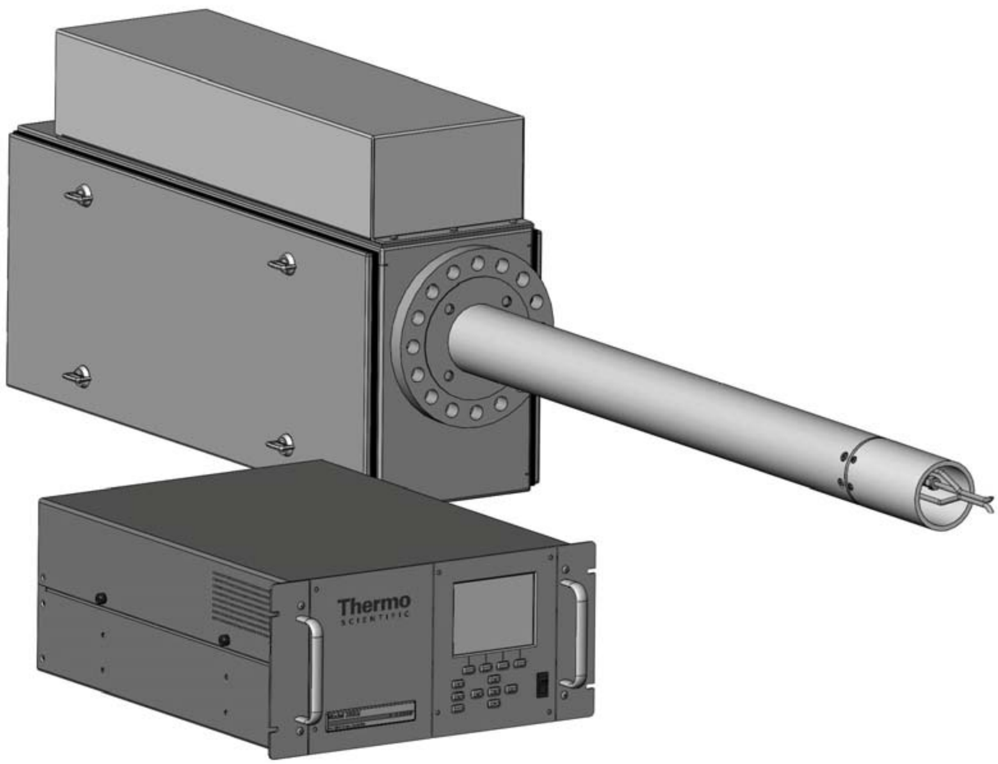
Model 3880*i*

Instruction Manual

Particulate Matter Continuous
Emissions Monitoring System
Part Number 112217-00
17Jul2019



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WEEE Compliance

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

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

About This Manual

This manual provides information about installing, maintaining, and servicing the Model 3880*i*. It also contains important alerts to ensure safe operation and prevent equipment damage. The manual is organized into the following chapters and appendixes to provide direct access to specific operation and service information.

- Chapter 1 "Introduction" provides an overview of the product, describes the theory of operations, and product specifications.
- Chapter 2 "Installation" describes how to install and start up the system.
- Chapter 3 "Operation" describes the front panel display, the front panel pushbuttons, and the menu-driven software. Each menu and submenu is explained.
- Chapter 4 "Calibration" provides an overview on the equipment needed for calibration and a description on how to calibrate the system.
- Chapter 5 "Preventive Maintenance" provides maintenance procedures to ensure reliable and consistent instrument operation.
- Chapter 6 "Troubleshooting" provides guidelines for diagnosing analyzer problems, isolating faults, and includes recommended actions for restoring proper operation.
- Chapter 7 "Servicing" presents safety alerts for technicians working on the analyzer, step-by-step instructions for repairing and replacing components, and a replacement parts list. It also includes contact information for product support and technical information.
- Chapter 8 "System Description" describes the function and location of the system components, provides an overview of the firmware structure, and includes a description of the system electronics and input/output connections.
- Appendix A "Warranty" is a copy of the warranty statement.
- Appendix B "C-Link Protocol Commands" provides a list of C-Link protocol commands that can be used to remotely control an analyzer using a host device such as a PC or datalogger.

- Appendix C "MODBUS Protocol" provides a description of the MODBUS Protocol Interface and is supported both over RS-232/485 (RTU protocol) as well as TCP/IP over Ethernet.

Safety

Review the following information carefully before using the probe. This manual provides specific information on how to operate the system, however if the system 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	Pneumatic umbilical must be supported during operations, installation, and removal of probe monitor. ▲
	The Model 3880*i* is supplied with a three-wire grounding cord. Under no circumstances should this grounding system be defeated. ▲
	The service procedures in this manual are restricted to qualified service representative. If the equipment is operated in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired. ▲
	Pneumatic umbilical must be supported during operations, installation, and removal of probe monitor. ▲

Alert		Description
⚠	**CAUTION**	While installing dilution and nozzle option, take care not to damage stack temperature sensor sticking out of the mantle cap. ▲
		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 it off immediately using soap and water. ▲
		When loosening or tightening the large VCO sealing nut, you must support the adjoining fittings. ▲
		The bypass tee fitting must be held in place with a wrench when either loosening or tightening the large VCO fitting to ensure the bypass tee does not spin. This could cause leaks and possible damage to the bypass thermocouple. ▲
		To prevent possible injury, insure hands are clear of the actuators moving parts before applying the pressurized air to the actuator. ▲
		All leak testing must be done with a vacuum pump. Pressurizing the TEOM mass transducer can cause damage. ▲
		Never pressurize the TEOM mass transducer. ▲
		When loosening or tightening the large VCO Sealing Nut, you must support the adjoining "T" fitting on the Heated Bench. ▲
		Take CAUTION not to bend the Stack Thermocouple. ▲
		Carefully observe the instructions in each procedure. ▲
		When removing the top cover, remove the three screws at the front of the cover before loosening or removing screws at the bulkhead. ▲
⚠	**Equipment Damage**	Do not attempt to lift the instrument by the cover or other external fittings. ▲
		Disconnect the serial cable before changing the RS-232 and RS-485 selection to prevent damage to any equipment currently connected to the analyzer. ▲
		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. 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. ▲

Alert	Description
	It's important to read all the following steps before replacing the filter. ▲
	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. ▲

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. ▲

Where to Get Help

Service is available from exclusive distributors worldwide. Contact one of the phone numbers below for product support and technical information or visit us on the web at www.thermoscientific.com/aqi.

1-866-282-0430 Toll Free

1-508-520-0430 International

We continue to support our customers with advanced online resources. Our Air Quality Instruments Online Library allows our customers access to product documents and information on a constant basis.

Available 24-hours a day and seven-days a week, the online library provides quick access to information regardless of time zone or office hours.

To register for an account or log in, please visit www.thermoscientific.com/aqilibrary.

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Chapter 1
Introduction

The Thermo Scientific™ Model 3880*i* Particulate Matter Continuous Emissions Monitoring System (PM CEMS) is designed to extract, dilute, and transport a flue gas sample for the measurement of a wet-based filterable particulate matter concentration. The system is comprised of a Model 3880*i* Probe Controller and a Probe Monitor, along with optional peripheral components, such as a zero air supply, freeze protected umbilical, and probe controller enclosure.

For details of the instrument's theory of operation and product specifications, see the following topics:

- "Theory of Operation" on page 1-2
- "Specifications" on page 1-7

Thermo Fisher Scientific is pleased to supply this Model 3880*i*. We are committed to the manufacture of instruments exhibiting high standards of quality, performance, and workmanship. Service personnel are available for assistance with any questions or problems that may arise in the use of this instrument. For more information on servicing, see the "Servicing" chapter starting on page 7-1.

Theory of Operation

The Model 3880*i* is based on two methods of particulate mass detection. These methods are light scattering and inertial weighing.

The continuous measurement of particulate mass is through the use of elastic light scattering. In the presence of light, particulate matter is known to scatter light in all directions. The intensity by which light is scattered in the presence of an incident beam of light is given by:

$$R = \frac{I_0 N}{C_m} \iiint f(d_p) \frac{\lambda^2}{8\pi^2 r^2} (i_1 + i_2) f(\lambda) F(\theta) dd_p d\lambda d\theta$$

where:

R	=	scattered light
Io	=	incident illumination irradiance
N	=	particle number concentration
C_m	=	mass concentration
f(dp)	=	size distribution function
λ	=	wavelength of illuminating source
r	=	distance to detector from particle scattering light
i1, i2	=	Lonenz-Mie scattering intensity functions
f(λ)	=	source/detector wavelength dependence
F(θ)	=	angular scattering geometry of optical system

While the detection of particulate with this method can offer an extensive dynamic range and rapid response, the multitude of parameters listed above can significantly influence the accuracy. Therefore, a continuous internal mass reference is used to scale the light scattering response.

The primary method of mass measurement is an inertial weighing technology based on measuring the frequency of vibration of a Tapered Element Oscillating Microbalance (TEOM). The tapered element is a hollow tube, clamped at one end and free to vibrate at the other. An exchangeable filter accumulates the particulate mass that is drawn as a collected sample. During sample collection, this tapered element vibrates precisely at its natural resonant frequency through the assistance of electronic controls. A precise electronic counter measures the frequency, which has a direct relationship with mass.

Specifically,

$$f^2 = \frac{K_0}{m}$$

where:

f	=	frequency of oscillation
K_0	=	calibration constant
m	=	mass

By arranging the above relationship into discrete time, the change in mass (Δm) can be measured between two separate frequencies (f1, f2) by the following:

$$\Delta \text{m} = K_0 \left[\frac{1}{f_2^2}\right] - \left[\frac{1}{f_1^2}\right]$$

By measuring the change in sample volume, passing through the TEOM, and the mass (as shown above) the mass concentration can be calculated as follows:

$$\text{C}_{\text{PM}} = \frac{\Delta \text{m}}{\Delta \text{V}}$$

where:

C_{PM}	=	particulate matter concentration
Δm	=	change in particulate mass
ΔV	=	change in air volume

It is the periodic use of the TEOM as an internal particulate mass reference that applies a correction factor (PM factor) to the light scattering response to calculate a final concentration, PM_{wet}.

The Model 3880*i* PM CEMS predominately operates in a functional mode called Monitor mode (Figure 1–1). During this period a slip-stream of the diluted sample passes through the forward light scattering assembly; whereby the PM factor is applied as follows to the forward light scatter signal (FWD).

$$PM_{wet} = PM_{factor} \text{ x FWD}$$

The PM_{factor} is simply derived from a different functional mode referenced as the Mass Mode. During this period the same slip-stream passes through both the light scattering assembly and the Tapered Element Oscillating Microbalance (TEOM) for a specified duration (e.g., 2-3 hours). At the end of this Mass Mode the average FWD and TEOM are used to update the PM factor as follows:

$$PM_{factor} = \frac{TEOM_{avg.}}{FWD_{avg.}}$$

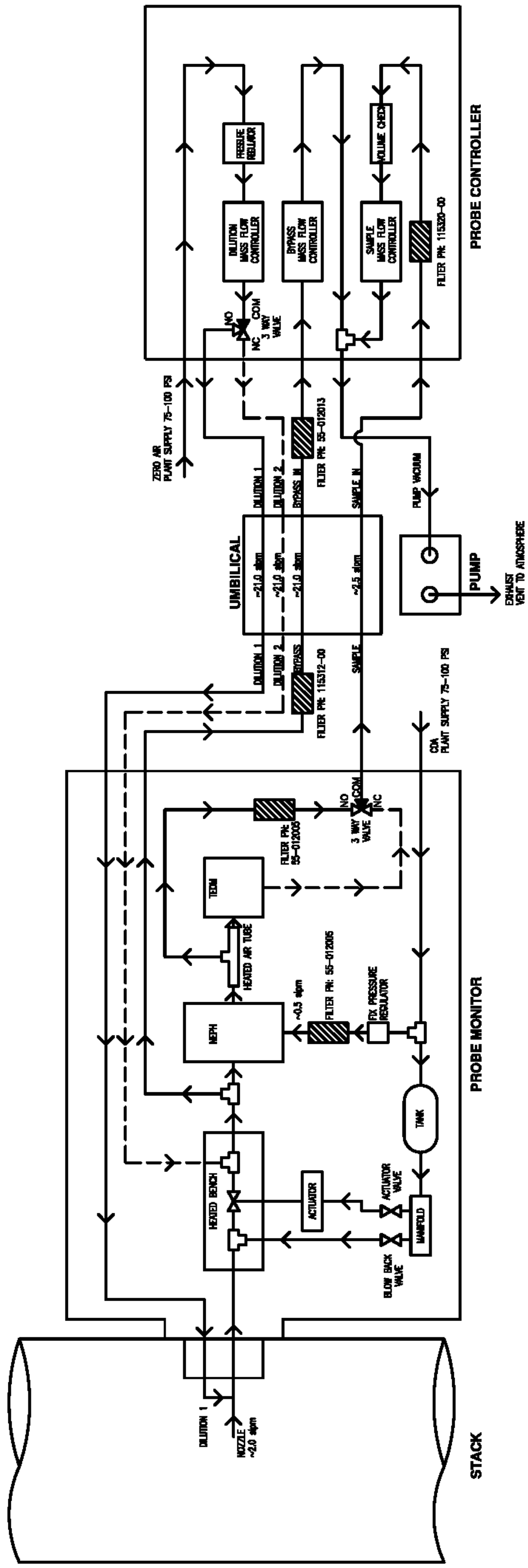


Figure 1–1. Model 3880*i* PM CEMS Flow Schematic

The relationship of frequency to mass is direct, as stated above. The TEOM system measures frequency. As the mass of this system changes, so too does the frequency. However, no matter what the particulate mass characteristics may be (i.e., size, shape, refractive index, or chemical composition) the accuracy of measurement remains.

Specifications

Table 1–1 lists the standard specifications for the Model 3880*i* PM CEMS.

Table 1–1. Model 3880*i* PM CEMS Specifications

Item	Description
Power requirements	200–240 VAC @ 50/60 Hz, ~20 amp service
Clean dry air	80 slpm @ 75–100 psi
Flange adapter	4” Universal mounting flange
IP rating	IP6_on probe enclosure @ stack
Probe monitor dimensions	44.01” W x 18.69” H x 12.09” D (111.8cm W x 47.47cm H x 30.71cm D)
Probe monitor weight	130 lbs (58.97 kg)
Probe controller dimensions	19.0” W x 8.62” H x 25.8” D (48.26cm W x 21.89cm H x 65.53cm D)
Probe controller weight	55 lbs (24.95 kg)
Probe length	60” L (152.4cm L)
Probe material	316 SS (coating available upon request)
Mantle material	Hastelloy, Stainless, or PFA coated
Enclosure options	Standard 19-in rack (custom umbilical required) Weather enclosure at flange (available upon request)
Umbilical options	Cold pneumatics with freeze protect flying leads 30-ft standard length with weather enclosure Custom length available upon request with 19-in rack
Range	0–250 mg/m^3
Accuracy	±20% vs. M-5, M-17 or ISO equivalent
Detection limit	0.25 mg/m^3 @ 15-minute integration time
Response time	15 minutes to 90% of value
Maximum stack temperature	100 °C (higher available upon request)
Flue gas	≤ 20% moisture (higher available upon request)
Velocity range	4–20 m/s (13.12–65.62 ft/sec)
System temperature range	4–50 °C; non-condensing for 19-in rack mounted probe controller
Analog outputs	6 voltage outputs; 0–100 mV, 1, 5, 10 V (user selectable), 5% of full-scale over/under range (user selectable), 12 bit resolution, measurement output user selectable per channel 6 current outputs firmware configured for any one of the following ranges, while maintaining a minimum resolution of 11 bits: 0-20 mA, 4-20 mA

Item	Description
Digital outputs	1 power fail relay Form C, 10 digital relays Form A, user selectable alarm output, relay logic, 100 mA @ 200 VDC
Digital inputs	16 digital inputs, user select programmable, TTL level, pulled high
Serial ports	1 RS-232 or RS-485 with two connectors, baud rate 1200–115200, data bits, parity, and stop bits, protocols: C-Link, MODBUS, and streaming data (all user selectable)
Ethernet connection	RJ45 connector for 10Mbs Ethernet connection, static or dynamic TCP/IP addressing

Chapter 2
Installation

Installation of the Model 3880*i* PM CEMS includes lifting the instrument, unpacking and inspection, connecting sample, zero, span, and exhaust lines, and attaching the analog outputs to a recording device. The installation should always be followed by instrument calibration as described in the "Calibration" chapter of this manual.

This chapter provides the following recommendations and procedures for installing the instrument:

Lifting

When lifting the instrument, use a procedure appropriate for lifting a heavy object, such as, bending at the knees while keeping your back straight and upright. Grasp the instrument at the bottom in the front and at the rear of the unit. Although one person can lift the unit, it is desirable to have two persons lifting, one by grasping the bottom in the front and the other by grasping the bottom in the rear.

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

Unpacking and Inspection

Depending on the intended use, the Model 3880*i* is shipped complete in two containers. One container includes the 3880*i* probe controller; the other container includes the vacuum pump.

Note When unpacking the pump, save the instruction manual that came with the pump for future reference. ▲

If there is obvious damage to the shipping container(s) 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.

3. Remove the packing material (Figure 2–1).

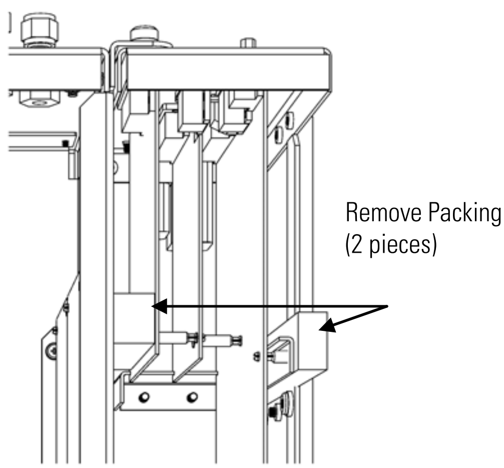


Figure 2–1. Remove the Packing Material

4. Check for possible damage during shipment.

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

6. Re-install the cover.

System Requirements

Voltage = 200V–240V 50/60 Hz AC

Clean Dry Air (CDA)

Particulate free with a dew point of -40 °C or less

80–100 psi with a flow capacity ≥80 slpm

Zero Air

Particulate free

80–100 psi with a flow capacity ≥80 slpm

(slpm: standard liters per minute @ 25 °C, 1 atm)

Instrument Installation

Ensure that the instrument is connected to the air supply using the support umbilical, noting all labels to ensure proper connection.

WARNING Pneumatic umbilical must be supported during operations, installation, and removal of probe monitor. ▲

Blow out the pneumatic umbilicals with clean dry air before installing. Connect the freeze protected umbilical to both the probe and the instrument (connector side goes toward the instrument chassis). Ensure that the umbilical is (properly strain relieved) on the outside of the instrument to prevent excessive strain on the monitor assembly.

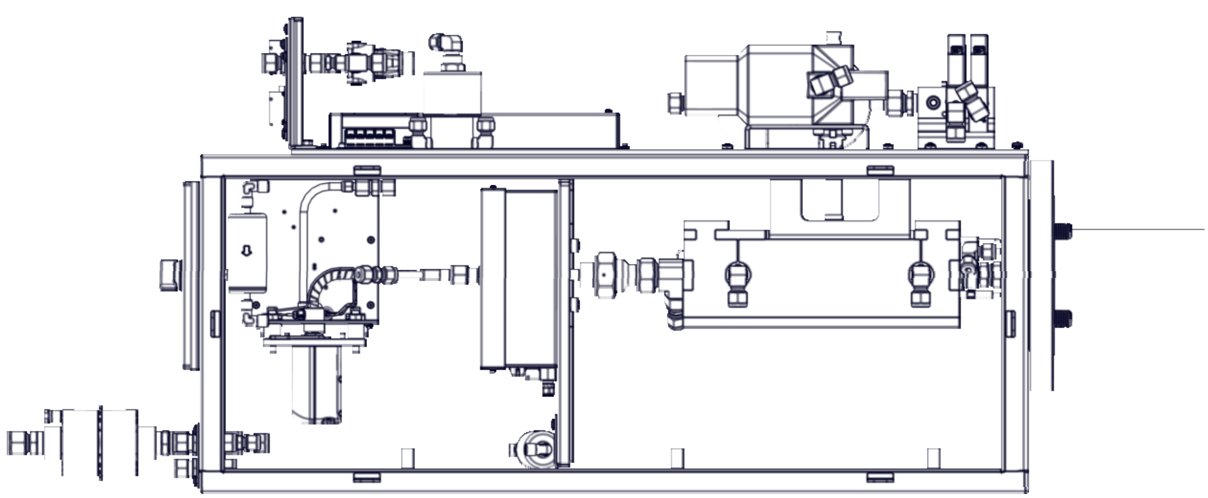


Figure 2–2. Component Layout – Open View of Monitor Assembly

Setup Procedure

The Model 3880*i* is capable of measuring filterable particulate matter from laboratory generated aerosol or as emitted from a coal-fired boiler, incinerator, or cement kiln.

The procedure for setting up the Model 3880*i* will only vary with regard to probe controller mounting and umbilical length logistics. Be sure to review the air and power supply requirements before install.

The Model 3880*i* is comprised of the following major assemblies:

1. Probe Mantle
2. Probe Monitor Enclosure
3. Umbilical (Pneumatic bundle and 2 electrical)
4. Probe Controller
5. Pump Assembly

Please note that the instrument is shipped in multiple containers. The probe mantle must be connected to the probe monitor enclosure prior to use. Refer to "Mantle Removal" section on page 7-50 in the Servicing section and follow the instructions in reverse order to connect the probe mantle to the probe monitor enclosure.

When installing, always make connectors to the Probe Controller first.

WARNING The Model 3880*i* is supplied with a three-wire grounding cord. Under no circumstances should this grounding system be defeated. ▲

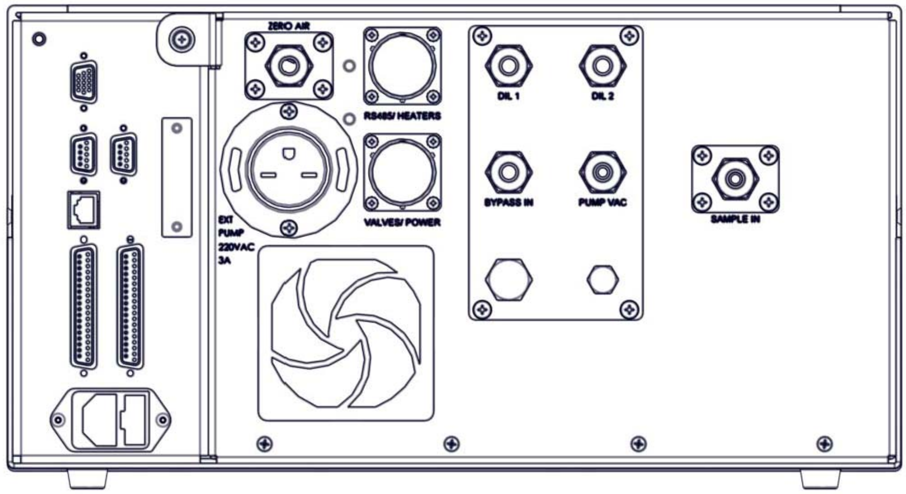


Figure 2–3. Model 3880*i* Rear Panel

Probe Monitor Preparation

Use the following procedure to prepare the probe monitor.

WARNING The Model 3880*i* is supplied with a three-wire grounding cord. Under no circumstances should this grounding system be defeated. ▲

1. On bench on floor, place probe monitor with support block under the mantle (Figure 2–4).

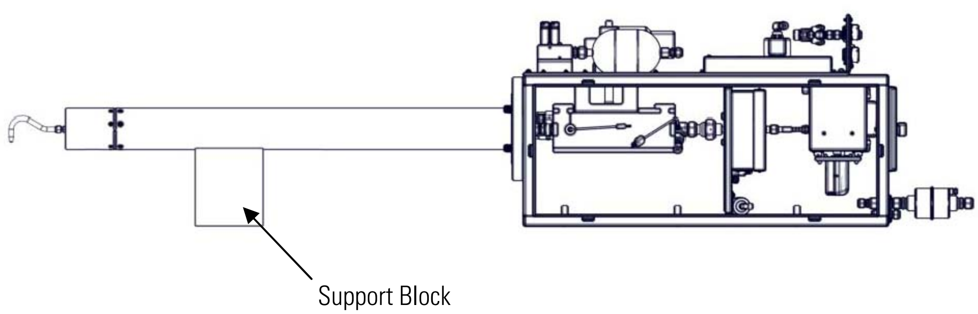


Figure 2–4. Probe Monitor with Support Block

2. Remove the six hex screws from the mantle shroud. Save screws for reinstallation (Figure 2–5).

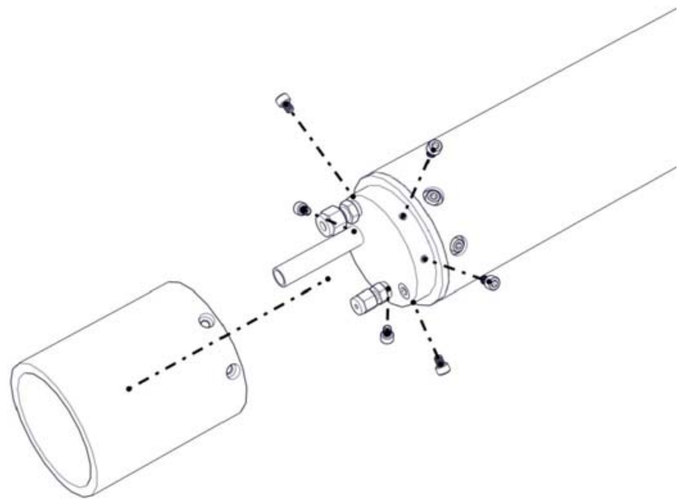


Figure 2–5. Probe Mantle Shroud

3. Install dilution assembly on to mantle cap. Aligning both the ½-inch port and dilution air supply line. Push with a slight twist to seat over the sealing 0-rings. Once in place, tighten 1/4 dilution air line. Then tighten the three set screw to secure dilution assemble to mantle cap (Figure 2–6).

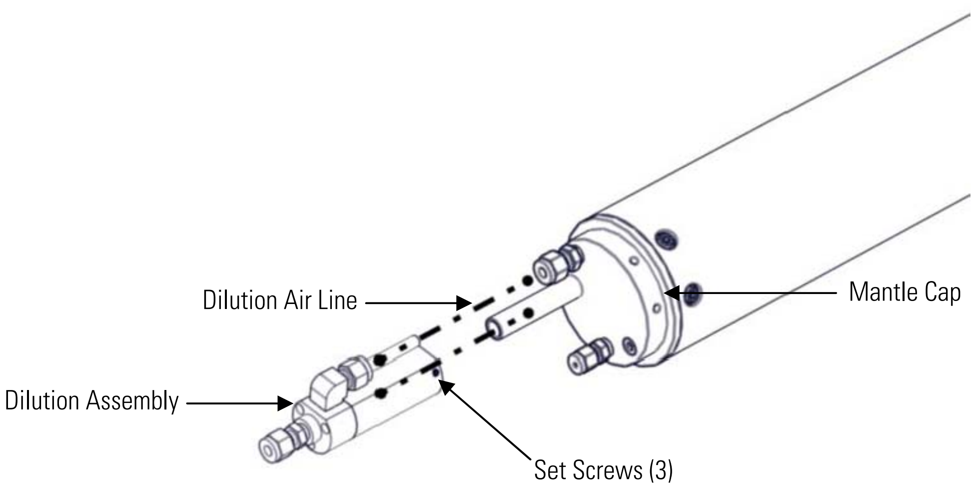


Figure 2–6. Dilution Assembly

4. Install nozzle into dilution assembly. Position nozzle tip pointing down, seat and tighten (Figure 2–7).

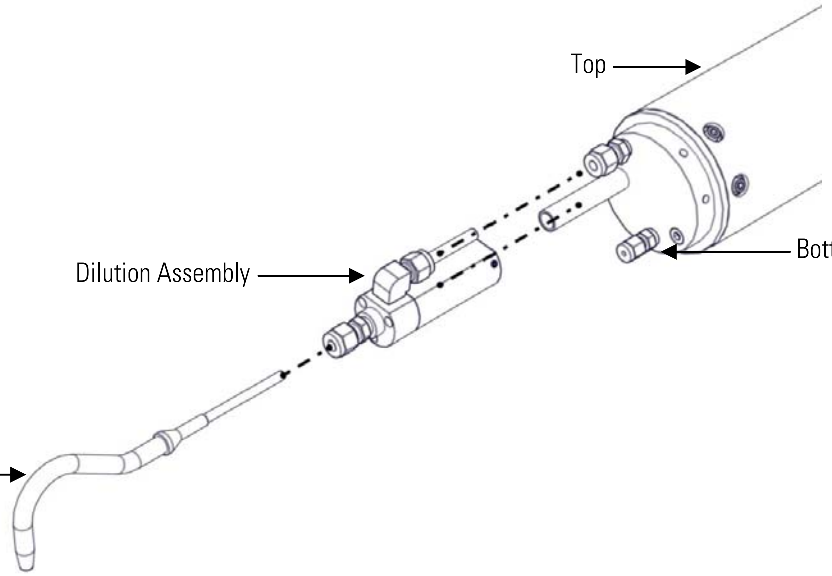


Figure 2–7. Nozzle Assembly

CAUTION While installing dilution and nozzle option, take care not to damage stack temperature sensor sticking out of the mantle cap. ▲

5. Reinstall mantle shroud in reverse order. Add silver goop to screw threads before installing.

Note Do not over tighten screws which could result in damaging shroud. (32 in/lbs [.6 N/m]). ▲

Probe Controller

Use the following procedure to install the Model 3880*i* PM CEMS Probe Controller in an emissions monitoring application. (Refer to Figure 2–11 for System Plumbing.)

1. Connect the 3/8-inch house zero air input line to the rear panel port labeled ZERO AIR. The pressure input should be 80–100 psi @ 80 slpm.

2. From the umbilical, connect the 3/8-inch tube labeled DIL1 to the rear panel port labeled DIL1.

3. From the umbilical, connect the 3/8-inch tube labeled DIL2 to the rear panel port labeled DIL2.

4. From the umbilical side labeled “to probe cntrl”, connect the 3/8-inch tube labeled BYPASS to the jumbo Hepa filter 1/2-inch fitting. Connect the 3/8-inch tube from the other end of the jumbo Hepa filter to the rear panel labeled BYPASS IN.

5. From the umbilical, connect the 1/4-inch tube labeled SAMPLE IN to the sample relief valve assembly rear panel port labeled SAMPLE IN.

6. With tubing assembly (PUMP VAC to pump intake) of 3/8-inch tubing, connect the rear panel port labeled PUMP VAC to the intake port of the 220 VAC vacuum pump provided.

7. From the umbilical, connect the 3/8-inch tube to the outlet of vacuum pump and vent to atmosphere (outside of CEMS shelter).

8. Connect the keyed electrical umbilical to the rear panel connector labeled RS485/HEAT, and connect the grounding strap to the rear panel ground lug.

9. Connect the keyed electrical umbilical to the rear panel connector labeled VALVES/POWER, and connect the grounding strap to the rear panel ground lug.

10. 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 2-9

    “External Device Connection Components” on page 7-8

    “Terminal Block and Cable Kits” on page 9-1

    “Instrument Controls” > “I/O Configuration” on page 3-44.

    For detailed information about troubleshooting a connection, refer to “Analog Output Testing” on page 7-22.

11. Plug the probe controller into an outlet of the appropriate voltage and frequency.

Connecting External Devices

Several components are available for connecting external devices to *i*Series instruments.

These connection options include:

- Individual terminal board PCB assemblies
- Terminal block and cable kits (optional)
- Individual cables (optional)

For detailed information on the optional connection components, refer to the "Optional Equipment" chapter. For associated part numbers, refer to "External Device Connection Components" on page 7-8.

Terminal Board PCB Assemblies

The terminal board PCB assemblies are circuit boards with a D-Sub connector on one side and a series of screw terminals on the other side. This assembly provide a convenient mechanism for connecting wires from a data system to the analyzer's I/O connectors.

The following terminal board PCB assemblies are available for *i*Series instruments:

- I/O terminal board PCB assembly, 37 pin (standard)
- D/O terminal board PCB assembly, 37 pin (standard)
- 25-pin terminal board PCB assembly, (included with optional I/O Expansion Board)

I/O Terminal Board

Figure 2–8 shows the recommended method for attaching the cable to the terminal board using the included tie-down and spacer. Table 2–1 identifies the connector pins and associated signals.

Note Not all of the I/O available in the instrument is brought out on the supplied terminal board. If more I/O is desired, an alternative means of connection is required. See optional "Terminal Block and Cable Kits". ▲

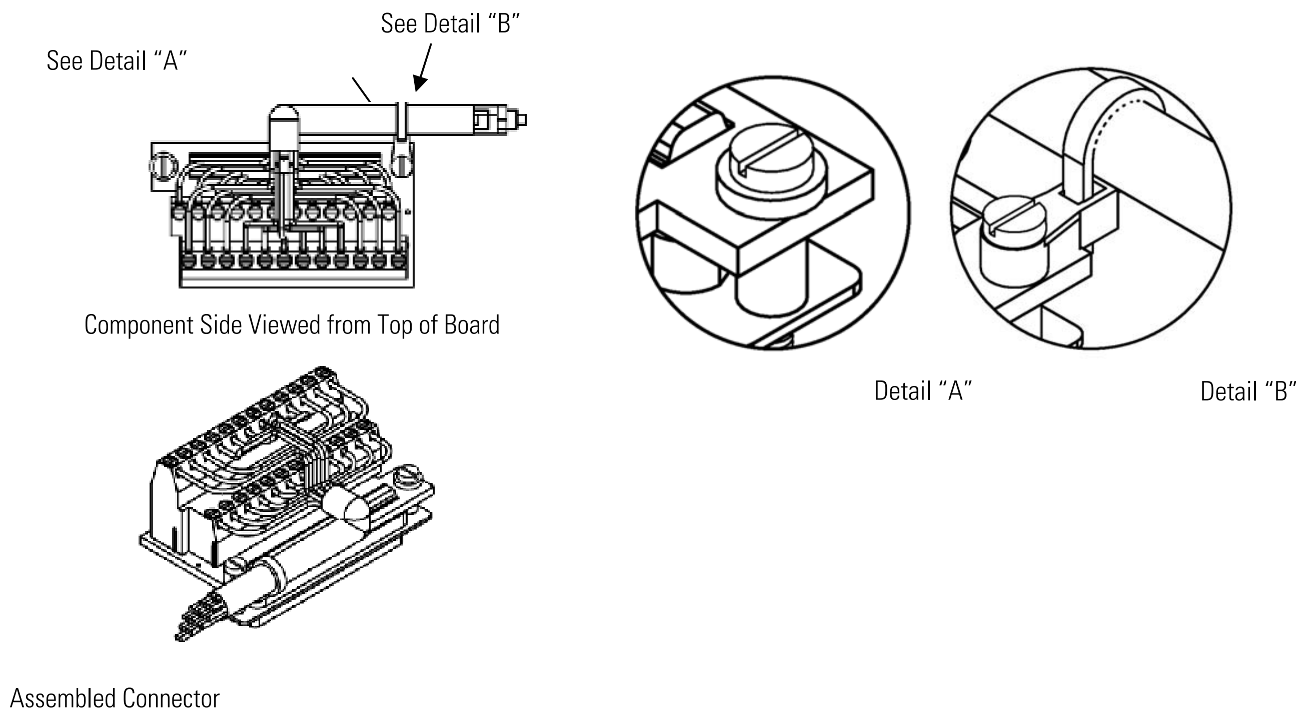


Figure 2–8. I/O Terminal Board Views

Table 2–1. I/O Terminal Board Pin Descriptions

Screw	Signal Description	Screw	Signal Description
1	Analog1	13	Power_Fail_NC
2	Analog ground	14	Power_Fail_COM
3	Analog2	15	Power_Fail_NO
4	Analog ground	16	TTL_Input1
5	Analog3	17	TTL_Input2
6	Analog ground	18	TTL_Input3
7	Analog4	19	TTL_Input4
8	Analog ground	20	Digital ground
9	Analog5	21	TTL_Input5
10	Analog ground	22	TTL_Input6
11	Analog6	23	TTL_Input7
12	Analog ground	24	Digital ground

D/O Terminal Board

Figure 2–9 shows the recommended method for attaching the cable to the terminal board using the included tie-down and spacer. Table 2–2 identifies the connector pins and associated signals.

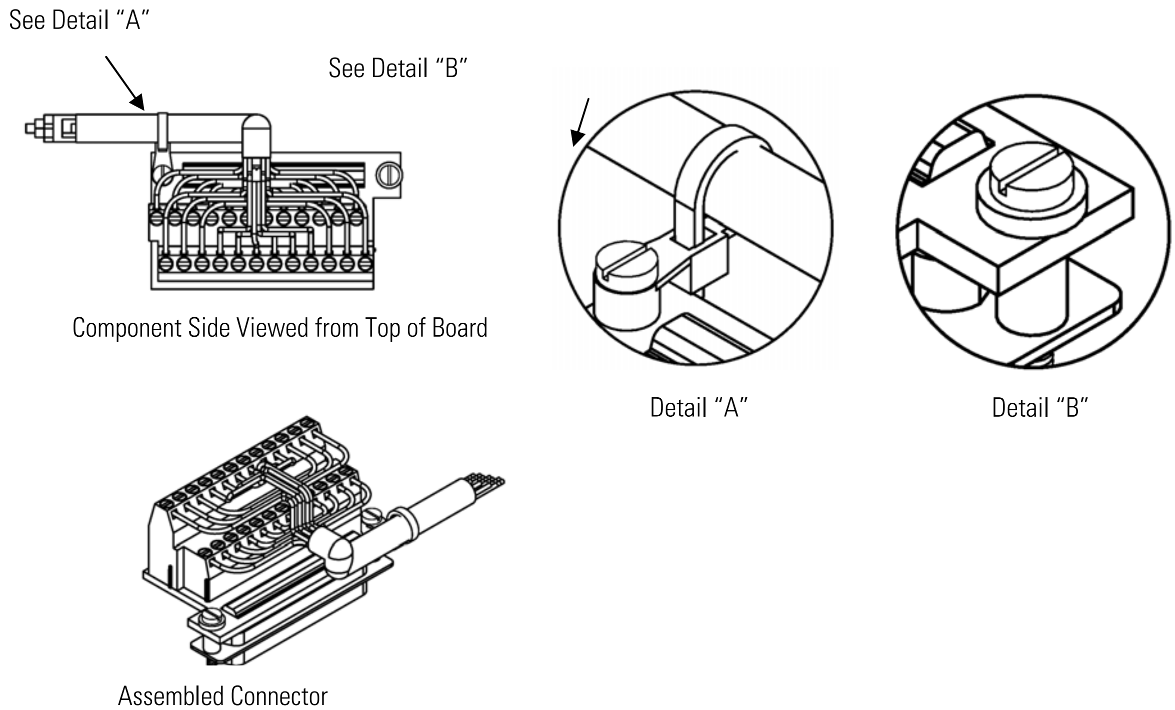


Figure 2–9. D/O Terminal Board Views

Table 2–2. D/O Terminal Board Pin Descriptions

Screw	Signal Description	Screw	Signal Description
1	Relay1_ContactA	13	Relay7_ContactA
2	Relay1_ContactB	14	Relay7_ContactB
3	Relay2_ContactA	15	Relay8_ContactA
4	Relay2_ContactB	16	Relay8_ContactB
5	Relay3_ContactA	17	Relay9_ContactA
6	Relay3_ContactB	18	Relay9_ContactB
7	Relay4_ContactA	19	Relay10_ContactA
8	Relay4_ContactB	20	Relay10_ContactB
9	Relay5_ContactA	21	Solenoid_Drive_Output1
10	Relay5_ContactB	22	+24V
11	Relay6_ContactA	23	Solenoid_Drive_Output2
12	Relay6_ContactB	24	+24V

25-Pin Terminal Board

The 25-pin terminal board is included with the optional I/O Expansion Board.

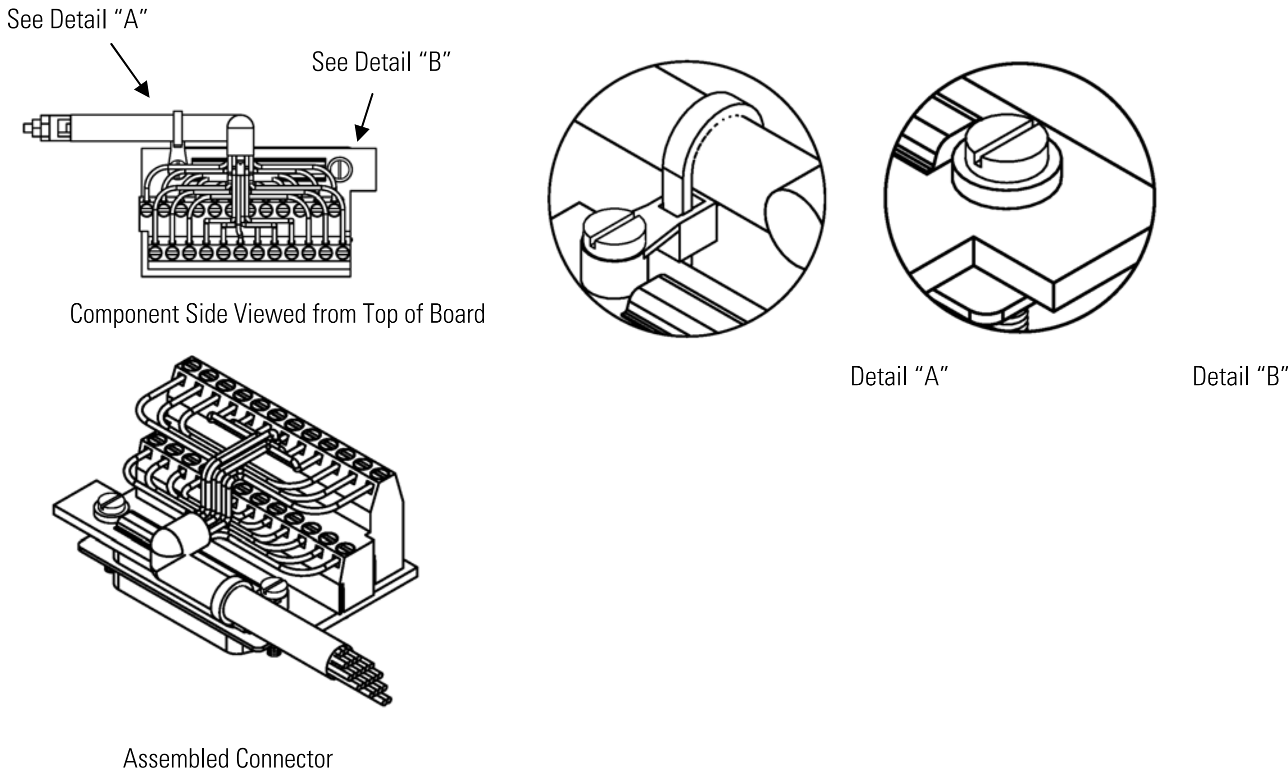


Figure 2–10. 25-Pin Terminal Board Views

Table 2–3. 25-Pin Terminal Board Pin Descriptions

Screw	Signal Description	Screw	Signal Description
1	IOut1	13	Analog_In1
2	GND_ISO	14	Analog_In2
3	IOut2	15	Analog_In3
4	GND_ISO	16	GNDD
5	IOut3	17	Analog_In4
6	GND_ISO	18	Analog_In5
7	IOut4	19	Analog_In6
8	GND_ISO	20	GNDD
9	IOut5	21	Analog_In7
10	GND_ISO	22	Analog_In8
11	IOut6	23	GNDD
12	GND_ISO	24	GNDD

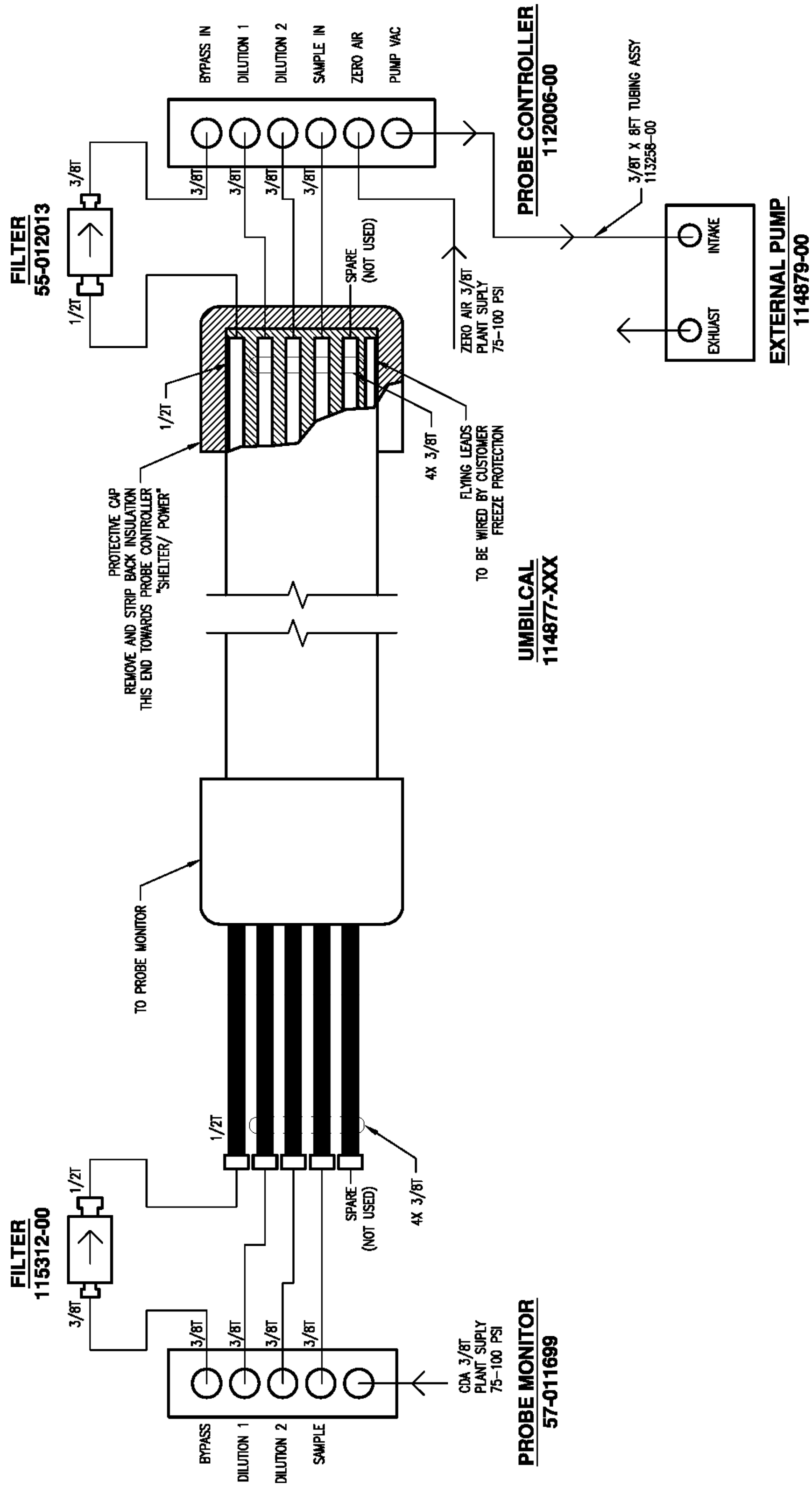


Figure 2–11. System Plumbing

Probe Monitor

Use the following procedure to install the Model 3880*i* PM CEMS probe monitor. (Refer to Figure 2–11 for System Plumbing on page 2-13.)

