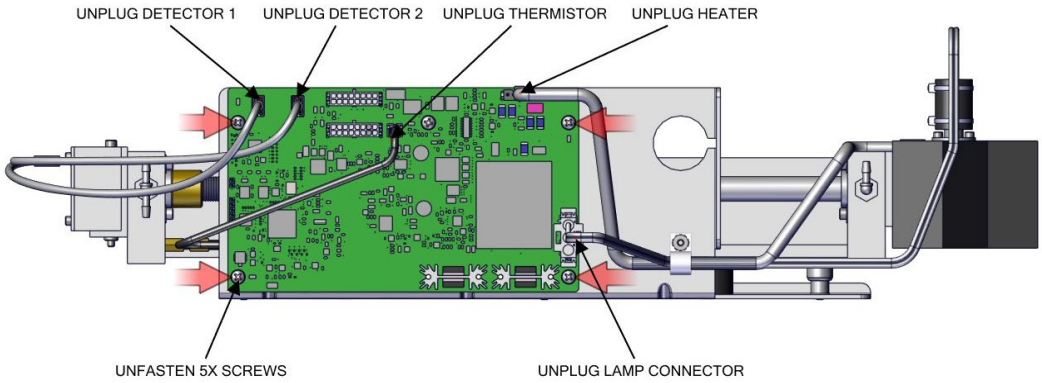


Figure 7–39. Photometer Board Replacement

3. Replace board and reassemble in reverse order.

Detector Assembly Replacement

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

Equipment required:

Hex drive, 7/64

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

2. Unplug electrical cable from detector 1 and detector 2.

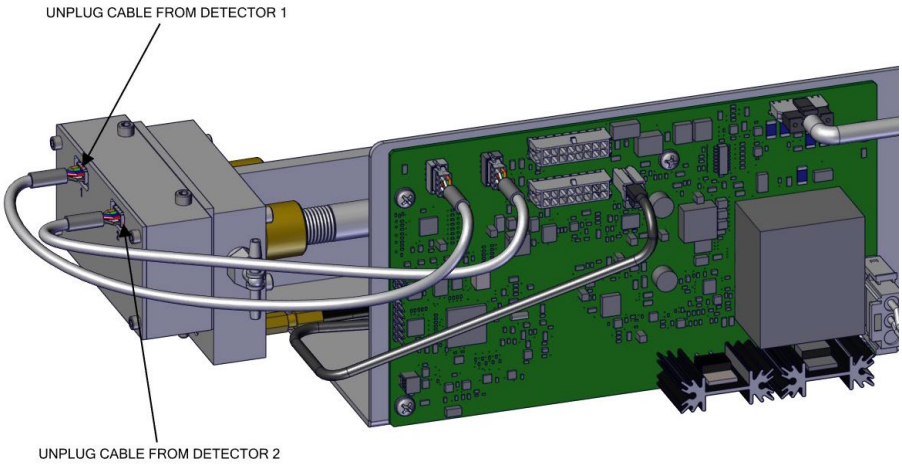


Figure 7–40. Preamp Detector Cover Removal

3. Using a 7/64 hex drive, unfasten two #6-32 cap screws.

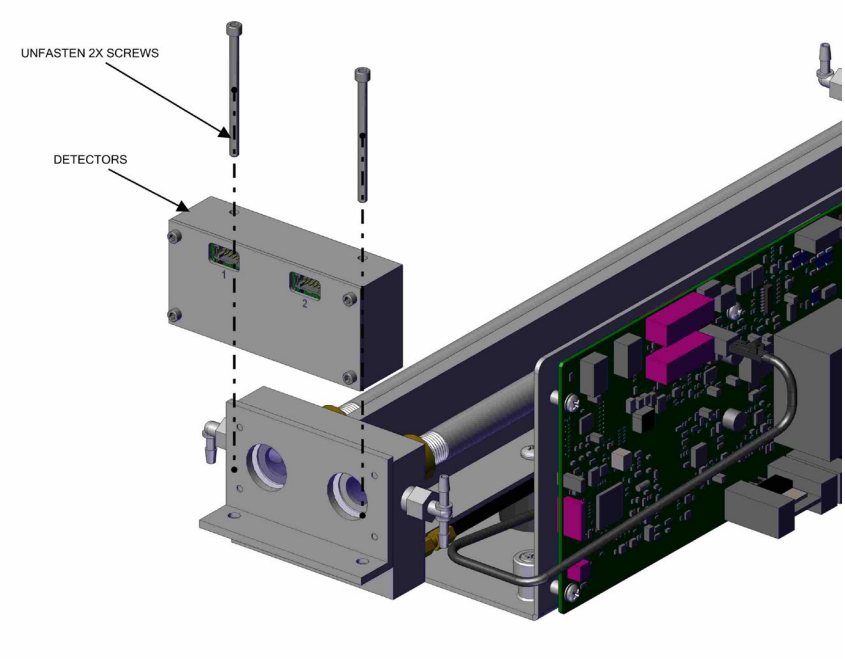


Figure 7–41. Replacing the Detector

4. Replace detector and reassemble in reverse order.

Detector Board Replacement

Use the following procedure to replace the detector board.

Equipment required:

Hex drive, 3/32

1. Turn instrument OFF, unplug power cord, and remove the cover (Figure 2–1).
2. Unplug electrical cable from detector 1 and detector 2.
3. Using a 3/32 hex drive, unfasten four #4-40 cap head screws to remove the cover.
4. Remove detector cover.
5. Using a 3/32 hex drive, unfasten four #4-40 cap head screws to replace per board.

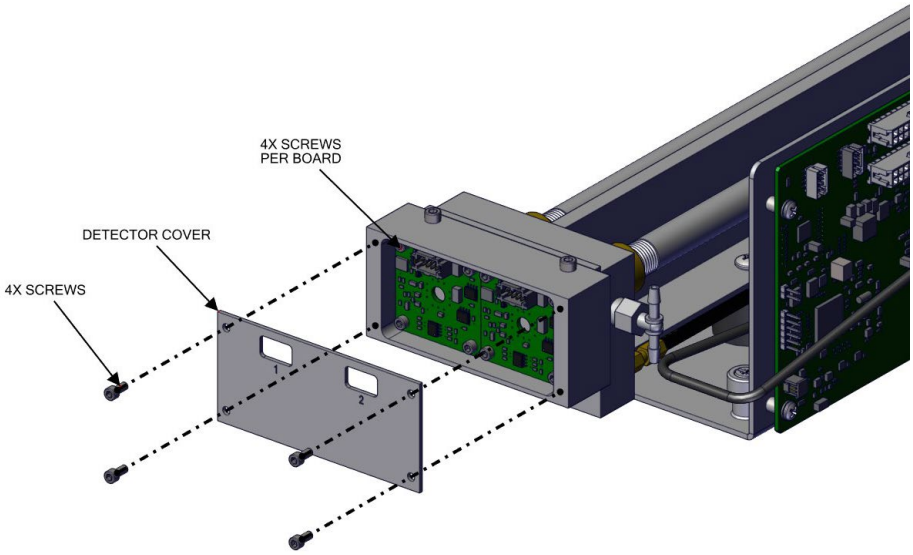


Figure 7–42. Replacing Detector Board

6. Replace detector board and reassemble in reverse order.

Thermistor Replacement

Use the following procedure to replace the thermistor.

Equipment required:

Wrench

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

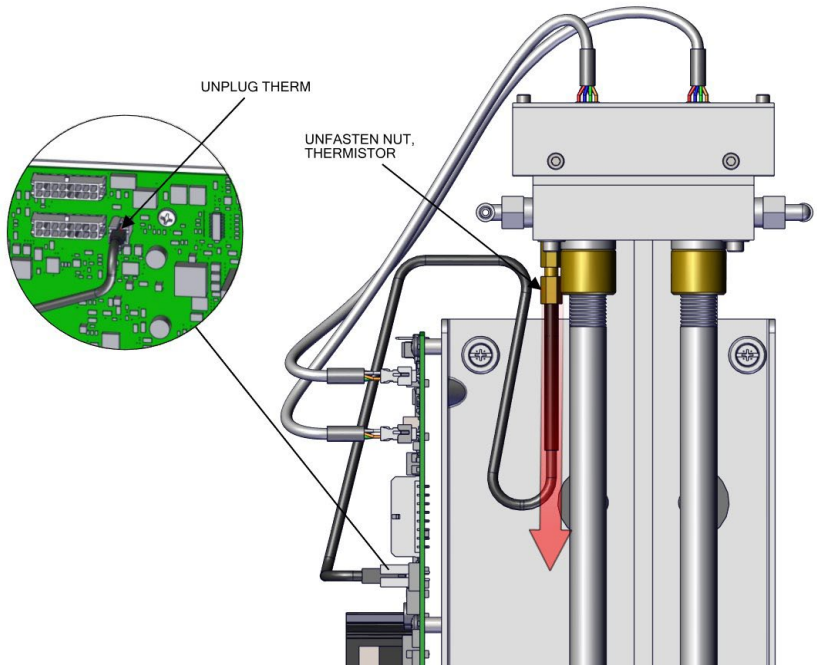


Figure 7–43. Replacing the Thermistor

Scrubber Replacement

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

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

2. Remove temporary shipping nylon tie.

3. Twist opposite direction to unlock tube clamps.

Note Push in tube clamp to lock. ▲

4. Disconnect 2X plumbing.

5. Pull scrubber out.

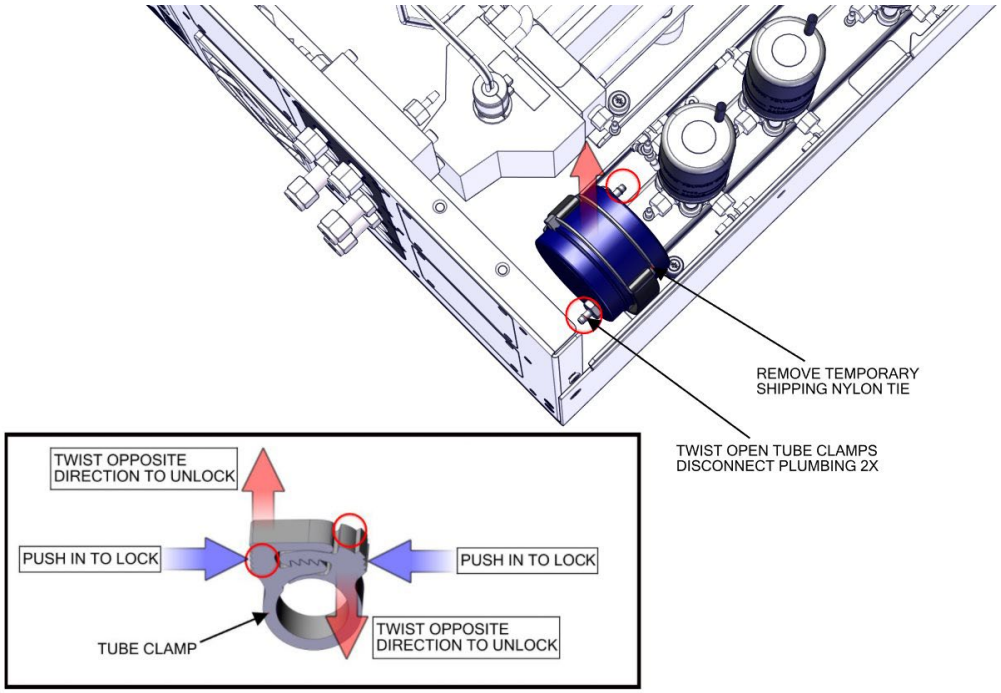


Figure 7–44. Replacing the Scrubber

Solenoid Replacement

Use the following procedure to replace the solenoids and optional solenoid. (Figure 7–45).

Equipment required:

Phillips drive, #2

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

7. Unplug electrical from Step POL board, solenoid valve sample (J8), solenoid valve reference (J6), and optional solenoid valve sam/cal (J5).

8. Disconnect 2X plumbing.

9. Using a #2 Phillips drive, unfasten four captive hardware and pull out the solenoid tray.

10. Pull solenoid tray outwards.

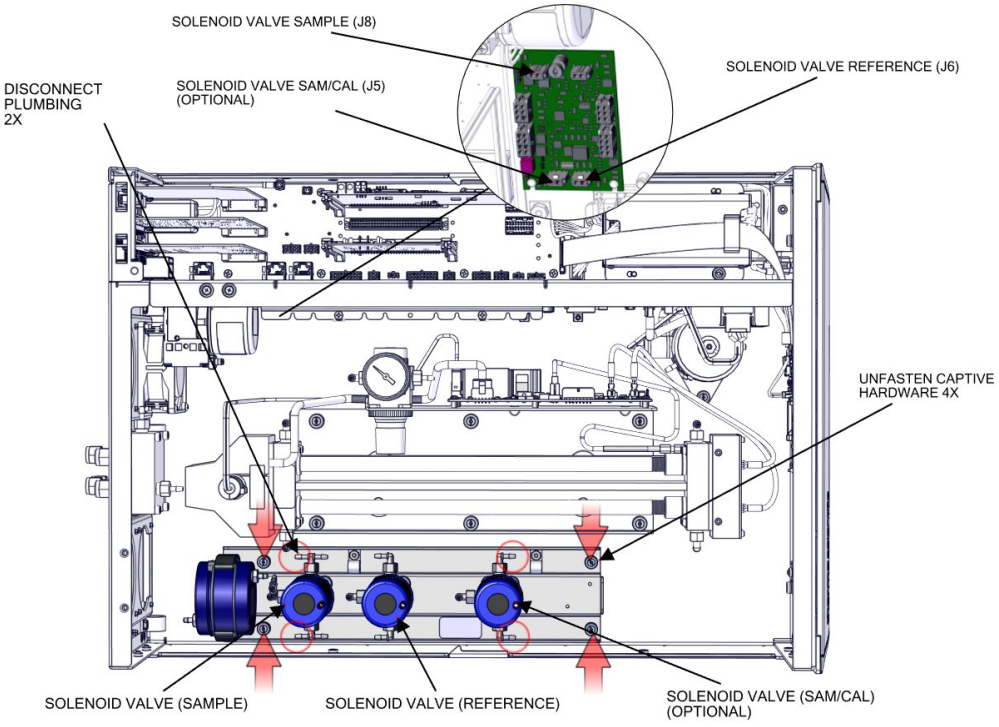


Figure 7–45. Removing the Solenoid Tray pt 1

11. Turn assembly upside down.

12. Unfasten kep nuts (two per valve).

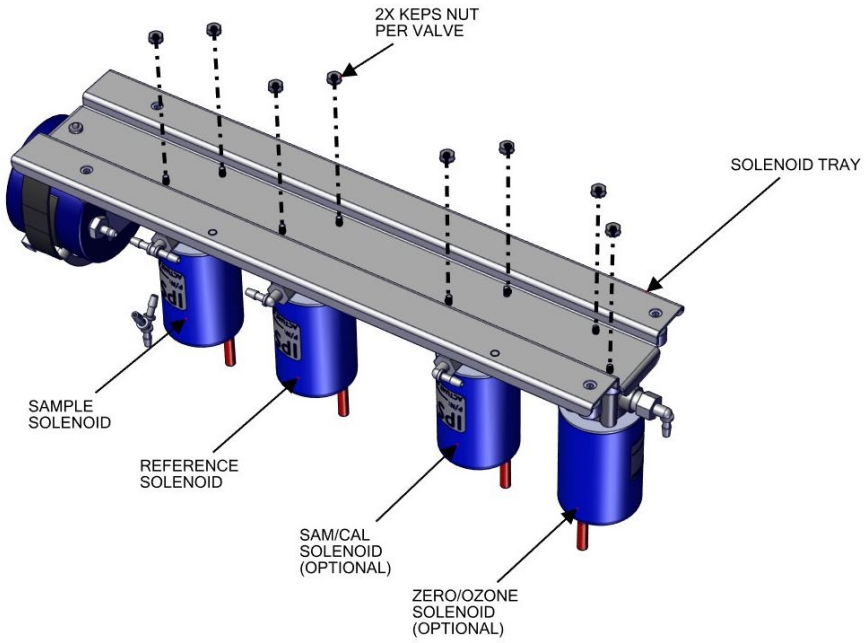


Figure 7–46. Removing the Solenoid Tray pt 2

13. Replace solenoids and reassembly in reverse order.

Optional DMC Ozonator

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

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

DMC Ozonator Removal

Use the following procedure to remove and replace the ozonator.

Equipment required:

Phillips drive, #2

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

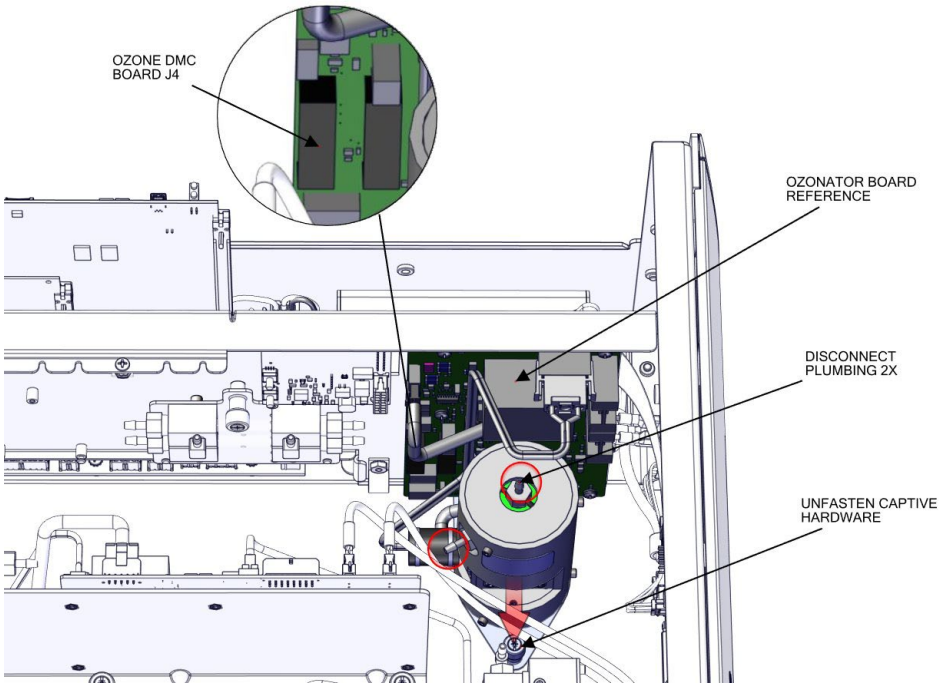


Figure 7–47. Ozone remove pt 1

5. Slide ozonator assembly left.

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

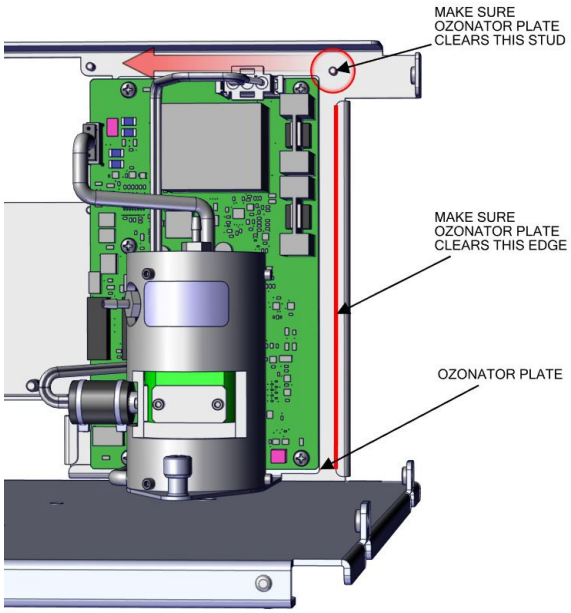


Figure 7–48. Ozone remove pt 2

6. Slide ozonator assembly upwards.

Note Make sure ozonator plate clears the edge. ▲

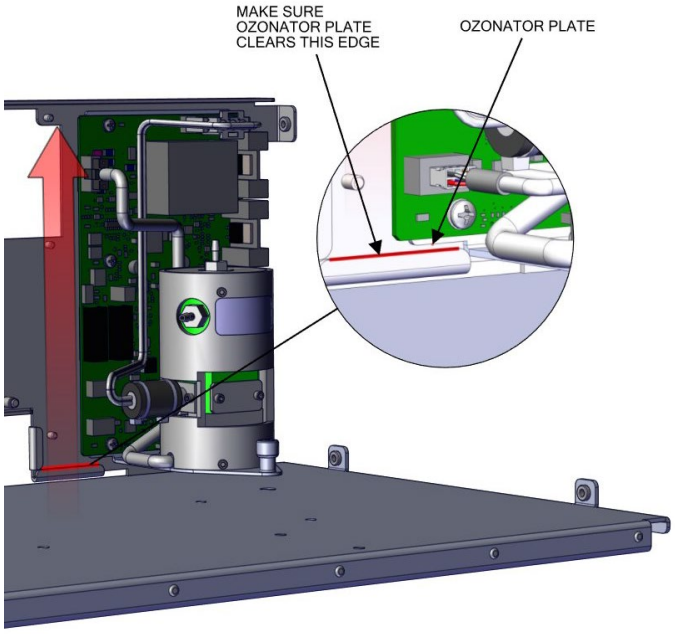


Figure 7–49. Ozone remove pt 3

7. Pull away from the partition panel.

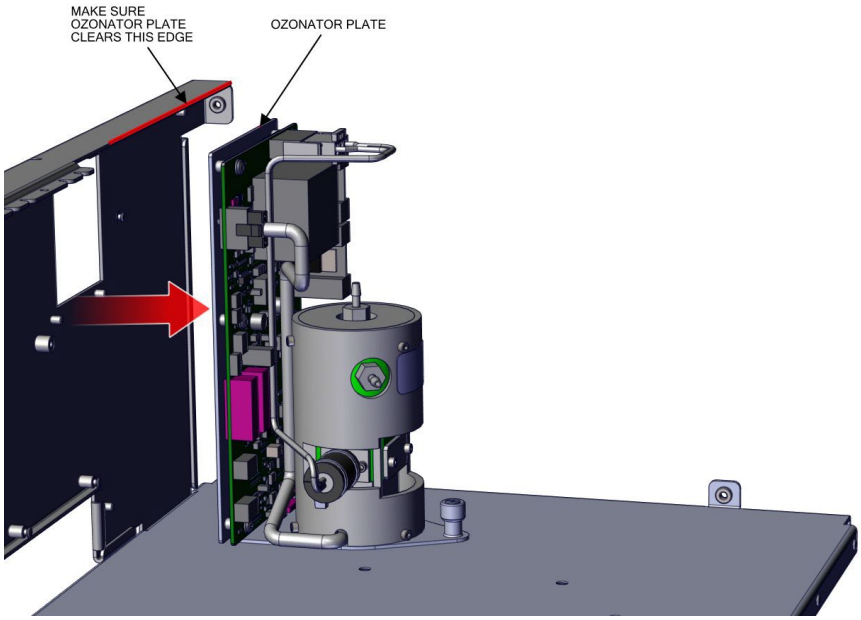


Figure 7–50. Ozone remove pt 4

Lamp Replacement

Use the following to replace the lamp.

Equipment required:

Ball-end hex drive, 3/32

1. Remove the ozonator DMC from the instrument. Refer to "DMC Ozonator Removal" on page 7-41.

2. Using a 3/32 ball-end hex drive (angle alignment of screws), unfasten two #4-40 cap screws.

3. Pull lamp out.

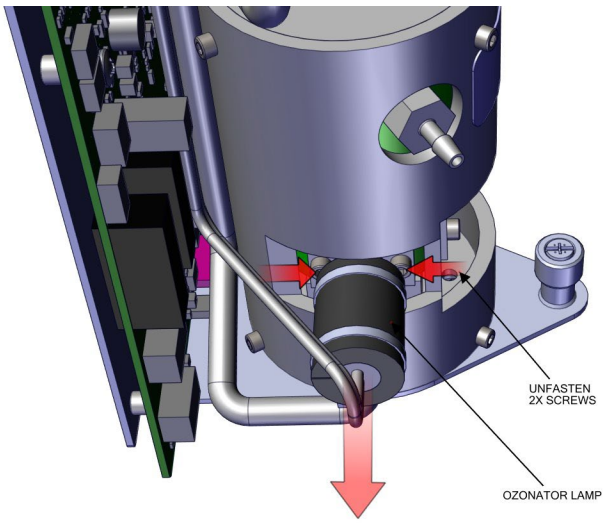


Figure 7–51. Replacing the Lamp

4. Replace lamp and reassemble in reverse order.

Ozonator DMC Board Replacement

Use the following procedure to replace the ozonator DMC board.

Equipment required:

Phillips drive, #2

1. Remove the ozonator DMC from the instrument. Refer to "DMC Ozonator Removal" on page 7-41.

2. Unplug heater and lamp cable.

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

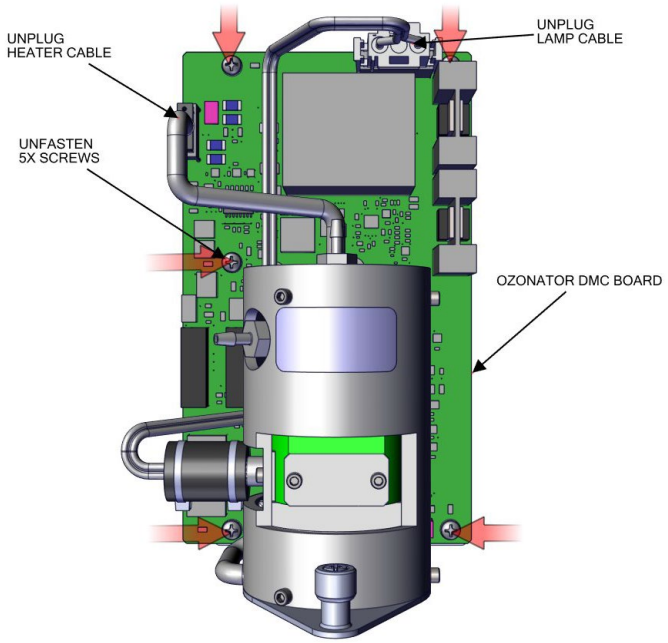


Figure 7–52. Replacing the Ozonator DMC Board

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

Ozonator Replacement

Use the following to replace the ozonator.