1. On a bench or floor, taking care not to damage the nozzle and dilution module (remove if necessary), line the mantle up with probe enclosure with 3/4-inch fitting in 12 o'clock position.

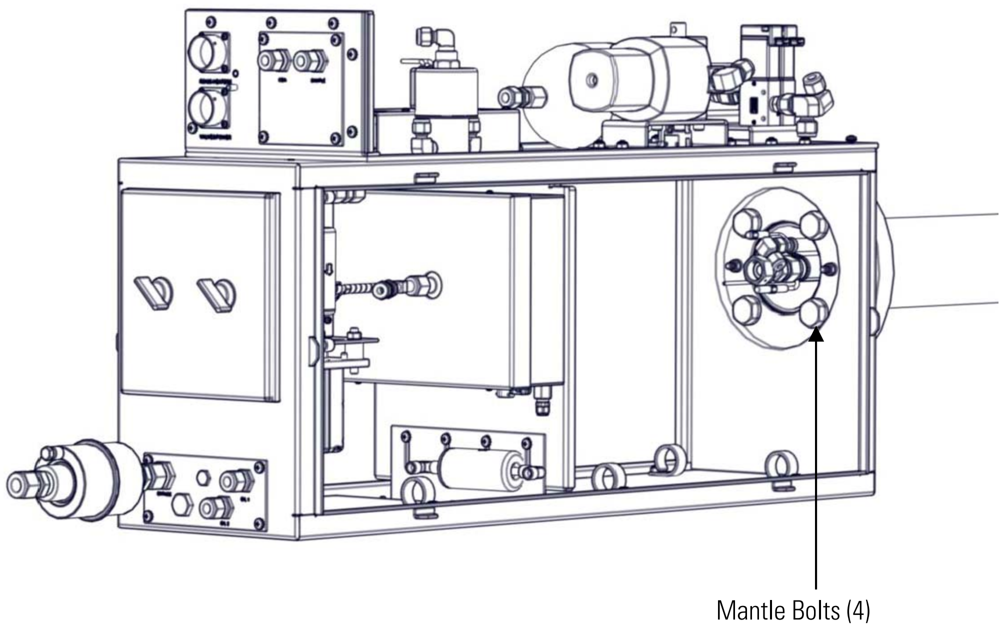


Figure 2–12. Rear View of Mantle and Monitor

2. Bolt mantle in place with four 5/8-inch-11 x 1 1/2-inch bolts and split lock washers.

Note If there is sufficient space, the probe monitor with the mantle connected should be arranged near the monitoring port. If some instances, the mantle may have to be inserted first and the probe monitor enclosure added next. ▲

3. Connect the 3/8-inch tubing to the CDA to the upper rear panel of the probe monitor.

4. Connect the 3/8-inch umbilical tubing labeled SAMPLE to the upper rear panel of the probe monitor.

5. Connect the 1/2-inch umbilical tube labeled BYPASS to the large coalescing filter provided, and connect the other end of the HEPA to the lower rear panel labeled BYPASS of the probe monitor.

6. Connect the 3/8-inch umbilical tube labeled DIL1 to the lower rear panel of the probe monitor.

7. Connect the 3/8-inch umbilical tube labeled DIL2 to the lower rear panel of the probe monitor.

8. Connect the keyed electrical umbilical to the upper rear panel of the probe monitor labeled RS485/HEAT and connect the grounding strap to the rear panel ground lug.

9. Connect the keyed electrical umbilical to the upper rear panel of the probe monitor labeled VALVES/POWER.

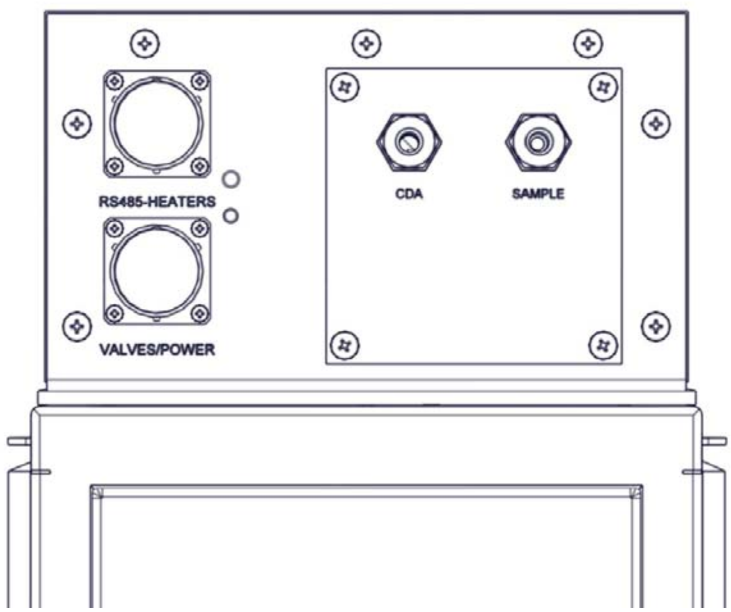


Figure 2–13. Upper View Probe Monitor (Rear)

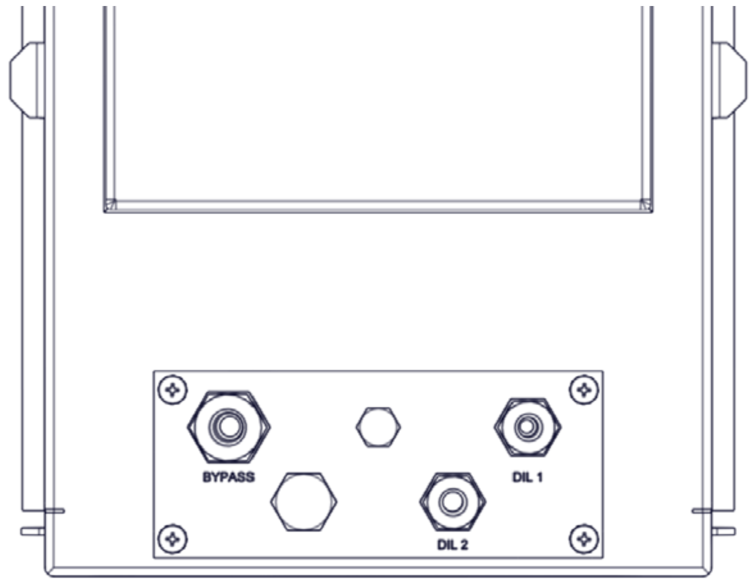


Figure 2–14. Lower View of Probe Monitor Connections (Rear)

System Startup

Use the following procedure when starting the instrument.

1. Check rear compartment of the probe monitor to be sure a TEOM module has been installed and the release lever is pushed firmly to the left (Figure 2–15).

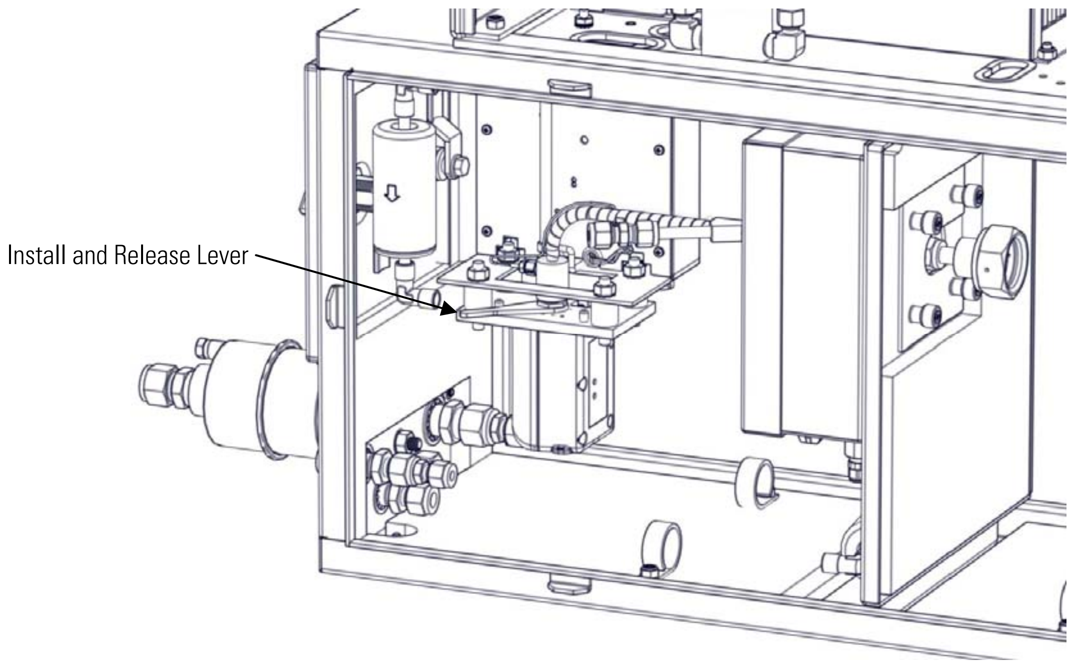


Figure 2–15. TEOM Mounting

2. Check condition of the sampling nozzle and dilution fittings. If the system has been shipped or located to the monitoring port with the nozzle assembly removed, locate the assembly, slide over the 1/2-inch sample tube at the mantle inlet and secure the dilution air fittings to the available 14-inch port.

3. Confirm adequate zero air and CDA are provided.

4. Power the system ON.

5. Place system into a Purge mode, using “Instrument Controls” > “Functional Mode”.

6. From Main Menu, choose “Instrument Controls” > “Set Flows” and verify the following flow settings: Both Dilution and Bypass=21.0 slpm, and Sample=2.5 slpm. Purge flow will have been calibrated in the factory and is approximately 0.4 slpm.

7. With the system in Purge mode, the dilution air will automatically increase to 3-4 slpm above the set point. This will result in a positive flow leaving the nozzle.

8. With the system in Monitor mode, test the flow using a reference flow meter measuring standard liters per minute (@760 mmHg, 25 deg C), measure the flow output of the nozzle. The measured flow should equal the nozzle flow (appearing negative under “Diagnostics” > “Flows”), within 0.2 slpm. If this is out of tolerance, check for leaks. Refer to “Leak Check” on page 5-19.

9. Set the system temperatures as follows:

   Dilution = 120 °C

   Stinger = 80 °C

   Block = 70 °C

   Nephelometer = 58 °C

   TEOM air tube = 60 °C

   TEOM case = 62 °C

10. System schedule set up:

    Mass Mode starts at 14:00

    - 30 minute stabilize
    - 15 minute integration
    - 2 hours (collect) sampling
    - 24 HRS period

    Blow back at 01:00

    - 24 HRS period

    System check at 00:01

    - 24 HRS period

11. After system comes to temperature, place system into Monitor mode and measure flow entering the nozzle. The nozzle flow displayed on the "Diagnostics" > "Flows" screen should match the flow measured by the reference flow meter within ±0.2 slpm. If not, refer to "Leak Check" on page 5-19.

12. The system may now be inserted into the monitoring location and secured to the flange. Place system in Purge mode and set all temperatures to zero. Let cool then install.

Mounting the Mantle to Stack

Depending on work area, manpower, and other site-specific criteria, you may opt to install the mantle and probe at once, or the mantle first, and then the probe.

Use the following procedure to mount the mantle to stack.

Align mantle thru holes (Figure 2–16) to stack sample port thru holes, so probe is in desired position. Refer to Figure 2–17 and install hardware in four places.

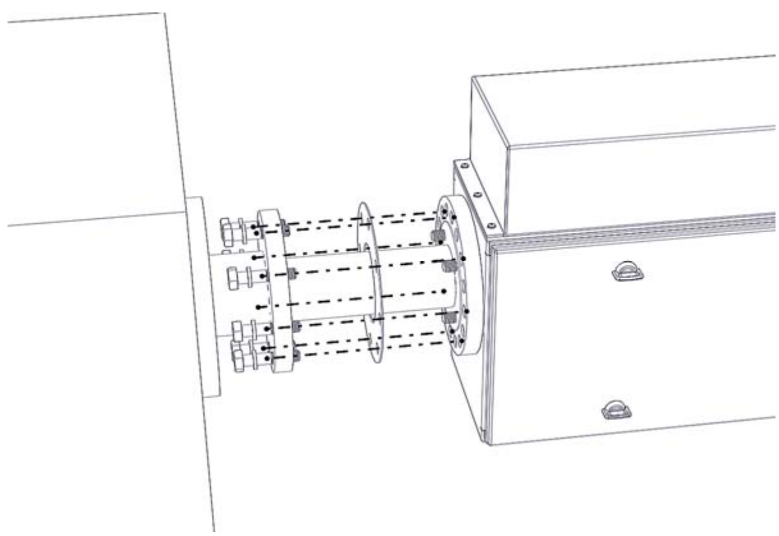


Figure 2–16. Mantle with Universal Mounting Flange

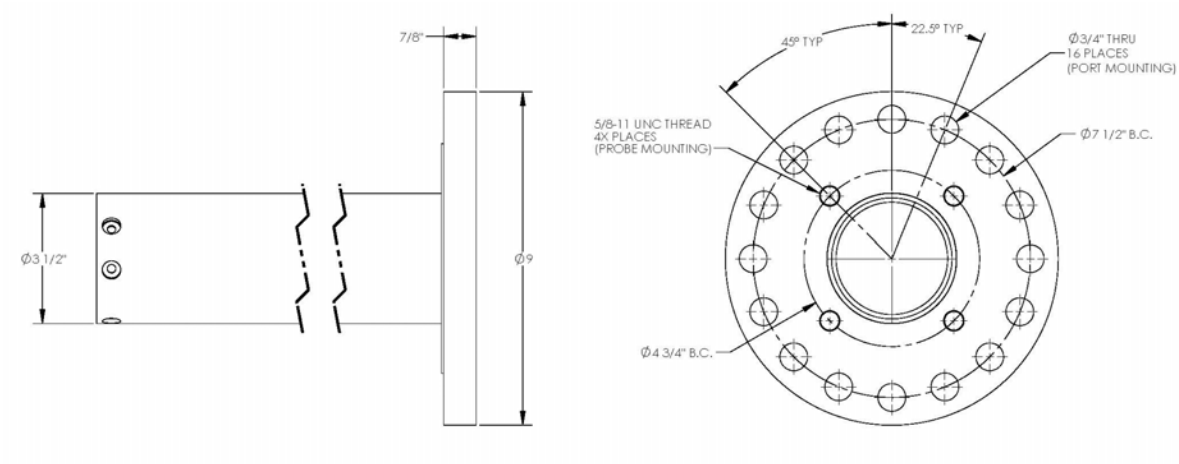


Figure 2–17. Mantle Mount

Chapter 3
Operation

This chapter describes the front panel display screens, front panel pushbuttons, and menu-driven firmware. For details, see the following topics:

Display

The 320 x 240 graphics liquid-crystal display (LCD) shows the sample concentrations, instrument parameters, instrument controls, help, and error messages. Some menus contain more items than can be displayed at one time. For these menus, use ⬆ and ⬇ to move the cursor up and down to each item.

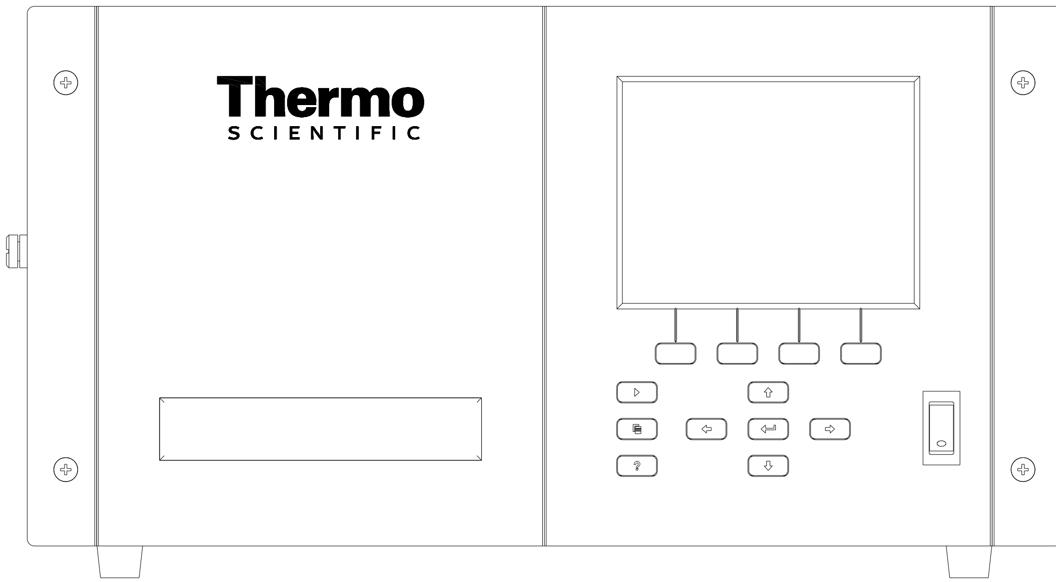


Figure 3–1. Front Panel Display

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 it off immediately using soap and water. ▲

Pushbuttons

The Pushbuttons allow the user to traverse the various screens/menus.

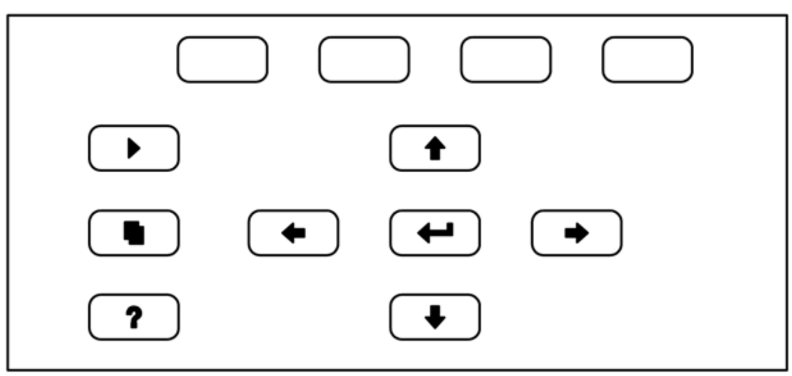


Figure 3–2. Front Panel Pushbuttons

Table 3–1 lists the front panel pushbuttons and their functions.

Table 3–1. Front Panel Pushbuttons

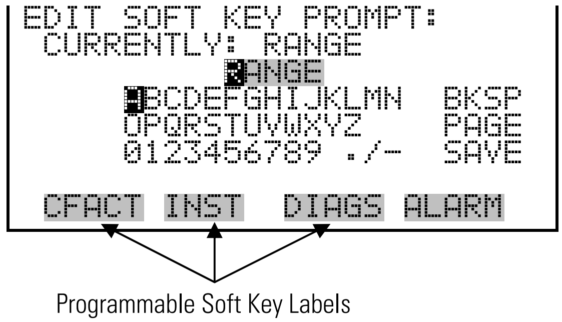
Key Name	Function
= Soft Keys	The (soft keys) are used to provide shortcuts that allow the user to jump to user-selectable menu screens. For more information on processing soft keys, see "Soft Keys" below.
▶ = Run	The ▶ is used to display the Run screen. The Run screen normally displays the current PM concentrations, but also has additional Run screens for ambient conditions, sample conditions, and mass sensor data. Press ↑ and ↓ to scroll through the different Run screens.
■ = Menu	The ■ is used to display the Main Menu when in the Run screen, or back up one level in the menu system. For more information about the Main Menu, see "Main Menu" later in this chapter.
? = Help	The ? is context-sensitive, that is, it provides additional information about the screen that is being displayed. Press ? for a brief explanation about the current screen or menu. Help messages are displayed using lower case letters to easily distinguish them from the operating screens. Press ▶ to return to the Run screen, or any other key to exit a help screen.
↑ ↓ = Up, Down ← → = Left, Right	The four arrow pushbuttons (↑, ↓, ←, and →) move the cursor up, down, left, and right or change values and states in specific screens.
↵ = Enter	The ↵ is used to select a menu item, accept/set/save a change, and/or toggle on/off functions.

Soft Keys

The soft keys are multi-functional keys that use part of the display to identify their function. The function of the soft keys is to provide a shortcut to the most often used menus and screens. They are located directly underneath the display, and user-defined labels in the lower part of the display indicate the function of each key at that time.

To change a soft key, place the menu cursor ">" on the item of the selected menu or screen you wish to set. Press → followed by the selected soft key within 1 second of pressing the right-arrow key. The "edit soft key prompt" will be displayed for configuration of the new label.

Note Not all menu items may be assigned to soft keys. If a particular menu or screen item cannot be assigned, the key assignment screen will not come up upon entering right-arrow-soft key combinations. All items under the Service menu (including the menu itself) cannot be assigned soft keys. ▲



Alphanumeric Entry Screen

The alphanumeric entry screen is used to enter strings consisting of letters, numbers, and other characters. The cursor may be positioned within the entry line using the ← and → keys. If a character is entered over an existing character, that character will be overwritten. Use the ↑ and ↓ keys to switch between the entry line and the keyboard as well as to move within the keyboard. To select a character to add to the string, use the cursor keys to position the cursor over the desired character, and then press the ↵ key to add that character to the entry line.

On the right side of the keyboard are special functions. BKSP is used to move the cursor in the entry line one place to the left, deleting the character that was to the left of the cursor and moving any character at or to the right of the cursor one place to the left. PAGE is used to change the keyboard character page. For the English language, this switches between upper and lower-case alphabetic characters. SAVE stores the string from the entry line into the parameter. Alternately, if the active cursor is moved to the entry line, ↵ may be pressed to store the string from the entry line into the parameter.

Firmware Overview

The PM CEMS utilizes the menu-driven firmware as illustrated by the flowchart in Figure 3–3. The Power-Up screen, shown at the top of the flowchart, is displayed each time the instrument is turned on. This screen is displayed while the instrument is warming up and performing self-checks. After the warm-up period, the Run screen is automatically displayed. The Run screen normally displays the current PM concentrations, but also has additional Run screens for ambient conditions, sample conditions, and mass sensor data. From the Run screen, the Main Menu can be displayed by pressing ☰. The Main Menu contains a list of submenus. Each submenu contains related instrument settings. This chapter describes each submenu and screen in detail. Refer to the appropriate sections for more information.

Figure 3–3. Flowchart of Menu-Driven Firmware

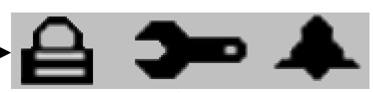
Power-Up Screen

The Power-Up screen is displayed when power is applied to the PM CEMS. This screen is displayed while the internal components are warming up and diagnostic checks are being performed.

Run Screens

The Run screens display PM concentrations, temperatures, pressures, flow, and neph/TEOM data. The status bar displays the time (24-hour format), the password (lock) icon, service (wrench) icon, alarm (bell) icon, and optional zero/span sample solenoid valve status, if installed.

Status Bar Icons

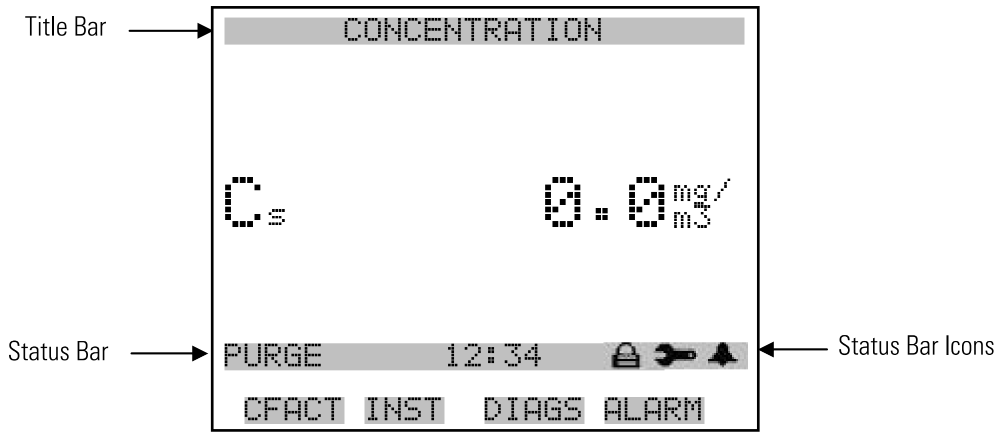


The password (lock) icon indicates that no parameter changes can be made from the front panel.

The alarm (bell) icon indicates that an alarm is active.

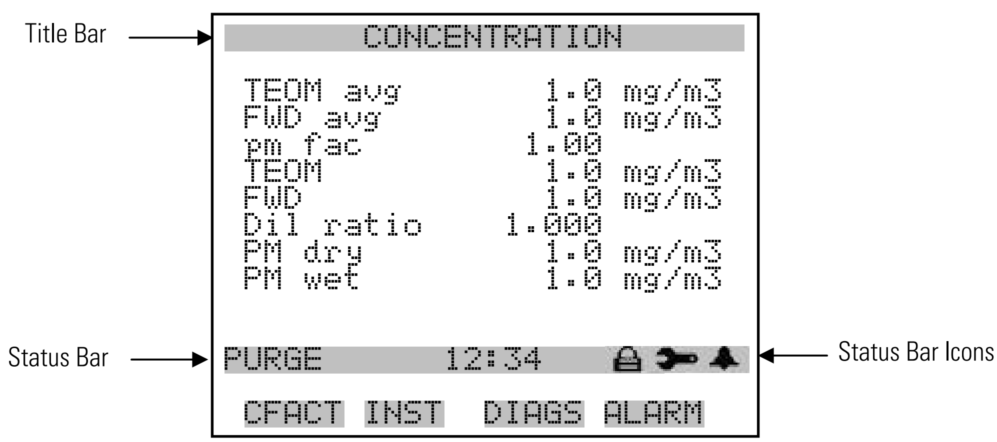
The service (wrench) icon indicates that the instrument is in the service mode.

The Concentration Run screen displays the current PM concentration. Pressing ↑ and ↓ will scroll through the different Run screens.



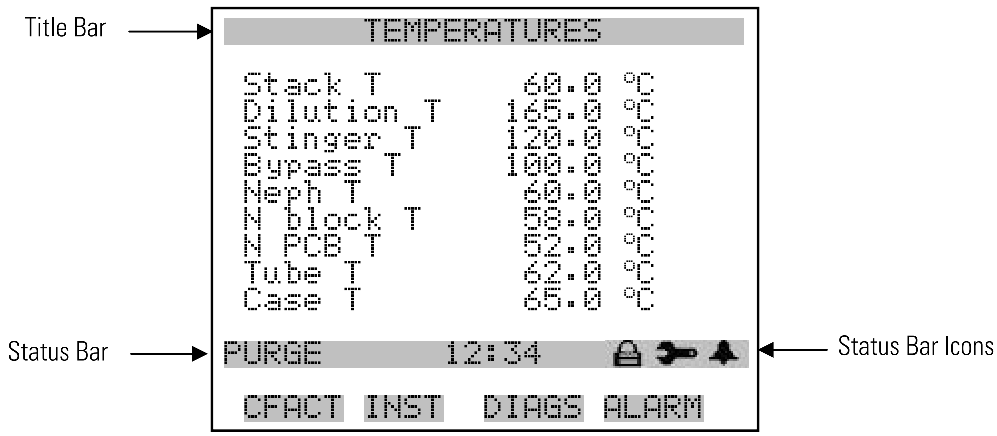
Concentration Screen

The Concentration Run screen displays PM concentrations. Pressing ↑ and ↓ will scroll through the different Run screens.



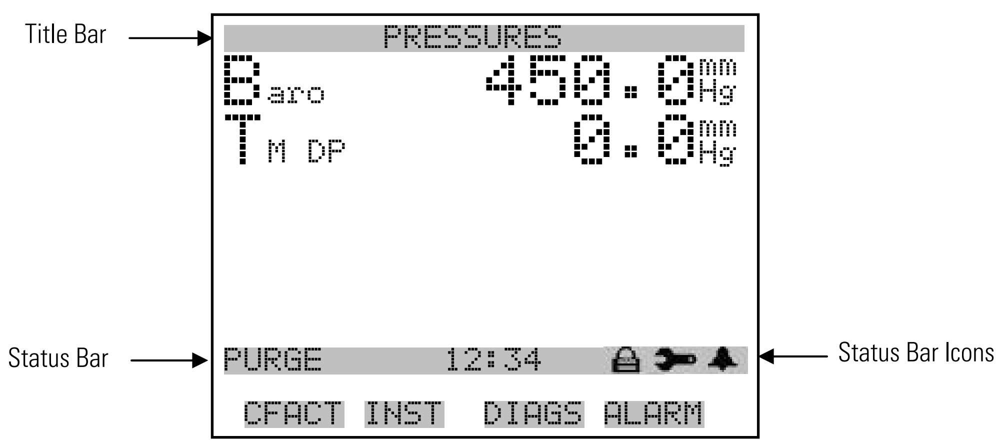
Temperatures Screen

The Temperatures Run screen normally displays the current temperatures. Pressing ↑ and ↓ will scroll through the different Run screens.



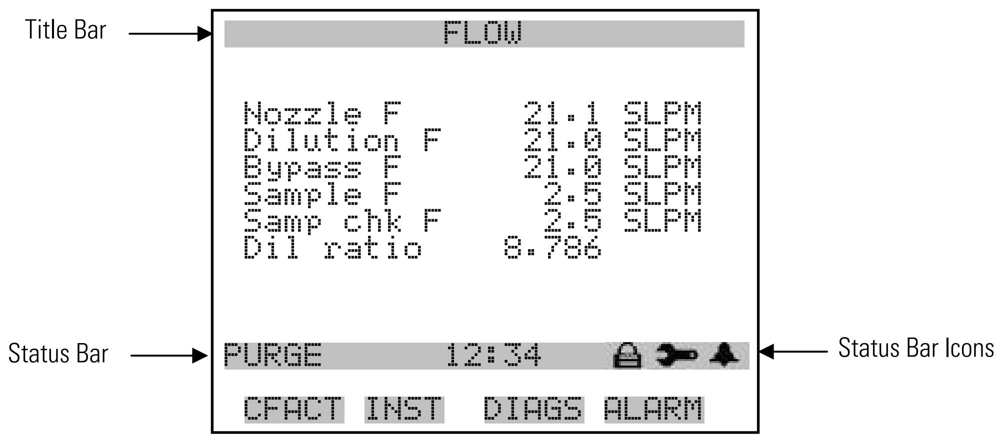
Pressures Screen

The Pressures Run screen normally displays the current PM pressures. Pressing ↑ and ↓ will scroll through the different Run screens.



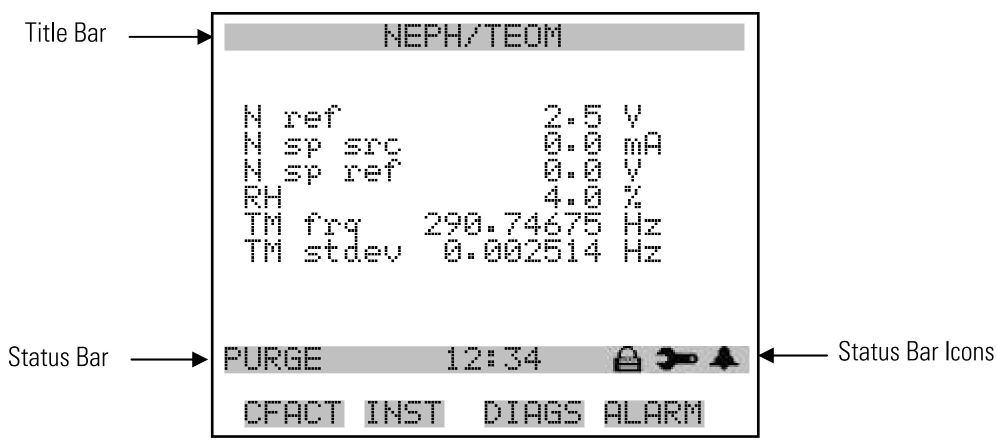
Flow Screen

The Flow Run screen normally displays the current PM flows. Pressing ↑ and ↓ will scroll through the different Run screens.



Neph/TEOM Screen

The Neph/TEOM Run screen displays the current nephelometer and TEOM data. Pressing ↑ and ↓ will scroll through the different Run screens.



Main Menu

The Main Menu contains a number of submenus. Instrument parameters and settings can be read and modified within the submenus according to their function. The concentration appears above the Main Menu and submenus in every screen. The Service menu is visible only when the instrument is in service mode. For more information on the service mode, see "Service Mode" later in this chapter.

- Use ↑ and ↓ to move the cursor up and down.
- Press ↵ to make a selection.
- Press ■ to return to the Main Menu or ▶ to return to the Run screen.

```
      CONCENTRATION
 Cs               0.0 mg/m3
PURGE       12:34
MAIN MENU:
>CALIBRATION FACTORS
 INSTRUMENT CONTROLS
 DIAGNOSTICS
 ALARMS
 SERVICE
 PASSWORD

 CFACT INST  DIAGS ALARM
```

Calibration Factors

The Calibration Factors screen allows the user to view current settings and choose the calibration curve type (Linear, Polynomial, Logarithmic, Exponential, Power or None) and calibration factors for PM wet concentration. Refer to PS-11 definitions to adjust these values.

- In the Main Menu, choose **Calibration Factors**.

```
PM WET CAL FACTORS:
       b0     b1     b2
>     0.000  0.000  0.000
                    NONE

 RESET USER CAL DEFAULTS

 CFACT INST  DIAGS ALARM
```

PM Wet Calibration Factors

The PM Wet Calibration Factors screen allows the user to view current settings and choose the calibration factors for the PM wet concentration. The factors use the same nomenclature as prescribed within the US EPA PS-11 document.

- In the Main Menu, choose Calibration Factors > (***current concentration calibration***).

```
PM WET VALUES:
  FACTOR b0: 000.0001     ?
  FACTOR b1: 000.0000
  FACTOR b2: 000.0000

           ←→ MOVE CURSOR
 ↑↓ CHANGE VALUE    ↵ SAVE

 CFACT INST  DIAGS ALARM
```

PM Wet Calibration Equation

The PM Wet Calibration Equation screen allows the user to view current settings and choose the calibration curve type (Linear, Polynomial, Logarithmic, Exponential, Power or None) for the PM wet concentration.

- In the Main Menu, choose Calibration Factors > (***current concentration calibration***).

```
PM WET CURVE:
 CURRENTLY:  NONE
    SET TO:  LINEAR       ?

 ↑↓ CHANGE VALUE    ↵ SAVE

 CFACT INST  DIAGS ALARM
```

Reset User Cal Defaults

The Reset user Cal Defaults screen is used to reset user calibration defaults.

- In the Main Menu, choose Calibration Factors > **Reset User Cal Defaults**.

```
RESTORE DEFAULT CAL:
                    ↵ RESTORE



 CFACT INST  DIAGS ALARM
```

```
RESTORE DEFAULT CAL:
                    ↵ RESTORE
ARE YOU SURE YOU WANT TO?
PRESS ➡ TO CONFIRM RESTORE

 CFACT INST  DIAGS ALARM
```

Instrument Controls Menu

The Instrument Controls menu contains a number of items dealing with instrument hardware control and configuration.

- In the Main Menu, choose **Instrument Controls**.

```
INSTRUMENT CONTROLS:
>FUNCTIONAL MODE
 VALUE POWER
 SET TEMPERATURES
 SET FLOWS
 SET FAILSAFES
 VELOCITY SETTINGS
 BLOW BACK SCHEDULE       ⬇

 CFACT INST  DIAGS ALARM
 MASS MODE SCHEDULE
 SYS CHECK SCHEDULE
 RESET TEOM TOTAL MASS
 NOZZLE SELECT
 SAMPLE STP
 DATALOGGING SETTINGS
 COMMUNICATION SETTINGS
 I/O CONFIGURATION
 SOLENOID STATES
 SCREEN CONTRAST
 SERVICE MODE
 DATE/TIME
 TIMEZONE
```

Functional Modes

The Functional Modes screen allows the user to select the current operating functional mode. This selection will be overridden by any set scheduled mode, unless in Service mode.

- In the Main Menu, choose Instrument Controls > **Functional Mode**.

```
FUNCTIONAL MODES:
>MONITOR
 MASS
 PURGE                  <--
 BLOWBACK
 MANUAL
 NEPH ZERO
 SINGL  SPAN SYS CHK      ↓

 CFACT INST  DIAGS ALARM

 MULTI SPAN SYS CHK
 PURGE ZERO   CHK
 PURGE SPAN 1 CHK
 PURGE SPAN 2 CHK
 PURGE SPAN 3 CHK
 PURGE SPAN 4 CHK
```

Valve Power

The Valve Power screen (read only) displays the valve status either ON or OFF. To toggle valves on/off, the system must be in Manual mode.

- In the Main Menu, choose Instrument Controls > **Valve Power**.

```
VALVE POWER:
>ACTUATOR                ON
 BLOWBACK               OFF
 DILUTION AIR            ON
 TEOM BYPASS             ON
 SAMPLE PUMP RELAY      OFF
 BYPASS PUMP RELAY       ON
 PI                      ON↓

 CFACT INST  DIAGS ALARM

 PD                     OFF
 PS                     OFF
```

Set Temperatures

The Set Temperatures menu allows the user to view and set all thermistor user desired values.

- In the Main Menu, choose Instrument Controls > **Set Temperatures**.

```
SET TEMPERATURES:
>DILUTION           120  °C
 STINGER             80  °C
 BYPASS              60  °C
 NEPH BLOCK          58  °C
 TEOM AIR TUBE       60  °C
 TEOM CASE           62  °C
 FAILSAFE             0  °C

 CFACT INST  DIAGS ALARM
```

Set Temperatures

The Set Temperatures screen allows the user to view and set temperature parameter for the selected component. The example below shows the Dilution Temp screen. The stinger, bypass, neph block, TEOM air tube, TEOM case, and failsafe screens function the same way.

- In the Main Menu, choose Instrument Controls > Set Temperatures > (***temperature***).

```
SET DILUTION TEMP:
 CURRENTLY:       120 °C
    SET TO:       100 °C ?

           ↑↓ INC/DEC
            ↵ SAVE VALUE

 CFACT INST  DIAGS ALARM
```

Set Flows

The Set Flows menu allows the user to view and set user desired flow values.

- In the Main Menu, choose Instrument Controls > **Set Flows**.

```
SET FLOWS:
>DILUTION SET FLOW
 BYPASS SET FLOW
 SAMPLE SET FLOW




 CFACT INST  DIAGS ALARM
```

Set Flows

The Set Flows screen allows the user to view and set flow parameter for the selected component. The example below shows the Dilution Flow screen. The bypass and sample flow screens function the same way.

- In the Main Menu, choose Instrument Controls > Set Flows > (***flow***).

```
SET DILUTION FLOW:
    CURRENTLY:   21.0 SLPM
       SET TO:   21.1 SLPM?

          ←→ MOVE CURSOR
 ↑↓ CHANGE VALUE    ↵ SAVE

 CFACT INST  DIAGS ALARM
```

Set Failsafes

The Set Failsafes screen allows the user to toggle the system failsafes ON or OFF. With the failsafe on, the system will go to Purge mode if either the relative humidity is greater than 90% or if the stinger or bypass temperatures fall below the set alarm values temperature.

- In the Main Menu, choose Instrument Controls > Set Flows > **Set Failsafes**.

```
SYSTEM FAILSAFES:
 CURRENTLY:          OFF
    SET TO:           ON ?

            ↵ TOGGLE VALUE

 CFACT INST  DIAGS ALARM
```

Velocity Settings

The Velocity Settings menu allows the user to enter the diluent stack gas concentrations analog or C-Link option for stack velocity measurement. It also permits the user to select the method of stack velocity measurement.

- In the Main Menu, choose Instrument Controls > **Velocity Settings**.

```
VELOCITY SETTINGS:
>CO2 %                5 %
 CO  %                0 %
 O2  %               12 %
 N2  %               78 %
 H2O %               15 %
 EXTERNAL VELOCITY

 CFACT INST  DIAGS ALARM
```

Set Gas

The Set Gas screen allows the user to establish the average stack gas concentration. The example below shows the Set CO_2 screen. The CO, O_2, N_2, and H_2O screens function the same way.

- In the Main Menu, choose Instrument Controls > Velocity Settings > (***Gas***).

```
SET CO2:
    CURRENTLY:      5 %
       SET TO:    005 %  ?

          ←→ MOVE CURSOR
 ↑↓ CHANGE VALUE   ↵ SAVE

 CFACT INST  DIAGS ALARM
```

External Velocity

The External Velocity screen allows the user to view and set external velocity to Measured, Analog, or CLink. This is necessary for isokinetic extraction.

- In the Main Menu, choose Instrument Controls > Velocity Settings > **External Velocity**

```
EXTERNAL VELOCITY:
 CURRENTLY:      MEASURED
    SET TO:        ANALOG?

           ↵ TOGGLE VALUE

 CFACT INST  DIAGS ALARM
```

Blow Back Schedule

The Blow Back Schedule menu allows the user to view the next scheduled time for a probe blow back as well as the period at which it occurs. It also allows schedule and period to be selected to bring you to the next screen to modify these values.

- In the Main Menu, choose Instrument Controls > **Blow Back Schedule**.

```
PROBE BLOW BACK SCHEDULE:
>NEXT TIME 01Jan06 00:00
 PERIOD     0 HRS  0 MIN




 CFACT INST  DIAGS ALARM
```

Next Time

The Next Time screen allows the user to view and set the date, hour and minute for the selected functional mode.

- In the Main Menu, choose Instrument Controls > Blow Back Schedule > **Next Time**.

```
NEXT DATE AND TIME:
 01 JAN 2006   00:00
 PRESS ↵ TO EDIT



 CFACT INST  DIAGS ALARM
```

```
NEXT DATE AND TIME:
 01 JAN 2006   00:00 ?
 SETTING:   DAYS
              ➡ SET MONTHS
             ⬆⬇ CHANGE VALUE
              ↵ SAVE VALUE
 CFACT INST  DIAGS ALARM
```

Period

The Blow Back Period screen allows the user to set hour and minute for the selected functional mode.

- In the Main Menu, choose Instrument Controls > Blow Back Schedule > **Period**.

```
BLOW BACK PERIOD:
 CURRENTLY:24 HRS  0 MIN
    SET TO: 8 HRS 00 MIN ?

         ⬅➡ SETTING HOURS
 ⬆⬇ CHANGE VALUE    ↵ SAVE
 CFACT INST  DIAGS ALARM
```

Mass Mode Schedule

The Mass Mode Schedule menu allows the user to view the next scheduled time for a TEOM Mass mode as well as the period at which it occurs. It also allows schedule and period to be selected to bring you to the next screen to modify these values. Auto Update toggles ON/OFF/NEVER.

- In the Main Menu, choose Instrument Controls > **Mass Mode Schedule**.

```
MASS MODE SCHEDULE:
>NEXT TIME   01Jan14 00:00
 PERIOD      24 HRS  0 MIN
 DURATION     2 HRS 30 MIN
 STABILIZE          25 MIN
 COLLECT      2 HRS  0 MIN
 INTEGRATION        15 MIN
 AUTO UPDATE           OFF

 CFACT INST  DIAGS ALARM
```

Next Time The Next Time screen is used to view and set the date, hour and minute for the selected functional mode.

- In the Main Menu, choose Instrument Controls > Mass Mode Schedule > **Next Time**.

```
NEXT DATE AND TIME:
 01 JAN 2014  00:00
 PRESS ↵ TO EDIT




 CFACT INST  DIAGS ALARM
```

```
NEXT DATE AND TIME:
 01 JAN 2014  00:00 ?
 SETTING:  DAYS
            ➡ SET MONTHS
           ⬆⬇ CHANGE VALUE
            ↵ SAVE VALUE

 CFACT INST  DIAGS ALARM
```

Period The Mass Mode Period screen allows the user to set hour and minute for the selected functional mode.

- In the Main Menu, choose Instrument Controls > Mass Mode Schedule > **Period**.

```
MASS MODE PERIOD:
 CURRENTLY: 0 HRS  0 MIN
    SET TO:24 HRS 00 MIN ?

       ⬅➡ SETTING MINUTES
 ⬆⬇ CHANGE VALUE   ↵ SAVE

 CFACT INST  DIAGS ALARM
```

Duration Duration allows the user to set stabilization and collection for the selected functional mode.

Stabilization

The Mass Mode Stabilization screen allows the user to set minute stabilization for the selected functional mode.

- In the Main Menu, choose Instrument Controls > Mass Mode Schedule > **Stabilization**.

```
MASS MODE STABILIZATION:
 CURRENTLY:       16 MIN
    SET TO:       30 MIN ?

 ↑↓ CHANGE VALUE    ↵ SAVE

 CFACT INST  DIAGS ALARM
```

Collection

The Mass Mode Collection screen allows the user to set hour and minute period for the selected functional mode.