Equipment required:

Phillips drive, #2

1. Remove the ozonator DMC from the instrument. Refer to "DMC Ozonator Removal" on page 7-41.

2. Unplug heater and lamp cable.

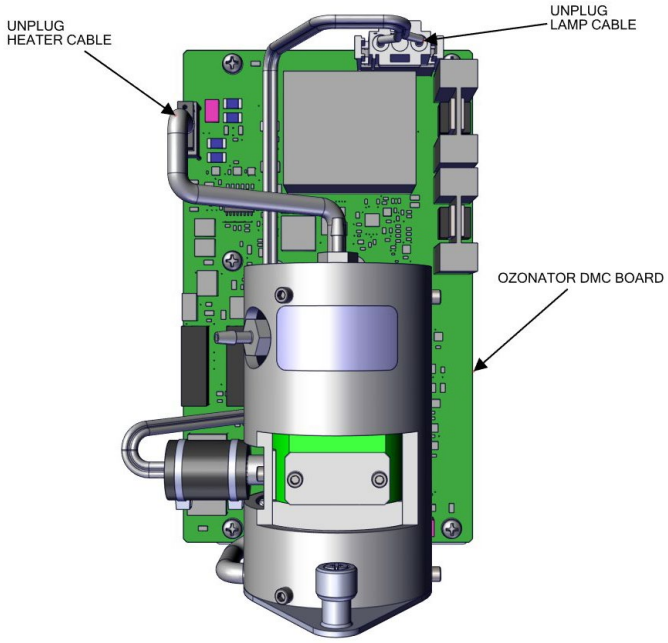


Figure 7–53. Ozonator replace pt 1

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

4. Pull out ozonator

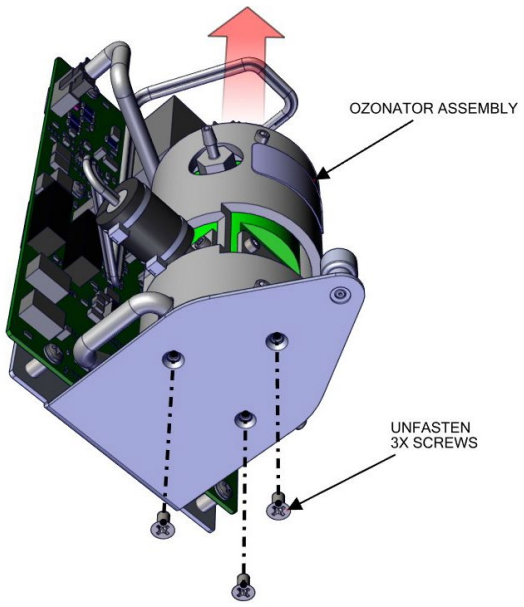


Figure 7–54. Replacing the Ozonator

5. Replace ozonator and reassemble in reverse order.

Ozonator DMC Install

Use the following to install the Ozonator DMC.

Equipment required:

Phillips drive, #2

1. Slide ozonator assembly downwards.

Note Make sure ozonator plate slides into bottom pocket. ▲

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

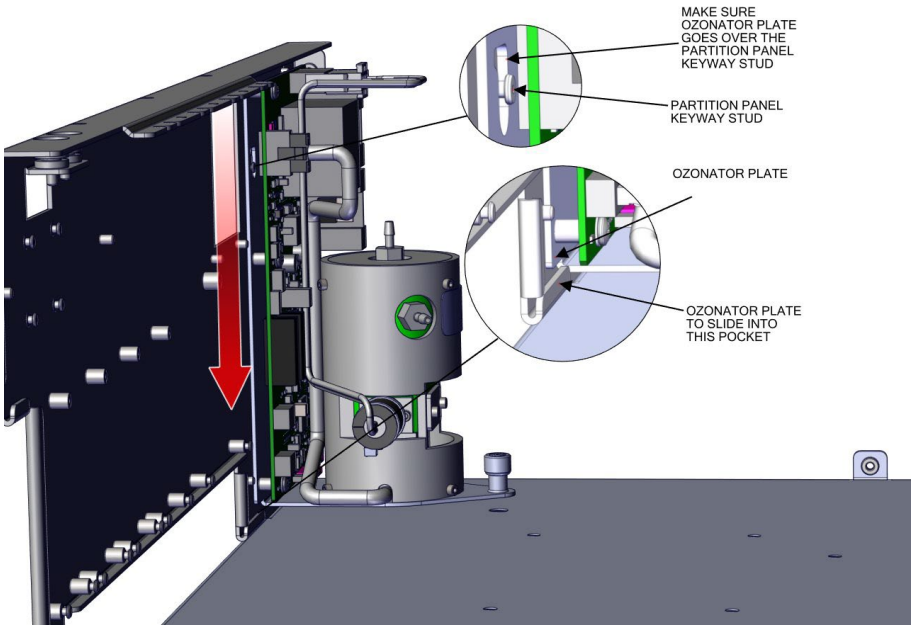


Figure 7–55. Installing the Ozonator DMC

2. Slide ozonator assembly right.

Note Make sure ozonator plate fits under the stud. ▲

Note Make sure ozonator plate slides into side pocket. ▲

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

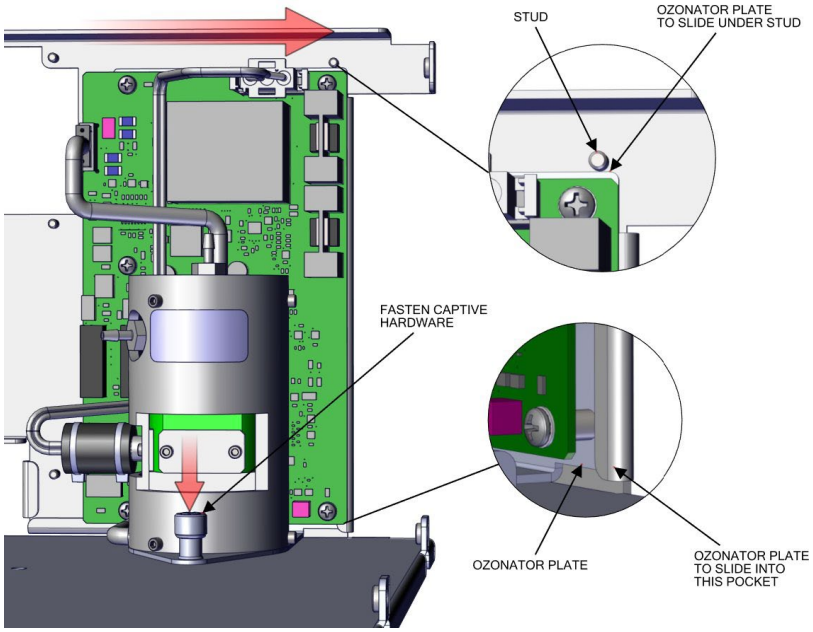


Figure 7–56. Ozone DMC install pt 2

Optional Pressure Regulator Replacement

Use the following procedure to remove and replace the optional pressure regulator.

Equipment required:

Wrench

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

2. Disconnect 2x plumbing.

3. Using a wrench, unfasten regulator nut. Remove as shown.

4. Pull pressure regulator outwards.

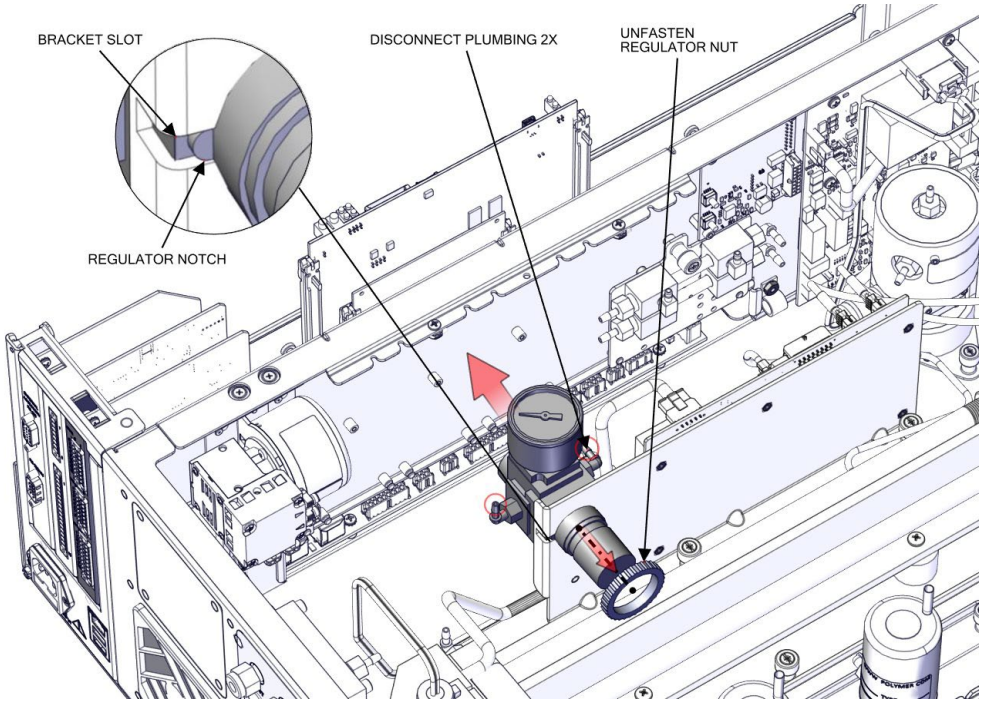


Figure 7–57. Pressure Regulator

Note Make sure regulator notch is in the bracket slot before fastening regulator nut. This will prevent the pressure regulator from rotating. ▲

5. Replace pressure regulator and reassemble in reverse order.

Optional Manifold Replacement

Use the following procedure to replace the manifold.

Equipment required:

Phillips drive, #2

Wrench

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

2. Using a wrench, unfasten three nuts. Remove the nuts, front and back ferrules as shown from back panel (Figure 7–58).

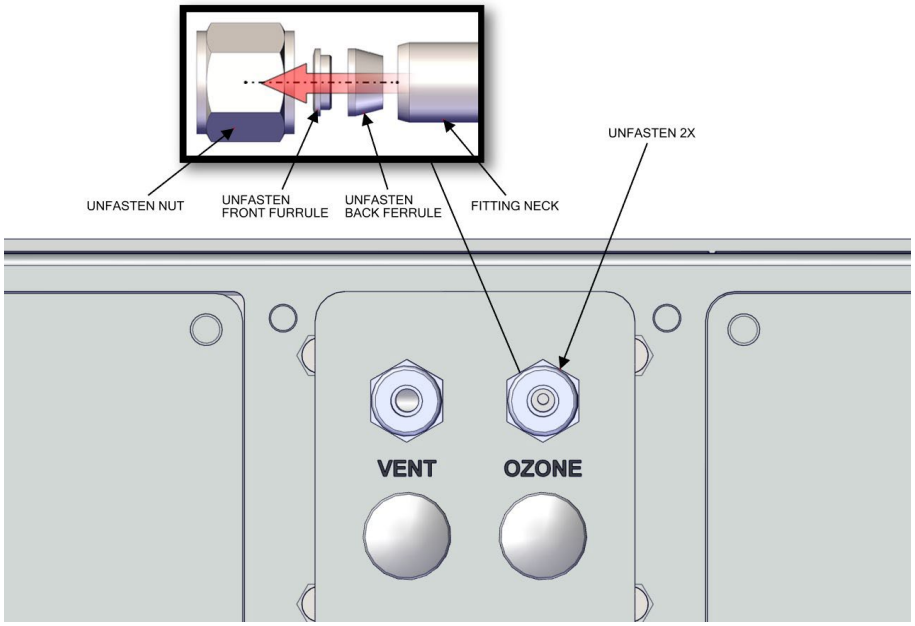


Figure 7–58. Replacing the Manifold pt 1

3. Disconnect tubing.

4. Using a #2 Phillips drive, unfasten four #8-32 socket cap head screws.

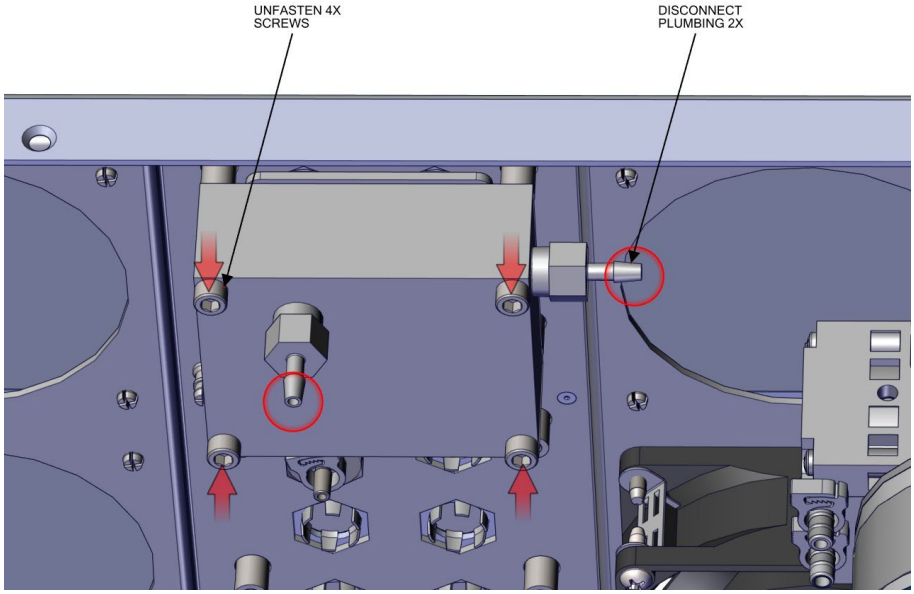


Figure 7–59. Replacing the Manifold pt 3

5. Replace the manifold and assemble in reverse order.

Chapter 8
System Description

The 49iQ 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 49iQ system components include:

- Photometer DMC with lamp
  - Detector assembly
  - Photometer lamp power supply
  - Photometer DMC board
- Ozonator DMC (optional)
  - Ozonator lamp power supply
  - Ozonator DMC board
- Common Electronics
  - Power supply
  - System Control board
  - Backplane board
  - Front panel
  - I/O (optional)
- Peripherals Support System
  - Fan (on rear panel)
  - Step POL board
  - Sample pump
  - Solenoid Sample/Cal Valve (optional)
  - Solenoid Zero/Ozone Valve (optional)
- Flow Pressure DMC with flow restricting capillary

- Ozone Scrubber
- Firmware

Photometer DMC with Lamp

The optical bench has two airtight chambers that contain the sample and reference gases with a common photometer lamp at one end and two individual detectors at the other end.

Detector System

The photo-diode in each detector transmits light intensity information to the DMC board for sample measurement computations.

Photometer Lamp Power Supply

The photometer lamp power supply generates high voltage AC and contains heater control circuits for the photometer lamp.

Ozonator DMC

The optional internal ozonator operates on the photolytic principle. The ozone level produced is a function of light intensity at 185 nm and gas flow. The light intensity is varied by changing the current into the lamp. The gas flow is held constant by a pressure regulator followed by a capillary.

Ozonator Lamp Power Supply

The optional ozonator lamp power supply generates high voltage AC and contains heater control circuits for the ozonator lamp.

Common Electronics

The common electronics contain the core computational and power routing hardware for the 49iQ, and is replicated throughout other iQ series products (Figure 8–1). It also contains front panel display, the USB ports, the Ethernet port, and the optional I/O interfaces (RS-485, analog, and digital).

Figure 8–2 shows the PCBA interconnect structure for the 49iQ, including options. The modular design of the instrument is conveyed in the architecture. Brief descriptions of the specific PCBAs follow.

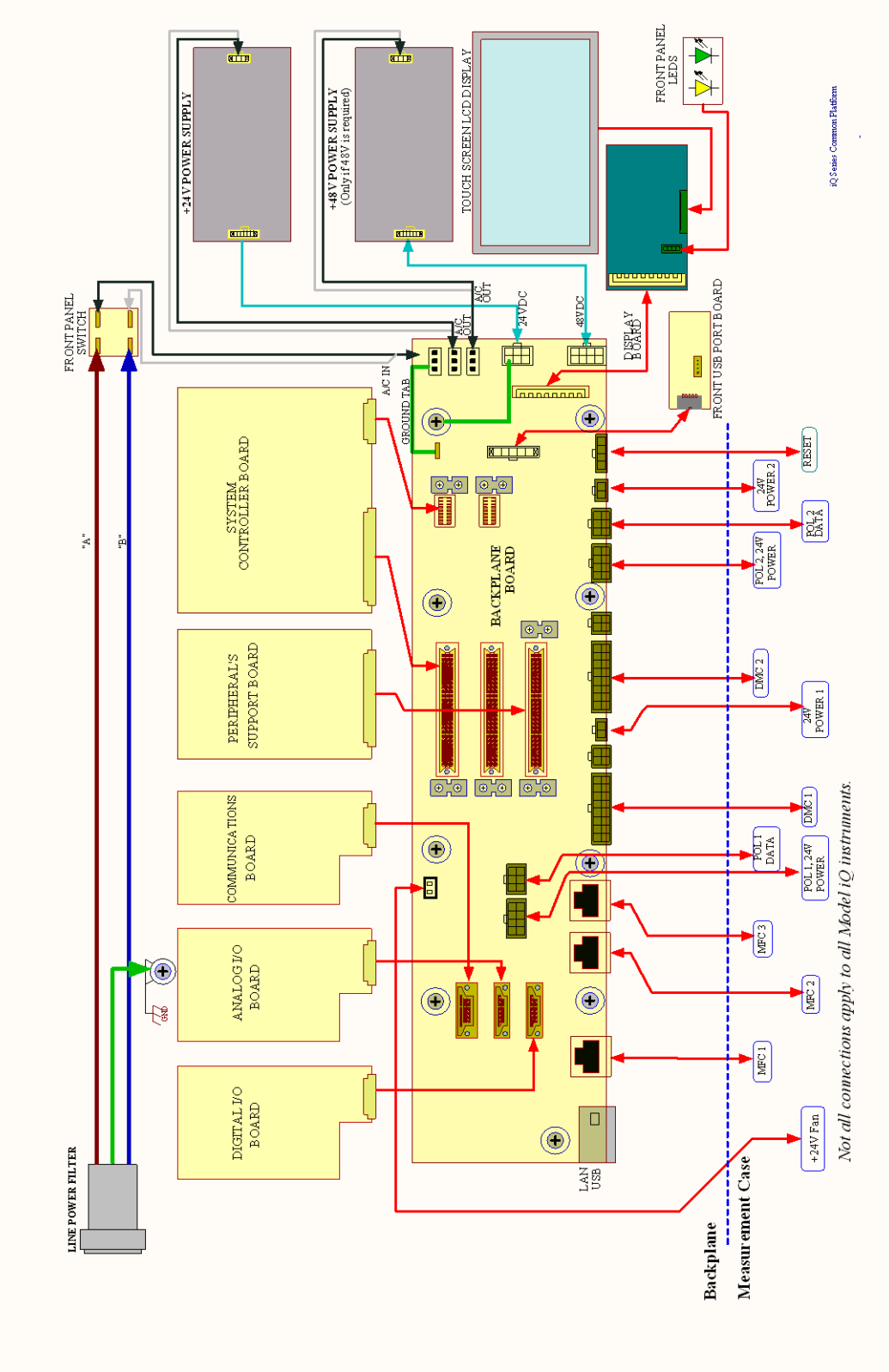


Figure 8–1. Common System Interconnect Diagram

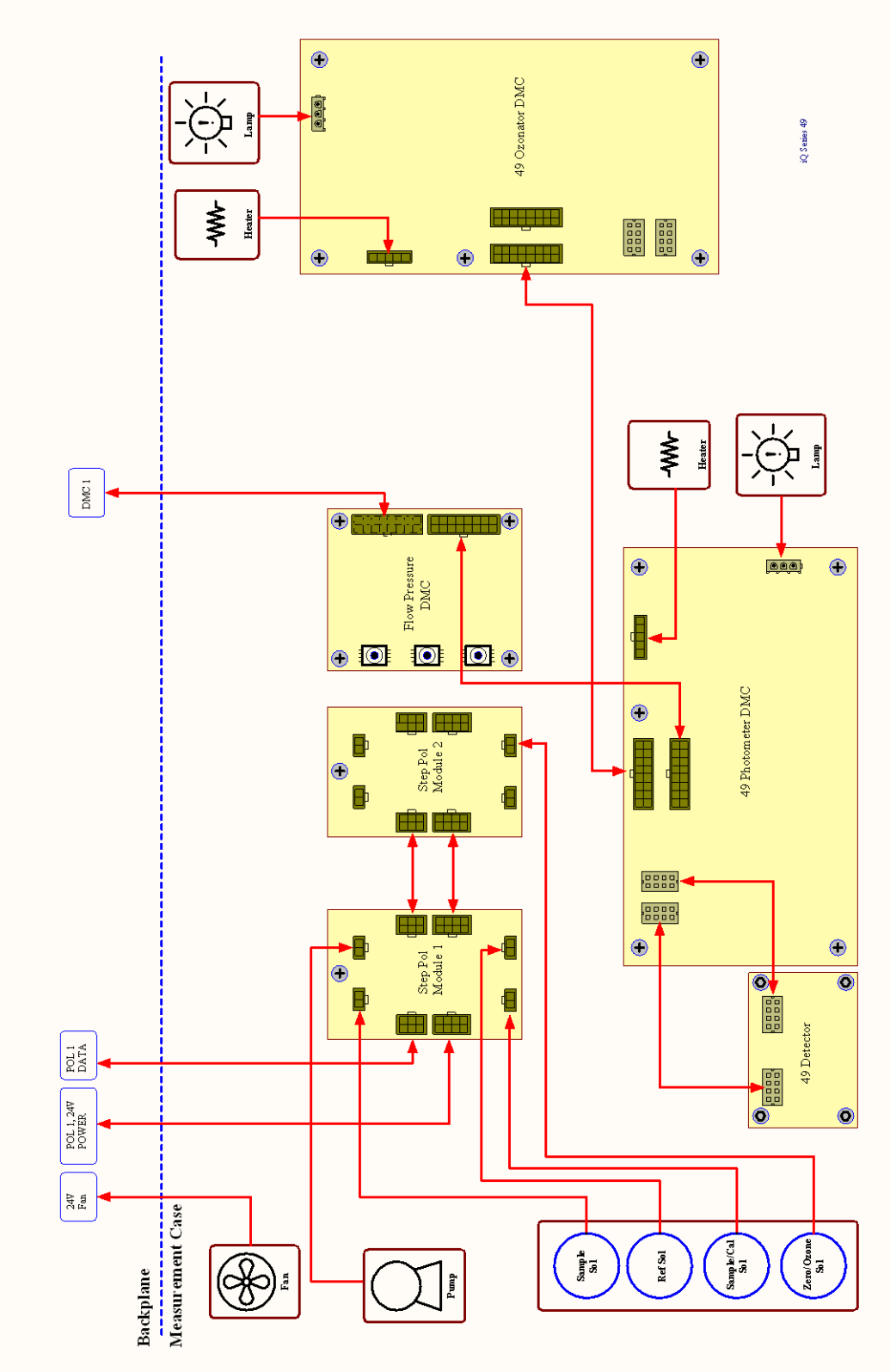


Figure 8–2. 49iQ System Interconnect Diagram

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 49iQ contains a 24 VDC channel for most electronics operation, including the pump and fan, and a 48 VDC channel dedicated specifically for optical bench heating.

System Controller Board

The System Controller Board (SCB) contains the main processor, power supplies, and a sub-processor, and serves as the communication hub for the instrument. The SCB receives operator inputs from the front panel GUI and/or over optional I/O connections on the rear panel. The SCB sends commands to the other boards to control the functions of the instrument and to collect measurement and diagnostic information. The SCB outputs instrument status and measurement data to the GUI, Ethernet/USB, and to the optional rear-panel I/O. The SCB plugs into the backplane via a single connector and has physical retainers to secure placement.

Backplane Board

The backplane board provides the routing and conditioning for +24 VDC (optional +48 VDC) and RS-485 communications within the instrument. It hosts the System Controller Board (SCB) and Peripherals Support Board (PSB) via direct plug ins, and similarly hosts optional I/O (communication, analog, and digital) with rear panel interfaces via direct plug in. It has connections for RS-485 communication with and powering of DMCs and the Step POL Module. It additionally routes the front panel display and driver, external USB and Ethernet.

Front Panel

Front panel electronic components include the touch screen display, the on off switch, and two indicator LEDs for power and alarm status, as described in operational detail in Chapter 2, “Installation and Setup”.

I/O and Communication Components

The iQ series instruments provide a number of methods for communicating the instrument results to the operator or external equipment. Every iQ series instrument includes a front panel display, 3 USB ports, and one Ethernet data port as standard equipment.

In addition, optional RS-232/485, analog I/O, and digital I/O ports are available to provide data to external systems as described in Chapter 9, “Connecting External Devices”. The front panel GUI allows the operator to configure these output communication channels as described in Chapter 3, “Operation”.

Peripherals Support System

The peripheral support system operates 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.

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 49iQ, microprocessors containing firmware are located as follows:

- Photometer DMC
- Ozonator DMC
- Flow/Pressure DMC
- Peripherals Support Board
- Step POL Module
- Optional I/O (Communications, Digital, and Analog)

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

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

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

In addition to the operating registers, the 49iQ 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 49iQ is available with the following options:

Connecting External Devices

Several components are available for connecting external devices. These connection options consist of three plug-in boards:

- Communication Board
- Analog I/O Board
- Digital I/O Board

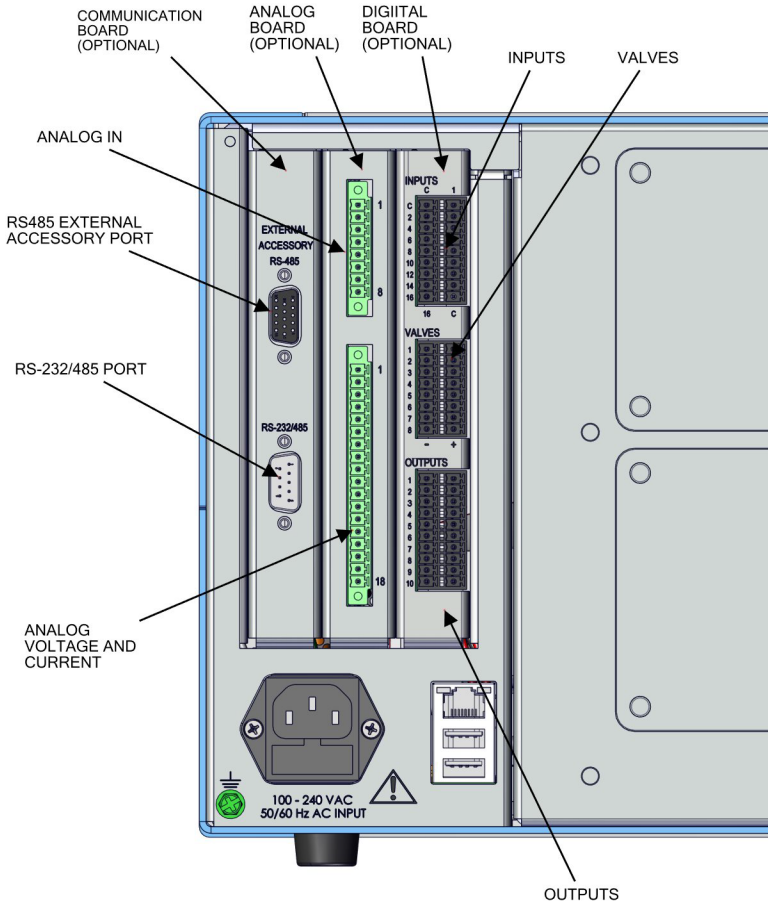


Figure 9–1. I/O Expansion Replacement Boards

Communication Board

The communication board consists of:

- RS-232/485 Port
- RS-485 External Accessory Port

RS-232/RS-485 Port

The RS-232/RS-485 port uses a 9-pin serial connector with a bi-directional serial interface that can be configured for either RS-232 or RS-485 communication.

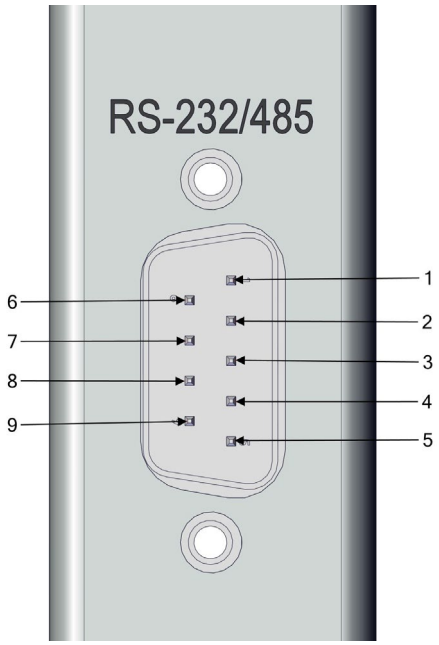


Figure 9–2. RS-232/RS-485 Port

Table 9–1. RS-232/RS-485 Port Terminal Assignment

Terminal Number	Signal Name
1	No Connect
2	RX/RS485_RX_P
3	TX/RS485_TX_N
4	No Connect
5	GND
6	No Connect
7	RTS/RS485_TX_P
8	CTS/RS485_RX_N
9	No Connect

RS-485 External Accessory Port

The RS-485 external accessory port uses a 15-pin serial connector for communication with external smart devices.

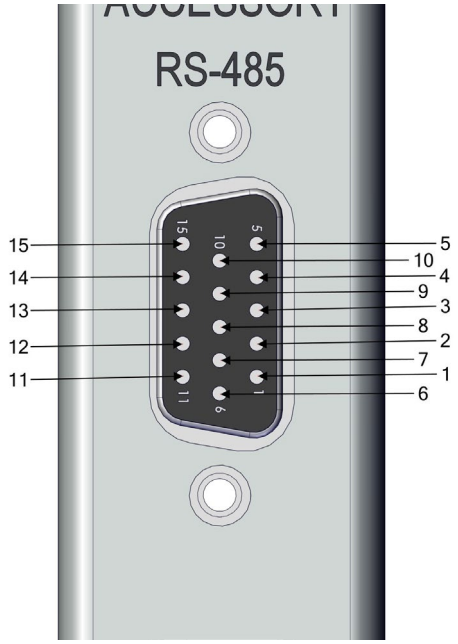


Figure 9–3. RS-485 External Accessory Port

Table 9–2. RS-485 External Accessory Port Terminal Assignment

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

Analog I/O Board

The Analog I/O Board consists of:

- 4 Isolated Analog Voltage Inputs, Input Voltage Range: 0–10 V
- 6 Isolated Analog Voltage Outputs, Three Ranges: 0–1.0 V, 0–5.0 V, 0–10 V
- 6 Isolated Analog Current Outputs, Two Ranges: 0mA–20mA, 4mA–20mA

Analog Voltage Inputs

Table 9–3 lists the analog voltage inputs are used to monitor four external 0–10V signals.

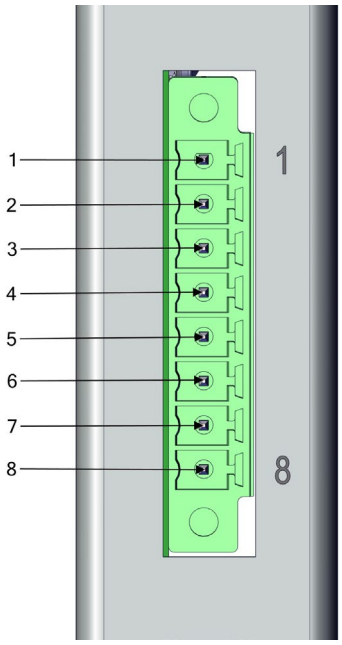


Figure 9–4. Analog Voltage Inputs

Table 9–3. Analog Voltage Inputs Assignment

Terminal Number	Signal Name
1	Analog In 1
2	Analog GND
3	Analog In 2
4	Analog GND
5	Analog In 3
6	Analog GND
7	Analog In 4
8	Analog GND

Analog Voltage Outputs

There are six globally isolated, 16-bit, Analog Output channels, each with a Voltage Output, a Current Output and a common Return (isolated ground). The Analog Outputs are configured through the software control registers to select Voltage Output ranges 0–1 V, 0–5 V or 0–10 V, as well as Current Output ranges 0–20 mA or 4–20 mA. The maximum allowable load for each Current Output is 1000 Ω. All Voltage Outputs and Current Outputs are continuously monitored separately for accuracy.

The Analog Outputs may be used to control and report parameters pertinent to the analyzers' measured functions.

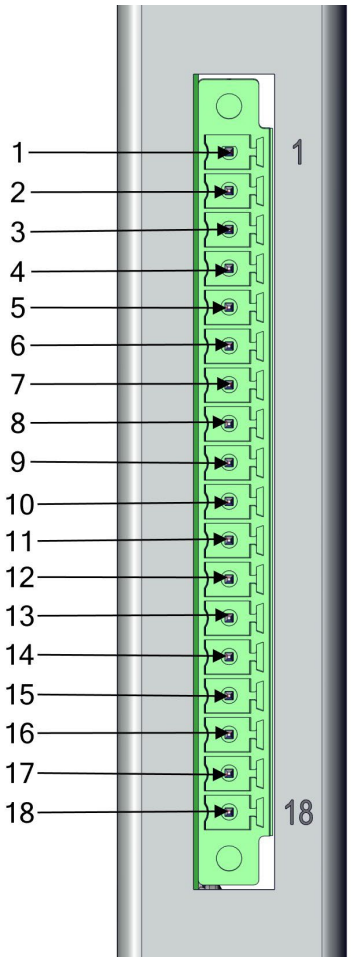


Figure 9–5. Analog Voltage and Current

Table 9–4. Analog Voltage and Current Assignment

Terminal Number	Signal Name
1	Current Out 1
2	Voltage Out 1
3	C/V Return 1
4	Current Out 2
5	Voltage Out 2
6	C/V Return 2
7	Current Out 3
8	Voltage Out 3
9	C/V Return 3
10	Current Out 4
11	Voltage Out 4
12	C/V Return 4
13	Current Out 5
14	Voltage Out 5
15	C/V Return 5
16	Current Out 6
17	Voltage Out 6
18	C/V Return 6

Analog Output Calibration

The iQ series instruments provide for the ability to calibrate the analog outputs (both voltage and current) of the instruments. The basic procedure for both voltage and current are the same using the following procedure:

- Complete the connections of the recording device to the desired analog output channel. (See page 9-5 for the channel information).
- Calibrate the output channel low level.

  Note When calibrating the current output when using the 0-20 mA scale, the low level will be set to 4 mA due to the inability to adjust the actual current output to below zero. ▲

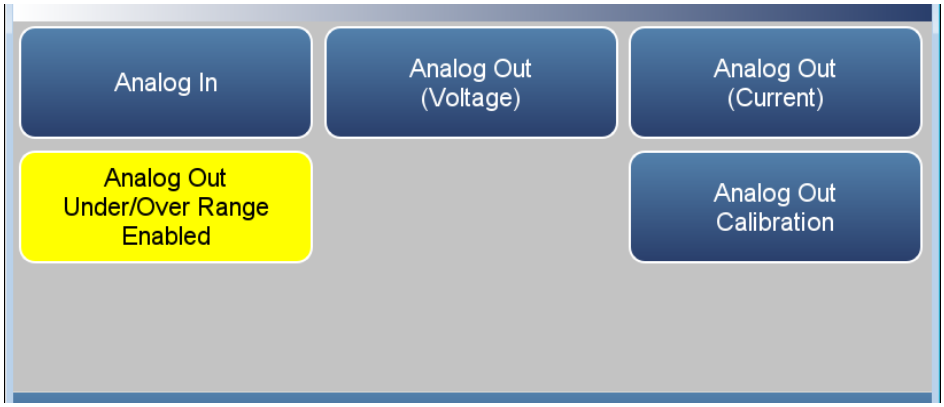
- Calibrate the output channel full scale.

Analog Output Zero Calibration

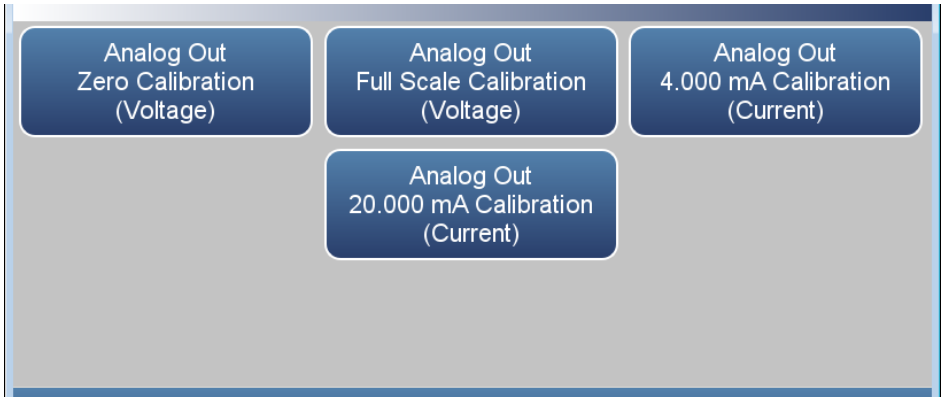
Use the following procedure to calibrate the output channel to low level. This analog output calibration procedure reflects the zero calibration for analog output voltage for demonstration purposes. To calibrate the 4 mA current calibration, follow the same procedure, by selecting the 4 mA current calibration option.