- In the Main Menu, choose Instrument Controls > Mass Mode Schedule > **Collect**.

```
MASS MODE COLLECTION:
 CURRENTLY: 0 HRS  0 MIN
    SET TO:24 HRS  0 MIN ?

       ←→ SETTING MINUTES
 ↑↓ CHANGE VALUE    ↵ SAVE

 CFACT INST  DIAGS ALARM
```

Integration

The Mass Mode Integration screen allows the user to set minute integration for the selected functional mode.

- In the Main Menu, choose Instrument Controls > Mass Mode Schedule > **Integration**.

```
MASS MODE INTEGRATION:
 CURRENTLY:       15 MIN
    SET TO:       16 MIN ?

 ↑↓ CHANGE VALUE    ↵ SAVE

 CFACT INST  DIAGS ALARM
```

Auto Update

There are three Auto Update settings: ON, OFF, and NEVER. ON=updating PM factors every integration period. OFF=updates PM factors at end of mass mode. NEVER=does not update the PM factor.Pressing Auto Update toggles ON/OFF/NEVER.

- In the Main Menu, choose Instrument Controls > Mass Mode Schedule > **Auto Update**.

System Check Schedule

The System Check Schedule menu allows the user to view the next scheduled time for a daily system check as well as the period at which it occurs. It also allows schedule and period to be selected to bring you to the next screen to modify these values.

- In the Main Menu, choose Instrument Controls > **Sys Check Schedule**.

```
SYS CHECK SCHEDULE:
>NEXT TIME 01Jan12 00:00
 PERIOD     0 HRS  0 MIN




 CFACT INST  DIAGS ALARM
```

Next Time

The Next Time screen is used to view and set the date, hour and minute for the selected system check.

- In the Main Menu, choose Instrument Controls > Sys Check Schedule > **Next Time**.

```
NEXT DATE AND TIME:
 01 JAN 2006  00:00
 PRESS ↵ TO EDIT



 CFACT INST  DIAGS ALARM
```

```
NEXT DATE AND TIME:
 01 JAN 2006  00:00 ?
 SETTING:  DAYS
             → SET MONTHS
            ↑↓ CHANGE VALUE
             ↵ SAVE VALUE

 CFACT INST  DIAGS ALARM
```

Period

The Period screen allows the user to set hour and minute for the selected mode.

- In the Main Menu, choose Instrument Controls > Sys Check Schedule > **Period**.

```
SYS CHECK PERIOD:
 CURRENTLY: 0 HRS  0 MIN
    SET TO:24 HRS 00 MIN ?

          ←→ SETTING HOURS
 ↑↓ CHANGE VALUE    ↵ SAVE

 CFACT INST  DIAGS ALARM
```

Reset TEOM Total Mass

The Reset TEOM Total Mass screen allows the user to reset the accumulated mass to zero.

Note This should be done with a preliminary mass mode after the TEOM temperatures have stabilized. ▲

- In the Main Menu, choose Instrument Controls > **Reset TEOM Total Mass**.

```
RESET TEOM TOTAL MASS:

                ↵ RESET



 CFACT INST  DIAGS ALARM
```

```
RESET TEOM TOTAL MASS:

                ↵ RESET
ARE YOU SURE YOU WANT TO?
 PRESS → TO CONFIRM RESET

 CFACT INST  DIAGS ALARM
```

Nozzle Select

The Nozzle Select screen allows the user to select which nozzle is used. Nozzle 0 is the default nozzle size and will only operate the system with a fixed dilution ratio. If Nozzle 1–5 is selected, the dilution air will vary to maintain an isokinetic sample extraction. The proper stack gas velocity profile will be needed.

Note Please consult the online library before selecting a nozzle size. ▲

- In the Main Menu, choose Instrument Controls > **Nozzle Select**.

```
NOZZLES:   D(in) D(mm)
>NOZZLE 0              <--
 NOZZLE 1 .047  1.194
 NOZZLE 2 .063  1.600
 NOZZLE 3 .078  1.981
 NOZZLE 4 .094  2.388
 NOZZLE 5 .125  3.175
 FLOW SET       2.50 SLPM

 CFACT INST  DIAGS ALARM
```

Sample STP

The Sample STP screen allows the user to correct the measured concentration to a standard pressure and temperature.

- In the Main Menu, choose Instrument Controls > **Sample STP**.

```
ENTER SAMPLE STP:
    PRESSURE: 780.0  mmHg
 TEMPERATURE: 020.0   °C

          ←→ MOVE CURSOR
 ↑↓ CHANGE VALUE    ↵ SAVE

 CFACT INST  DIAGS ALARM
```

Datalogging Settings

The PM CEMS includes a built-in datalogging capability as a standard feature. The operator is allowed to create two different types of records, which for historical reasons, are named lrecs and srecs. Each record can contain up to 32 different fields, or data items, and records can be created at user-defined intervals ranging from 1 to 60 minutes.

Record generation is tied to the instrument's real-time clock. For example, if the logging period for srecs is set to 30 minutes, a new srec will be generated on every hour and every half hour (10:00, 10:30, 11:00 …). Lrecs and srecs function independent of each other. So, for example, an srec containing just the current PM level could be generated every 5 minutes while an lrec containing a full set of diagnostic data could be generated once every hour.

The analyzer's computer system includes three megabytes of flash memory which is enough to store a full lrec containing 32 data items and a full srec containing 32 items once each minute for a week (>20,000 total records). If logging is limited to the minimum content of date, time, PM concentration and error flags, the analyzer can store data once each minute for 4 months (>190,000 total records).

See Table 3–2 for a list of default datalogging variables and descriptions.

Table 3–2. Default Datalogging Variables

Concentration Menu	In Log Files	Description
PM WET	PMWET	Wet basis PM - in mg/m3
PM DRY	PMDRY	Dry basis PM - in mg/m3
PM FACTOR	PMFAC	PM Factor - current PM Factor
FWD	FWD	Nephelometer Forward Concentration - in mg/m3 (1 minute average)
TEOM CONC	TMC	TEOM Concentration - in mg/m3 (1 minute average)
FWD AVG	FAVG	Forward Concentration Average - in mg/m3 (based on customer defined average time)
TEOM INST	TMCI	TEOM Concentration Instantaneous - in mg/m3
FWD INST	FWDI	Forward Concentration Instantaneous - in mg/m3
TEOM AVG	TMAVG	TEOM Average - in mg/m3 (average over entire mass mode)
NEPH CAL MAX	NCM	Nephelometer MAX Cal
CS	CS	PS-11 based PM Concentration - in mg/m3
Other Measurements Menu	**In Log Files**	**Description**
TEMP STACK	TSTK	Stack Temperature - in Degrees C
TEMP DELUTN	TDIL	Dilution Temperature - in Degrees C
TEMP STINGER	TSTG	Stinger Temperature - in degrees C
TEMP BYPASS	TBLK	Bypass Temperature - in degrees C
TEMP NEPH	NITMP	Nephelometer Temperature - in Degrees C
TEMP NEPH BK	TNBLK	Nephelometer Block Temperature - in Degrees C
TEMP NEPH PC	NETMP	Nephelometer PC Temperature - in Degrees C
TEMP TE AIR	TAIR	TEOM Air Temperature - in Degrees C
TEMP TE CASE	TCAS	TEOM Case Temperature - in Degrees C
TEMP PROB CN	TMPC	Probe Controller Temperature - in Degrees C
NEPH SOURCE	NSRC	Nephelometer Source Current - in mA
NEPH REF DET	NREFV	Nephelometer Reference Detector Source Voltage - in VDC
NEPH SPN SRC	SIRED	Nephelometer Span Source Current - in mA
NEPH SPN REF	NSREF	Nephelometer Span Reference Detector Source Voltage - in VDC
NEPH RH	NRH	Nephelometer Relative Humidity - in %

Concentration Menu	In Log Files	Description
TEOM FREQ	TFREQ	TEOM Frequency - in Hz
TEOM STDEV	TSTDV	TEOM Standard Deviation - in Hz
TEOM K0	TK0	TEOM K0 Factor - of the TEOM Transducer
NEPH GAINS	NGAIN	Nephelometer Gains - current Nephelometer gain range.
AIR TUBE PWR	AIRDC	Air Tube Power - in % cycle power 'ON'
CASE POWER	CASDC	Case Power - in % cycle power 'ON'
TEOM F0	TF0	TEOM F0
Other Measurements 2 Menu	**In Log Files**	**Description**
PRESS BARO	PBAR	Barometric Pressure - at the PM CEMS Controller in mmHG.
SPAN 4 CONC	SP4	Nephelometer Span 4 Concentration - in mg/m3
SPAN 3 CONC	SP3	Nephelometer Span 3 Concentration - in mg/m3
DP TEOM	TMDP	TEOM DP Pressure - in mmHg
FLOW NOZZLE	FNOZ	Nozzle flow - in SLPM
SPAN 2 CONC	SP2	Nephelometer Span 2 Concentration - in mg/m3
FLW DILUTION	FDIL	Dilution Flow - in SLPM
FLOW BYPASS	FBSTD	Bypass Flow - in SLPM
FLW SAMPLE	FSAMP	Sample Flow - in SLPM
FLOW SAMP CHK	SCHK	Sample Check Flow - in SLPM
DIL RATIO	DILRA	Dilution Ratio - of the stack gas sample
STK VELOCITY	STVEL	Stack Velocity - m/s
FWD Z DRIFT	FZDFT	Forward Zero Drift - in %
FWD SP DRIFT	FSDFT	Forward Span Drift - in %
TOTAL MASS	TMASS	Total Mass - that has been accumulated on the TEOM filter.
FLW SAMP DFT	FPDFT	Sample Flow Drift - in %
TEOM CYCLES	TECYC	TEOM Cycles
REF CLOCKS	RCLK	Reference Clocks
NEPH BKG FLAG	NBKGF	Nephelometer Back Ground Flags
NEPH OFT FLG	NOFTF	Nephelometer Offset Flags
FLOW PURGE	FPURG	Purge Flow - purge flow of the Nephelometer.

The Datalogging Settings menu allows the user flexibility in how data is stored and recorded.

- In the Main Menu, choose Instrument Controls > **Datalogging Settings**.

```
DATALOGGING:
>SELECT SREC/LREC    LREC
 VIEW LOGGED DATA
 ERASE LOG
 SELECT CONTENT
 COMMIT CONTENT
 RESET TO DEFAULT CONTENT
 CONFIGURE DATALOGGING

 CFACT INST  DIAGS ALARM
```

Select Srec/Lrec

The Select Srec/Lrec screen is used to select the log record type for other operations in this menu.

- In the Main Menu, choose Instrument Controls > Datalogging Settings > **Select Srec/Lrec**.

```
SELECT LOG TYPE:
 CURRENTLY:         SREC
    SET TO:         LREC ?

            ↵ TOGGLE VALUE

 CFACT INST  DIAGS ALARM
```

View Logged Data

The View Logged Data screen is used to select the starting point to view the logged data by the number of records or by date and time. Note that both types of records cannot be viewed at the same time, only the selected record type.

- In the Main Menu, choose Instrument Controls > Datalogging Settings > **View Logged Data**.

```
SELECT START POINT BY:

    SET TO: # OF RECS

  ↑↓ CHANGE     ↵ ACCEPT
 CFACT INST  DIAGS ALARM
```

Number of Records

The Number of Records screen is used to select the number of records to view, ending with the most recent. It also shows the total number of records that have been logged for the selected record type.

```
SET # BACK FROM CURRENT:
                 0000000
TOTAL LRECS:          20

          ←→ MOVE CURSOR
 ↑↓ CHANGE VALUE    ↵ SAVE

 CFACT INST  DIAGS ALARM
```

The Record Display screen (read only) displays the selected records.

```
 time    date    flags
 10:01 01/20/09  8105151
 10:02 01/20/09  8105151
 10:03 01/20/09  8105151
 10:04 01/20/09  8105151
  ↑↓ PGUP/DN   ←→ PAN L/R

 CFACT INST  DIAGS ALARM
```

Date and Time

The Date and Time screen is used to set a start date and time for which to view logged data. For example, if "20 Jan 2009 10:00" is entered, then the first logged data record that is displayed is the first record after this time. If set to one minute logging, this would be at "20 Jan 2009 10:01".

```
DATE AND TIME:
 20 JAN 2009  10:00
 ↑↓ CHG   DAYS
 → SET CURSOR TO MONTHS
 ↵ ACCEPT AS SHOWN

 CFACT INST  DIAGS ALARM
```

The Record Display screen (read only) displays the selected records.

```
time    date     flags
10:01 01/20/09  8105151
10:02 01/20/09  8105151
10:03 01/20/09  8105151
10:04 01/20/09  8105151
 ↑↓ PGUP/DN   ←→ PAN L/R

CFACT INST  DIAGS ALARM
```

Erase Log

The Erase Log screen is used to erase all saved data for the selected record type only (not both srecs and lrecs).

- In the Main Menu, choose Instrument Controls > Datalogging Settings > **Erase Log**.

```
ERASE LREC LOG FILE DATA?

               ↵ ERASE



 CFACT INST  DIAGS ALARM
```

```
ERASE LREC LOG FILE DATA?

               ↵ ERASE
ARE YOU SURE YOU WANT TO?
PRESS → TO CONFIRM ERASURE


 CFACT INST  DIAGS ALARM
```

Select Content

The Select Content submenu displays a list of 32 record fields to use to configure the data to be logged. When a field is selected, a submenu list appears of the items to choose from to assign to those fields. Item types are Concentrations, Other Measurements, and Analog Inputs. These record fields comprise a temporary list of items for the selected record type that must be committed via the datalogging menu before the changes will apply. Note that committing any changes to this list will erase all currently logged data for the selected record type only, as the format of the stored data is changed.

- In the Main Menu, choose Instrument Controls > Datalogging Settings > **Select Content**.

```
LREC FIELDS:
>FIELD 1             FDSTD
 FIELD 2             PMWET
 FIELD 3              TBLK
 FIELD 4              TSTK
 FIELD 5              TMPC
 FIELD 6              PVOR
 FIELD 7             FVSTD ↓

 CFACT INST  DIAGS ALARM
```

Choose Field Data

The Choose Field Data submenu displays a list of the types of data that can be logged for the current field. Choices are Concentrations, Other Measurements, Analog Inputs, and Other Measurements 2.

- In the Main Menu, choose Instrument Controls > Datalogging Settings > Select Content > **Field 1–32**.

```
DATA IN LREC FIELD 1:
>CONCENTRATIONS
 OTHER MEASUREMENTS
 ANALOF INPUTS
 OTHER MEASUREMENTS 2



 CFACT INST  DIAGS ALARM
```

Concentrations

The Concentrations screen allows the user to assign one of the concentrations to the selected record field. The currently selected item is shown by "<--" after it. Note that at this point, pressing indicates that these are proposed changes as opposed to implemented changes. To change the selected record format and erase record log file data, see "Commit Content" below.

- In the Main Menu, choose Instrument Controls > Datalogging Settings > Select Content > select Field > **Concentrations**.

```
CONCENTRATIONS:
>NONE
 PM WET                 <--
 PM DRY
 PM FACTOR
 FWD
 TEOM CONC
 FWD AVG                  ↓

 CFACT INST  DIAGS ALARM

 TEOM INST
 FWD INST
 TEOM AVG
 CS
```

Other Measurements

The Other Measurements screen allows the user to assign one of the other available measurement types to the selected record field. The currently selected item is shown by "<--" after it. Items displayed are determined by the options installed. For Flags, see Figure 3–4 for data descriptions. Note that at this point, pressing ↵ indicates that these are proposed changes as opposed to implemented changes. To change the selected record format and erase record log file data, see "Commit Content" below.

- In the Main Menu, choose Instrument Controls > Datalogging Settings > Select Content > select Field > **Other Measurements**.

```
OTHER MEASUREMENTS:
>NONE
 TEMP STACK
 TEMP DILUTN
 TEMP STINGER
 TEMP BYPASS
 TEMP NEPH
 TEMP NEPH BK

 CFACT INST  DIAGS ALARM
 TEMP NEPH PC
 TEMP TE AIR
 TEMP TE CASE
 TEMP PROB CN
 NEPH SOURCE
 NEPH REF DET
 NEPH SPN SRC
 NEPH SPN REF
 NEPH RH
 TEOM FREQ
 TEOM STDEV
 TEOM K0
 NEPH GAINS
 AIR TUBE PWR
 CASE PWR
```

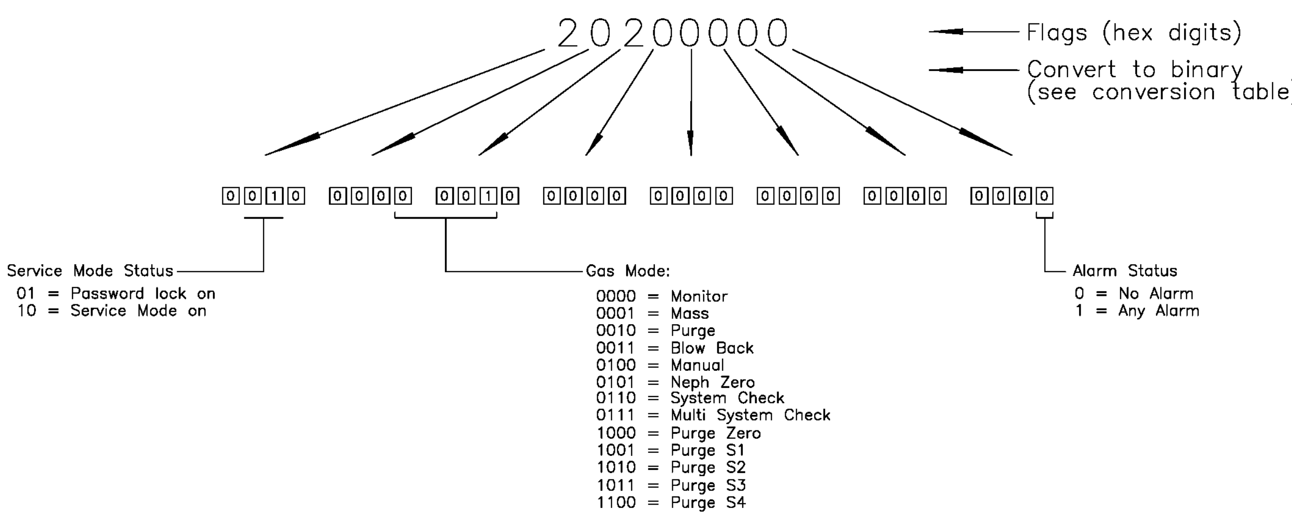


Figure 3–4. Flags Field

Analog Inputs

The Analog Inputs screen allows the user to select the parameter (none or analog input 1–8) to the selected field. The selected item is shown by "<--" after it. Note that at this point, pressing ↵ indicates that these are proposed changes as opposed to implemented changes. To change the selected record format and erase record log file data, see "Commit Content" below.

- In the Main Menu, choose Instrument Controls > Datalogging Settings > Select Content > select Field > **Analog Inputs**.

```
ANALOG INPUTS:
>NONE
 ANALOG IN 1           <--
 ANALOG IN 2
 ANALOG IN 3
 ANALOG IN 4
 ANALOG IN 5
 ANALOG IN 6             ↓

 CFACT INST  DIAGS ALARM
```

Other Measurements 2

The Other Measurements 2 screen allows the user to assign one of the other available measurement types to the selected record field. The currently selected item is shown by "<--" after it. Items displayed are determined by the options installed. Note that at this point, pressing ↵ indicates that these are proposed changes as opposed to implemented changes. To change the selected record format and erase record log file data, see "Commit Content" below.

- In the Main Menu, choose Instrument Controls > Datalogging Settings > Select Content > select Field > **Other Measurements 2**.

```
OTHER MEASUREMENTS 2:
>NONE
 PRES BARO
 DP TEOM
 FLOW NOZZLE
 FLOW NOX STK
 FLW DILUITON
 FLW BYPASS                  ↓

 CFACT INST   DIAGS ALARM
```

```
 FLW SAMPLE
 FLW SAMP CHK
 DIL RATIO
 STK VELOCITY
 FWD Z DRIFT
 FWD SP DRIFT
 TOTAL MASS
 FLW SAMP DFT
 TEOM CYCLES
 REF CLOCKS
 NEPH BKG G4
 NEPH BKG G5
 FLW PURGE
```

Commit Content

The Commit Content screen is used to save any changes that have been made to any of the record fields for the selected record type. Saving changes will erase record log file data for that record type. If no changes have been made "NO CHANGES TO RECORD LIST!" will appear. For more information about selecting the content of logged data fields, see "Select Content" above.

- In the Main Menu, choose Instrument Controls > Datalogging Settings > **Commit Content**.

```
CHANGE LREC DATA AND
ERASE LREC LOG FILE DATA?
                ↵ COMMIT




 CFACT INST   DIAGS ALARM
```

```
CHANGE LREC DATA AND
ERASE LREC LOG FILE DATA?
                ↵ COMMIT
ARE YOU SURE YOU WANT TO?
PRESS → TO CONFIRM ERASURE


 CFACT INST   DIAGS ALARM
```

Reset to Default Content

The Reset to Default Content screen is used to reset all of the datalogging record field items to default values for the selected record type. For more information about selecting the content of logged data fields, see "Select Content" above.

- In the Main Menu, choose Instrument Controls > Datalogging Settings > **Reset to Default Content**.

```
RESET LREC DATA AND
ERASE LREC LOG FILE DATA?
                ↵ RESET



 CFACT INST  DIAGS ALARM
```

```
RESET LREC DATA AND
ERASE LREC LOG FILE DATA?
                ↵ RESET
ARE YOU SURE YOU WANT TO?
PRESS ➡ TO CONFIRM RESET


 CFACT INST  DIAGS ALARM
```

Configure Datalogging

The Configure Datalogging menu deals with datalogging configuration for the currently selected record type.

- In the Main Menu, choose Instrument Controls > Datalogging Settings > **Configure Datalogging**.

```
DATALOGGING SETTINGS:
>LOGGING PERIOD MIN    60
 MEMORY ALLOCATION %   50
 DATA TREATMENT       AVG
 FLAG STATUS DATA      ON


 CFACT INST  DIAGS ALARM
```

Logging Period Min

The Logging Period Min screen is used to select the logging period in minutes for the selected record format (srec or lrec). List of choices include: off, 1, 5, 15, 30, and 60 minutes (default).

- In the Main Menu, choose Instrument Controls > Datalogging Settings > Configure Datalogging > **Logging Period Min**.

```
SET PERIOD FOR SREC:
 CURRENTLY:       5 MIN
    SET TO:         OFF ?

 ↑↓ CHANGE VALUE    ↵ SAVE


 CFACT INST  DIAGS ALARM
```

Memory Allocation Percent

The Memory Allocation Percent screen is used to select the percentage of total memory that may be used by the selected record type (lrecs or srecs). Percentages between 0 and 100% are available in increments of 10. Changing this value results in log erasure for both types of records, and changing the percent allocated to one record type will automatically change the other.

- In the Main Menu, choose Instrument Controls > Datalogging Settings > Configure Datalogging > **Memory Allocation %**.

```
SET PERCENT LRECS:
 CURRENTLY:          50%
    SET TO:          30% ?

 ↑↓ CHANGE VALUE    ↵ SAVE

 CFACT INST  DIAGS ALARM
```

```
SET PERCENT LRECS:
 CURRENTLY:          50%
    SET TO:          30% ?
THIS WILL ERASE ALL LOGS!
 PRESS ➡ TO CONFIRM CHANGE

 CFACT INST  DIAGS ALARM
```

Data Treatment

The Data Treatment screen is used to select the data type for the selected record type: whether the data should be averaged over the interval, the minimum or maximum measured during the interval, or the current value (last value measured). Data treatment doesn't apply to all data, just to the concentration measurement. All other data points log the current value at the end of the interval.

Note This feature is found in all *i*Series instruments, but it is recommended that the data type be set to ONLY the current value (cur), as the datalogging averaging is done in addition to the normal concentration averaging. ▲

- In the Main Menu, choose Instrument Controls > Datalogging Settings > Configure Datalogging > **Data Treatment**.

```
SET LREC DATA TYPE:
 CURRENTLY:  AVG
    SET TO:  CUR         ?

 ↑↓ CHANGE VALUE    ↵ SAVE

 CFACT INST  DIAGS ALARM
```

Flag Status Data

The Flag Status Data screen is used to set the flag status data to either ON or OFF for the selected record type.

- In the Main Menu, choose Instrument Controls > Datalogging Settings > Configure Datalogging > **Flag Status Data**.

```
SET LREC FLAG STATUS DATA:
 CURRENTLY: OFF
    SET TO: ON          ?

 ↑↓ CHANGE VALUE    ↵ SAVE

 CFACT INST  DIAGS ALARM
```

Communication Settings

The Communication Settings menu is used for communications control and configuration.

- In the Main Menu, choose Instrument Controls > **Communication Settings**.

```
COMMUNICATION SETTINGS:
>SERIAL SETTINGS
 INSTRUMENT ID
 GESYTEC SERIAL NO
 COMMUNICATION PROTOCOL
 STREAMING DATA CONFIG
 TCP/IP SETTINGS

 CFACT INST  DIAGS ALARM
```

Serial Settings

The Serial Setting submenu is used for serial communications control and configuration.

- In the Main Menu, choose Instrument Controls > Communication Settings > **Serial Settings**.

```
SERIAL SETTINGS:
>BAUD RATE          9600
 DATA BITS             8
 PARITY             NONE
 STOP BITS             1
 RS-232/485 SEL   RS-232


 CFACT INST  DIAGS ALARM
```

Baud Rate

The Baud Rate screen is used to set the RS-232/RS-485 interface baud rate. Baud rates of 1200, 2400, 4800, 9600, 19200, 38400, 57600, and 115200 are available. The analyzer's default baud rate is set to 9600 to provide backwards compatibility with the older C-series analyzers.

- In the Main Menu, choose Instrument Controls > Communication Settings > Serial Settings > **Baud Rate**.

```
BAUD RATE:
 CURRENTLY:           9600
    SET TO:          19200 ?

             ↑↓ CHANGE VALUE
              ↵ SAVE VALUE

 CFACT INST  DIAGS ALARM
```

Data Bits The Data Bits screen is used to set the number of serial data bits to either 7 or 8 (default).

- In the Main Menu, choose Instrument Controls > Communication Settings > Serial Settings > **Data Bits**.

```
DATA BITS:
 CURRENTLY:              8
    SET TO:              7 ?

             ↑↓ CHANGE VALUE
              ↵ SAVE VALUE

 CFACT INST  DIAGS ALARM
```

Parity The Parity screen is used to select the parity bit for the serial port to None (default), Even, or Odd.

- In the Main Menu, choose Instrument Controls > Communication Settings > Serial Settings > **Parity**.

```
PARITY:
 CURRENTLY:           NONE
    SET TO:            ODD ?

             ↑↓ CHANGE VALUE
              ↵ SAVE VALUE

 CFACT INST  DIAGS ALARM
```

Stop Bits The Stop Bits screen is used to set the number of stop bits for the serial port to 1 (default) or 2.

- In the Main Menu, choose Instrument Controls > Communication Settings > Serial Settings > **Stop Bits**.

```
STOP BITS:
 CURRENTLY:            1
    SET TO:            2 ?

           ↑↓ CHANGE VALUE
            ↵ SAVE VALUE

 CFACT INST   DIAGS ALARM
```

RS-232/RS-485 Selection

The RS-232/RS-485 Selection screen allows the user to choose between the RS-232 or RS-485 specification for serial communication.

Equipment Damage Disconnect the serial cable before changing the RS-232 and RS-485 selection to prevent damage to any equipment currently connected to the analyzer. ▲

- In the Main Menu, choose Instrument Controls > Communication Settings > Serial Settings > **RS-232/485 Selection**.

```
RS-232/RS-485 SELECT:
      ** WARNING **
  DISCONNECT THE SERIAL
  CABLES BEFORE CHANGING
      THE SELECTION!
            ↵ TO CONTINUE

 CFACT INST   DIAGS ALARM
```

```
RS-232/RS-485 SELECT:
 CURRENTLY:        RS-232
    SET TO:        RS-485 ?
MAKE SURE THAT THE CABLE
IS OFF: PRESS → TO CONFIRM
            ↵ TOGGLE VALUE

 CFACT INST   DIAGS ALARM
```

Instrument ID

The Instrument ID screen allows the operator to edit the instrument ID number. The ID is used to identify the instrument when using the C-Link or MODBUS protocols to control the instrument or collect data. It may be necessary to edit the ID number if two or more instruments of the same model are connected to one computer. Valid instrument ID numbers are from 0 to 127. The PM CEMS has a default instrument ID of 80. For more information about the instrument ID, see Appendix B "C-Link Protocol" or Appendix C "MODBUS Protocol".

- In the Main Menu, choose Instrument Controls > Communication Settings > **Instrument ID**.

```
INSTRUMENT ID:
 CURRENTLY:            80
    SET TO:            81 ?

           ↑↓ CHANGE VALUE
            ↵ SAVE VALUE

 CFACT INST  DIAGS ALARM
```

Gesytec Serial Nunber

The Gesytec Serial Number screen is used to set the serial number for the Gesytec protocol. The Gesytec serial number defaults to zero. For more information about the serial number, see Appendix D, "Gesytec (BH) Protocol".

- In the Main Menu, choose Instrument Controls > Communication Settings > **Gesytec Serial No**.

```
GESYTEC SERIAL NO:
 CURRENTLY:             0
    SET TO:             1 ?

           ↑↓ CHANGE VALUE
            ↵ SAVE VALUE

 CFACT INST  DIAGS ALARM
```

Communication Protocol

The Communication Protocol screen is used to change the protocol for serial communications. Possible choices include: C-Link, MODBUS, Gesytec, and Streaming Data.

- In the Main Menu, choose Instrument Controls > Communication Settings > **Communication Protocol**.

```
COMMUNICATION PROTOCOL:
 CURRENTLY:         CLINK
    SET TO:     STREAMING ?

           ↑↓ CHANGE VALUE
            ↵ SAVE VALUE

 CFACT INST  DIAGS ALARM
```

Streaming Data Configuration

The Streaming Data Configuration menu is used to allow for configuration of the 8 streaming data output items, streaming interval, current data format, and current timestamp setting. The Choose Stream Data submenu displays a list of the analog output signal group choices to choose from.

Choices are Concentrations, Other Measurements, Other Measurements 2 and Analog Inputs.

- In the Main Menu, choose Instrument Controls > Communication Settings > **Streaming Data Config**.

```
STREAMING DATA CONFIG
>INTERVAL           10 SEC
 ADD LABELS            YES
 PREPEND TIMESTAMP     YES
 ADD FLAGS             YES
 ITEM 1             PM WET
 ITEM 2               NONE
 ITEM 3               NONE ↓

 CFACT INST  DIAGS ALARM
```

Streaming Data Interval

The Streaming Data Interval screen is used to adjust how frequently a new record will be generated. The following interval times are available: 1, 2, 5, 10, 20, 30, 60, 90, 120, 180, 240, and 300 seconds.

- In the Main Menu, choose Instrument Controls > Communication Settings > Streaming Data Config > **Interval**.

```
STREAMING DATA INTERVAL:
 CURRENTLY:         10 SEC
    SET TO:         20 SEC ?

           ↑↓ CHANGE VALUE
            ↵ SAVE VALUE

 CFACT INST  DIAGS ALARM
```

Note Add Labels, Prepend Timestamp, and Add Flags are toggle items that change between yes or no when selected. ▲

Select Stream Data

The Select Stream Data screen displays a list of the types of data that can be sent via streaming data. Choices are Concentrations, Other Measurements, Measurements 2, and Analog Outputs.

- In the Main Menu, choose Instrument Controls > Communication Settings > Streaming Data Config > **Item 1–8**.

```
SELECT STREAM DATA:
>CONCENTRATIONS
 OTHER MEASUREMENTS
 OTHER MEASUREMENTS 2



 CFACT INST  DIAGS ALARM
```

Concentrations

The Concentrations screen allows the user to assign one of the concentrations to the selected streaming data item. The currently selected item is shown by "<--" after it. Once an item is selected, pressing ↵ will save the selected streaming data item.

- In the Main Menu, choose Instrument Controls > Communication Settings > Streaming Data Config > select Item > **Concentrations**.

```
CONCENTRATIONS:
>NONE
 PM WET                   <--
 PM DRY
 PM FACTOR
 FWD
 TEOM CONC
 FWD AVG                    ↓

 CFACT INST  DIAGS ALARM
 TEOM INST
 FWD INST
 TEOM AVG
 CS
```

Other Measurements

The Other Measurements screen allows the user to assign one of the other available measurement types to the selected streaming data item. The currently selected item is shown by "<--" after it. Once an item is selected, pressing ↵ will save the selected streaming data item.

- In the Main Menu, choose Instrument Controls > Communication Settings > Streaming Data Config > select Item > **Other Measurements**.

```
OTHER MEASUREMENTS:
>NONE
 TEMP STACK
 TEMP DILUTN
 TEMP STINGER
 TEMP BYPASS
 TEMP VENTURI
 TEMP NEPH                    ↓

 CFACT INST  DIAGS ALARM

 TEMP NEPH BK
 TEMP NEPH PC
 TEMP TE AIR
 TEMP TE CASE
 TEMP PROB CN
 NEPH SOURCE
 NEPH REF DET
 NEPH SPN SRC
 NEPH SPN REF
 NEPH RH
 TEOM FREQ
 TEOM STDEV
 TEOM K0
 NEPH GAINS
 AIR TUBE PWR
 CASE PWR
```

Other Measurements 2

The Other Measurements 2 screen allows the user to assign one of the other available measurement types to the selected record field. The currently selected item is shown by "<--" after it. Items displayed are determined by the options installed. Note that at this point, pressing ↵ indicates that these are proposed changes as opposed to implemented changes. To change the selected record format and erase record log file data, see "Commit Content" below.

- In the Main Menu, choose Instrument Controls > Datalogging Settings > Select Content > select Field > **Other Measurements 2**.

```
OTHER MEASUREMENTS 2:
>NONE
 PRES BARO
 PRES STATIC
 DP NOZZLE
 FLW NOZZLE
 FLW NOZZLE STK
 FLW DILUTION                 ↓

 CFACT INST  DIAGS ALARM
```

```
 FLW BYPASS
 FLW SAMPLE
 FLW SAMP CHK
 DIL RATIO
 STK VELOCITY
 FWD Z DRIFT
 FWD SP DRIFT
 TOTAL MASS
 FLW SAMP DFT
 TEOM CYCLES
 REF CLOCKS
 NEPH BKG G4
 NEPH BKG G5
 FLW PURGE
```

Analog Inputs

The Analog Inputs screen allows the user to assign an analog input signal (none or analog input 1–8) to the selected streaming data item. The currently selected item is shown by “<--” after it. Once an item is selected, pressing ↵ will save the selected streaming data item.

- In the Main Menu, choose Instrument Controls > Datalogging Settings > Select Content > select Field > **Analog Inputs**.

```
ANALOG INPUTS:
>NONE
 ANALOG IN 1            <--
 ANALOG IN 2
 ANALOG IN 3
 ANALOG IN 4
 ANALOG IN 5
 ANALOG IN 6                  ↓

 CFACT INST  DIAGS ALARM
```

TCP/IP Settings

The TCP/IP Settings menu is used for defining parameters that are required for Ethernet communications.

Note The instrument power must be cycled after any of these parameters have been changed for the change to take effect. ▲

- In the Main Menu, choose Instrument Controls > Communication Settings > **TCP/IP Settings**.

```
TCP/IP SETTINGS:
>USE DHCP              OFF
 IP ADDR     10.209.40.149
 NETMASK     255.255.252.0
 GATEWAY       10.209.42.1
 HOST NAME         ISERIES
 NTP SVR     10.209.43.237

 CFACT INST  DIAGS ALARM
```

Use DHCP

The Use DHCP screen is used to specify whether to use Dynamic Host Configuration Protocol (DHCP) or not. When DHCP is enabled, the network dynamically provides an IP address for the instrument.

- In the Main Menu, choose Instrument Controls > Communication Settings > TCP/IP Settings **> Use DHCP**.

```
DHCP:
 CURRENTLY:           OFF
    SET TO:            ON ?

           ↵ TOGGLE VALUE
CYCLE POWER TO CHANGE DHCP
 CFACT INST  DIAGS ALARM
```

IP Address

The IP Address screen is used to edit the IP address. The IP address can only be changed when DHCP is off. If DHCP is on, the instrument will respond with "NOT SETTABLE IF DHCP IS ON". For more information on DHCP, see "Use DHCP" above.

- In the Main Menu, choose Instrument Controls > Communication Settings > TCP/IP Settings **> IP Addr**.

```
IP ADDRESS:
 CURRENT: 10.209.40.149
  SET TO: 10.209.40.149 █
          ←→ MOVE CURSOR
          ↑↓ CHANGE VALUE
           ↵ SAVE VALUE

 CFACT INST  DIAGS ALARM
```

Netmask

The Netmask screen is used to edit the netmask. The netmask is used to determine the subnet on which the instrument can directly communicate to other devices. The netmask can only be changed when DHCP is off. If DHCP is on, the instrument will respond with "NOT SETTABLE IF DHCP IS ON". For more information on DHCP, see "Use DHCP" above.

- In the Main Menu, choose Instrument Controls > Communication Settings > TCP/IP Settings > **Netmask**.

```
NETMASK:
 CURRENT:  255.255.252.0
  SET TO:  255.255.252.0
           ←→ MOVE CURSOR
           ↑↓ CHANGE VALUE
            ↵ SAVE VALUE

 CFACT INST  DIAGS ALARM
```

Default Gateway

The Default Gateway screen is used to edit the gateway address. The default gateway can only be changed when DHCP is off. If DHCP is on, the instrument will respond with "NOT SETTABLE IF DHCP IS ON". For more information on DHCP, see "Use DHCP" above. Any traffic to addresses that are not on the local subnet will be routed through this address.

- In the Main Menu, choose Instrument Controls > Communication Settings > TCP/IP Settings > **Gateway**.

```
DEFAULT GATEWAY:
 CURRENT:  10.209.42.1
  SET TO:  10.209.42.1
           ←→ MOVE CURSOR
           ↑↓ CHANGE VALUE
            ↵ SAVE VALUE

 CFACT INST  DIAGS ALARM
```

Host Name

The Host Name screen is used to edit the host name. When DHCP is enabled, this name is reported to the DHCP server.

- In the Main Menu, choose Instrument Controls > Communication Settings > TCP/IP Settings > **Host Name**.

```
HOST NAME:
  CURRENT: ISERIES
           ISERIES        ?
     ABCDEFGHIJKLMN  BKSP
     OPQRSTUVWXYZ    PAGE
     0123456789 ./-  SAVE

 CFACT INST  DIAGS ALARM
```

Network Time Protocol Server

The Network Time Protocol (NTP) Server screen is used to edit the IP address of the NTP server. An NTP server may be used to periodically synchronize the instrument's real-time clock with a standard. More information about the NTP servers and a list of public servers may be found at http://www.ntp.org.

- In the Main Menu, choose Instrument Controls > Communication Settings > TCP/IP Settings **> NTP Svr**.

```
NTP SERVER IP ADDRESS:
 CURRENT: 10.209.43.237
  SET TO: 10.209.43.237
          ←→ MOVE CURSOR
          ↑↓ CHANGE VALUE
           ↵ SAVE VALUE

 CFACT INST  DIAGS ALARM
```

I/O Configuration

The I/O Configuration menu deals with configuration of the analyzer's I/O system.

- In the Main Menu, choose Instrument Controls > **I/O Configuration**.

```
I/O CONFIGURATION:
>OUTPUT RELAY SETTINGS
 DIGITAL INPUT SETTINGS
 ANALOG OUTPUT CONFIG
 ANALOG INPUT CONFIG




 CFACT INST  DIAGS ALARM
```

Output Relay Settings

The Output Relay Settings menu displays a list of the 10 digital output relays available, and allows the user to select the logic state and instrument parameter for the relay selected.

Note The digital outputs may take up to one second after the assigned state occurs to show up on the outputs. ▲

- In the Main Menu, choose Instrument Controls > I/O Configuration > **Output Relay Settings**.

```
OUTPUT RELAY SETTINGS:
>1   NOP    LOCAL/REMOTE
 2   NOP    MONITOR MODE
 3   NOP       MASS MODE
 4   NOP  BLOW BACK MODE
 5   NOP  SPAN FLOW MODE
 6   NOP       PM FACTOR
 7   NOP            NONE ↓

 CFACT INST  DIAGS ALARM
```

Logic State

The Logic State menu item is used to change the selected I/O relay to either normally open or normally closed. The default state is open, which indicates that a relay connected between the digital output pin and ground is normally open and closes to trigger the digital output action.

- Press ↵ to toggle and set the logic state to normally open or normally closed.

```
OUTPUT RELAY SETUP:
>LOGIC STATE           OPEN
 INSTRUMENT STATE






 CFACT INST  DIAGS ALARM
```

Instrument State

The Instrument State submenu allows the user to select the instrument state that is assigned to the selected relay output. A submenu lists signal types of either alarms or non-alarm to choose from.

- In the Main Menu, choose Instrument Controls > I/O Configuration > Output Relay Settings > select Relay > **Instrument State**.

```
CHOOSE SIGNAL TYPE:
>ALARMS
 ALARM 2
 NON-ALARM



 CFACT INST  DIAGS ALARM
```

Alarms The Alarms screen allows the user to select an alarm status for the selected relay output. The currently selected item is shown by "<--" after it.

- In the Main Menu, choose Instrument Controls > I/O Configuration > Output Relay Settings > select Relay > Instrument State > **Alarms**.

```
ALARM STATUS ITEMS:
>NONE
 GEN ALARM
 TEMP STACK
 TEMP DILUTION
 TEMP STINGER
 TEMP BYPASS
 TEMP NEPH BLOCK          ↓
 CFACT INST  DIAGS ALARM
  TEMP NEPH
  TEMP NEPH PCB
  TEMP TEOM CASE
  TEMP TEOM TUBE
  TEMP PROBE CN
  PRES BAROMETER
  PRES STATIC
  PRES TEOM DP
  FLOW BYPASS
  FLOW DIL
  FLOW TEOM
  FLOW NOZ
  FLOW STINGER
  FLOW DIL RATIO
  SAMPLE FLOW %DR
```

Alarms 2 The Alarms 2 screen allows the user to select an alarm status for the selected relay output. The currently selected item is shown by "<--" after it.

- In the Main Menu, choose Instrument Controls > I/O Configuration > Output Relay Settings > select Relay > Instrument State > **Alarms**.

```
ALARM 2 STATUS ITEMS:
>NONE
 VELOCITY
 PM WET
 PM DRY
 PM FACTOR
 NEPH FORWARD
 NEPH BACK                       ↓

 CFACT INST  DIAGS ALARM
```

```
 NEPH FWD AVG
 NEPH SOURCE
 NEPH REF DET
 NEPH SPAN SRC
 NEPH SPAN REF
 NEPH RH
 NEPH F% ZDRIFT
 NEPH F% SDRIFT
 NEPH CONC INST
 TEOM
 TEOM INST
 TEOM FREQ
 TEOM STD DEV
 TEOM K0
 MIB STATUS
 I/O BD STATUS
 TCB STATUS
 NEPH STATUS
 TEOM STATUS
```

Non-Alarm

The Non-Alarm screen allows the user to select a non-alarm status for the selected relay output. The currently selected item is shown by “<--” after it.

- In the Main Menu, choose Instrument Controls > I/O Configuration > Output Relay Settings > select Relay > Instrument State > **Non-Alarm**.

```
NON ALARM STATUS ITEMS:
>NONE
 SERVICE
 LOCAL/REMOTE             <--
 MONITOR MODE
 MASS MODE
 PURGE MODE
 BLOW BACK MODE                  ↓

 CFACT INST  DIAGS ALARM
```

```
 MANUAL MODE
 NEPH ZERO MODE
 NEPH SPAN MODE
 SSPAN SYS CHK
 MSPAN SYS CHK
 PURGE Z CHK
 PURGE S1 CHK
 PURGE S2 CHK
 PURGE S3 CHK
 PURGE S4 CHK
```

Digital Input Settings

The Digital Input Settings menu displays a list of the 16 digital inputs available, and allows the user to select the logic state and instrument parameter for the relay selected.

Note The digital inputs must be asserted for at least one second for the action to be activated. ▲

- In the Main Menu, choose Instrument Controls > I/O Configuration > **Digital Input Settings**.

```
DIGITAL INPUT SETTINGS:
>1   NOP     MONITOR MODE
 2   NOP       PURGE MODE
 3   NOP      MANUAL MODE
 4   NOP    VENT AUTO CAL
 5   NOP    VENT CAL SAVE
 6   NOP    VENT CAL REST
 7   NOP    NEPH AUTO CAL ↓

 CFACT INST  DIAGS ALARM
```

Logic State

The Logic State menu item is used to change the selected I/O relay to either normally open or normally closed. The default state is open, which indicates that a relay connected between the digital input pin and ground is normally open and closes to trigger the digital input action.

- Press [↵] to toggle and set the logic state to normally open or normally closed.

```
DIGITAL INPUT SETUP:
>LOGIC STATE          OPEN
 INSTRUMENT ACTION





 CFACT INST  DIAGS ALARM
```

Instrument Action

The Instrument Action submenu allows the user to choose the instrument action that is assigned to the selected digital input.

- In the Main Menu, choose Instrument Controls > I/O Configuration > Digital Input Settings > select Relay > **Instrument Action**.

```
CHOOSE ACTION:
>NONE
 MONITOR MODE          <--
 PURGE MODE
 MANUAL MODE
 MASS MODE
 BLOWBACK MODE
 NEPH ZERO MODE             ↓

 CFACT INST  DIAGS ALARM
 SSPAN CHK MODE
 MSPAN CHK MODE
 PRG ZERO CHECK
 PURGE S1 CHECK
 PURGE S2 CHECK
 PURGE S3 CHECK
 PURGE S4 CHECK
 NEPH AUTO CAL
 NEPH CAL SAVE
 NEPH CAL REST
 EXT ALARM
```

Analog Output Configuration (Select Channel)

The Analog Output Configuration menu displays a list of the analog output channels available for configuration. Channel choices include all voltage channels, all current channels, individual voltage channels 1–6, and individual current channels 1–6.