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

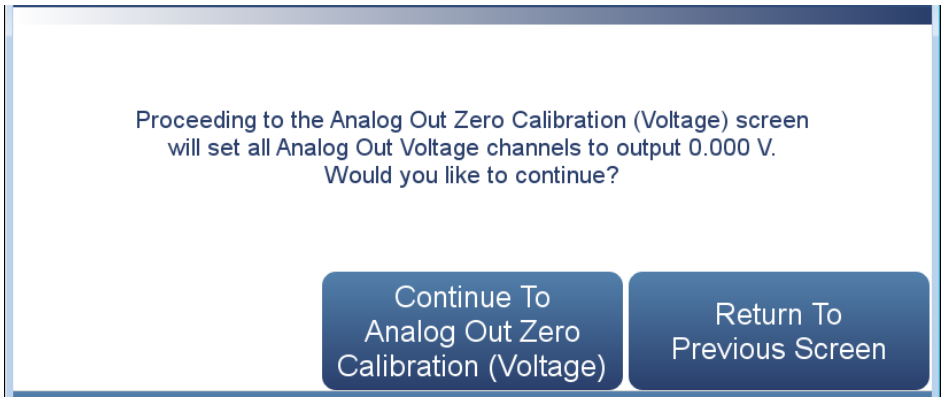
1. From the Home screen, choose **Settings>Communications>Analog I/O>Analog Out Calibration.**



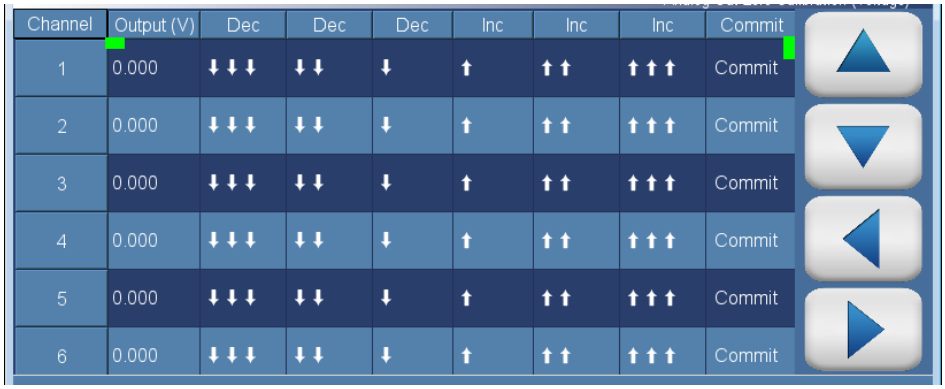
2. Depending on the output type being used, select either Analog Out Zero Calibration (Voltage) or Analog Out 4.000 mA Calibration (Current).



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



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



- *Output (V):* Displays the actual output level at the terminal of the analog output board. For analog voltage, this value will default at zero. For analog current, this value will default at 4 mA.
- *Decrease* ↓↓↓, *Decrease* ↓↓, *and Decrease* ↓*:* Decreases the output by coarse, medium, or fine amounts.
- *Increase* ↑, *Increase* ↑↑, and *Increase* ↑↑↑*:* Increases the output by coarse, medium, or fine amounts.
- *Commit:* Accepts the changes to the analog output levels.

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

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

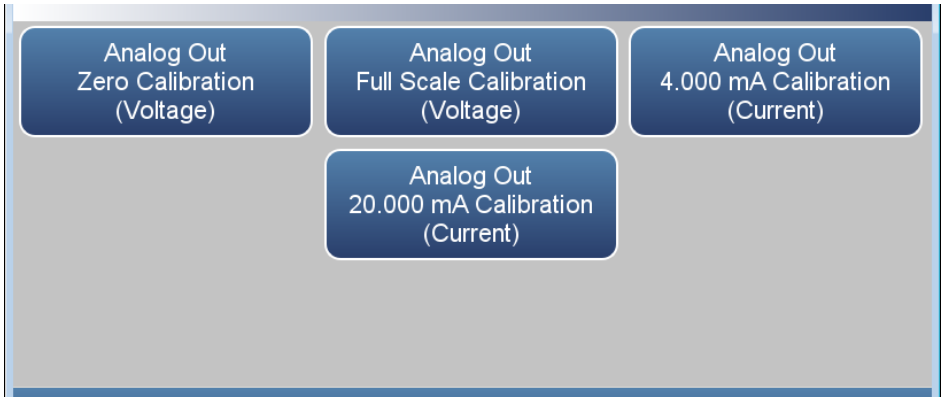
Analog Output Full Scale Calibration

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

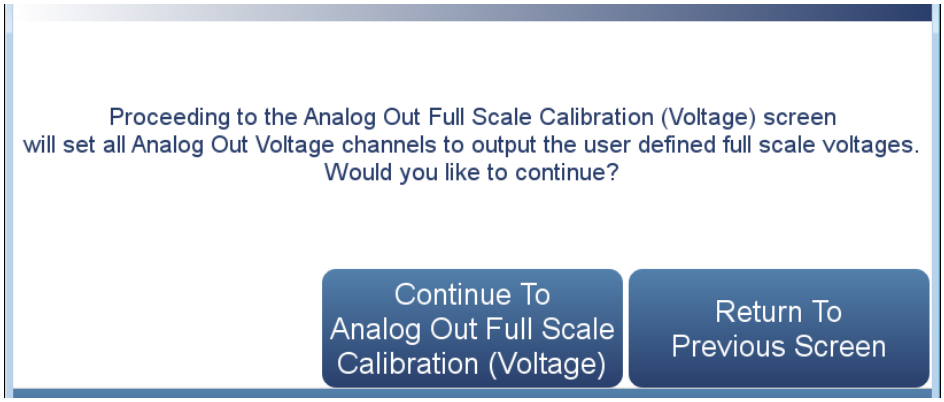
Note This adjustment should only be performed by an instrument service technician. ▲

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

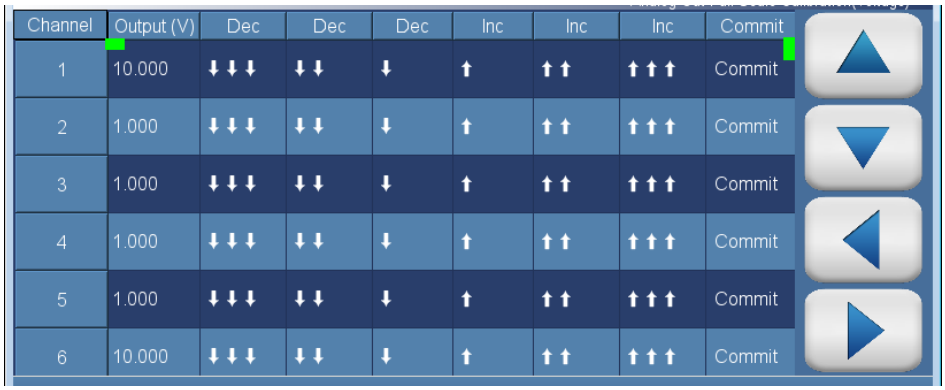
2. Depending on the output type being used, select either Analog Out Full Scale Calibration (Voltage) or Analog Out 20.000 mA Calibration (Current).



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



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



- *Output (V):* Displays the actual output level at the terminal of the analog output board. For analog voltage, this value will default at the setting of the output channel, 1, 5, or 10 V. For analog current, this value will default at 20 mA.
- *Decrease* ↓↓↓, *Decrease* ↓↓, *and Decrease* ↓*:* Decreases the output by coarse, medium, or fine amounts.
- *Increase* ↑*, Increase* ↑↑, and *Increase* ↑↑↑*:* Increases the output by coarse, medium, or fine amounts.
- *Commit:* Accepts the changes to the analog output levels.

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

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

Digital I/O Board

The digital I/O board consists of:

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

Digital Inputs

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

- Logic Low Threshold: 0.8 V
- Logic High Threshold: 2.0 V
- Absolute allowable input voltages: -0.5 to 5.5 V

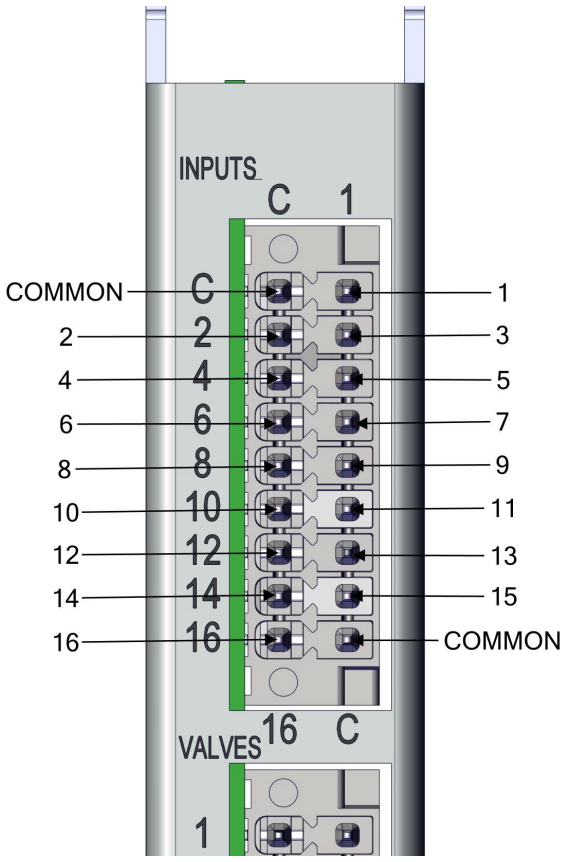


Figure 9–6. Digital Inputs

Table 9–5. Digital Inputs Terminal Assignment

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

Digital Relay Switches

Table 9–6 lists the digital relay switches.

- Maximum Voltage: 300 VDC
- Maximum Current: 500 mA
- Fuse: 800 mA

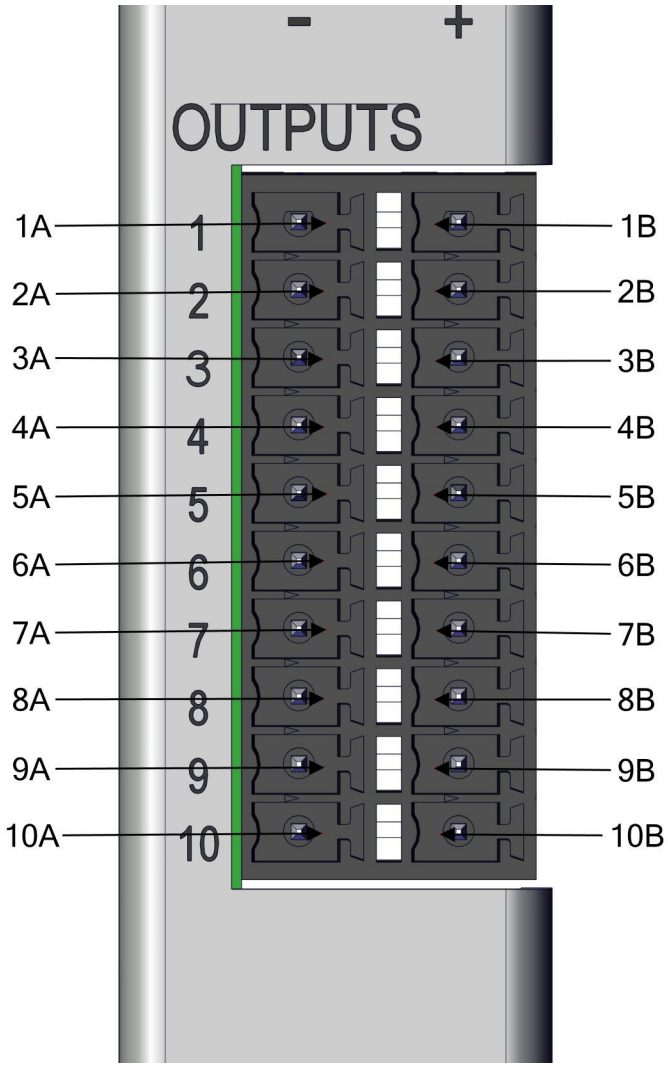


Figure 9–7. Digital Relay Switches

Table 9–6. Digital Relay Switch Assignment

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

Valve Driver Outputs

Table 9–7 lists the valve driver outputs.

- Actual Output Voltage: 22–24 VDC
- Maximum Current: 300 mA per channel, 2A total
- Both positive and negative outputs are protected from over voltage and over current by 500 mA fuses.