- In the Main Menu, choose Instrument Controls > I/O Configuration > **Analog Output Config**.

```
OUTPUT CHANNELS:
>ALLOW OVER/UNDER RANGE
 ALL VOLTAGE CHANNELS
 ALL CURRENT CHANNELS
 VOLTAGE CHANNEL 1
 VOLTAGE CHANNEL 2
 VOLTAGE CHANNEL 3
 VOLTAGE CHANNEL 4          ↓

 CFACT INST  DIAGS ALARM
```

Allow Over/Under Range

The Allow Over/Under Range screen is used to select whether or not the analog outputs are allowed to exceed the maximum selected value of 100 mV, 1 V, 5 V, 10 V, or 20 mA or the minimum selected value of 0 V, 0 mA, or 4 mA. By default, this parameter is set to on and 5% over and under range is allowed for all analog output channels.

- In the Main Menu, choose Instrument Controls > I/O Configuration > Analog Output Config > **Allow Over/Under Range**.

```
ALLOW OVER/UNDER RANGE:
 CURRENTLY:          ON
    SET TO:         OFF   ?

              ↵ TOGGLE VALUE

 CFACT INST  DIAGS ALARM
```

Analog Output Configuration (Select Action)

The Analog Output Configuration menu displays a list of the analog output configuration choices, from which the user selects the parameter to adjust for the selected output channel. Configuration choices include selecting range, setting minimum/maximum values, and choosing the signal to output.

- In the Main Menu, choose Instrument Controls > I/O Configuration > Analog Output Config > **All Voltage Channels, All Current Channels, Voltage Channel 1–6 or Current Channel 1–6**.

```
ANALOG OUTPUT CONFIG:
>SELECT RANGE
 SET MINIMUM VALUE
 SET MAXIMUM VALUE
 CHOOSE SIGNAL TO OUTPUT



 CFACT INST  DIAGS ALARM
```

Select Range

The Select Range screen is used to select the hardware range for the selected analog output channel. Possible ranges for the voltage outputs are: 0-100 mV, 0-1, 0-5, and 0-10 V. Possible ranges for the current outputs are: 0-20 mA and 4-20 mA.

- In the Main Menu, choose Instrument Controls > I/O Configuration > Analog Output Config > select Channel > **Select Range**.

```
SELECT OUTPUT RANGE:
 SELECTED OUTPUT:   V ALL
 CURRENTLY:       0-10V
    SET TO:      0-100mV ?

 ↑↓ CHANGE VALUE    ↵ SAVE

 CFACT INST  DIAGS ALARM
```

Minimum and Maximum Value

The Minimum and Maximum Value screens are used to edit the zero (0) and full-scale (100) values, respectively, in percentages for the selected analog output channel. See Table 3–3 for a list of choices. The minimum and maximum output value screens function the same way. The following example shows the set minimum value screen.

- In the Main Menu, choose Instrument Controls > I/O Configuration > Analog Output Config > select Channel > **Set Minimum** or **Maximum Value**.

```
MINIMUM OUTPUT PERCENT:
 SELECTED OUTPUT:   V ALL
 CURRENTLY:         N/A %
    SET TO:       0000.0 % ?

 ↑↓ CHANGE VALUE    ↵ SAVE

 CFACT INST  DIAGS ALARM
```

Table 3–3. Analog Output Zero to Full-Scale

Output	Zero (0)% Value	Full-Scale 100% Value
PM Wet	Zero (0)	250
PM Dry	Zero (0)	250
PM Factor	Zero (0)	250
Fwd	Zero (0)	250
TEOM Conc	Zero (0)	250
Fwd Avg	Zero (0)	250
TEOM Inst	Zero (0)	250
Fwd Inst	Zero (0)	250
TEOM Avg	Zero (0)	250
CS	Zero (0)	250
Temp Stack	Zero (0)	250
Temp Dilutn	User-set alarm min value	User-set alarm max value
Temp Stinger	User-set alarm min value	User-set alarm max value
Temp Bypass	User-set alarm min value	User-set alarm max value
Temp Neph	User-set alarm min value	User-set alarm max value
Temp Neph Bk	User-set alarm min value	User-set alarm max value
Temp Neph PC	User-set alarm min value	User-set alarm max value

Output	Zero (0)% Value	Full-Scale 100% Value
Temp TE Air	User-set alarm min value	User-set alarm max value
Temp TE Case	User-set alarm min value	User-set alarm max value
Temp Prob CN	User-set alarm min value	User-set alarm max value
Neph Source	User-set alarm min value	User-set alarm max value
Neph Ref Det	User-set alarm min value	User-set alarm max value
Neph Spn Src	User-set alarm min value	User-set alarm max value
Neph Spn Ref	User-set alarm min value	User-set alarm max value
Neph RH	User-set alarm min value	User-set alarm max value
TEOM Freq	User-set alarm min value	User-set alarm max value
TEOM Stdev	User-set alarm min value	User-set alarm max value
TEOM K0	User-set alarm min value	User-set alarm max value
Neph Gains	User-set alarm min value	User-set alarm max value
Air Tube Pwr	User-set alarm min value	User-set alarm max value
Case Pwr	User-set alarm min value	User-set alarm max value
Pres Baro	User-set alarm min value	User-set alarm max value
Pres Static	User-set alarm min value	User-set alarm max value
DP TEOM	User-set alarm min value	User-set alarm max value
Flw Nozzle	User-set alarm min value	User-set alarm max value
Flw Noz Stk	User-set alarm min value	User-set alarm max value
Flw Dilution	User-set alarm min value	User-set alarm max value
Flw Bypass	User-set alarm min value	User-set alarm max value
Flw Sample	User-set alarm min value	User-set alarm max value
Flw Samp Chk	User-set alarm min value	User-set alarm max value
Dil Ratio	User-set alarm min value	User-set alarm max value
Stk Velocity	User-set alarm min value	User-set alarm max value
Fwd Z Drift	User-set alarm min value	User-set alarm max value
Fwd Sp Drift	User-set alarm min value	User-set alarm max value
Total Mass	User-set alarm min value	User-set alarm max value
Flw Samp Dft	User-set alarm min value	User-set alarm max value
TEOM Cycles	User-set alarm min value	User-set alarm max value
Ref Clocks	User-set alarm min value	User-set alarm max value
Neph Bkg G4	User-set alarm min value	User-set alarm max value
Neph Bkg G5	User-set alarm min value	User-set alarm max value

Output	Zero (0)% Value	Full-Scale 100% Value
Flw Purge	User-set alarm min value	User-set alarm max value

Choose Signal to Output

The Choose Signal to Output screen displays a list of the analog output signal choices. Choices are grouped into three categories: Concentrations, Other Measurements, and Analog Inputs. This allows the user to select the output signal that will be assigned to each analog channel. The Concentrations screen is shown below. See Table 3–4 for a list of items for each signal group choice.

- In the Main Menu, choose Instrument Controls > I/O Configuration > Analog Output Config > select Channel > **Choose Signal to Output**.

```
CHOOSE SIGNAL TYPE:
>CONCENTRATIONS
 OTHER MEASUREMENTS
 OTHER MEASUREMENTS 2
 ANALOG INPUTS



 CFACT INST  DIAGS ALARM
```

```
CHOOSE SIGNAL -    MEAS
 SELECTED OUTPUT:    V1
 CURRENTLY: PM
    SET TO: NONE         ?

 ↑↓ CHANGE VALUE    ↵ SAVE

 CFACT INST  DIAGS ALARM
```

Table 3–4. Signal Type Group Choices

Concentrations	Other Measurements	Other Measurements 2	Analog Inputs
None	None	None	None
PM Wet	Temp Stack	Pres Baro	Analog Input 1
PM Dry	Temp Dilutn	Pres Static	Analog Input 2
PM Factor	Temp Stinger	DP TEOM	Analog Input 3
Fwd	Temp Bypass	Flw Nozzle	Analog Input 4
TEOM Conc	Temp Neph	Flw Noz Stk	Analog Input 5
Fwd Avg	Temp Neph Bk	Flw Dilution	Analog Input 6
TEOM Inst	Temp Neph PC	Flw Bypass	Analog Input 7

Concentrations	Other Measurements	Other Measurements 2	Analog Inputs
TEOM Avg	Temp TE Air	Flw Sample	Analog Input 8*
CS	Temp TE Case	Flw Samp Chk	
	Temp Prob CN	Dil Ratio	
	Neph Source	Stk Velocity	
	Neph Ref Det	Fwd Z Drift	
	Neph Spn Src	Fwd Sp Drift	
	Neph Spn Ref	Total Mass	
	Neph RH	Flw Samp Dft	
	TEOM Freq	TEOM Cycles	
	TEOM Stdev	Ref Clocks	
	TEOM K0	Neph Bkg G4	
	Neph Gains	Neph Bkg G5	
	Air Tube Pwr	Flw Purge	
	Case Pwr		

*Note: Analog input 8 is reserved for a stack velocity signal input scaled to meters per second to use the site specific velocity in conjuction with an isokinetic application.

Analog Input Configuration

The Analog Input Configuration menu displays a list of the 8 analog input channels available for configuration. Configuration includes entering the Descriptor, Units, Decimal Places, choice of 1–10 points in the table, and corresponding number of points selected.

- In the Main Menu, choose Instrument Controls > I/O Configuration > **Analog Input Config**.

```
ANALOG INPUT CONFIG:
>CHANNEL 1              IN1
 CHANNEL 2              IN2
 CHANNEL 3              IN3
 CHANNEL 4              IN4
 CHANNEL 5              IN5
 CHANNEL 6              IN6
 CHANNEL 7              IN7↓

 CFACT  INST   DIAGS  ALARM
```

```
ANALOG INPUT 01 CONFIG:
>DESCRIPTOR            IN1
 UNITS                   V
 DECIMAL PLACES          2
 TABLE POINTS            2
 POINT 1
 POINT 1

 CFACT INST  DIAGS ALARM
```

Descriptor The Descriptor screen allows the user to enter the descriptor, or name, for the selected analog input channel. The descriptor is used in datalogging and streaming data to report what data is being sent out. The descriptor may be from 1 to 3 characters in length, and defaults to IN1 to IN8 (user input channel number).

- In the Main Menu, choose Instrument Controls > I/O Configuration > Analog Input Config > select Channel > **Descriptor**.

```
ANALOG INPUT DESCRIPTOR:
 CURRENTLY: IN1
             IN1
     ABCDEFGHIJKLMN  BKSP
     OPQRSTUVWXYZ    PAGE
     0123456789 ./-  SAVE

 CFACT INST  DIAGS ALARM
```

Units The Units screen allows the user to enter the units for the selected analog input channel. The units are displayed on the diagnostic screen and in datalogging and streaming data. The units may be from 1 to 3 characters in length, and defaults to V (volts).

- In the Main Menu, choose Instrument Controls > I/O Configuration > Analog Input Config > select Channel > **Units**.

```
ANALOG INPUT UNITS:
 CURRENTLY: V
             V
     ABCDEFGHIJKLMN  BKSP
     OPQRSTUVWXYZ    PAGE
     0123456789 ./-  SAVE

 CFACT INST  DIAGS ALARM
```

Decimal Places The Decimal Places screen allows the user to select how many digits are displayed to the right of the decimal point, from 0 to 6, with a default of 2.

- In the Main Menu, choose Instrument Controls > I/O Configuration > Analog Input Config > select Channel > **Decimal Places**.

```
DECIMAL PLACES:
 CURRENTLY:              2
    SET TO:              3 ?

            ↑↓ INC/DEC
             ↵ SAVE VALUE

 CFACT INST  DIAGS ALARM
```

Number of Table Points

The Number of Table Points screen allows the user to select how many points are used in the analog input conversion table for the selected channel. The instrument uses linear interpolation between the points in this table to determine what the reading value is based on the analog input voltage. Each point in the table consists of an analog input voltage value (0–10.5 V) and a corresponding reading value. Only two points are necessary for linear inputs, however a larger number of points may be used to approximate non-linear inputs. The points range from 2 to 10, with a default of 2.

- In the Main Menu, choose Instrument Controls > I/O Configuration > Analog Input Config > select Channel > **Table Points**.

```
NUMBER OF TABLE POINTS:
 CURRENTLY:              2
    SET TO:             10 ?

            ↑↓ INC/DEC
             ↵ SAVE VALUE

 CFACT INST  DIAGS ALARM
```

Table Points

The Table Point submenu allows the user to set up an individual table point.

- In the Main Menu, choose Instrument Controls > I/O Configuration > Analog Input Config > select Channel > **Point 1–10**.

```
TABLE POINT 01 CONFIG:
>VOLTS              0.00
 USER VALUE         0.00



 CFACT INST  DIAGS ALARM
```

Volts The Volts screen allows the user to set the input voltage for the selected table point in the conversion table, from 0.00 to 10.50. The default table is a two-point table with point 1: 0.00 V = 000.0 U and point 2: 10.00 V = 10.0 U, where U is the previously entered unit of measure.

- In the Main Menu, choose Instrument Controls > I/O Configuration > Analog Input Config > select Channel > select Point > **Volts**.

```
TABLE POINT 01 VOLTS:
 CURRENTLY:         0.00
    SET TO:        00.00

           ←→ MOVE CURSOR
 ↑↓ CHANGE VALUE   ↵ SAVE
 CFACT INST  DIAGS ALARM
```

User Value The User Value screen allows the user to set the output value for the corresponding input voltage for the selected table point in the conversion table, from -9999999 to 99999999. The default table is a two-point table with point 1: 0.00 V = 000.0 U and point 2: 10.00 V = 10.0 U, where U is the previously entered unit of measure.

- In the Main Menu, choose Instrument Controls > I/O Configuration > Analog Input Config > select Channel > select Point > **User Value**.

```
TABLE POINT 01 USER VAL:
 CURRENTLY:         0.00
    SET TO:     00000.00

           ←→ MOVE CURSOR
 ↑↓ CHANGE VALUE   ↵ SAVE
 CFACT INST  DIAGS ALARM
```

Solenoid States

The Relay State screen displays the state of the 8 digital outputs and allows toggling of the state to either on (1) or off (off). The solenoids are restored to their original states upon exiting this screen.

- In the Main Menu, choose Instrument Controls > **Solenoid States**.

```
RELAY STATE:
>SOLENOID  1          1
 SOLENOID  2          0
 SOLENOID  3          0
 SOLENOID  4          0
 SOLENOID  5          0
 SOLENOID  6          0
 SOLENOID  7          0↓

 CFACT INST  DIAGS ALARM
```

Screen Contrast

The Screen Contrast screen is used to change the contrast of the display. Intensities between 0 and 100% in increments of 5 are available. Changing the screen contrast may be necessary if the instrument is operated at extreme temperatures.

Note The optimal contrast will change with changes in temperature. ▲

Note The optimal contrast will change from one LCD to another. If the LCD is replaced, the contrast may need to be reset. ▲

Note If the display contrast is not optimal, but the content on the screen is visible, select Instrument Controls > **Screen Contrast** and adjust the screen contrast. If the content on the screen is not visible, use the "set contrast 10" C-Link command to set the screen contrast to mid-range, then optimize the contrast. ▲

- In the Main Menu, choose Instrument Controls > **Screen Contrast**.

```
SCREEN CONTRAST:
 CURRENTLY:        50 %
    SET TO:        55 % ?

            ↑↓ CHANGE VALUE
             ↵ SAVE VALUE

 CFACT INST  DIAGS ALARM
```

Service Mode

The Service Mode screen is used to turn the service mode on or off. Turning service mode "ON" locks out any remote actions and allows access to parameters and functions that are useful when making adjustments or diagnosing the PM CEMS. The service (wrench) icon on the status bar is shown when service mode is on. For more information about the service mode, see "Service Menu" later in this chapter.

Note The service mode should be turned off when finished, as it prevents remote operation. ▲

- In the Main Menu, choose Instrument Controls > **Service Mode**.

```
SERVICE MODE:
 CURRENTLY:           OFF
    SET TO:            ON ?

           ↵ TOGGLE VALUE

 CFACT INST  DIAGS ALARM
```

Date/Time

The Date/Time screen allows the user to view and change the system date and time (24-hour format). The internal clock is powered by its own battery when instrument power is off.

- In the Main Menu, choose Instrument Controls > **Date/Time**.

```
DATE AND TIME:
 19 MAR 2005  12:34:56
 PRESS ↵ TO EDIT




 CFACT INST  DIAGS ALARM
```

```
DATE AND TIME:
 19 MAR 2005  12:34:56   ?
 SETTING: DAYS
            → SET MONTHS
           ↑↓ CHANGE VALUE
            ↵ SAVE VALUE

 CFACT INST  DIAGS ALARM
```

Timezone

The Timezone screen is used to set the timezone for the Network Time Protocol (NTP) server. This should be set to the timezone that the instrument is located in. If the exact timezone is not shown in the list, it may be entered via the C-LINK "tz" command (see Appendix B). The selections are: UTC (GMT), EST (GMT+5), CST (GMT+6), MST (GMT+7), PST (GMT+8), YST (GMT+9), HST (GMT+10), NST (GMT+11), DLW (GMT+12), CET (GMT-1), EET (GMT-2), BST (GMT-3), DLT (GMT-4), ECH (GMT-5), FOX (GMT-6), GLF (GMT-7), CCT (GMT-8), JST (GMT-9), GST (GMT-10), LMA (GMT-11), DLE (GMT-12), EDT (GMT+5/4), CDT (GMT+6/5), MDT (GMT+7/6), and PDT (GMT+8/7).

Note The current timezone may say NULL before the timezone is set for the first time, or if the timezone was cleared with a C-Link command. ▲

- In the Main Menu, choose Instrument Controls > **Timezone**.

```
TIMEZONE FOR TIMESERVER:
 CURRENTLY: UTC (GMT)
    SET TO: EST (GMT+5)  ?

            ↑↓ CHANGE VALUE
             ↵ SAVE VALUE

 CFACT INST  DIAGS ALARM
```

Diagnostics Menu

The Diagnostics menu provides access to diagnostic information and functions. This menu is useful when troubleshooting the instrument.

- In the Main Menu, choose **Diagnostics**.

```
DIAGNOSTICS:
>PROGRAM VERSIONS
 CONCENTRATIONS
 VOLTAGES
 TEMPERATURES
 PRESSURE
 FLOWS
 VELOCITY                  ↓

 CFACT INST  DIAGS ALARM

 NEPHELOMETER
 TEOM PARAMETERS
 SYSTEM CHECKS
 ANALOG INPUT READINGS
 ANALOG INPUT VOLTAGES
 DIGITAL INPUTS
 RELAY STATES
 TEST ANALOG OUTPUTS
 INSTRUMENT CONFIGURATION
 CONTACT INFORMATION
```

Program Versions

The Program Versions screen (read only) shows the version numbers of the programs installed. Prior to contacting the factory with any questions regarding the instrument, please note the product model name and the program version numbers.

- In the Main Menu, choose Diagnostics > **Program Versions**.

```
PROGRAM VERSIONS:
   PRODUCT:  MODEL 3880i
   VERSION:  01.05.05.010
  FIRMWARE:     11.21.121
      NEPH:      01.15.30
      TEOM:      02.08.00

 CFACT INST  DIAGS ALARM
```

Concentrations

The Concentrations screen displays the current concentration readings.

- In the Main Menu, choose Diagnostics > **Concentrations**.

```
CONCENTRATIONS:
>PM WET         0.00 mg/m3
 PM DRY         0.00 mg/m3
 PM FAC        1.000
 FWD (0)        0.00 mg/m3
 FWD INST       0.00 mg/m3
 TEOM AVG       1.00 mg/m3
 FWD AVG        1.00 mg/m3↓

 CFACT INST  DIAGS ALARM
```

```
 TEOM          0.00 mg/m3
```

Voltages

The Voltages menu displays the current diagnostic voltage readings. This screen enables the power supply to be quickly read for low or fluctuating voltages without having to use a voltage meter.

- In the Main Menu, choose Diagnostics > **Voltages**.

```
VOLTAGES:
>MOTHERBOARD
 INTERFACE BOARD PM
 I/O BOARD
 DUAL NEPHELOMETER BOARD
 TEOM BOARD
 THERMOCOUPLE BOARD


 CFACT INST  DIAGS ALARM
```

Motherboard Voltages

The Motherboard screen (read only) is used to display the current voltage readings.

- In the Main Menu, choose Diagnostics > Voltages > **Motherboard**.

```
MOTHERBOARD VOLTAGES:
   3.3 SUPPLY        3.3 V
   5.0 SUPPLY        5.0 V
  15.0 SUPPLY       15.0 V
  24.0 SUPPLY       24.1 V
  -3.3 SUPPLY       -3.3 V


 CFACT INST  DIAGS ALARM
```

Interface Board Voltages

The Interface Board screen (read only) is used to display the current voltages.

- In the Main Menu, choose Diagnostics > Voltages > **Interface Board PM**.

```
INTERFACE BOARD VOLTAGES:
   3.3 SUPPLY        3.3 V
   5.0 SUPPLY        5.0 V
  15.0 SUPPLY       15.0 V
  24.0 SUPPLY       24.0 V
 -15.0 SUPPLY      -15.0 V


 CFACT INST  DIAGS ALARM
```

I/O Board Voltages

The I/O Board screen (read only) is used to display the voltage readings on the I/O expansion board.

- In the Main Menu, choose Diagnostics > Voltages > **I/O Board**.

```
I/O BOARD VOLTAGES:
   3.3 SUPPLY        3.3 V
   5.0 SUPPLY        5.0 V
  24.0 SUPPLY       24.0 V
  -3.3 SUPPLY       -3.3 V



 CFACT INST  DIAGS ALARM
```

Dual Nephelometer Board Voltages

The Dual Nephelometer Board screen (read only) is used to display the current voltage readings.

- In the Main Menu, choose Diagnostics > Voltages > **Dual Nephelometer Board**.

```
DUAL NEPH BOARD VOLTAGES:
   3.3   SUPPLY      3.3 V
   3.3A SUPPLY       3.3AV
   5.0   SUPPLY      5.0 V
   7.0   SUPPLY      7.0 V
  15.0   SUPPLY     15.0 V
  24.0   SUPPLY     24.0 V
  -5.0   SUPPLY     -5.0 V

 CFACT INST  DIAGS ALARM
```

TEOM Board

The TEOM Board screen (read only) is used to display the current voltage readings.

- In the Main Menu, choose Diagnostics > Voltages > **TEOM Board**.

```
TEOM BOARD:
   5.0 SUPPLY        5.0 V
  15.0 SUPPLY       15.0 V
  24.0 SUPPLY       24.0 V
 -15.5 SUPPLY      -15.0 V
   5.0 SUPPLY RE     5.0 V


 CFACT INST  DIAGS ALARM
```

Thermocouple Board Voltages

The Thermocouple Board screen (read only) is used to display the current voltage readings.

- In the Main Menu, choose Diagnostics > Voltages > **Thermocouple Board**.

```
THERMOCOUPLE VOLTAGES:
   3.3   SUPPLY      3.3 V
   5.0   SUPPLY      5.0 V
  15.0   SUPPLY     15.0 V
  24.0   SUPPLY     24.0 V
   2.5   SUPPLY      2.5 V
 -15.0   SUPPLY    -15.0 V

 CFACT INST  DIAGS ALARM
```

Temperatures

The Temperatures screen (read only) displays the current relative humidity and temperature readings. The board temperature is the air temperature measured by a sensor located on the measurement interface board.

- In the Main Menu, choose Diagnostics > **Temperatures**.

```
TEMPERATURES:
>STACK                0.0  °C
 DILUTION             0.0  °C
 STINGER              0.0  °C
 BYPASS               0.0  °C
 NEPH                 0.0  °C
 NEPH BLOCK           0.0  °C
 NEPH PCB             0.0  °C↓

 CFACT INST  DIAGS ALARM

 TEOM AIR             0.0  °C
 TEOM CASE            0.0  °C
 PROBE CNTRL          0.0  °C
```

Pressures

The Pressures screen (read only) displays the current pressure readings. The pressure is measured by a pressure transducer.

- In the Main Menu, choose Diagnostics > **Pressures**.

```
PRESSURES:
 BAROMETRIC    760.0  mmHg
 STATIC          0.0  mmHg
 TEOM DP         0.0  mmHg

 CFACT INST  DIAGS ALARM
```

Flows

The Flows screen (read only) displays the current flow readings. The flow is measured by mass flow controllers.

- In the Main Menu, choose Diagnostics > **Flows**.

```
FLOWS:
 NOZZLE          2.00 SLPM
 DILUTION       21.00 SLPM
 BYPASS         21.00 SLPM
 SAMPLE          2.40 SLPM
 PURGE           0.40 SLPM
 SAMPLE CHK      2.40 SLPM
 DIL RATIO      10.00

 CFACT INST  DIAGS ALARM
```

Velocity

The Velocity screen (read only) displays the current stack velocity.

- In the Main Menu, choose Diagnostics > **Velocity**.

```
VELOCITY:
 STACK            1.00 m/s





 CFACT INST  DIAGS ALARM
```

Nephelometer

The Nephelometer screen (read only) displays the nephelometer parameters.

- In the Main Menu, choose Diagnostics > **Nephelometer**.

```
NEPHELOMETER:
 CONC INST     12.41 mg/m3
 FWD (0)        0.00 mg/m3
 SOURCE        65.38 mA
 REF DET        2.49 VDC
 SPAN SRC       0.00 mA
 SPAN REF       0.00 VDC
 RH             4.80 %

 CFACT INST  DIAGS ALARM
```

TEOM Parameters

The TEOM Parameters screen (read only) displays the current CRn reading.

- In the Main Menu, choose Diagnostics > **TEOM Parameters**.

```
TEOM PARAMETERS:
 FREQUENCY     295.3474 Hz
 STDEV         0.000146 Hz
 TUBE TEMP        62.31 °C
 CASE TEMP        65.04 °C
 TUBE HEAT        20.38  %
 CASE HEAT         45.8  %
 k0               15125

 CFACT INST  DIAGS ALARM
```

System Checks

The System Checks screen displays current scales analog readings.

- In the Main Menu, choose Diagnostics > **System Checks**.

```
SYSTEM CHECKS:
>CURRENT
 00/00/00  00:00
 00/00/00  00:00
 00/00/00  00:00
 00/00/00  00:00
 00/00/00  00:00
 00/00/00  00:00

 CFACT INST  DIAGS ALARM
```

Current System Checks

The Current System Checks screen displays the results for the latest daily system checks.

- In the Main Menu, choose Diagnostics > System Checks > **Current** or **Current 1–6**.

```
CURRENT SYS CAL:
       UDC:      0.000000
       VDC:      0.000000
        ZD:      0.000000



 CFACT INST  DIAGS ALARM
```

Analog Input Readings

The Analog Input Readings screen (read only) displays the 8 user-scaled analog readings.

- In the Main Menu, choose Diagnostics > **Analog Input Readings**.

```
ANALOG INPUT READINGS:
>IN1            -0.00   V
 IN2            -0.00   V
 IN3            -0.00   V
 IN4            -0.00   V
 IN5            -0.00   V
 IN6            -0.00   V
 IN7            -0.00   V ↓

 CFACT INST  DIAGS ALARM
```

Analog Input Voltages

The Analog Input Voltages screen (read only) displays the 8 raw analog voltage readings.

- In the Main Menu, choose Diagnostics > **Analog Input Voltages**.

```
ANALOG INPUT VOLTAGES:
>ANALOG IN 1         6.24 V
 ANALOG IN 2         4.28 V
 ANALOG IN 3         0.00 V
 ANALOG IN 4         0.00 V
 ANALOG IN 5         0.00 V
 ANALOG IN 6         0.00 V
 ANALOG IN 7         0.00 V↓

 CFACT INST  DIAGS ALARM
```

Digital Inputs

The Digital Inputs screen (read only) displays the state of the 16 digital inputs. Pull-ups are provided on all of the inputs, so if nothing they will read (1), if an input is brought to ground, it will read (0).

- In the Main Menu, choose Diagnostics > **Digital Inputs**.

```
DIGITAL INPUTS:
>INPUT 1                  1
 INPUT 2                  1
 INPUT 3                  1
 INPUT 4                  1
 INPUT 5                  1
 INPUT 6                  1
 INPUT 7                  1↓

 CFACT INST  DIAGS ALARM
```

Relay States

The Relay States screen displays the state of the 10 digital outputs and allows toggling of the state to either on (1) or off (0). The relays are restored to their original states upon exiting this screen.

- In the Main Menu, choose Diagnostics > **Relay States**.

- Press ↵ to toggle and set the relay state to open or closed for the selected digital output.

```
RELAY STATE:
>OUTPUT 1              0
 OUTPUT 2              0
 OUTPUT 3              0
 OUTPUT 4              1
 OUTPUT 5              1
 OUTPUT 6              1
 OUTPUT 7              1↓

 CFACT INST  DIAGS ALARM
```

Test Analog Outputs

The Test Analog Outputs menu is used to set each of the analog output channels to zero or full-scale. Channel choices include all analog outputs, 6 voltage channels, and 6 current channels.

- In the Main Menu, choose Diagnostics > **Test Analog Outputs**.

```
TEST ANALOG OUTPUTS:
>ALL
 VOLTAGE CHANNEL 1
 VOLTAGE CHANNEL 2
 VOLTAGE CHANNEL 3
 VOLTAGE CHANNEL 4
 VOLTAGE CHANNEL 5
 VOLTAGE CHANNEL 6

 CFACT INST  DIAGS ALARM
```

Set Analog Outputs

The Set Analog Outputs screen contains three choices: Set to full-scale, set to zero, or reset to normal. Full-scale sets the analog outputs to the full-scale voltage, zero sets the analog outputs to 0 volts, and reset returns the output to normal operation. The analog outputs are returned to normal operation upon exiting this screen. The following example shows the screen when all analog outputs are set to "normal" operating mode.

- In the Main Menu, choose Diagnostics > Test Analog Outputs > **ALL, Voltage Channel 1–6**, or **Current Channel 1–6**.

```
SET ANALOG OUTPUTS:
 SETTING:             ALL
 OUTPUT SET TO:    NORMAL
 ↑ SET TO FULL SCALE
 ↓ SET TO ZERO
 ← RESET TO NORMAL

 CFACT INST  DIAGS ALARM
```

Instrument Configuration

The Instrument Configuration screen displays information on the hardware configuration on the instrument.

- In the Main Menu, choose Diagnostics > **Instrument Configuration**.

```
INSTUMENT CONFIGURATION:
 I/O EXPANSION BOARD  YES


 ↑↓ CHANGE VALUE   ↵ SAVE


 CFACT INST  DIAGS ALARM
```

Contact Information

The Contact Information screen displays the customer service information.

- In the Main Menu, choose Diagnostics > **Contact Information**.

```
CONTACT INFORMATION:

 CALL CENTER: 508-520-0430

 WEB:   WWW.THERMO.COM/AQI

 CFACT INST  DIAGS ALARM
```

Alarms Menu

The alarms menu allows the user to view a set of alarms for different boards and displays a list of items that are monitored by the analyzer. The number of alarms detected is displayed to indicate how many alarms have occurred. If no alarms are detected, the number zero is displayed.

If the item being monitored goes outside the lower or upper limit, the status of that item will go from "OK" to either "LOW" or "HIGH", respectively. If the alarm is not a level alarm, the status will go from "OK" to "FAIL". The number of alarms detected is displayed to indicate how many alarms have occurred. If no alarms are detected, the number zero is displayed.

Items displayed are determined by the options installed. To see the actual reading of an item and its minimum and maximum limits, move the cursor to the item and press ↵. If the readings go beyond either the minimum or maximum limit, an alarm is activated and the alarm (bell) icon appears in the status bar on the Run screen and in the Main Menu. All minimum and maximum concentration screens function the same way.

If any alarms are active, the alarm (bell) icon is displayed on the right side of the status bar.

- In the Main Menu, choose **Alarms**.

```
ALARMS:
>CONCENTRATIONS         0
 TEMPERATURES           0
 PRESSURE               0
 FLOWS                  0
 NEPHELOMETER           0
 TEOM                   0
 INSTRUMENT             0

 CFACT INST  DIAGS ALARM
```

Concentrations

The Concentration submenu allows the user to view and set the selected concentration alarm parameters.

- In the Main Menu, choose Alarms > **Concentrations**.

```
CONCENTRATION ALARMS:
 ALARMS DETECTED        0
>PM WET                OK
 PM DRY                OK
 PM FACTOR             OK
 NEPH FWD              OK
 NEPH FWD INST         OK
 NEPH FWD AVG          OK↓

 CFACT INST  DIAGS ALARM
 TEOM                  OK
 TEOM INST             OK
 TEOM AVG              OK
 Cs                    OK
```

PM Wet Conc/PM Dry Conc

The PM Wet Conc screen allows the user to view and set the selected alarm parameters. Acceptable alarm limits range from .1 to 200 mg/m^3. If the reading goes beyond the minimum or maximum limit, an alarm is activated and the alarm (bell) icon appears in the status bar on the Run screen and in the Main Menu. The PM Dry Conc screen functions the same way.

- In the Main Menu, choose Alarms > Concentrations > **PM Wet**.

```
PM WET CONC:
 ACTUAL        0.00 mg/m3
>MIN           0.10 mg/m3
 MAX         200.00 mg/m3



 CFACT INST  DIAGS ALARM
```

- In the Main Menu, choose Alarms > Concentrations > (*Concentration*) > **Min** or **Max**.

```
PM WET CONC:
 ACTUAL MIN:        1.00
 SET MIN TO:        1.01 ?

           ↑↓ INC/DEC
            ↵ SAVE VALUE
 CFACT INST  DIAGS ALARM
```

PM Factor

The PM Factor screen allows the user to view and set the selected alarm parameters. Acceptable alarm limits range from .1 to 25. If the reading goes beyond the minimum or maximum limit, an alarm is activated and the alarm (bell) icon appears in the status bar on the Run screen and in the Main Menu.

- In the Main Menu, choose Alarms > Concentrations > **PM Factor**.

```
PM FACTOR:
 ACTUAL             1.00
>MIN                0.10
 MAX               25.00



 CFACT INST  DIAGS ALARM
```

- In the Main Menu, choose Alarms > Concentrations > PM Factor > **Min** or **Max**.

```
PM FACTOR:
 ACTUAL MIN:          0.10
 SET MIN TO:          0.11 ?

          ↑↓ INC/DEC
           ↵ SAVE VALUE

 CFACT INST  DIAGS ALARM
```

Neph Forward//Neph Fwd Inst/Neph Forward Avg

The Neph Fwd screen allows the user to view and set the selected alarm parameters. Acceptable alarm limits range from .1 to 400. If the reading goes beyond the minimum or maximum limit, an alarm is activated and the alarm (bell) icon appears in the status bar on the Run screen and in the Main Menu. The Neph Fwd Inst and Neph Fwd Avg screens function the same way

- In the Main Menu, choose Alarms > Concentrations > **Neph Fwd**.

```
NEPH FORWARD:
 ACTUAL          0.00 mg/m3
>MIN             0.10 mg/m3
 MAX           400.00 mg/m3




 CFACT INST  DIAGS ALARM
```

- In the Main Menu, choose Alarms > Concentrations > Neph Fwd > **Min** or **Max**.

```
NEPH FORWARD:
 ACTUAL MIN:          0.10
 SET MIN TO:          0.11 ?

          ↑↓ INC/DEC
           ↵ SAVE VALUE

 CFACT INST  DIAGS ALARM
```

TEOM/TEOM Inst/TEOM Avg/Cs Conc

The TEOM screen allows the user to view and set the selected alarm parameters. Acceptable alarm limits range from .1 to 200 mg/m^3. If the reading goes beyond the minimum or maximum limit, an alarm is activated and the alarm (bell) icon appears in the status bar on the Run screen and in the Main Menu. The TEOM Inst, TEOM Avg, and Cs Conc screens function the same way.

- In the Main Menu, choose Alarms > Concentrations > **TEOM**.

```
TEOM:
 ACTUAL          0.00 mg/m3
>MIN             0.10 mg/m3
 MAX           200.00 mg/m3




 CFACT INST  DIAGS ALARM
```

- In the Main Menu, choose Alarms > Concentrations > TEOM > **Min** or **Max**.

```
TEOM:
 ACTUAL MIN:         0.10
 SET MIN TO:         0.11 ?

            ↑↓ INC/DEC
             ↵ SAVE VALUE
 CFACT INST  DIAGS ALARM
```

Temperatures

The Temperatures submenu allows the user to view and set the selected termperature alarm parameters.

- In the Main Menu, choose Alarms > **Temperatures**.

```
ALARMS TEMPERATURE:
 ALARMS DETECTED         0
>STACK                  OK
 DILUTION               OK
 STINGER                OK
 BYPASS                 OK
 NEPH BLOCK             OK
 NEPH                   OK↓

 CFACT INST  DIAGS ALARM

 NEPH PCB               OK
 TEOM CASE              OK
 TEOM AIR TUBE          OK
 PROBE CNTRL            OK
```

Stack Temperature

The Stack Temperature screen allows the user to view and set the selected alarm parameters. Acceptable alarm limits range from 25 to 225 °C. If the stack temperature reading goes beyond the minimum or maximum limit, an alarm is activated and the alarm (bell) icon appears in the status bar on the Run screen and in the Main Menu.

- In the Main Menu, choose Alarms > Temperatures > **Stack**.

```
STACK TEMPERATURE:
 ACTUAL             0.0  °C
>MIN               25.0  °C
 MAX              225.0  °C




 CFACT  INST   DIAGS  ALARM
```

- In the Main Menu, choose Alarms > Temperatures > Stack > **Min** or **Max**.

```
STACK TEMPERATURE:
 ACTUAL MIN:    25.0  °C
 SET MIN TO:    25.1  °C    ?

              ↑↓  INC/DEC
               ↵  SAVE VALUE

 CFACT  INST   DIAGS  ALARM
```

Dilution Temperature

The Dilution Temperature screen allows the user to view and set the selected alarm parameters. Acceptable alarm limits range from 100 to 200 °C. If the dilution temperature reading goes beyond the minimum or maximum limit, an alarm is activated and the alarm (bell) icon appears in the status bar on the Run screen and in the Main Menu.

- In the Main Menu, choose Alarms > Temperatures > **Dilution**.

```
DILUTION TEMPERATURE:
 ACTUAL              0.0  °C
>MIN               100.0  °C
 MAX               100.1  °C




 CFACT INST  DIAGS ALARM
```

- In the Main Menu, choose Alarms > Temperatures > Dilution > **Min** or **Max**.

```
DILUTION TEMPERATURE:
 ACTUAL MIN:       100.0  °C
 SET MIN TO:       100.1  °C?

           ↑↓ INC/DEC
            ↵ SAVE VALUE
 CFACT INST  DIAGS ALARM
```

Stinger Temperature

The Stinger Temperature screen allows the user to view and set the selected alarm parameters. Acceptable alarm limits range from 95 to 125 °C. If the stinger temperature reading goes beyond the minimum or maximum limit, an alarm is activated and the alarm (bell) icon appears in the status bar on the Run screen and in the Main Menu.

- In the Main Menu, choose Alarms > Temperatures > **Stinger**.

```
STINGER TEMPERATURE:
 ACTUAL              0.0  °C
>MIN                90.0  °C
 MAX               125.0  °C




 CFACT INST  DIAGS ALARM
```

- In the Main Menu, choose Alarms > Temperatures > Stinger Temperature > **Min** or **Max**.

```
STINGER TEMPERATURE:
 ACTUAL MIN:       95.0  °C
 SET MIN TO:       95.1  °C?

             ↑↓ INC/DEC
              ↵ SAVE VALUE

 CFACT INST   DIAGS ALARM
```

Bypass Temperature

The Bypass Temperature screen allows the user to view and set the selected alarm parameters. Acceptable alarm limits range from 95 to 105 °C. If the bypass temperature reading goes beyond the minimum or maximum limit, an alarm is activated and the alarm (bell) icon appears in the status bar on the Run screen and in the Main Menu.

- In the Main Menu, choose Alarms > Temperatures > **Bypass**.

```
BYPASS TEMPERATURE:
 ACTUAL              0.0  °C
>MIN                95.0  °C
 MAX               105.0  °C




 CFACT INST   DIAGS ALARM
```

- In the Main Menu, choose Alarms > Temperatures > Bypass > **Min** or **Max**.

```
BYPASS TEMPERATURE:
 ACTUAL MIN:       95.0  °C
 SET MIN TO:       95.1  °C?

             ↑↓ INC/DEC
              ↵ SAVE VALUE

 CFACT INST   DIAGS ALARM
```

Neph Block Temperature

The Neph Block Temperature screen allows the user to view and set the selected alarm parameters. Acceptable alarm limits range from 55 to 65 °C. If the nephelometer block temperature reading goes beyond the minimum or maximum limit, an alarm is activated and the alarm (bell) icon appears in the status bar on the Run screen and in the Main Menu.

- In the Main Menu, choose Alarms > Temperatures > **Neph Block**.

```
NEPH BLK TEMPERATURE:
 ACTUAL             0.0  °C
>MIN               55.0  °C
 MAX               65.0  °C



 CFACT INST  DIAGS ALARM
```

- In the Main Menu, choose Alarms > Temperatures > Neph Block > **Min** or **Max**.

```
NEPH BLOCK TEMPERATURE:
 ACTUAL MIN:       55.0  °C
 SET MIN TO:       55.1  °C?

           ↑↓ INC/DEC
            ↵ SAVE VALUE
 CFACT INST  DIAGS ALARM
```

Neph Temperature/Neph PCB Temperature

The Nephelometer Temperature screen allows the user to view and set the selected alarm parameters. Acceptable alarm limits range from 5 to 70 °C. If the nephelometer temperature reading goes beyond the minimum or maximum limit, an alarm is activated and the alarm (bell) icon appears in the status bar on the Run screen and in the Main Menu. The Neph PCB Temperature screen functions the same way.

- In the Main Menu, choose Alarms > Temperatures > **Neph**.

```
NEPH TEMPERATURE:
 ACTUAL             0.0  °C
>MIN                5.0  °C
 MAX               70.0  °C



 CFACT INST  DIAGS ALARM
```

- In the Main Menu, choose Alarms > Temperatures > Neph > **Min** or **Max**.

```
NEPH TEMPERATURE:
 ACTUAL MIN:        5.0  °C
 SET MIN TO:        5.1  °C?

            ↑↓ INC/DEC
             ↵ SAVE VALUE

 CFACT INST  DIAGS ALARM
```

TEOM Case Temperature

The TEOM Case Temperature screen allows the user to view and set the selected alarm parameters. Acceptable alarm limits range from 64 to 66 °C. If the TEOM case temperature reading goes beyond the minimum or maximum limit, an alarm is activated and the alarm (bell) icon appears in the status bar on the Run screen and in the Main Menu.

- In the Main Menu, choose Alarms > Temperatures > **TEOM Case**.

```
TEOM CASE TEMPERATURE:
 ACTUAL             0.0  °C
>MIN               64.0  °C
 MAX               66.0  °C




 CFACT INST  DIAGS ALARM
```

- In the Main Menu, choose Alarms > Temperatures > TEOM Case > **Min** or **Max**.

```
TEOM CASE TEMPERATURE:
 ACTUAL MIN:       64.0  °C
 SET MIN TO:       64.1  °C?

            ↑↓ INC/DEC
             ↵ SAVE VALUE

 CFACT INST  DIAGS ALARM
```

TEOM Air Tube Temperature

The TEOM Air Tube Temperature screen allows the user to view and set the selected alarm parameters. Acceptable alarm limits range from 61 to 63 °C. If the TEOM air tube temperature reading goes beyond the minimum or maximum limit, an alarm is activated and the alarm (bell) icon appears in the status bar on the Run screen and in the Main Menu.

- In the Main Menu, choose Alarms > Temperatures > **TEOM Air Tube**.

```
TEOM AIR TUBE TEMPERATURE:
 ACTUAL             0.0  °C
>MIN               61.0  °C
 MAX               63.0  °C




 CFACT INST  DIAGS ALARM
```

- In the Main Menu, choose Alarms > Temperatures > TEOM Air Tube > **Min** or **Max**.

```
TEOM TUBE TEMPERATURE:
 ACTUAL MIN:       61.0  °C
 SET MIN TO:       61.1  °C?

          ↑↓ INC/DEC
           ← SAVE VALUE
 CFACT INST  DIAGS ALARM
```

Probe Control Temperature

The Probe Control Temperature screen allows the user to view and set the selected alarm parameters. Acceptable alarm limits range from 10 to 50 °C. If the probe control temperature reading goes beyond the minimum or maximum limit, an alarm is activated and the alarm (bell) icon appears in the status bar on the Run screen and in the Main Menu.

- In the Main Menu, choose Alarms > Temperatures > **Probe Cntrl**.

```
PROBE CNTRL:
 ACTUAL             0.0  °C
>MIN               10.0  °C
 MAX               50.0  °C




 CFACT INST  DIAGS ALARM
```

- In the Main Menu, choose Alarms > Temperatures > Probe Cntrl > **Min** or **Max**.

```
PROBE CNTRL:
 ACTUAL MIN:       10.0  °C
 SET MIN TO:       10.1  °C?

           ↑↓ INC/DEC
            ↵ SAVE VALUE

 CFACT INST  DIAGS ALARM
```

Pressure

The Pressure submenu allows the user to view and set the selected pressure alarm parameters.

- In the Main Menu, choose Alarms > **Pressure**.

```
PRESSURE ALARMS:
 ALARMS DETECTED         0
>BAROMETRIC             OK
 STATIC                 OK
 TEOM DP                OK



 CFACT INST  DIAGS ALARM
```

Barometric Pressure

The Barometric Pressure screen screen allows the user to view and set the selected alarm parameters. Acceptable alarm limits range from 500 to 800 mmHg. If the barometric pressure reading goes beyond the minimum or maximum limit, an alarm is activated and the alarm (bell) icon appears in the status bar on the Run screen and in the Main Menu.

- In the Main Menu, choose Alarms > Pressure > **Barometric**.

```
BAROMETRIC PRESSURE:
 ACTUAL           0.0  mmHg
>MIN            500.0  mmHg
 MAX            800.0  mmHg




 CFACT INST  DIAGS ALARM
```

- In the Main Menu, choose Alarms > Pressure > Barometric > **Min** or **Max**.

```
BAROMETRIC PRESSURE:
 ACTUAL MIN:     500.0mmHg
 SET MIN TO:     500.1mmHg?

           ↑↓ INC/DEC
            ↵ SAVE VALUE

 CFACT INST  DIAGS ALARM
```

Static Pressure

The Static Pressure screen allows the user to view and set the selected alarm parameters. Acceptable alarm limits range from -18.7 to 18.7 mmHg. If the static pressure reading goes beyond the minimum or maximum limit, an alarm is activated and the alarm (bell) icon appears in the status bar on the Run screen and in the Main Menu.

- In the Main Menu, choose Alarms > Pressure > **Static**.

```
STATIC PRESSURE:
 ACTUAL              0.0 mmHg
>MIN               -18.7 mmHg
 MAX                18.7 mmHg




 CFACT INST  DIAGS ALARM
```

- In the Main Menu, choose Alarms > Pressure > Static > **Min** or **Max**.

```
STATIC PRESSURE:
 ACTUAL MIN:     0.0 mmHg
 SET MIN TO:     0.1 mmHg ?

           ↑↓ INC/DEC
            ↵ SAVE VALUE

 CFACT INST  DIAGS ALARM
```

TEOM DP Pressure

The TEOM DP Pressure screen allows the user to view and set the selected alarm parameters. Acceptable alarm limits range from 0 to 125 mmHg. If the TEOM DP pressure reading goes beyond the minimum or maximum limit, an alarm is activated and the alarm (bell) icon appears in the status bar on the Run screen and in the Main Menu.

- In the Main Menu, choose Alarms > Pressure > **TEOM DP**.

```
TEOM DP PRESSURE:
 ACTUAL            0.0 mmHg
>MIN               0.0 mmHg
 MAX             125.0 mmHg




 CFACT INST  DIAGS ALARM
```

- In the Main Menu, choose Alarms > Pressure > TEOM DP > **Min** or **Max**.

```
TEOM DP PRESSURE:
 ACTUAL MIN:       0.0 mmHg
 SET MIN TO:       0.1 mmHg?

           ⬆⬇ INC/DEC
            ↵ SAVE VALUE
 CFACT INST  DIAGS ALARM
```

Flows

The Flows submenu allows the user to view and set the selected flow alarm parameters.

- In the Main Menu, choose Alarms > **Flows**.

```
FLOW ALARMS:
 ALARMS DETECTED         0
>NOZZLE                 OK
 DILUTION               OK
 BYPASS                 OK
 SAMPLE                 OK
 SAMPLE CHECK           OK
 SAMPLE DRIFT           OK⬇

 CFACT INST  DIAGS ALARM

 DILUTION RATIO         OK
```

Nozzle Flow

The Nozzle Flow screen allows the user to view and set the selected alarm parameters. Acceptable alarm limits range from 1 to 5 SLPM. If the nozzle flow reading goes beyond the minimum or maximum limit, an alarm is activated and the alarm (bell) icon appears in the status bar on the Run screen and in the Main Menu.

- In the Main Menu, choose Alarms > Flows > **Nozzle**.

```
NOZZLE FLOW:
 ACTUAL          0.00 SLPM
>MIN             1.00 SLPM
 MAX             5.00 SLPM




 CFACT INST  DIAGS ALARM
```

- In the Main Menu, choose Alarms > Flow > Nozzle > **Min** or **Max**.

```
NOZZLE FLOW:
 ACTUAL MIN:     1.0 SLPM
 SET MIN TO:     1.1 SLPM ?

           ↑↓ INC/DEC
            ↵ SAVE VALUE
 CFACT INST  DIAGS ALARM
```

Dilution Flow/Bypass Flow

The Dilution Flow screen allows the user to view and set the selected alarm parameters. Acceptable alarm limits range from 17 to 30 SLPM. If the dilution flow reading goes beyond the minimum or maximum limit, an alarm is activated and the alarm (bell) icon appears in the status bar on the Run screen and in the Main Menu. The Bypass Flow screen functions the same way.

- In the Main Menu, choose Alarms > Flows > **Dilution**.

```
DILUTION FLOW:
 ACTUAL           0.0 SLPM
>MIN             17.0 SLPM
 MAX             30.0 SLPM




 CFACT INST  DIAGS ALARM
```

- In the Main Menu, choose Alarms > Flows > Dilution > **Min** or **Max**.

```
DILUTION FLOW:
 ACTUAL MIN:    17.00 SLPM
 SET MIN TO:    17.01 SLPM?

         ↑↓ INC/DEC
          ↵ SAVE VALUE

 CFACT INST  DIAGS ALARM
```

Sample Flow/Sample Check Flow

The Sample Flow screen allows the user to view and set the selected alarm parameters. Acceptable alarm limits range from 1 to 4 SLPM. If the sample flow reading goes beyond the minimum or maximum limit, an alarm is activated and the alarm (bell) icon appears in the status bar on the Run screen and in the Main Menu. The Sample Check Flow screen functions the same way.

- In the Main Menu, choose Alarms > Flows > **Sample**.

```
SAMPLE FLOW:
 ACTUAL          0.00 SLPM
>MIN             1.00 SLPM
 MAX             4.00 SLPM




 CFACT INST  DIAGS ALARM
```

- In the Main Menu, choose Alarms > Flows > Sample > **Min** or **Max**.

```
SAMPLE FLOW:
 ACTUAL MIN:     1.00 SLPM
 SET MIN TO:     1.01 SLPM?

         ↑↓ INC/DEC
          ↵ SAVE VALUE

 CFACT INST  DIAGS ALARM
```

Sample Drift

The Sample Drift screen allows the user to view and set the selected alarm parameters. Acceptable alarm limits range from -10 to 10 in percent. If the sample drift reading goes beyond the minimum or maximum limit, an alarm is activated and the alarm (bell) icon appears in the status bar on the Run screen and in the Main Menu.

- In the Main Menu, choose Alarms > Flows > **Sample Drift**.

```
SAMPLE DRIFT:
 ACTUAL              0.00 %
>MIN               -10.00 %
 MAX                10.00 %



 CFACT INST  DIAGS ALARM
```

- In the Main Menu, choose Alarms > Flows > Sample Drift > **Min** or **Max**.

```
SAMPLE FLOW DRIFT:
 ACTUAL MIN:        -4.00 %
 SET MIN TO:        -3.99 %?

           ↑↓ INC/DEC
            ↵ SAVE VALUE
 CFACT INST  DIAGS ALARM
```

Dilution Ratio Flow

The Dilution Ratio Flow screen allows the user to view and set the selected alarm parameters. Acceptable alarm limits range from 2 to 25. If the dilution ratio flow reading goes beyond the minimum or maximum limit, an alarm is activated and the alarm (bell) icon appears in the status bar on the Run screen and in the Main Menu.

- In the Main Menu, choose Alarms > Flows > **Dilution Ratio**.

```
DILUTION RATIO FLOW:
 ACTUAL                  1
>MIN                     5
 MAX                   100



 CFACT INST  DIAGS ALARM
```

- In the Main Menu, choose Alarms > Flows > Dilution Ratio > **Min** or **Max**.

```
DILUTION RATIO FLOW:
 ACTUAL MIN:           5
 SET MIN TO:    1      6 ?

           ↑↓ INC/DEC
            ↵ SAVE VALUE

 CFACT INST  DIAGS ALARM
```

Nephelometer

The Nephelometer submenu allows the user to view and set the selected nephelometer alarm parameters.

- In the Main Menu, choose Alarms > **Nephelometer**.

```
NEPHELOMETER ALARMS:
 ALARMS DETECTED        0
>NEPH SRC              OK
 NEPH REF DET          OK
 NEPH SPAN SRC         OK
 NEPH SPAN REF         OK
 NEPH RH               OK
 NEPH ZERO DRIFT       OK↓

 CFACT INST  DIAGS ALARM

 NEPH SPAN DRIFT       OK
 NEPH FWD GAINS        OK
```

Neph Source

The Neph Source screen allows the user to view and set the selected alarm parameters. Acceptable alarm limits range from 60 to 100 mA. If the neph source reading goes beyond the minimum or maximum limit, an alarm is activated and the alarm (bell) icon appears in the status bar on the Run screen and in the Main Menu.

- In the Main Menu, choose Alarms > Nephelometer > **Neph Source**.

```
NEPH SOURCE:
 ACTUAL            0.00 mA
>MIN              60.00 mA
 MAX             100.00 mA




 CFACT INST  DIAGS ALARM
```

- In the Main Menu, choose Alarms > Nephelometer > Neph Source > **Min** or **Max**.

```
NEPH SOURCE:
 ACTUAL MIN:      60.00 mA
 SET MIN TO:      60.01 mA?

           ↑↓ INC/DEC
            ↵ SAVE VALUE

 CFACT INST  DIAGS ALARM
```

Neph Ref Det

The Neph Source screen allows the user to view and set the selected alarm parameters. Acceptable alarm limits range from 2.40 to 2.60 VDC. If the neph ref det reading goes beyond the minimum or maximum limit, an alarm is activated and the alarm (bell) icon appears in the status bar on the Run screen and in the Main Menu.

- In the Main Menu, choose Alarms > Nephelometer > **Neph Ref Det**.

```
NEPH REF DET:
 ACTUAL           0.00 VDC
>MIN              2.40 VDC
 MAX              2.60 VDC




 CFACT INST  DIAGS ALARM
```

- In the Main Menu, choose Alarms > Nephelometer > Neph Ref Det > **Min** or **Max**.

```
NEPH REF DET:
 ACTUAL MIN:      2.40 VDC
 SET MIN TO:      2.41 VDC?

           ↑↓ INC/DEC
            ↵ SAVE VALUE

 CFACT INST  DIAGS ALARM
```

Neph Span Source

The Neph Span Source screen allows the user to view and set the selected alarm parameters. Acceptable alarm limits range from 0 to 100 mA. If the neph span source reading goes beyond the minimum or maximum limit, an alarm is activated and the alarm (bell) icon appears in the status bar on the Run screen and in the Main Menu.

- In the Main Menu, choose Alarms > Nephelometer > **Neph Span Source**.

```
NEPH SPAN SOURCE:
 ACTUAL              0.00 mA
>MIN                 0.01 mA
 MAX               100.00 mA




 CFACT INST  DIAGS ALARM
```

- In the Main Menu, choose Alarms > Nephelometer > Neph Span Source > **Min** or **Max**.

```
NEPH SPAN SOURCE:
 ACTUAL MIN:         0.00 mA
 SET MIN TO:         0.01 mA?

          ↑↓ INC/DEC
           ↵ SAVE VALUE
 CFACT INST  DIAGS ALARM
```

Neph Span Ref

The Neph Span Ref screen allows the user to view and set the selected alarm parameters. Acceptable alarm limits range from 0 to 4.50 VDC. If the neph Span Ref reading goes beyond the minimum or maximum limit, an alarm is activated and the alarm (bell) icon appears in the status bar on the Run screen and in the Main Menu.

- In the Main Menu, choose Alarms > Nephelometer > **Neph Span Ref**.

```
NEPH SPAN REF:
 ACTUAL             0.00 VDC
>MIN                0.00 VDC
 MAX                4.50 VDC




 CFACT INST  DIAGS ALARM
```

- In the Main Menu, choose Alarms > Nephelometer > Neph Span Ref > **Min** or **Max**.

```
NEPH SPAN REF:
 ACTUAL MIN:      0.00 VDC
 SET MIN TO:      0.01 VDC?

          ↑↓ INC/DEC
           ↵ SAVE VALUE

 CFACT INST  DIAGS ALARM
```

Neph RH

The Neph RH screen allows the user to view and set the selected alarm parameters. Acceptable alarm limits range from 0 to 50 in percent. If the neph RH reading goes beyond the minimum or maximum limit, an alarm is activated and the alarm (bell) icon appears in the status bar on the Run screen and in the Main Menu.

- In the Main Menu, choose Alarms > Nephelometer > **Neph RH**.

```
NEPH RH:
 ACTUAL             0.00 %
>MIN                0.00 %
 MAX               50.00 %




 CFACT INST  DIAGS ALARM
```

- In the Main Menu, choose Alarms > Nephelometer > Neph RH > **Min** or **Max**.

```
NEPH RH:
 ACTUAL MIN:        0.00 %
 SET MIN TO:        0.01 %?

          ↑↓ INC/DEC
           ↵ SAVE VALUE

 CFACT INST  DIAGS ALARM
```

Neph Zero Drift

The Neph Zero Drift screen allows the user to view and set the selected alarm parameters. Acceptable alarm limits range from -4 to 4 in percent. If the neph zero drift reading goes beyond the minimum or maximum limit, an alarm is activated and the alarm (bell) icon appears in the status bar on the Run screen and in the Main Menu.

- In the Main Menu, choose Alarms > Nephelometer > **Neph Zero Drift**.

```
NEPH ZERO DRIFT:
 ACTUAL              0.00 %
>MIN                -4.00 %
 MAX                 4.00 %



 CFACT INST   DIAGS ALARM
```

- In the Main Menu, choose Alarms > Nephelometer > Neph Zero Drift > **Min** or **Max**.

```
NEPH ZERO DRIFT:
 ACTUAL MIN:        -4.00 %
 SET MIN TO:        -4.00 %?

           ↑↓ INC/DEC
            ↵ SAVE VALUE
 CFACT INST   DIAGS ALARM
```

Neph Span Drift

The Neph Span Drift screen allows the user to view and set the selected alarm parameters. Acceptable alarm limits range from -4 to 4 in percent. If the neph span drift reading goes beyond the minimum or maximum limit, an alarm is activated and the alarm (bell) icon appears in the status bar on the Run screen and in the Main Menu.

- In the Main Menu, choose Alarms > Nephelometer > **Neph Span Drift**.

```
NEPH SPAN DRIFT:
 ACTUAL              0.00 %
>MIN                -4.00 %
 MAX                 4.00 %



 CFACT INST   DIAGS ALARM
```

- In the Main Menu, choose Alarms > Nephelometer > Neph Span Drift > **Min** or **Max**.

```
NEPH SPAN DRIFT:
 ACTUAL MIN:       -4.00 %
 SET MIN TO:       -4.01 %?

          ↑↓ INC/DEC
           ↵ SAVE VALUE

 CFACT INST  DIAGS ALARM
```

Neph Fwd Gains

The Neph Fwd Gains screen allows the user to view and set the selected alarm parameters. Acceptable minimum alarm limits range from 2 to 5. If the neph fwd gains reading goes beyond the minimum, an alarm is activated and the alarm (bell) icon appears in the status bar on the Run screen and in the Main Menu.

- In the Main Menu, choose Alarms > Nephelometer > **Neph Fwd Gains**.

```
NEPH FWD GAINS:
 ACTUAL                 0
>MIN                    2







 CFACT INST  DIAGS ALARM
```

- In the Main Menu, choose Alarms > Nephelometer > Neph Fwd Gains > **Min**.

```
NEPH FWD GAINS:
 ACTUAL MIN:            2
 SET MIN TO:            3 ?

          ↑↓ INC/DEC
           ↵ SAVE VALUE

 CFACT INST  DIAGS ALARM
```

TEOM

The TEOM submenu allows the user to view and set the selected nephelometer alarm parameters.

- In the Main Menu, choose Alarms > **TEOM**.

```
TEOM ALARMS:
 ALARMS DETECTED        0
>TEOM FREQUENCY        OK
 TEOM STD DEV          OK
 TEOM K0               OK
 TOTAL MASS            OK



 CFACT INST  DIAGS ALARM
```

TEOM Frequency

The TEOM Frequency screen allows the user to view and set the selected alarm parameters. Acceptable alarm limits range from 280 to 310 Hz. If the TEOM frequency reading goes beyond the minimum or maximum limit, an alarm is activated and the alarm (bell) icon appears in the status bar on the Run screen and in the Main Menu.

- In the Main Menu, choose Alarms > TEOM > **TEOM Frequency**.

```
TEOM FREQUENCY:
 ACTUAL          0.0000 Hz
>MIN           280.0000 Hz
 MAX           310.0000 Hz




 CFACT INST  DIAGS ALARM
```

- In the Main Menu, choose Alarms > TEOM > TEOM Frequency > **Min** or **Max**.

```
TEOM FREQUENCY:
 ACTUAL MIN:   280.0000 Hz
 SET MIN TO:   280.0010 Hz?

            ↑↓ INC/DEC
             ↵ SAVE VALUE

 CFACT INST  DIAGS ALARM
```

TEOM Std Dev

The TEOM Std Dev screen allows the user to view and set the selected alarm parameters. Acceptable alarm limits range from 0005 to .01 Hz. If the TEOM std dev reading goes beyond the minimum or maximum limit, an alarm is activated and the alarm (bell) icon appears in the status bar on the Run screen and in the Main Menu.

- In the Main Menu, choose Alarms > TEOM > **TEOM Std Dev**.

```
TEOM STD DEV:
 ACTUAL         0.00000 Hz
>MIN            0.00050 Hz
 MAX            0.01000 Hz




 CFACT INST  DIAGS ALARM
```

- In the Main Menu, choose Alarms > TEOM > TEOM Std Dev > **Min** or **Max**.

```
TEOM STD DEV:
 ACTUAL MIN:    0.00050 Hz
 SET MIN TO:    0.00051 Hz?

              ↑↓ INC/DEC
               ↵ SAVE VALUE

 CFACT INST  DIAGS ALARM
```

TEOM K0

The TEOM K0 screen allows the user to view and set the selected alarm parameters. Acceptable alarm limits range from 125 to 145. If the TEOM K0 reading goes beyond the minimum or maximum limit, an alarm is activated and the alarm (bell) icon appears in the status bar on the Run screen and in the Main Menu.

- In the Main Menu, choose Alarms > TEOM > **TEOM K0**.

```
TEOM K0:
 ACTUAL                0
>MIN               12500
 MAX               15500



 CFACT INST  DIAGS ALARM
```

- In the Main Menu, choose Alarms > TEOM > TEOM K0 > **Min** or **Max**.

```
TEOM K0:
 ACTUAL MIN:       12500
 SET MIN TO:       12501 ?

           ↑↓ INC/DEC
            ↵ SAVE VALUE
 CFACT INST  DIAGS ALARM
```

Total Mass

The Total Mass screen allows the user to view and set the selected alarm parameters. Acceptable alarm limits range from -1 to 5 mg. If the total mass reading goes beyond the minimum or maximum limit, an alarm is activated and the alarm (bell) icon appears in the status bar on the Run screen and in the Main Menu.

- In the Main Menu, choose Alarms > TEOM > **Total Mass**.

```
TOTAL MASS:
 ACTUAL         0.000000 mg
>MIN           -1.000000 mg
 MAX            5.000000 mg



 CFACT INST  DIAGS ALARM
```

- In the Main Menu, choose Alarms > TEOM > Total Mass > **Min** or **Max**.

```
TOTAL MASS:
 ACTUAL MIN:     -1.000 mg
 SET MIN TO:     -0.999 mg?

          ↑↓ INC/DEC
           ↵ SAVE VALUE

 CFACT INST  DIAGS ALARM
```

Instrument

The Instrument submenu allows the user to choose which pressure alarm values to modify/inspect.The Velocity sceen allows the user to view and set the selected velocity alarm parameter. All other items are read only.

- In the Main Menu, choose Alarms > **Instrument**.

```
INSTRUMENT ALARMS:
 ALARMS DETECTED          0
>VELOCITY                OK
 MANUAL MODE             OK
 SERVICE MODE            OK
 BLOW BACK PERIOD        OK
 MOTHERBOARD STATUS      OK
 INTERFACE   STATUS      OK

 CFACT INST  DIAGS ALARM

 TCB         STATUS      OK
 DUAL NEPH   STATUS      OK
 TEOM        STATUS      OK
 I/O EXP     STATUS      OK
 EXT 1       STATUS      OK
```

Velocity

The Velocity screen allows the user to view and set the selected velocity alarm parameters. Acceptable alarm limits range from 0 to 30 m/s. If the velocity reading goes beyond the minimum or maximum limit, an alarm is activated and the alarm (bell) icon appears in the status bar on the Run screen and in the Main Menu.

- In the Main Menu, choose Alarms > Instrument > **Velocity**.

```
VELOCITY:
 ACTUAL            0.00 m/s
>MIN               0.00 m/s
 MAX              30.00 m/s




 CFACT INST  DIAGS ALARM
```

- In the Main Menu, choose Alarms > Instrument > Velocity > **Min** or **Max**.

```
VELOCITY:
 ACTUAL MIN:      0.00 m/s
 SET MIN TO:      0.01 m/s?

           ↑↓ INC/DEC
            ↵ SAVE VALUE

 CFACT INST  DIAGS ALARM
```

Service Menu

The Service menu appears only when the instrument is in the service mode. When the service mode is active, the service (wrench) icon is displayed on the right side of the status bar. To put the instrument into the service mode:

- In the Main Menu, choose Instrument Controls > **Service Mode**.

Advanced diagnostic functions are included in the service mode. Meaningful data should not be collected when the instrument is in the service mode.

- In the Main Menu, choose **Service**.

```
SERVICE:
>TEMPERATURE CALIBRATION
 PRES PROBE CALIBRATION
 MFC CAL PRES/TEMP
 SAMPLE MFC CALIBRATION
 DILUTION MFC CALIBRATION
 BYPASS MFC CALIBRATION
 NEPH PURGE FLOW           ↓

 CFACT INST  DIAGS ALARM

 NEPHELOMETER CALIBRATION
 ANALOG OUT CALIBRATION
 ANALOG INPUT CALIBRATION
 DISPLAY PIXEL TEST
 RESTORE USER DEFAULTS
```

Temperature Calibration

The Temperature Calibration submenu allows the user to view and set other temperature calibration values. The temperature calibration submenu is visible only when the instrument is in service mode. For more information on the service mode, see "Service Mode" earlier in this chapter.

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

- In the Main Menu, choose Service > **Temperature Calibration**.

```
TEMPERATURES PROBE CAL:
>NEPH BLK OFFSET    0.0  °C
 DILUTION OFFSET    0.0  °C
 STINGER  OFFSET    0.0  °C
 BYPASS   OFFSET    0.0  °C
 STACK    OFFSET    0.0  °C
 MIB      OFFSET    0.0  °C


 CFACT  INST   DIAGS  ALARM
```

- In the Main Menu, choose Service > Temperature Calibration > **Neph Blk Offset**. The Temperatures Dilution, Stinger, Bypass, Stack, and MIB Offset screens function the same way.

```
CALIBRATE NEPH BLOCK TEMP:
>TEMPERATURE:       0.0  °C
      OFFSET:       0.1  °C?

          ↑↓  INC/DEC
           ↵  SAVE VALUE
 CFACT  INST   DIAGS  ALARM
```

Pressure Probe Calibration

The Pressure Probe Calibration submenu allows the user to view and calibrate the barametric pressure and the vacuum pressure. The pressure probe calibration submenu is visible only when the instrument is in service mode. For more information on the service mode, see "Service Mode" earlier in this chapter.

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

- In the Main Menu, choose Service > **Pres Probe Calibration**.

```
PRES PROBE CALIBRATION:
>BARO PRES
 STATIC PRES
 TEOM DP PRES




 CFACT  INST   DIAGS  ALARM
```

Barometer Pressure Calibration

The Barometer Pressure Calibration submenu is used to calibrate the barometer pressure offset, span or reset default values.

- In the Main Menu, choose Service > Pres Probe Calibration > **Baro Pres**.

```
BARO PRES CALIBRATION:
>SPAN                 1.0000
 SET DEFAULTS




 CFACT INST  DIAGS ALARM
```

Calibrate Barometer Pressure Span

The Calibrate Barometer Pressure Span screen allows the user to view and set the pressure sensor calibration span point.

Note The operator should use an independent barometer to measure the ambient pressure and enter the value on this screen before calibrating. ▲

- In the Main Menu, choose Service > Pres Probe Calibration > Baro Pres Calibration > **Span**.

```
CAL BARO PRESSURE SPAN:
 PRESSURE:    750.0  mmHg
   SET TO:    750.01 mmHg?

          ←→ MOVE CURSOR
 ↑↓ CHANGE VALUE    ↵ SAVE

 CFACT INST  DIAGS ALARM
```

Restore Default Calibration

The Restore Default Calibration screen allows the user to reset the default values.

- In the Main Menu, choose Service > Pres Probe Calibration > Baro Pres Calibration > **Set Defaults**.

```
RESTORE DEFAULT CAL:

                ↵ RESTORE




 CFACT INST  DIAGS ALARM
```

```
RESTORE DEFAULT CAL:

                ↵ RESTORE
ARE YOU SURE YOU WANT TO?
PRESS ➡ TO CONFIRM RESTORE


 CFACT INST  DIAGS ALARM
```

Static Pressure Calibration

The Static Pressure Calibration submenu is used to calibrate the static pressure offset, zero, span or reset default values. The TEOM DP Pressure screen functions the same way.

- In the Main Menu, choose Service > Pres Probe Calibration > **Static Pres**.

```
STATIC PRES CAL:
>ZERO
 SPAN                 1.0000
 SET DEFAULTS





 CFACT INST  DIAGS ALARM
```

Calibrate Static Pressure Zero

The Calibrate Static Pressure Zero promts user zero both vacuum and flow while a zero is being applied. When enter is pressed, both vailues will consider their current voltage values to be the new zero value.

- In the Main Menu, choose Service > Pres Probe Calibration > Static Pres Calibration > **Zero**.

```
CAL STATIC PRES ZERO:
 OFFSET:                 0.0


  ↵ TO CALIBRATE AFTER
      PROVIDING ZERO

 CFACT INST  DIAGS ALARM
```

Calibrate Static Pressure Span

The Calibrate Static Pressure Span screen allows the user to view and set the pressure sensor calibration span point.

Note The operator should use an independent manometer to measure the ambient pressure and enter the value on this screen before calibrating. ▲

- In the Main Menu, choose Service > Pres Probe Calibration > Static Pres Calibration > **Span**.

```
CAL STATIC PRES SPAN:
 PRESSURE:      0.0  mmHg
   SET TO:      0.01 mmHg?

          ←→ MOVE CURSOR
 ↑↓ CHANGE VALUE   ↵ SAVE

 CFACT INST  DIAGS ALARM
```

Restore Default Calibration

The Restore Default Calibration screen allows the user to reset the default values.

- In the Main Menu, choose Service > Pres Probe Calibration > Static Pres Calibration > **Set Defaults**.

```
RESTORE DEFAULT CAL:

                ↵ RESTORE



 CFACT INST  DIAGS ALARM
```

```
RESTORE DEFAULT CAL:

                ↵ RESTORE
ARE YOU SURE YOU WANT TO?
PRESS → TO CONFIRM RESTORE

 CFACT INST  DIAGS ALARM
```

MFC Calibration Pressure/Temperature

The MFC Calibration Pressure/Temperature screen allows the user to view and set the mass flow controller calibrations for temperature and pressure. The MFC calibration pressure/temperature submenu is visible only when the instrument is in service mode. For more information on the service mode, see "Service Mode" earlier in this chapter.

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

- In the Main Menu, choose Service > **MFC Cal Pres/Temp**.

```
ENTER PRES AND TEMP:
    PRESSURE: 760.01 mmHg?
 TEMPERATURE: 025.0   °C

             ←→ MOVE CURSOR
 ↑↓ CHANGE VALUE    ↵ SAVE

 CFACT INST  DIAGS ALARM
```

Sample MFC Calibration

The Sample MFC Calibration screen allows the user to calibrate the sample mass flow controller at set SLPM points. The sample MFC calibration submenu is visible only when the instrument is in service mode. For more information on the service mode, see "Service Mode" earlier in this chapter.

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

- In the Main Menu, choose Service > **Sample MFC Calibration**.

```
SAMPLE MFC CAL:
>40% FS          2045 SCCM
 50% FS          2556 SCCM
 60% FS          3070 SCCM




 CFACT INST  DIAGS ALARM
```

Set Sample MFC Calibration

The Set Sample MFC calibration point screen allows the user to view and set the selected point for sample mass flow controller calibration of volume flow. It also displays the standard flow computed from the specified volume flow. All Sample MFC set screens function the same way.

- In the Main Menu, choose Service > Sample MFC Calibration > **40%**.

```
SAMPLE MFC DRIVE 40%:
 STD FLOW:     002045 SCCM
 VOL FLOW:     002045 CCM
 1590    14 1449
             ←→ MOVE CURSOR
 ↑↓ CHANGE VALUE    ↵ SAVE

 CFACT INST  DIAGS ALARM
```

Dilution MFC Calibration

The Dilution MFC Calibration screen allows the user to calibrate the dilution mass flow controller at set SLPM points. The dilution MFC calibration submenu is visible only when the instrument is in service mode. For more information on the service mode, see “Service Mode” earlier in this chapter.

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

- In the Main Menu, choose Service > **Dilution MFC Calibration**.

```
DILUTION MFC CAL:
>35% FS          17.000 SLPM
 40% FS          19.490 SLPM
 45% FS          21.830 SLPM



 CFACT INST   DIAGS ALARM
```

Set Dilution MFC Calibration

The Set Dilution MFC calibration point screen allows the user to view and set the selected point for dilution mass flow controller calibration of volume flow. It also displays the standard flow computed from the specified volume flow. All Dilution MFC set screens function the same way.

- In the Main Menu, choose Service > Dilution MFC Calibration > **35%**.

```
DILUTION MFC DRIVE 35%:
 STD FLOW:       17.000 SLPM
 VOL FLOW:       17.000 LPM
 1226       0 1353
             ←→ MOVE CURSOR
 ↑↓ CHANGE VALUE     ↵ SAVE

 CFACT INST   DIAGS ALARM
```

Bypass MFC Calibration

The Bypass MFC Calibration screen allows the user to calibrate the bypass mass flow controller at set SLPM points. The bypass MFC calibration submenu is visible only when the instrument is in service mode. For more information on the service mode, see “Service Mode” earlier in this chapter.

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

- In the Main Menu, choose Service > **Bypass MFC Calibration**.

```
BYPASS MFC CAL:
>70% FS          17.500 SLPM
 80% FS          20.240 SLPM
 90% FS          22.250 SLPM




 CFACT INST  DIAGS ALARM
```

Set Bypass MFC Calibration

The Set Bypass MFC calibration point screen allows the user to view and set the selected point for bypass mass flow controller calibration of volume flow. It also displays the standard flow computed from the specified volume flow. All Bypass MFC set screens function the same way.

- In the Main Menu, choose Service > Bypass MFC Calibration > **70%**.

```
BYPASS MFC DRIVE 70%:
 STD FLOW:      17.500 SLPM
 VOL FLOW:      17.500 LPM
 2783     17 2557
             ←→ MOVE CURSOR
 ↑↓ CHANGE VALUE    ↵ SAVE

 CFACT INST  DIAGS ALARM
```

Nephelometer Purge Flow

The Nephelometer Purge Flow screen allows the user to calibrate the nephelometer as well as perform other actions like mode selection and restore background settings to previous values. The nephelometer purge flow submenu is visible only when the instrument is in service mode. For more information on the service mode, see “Service Mode” earlier in this chapter.

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

- In the Main Menu, choose Service > **Neph Purge Flow**.

```
ENTER NEPH PURGE FLOW:
 CURRENTLY:     0.000 SLPM
    SET TO:     0.001 SLPM?

             ←→ MOVE CURSOR
 ↑↓ CHANGE VALUE    ↵ SAVE

 CFACT INST  DIAGS ALARM
```

Nephelometer Calibration

The Nephelometer Calibration submenu allows the user to calibrate the nephelometer as well as perform other actions like mode selection and restore background settings to previous values. The nephelometer calibration submenu is visible only when the instrument is in service mode. For more information on the service mode, see "Service Mode" earlier in this chapter.

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

- In the Main Menu, choose Service > **Nephelometer Calibration**.

```
NEPHELOMETER CAL:
>ZERO CAL VALUES
 SPAN CAL VALUES
 NEPH RH
 NEPH INT TEMP
 NEPH SOURCE
 AUTO SPAN

 CFACT INST  DIAGS ALARM
```

Zero Calibration Values

The Zero Calibration Values submenu allows the user to zero the nephelometer.

- In the Main Menu, choose Service > Nephelometer Calibration > **Zero Cal Values**.

```
NEPH ZERO CAL:
>AUTO NEPH ZERO CAL
 RESTORE PREVIOUS CAL
 CLEAR CURRENT CAL
 DISPLAY OFFSET VALUES




 CFACT INST  DIAGS ALARM
```

- In the Main Menu, choose Service > Nephelometer Calibration > Zero Cal Values > **Auto Neph Zero Cal**.

```
      CALIBRATING
    CURRENT    PREVIOUS
1A:  0.00000    0.00000
1A:  0.00000    0.00000
1A:  0.00000    0.00000
1A:  0.00000    0.00000
1A:  0.00000    0.00000
1A:  0.00000    0.00000

CFACT INST  DIAGS ALARM
```

The Restore Previous Calibration screen allows the user to restore the nephelometer zero calibration.

- In the Main Menu, choose Service > Nephelometer Calibration > Zero Cal Values > Restore Zero Cal > **Restore Previous Cal**.

```
RESTORE NEPH ZERO CAL:
                ↵ RESTORE




 CFACT INST  DIAGS ALARM
```

```
RESTORE NEPH ZERO CAL:
                ↵ RESTORE
ARE YOU SURE YOU WANT TO?
PRESS ➡ TO CONFIRM RESTORE


 CFACT INST  DIAGS ALARM
```

The Clear Current Calibration screen allows the user to clear the nephelometer zero calibration.

- In the Main Menu, choose Service > Nephelometer Calibration > Zero Cal Values > Restore Zero Cal > **Clear Current Cal**.

```
CLEAR NEPH ZERO CAL:
                ↵ CLEAR




 CFACT INST  DIAGS ALARM
```

```
CLEAR NEPH ZERO CAL:
                ↵ CLEAR
ARE YOU SURE YOU WANT TO?
PRESS ➡ TO CONFIRM RESTORE


 CFACT INST  DIAGS ALARM
```

The Display Offset Values screen (read only) is used to display the nephelometer offset values.

- In the Main Menu, choose Service > Nephelometer Calibration > Zero Cal Values > **Display Offset Values**.

```
DISPLAY OFFSET VALUES:
      CURRENT   PREVIOUS
 1A:        0          0
 2A:        0          0
 3A:        0          0
 4A:       42          0
 1B:        0          0
 2B:       21          0  ↓

 CFACT INST  DIAGS ALARM
```

Span Calibration Values

The Span Calibration Values submenu allows the user to read the span values and set the duration of each span value.

- In the Main Menu, choose Service > Nephelometer Calibration > **Span Cal Values**.

```
NEPH SPAN CAL:
 SPAN CONC 1     1.0 mg/m3
 SPAN CONC 2     5.0 mg/m3
 SPAN CONC 3    25.0 mg/m3
 SPAN CONC 4    50.0 mg/m3
>SPAN DURATION 1  90  sec
 SPAN DURATION 2  90  sec
 SPAN DURATION 3  90  sec↓

 CFACT INST  DIAGS ALARM
```

The Span Dilution screen allows the user to view and set the temperature parameter for the selected component.

- In the Main Menu, choose Service > Nephelometer Calibration > Span Cal Values > **Span Duration 1**.

```
SPAN DURATION 1:
 CURRENTLY:         90 sec
     SET TO:        91 sec?

            ↑↓ INC/DEC
             ↵ SAVE VALUE

 CFACT INST  DIAGS ALARM
```

Nephelometer RH

The Nephelometer RH screen allows the user to set the nephelometer RH offset.

- In the Main Menu, choose Service > Nephelometer Calibration > **Neph RH**.

```
SET NEPH RH OFFSET:
 NEPH RH:          0.01 %
  OFFSET:          0.01 % ?

            ↑↓ INC/DEC
             ↵ SAVE VALUE

 CFACT INST  DIAGS ALARM
```

Nephelometer INT Temperature

The Nephelometer Int Temperature screen allows the user to set the nephelometer int offset.

- In the Main Menu, choose Service > Nephelometer Calibration > **Neph Int Temp**.

```
SET NEPH INT OFFSET:
 NEPH INT:         0.01 °C
   OFFSET:         0.01 °C ?

           ↑↓ INC/DEC
            ↵ SAVE VALUE

 CFACT INST  DIAGS ALARM
```

Nephelometer Source

The Nephelometer Source screen allows the user to view and set the nephelometer source.

- In the Main Menu, choose Service > Nephelometer Calibration > **Neph Source**.

```
SET NEPH SOURCE LEVEL:
    IRED A:          0 mA
 SRC LEVEL:      000.1 %  ?

          ←→ MOVE CURSOR
 ↑↓ CHANGE VALUE   ↵ SAVE

 CFACT INST  DIAGS ALARM
```

Auto Span The Auto Span submenu allows the user to first select a maximum concentration (compatible with the operating permit) and initiate an auto-span curve.

- In the Main Menu, choose Service > Nephelometer Calibration > **Auto Span**.

```
AUTO SPAN:
>MAX
 START AUTO SPAN





 CFACT INST  DIAGS ALARM
```

The Auto Span Max screen allows the user to select a site-specific maximum-span value.

- In the Main Menu, choose Service > Nephelometer Calibration > Auto Span > **Max**.

```
SET NEPH INT OFFSET:
 NEPH INT:        0.01 °C
   OFFSET:        0.01 °C ?

          ↑↓ INC/DEC
           ↵ SAVE VALUE

 CFACT INST  DIAGS ALARM
```

The Auto Span Start Auto Span screen allows the user to initiate a span curve. Allow 15 minutes.

- In the Main Menu, choose Service > Nephelometer Calibration > Auto Span > **Start Auto Span**.

```
        CALIBRATING



 CFACT INST  DIAGS ALARM
```

Analog Output Calibration

The Analog Output Calibration menu provides access to the 6 voltage channels and 6 current channels for calibration. The analog output calibration menu is visible only when the instrument is in service mode. For more information on the service mode, see "Service Mode" earlier in this chapter.

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

- In the Main Menu, choose Service > **Analog Out Calibration**.

```
ANALOG OUTPUT CAL:
>VOLTAGE CHANNEL 1
 VOLTAGE CHANNEL 2
 VOLTAGE CHANNEL 3
 VOLTAGE CHANNEL 4
 VOLTAGE CHANNEL 5
 VOLTAGE CHANNEL 6
 CURRENT CHANNEL 1       ↓
 CFACT INST  DIAGS ALARM
```

```
ANALOG OUTPUT CAL:
>CALIBRATE ZERO
 CALIBRATE FULL SCALE




 CFACT INST  DIAGS ALARM
```

Analog Output Calibrate Zero

The Analog Output Calibrate Zero screen allows the user to calibrate the zero state of the selected analog output. The operator must connect a volt meter to the output and adjust the output until it reads 0.0 V on the meter for a voltage channel, or either 0 or 4 mA for a current channel (depending on the selected range). See the "set output to:" field on the display.

- In the Main Menu, choose Service > Analog Out Cal > select Channel > **Calibrate Zero**.

```
ANALOG OUTPUT CAL:    ZERO
 CONNECT METER TO OUTPUT!
  SELECTED OUTPUT:    V1
  SET TO:             100
 ↵ SAVE VALUE   ↑↓ INC/DEC
 SET OUTPUT TO:      0.0 V

 CFACT INST   DIAGS ALARM
```

Analog Output Calibrate Full-Scale

The Analog Output Calibrate Full-Scale screen allows the user to calibrate the full-scale state of the selected analog output. The operator must connect a volt meter to the output and adjust the output until the meter reads the value shown in the "set output to:" field, in either V or mA, depending on the selected output channel.

- In the Main Menu, choose Service > Analog Out Cal > select Channel > **Calibrate Full Scale**.

```
ANALOG OUTPUT CAL:    SPAN
 CONNECT METER TO OUTPUT!
  SELECTED OUTPUT:    V1
  SET TO:            3397
 ↵ SAVE VALUE   ↑↓ INC/DEC
 SET OUTPUT TO:       10 V

 CFACT INST   DIAGS ALARM
```

Analog Input Calibration

The Analog Input Calibration menu is used to calibrate the 8 analog input channels at both zero and full-scale. The analog input calibration menu is visible only when the instrument is in service mode. For more information on the service mode, see "Service Mode" earlier in this chapter.

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

- In the Main Menu, choose Service > **Analog Input Calibration**.

```
ANALOG INPUT CAL:
>INPUT CHANNEL 1
 INPUT CHANNEL 2
 INPUT CHANNEL 3
 INPUT CHANNEL 4
 INPUT CHANNEL 5
 INPUT CHANNEL 6
 INPUT CHANNEL 7        ↓

 CFACT INST  DIAGS ALARM
```

```
ANALOG INPUT CAL:
>CALIBRATE ZERO
 CALIBRATE FULL SCALE






 CFACT INST  DIAGS ALARM
```

Analog Input Calibrate Zero

The Analog Input Calibrate Zero screen allows the user to calibrate the zero state of the selected analog input.

- In the Main Menu, choose Service > Analog Input Cal > select Channel > **Calibrate Zero**.

```
ANALOG INPUT CAL:    ZERO
DISCONNECT SELECTED INPUT!
 SELECTED INPUT:   INPUT 1
 CURRENTLY:       0.04 V

 ↵ CALIBRATE INPUT TO ZERO

 CFACT INST  DIAGS ALARM
```

Analog Input Calibrate Full-Scale

The Analog Input Calibrate Full-Scale screen allows the user to calibrate the full-scale state of the selected analog input.

- In the Main Menu, choose Service > Analog Input Cal > select Channel > **Calibrate Full Scale**. (Hook up a voltage source of 10 V to the analog input channel.)

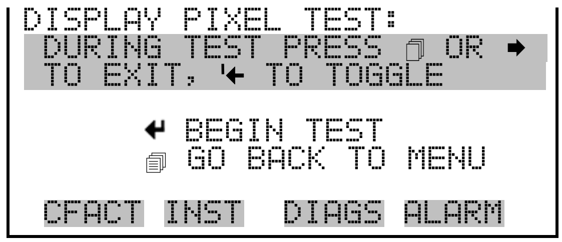
```
ANALOG INPUT CAL:    SPAN
PROVIDE VOLTAGE TO INPUT!
 SELECTED INPUT:   INPUT 1
 CURRENTLY:        9.84 V
    SET TO:       10.00 V
     ↵ CALIBRATE TO VALUE

 CFACT INST  DIAGS ALARM
```

Display Pixel Test

The Display Pixel Test screen is used to test the LCD display, by toggling between all pixels on and all pixels off to ensure that they are functioning properly. The display pixel test screen is visible only when the instrument is in service mode. For more information on the service mode, see "Service Mode" earlier in this chapter.

- In the Main Menu, choose Service > **Display Pixel Test**.



Restore User Defaults

The Restore User Defaults screen is used to reset the user calibration and configuration values to factory defaults. The restore user defaults screen is visible only when the instrument is in service mode. For more information on the service mode, see "Service Mode" earlier in this chapter.

- In the Main Menu, choose Service > **Restore User Defaults.**

Restore Factory Defaults

The Restore User Defaults screen is used to reset the user calibration and configuration values to factory defaults. The restore user defaults screen is visible only when the instrument is in service mode. For more information on the service mode, see "Service Mode" earlier in this chapter.

- In the Main Menu, choose Service > **Restore User Defaults.**

```
RESTORE FACTORY DEFAULTS:

                 ↵ RESTORE



 CFACT INST  DIAGS ALARM
```

```
RESTORE FACTORY DEFAULTS:

                 ↵ RESTORE
ARE YOU SURE YOU WANT TO?
PRESS ➡ TO CONFIRM RESTORE


 CFACT INST  DIAGS ALARM
```

Password Menu

The Password menu allows the user to configure password protection. If the instrument is "locked", none of the settings may be changed via the front panel user interface, but they can still be changed via remote operation. When the front panel is locked, the user can still navigate the menu and view data, instrument parameters, and settings, but nothing can be changed. The password (lock) icon on the right side of the status bar indicates that the password lock is active. The items visible under the Password menu are determined by the instrument's password status.

- In the Main Menu, choose **Password**.

```
PASSWORD MENU:
>SET PASSWORD
 LOCK INSTRUMENT
 CHANGE PASSWORD
 REMOVE PASSWORD
 UNLOCK INSTRUMENT



 CFACT INST  DIAGS ALARM
```

Set Password

The Set Password screen is used to set the password that is used to unlock the front panel, and is shown if the instrument is unlocked and the password is not set.

- In the Main Menu, choose Password > **Set Password**

```
ENTER NEW PASSWORD:
           █

     ABCDEFGHIJKLMN  BKSP
     OPQRSTUVWXYZ    PAGE
     0123456789 ./-  SAVE
 CFACT INST  DIAGS ALARM
```

Lock Instrument

The Lock Instrument screen is used to lock the instrument's front panel so users cannot change any settings from the front panel. The lock instrument screen is shown if the instrument is unlocked and the password is set.

- In the Main Menu, choose Password > **Lock Instrument**

```
LOCK FRONT PANEL:
   PRESSING ENTER WILL
PREVENT USER FROM CHANGING
 CONFIG FROM FRONT PANEL
 ↵ LOCK AND RETURN TO RUN

 CFACT INST  DIAGS ALARM
```

Lock/Unlock and Local/Remote Operation

If the instrument is locked via the front panel using Password > **Lock Instrument**, the instrument reports being in Remote mode. In this mode, the front panel is "locked", where data can be viewed, settings can be viewed but not changed using the front panel interface, and the remote "Set" commands are active.

If the instrument keyboard is unlocked via the front panel using Password > **Unlock Instrument**, the instrument reports being in Local mode, the front panel interface is unlocked, and settings can be changed from the front panel.

Change Password

The Change Password screen is used to change the password used to unlock the instrument's front panel. The change password screen is shown if the instrument is unlocked.

- In the Main Menu, choose Password > **Change Password**

```
ENTER NEW PASSWORD:
           █

     ABCDEFGHIJKLMN  BKSP
     OPQRSTUVWXYZ    PAGE
     0123456789 ./-  SAVE
 CFACT INST  DIAGS ALARM
```

Remove Password

The Remove Password screen is used to erase the current password and disable password protection. The remove password screen is shown if the instrument is unlocked and the password is set.

- In the Main Menu, choose Password > **Remove Password**

```
REMOVE PASSWORD:
   PRESSING ENTER WILL
 REMOVE CURRENT PASSWORD
   AND DISABLE LOCKING
       ↵ REMOVE PASSWORD

 CFACT INST  DIAGS ALARM
```

Unlock Instrument

The Unlock Instrument screen is used to enter the password to unlock the front panel. The unlock instrument screen is shown if the instrument is locked.