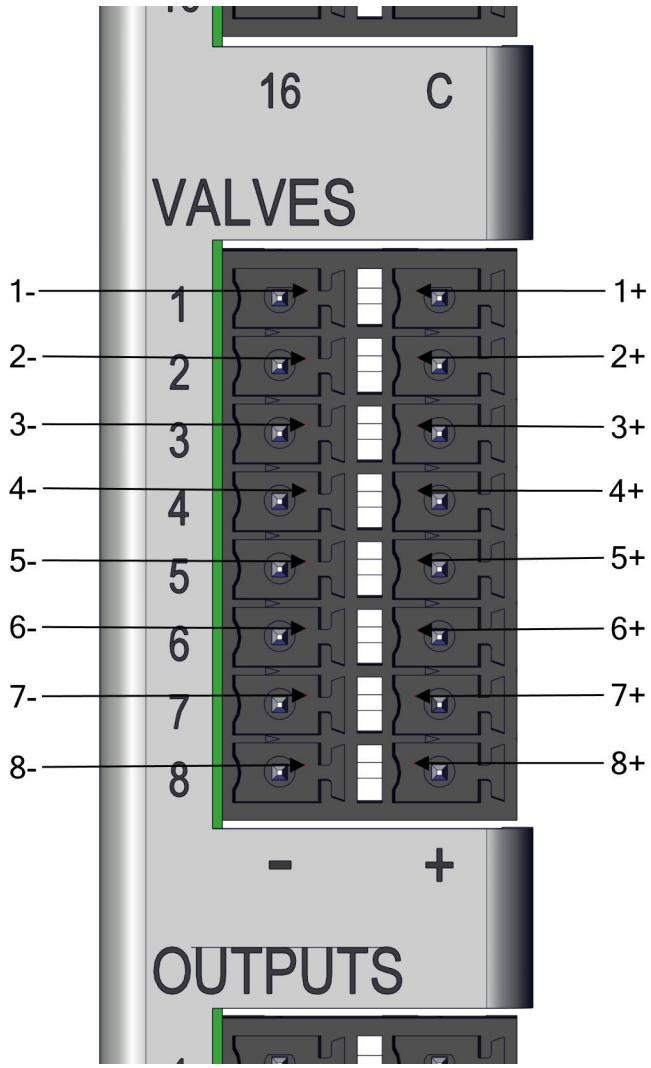


Figure 9–8. Valve Driver Outputs

Table 9–7. Valve Driver Outputs Assignment

Terminal Number	Signal Name
1+	Valve Drive 1+
1-	Valve Drive 1-
2+	Valve Drive 2+
2-	Valve Drive 2-
3+	Valve Drive 3+
3-	Valve Drive 3-
4+	Valve Drive 4+
4-	Valve Drive 4-
5+	Valve Drive 5+
5-	Valve Drive 5-
6+	Valve Drive 6+
6-	Valve Drive 6-
7+	Valve Drive 7+
7-	Valve Drive 7-
8+	Valve Drive 8+
8-	Valve Drive 8-

Note Intended for 24 V valves. These outputs will also drive any DC load of 22–24 VDC, up to 300 mA. ▲

Ozonator

The internal ozone generator provides easy determination of zero, precision, and Level 1 span checks. The ozone level produced is a function of light intensity at 185 nm and gas flow. The light intensity is varied by changing the current into the lamp. The gas flow is held constant by a pressure regulator followed by a capillary.

Zero Air Source

The zero air source option is a convenient system for generating pollutant free zero gas for O_3 monitoring requirements. This option includes the pump, filter, filter holder, and Silastic tubing.

PTFE Particulate Filter

A 5-10 micron pore size, two-inch diameter PTFE element is available for the 49iQ. 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.

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.

Notwithstanding the foregoing, Products supplied by Seller that are obtained by Seller from an original manufacturer or third party supplier are not warranted by Seller, but Seller agrees to assign to Buyer any warranty rights in such Product that Seller may have from the original manufacturer or third party supplier, to the extent such assignment is allowed by such original manufacturer or third party supplier.

In no event shall Seller have any obligation to make repairs, replacements or corrections required, in whole or in part, as the result of (i) normal wear and tear, (ii) accident, disaster or event of force majeure, (iii) misuse, fault or negligence of or by Buyer, (iv) use of the Products in a manner for which they were not designed, (v) causes external to the Products such as, but not limited to, power failure or electrical power surges, (vi) improper storage and handling of the Products or (vii) use of the Products in combination with equipment or software not supplied by Seller. If Seller determines that Products for which Buyer has requested warranty services are not covered by the warranty hereunder, Buyer shall pay or reimburse Seller for all costs of investigating and responding to such request at Seller's then

prevailing time and materials rates. If Seller provides repair services or replacement parts that are not covered by the warranty provided in this warranty, Buyer shall pay Seller therefor at Seller's then prevailing time and materials rates. ANY INSTALLATION, MAINTENANCE, REPAIR, SERVICE, RELOCATION OR ALTERATION TO OR OF, OR OTHER TAMPERING WITH, THE PRODUCTS PERFORMED BY ANY PERSON OR ENTITY OTHER THAN SELLER WITHOUT SELLER'S PRIOR WRITTEN APPROVAL, OR ANY USE OF REPLACEMENT PARTS NOT SUPPLIED BY SELLER, SHALL IMMEDIATELY VOID AND CANCEL ALL WARRANTIES WITH RESPECT TO THE AFFECTED PRODUCTS.

THE OBLIGATIONS CREATED BY THIS WARRANTY STATEMENT TO REPAIR OR REPLACE A DEFECTIVE PRODUCT SHALL BE THE SOLE REMEDY OF BUYER IN THE EVENT OF A DEFECTIVE PRODUCT. EXCEPT AS EXPRESSLY PROVIDED IN THIS WARRANTY STATEMENT, SELLER DISCLAIMS ALL OTHER WARRANTIES, WHETHER EXPRESS OR IMPLIED, ORAL OR WRITTEN, WITH RESPECT TO THE PRODUCTS, INCLUDING WITHOUT LIMITATION ALL IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR ANY PARTICULAR PURPOSE. SELLER DOES NOT WARRANT THAT THE PRODUCTS ARE ERROR-FREE OR WILL ACCOMPLISH ANY PARTICULAR RESULT.

WEEE Compliance

This product is required to comply with the European Union's Waste Electrical & Electronic Equipment (WEEE) Directive 2002/96/EC. It is marked with the following symbol:

Thermo Fisher Scientific has contracted with one or more recycling/disposal companies in each EU Member State, and this product should be disposed of or recycled through them. Further information on Thermo Fisher Scientific's compliance with these Directives, the recyclers in your country, and information on Thermo Fisher Scientific products which may assist the detection of substances subject to the RoHS Directive are available at: www.thermoscientific.com/WEEERoHS.

WEEE Symbol

The following symbol and description identify the WEEE marking used on the instrument and in the associated documentation.

Symbol	Description
	Marking of electrical and electronic equipment which applies to electrical and electronic equipment falling under the Directive 2002/96/EC (WEEE) and the equipment that has been put on the market after 13 August 2005. ▲

Appendix B
Quick Reference

List of Figures

List of Tables

Appendix C
GNU Lesser General Public License

Version 2.1, February 1999

51 Franklin Street, Fifth Floor, Boston, MA 02110-1301 USA

BECAUSE THE LIBRARY IS LICENSED FREE OF CHARGE, THERE IS NO WARRANTY FOR THE LIBRARY, TO THE EXTENT PERMITTED BY APPLICABLE LAW.

The Open Source code used in the development of this product will be provided for a period of 3-years from date of purchase to the original purchaser provided they supply Thermo Fisher Scientific with the applicable serial number for the product the Open Source code is being requested for.

[This is the first released version of the Lesser GPL. It also counts as the successor of the GNU Library Public License, version 2, hence the version number 2.1.]

Preamble

The licenses for most software are designed to take away your freedom to share and change it. By contrast, the GNU General Public Licenses are intended to guarantee your freedom to share and change free software--to make sure the software is free for all its users.

This license, the Lesser General Public License, applies to some specially designated software packages--typically libraries--of the Free Software Foundation and other authors who decide to use it. You can use it too, but we suggest you first think carefully about whether this license or the ordinary General Public License is the better strategy to use in any particular case, based on the explanations below.

When we speak of free software, we are referring to freedom of use, not price. Our General Public Licenses are designed to make sure that you have the freedom to distribute copies of free software (and charge for this service if you wish); that you receive source code or can get it if you want it;

that you can change the software and use pieces of it in new free programs; and that you are informed that you can do these things.

To protect your rights, we need to make restrictions that forbid distributors to deny you these rights or to ask you to surrender these rights. These restrictions translate to certain responsibilities for you if you distribute copies of the library or if you modify it.

For example, if you distribute copies of the library, whether gratis or for a fee, you must give the recipients all the rights that we gave you. You must make sure that they, too, receive or can get the source code. If you link other code with the library, you must provide complete object files to the recipients, so that they can relink them with the library after making changes to the library and recompiling it. And you must show them these terms so they know their rights.

We protect your rights with a two-step method: (1) we copyright the library, and (2) we offer you this license, which gives you legal permission to copy, distribute and/or modify the library.

To protect each distributor, we want to make it very clear that there is no warranty for the free library. Also, if the library is modified by someone else and passed on, the recipients should know that what they have is not the original version, so that the original author's reputation will not be affected by problems that might be introduced by others.

Finally, software patents pose a constant threat to the existence of any free program. We wish to make sure that a company cannot effectively restrict the users of a free program by obtaining a restrictive license from a patent holder. Therefore, we insist that any patent license obtained for a version of the library must be consistent with the full freedom of use specified in this license.

Most GNU software, including some libraries, is covered by the ordinary GNU General Public License. This license, the GNU Lesser General Public License, applies to certain designated libraries, and is quite different from the ordinary General Public License. We use this license for certain libraries in order to permit linking those libraries into non-free programs.

When a program is linked with a library, whether statically or using a shared library, the combination of the two is legally speaking a combined work, a derivative of the original library. The ordinary General Public License therefore permits such linking only if the entire combination fits its criteria of freedom. The Lesser General Public License permits more lax criteria for linking other code with the library.

We call this license the "Lesser" General Public License because it does Less to protect the user's freedom than the ordinary General Public License. It also provides other free software developers Less of an advantage over competing non-free programs. These disadvantages are the reason we use

the ordinary General Public License for many libraries. However, the Lesser license provides advantages in certain special circumstances.

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

In other cases, permission to use a particular library in non-free programs enables a greater number of people to use a large body of free software. For example, permission to use the GNU C Library in non-free programs enables many more people to use the whole GNU operating system, as well as its variant, the GNU/Linux operating system.

Although the Lesser General Public License is Less protective of the users' freedom, it does ensure that the user of a program that is linked with the Library has the freedom and the wherewithal to run that program using a modified version of the Library.

The precise terms and conditions for copying, distribution and modification follow. Pay close attention to the difference between a "work based on the library" and a "work that uses the library". The former contains code derived from the library, whereas the latter must be combined with the library in order to run.

GNU LESSER GENERAL PUBLIC LICENSE TERMS AND CONDITIONS FOR COPYING, DISTRIBUTION AND MODIFICATION

0. This License Agreement applies to any software library or other program which contains a notice placed by the copyright holder or other authorized party saying it may be distributed under the terms of this Lesser General Public License (also called "this License"). Each licensee is addressed as "you".

A "library" means a collection of software functions and/or data prepared so as to be conveniently linked with application programs (which use some of those functions and data) to form executables.

The "Library", below, refers to any such software library or work which has been distributed under these terms. A "work based on the Library" means either the Library or any derivative work under copyright law: that is to say, a work containing the Library or a portion of it, either verbatim or with modifications and/or translated straightforwardly into another language. (Hereinafter, translation is included without limitation in the term "modification".)

"Source code" for a work means the preferred form of the work for making modifications to it. For a library, complete source code means all the source code for all modules it contains, plus any associated interface definition files, plus the scripts used to control compilation and installation of the library.

Activities other than copying, distribution and modification are not covered by this License; they are outside its scope. The act of running a program using the Library is not restricted, and output from such a program is covered only if its contents constitute a work based on the Library (independent of the use of the Library in a tool for writing it). Whether that is true depends on what the Library does and what the program that uses the Library does.

1. You may copy and distribute verbatim copies of the Library's complete source code as you receive it, in any medium, provided that you conspicuously and appropriately publish on each copy an appropriate copyright notice and disclaimer of warranty; keep intact all the notices that refer to this License and to the absence of any warranty; and distribute a copy of this License along with the Library.

You may charge a fee for the physical act of transferring a copy, and you may at your option offer warranty protection in exchange for a fee.

2. You may modify your copy or copies of the Library or any portion of it, thus forming a work based on the Library, and copy and distribute such modifications or work under the terms of Section 1 above, provided that you also meet all of these conditions:

a) The modified work must itself be a software library.

b) You must cause the files modified to carry prominent notices stating that you changed the files and the date of any change.

c) You must cause the whole of the work to be licensed at no charge to all third parties under the terms of this License.

d) If a facility in the modified Library refers to a function or a table of data to be supplied by an application program that uses the facility, other than as an argument passed when the facility is invoked, then you must make a good faith effort to ensure that, in the event an application does not supply such function or table, the facility still operates, and performs whatever part of its purpose remains meaningful.

(For example, a function in a library to compute square roots has a purpose that is entirely well-defined independent of the application. Therefore, Subsection 2d requires that any application-supplied function or table used by this function must be optional: if the application does not supply it, the square root function must still compute square roots.)

These requirements apply to the modified work as a whole. If identifiable sections of that work are not derived from the Library, and can be reasonably considered independent and separate works in themselves, then this License, and its terms, do not apply to those sections when you distribute them as separate works. But when you distribute the same sections as part of a whole which is a work based on the Library, the distribution of the whole must be on the terms of this License, whose permissions for other licensees extend to the entire whole, and thus to each and every part regardless of who wrote it.

Thus, it is not the intent of this section to claim rights or contest your rights to work written entirely by you; rather, the intent is to exercise the right to control the distribution of derivative or collective works based on the Library.

In addition, mere aggregation of another work not based on the Library with the Library (or with a work based on the Library) on a volume of a storage or distribution medium does not bring the other work under the scope of this License.

3. You may opt to apply the terms of the ordinary GNU General Public License instead of this License to a given copy of the Library. To do this, you must alter all the notices that refer to this License, so that they refer to the ordinary GNU General Public License, version 2, instead of to this License. (If a newer version than version 2 of the ordinary GNU General Public License has appeared, then you can specify that version instead if you wish.) Do not make any other change in these notices.

Once this change is made in a given copy, it is irreversible for that copy, so the ordinary GNU General Public License applies to all subsequent copies and derivative works made from that copy. This option is useful when you wish to copy part of the code of the Library into a program that is not a library.

4. You may copy and distribute the Library (or a portion or derivative of it, under Section 2) in object code or executable form under the terms of Sections 1 and 2 above provided that you accompany it with the complete corresponding machine-readable source code, which must be distributed under the terms of Sections 1 and 2 above on a medium customarily used for software interchange.

If distribution of object code is made by offering access to copy from a designated place, then offering equivalent access to copy the source code from the same place satisfies the requirement to distribute the source code, even though third parties are not compelled to copy the source along with the object code.

5. A program that contains no derivative of any portion of the Library, but is designed to work with the Library by being compiled or linked with it, is

called a "work that uses the Library". Such a work, in isolation, is not a derivative work of the Library, and therefore falls outside the scope of this License.

However, linking a "work that uses the Library" with the Library creates an executable that is a derivative of the Library (because it contains portions of the Library), rather than a "work that uses the library". The executable is therefore covered by this License. Section 6 states terms for distribution of such executables.

When a "work that uses the Library" uses material from a header file that is part of the Library, the object code for the work may be a derivative work of the Library even though the source code is not. Whether this is true is especially significant if the work can be linked without the Library, or if the work is itself a library. The threshold for this to be true is not precisely defined by law.

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

Otherwise, if the work is a derivative of the Library, you may distribute the object code for the work under the terms of Section 6. Any executables containing that work also fall under Section 6, whether or not they are linked directly with the Library itself.

6. As an exception to the Sections above, you may also combine or link a "work that uses the Library" with the Library to produce a work containing portions of the Library, and distribute that work under terms of your choice, provided that the terms permit modification of the work for the customer's own use and reverse engineering for debugging such modifications.

You must give prominent notice with each copy of the work that the Library is used in it and that the Library and its use are covered by this License. You must supply a copy of this License. If the work during execution displays copyright notices, you must include the copyright notice for the Library among them, as well as a reference directing the user to the copy of this License. Also, you must do one of these things:

a) Accompany the work with the complete corresponding machine-readable source code for the Library including whatever changes were used in the work (which must be distributed under Sections 1 and 2 above); and, if the work is an executable linked with the Library, with the complete machine-readable "work that uses the Library", as object code and/or source code, so that the user can modify the Library and then relink to produce a modified executable containing the modified Library. (It is

understood that the user who changes the contents of definitions files in the Library will not necessarily be able to recompile the application to use the modified definitions.)

b) Use a suitable shared library mechanism for linking with the Library. A suitable mechanism is one that (1) uses at run time a copy of the library already present on the user's computer system, rather than copying library functions into the executable, and (2) will operate properly with a modified version of the library, if the user installs one, as long as the modified version is interface-compatible with the version that the work was made with.

c) Accompany the work with a written offer, valid for at least three years, to give the same user the materials specified in Subsection 6a, above, for a charge no more than the cost of performing this distribution.

d) If distribution of the work is made by offering access to copy from a designated place, offer equivalent access to copy the above specified materials from the same place.

e) Verify that the user has already received a copy of these materials or that you have already sent this user a copy.

For an executable, the required form of the "work that uses the Library" must include any data and utility programs needed for reproducing the executable from it. However, as a special exception, the materials to be distributed need not include anything that is normally distributed (in either source or binary form) with the major components (compiler, kernel, and so on) of the operating system on which the executable runs, unless that component itself accompanies the executable.

It may happen that this requirement contradicts the license restrictions of other proprietary libraries that do not normally accompany the operating system. Such a contradiction means you cannot use both them and the Library together in an executable that you distribute.

7. You may place library facilities that are a work based on the Library side-by-side in a single library together with other library facilities not covered by this License, and distribute such a combined library, provided that the separate distribution of the work based on the Library and of the other library facilities is otherwise permitted, and provided that you do these two things:

a) Accompany the combined library with a copy of the same work based on the Library, uncombined with any other library facilities. This must be distributed under the terms of the Sections above.

b) Give prominent notice with the combined library of the fact that part of it is a work based on the Library, and explaining where to find the accompanying uncombined form of the same work.

8. You may not copy, modify, sublicense, link with, or distribute the Library except as expressly provided under this License. Any attempt otherwise to copy, modify, sublicense, link with, or distribute the Library is void, and will automatically terminate your rights under this License. However, parties who have received copies, or rights, from you under this License will not have their licenses terminated so long as such parties remain in full compliance.

9. You are not required to accept this License, since you have not signed it. However, nothing else grants you permission to modify or distribute the Library or its derivative works. These actions are prohibited by law if you do not accept this License. Therefore, by modifying or distributing the Library (or any work based on the Library), you indicate your acceptance of this License to do so, and all its terms and conditions for copying, distributing or modifying the Library or works based on it.

10. Each time you redistribute the Library (or any work based on the Library), the recipient automatically receives a license from the original licensor to copy, distribute, link with or modify the Library subject to these terms and conditions. You may not impose any further restrictions on the recipients' exercise of the rights granted herein. You are not responsible for enforcing compliance by third parties with this License.

11. If, as a consequence of a court judgment or allegation of patent infringement or for any other reason (not limited to patent issues), conditions are imposed on you (whether by court order, agreement or otherwise) that contradict the conditions of this License, they do not excuse you from the conditions of this License. If you cannot distribute so as to satisfy simultaneously your obligations under this License and any other pertinent obligations, then as a consequence you may not distribute the Library at all. For example, if a patent license would not permit royalty-free redistribution of the Library by all those who receive copies directly or indirectly through you, then the only way you could satisfy both it and this License would be to refrain entirely from distribution of the Library.

If any portion of this section is held invalid or unenforceable under any particular circumstance, the balance of the section is intended to apply, and the section as a whole is intended to apply in other circumstances.

It is not the purpose of this section to induce you to infringe any patents or other property right claims or to contest validity of any such claims; this section has the sole purpose of protecting the integrity of the free software distribution system which is implemented by public license practices. Many people have made generous contributions to the wide range of software distributed through that system in reliance on consistent application of that system; it is up to the author/donor to decide if he or she is willing to distribute software through any other system and a licensee cannot impose that choice.

This section is intended to make thoroughly clear what is believed to be a consequence of the rest of this License.

12. If the distribution and/or use of the Library is restricted in certain countries either by patents or by copyrighted interfaces, the original copyright holder who places the Library under this License may add an explicit geographical distribution limitation excluding those countries, so that distribution is permitted only in or among countries not thus excluded. In such case, this License incorporates the limitation as if written in the body of this License.

13. The Free Software Foundation may publish revised and/or new versions of the Lesser General Public License from time to time. Such new versions will be similar in spirit to the present version, but may differ in detail to address new problems or concerns.

Each version is given a distinguishing version number. If the Library specifies a version number of this License which applies to it and "any later version", you have the option of following the terms and conditions either of that version or of any later version published by the Free Software Foundation. If the Library does not specify a license version number, you may choose any version ever published by the Free Software Foundation.

14. If you wish to incorporate parts of the Library into other free programs whose distribution conditions are incompatible with these, write to the author to ask for permission. For software which is copyrighted by the Free Software Foundation, write to the Free Software Foundation; we sometimes make exceptions for this. Our decision will be guided by the two goals of preserving the free status of all derivatives of our free software and of promoting the sharing and reuse of software generally.

NO WARRANTY

15. BECAUSE THE LIBRARY IS LICENSED FREE OF CHARGE, THERE IS NO WARRANTY FOR THE LIBRARY, TO THE EXTENT PERMITTED BY APPLICABLE LAW. EXCEPT WHEN OTHERWISE STATED IN WRITING THE COPYRIGHT HOLDERS AND/OR OTHER PARTIES PROVIDE THE LIBRARY "AS IS" WITHOUT WARRANTY OF ANY KIND, EITHER EXPRESSED OR IMPLIED, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. THE ENTIRE RISK AS TO THE QUALITY AND PERFORMANCE OF THE LIBRARY IS WITH YOU. SHOULD THE LIBRARY PROVE DEFECTIVE, YOU ASSUME THE COST OF ALL NECESSARY SERVICING, REPAIR OR CORRECTION.

16. IN NO EVENT UNLESS REQUIRED BY APPLICABLE LAW OR AGREED TO IN WRITING WILL ANY COPYRIGHT HOLDER, OR

ANY OTHER PARTY WHO MAY MODIFY AND/OR REDISTRIBUTE THE LIBRARY AS PERMITTED ABOVE, BE LIABLE TO YOU FOR DAMAGES, INCLUDING ANY GENERAL, SPECIAL, INCIDENTAL OR CONSEQUENTIAL DAMAGES ARISING OUT OF THE USE OR INABILITY TO USE THE LIBRARY (INCLUDING BUT NOT LIMITED TO LOSS OF DATA OR DATA BEING RENDERED INACCURATE OR LOSSES SUSTAINED BY YOU OR THIRD PARTIES OR A FAILURE OF THE LIBRARY TO OPERATE WITH ANY OTHER SOFTWARE), EVEN IF SUCH HOLDER OR OTHER PARTY HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES.

END OF TERMS AND CONDITIONS

How to Apply These Terms to Your New Libraries

If you develop a new library, and you want it to be of the greatest possible use to the public, we recommend making it free software that everyone can redistribute and change. You can do so by permitting redistribution under these terms (or, alternatively, under the terms of the ordinary General Public License).

To apply these terms, attach the following notices to the library. It is safest to attach them to the start of each source file to most effectively convey the exclusion of warranty; and each file should have at least the "copyright" line and a pointer to where the full notice is found.

<one line to give the library's name and a brief idea of what it does.>
Copyright (C) <year> <name of author>

This library is free software; you can redistribute it and/or modify it under the terms of the GNU Lesser General Public License as published by the Free Software Foundation; either version 2.1 of the License, or (at your option) any later version.

This library is distributed in the hope that it will be useful, but WITHOUT ANY WARRANTY; without even the implied warranty of MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE. See the GNU Lesser General Public License for more details.

You should have received a copy of the GNU Lesser General Public License along with this library; if not, write to the Free Software Foundation, Inc., 51 Franklin Street, Fifth Floor, Boston, MA 02110-1301 USA

Also add information on how to contact you by electronic and paper mail.

You should also get your employer (if you work as a programmer) or your school, if any, to sign a "copyright disclaimer" for the library, if necessary. Here is a sample; alter the names:

Yoyodyne, Inc., hereby disclaims all copyright interest in the library `Frob' (a library for tweaking knobs) written by James Random Hacker.

<signature of Ty Coon>, 1 April 1990

Ty Coon, President of Vice

That's all there is to it!

Nokia Qt LGPL Exception version 1.1

As an additional permission to the GNU Lesser General Public License version 2.1, the object code form of a ""work that uses the Library"" may incorporate material from a header file that is part of the Library. You may distribute such object code under terms of your choice, provided that:

(i) the header files of the Library have not been modified; and

(ii) the incorporated material is limited to numerical parameters, data structure layouts, accessors, macros, inline functions and templates; and

(iii) you comply with the terms of Section 6 of the GNU Lesser General Public License version 2.1.

Moreover, you may apply this exception to a modified version of the Library, provided that such modification does not involve copying material from the Library into the modified Library's header files unless such material is limited to (i) numerical parameters; (ii) data structure layouts; (iii) accessors; and (iv) small macros, templates and inline functions of five lines or less in length.

Furthermore, you are not required to apply this additional permission to a modified version of the Library.

thermo scientific

USA
27 Forge Parkway
Franklin, MA 02038
Ph: (866) 282-0430
Fax: (508) 520-2800
orders.aqi@thermofisher.com

India
C/327, TTC Industrial Area
MIDC Pawane
New Mumbai 400 705, India
Ph: +91 22 4157 8800
india@thermofisher.com

China
8/F Bldg C of Global Trade Ctr,
No.36, North 3rd Ring Road,
Dong Cheng District
Beijing, China 100013
Ph: +86 10 84193588
info.eid.china@thermofisher.com

Europe
Ion Path, Road Three,
Winsford, Cheshire CW73GA UK
Ph: +44 1606 548700
Fax: +44 1606 548711
sales.epm.uk@thermofisher.com

Find out more at **thermofisher.com/49iQ**

ThermoFisher SCIENTIFIC