- In the Main Menu, choose Password > **Unlock Instrument**

```
ENTER THE PASSWORD:

     ABCDEFGHIJKLMN  BKSP
     OPQRSTUVWXYZ    PAGE
     0123456789 ./-  SAVE
 CFACT INST  DIAGS ALARM
```

Chapter 4
Calibration

This chapter describes procedures for performing the necessary calibrations for the 3880*i*. The Service mode must be enabled.

For details, see the following topics:

- "Pressure Sensors" on page 4-1
- "Sample MFC" on page 4-3
- "Dilution MFC" on page 4-4
- "Bypass MFC" on page 4-5
- "Nephelometer Purge Flow Calibration" on page 4-6
- "Nephelometer" on page 4-6

Pressure Sensors

The pressure sensor assembly is a PCB with two pressure sensors. An additional pressure sensor (TEOM DP) is added later with the Probe Monitor in Step 7. The Pressure sensor assembly includes 1/8-inch tygon lines that are glued to the tapered ports of each applicable pressure sensor or fit over a barbed-style sensor. This assembly should be received leak checked and qualified that no glue has impeded the function of the pressure sensor.

1. From the Main Menu, choose Service > Pres Probe Calibration > Baro Pres > **Span**. Enter the reference value using the keypad and press to save. Press twice to return to the Pres Probe Calibration menu.

Note If Service is not displayed, refer to "Accessing the Service Mode" on page 7-14 , then return to the beginning of this step. ▲

2. From the Pres Probe Calibration menu, choose **TEOM DP Pres**. Disconnect the Low tube from the TEOM Mounting Assembly within the Probe Monitor and leave open to atmosphere. From the TEOM DP Pres Cal menu, choose **Zero** to zero the TEOM DP sensor. Press

[Enter] to calibrate the zero value. Press [Menu] to return to the TEOM DP Pres Cal menu.

3. From the TEOM DP Pres Cal menu, choose **Span**. Set span for the TEOM DP Pres targeting 225 mmHg. Refer to Figure 4–1.

   a. Connect 1/8-inch tubing (Low) from the TEOM Mounting Assembly to one side of the 1/8-inch push connect T-fitting.

   b. Zero manometer before connecting the other end of the 1/8-inch tubing from the 1/8-inch T-Fitting, then connect directly to the manometer (e.g. DPI 705 series).

   c. Using a 10 cc Syringe, draw the syringe back before connecting to the last port on the 1/8-inch T-Fitting.

   d. **SLOWLY** push the syringe in to apply pressure to obtain 225 mmHg, once stable. Enter the manometer reading into the “Set To” value and using the keypad and press [Enter] to save.

   e. Carefully reconnect the Low tube to the TEOM mounting assembly.

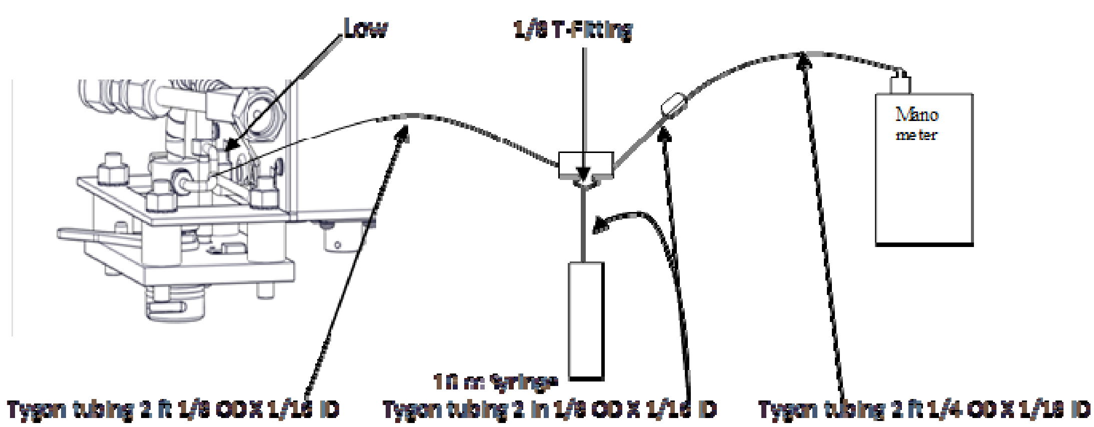


Figure 4–1. TEOM Calibration Diagram

Sample MFC

Use the following procedure to calibrate the sample mass flow controller.

Equipment Required:

Flow meter with a min/max range of 0.5–50 slpm and accuracy of ±2% of reading max

Wrench, 9/16-inch

Note System must be operational for a minimum of 30 minutes before starting this procedure. All flows entered must reference standard conditions (i.e., 25 °C, 760 mmHg). ▲

1. At the Probe Controller remove the Sample umbilical line and connect the flow meter to the available port.

2. From the Main Menu, choose Service > **MFC Cal Pres/Temp**. Set the pressure to 760.0 mmHg and the temperature to 25.0 °C using the keypad and press ↵ to save. Press ■ to return to the Service menu.

Note If Service is not displayed, refer to "Accessing the Service Mode" on page 7-14 , then return to the beginning of this step. ▲

3. From the Service menu, choose Sample MFC Calibration > **60% FS**. Observe flow meter and allow time for flow reading to stabilize. When flow is stable enter the standard flow from the reference meter, and press ↵ to save. Press ■ to return to the Sample MFC Cal menu.

4. Repeat step 3 for each of the flow values, in order, from largest % value to smallest.

5. Remove the flow meter and reconnect the Sample umbilical line to the Probe Monitor.

Dilution MFC

Use the following procedure to calibrate the dilution mass flow controller.

Equipment Required:

Flow meter with a min/max range of 0.5–50 slpm and accuracy of ±2% of reading max

Wrench, 11/16-inch

Note System must be operational for a minimum of 30 minutes before starting this procedure. All flows entered must reference standard conditions (i.e., 25 °C, 760 mmHg). ▲

1. At the Probe Controller remove the Dilution 1 umbilical line and connect the flow meter to the available port.

2. From the Main Menu, choose Service > **MFC Cal Pres/Temp**. Set the pressure to 760.0 mmHg and the temperature to 25.0 °C using the keypad and press ↵ to save. Press ◼ to return to the Service menu.

Note If Service is not displayed, refer to "Accessing the Service Mode" on page 7-14 , then return to the beginning of this step. ▲

3. From the Service menu, choose Dilution MFC Calibration > **60% FS**. Observe flow meter and allow time for flow reading to stabilize. When flow is stable enter the standard flow from the reference meter, and press ↵ to save. Press ◼ to return to the Dilution MFC Cal menu.

4. Repeat step 3 for each of the flow values, in order, from largest % value to smallest.

5. Remove the flow meter and reconnect the Dilution 1 umbilical line to the Probe Monitor.

Bypass MFC

Use the following procedure to calibrate the bypass/return mass flow controller.

Equipment Required:

Flow meter with a min/max range of 0.5–50 slpm and accuracy of ±2% of reading max

Wrench, 11/16-inch

Note System must be operational for a minimum of 30 minutes before starting this procedure. All flows entered must reference standard conditions (i.e., 25 °C, 760 mmHg). ▲

1. At the Probe Controller remove the Bypass umbilical line and connect the flow meter to the available port.

2. From the Main Menu, choose Service > **MFC Cal Pres/Temp**. Set the pressure to 760.0 mmHg and the temperature to 25.0 °C using the keypad and press to save. Press to return to the Service menu.

Note If Service is not displayed, refer to "Accessing the Service Mode" on page 7-14 , then return to the beginning of this step. ▲

3. From the Service menu, choose Bypass MFC Calibration > **60% FS**. Observe flow meter and allow time for flow reading to stabilize. When flow is stable enter the standard flow from the reference meter, and press to save. Press to return to the Bypass MFC Cal menu.

4. Repeat step 3 for each of the flow values, in order, from largest % value to smallest.

5. Remove the flow meter and reconnect the Bypass umbilical line to the Probe Monitor.

Nephelometer Purge Flow Calibration

To calibrate the nephelometer purge flow place the instrument into Purge mode. With the inlet to the nephelometer capped off, disconnect the TEOM air tube fitting from the outlet of the nephelometer. Measure the positive flow coming from the outlet of the nephelometer, which is due to the purge flow supply (approximately 0.4 slpm; ±0.1 slpm is expected).

From the Main Menu, choose Service > **Neph Purge Flow**. Enter this value using the keypad and press ↵ to save. Press ■ to return to the Service menu.

Note If Service is not displayed, refer to "Accessing the Service Mode" on page 7-14 , then return to the beginning of this step. ▲

Nephelometer

See the following to calibrate the nephelometer.

Zero Cal Values

This is achieved throught the service menu Main Menu > Instrument Controls > Service > Nephelometer Calibration > Zero Cal Values > Auto Neph Zero Cal. The system will automatically enter into a Purge mode, followed by a Neph Zero mode. Allow 15 minutes for this to be completed.

Span Cal Values

This is for the span calibration of the nephelometer. This will verify the concentration value set in "Auto Span".

Span source 1, 2, 3, and 4 are determined during an auto-cal and are equal to 5, 10, 50, and 90% of the user-selected max value, respectively.

Span duration 1, 2, 3, and 4 are the respective duration for the above referenced span values.

The span duration has a range of 90 to 240 seconds and is defalulted to use 180 seconds.

Neph RH

The calibration of the internal RH/Temperature is recommended to be done by a trained technician.

Neph Int Temp

The internal temperature can be adjusted once the system has stabilized at temperature. You can use the NEPH BLOCK temperature to calibrate the Internal NEPH Temp, this will be approximate. This is done through the service menu Main Menu > Instrument Controls > Service >

Nepheleometer Calibrations > Neph INT Temp. The internal RH sensor is calibrated at the factory and is not able to be calibrated by the user.

Neph Source

To adjust the nephelometer light source place the instrument into Purge mode. From the Main Menu, choose Instrument Controls > Service Mode, toggle "on". Return to the Main Menu, choose Service > Nephelometer Calibration > Neph Source, set the LED Current to 65 mA, +/- 5 mA by one of the following:

a. Adjust the % value of the source and read the source current value.

b. The second option is to use [CLINK = set neph src level xxx]; where xxx = 0-255. To read back the LED Current, either the Diagnostics > Nephelometer Menu or through the use of the [CLINK = neph ired].

Read the RefDet volts. This is influenced by the setting of the LED current.

c. Target is 2.500 V (+/- 3% or +/- 0.075 VDC).

d. The reference detector volts are always trying to maintain the value of 2.5 V while source current being applied.

e. Using either the Diagnostics, Nephelometer Menu or through the use of the [CLINK = neph refv} to read the value.

After adjusting the nehp source, a neph zero must be performed.

Auto Span

To set the Auto Span Values go to Main Menu > Instrument Controls > Service > Nephelometer Calibrations > Auto Span. Then select "MAX" to set the maximum value. The default value is 50 mg/m^3 and the maximum value you can set is 200 mg/m^3. This max value will be approximately equal to the Span Source 4 in the Span Cal Value in the previous calibration menu. After the max value is entered you can now start an auto calibration: Main Menu > Instrument Controls > Service > Nephelometer Calibrations > Auto Span > Start Auto Span. The display will start "Calibrating". This calibration will take several minutes to complete. The result will be displayed in the Span cal Values screen.

TEOM

The TEOM is serviced and calibrated at the factory to determine the K0 value. Typically, the K0 is a fixed value based on the tapered element. Calibration of the TEOM-mass transducer must be done by a trained technician.

Chapter 5
Preventive Maintenance

This chapter describes the periodic maintenance that should be performed on the system to ensure proper operation.

Since usage and environmental conditions vary greatly you should inspect the system components frequently until an appropriate maintenance schedule is determined. Suggested maintenance frequencies are maximum limits and depending on conditions may have to be performed more frequently.

This chapter includes the following maintenance information and replacement procedures:

Safety Precautions

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

WARNING The service procedures in this manual are restricted to qualified service representative. If the equipment is operated in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired. ▲

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. 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. ▲

Preventive Maintenance Schedule

Table 5–1 provides a list of components that require periodic maintenance.

Note The preventive maintenance schedule is site specific. Inspect the components periodically until you can establish a schedule appropriate for your site. ▲

Equipment Damage The preventive schedule listed in Table 5–1 are intial recommendations. Sites with exceptionally high PM concentrations or very high to moisture content in the stack may require more frequent maintenance. ▲

Table 5–1. Preventive Maintenance Schedule

Component	Quarterly	Semi-Annually	Annually
Fan Filter Inspect/Clean	X		
TEOM Filter Replacement*	X		
HEPA Filter Replacement	X		
Install O-Ring Replacement Kit		X	
By-Pass Pump Rebuild/Replace			X
Brush Out Sample Line			X
TEOM Transducer Service**			X
Nephelometer Service**			X

Component	Quarterly	Semi-Annually	Annually
Heated Block Service			X
Clean/Inspect Nozzle & Dilution Module			X
Coalescing Filter Assembly	X		
Inline Filter Assembly	X		

*May vary with source concentration and frequency of reference measurement.

**Factory Service Only.

Fan Filter Inspection and Cleaning

Use the following procedure to inspect and clean the fan filter (Figure 5–1) on the Probe Controller.

1. Remove the fan guard from the fan by unsnapping it. (No tools are required.) DO NOT remove the four mounting screws.

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

3. Re-install the filter and fan guard.

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. 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. ▲

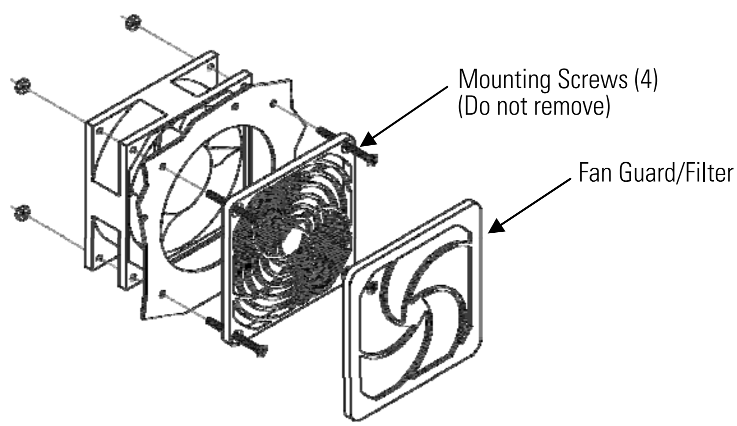


Figure 5–1. Inspecting and Cleaning the Fan Filters

HEPA Filter Replacement

Use the following procedure to replace the HEPA filters within the Probe Monitor.

Equipment Required:

1 Inline filter, medium-controller

3 Inline filters, medium-monitor

1 HEPA filter, jumbo

3 CFM coalescing filters

Open end wrench, 5/32-inch and 11/16-inch

Adjustable wrench, 1-inch

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. 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. ▲

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

2. At the probe monitor, replace the by-pass HEPA filter (jumbo) located on the outside of the probe monitor connected to the by-pass bulkhead fitting. Remove the filter by loosening the fittings on each end. When reinstalling, ensure flow arrow is pointing away from the monitor, which is the direction of the air flow.

3. Remove the side covers of the probe monitor and locate the purge, TEOM and neph HEPA filters. Remove filters by loosening the connectors at the filter side if connectors are not being replaced or at the PTFE line side if connectors are being replaced.

4. When reinstalling filters, if there is a flow arrow indicator on the filter, install filter with the flow arrow going the opposite direction of the actual flow. If there is no indicator arrow: install the filters so that the inlet air enters the filter on the outside surface of the filter. This is so that the filtered particulate will build up on the outside surface of the filter giving a better visual indication of filter contamination.

5. Replace probe monitor covers.

6. At the probe controller, remove the top cover, and locate the sample (medium) HEPA filter.

7. Remove filter by pressing the orange ring on the PTC fitting back towards the fitting and the filter should easily pull out of the fitting. When reinstalling filter, the flow indicator arrow on filter should point opposite of the actual flow. To reinstall filter, simply press the filter tip into the PTC fitting unit it bottoms out.

8. Replace probe controller top cover.

9. Power up the system.

TEOM Filter Replacement

The 3880*i* unit is shipped with a Tapered Element Oscillating Microbalance (TEOM) filter installed on the tapered element (TE), but the filter must be changed periodically.

Use the following procedure to replace the TEOM filter within the Probe Monitor.

Equipment Required:

TEOM Filter (box of 20)

TEOM filter tool

⚠ **Equipment Damage** It's important to read all the following steps before replacing the filter. ▲

⚠ **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. 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. ▲

1. Remove the right side cover of the probe monitor. Locate the TE handle (Figure 5–2). Slide handle to the right (until it stops) and carefully pull the mass transducer assembly straight down, ensuring the filter clears the TEOM mounting assembly before removing transducer from the monitor.

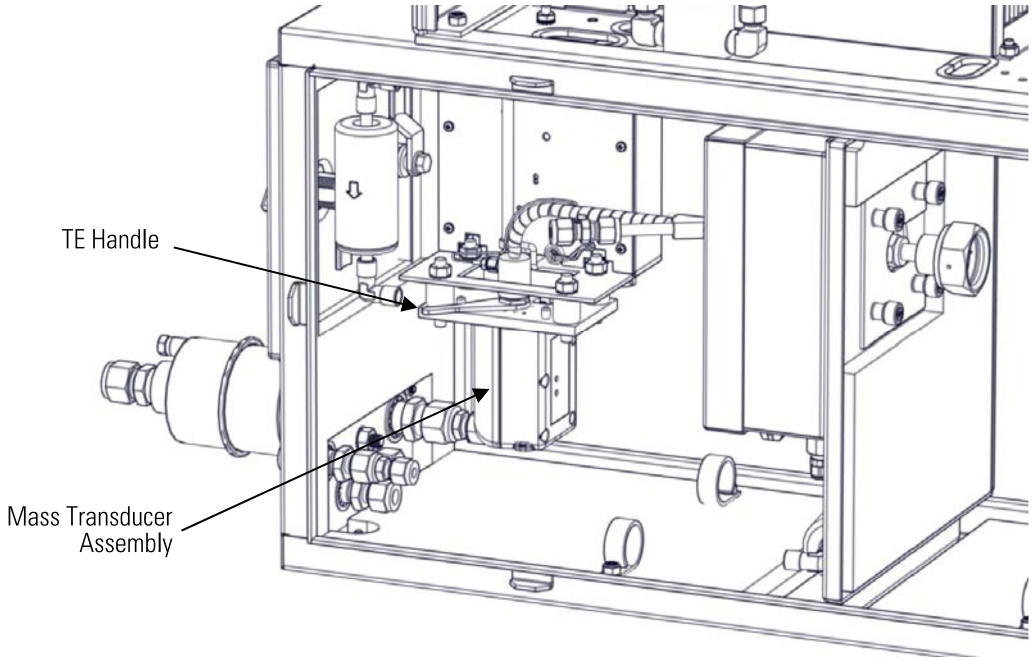


Figure 5–2. Replacing the TEOM Filter

Removing a TEOM Filter

Use the following procedure to remove a TEOM filter.

1. Carefully insert the lower fork of the filter exchange tool under the TEOM filter that is in the mass transducer so that the filter disk is between the lower fork and the upper tab of the filter exchange tool. The tines of the lower fork should straddle the hub of the filter base (Figure 5–3 and Figure 5–4).

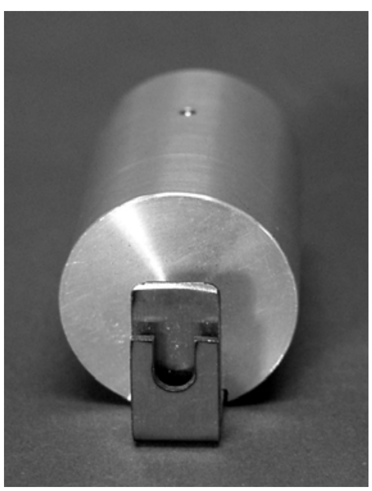


Figure 5–3. Filter Tool

Figure 5–4. Removing the TEOM Filter with the Filter Tool

2. Gently pull straight up from the tapered element (TE), lifting the TEOM filter from the TE (Figure 5–5).

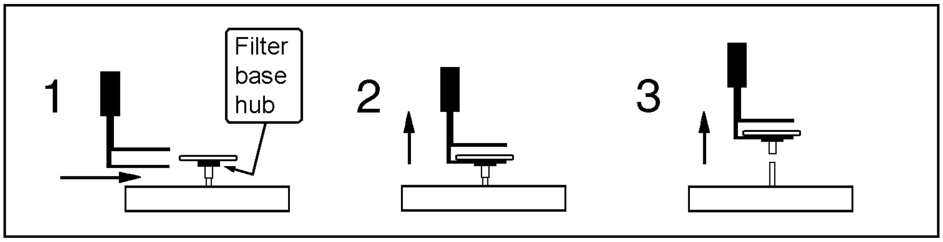


Figure 5–5. Removing the TE Filter

Note Do not twist or tilt the filter exchange tool from side-to-side while removing the filter from the TE. This will damage the TE. ▲

Installing a TEOM Filter

Use the following procedure to install a TEOM filter.

1. Clean the exchange tool with canned air or a clean cloth. Use it pick up a new TEOM filter from the box of filters, so that the filter disk lies between the fork and the upper tab of the tool, and the hub of the filter lies between the tines of the fork (Figure 5–6). Do not touch the filter with your fingers.

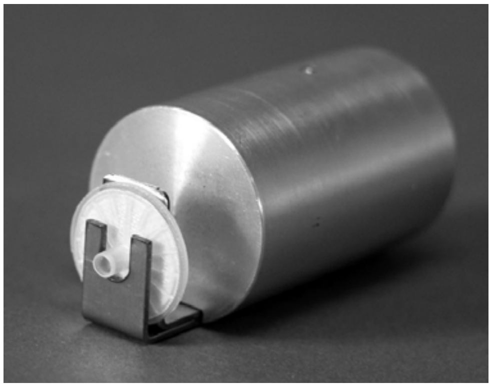


Figure 5–6. Filter Tool with Clean Filter

2. Lightly place the hub of the filter onto the tip of the tapered element, then slide the tool toward the notch and remove (Figure 5–7 and Figure 5–8).

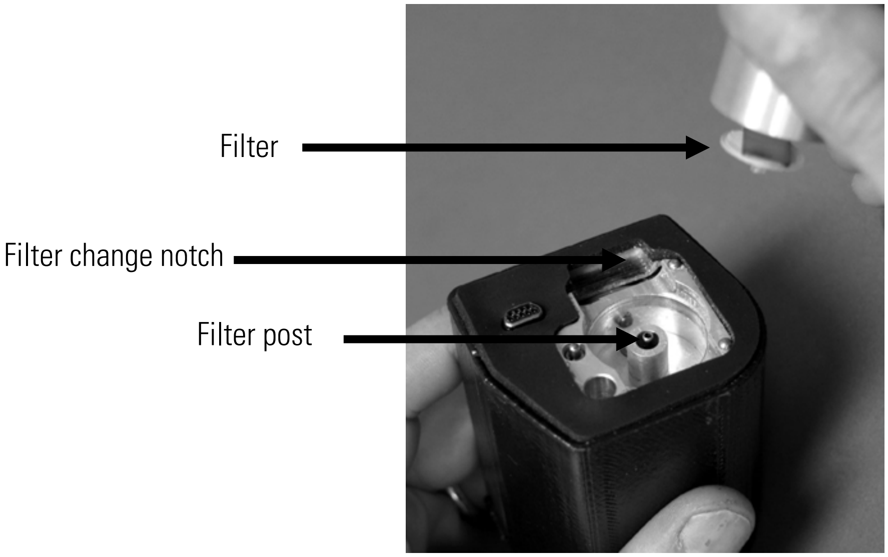


Figure 5–7. Empty Mass Transducer with Filter Change Notch

Figure 5–8. Placing the FIlter on the Post

3. Turn the tool upside down, place the bottom of the spring loaded filter exchange tool on top of the filter and apply downward pressure until the filter tool stops (Figure 5–9 and Figure 5–10).

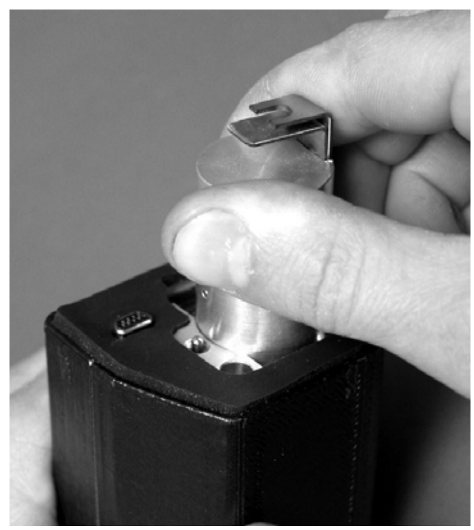


Figure 5–9. Back of Filter Exchange Tool

Figure 5–10. Setting the Filter

4. Install the mass transducer back into the unit.

O-Ring Replacement

Use the following procedure to replace the system o-rings using the o-ring kit (Figure 5–11).

Equipment Required:

O-ring replacement kit

Vacuum grease

Wrench, 1-inch, 1 1/2-inch, 9/16-inch and 3/8-inch

Tweezers

Needle nose pliers

Flat screwdriver, small

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. 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. ▲

Heated Bench

1. At the probe controller, turn off the instrument and unplug the power cord.

2. Remove the side cover of the probe monitor to access internal components.

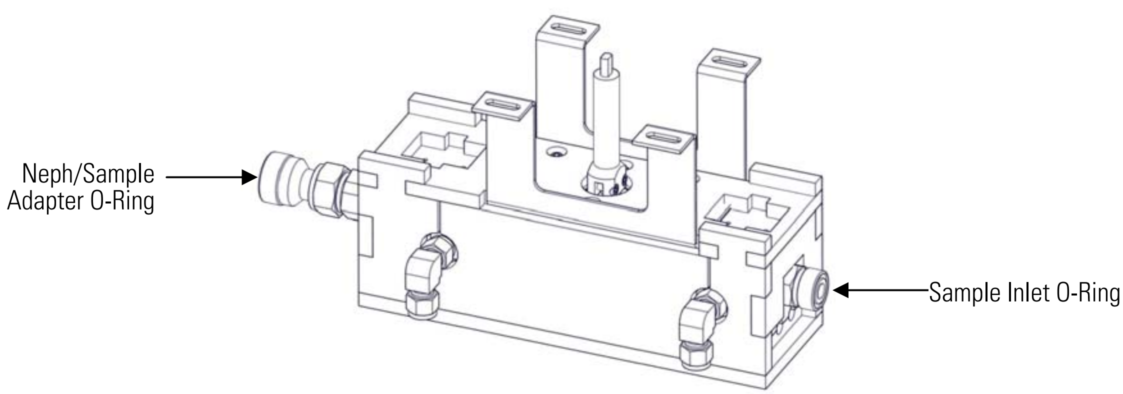


Figure 5–11. Replacing the Heated Bench External O-Rings

Nephelometer

3. Loosen the inlet and outlet connections. Loosen and remove the stinger from the sample inlet, remove o-ring, replace with new o-ring. Loosen and remove the neph/sample adapter to gain access to both the o-rings of the inlet to the nephelometer and the outlet of the heated bench assembly (Figure 5–12).

CAUTION When loosening or tightening the large VCO sealing nut, you must support the adjoining fittings. ▲

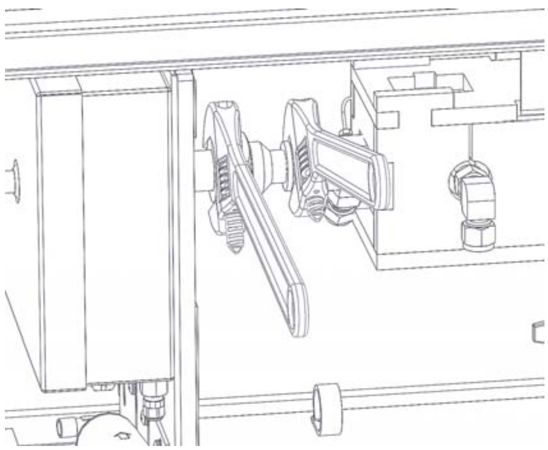


Figure 5–12. VCO Sealing Nut and "T" Fitting

4. Using the small flat head screwdriver, gently pry out the inlet assembly. Inspect assembly and replace the two o-rings. Add a light coating of vacuum grease to o-rings before re-installing (Figure 5–13).

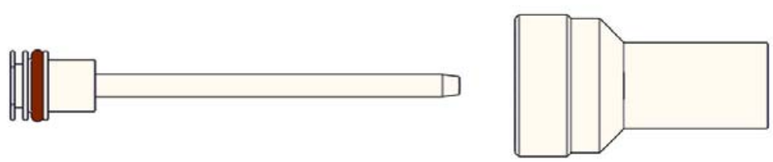


Figure 5–13. Nephelometer/Sample Adapter

5. Replace both o-rings, one to the inlet of the nephelometer and the outlet of the heated bench assembly. When completed re-install the nephelometer/sample adapter, follow the tightening specification for VCO seals.

6. Loosen and remove the heated air tube assembly from the outlet of the nephelometer. Then gain access to the o-ring on the nephelometer outlet o-ring.

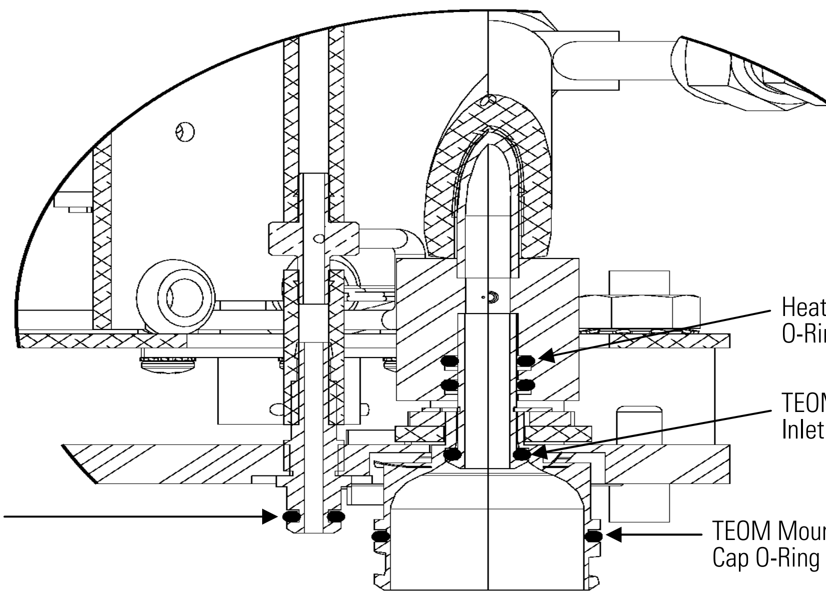


Figure 5–14. TEOM Mounting Assembly Cutaway

TEOM

7. It is recommended to remove the TEOM Mounting Assembly from the Probe Monitor, using a 3/8-inch wrench. There are several small parts and the possibility of causing damage to the assembly. Disconnect the two seven pin cable connection and the two filter assemblies. Note: the orientation for re-installation.

8. Remove the TEOM Mass Transducer from the Mounting Assembly. Note the orientation of the release handle and the position of the TEOM Mounting Cap. This will assist you later in re-assembly.

9. Use tweezers to remove the o-rings from the Heated Air Tube Assembly. When re-installing the two o-rings on the Heated Air Tube Assembly, take care not to damage the new o-rings while installing. Apply a very light coating of Vacuum Grease to the o-rings before installation (Figure 5–14).

10. To replace the TEOM Sample Inlet o-ring remove the retaining E-Clip by prying it back using a flat headed screwdriver and then remove locking nut. Lift handle and Mounting Cap with the Sample Inlet will drop out. Note: the orientation of both the handle and the mounting cap (Figure 5–15).

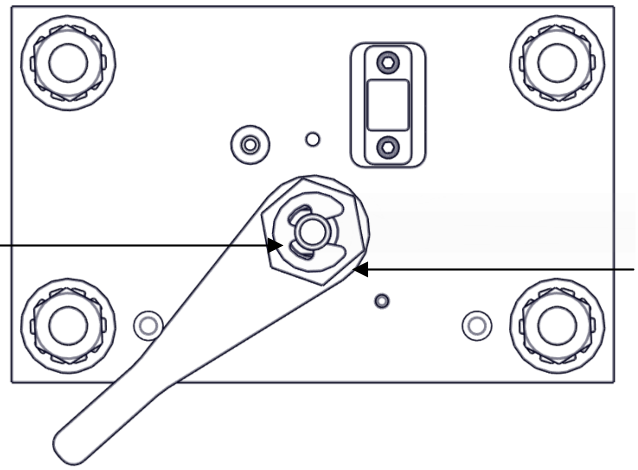


Figure 5–15. TEOM Mounting Lever and Cap Top View

11. With the Mounting Cap placed on a flat surface, push down on the Sample Inlet tube to gain access to the o-ring. Remove old o-ring and clean the parts before reassembling. Apply a very light coating of Vacuum Grease to the o-ring before installation. Reassemble in the reverse order (Figure 5–14).

12. To replace the TEOM Mounting Cap o-ring first by removing the old o-ring and replace with the new from the o-ring kit. Apply a very light coating of Vacuum Grease to the o-ring before installation (Figure 5–14).

13. To replace the TEOM Sample Port o-ring first by removing the old o-ring and replace with the new from the o-ring kit. Apply a very light coating of Vacuum Grease to the o-ring before installation (Figure 5–14).

Bypass Pump Rebuild

The bypass pump will require periodic maintenance including rebuild or replacement. To replace the bypass pump, see "External Pump Replacement" in the "Servicing" chapter. To rebuild the bypass pump, the following parts and tools are required. The instructions are included in the bypass pump rebuild kit.

Equipment Required:

Pump rebuild kit

Open end wrench, 11/16-inch

T-25 Torx driver

Clean rags/paper towels

Nylon cleaning brush

Sample Line Brush Down

Use the following procedure to brush down the probe monitor sample line.

Equipment Required:

Open end wrench, 1/2-inch, 3/8-inch, 9/16-inch and 11/16-inch

2 Adjustable wrench, 2-inch

Phillips screwdriver, stubby #2

Allen wrench, 5/64-inch and 5/32-inch

Nylon brush, 1/2-inch diameter with at least a 3-foor extension

⚠ **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. 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. ▲

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

2. Remove the Probe Monitor from the stack. While the monitor is removed insure the probe mantle is properly supported to prevent damage to the monitor chassis do to the weight of the mantle. Remove the rear and two side covers.

3. Remove the TE transducer.

4. At the TEOM tube, remove the 1/4-inch PTFE line at the coupling and disconnect the TEOM tube from the NEPH assembly.

5. At the TEOM mounting assembly, remove the top Viton line from the reducing tee fitting located just behind the bottom TEOM tube coupling. At the top of the assembly remove the two mounting nuts and remove the TEOM mounting assembly from the monitor.

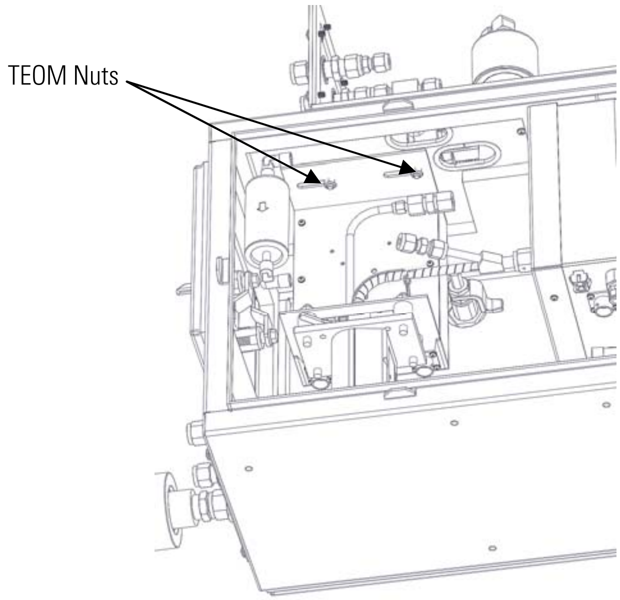


Figure 5–16. TEOM Mounting Nuts

6. At the NEPH assembly, remove the 1/8-inch purge line, the thermocouple cable and the heater cable. Loosen the large VCO fitting between the heated block and Neph assemblies. Loosen the screws on the NEPH mounting plate and remove the NEPH assembly from the Monitor.

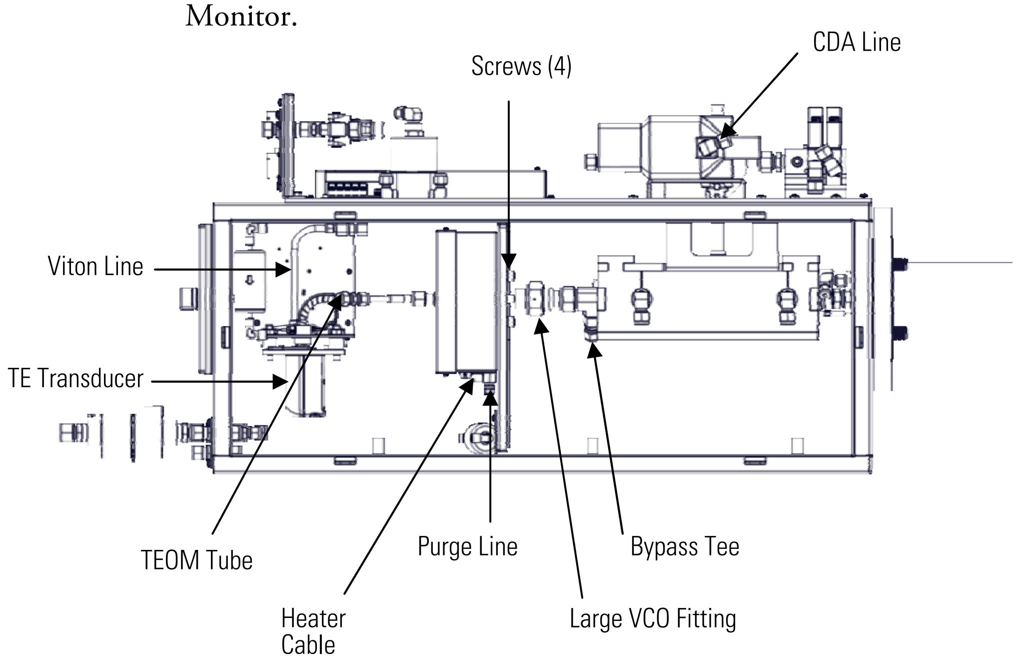


Figure 5–17. Sample Line Brush Down

CAUTION The bypass tee fitting must be held in place with a wrench when either loosening or tightening the large VCO fitting to ensure the bypass tee does not spin. This could cause leaks and possible damage to the bypass thermocouple. ▲

Note Support the NEPH assembly when loosening the captive hardware as to ensure the assembly does not drop during removal. ▲

7. At the bypass tee on the outlet side of the heated bench, carefully use a small straight edge screwdriver to gently pull the mini stinger straight out of the bypass tee. While the mini stinger is removed inspect and clean with acetone as needed. Also inspect the o-ring and replace if needed.

8. At the heated bench, remove and inspect the bypass and dilution thermocouples.

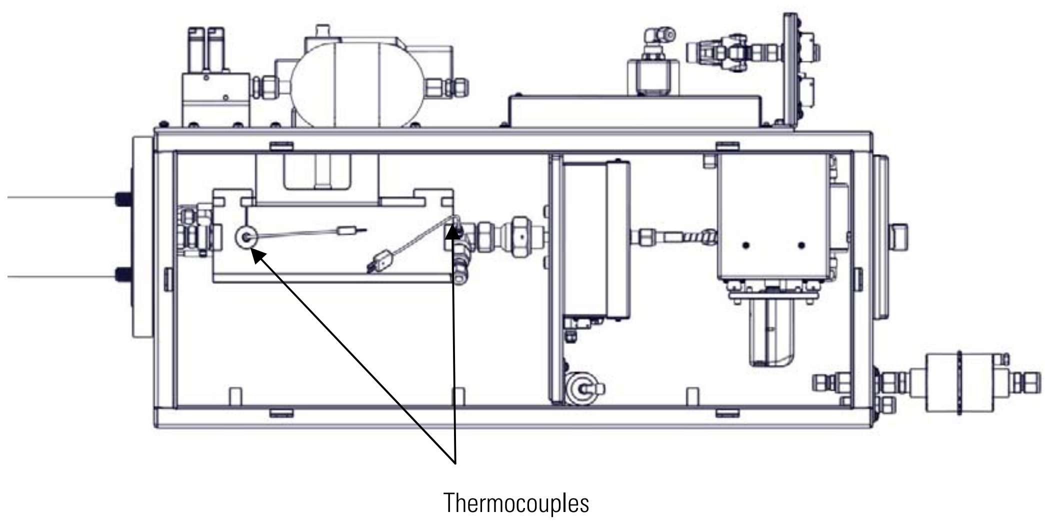


Figure 5–18. Thermocouple Side View

Note The thermocouples must remain removed from the Heated Bench during the brush down to prevent damage the assemblies. ▲

9. The ball valve inside the Heated Bench is normally closed when the system is powered down; therefore clean dry pressurized air must be applied to the Actuator to open the ball valve to perform the brush down. This can be accomplished by removing the umbilical CDA line

from the Probe Monitor bulkhead fitting and attaching it directly to the input air line connection of the Actuator.

CAUTION To prevent possible injury, insure hands are clear of the actuators moving parts before applying the pressurized air to the actuator. ▲

10. At the Probe Mantle, remove the PTFE mantle shroud. Remove the Dilution Module with the Nozzle for inspection and cleaning following the procedure listed in the Section. Place a clean rag at the outlet side of the sample line to catch any debris being pushed out during the brush down procedure.

11. Starting from the inlet side, run the cleaning brush through the sample line until it comes out the outlet side. Run the brush back through the sample line from back to front and clean off the brush. Repeat as needed until there is little to no contamination on the brush after the last pass. When completed, you can shine a light into the outlet side of the sample line and look into the inlet to see if there is any residue left in the line.

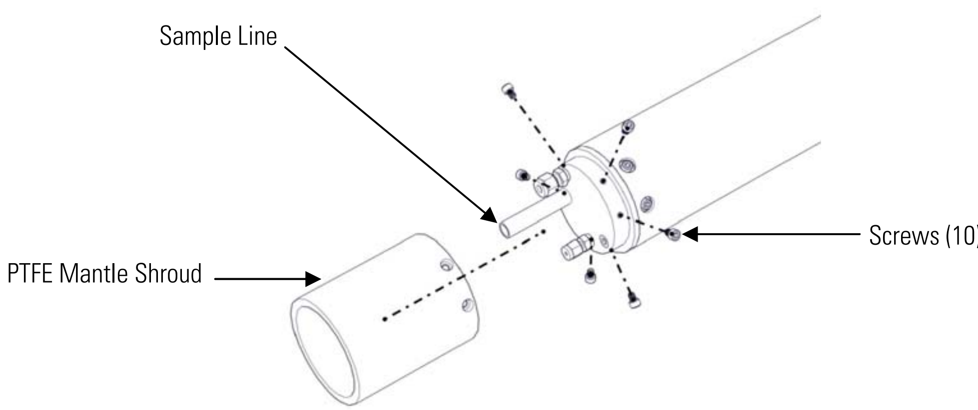


Figure 5–19. Brush Down Sample Line

12. When you are satisfied that the line is clear, follow the preceding steps in reverse to reassemble the system.

TEOM Transducer Service

This service is recommended annually or as needed. This is a factory service that can only be performed at the Thermo Fisher Scientific Service Depot. See the "Service Locations" section of this chapter for contact information.

Nephelometer Service

This service is recommended annually or as needed. This can only be performed at the Thermo Fisher Scientific Service Depot. See the "Service Locations" section of this chapter for contact information.

Heated Block Service

This service is recommended annually or as needed. This is a factory service that can only be performed by a trained technician. See the "Service Locations" section of this chapter for contact information if needed or for proper training.

Nozzle and Dilution Module Cleaning

Use the following procedure to clean and inspect the nozzle and dilution assemblies.

Equipment Required:

Open end wrench, 1/2-inch and 9/16-inch

Allen wrench, 5/64-inch and 7/64-inch

Nylon cleaning brush

Paper towels/clean rags

Acetone

2 O-ring (1/2 ID x 11/16 OD)

1 O-ring (5/8 ID x 3/4 OD)

Vacuum grease

Pipe cleaner, small

Scribe or pick

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. 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. ▲

1. Remove the dilution module by loosening the swagelok fitting of the PTFE line. Loosen the three 5/64-inch Allen set screws at the base of the module. The assembly should slide forward off the sample line.

2. Clean the outside of the assemblies with a stiff bristle nylon brush and acetone. Use a scribe to scrap off any thickly built-up contamination.

3. Remove the nozzle by loosening the 1/4-inch swagelok cap at the base of the nozzle and pull the assembly straight out of the dilution module.

4. Clean the inside of the nozzle with a pipe cleaner and flushing with acetone. Inspect assembly for excessive corrosion or cracks that could cause leaks.

5. Remove the top cap from the dilution module by removing the three 7/64-inch Allen screws from the top of the assembly. Clean the inside of the cap with pipe cleaners and acetone.

6. On the main body of the dilution module you will see a white air defuser and an o-ring on the cap side. Remove and clean the defuser ensuring all of the small holes are clear of obstructions.

7. Clean the interior of the main body of the assembly. Again, if they have not been replaced in six months, remove the two o-rings from the inside of the housing (1/2 ID x 11/16 OD). You will need a scribe or pick to gently pry this from their slotted mounts. Reinstall the o-rings and apply a light coating of vacuum grease.

8. At this time if the o-rings have not been replaced in six months, replace the cap o-ring (5/8 ID x 3/4 OD). Reinstall the air defuser and replace the cap onto the assembly.

9. Reinstall the dilution module onto the probe monitor. First push the assembly in place and then tighten the 1/4-inch swagelok connection. Then tighten the three 5/64-inch set screws.

10. Reinstall the nozzle and tighten the 1/4-inch swagelok fitting. Then tighten the three set screws at the base of the module by tightening each screw a quarter turn at a time until the unit is properly secured.

Leak Check

Use the following procedure to perform a leak check.

Equipment Required:

Leack check kit

Open end wrench, 1/2-inch, 7/16-inch, 9/16-inch and 11/16-inch

2 Large adjustable wrenches (1-inch to 2-inch adjusting range)

Allen head wrench, 5/32-inch and 5/64-inch

Stiff nylon brush

Pick or awl

Phillips screwdriver, #2

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. 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. ▲

Probe Controller:

1. Turn off instrument and disconnect the power.

2. All leak testing is done under vacuum. When using the supplied hand vacuum pump set the lever to "VACUUM". See Figure 5–20.

Figure 5–20. Hand Vacuum Pump

3. Sample Line/Bypass.

   a. At the rear of the PROBE CONTROLER, remove the PRESSURE RELIEF VALVE assembly from the bulkhead of SAMPLE IN.

   b. Connect a 3/8-inch port adapter and nut onto the SAMPLE IN bulkhead.

   c. Cap the PUMP VAC and BYPASS IN connection on the controller with a 3/8-inch Swagelok cap on the outlet side.

   d. Connect the red silicone tubing to port adapter and draw the vacuum back to 25 inHg and wait for the reading to stabilize and record reading. Reading should be within in 2% of initial vacuum reading (e.g. @ 25 in Hg = 0.5 in Hg over 5 minutes).

   e. If vacuum reading drops troubleshoot internal plumbing and fittings for leaks.

   f. Place a 3/8-inch port adapter and nut on to the BYPASS IN and the 3/8-inch Swagelok cap on the SMAPLE IN.

   g. Connect the hand vacuum pump using the red silicone tube, set the hand pump to "VACUUM" and draw 25 in Hg on the vacuum gauge. Wait for the reading to stabilize and record reading. Reading should be within 2% of initial vacuum reading (e.g. @ 25 in Hg = 0.5 in Hg over 5 minutes. See Figure 5–21.

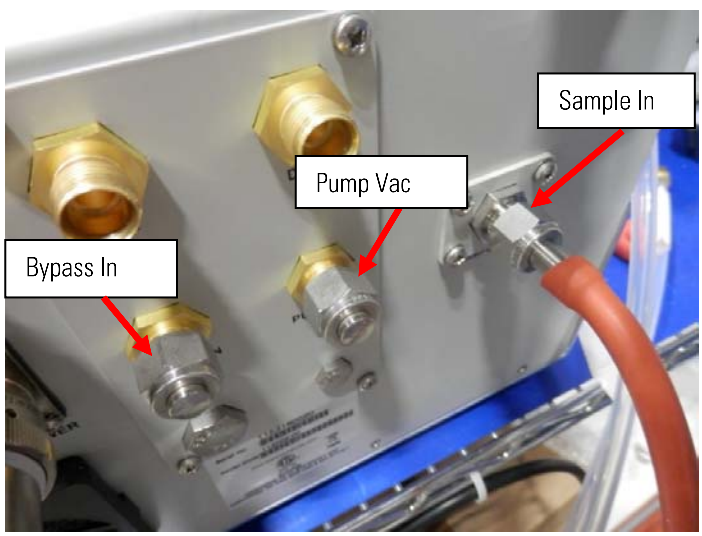


Figure 5–21. Sample In/Bypass In

4. Dilution Air Line.

   a. At the PROBE CONTROLER cap off the ZERO AIR port and DIL 2 with a 3/8-inch Swagelok cap.

b. Place a 3/8 port adapter and 3/8 nut on to **DIL 1**. Connect the hand vacuum pump using the red silicone tube, set the hand pump to **"VACUUM"** and draw 25 in HG on the vacuum gauge. Wait for the reading to stabilize and record reading. Reading should be within 2% of initial vacuum reading (e.g. @ 25 in Hg = 0.5 in Hg over 5 minutes).

c. If vacuum reading drops, troubleshoot for internal Dilution plumbing and fitting for leaks.

5. Swap the 3/8 cap to DIL1 and the 3/8 port adapter with nut to DIL 2 and repeat the steps. If vacuum reading drops troubleshoot for internal Dilution plumbing and fittings leaks. See Figure 5–22.

Figure 5–22. Dilution 1 and 2

Probe Monitor:

CAUTION All leak testing must be done with a vacuum pump. Pressurizing the TEOM mass transducer can cause damage. ▲

1. The Probe Monitor can be broken up to into two main sections, front and back. The separation is from the Ball Valve (ACTUATOR) in the Heated Block assembly. If system is not installed in the stack, all testing can be done with the instrument power turned off and with the TEOM Transducer installed. With the Probe Monitor installed in the stack, a leak check of the back half can be accomplished by placing the instrument into "Manual Mode".

   a. Turn down the heater settings. This is done under Instrument Controls Menu > Set Temperature. Lower the Stinger and Bypass temperatures to 0° C below the current Stack Temperature.

   b. Place the unit into "Manual Mode" via the Instrument Controls Menu > Functional Mode.

c. Place the "Actuator Valve" in the off position via the Instrument Controls Menu > Valve Power. (This will close the Ball Valve.)

2. With the Probe Monitor out of the stack and the instrument power "OFF" (this will automatically close the Actuator Valve). We can begin walking through the Leak Check process.

3. Using three 3/8 Swagelok caps, cap off the Bypass, Dil 1 and Dil 2. Remove Purge Air line from Nephelometer the Purge Air port and insert 1/4 plulg in Purge Air port. At the rear of the Probe Monitor Assembly add the swagelok 1/4 port adapter and nut to the Sample Port. See Figure 5–23 and Figure 5–23.

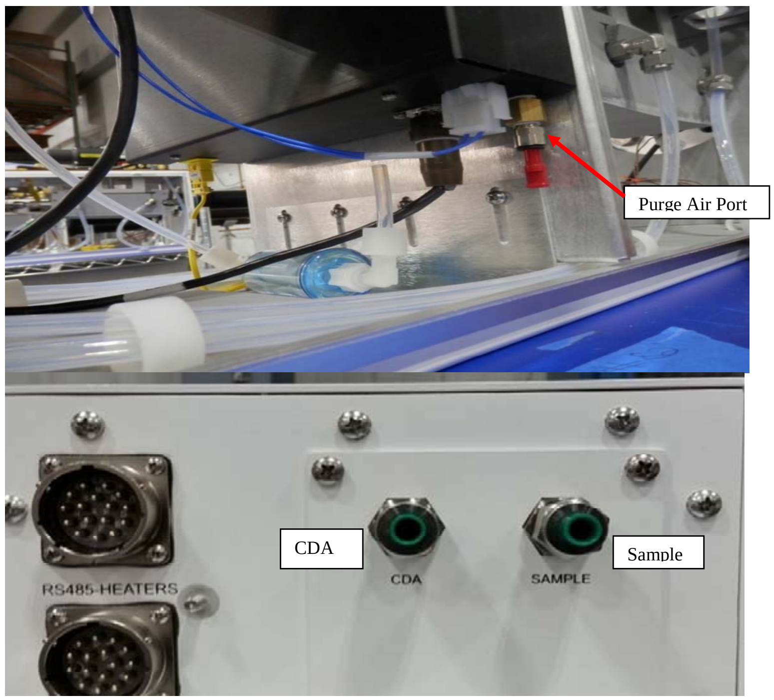


Figure 5–23. Purge Air and Sample Port

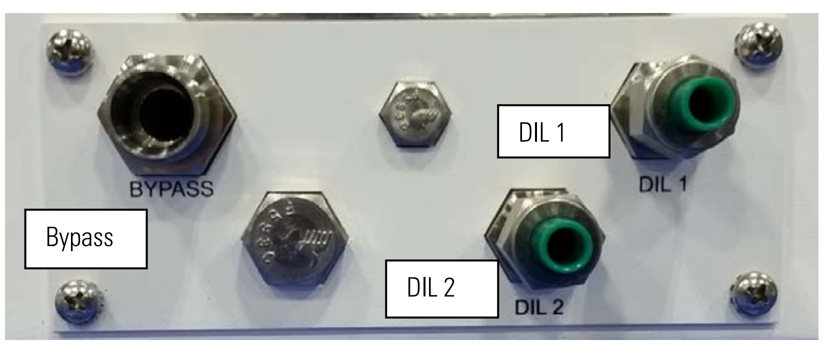


Figure 5–24. Rear View of the Probe Monitor

4. For the Back Section.

    a. Connect the hand vacuum pump using the red silicone tube to the 3/8-inch port adapter, set the hand pump to "VACUUM".

    b. Draw 6 in Hg on the vacuum gauge.

CAUTION Never pressurize the TEOM mass transducer. ▲

Note Because of the Purge Air orifice on the Nephelometer, you will have to wait a minute for the vacuum value to stabilize. Draw the vacuum back to 6 in Hg and wait for the reading to stabilize and record reading. ▲

    c. Reading should be within 2% of initial vacuum reading (e.g. @ 6 in Hg = 0.5 in Hg over 5 minutes). If vacuum reading drops troubleshoot for leaks.

5. If a leak is encountered, we can further break the rear section into smaller section to isolate the leak source.

    a. First remove the connection between the Nephelometer and the Heated Block Assembly (Interconnect Fitting Assembly).

CAUTION When loosening or tightening the large VCO Sealing Nut, you must support the adjoining "T" fitting on the Heated Bench (Figure 5–25). ▲

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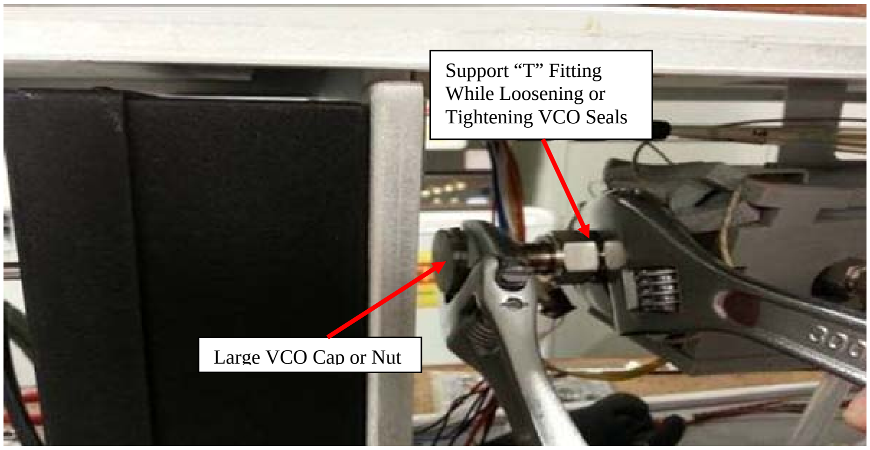

Figure 5–25. Bypass "T" Fitting – Large VCO Cap

Note Tightening specification for VCO seals: Tighten all Swagelok VCO fittings to finger tight, then an additional 45° tighter, per Swagelok

6. Place the small VCO cap onto the Nephelometer Inlet and the Large VCO cap onto the Neph/Sample Adapter on the Heated Bench Assembly. This now isolates the rear of the Heated Bench Assembly. See Figure 5–26.

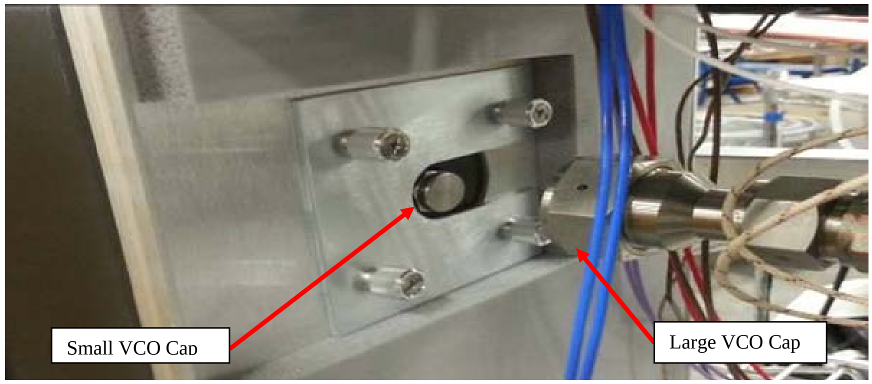

Figure 5–26. Nephelometer Inlet and Neph/Sample Adapter VCO Caps

   a. Remove the 3/8 sealing cap from the Bypass on the rear of the Probe Monitor Assembly and connect the 3/8 Tube Adapter and nut to the Bulkhead.

   b. Connect the hand vacuum pump using the red silicone tube, set the hand pump to "VACUUM" and draw 25 in Hg on the vacuum gauge. Wait for the reading to stabilize and record reading.

   c. Reading should be within 2% of initial vacuum reading (e.g. @ 25 in Hg = 0.5 in Hg over 5 minutes). If NO leak is found continue.

7. To isolate the Nephelometer Assembly.

   a. Remove the Heated Air Tube Assembly from the Outlet of the Nephelometer.

   b. Attach the Fitting adapter, Nut and Push-connect fitting and ¼ tubing to the Outlet. See Figure 5–27.

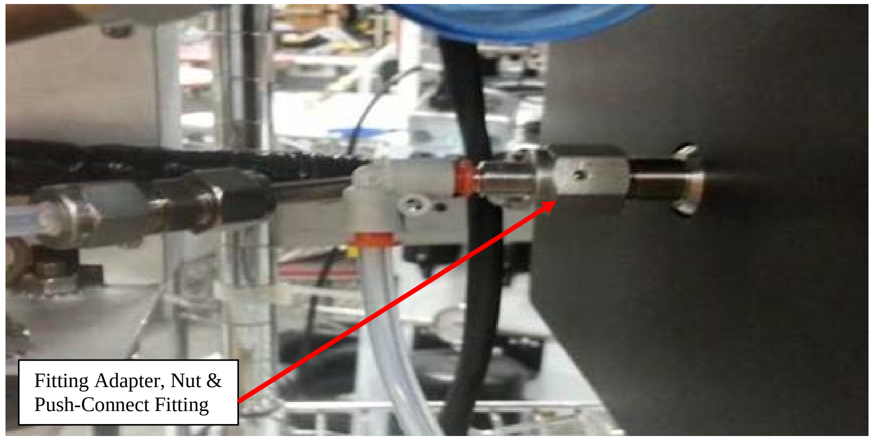

Figure 5–27. Nephelometer Outlet with Adapter Fitting

c. Connect the hand vacuum pump using the red silicone, set the hand pump to "VACUUM" and draw 6 in Hg on the vacuum gauge.

CAUTION Never pressurize the TEOM mass transducer. ▲

Note Because of the Purge Air orifice on the Nephelometer, you will have to wait a minute for the vacuum value to stabilize. Draw the vacuum back to 6 in Hg and wait for the reading to stabilize. ▲

d. Draw the vacuum back to 6 in Hg and wait for the reading to stabilize and record reading. Reading should be within in 2% of initial vacuum reading (e.g. @ 6 in Hg = 0.5 in Hg over 5 minutes).

e. If vacuum reading drops troubleshoot for leaks.

8. Verify that both O-rings are in place on the Inlet and the Outlet of the Nephelometer. Disconnect Purge Air from the Nephelometer (Push fitting collar in to remove tubing).

    a. Insert 1/4-inch sealing plug into the purge air port on the Nephelometer and draw the vacuum back to 6 in Hg and wait for the reading to stabilize and record reading. Reading should be within in 2% of initial vacuum reading (e.g. @ 6 in Hg = 0.5 in Hg over 5 minutes).

    b. If vacuum reading drops troubleshoot for leaks. If leak is internal to the Nephelometer this must be service by a qualified Thermo Technician. If No leak is found, then go to the next step.

9. Check Purge Air Filter Assembly fittings and tubing.

a. Connect the red silicone tubing from the hand vacuum pump to the 1/4-inch tubing of the filter assembly and draw vacuum back to 6 in Hg and wait for the reading to stabilize and record reading. Reading should be within 2% of initial vacuum reading (e.g. @ 6 in Hg = 0.5 in Hg over 5 minutes).

b. If no leak is found, then go to the next step after removing sealing plug from the Nephelometer assembly and reinserting the Purge Air tube into the Nephelometer.

10. Remove the Leak Test Fitting from the Nephelometer Outlet and reattach the Heated Air tube Assembly. Take care to keep the Heated Air Tube Assembly aligned with the TEOM Mounting Assembly.

    a. Disconnect the Sample Line from the “Y” of the Heated Tube; attach 1/4 tube Adapter and Nut to union fitting on the Heated Air Tube.

    b. Connect the red tubing to port adapter and draw the vacuum back to 6 in Hg and wait for the reading to stabilize and record reading. Reading should be within 2% of initial vacuum reading (e.g. @ 6 in Hg = 0.5 in Hg over 5 minutes).

    c. If vacuum reading drops troubleshoot for leaks, continue to the next step. See Figure 5–28.

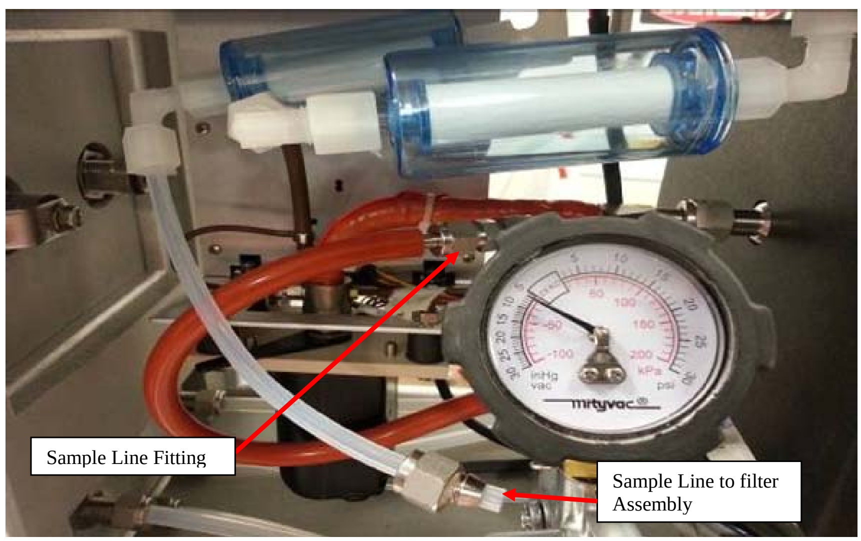

Figure 5–28. Sample Line Connection to Heated Air Tube

11. To verify Sample Filter Assembly.

    a. Connect the red tubing to the sample line that was disconnected from the Heated Air tube Assembly and draw the vacuum back to 6 in Hg and wait for the reading to stabilize and record reading.

Reading should be within in 2% of initial vacuum reading (e.g. @ 6 in Hg = 0.5 in Hg over 5 minutes).

b. If vacuum reading drops troubleshoot for leaks on fittings and tubing. See Figure 5–28.

12. To verify the TEOM Mounting Assembly, Heated Air Tube, Filter Assembly, Mass Transducer and the Normally Close side of the TEOM Bypass Valve.

    a. Disconnect the Heated Air Tube Assembly from the Nephelometer Assembly and cap off the end of the Air tube using a Blind VCO plug.

    b. Disconnect the Sample Line from the "Y" of the Heated Tube; attach 1/4 tube Adapter and Nut to union fitting on the Heated Air Tube.

    c. Connect the red tubing to port adapter and draw the vacuum back to 6 in Hg and wait for the reading to stabilize and record reading. Reading should be within 2% of initial vacuum reading (e.g. @ 6 in Hg = 0.5 in Hg over 5 minutes).

    d. If vacuum reading drops troubleshoot for leaks. See Figure 5–29.

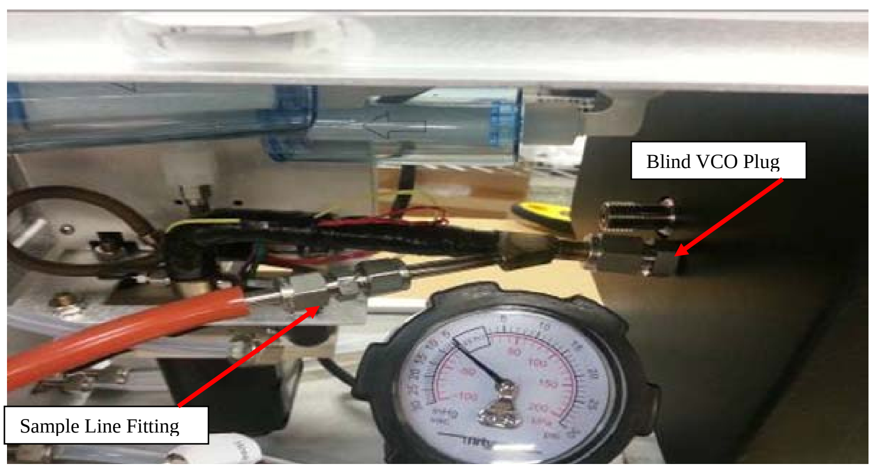

Figure 5–29. Sample Line Connection with Capped Air Tube – Blind VCO Plug

13. To isolate the TEOM Mounting Assembly, Filter Assembly, Mass Transducer and the Normally Close side of the TEOM Bypass Valve.

    a. Remove heated Air Tube from the TEOM Mounting Assembly.

    b. Connect the red silicone tubing to the TEOM Sample Port of the mounting assembly and draw the vacuum back to 6 in Hg and wait for the reading to stabilize and record reading. Reading should be within 2% of initial vacuum reading (e.g. @ 6 in Hg = 0.5 in Hg over 5 minutes).

c. If vacuum reading drops troubleshoot for leaks, continue to the next step. See Figure 5–30.

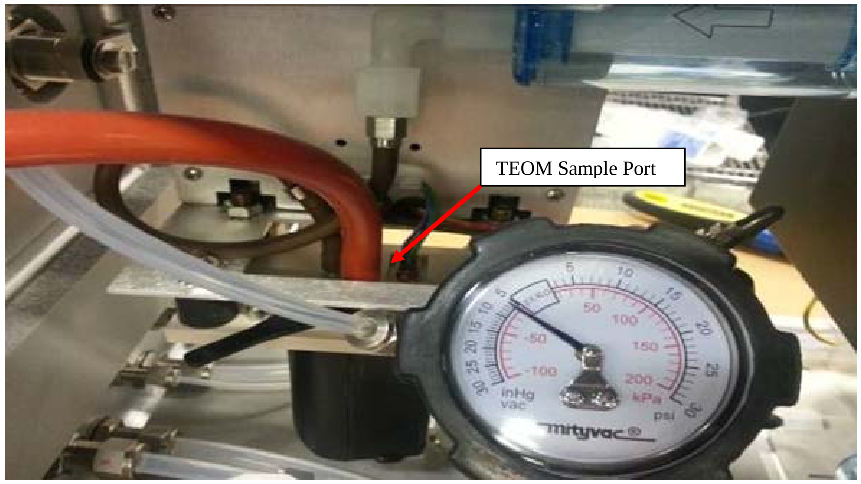

Figure 5–30. TEOM Sample Port

14. To isolate the TEOM Mounting Assembly, Filter Assembly and the Mass Transducer.

    a. Disconnect the Viton Tubing from the reducing "T" fitting and insert a 1/8 inch sealing plug into the Viton tubing.

    b. Connect the red silicone tubing to sample port of the TEOM and draw the vacuum back to 6 in Hg and wait for the reading to stabilize and record reading. Reading should be within in 2% of initial vacuum reading (e.g. @ 6 in Hg = 0.5 in Hg over 5 minutes).

    c. If a leak persist that it is either in the TEOM Mass Transducer or the TEOM Mounting cap. See Figure 5–31.

    d. Troubleshooting becomes limited at this point. Either you can swap out the TEOM Mass Transducer with a known good one or verify the O-Rings on the TEOM Mounting Assembly

    e. Figure 5–33 shows a detailed view of the location of the O-Rings in the TEOM Mounting Assembly and Heated Air Tube Assembly.

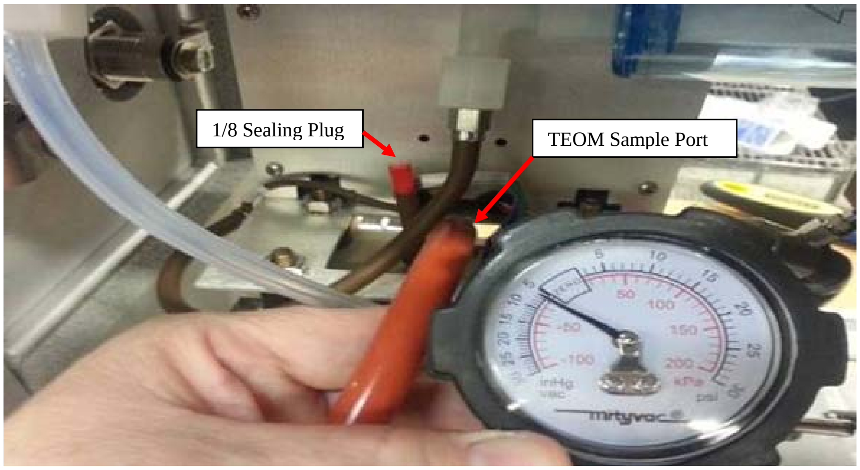

Figure 5–31. TEOM Sample Port Isolated from Sample Valve and Filter

15. Replace or service the Heated Air Tube and TEOM Mounting Assembly O-Rings.

    a. It is recommended to remove the TEOM Mounting Assembly from the Probe Monitor, using a 3/8-inch wrench. There are several small parts and the possibility of causing damage to the assembly. Disconnect the two seven pin cable connection and the two filter assemblies. Note the orientation for re-installation.

    b. Remove the TEOM Mass Transducer from the Mounting Assembly. Note the orientation of the release handle and the position of the TEOM Mounting Cap. This will assist you later in re-assembly.

    c. Use Tweezers to remove the O-Rings from the Heated Air Tube Assembly. When re-installing the two O-Rings on the Heated Air Tube Assembly, take care not to damage the new O-Rings while installing. Apply a very light coating of Vacuum Grease to the O-Rings before installation. See Figure 5–33.

    d. To replace the TEOM Sample Inlet O-Ring remove the retaining E-Clip by prying it back using a flat headed screwdriver and then remove locking nut. Lift handle and Mounting Cap with the Sample Inlet will drop out. Note: the orientation of both the handle and the mounting cap. See Figure 5–32.

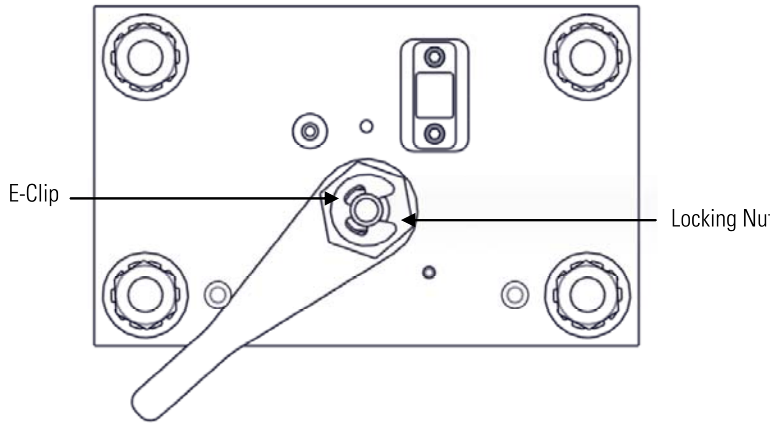

Figure 5–32. Top View of TEOM Sample Inlet

e. With the Mounting Cap placed on a flat surface, push down on the Sample Inlet tube to gain access to the O-Ring. Remove old O-Ring and clean the parts before reassembling. Apply a very light coating of Vacuum Grease to the O-Ring before installation. Reassemble in the reverse order. See Figure 5–33.

f. To replace the TEOM Mounting Cap O-Ring first by removing the old O-Ring and replace with the new from the O-Ring kit. Apply a very light coating of Vacuum Grease to the O-Ring before installation. See Figure 5–33.

g. To replace the TEOM Sample Port O-Ring first by removing the old O-Ring and replace with the new from the O-Ring kit. Apply a very light coating of Vacuum Grease to the O-Ring before installation. See Figure 5–33.

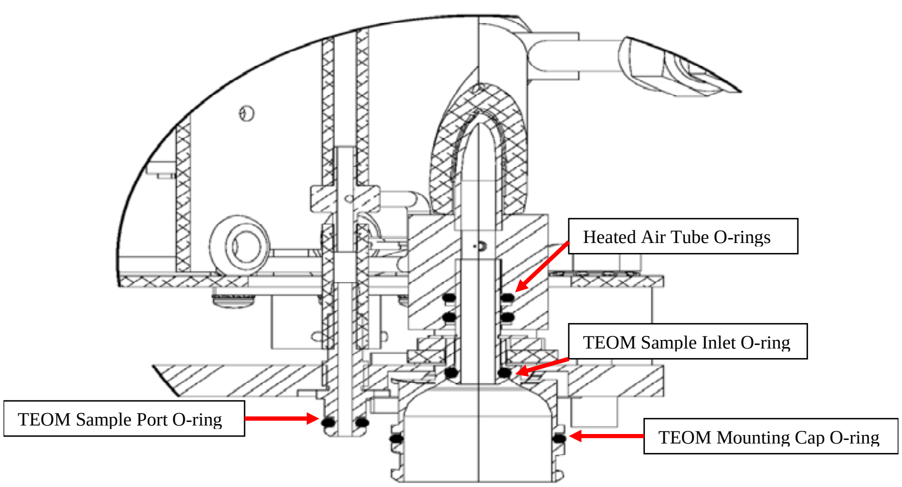

Figure 5–33. O-Ring Locations of the TEOM Mounting Assembly

16. After replacing the O-ring you must realign the "TEOM Transducer Mounting". There is an adjusting nut above the locking lever. Adjust nut so that the TEOM sits flush and evenly on all side while in the latched position.

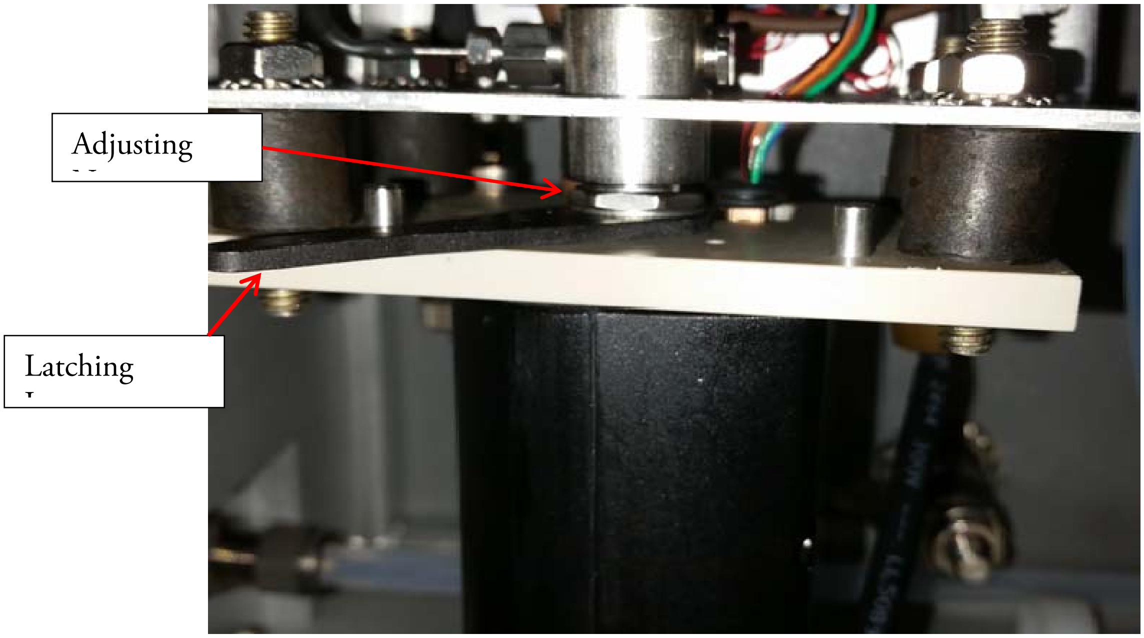

Figure 5–34. Adjusting Nut

Figure 5–35. TEOM Flush Mounted

Front Section of the Probe Monitor:

Note With the ACTUATOR in the off position and or no power applied to the Probe Monitor. With the unit in the stack it becomes limited to leak test the front end. Without access to the Dilution Module and the Nozzle, you are restricted to just the front end of the Heated Bench Assembly. If unit is located out of the Stack, proceed to step 3 to start leak check. ▲

1. To leak check the front half of the Heated Bench Assembly.
   a. Remove the Stinger Tube from the Heated Bench Assembly and cap with the medium VCO cap.
   b. Remove the Blowback tube and attach the 3/8 adapter tube to the fitting.
   c. Connect the red silicone tubing to port adapter and draw the vacuum back to 6 in Hg and wait for the reading to stabilize and record reading. Reading should be within 2% of initial vacuum reading (e.g. @ 6 in Hg = 0.5 in Hg over 5 minutes).
   d. If vacuum reading drops troubleshoot for leaks. If the leak is within the Heated Bench Assembly, this must be serviced by a qualified Thermo Technician. See Figure 5–36.

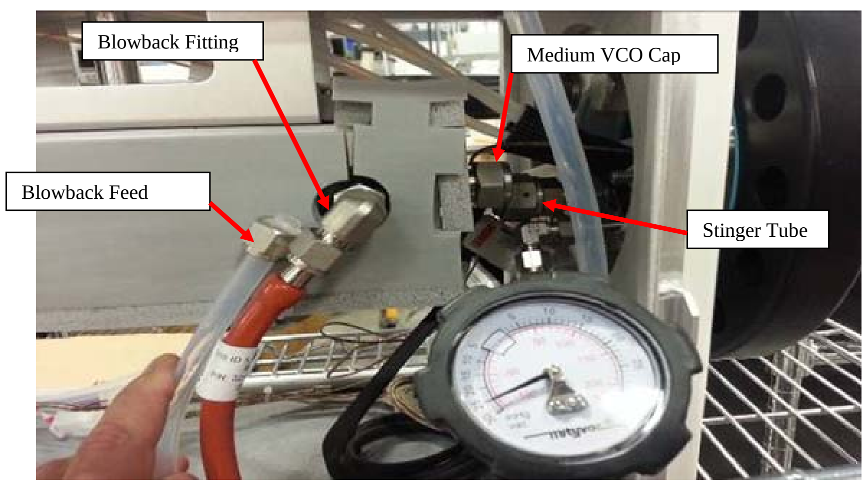

Figure 5–36. Isolation of the Front Half of the Heated Bench Assembly

2. A potential leak point can also be a failure of the Blowback Valve.
   a. To verify if the valve is closed properly Connect the red silicone tubing to the Blowback feed tube and draw the vacuum back to 25 in Hg and wait for the reading to stabilize and record reading. Reading should be within 2% of initial vacuum reading (e.g. @ 25

in Hg = 0.5 in Hg over 5 minutes). If vacuum reading drops troubleshoot for leaks. See Figure 5–36.

3. When the Probe Monitor is removed from the stack the leak check for the front section is more comprehensive.

   a. Cap off DIL1 and the BYPASS with 3/8 Swagelok caps on the rear panel of the Probe Monitor.

   b. Connect the red tubing to Nozzle Tip and draw the vacuum back to 25 in Hg and wait for the reading to stabilize and record reading. Reading should be within 2% of initial vacuum reading (e.g. @ 25 in Hg = 0.5 in Hg over 5 minutes).

   c. If vacuum reading drops troubleshoot for leaks.

4. To isolate the Dilution Assembly of the Mantle.

Remove the mantle shroud using 5/32 Allen head wrench, clean off the stack debris using a stiff Nylon Brush and a pick to clean out the socket head screws.

   a. To remove the Dilution Module, loosen the 9/16 nut closest to the mantle cap.

   b. Then loosen the 3 set screws (5/64th Allen Head Wrench) that secure the dilution module to the sample tube, slide off the Dilution module.

   c. The Dilution Air Supply is the top fitting on the mantle cap; connect the ¼ inch port adapter with the nut. See Figure 5–37.

   d. Connect the red silicone tubing to the port adaptor and draw the vacuum back to 25 in Hg and wait for the reading to stabilize and record reading. Reading should be within 2% of initial vacuum reading (e.g. @ 25 in Hg = 0.5 in Hg over 5 minutes).

   e. If vacuum reading drops troubleshoot for leaks.

   f. First cap off the 1/4 elbow (this feeds the dilution air to the mantle) with a 1/4 swagelok cap to isolate just the dilution tube internal to the mantle assembly.

   g. Repeat test. If leak persists, then it is inside the mantle or the elbow. You can remove the elbow and then using a ¼ swagelok plug, this isolates just the internal Dilution Assembly.

   h. If leak persists, refer to step 7 below to remove the internal Dilution Assembly from the Mantle.

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Figure 5–37. Isolated Dilution Assembly of the Mantle

5. To isolate the Stinger/Sample Assembly from the Mantle.

    a. With the dilution module removed and the Stinger attached to the Heated Bench Assembly and have verified that the front half of the Heated Bench does not leak.

    b. Connect the red tubing to the 1/2-inch sample tube on the mantle cap and draw the vacuum back to 25 in Hg and wait for the reading to stabilize and record reading. Reading should be within 2% of initial vacuum reading (e.g. @ 25 in Hg = 0.5 in Hg over 5 minutes). If vacuum reading drops troubleshoot for leaks. See Figure 5–38.

    c. Repeat test, if leak persist, then it is internal to the mantle assembly. Refer to the next step.

Figure 5–38. Isolated Stinger/Sample Assembly of the Mantle

6. To remove the internal assemblies from the Mantle these are the steps to follow. Note: the Mantle does not have to be removed from the Probe Monitor housing to service the internals.

   a. Using a stiff Nylon bristle brush and pick to clean off the stack residue from the socket head mounting screws (5/32 Allen Head Wrench) on the mantle shroud and mantle cap.

CAUTION Take CAUTION not to bend the Stack Thermocouple. ▲

   b. Mantle must be cool and instrument must be turned off with the power removed.

   c. Disconnect the Stack and Dilution Thermocouple from the connecting cables.

   d. Disconnect the Dilution air supply from the elbow.

   e. Disconnect the Stinger Tube Face Seal from the Heated bench Assembly.

   f. Disconnect the 3/4-inch Dump tube from the Union Reducer, take care not to lose the front & back ferrule, they tend not to bite into the PTFE tube.

   g. Carefully dislodge the mantle cap from the mantle body and slowly pull the internal assemblies out, guiding the cables and the dump tube through the mantle body. See Figure 5–39 for Mantle Cap view.

   h. Refer to steps 4 & 5 to find the leaks in both the Dilution and Stinger Assemblies. Note now you have access to the Dilution Thermocouple and the fittings on the rear of the mantle cap.

   i. Reinstall in the reverse order and apply Silver Goop to the socket head mounting screws thread before re-installing.

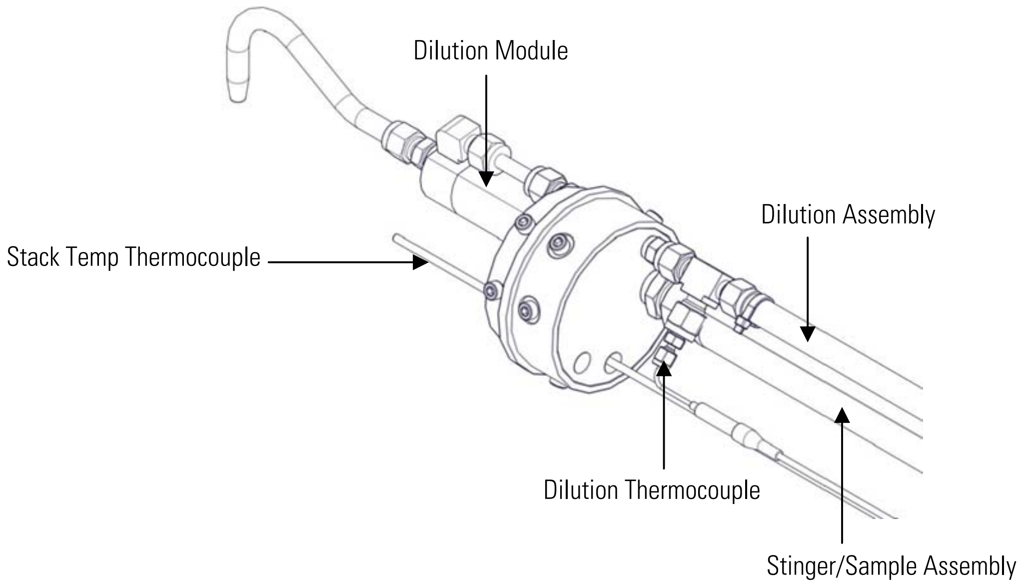

Figure 5–39. Mantle Cap View

Service Locations

For additional assistance, Thermo Fisher Scientific has service available from exclusive distributors worldwide. Contact one of the phone numbers below for product support and technical information or visit us on the web at www.thermo.com/aqi.

Toll Free U.S. only 1-866-282-0430

U.S., Latin America, and Canada 1-508-520-0430

Europe +31 76 579 5555

China +86 10 8419 3588

Asia Pacific +91 22 27781102

Chapter 6
Troubleshooting

This chapter provides the following troubleshooting and service support information for the PM CEMS.

The Technical Support Department at Thermo Fisher Scientific can also be consulted in the event of problems. See "Service Locations" on page 6-38 for contact information. In any correspondence with the factory, please note both the serial number and program number of the instrument.

Safety Precautions

Read the safety precautions in the Preface and "Servicing" chapter before performing any actions listed in this chapter.

Troubleshooting Guides

The troubleshooting guides presented in this chapter are designed to help isolate and identify instrument problems.

Table 6–1 provides troubleshooting information and indicates the checks that you should perform if you experience a general instrument problem.

Table 6–2 provides troubleshooting information and indicates the checks that you should perform if you experience a probe controller problem.

Table 6–3 provides troubleshooting information and indicates the checks that you should perform if you experience an instrument alarm problem.

Table 6–4 provides troubleshooting information and indicates the checks that you should perform if you experience a power-thermocouple assembly problem.

Table 6–5 provides troubleshooting information and indicates the checks that you should perform if you experience a nephelometer problem.

Table 6–6 provides troubleshooting information and indicates the checks that you should perform if you experience a TEOM problem.

Table 6–1. Troubleshooting – General Guide

Malfunction	Possible Cause	Action
No concentration on sample	Instrument mode	Verify instrument mode-monitor or mass.
Flow alarm	Flow error	Verify all flows in Diagnostics-All flow are equal to set points. Calibrate is needed.
	Bypass pump in OFF position	Verify bypass pump is ON. From Main Menu > Instrument Controls > Valve Power > Bypass pump relay "ON".
	Bypass pump OFF	Verify on bypass pump external switch position is ON.
		Verify bypass pump power cord is plugged into instrument and pump.
	Bypass pump relay is ON but not running.	Verify fuses on SSR board are not blown.
	Blown fuse on SSR board	Turn power off-unplug load from SSR board. Replace fuse(s). Turn instrument on with load still disconnected. Verify fuse(s) does not blow. Turn instrument off and connect load-turn instrument on and verify function. If fuse(s) blow again without load-replace SSR board.
Bypass pump low or eratic flow	Aged pump	Replace pump or use rebuild kit to repair.
	Need to re-calibrate bypass MFC	Refer to "Calibration" chapter.
Low nozzle flow	System leak	Refer to system leak procedure.
	Clogging nozzle	Refer to "Preventive Maintenance" chapter.
No temperature readings on controller	Disconnected electrical umbilical	Turn instrument off and verify umbilical connection.
	Disconnected AC input to the power-thermocouple assembly	Turn instrument off and verify AC connection to 24 VDC power supply.
	Disconnected RS-485 connection on the power-thermocouple assembly	Turn instrument off and verify RS-485 connection to RS-485 is on the power-thermocouple

Malfunction	Possible Cause	Action
		assembly.
	Malfunctioning thermocouple PCBA	Replace thermocouple PCBA.
	Malfunctioning 24 VDC power supply	Replace 24 VDC power supply.

Table 6–2. Troubleshooting – Probe Controller

Malfunction	Possible Cause	Action
Does not start (no light on display)	No power or wrong power configuration	Check the line to confirm that power is supplied and is the right voltage and frequency.
	Main fuse blown or missing	Unplug the power cord-open fuse draw and check fuse(s).
	Bad power switch or wiring connection	Unplug power cord-disconnect switch and check operation.
Does not start (display background lit)	AC line voltage outside limits	Ensure AC line voltage is within system operating range.
	Front panel ribbon cable not connected properly	Ensure cable is seated properly into connector.
	LCD flat cable not connected properly	Ensure cable is seated properly and connector is in locked position.
	24 VDC monitor cable not connected properly	Ensure power supply 24 VDC monitor cable is properly connected to power supply and to 24 VDC on motherboard.
	Faulty or corrupted firmware processor board	Attempt to reload latest version firmware. Replace processor board.
	Faulty motherboard	Replace motherboard.
TEOM alarms	No power to probe monitor	Check umbilical connections for proper seating. Check umbilical for damage.
	No power to TEOM only	Check for proper seating of TEOM power cable.
		For further troubleshooting of TEOM alarms, refer to Table 6–6.
Nephelometer alarms	No power to probe monitor	Check umbilical connections for proper seating. Check umbilical for damage.
	No power to nephelometer	Check for proper seating of

Malfunction	Possible Cause	Action
	only	nephelometer power cable. For further troubleshooting of nephelometer alarms, refer to Table 6–5.
Probe controller temperature alarm	Faulty thermistor	Replace thermistor.
	Missing thermistor	Install thermistor.
Barometric pressure alarm	Barometric pressure sensor out of calibration	Calibrate the barometric pressure sensor.
	Faulty barometric pressure	Replace the TEOM board.
Sample check alarm	No power to sample or bypass pump	Verify pumps are turned on and power is being applied. Ensure fuses on SSR board are not blown.
	MFC flow out of tolerance	Audit/calibrate sample dilution and bypass MFCs.
	Faulty sample mems sensor	Audit sample flow. If actual and sample flow reading OK but sample check is not, replace mems sensor.
	Faulty sample MFC	If actual flow, sample and sample audit flow match but out of spec/setpoint, replace sample MFC.
Dilution ratio alarm	Improper dilution flow	Verify dilution flow setting and actual flow. Verify zero air supply pressure. If needed, calibrate MFC. If unit will not calibrate, replace MFC.
	Improper bypass flow	Verify bypass flow setting and actual flow. If needed, calibrate MFC. If unit will not calibrate, replace MFC.
	Improper sample flow	Verify sample flow setting and actual flow. If needed, calibrate MFC. If unit will not calibrate, replace MFC. When flow audits are satisfactory, perform a leack check on system.
	Clogged nozzle	Perform a system blow back. If blow back does not clear clog, nozzle will need removal and servicing.

Table 6–3. Troubleshooting – Instrument Alarms

Alarm Message	Possible Cause	Action
Velocity alarm	Customer setting	This setting is customer based. The default values are 0.00 to 30.0 ms.
Manual mode alarm	Instrument left in Manual mode	Change instrument mode.
Service mode alarm	Instrument left in service mode	Turn service mode OFF. From Main Menu > Instrument Controls > Service Mode and toggle "OFF" to turn off-exit.
Blow back period alarm	Blow back period not set or scheduled	Set blow back schedule and period. From Main Menu > Blow Back Schedule to set.
Motherboard status alarm	Dislodged Arcturus board	Remove Arcturus board. Clean contacts and reseat.
.	Damaged motherboard	Replace motherboard.
Interface status alarm	Disconnected cable	Verify communications and 24 VDC cable connections.
	No 24 VDC power	Verify 24 VDC power input. If no 24 VDC, replace power supply.
TCB status alarm	No communications	Refer to Table 6–4 (Power-Thermocouple assy troubleshooting section.
Dual nephelometer status alarm	No communications	Refer to Table 6–5 (Nephelometer troubleshooting section.
TEOM status alarm	No communications	Refer to Table 6–6 (TEOM troubleshooting section.
I/O exp status alarm	Disconnected cable	Verify cable connection.
	Faulty board	Replace I/O exp board

Table 6–4. Troubleshooting – Power-Thermocouple Assembly

Malfunction	Possible Cause	Action
TCB alarm	Disconnected umbilical	Verify umbilical connections.
	Disconnected cable from power supply or RS-485 cable	Verify cable connections.
	Faulty power supply	Verify 220 VAC to input of power supply. Verify 24 VDC to output of power supply. If no 24 VDC, replace power supply.
	Blown fuse on thermocouple board assembly	Verify fuse. If faulty, replace fuse.
Stack temperature alarm	Disconnected cable	Verify cable connections. If cable connections are valid, swap thermcouple connector with a known good connector on the thermocouple board. If error follows thermocouple, replace thermocouple. Otherwise replace thermocouple board assembly.
Dilution temperature alarm	Disconnected cable	Verify cable connections. If cable connections are valid, swap thermcouple connector with a known good connector on the thermocouple board. If error follows thermocouple, replace thermocouple. Otherwise replace thermocouple board assembly.
	Faulty heater	Verify for blown fuses on SSR board. If fuses blown, replace. If blow again, disconnect heater ohm out across heater pins. If open or shorted, replace heater assembly. If heaters ohm out, replace SSR board.
Stinger temperature alarm	Disconnected cable	Verify cable connections. If cable connections are valid, swap thermcouple connector with a known good connector on the thermocouple board. If error follows thermocouple, replace thermocouple. Otherwise replace thermocouple board assembly.
	Faulty heater	Verify for blown fuses on SSR board. If fuses blown, replace. If blow again, disconnect heater ohm out across heater pins. If open or shorted, replace heater assembly. If heaters ohm out, replace SSR board.

Malfunction	Possible Cause	Action
Bypass temperature alarm	Disconnected cable	Verify cable connections. If cable connections are valid, swap thermcouple connector with a known good connector on the thermocouple board. If error follows thermocouple, replace thermocouple. Otherwise replace thermocouple board assembly.
	Faulty bypass heater	Check cable connections. Bypass heater has two thermal fuses on top of assembly. Place system in Purge mode. Set all temperatures to 0 °C to reset thermal fuses.
Nephelometer temperature alarm	Disconnected cable	Verify cable connections. If cable connections are valid, swap thermcouple connector with a known good connector on the thermocouple board. If error follows thermocouple, replace thermocouple. Otherwise replace thermocouple board assembly.

Table 6–5. Troubleshooting – Nephelometer

Malfunction	Possible Cause	Action
Nephelometer board failure	External cable not connected	Verify cable connection.
	Internal cable not connected.	Verify cable connection.
	Disconnected electrical umbilical	Verify electrical umbilical connection.
Low/high source current alarm	Incorrect setting in the service menu-nephelometer calibration	Verify that the source current is set to 65mA ± 5mA.
	Disconnected source/ref det cable	Verify cable connection.
No nephelometer RH/temperature readings	Disconnected RH/temp cable	Verify cable connection.
Nephlelometer span source	Only active during system check	Verify that instrument is doing a scheduled system check.
	No current during system check	Verify cable connection on span source assembly
Nephelometer zero drift alarm	Optics becoming fouled	Try re-zeroing. If fails, send nephelometer in for servicing.

Malfunction	Possible Cause	Action
Nephelometer span reference	Only active during system check	Verify that instrument is doing a scheduled system check.
	No reference detector voltage during system check	Verify cable connection on source/reference detector assembly
Neph forward gains alarm	Nephelometer optics becoming fouled	Try re-zeroing. If fails, send nephelometer in for servicing.

Table 6–6. Troubleshooting – TEOM

Malfunction	Possible Cause	Action
TEOM frequency alarm	Sample filter improperly seated	Re-seat filter wiring filter tool-replace sample filter.
	Transducer not installed	Install transducer.
TEOM std dev alarm	Improperly installed sample filter	Re-seat or replace or replace sample filter.
	Filter has accumulated too much sample	Replace sample filter.
TEOM mass alarm	Filter has accumulated too much sample	Replace sample filter.
	Mass not reset after new filter installed	Reset filter for mass-instrument controls. Reset TEOM total mass. From Main Menu > Instrument Controls.
No communications with TEOM assembly	Disconnected cable	Verify cable connections.
	TEOM board in standby mode-red led on constantly	Press reset button (need image to show) then verify TEOM board voltage. From Main Menu > Diagnostics > Voltage > TEOM board.
	Blown fuse on TEOM board	Replace fuse.
	No 24 VDC power supplied or RS-485 communication	Refer to Table 6–4 (power-thermocouple assy troubleshooting section.
TEOM frequency std and K0 alarms together	Disconnected transducer	Re-seat transducer assembly or replace transducer assembly.
Transducer assembly will not heat	Heater temperature set too low	Verify heater set temperature. From Main Menu > Instrument Controls > Set Temperature > TEOM Case.

Malfunction	Possible Cause	Action
	Blown fuse on TEOM board	Replace fuse.
	Transducer not installed properly	Re-install transducer assembly.
	Disconnected transducer	Verify transducer cable is connected to TEOM board.
	Faulty transducer	Replace transducer assembly
Air tube will not heat	Heater temperature set too low	Verify heater set temperature. From Main Menu > Instrument Controls > Set Temperature > TEOM Air Tube.
	Disconnected air tube cable	Verify air tube cable connected to TEOM board.
	Blown air tube heater fuse	Replace air tube heater fuse on TEOM board.
	Faulty air tube assembly	Replace TEOM air tube assembly.
	Faulty air tube thermisor	Repalce TEOM air tube assembly.
TEOM Dp pressure alarm	Sample filter has collected too much sample	Replace filter and reset TEOM total mass. From Main Menu > Instrument Controls.
	no mass transducer installed	Install mass transducer with new sample filter.
	Faulty pressure sensor	Replace TEOM mounting assembly board.
	Disconnected pressure sensor plumbing lines	Verify pressure sensor plumbing lines are connected.
Negative Dp pressure alarm	Pressure sensor plumbing lines are backward plumbed	Verify pressure sensor plumbing lines are plumbed correctly.

Board-Level Connection Diagrams

Figure 6–1 is a board-level connection diagram. These illustrations can be used along with the connector pin descriptions in Table 6–7 through Table 6–9 to troubleshoot board-level faults.

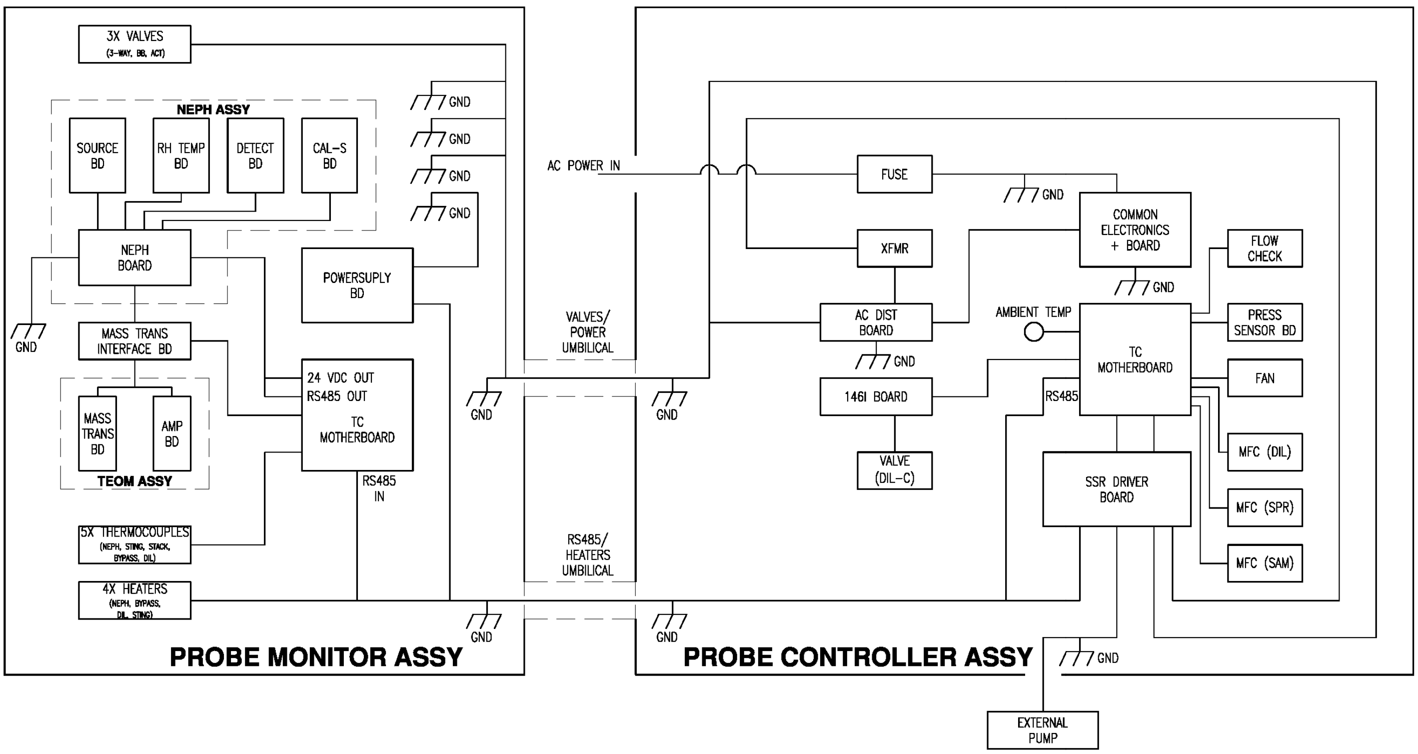

Figure 6–1. Board-Level Connection Diagram

Connector Pin Descriptions

The connector pin descriptions in Table 6–7 through Table 6–16 can be used along with the board-level connection diagram to troubleshoot board-level faults.

Table 6–7. Motherboard Connector Pin Descriptions

Connector Label	Reference Designator	Pin	Signal Description
RS-485	J1	1	Ground
		2	RS485_P to Partisol Interface Board
		3	RS485_N to Partisol Interface Board
ETHERNET	J2	1	ETX1_P
		2	ETX1_N
		3	ERX1_P
		4	N.C.
		5	N.C.
		6	ERX1_N
		7	N.C.
		8	N.C.
I/O EXPANSION BOARD	J3	1	+15V
		2	+24V
		3	+24V
		4	GND
		5	GND
		6	GND
		7	RS485_P
		8	RS485_N
INTF 24V	J4	1	+24V
		2	GND
I/O EXPANSION CONNECTOR	J5	1	GNDC
		2	PFLT_NC
		3	GND
		4	DIGITAL_IN1
		5	DIGITAL_IN2

Connector Label	Reference Designator	Pin	Signal Description
		6	GND
		7	DIGITAL_IN5
		8	DIGITAL_IN7
		9	DIGITAL_IN8
		10	DIGITAL_IN9
		11	GND
		12	DIGITAL_IN13
		13	DIGITAL_IN15
		14	GND
		15	ANALOG_OUT1
		16	ANALOG_OUT2
		17	GNDA
		18	ANALOG_OUT5
		19	GNDA
		20	GNDA
		21	PFLT_COM
		22	PFLT_NO
		23	GNDA
		24	DIGITAL_IN3
		25	DIGITAL_IN4
		26	DIGITAL_IN6
		27	GNDA
		28	DIGITAL_IN9
		29	DIGITAL_IN11
		30	DIGITAL_IN12
		31	DIGITAL_IN14
		32	DIGITAL_IN16
		33	GNDA
		34	ANALOG_OUT2
		35	ANALOG_OUT4
		36	GNDA
		37	ANALOG_OUT6
USER RS-485/RS-232	J6	1	1A - N.C.

Connector Label	Reference Designator	Pin	Signal Description
		2	2A - RS485_IN_P / RX
		3	3A - RS485_OUT_N / TX
		4	4A - N.C.
		5	5A - GND
		6	6A - N.C.
		7	7A - RS485_OUT_P / RTS
		8	8A - RS485_IN_N / CTS
		9	9A - N.C.
		10	1B - N.C.
		11	2B - RS485_IN_P / RX
		12	3B - RS485_OUT_N / TX
		13	4B - N.C.
		14	5B - GND
		15	6B - N.C.
		16	7B - RS485_OUT_P / RTS
		17	8B - RS485_IN_N / CTS
		18	9B - N.C.
USB A&B	J8	1	VBUS_A
		2	VBUS_B
		3	USB_PORTA_N
		4	USB_PORTB_N
		5	USB_PORTA_P
		6	USB_PORTB_P
		7	GND
		8	GND
		9	GND
		10	GND
USB C&D	J9	1	VBUS_C
		2	VBUS_D
		3	USB_PORTC_N
		4	USB_PORTD_N
		5	USB_PORTC_P
		6	USB_PORTD_P
		7	GND

Connector Label	Reference Designator	Pin	Signal Description
		8	GND
		9	GND
		10	GND
24V IN	J10	1	+24
		2	GND
WATCH DOG DISABLE	J11	1	DISABLE
		2	GND
MCU RESET	J12	1	DISABLE
		2	GND
DIGITAL OUTPUT	J14	1	+15V
		2	+24V
		3	+24V
		4	GND
		5	GND
		6	GND
		7	RESET
		8	SPI_MISO
		9	SPI_MOSI
		10	SPI_CS2
		11	SPI_CLK
EXTERNAL ACCESSORY	J15	1	EXT_RS485_N
		2	EXT_RS485_P
		3	+5V 1/2A
		4	+5V 1/2A
		5	+5V 1/2A
		6	GND
		7	GND
		8	GND
		9	N.C.
		10	N.C.
		11	+24V1/2A
		12	+24V1/2A

Connector Label	Reference Designator	Pin	Signal Description
		13	+24V1/2A
		14	+24V1/2A
		15	+24V1/2A
JTAG	J16	1	TDO
		2	N.C.
		3	TDI
		4	N.C.
		5	TMS
		6	N.C.
		7	TCK
		7	N.C.
		9	GND
		10	N.C.
		11	N.C.
		12	N.C.
		13	N.C.
		14	N.C.
24V MONITOR	J17	1	+24V
		2	GND
LCD	J18	1	GND
		2	GND
		3	LCDOUT_CLK
		4	GND
		5	GND
		6	LCDOUT_LP
		7	LCDOUT_FLM
		7	LCDOUT4
		9	LCDOUT0
		10	LCDOUT5
		11	LCDOUT1
		12	LCDOUT6
		13	LCDOUT2
		14	LCDOUT7
		15	LCDOUT3

Connector Label	Reference Designator	Pin	Signal Description
		16	LCDBIAS
		17	+5V
		18	GND
		19	GND
		20	LCDOUT_ONOFF
		21	KEYPAD_ROW2
		22	KEYPAD_ROW1
		23	KEYPAD_ROW4
		24	KEYPAD_ROW3
		25	KEYPAD_COL2
		26	KEYPAD_COL1
		27	KEYPAD_COL4
		28	KEYPAD_COL3
		29	GND
		30	GND
		31	GND
		32	GND
		33	+24V
		34	+24V
AC IN	J19	1	NEUTRAL
		2	LIVE
		3	EARTH
AC 24V POWER SUPPLY	J20	1	NEUTRAL
		2	LIVE
		3	EARTH
AC INTF BOARD	J21	1	NEUTRAL
		2	LIVE
		3	EARTH
DISPLAY	J22	1	GND
		2	LCDOUT_CLK
		3	LCDOUT_LP
		4	LCDOUT_FLM
		5	GND

Connector Label	Reference Designator	Pin	Signal Description
		6	LCDOUT12
		7	LCDOUT13
		8	LCDOUT14
		9	LCDOUT15
		10	LCDOUT16
		11	LCDOUT17
		12	GND
		13	LCDOUT6
		14	LCDOUT7
		15	LCDOUT8
		16	LCDOUT9
		17	LCDOUT10
		18	LCDOUT11
		19	GND
		20	LCDOUT0
		21	LCDOUT1
		22	LCDOUT2
		23	LCDOUT3
		24	LCDOUT4
		25	LCDOUT5
		26	GND
		27	LCDOUT_ONOFF
		28	+3.3V
		29	+3.3V
		30	CONTRAST
KEYPAD	J23	1	KEYPAD_ROW1
		2	KEYPAD_ROW2
		3	KEYPAD_ROW3
		4	KEYPAD_ROW4
		5	KEYPAD_COL1
		6	KEYPAD_COL2
		7	KEYPAD_COL3
		8	KEYPAD_COL4
DISPLAY BACKLIGHT	J24	1	+24V 1/4A

Connector Label	Reference Designator	Pin	Signal Description
		2	GND
		3	+24V 1/4A
		4	GND
POWER SUPPLY TEST	J25	1	+5V
		2	+3.3V
		3	+15V
		4	-3.3V

Table 6–8. I/O Expansion Board Connector Pin Descriptions

Connector Label	Reference Designator	Pin	Signal Description
EXPANSION I/O	J1	1	Analog Voltage Input 1
		2	Analog Voltage Input 2
		3	Analog Voltage Input 3
		4	Ground
		5	Analog Voltage Input 4
		6	Analog Voltage Input 5
		7	Analog Voltage Input 6
		8	Ground
		9	Analog Voltage Input 7
		10	Analog Voltage Input 8 (Flow)
		11	Ground
		12	NC
		13	Current Output Return
		14	Ground
		15	Current Output 1
		16	Current Output Return
		17	Current Output 2
		18	Current Output Return
		19	Current Output 3
		20	Current Output Return
		21	Current Output 4
		22	Current Output Return

Connector Label	Reference Designator	Pin	Signal Description
		23	Current Output 5
		24	Current Output Return
		25	Current Output 6
MOTHER BD	J2	1	+5V
		2	+24V
		3	+24V
		4	Ground
		5	Ground
		6	Ground
		7	+RS485 to Motherboard
		8	-RS485 to Motherboard

Table 6–9. Digital Output Board Connector Pin Descriptions

Connector Label	Reference Designator	Pin	Signal Description
MOTHER BD	J1	1	+5V
		2	+24V
		3	+24V
		4	Ground
		5	Ground
		6	Ground
		7	SPI Reset
		8	SPI Input
		9	SPI Output
		10	SPI Board Select
		11	SPI Clock
DIGITAL OUTPUTS	J2	1	Relay 1 Contact a
		2	Relay 2 Contact a
		3	Relay 3 Contact a
		4	Relay 4 Contact a
		5	Relay 5 Contact a
		6	Relay 6 Contact a
		7	Relay 7 Contact a
		8	Relay 8 Contact a
		9	Relay 9 Contact a

Connector Label	Reference Designator	Pin	Signal Description
		10	Relay 10 Contact a
		11	NC
		12	Solenoid Drive Output 1
		13	Solenoid Drive Output 2
		14	Solenoid Drive Output 3
		15	Solenoid Drive Output 4
		16	Solenoid Drive Output 5
		17	Solenoid Drive Output 6
		18	Solenoid Drive Output 7
		19	Solenoid Drive Output 8
		20	Relay 1 Contact b
		21	Relay 2 Contact b
		22	Relay 3 Contact b
		23	Relay 4 Contact b
		24	Relay 5 Contact b
		25	Relay 6 Contact b
		26	Relay 7 Contact b
		27	Relay 8 Contact b
		28	Relay 9 Contact b
		29	Relay 10 Contact b
		30	+24V
		31	+24V
		32	+24V
		33	+24V
		34	+24V
		35	+24V
		36	+24V
		37	+24V

Table 6–10. Measurement Interface Board Connector Pin Descriptions

Connector Label	Reference Designator	Pin	Signal Description
RS485	J1	1	Ground
		2	+RS485
		3	-RS485
PRESSURE	J2	1	NC
		2	AIN BARO
		3	AIN DPL
		4	AIN DPH
		5	AIN PS
		6	AIN VT
		7	+5V
		8	NC
		9	Ground
BOX TMP	J3	1	Controller Therm
		2	Ground
24 IN	J4	1	+24V
		2	Ground
RS485	J5	1	Ground
		2	+RS485
		3	-RS485
24V OUT	J6	1	+24V
		2	Ground
FAN	J7	1	+24V
		2	Ground
SAM MFC	J8	1	AIN MFC SAM
		2	AOUT MFC SAM
		3	Ground
		4	+15V
		5	-15V
		6	Ground
By-Pass MFC	J9	1	AIN MFC By-Pass
		2	AOUT MFC By-Pass
		3	Ground
		4	+15V

Connector Label	Reference Designator	Pin	Signal Description
		5	-15V
		6	Ground
DIL MFC	J10	1	AIN MFC DiL
		2	AOUT MFC DiL
		3	Ground
		4	+15V
		5	-15V
		6	Ground
SERVO POT	J11	1	H1
		2	W1
		3	L1
		4	H2
		5	W2
		6	L2
SPR 24V	J12	1	+24V
		2	SPR SOL 1
RED ED	J13	1	AOUT EDUCTOR PRES
		2	Ground
SPR 24V	J14	1	+24V
		2	SPR SOL 2
SETRA VAC	J15	1	+24V A1
		2	AIN VAC PRES +
		3	+24V A1 RET
		4	AIN VAC PRES
SERVOMEX	J16	1	NC
		2	AIN SERVOMEX
		3	Ground
SERVOMEX	J17	1	NC
		2	TEMP STATUS
		3	Ground
FLOW CHK	J18	1	+15V
		2	AIN FLOW CHK
		3	Ground
SPR 24	J19	1	+24V

Connector Label	Reference Designator	Pin	Signal Description
		2	SPR 24V CNTRL
REG VTX	J20	1	AOUT VORTEX PRES
		2	Ground
SENTRA VEN	J21	1	+24V A2
		2	AIN VENT PRES +
		3	+24V A2 RET
		4	AIN VENT PRES -
SRVMX PWR	J22	1	+15V
		2	Ground
		3	+15V
		4	Ground
	J23	1	+24V
		2	AIN SETRAP 4-20mA
REG SPR	J24	1	+24V
		2	Ground
AC SOL	J25	1	ACT SOL
		2	+5V
		3	BB SOL
		4	+5V
		5	TEOM BY SOL
		6	Ground
		7	DI BB SOL
		8	Ground
		9	SPARE SOL
		10	Ground
DC VALVES	J26	1	CO2 1 SOL
		2	DIL AIR SOL
		3	+24V
		4	PC SOL
		5	PS SOL
		6	CO2 2 SOL
		7	ED SOL
		8	+24V
		9	PD SOL

Connector Label	Reference Designator	Pin	Signal Description
		10	N.C.
SSR CNTRL	J27	1	STINGER RELAY
		2	+15V
		3	BLOCK RELAY
		4	+15V
		5	VEN RELAY
		6	+15V
		7	DIL RELAY
		8	+15V
		9	N.C.
		10	+15V
		11	SPARE 1 RELAY
		12	+15V
		13	PUMP RELAY
		14	+15V
		15	N.C.
		16	N.C.
SETRAV	J28	1	+24V
		2	AIN SETREV 4-20mA
WDT DISABLE	J29	1	WDT
		2	Ground
JTAG	J30	1	TDO
		2	TDI
		3	TMS
		4	TCK
		5	RESET MUX
		6	Ground D

Table 6–11. 146*i* Connector Board Connector Pin Descriptions

Connector Label	Reference Designator	Pin	Signal Description
Gas A	J1	1	+24V
		2	CO2 1 SOL
Gas B	J2	1	+24V
		2	CO2 2 SOL
Gas C	J3	1	+24V
		2	DIL AIR SOL
Gas D	J4	1	+24V
		2	ED SOL
Gas E	J5	1	+24V
		2	PC SOL
Gas F	J6	1	+24V
		2	PD SOL
Z-A	J7	1	+24V
		2	PS SOL
EXT/INT	J8	1	+24V
		2	NC

Table 6–12. AC Distribution Board Connector Pin Descriptions

Connector Label	Reference Designator	Pin	Signal Description
AC IN	J1	1	AC+
		2	AC-
		3	Ground
PWR SPLY	J2	1	AC+
		2	AC-
		3	Ground
PSPB	J3	1	AC+
		2	AC-
		3	Ground
SPR1	J4	1	AC+
		2	AC-
		3	Ground

Connector Label	Reference Designator	Pin	Signal Description
SPR2	J5	1	AC+
		2	AC-
		3	

Table 6–13. Probe Temperature Control Board Connector Pin Descriptions

Connector Label	Reference Designator	Pin	Signal Description
RS485	J1	1	Ground
		2	+RS485
		3	-RS485
24V IN	J2	1	+24V
		2	Ground
DIL TC	J3	1	DIL TC+
		2	DIL TC-
RS485	J4	1	Ground
		2	+RS485
		3	-RS485
24V OUT	J5	1	+24V
		2	Ground
STACK TC	J6	1	STACK TC+
		2	STACK TC-
SPACE TC	J7	1	SPARE TC+
		2	SPARE TC-
WDT DISABLE	J8	1	WDT
		2	Ground
JTAG	J9	1	TDO
		2	TDI
		3	TMS
		4	TCK
		5	RESET
		6	Ground
STINGER TC	J10	1	STINGER TC+
		2	STINGER TC-

Connector Label	Reference Designator	Pin	Signal Description
NEPH TC	J118	1	NEPH TC+
			NEPH TC-
BY-PASS TC	J12	1	BY-PASS TC+
		2	BY-PASS TC-

Table 6–14. TEOM Head Controller Board Connector Pin Descriptions

Connector Label	Reference Designator	Pin	Signal Description
RS485	J1	1	Ground
		2	+RS485
		3	-RS485
TEOM	J2	1	NVRAM I/O
		2	TE FREQ
		3	TE HEATER RTN
		4	ANALOG GROUND
		5	+10V
		6	DIGITAL GROUND
		7	TE THERM RTN
		8	TE HEATER PWR
		9	-10V
		10	NC
		11	NC
RS485	J3	1	Ground
		2	+RS485
		3	-RS485
AIR TUBE	J4	1	+5V REF
		2	TUBE HEATER RTN
		3	ANALOG GROUND
		4	+10V
		5	DIGITAL GROUND
		6	TUBE THERMO RTN
		7	TUBE HEATER PWR
		8	-10V

Connector Label	Reference Designator	Pin	Signal Description
JTAG	J5	1	TDO
		2	TDI
		3	TMS
		4	TCK
		5	RESET
		6	GROUND
24V IN	J6	1	+24V
		2	GROUND
24V OUT	J7	1	+24V
		2	GROUND

Table 6–15. SSR Driver Board Connector Pin Descriptions

Connector Label	Reference Designator	Pin	Signal Description
STINGER	J1	1	AC1
		2	AC2
BY-PASS	J2	1	AC1
		2	AC2
EXT PUMP	J3	1	AC1
		2	AC2
MAIN POWER	J4	1	AC1
		2	AC2
SSR DRIVER	J5	1	Stinger Relay -
		2	Stinger Relay +
		3	By-Pass Relay -
		4	By-Pass Relay +
		5	Ext Pump Relay -
		6	Ext Pump Relay +
		7	Dil Relay -
		8	Dil Relay +
		9	Spare -
		10	Spare +
		11	Neph -

Connector Label	Reference Designator	Pin	Signal Description
		12	Neph +
		13	Pump Relay -
		14	Pump Relay +
		15	NC
		16	NC
Sol Valves	J6	1	ACT SOL
		2	+5V
		3	BB SOL
		4	+5V
		5	TEOM BY SOL
		6	Ground
		7	P1 BB SOL
		8	Ground
		9	SPARE SOL
		10	Ground
Dilution	J7	1	AC1
		2	AC2
Spare	J8	1	AC1
		2	AC2
Neph	J9	1	AC1
		2	AC2
ISO 120/208 LINE	J10	1	ISO 208 LINE
		2	ISO 120 LINE
		3	ISO Return
INT PUMP	J11	1	ISO 120 LINE
		2	ISO 120 Return
		3	Ground
AC Valves	AC1	1	NC
		2	ACT AC2
		3	BB AC2
		4	TEOM BY AC2
		5	P1 BB AC2
		6	SPARE AC2
AC Valves	AC2	1	NC

Connector Label	Reference Designator	Pin	Signal Description
		2	ACT AC1
		3	BB AC1
		4	TEOM BY AC1
		5	P1 BB AC1
		6	SPARE AC1

Table 6–16. Dichot NEPH MIB Connector Pin Descriptions

Connector Label	Reference Designator	Pin	Signal Description
JTAG	J1	1	TDO
		2	NC
		3	TDI
		4	NC
		5	TMS
		6	NC
		7	TCK
		8	NC
		9	Ground
		10	NC
		11	NC
		12	NC
		13	NC
		14	NC
24V	J2	1	+24V
		2	Ground
Det A	J3	1	Ground
		2	Det A
		3	-5V
		4	+5V
RS485	J4	1	Ground
		2	+RS485
		3	-RS485
Det B	J5	1	Ground

Connector Label	Reference Designator	Pin	Signal Description
		2	Det B
		3	-5V
		4	+5V
Source	J6	1	IRED K
		2	IRED A
		3	Ground
		4	Ref PD+
		5	NC
RH/TEMP	J7	1	Ground
		2	+5V
		3	TEMP HIH
		4	RH HIH
TEMP SEN	J8	1	+5V
		2	TEMP1 SEN
SPAN SOURCE	J11	1	SPAN IRED K
		2	SPAN IRED A
		3	Ground
		4	SPAN REF PD+
		5	NC

PM CEMS Board Diagrams

Figure 6–2 through Figure 6–5 are board-level connection diagrams for the PM CEMS. See Table 6–17 through Table 6–26 for status LEDs, fuses, and test points.

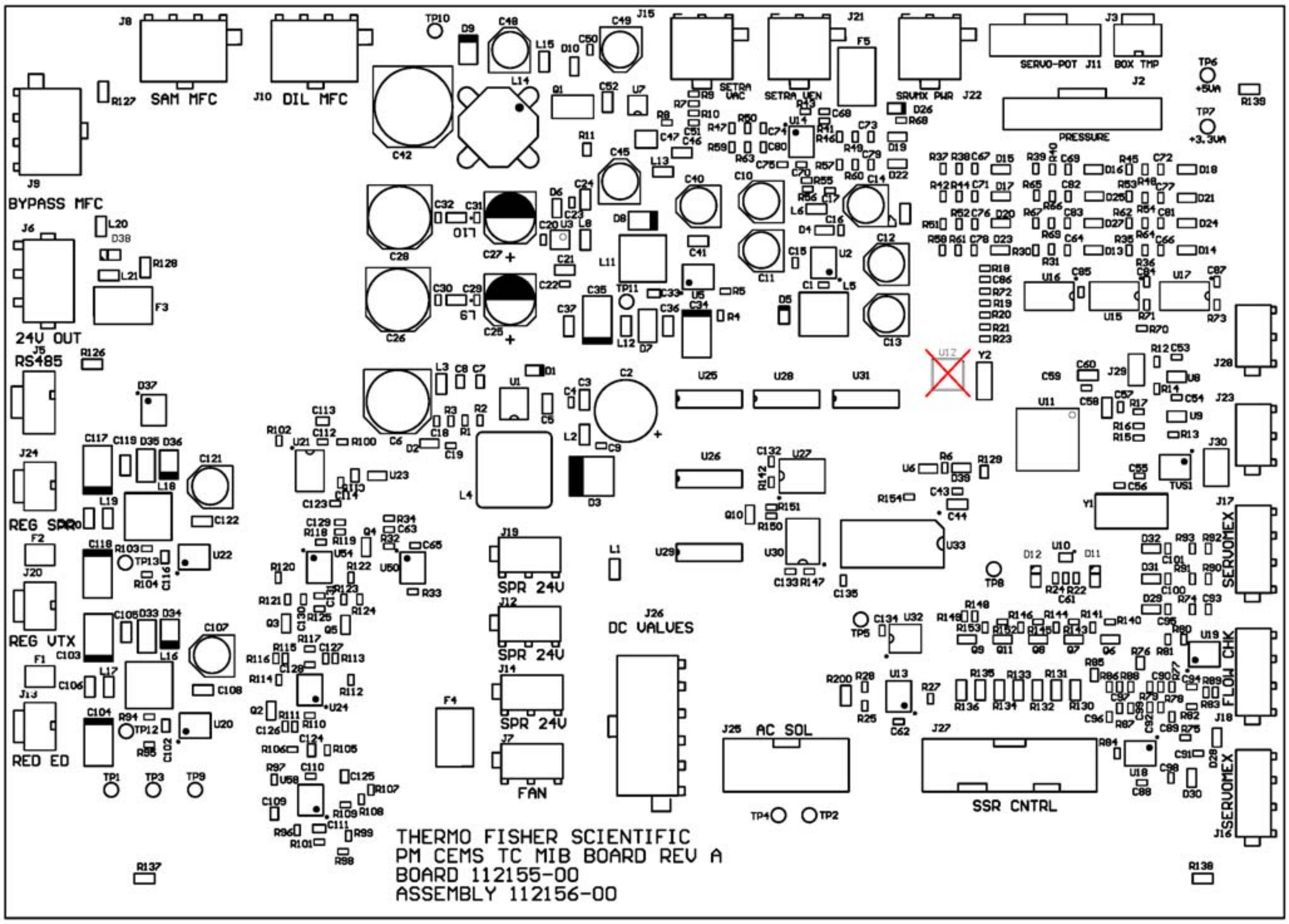

Figure 6–2. Board-Level Connection Diagram – Measurement Interface

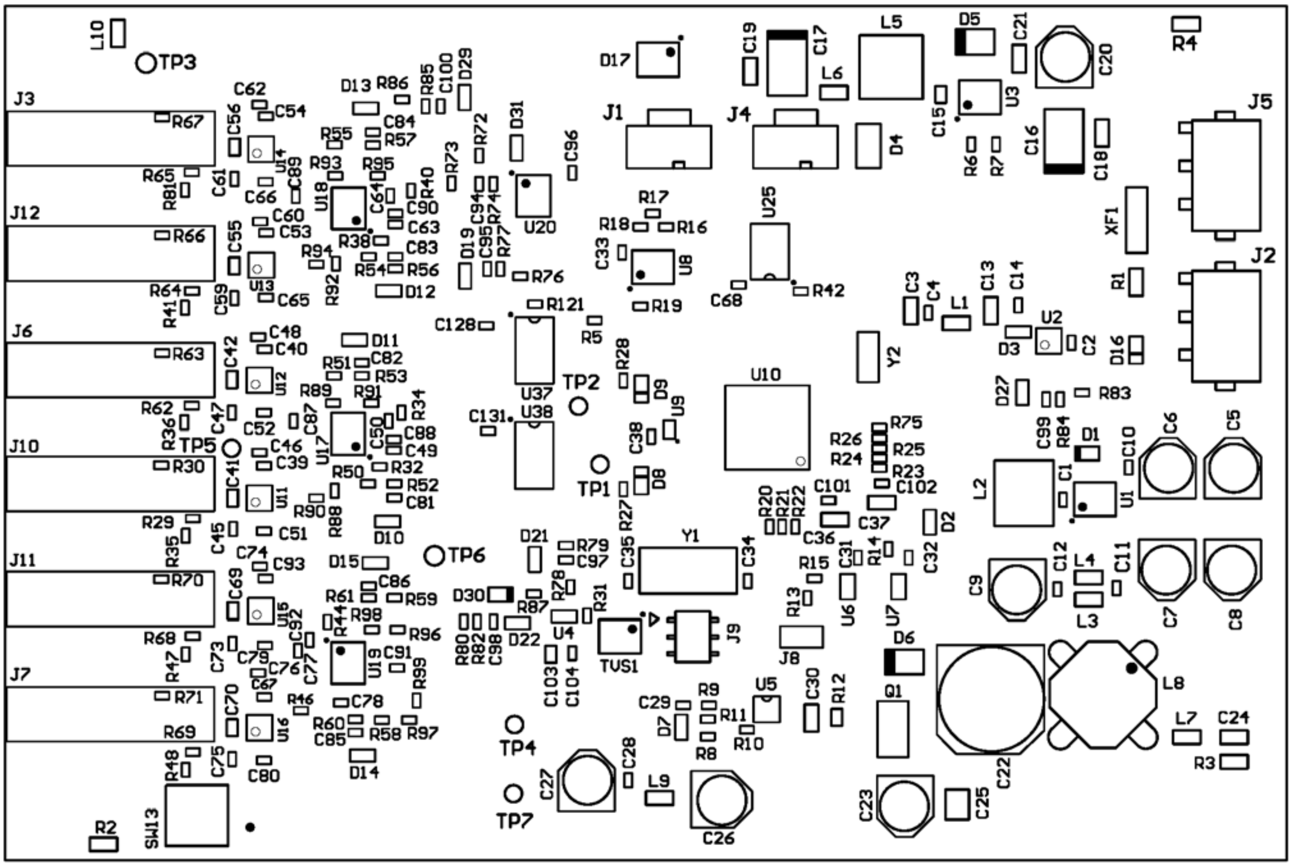

Figure 6–3. Board-Level Connection Diagram - Probe Temperature Controller

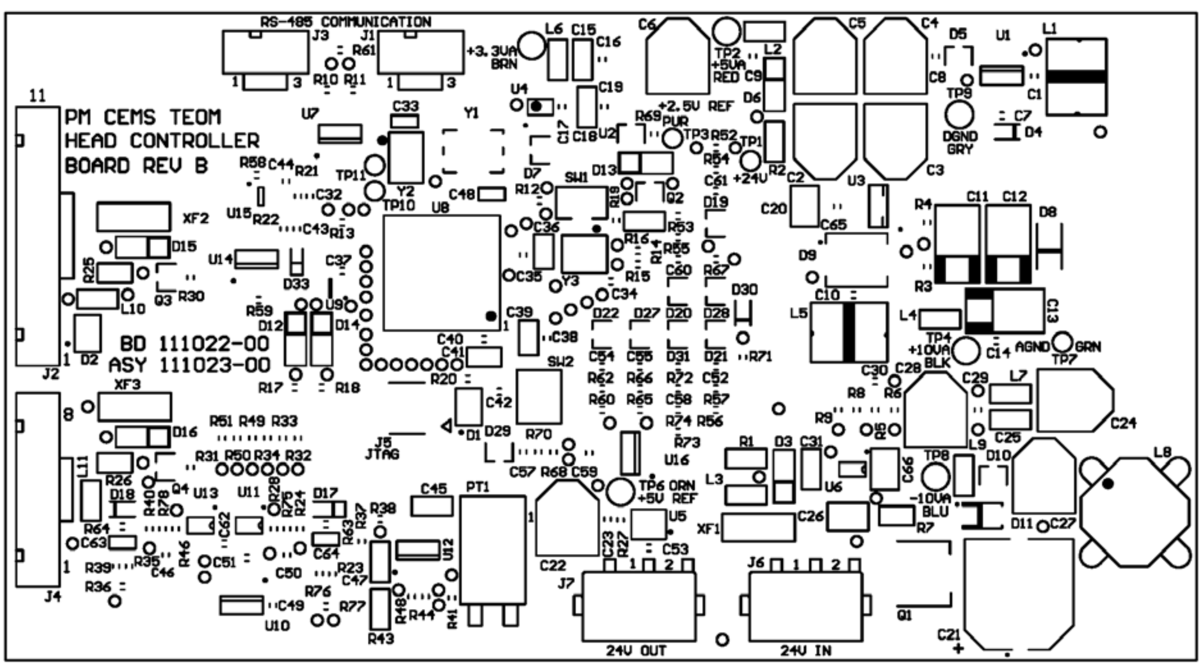

Figure 6–4. Board-Level Connection Diagram – TEOM Head Controller

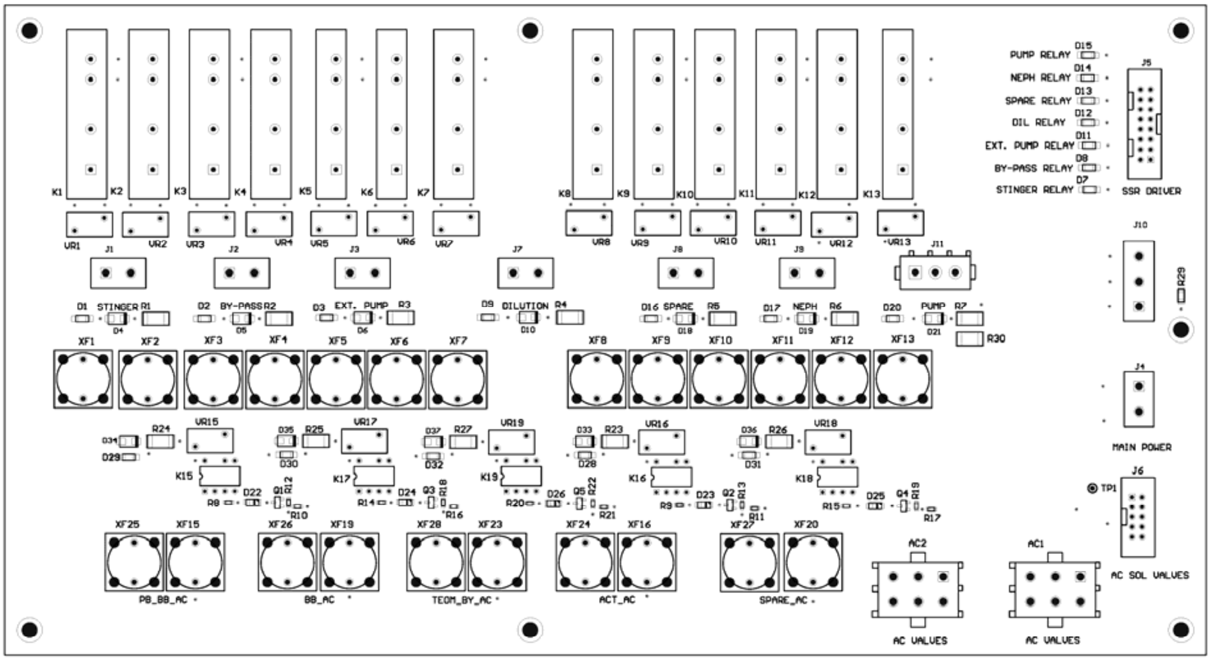

Figure 6–5. Board-Level Connection Diagram – SSR Driver

Table 6–17. MIB Status LEDs

Designator	Color	Desciption
D11	Green	Processor Status (1Y)
D12	Green	Processor Status (2Y)
D38	Green	+24V Power In

Table 6–18. MIB Test Points

Designator	Color	Desciption
TP1	Black	A Gnd
TP2	Black	A Gnd
TP3	Black	D Gnd
TP4	Orange	D Gnd
TP5	Orange	+5V D
TP6	Orange	+5V A
TP7	Orange	+3.3V A

Designator	Color	Desciption
TP8	Red	+3.3V D
TP9	Red	+15V A
TP10	Red	-15V A
TP11	Red	+5V Serv

Table 6–19. SSR Driver Board Status LEDs

Designator	Color	Desciption
D1	Red	Stinger Relay Fuse
D2	Red	Bypass Relay Fuse
D3	Red	Ext Pump Relay Fuse
D7	Red	Singer Relay +
D8	Red	Bypass Relay -
D9	Red	Iso 108V Fuse
D11	Red	Ext Pump Relay +
D12	Red	Dilution Relay +
D13	Red	Spare +
D14	Red	Neph +
D15	Red	Pump Relay +
D16	Red	Spare Fuse
D17	Red	Neph Fuse
D20	Red	Pump Relay Fuse
D22	Green	PI BB Solenoid Control
D23	Green	Actuator Solenoid Control
D24	Green	BB Solenoid Control
D25	Green	Spare Solenoid Control
D26	Green	TEOM Bypass Control
D28	Red	Actuator Fuse
D29	Red	PI BB Fuse
D30	Red	BB Fuse
D31	Red	Spare Solenoid Fuse
D32	Red	TEOM Bypass Fuse

Table 6–20. SSR Board Fuses

Designator	Value	Desciption
XF1	4A 250V	Stinger Relay AC1
XF2	4A 250V	Stinger Relay AC2
XF3	4A 250V	Bypass Relay AC1
XF4	4A 250V	Bypass Relay AC2
XF5	4A 250V	Ext Pump Relay AC1
XF6	4A 250V	Ext Pump Relay AC2
XF7	4A 250V	ISO 208V Line
XF8	4A 250V	ISO 208V Return
XF9	4A 250V	Spare AC1
XF10	4A 250V	Spare AC2
XF11	4A 250V	Neph AC1
XF12	4A 250V	Neph AC2
XF13	4A 250V	ISO 120V Line
XF`4	4A 250V	ISO 120V Return
XF15	0.250A 250V	PI BB AC1
XF16	0.250A 250V	Actuator AC1
XF19	0.250A 250V	BB AC1
XF20	0.250A 250V	Spare AC1
XF23	0.250A 250V	TEOM Bypass AC1
XF24	0.250A 250V	Actuator AC2
XF25	0.250A 250V	PI BB AC2
XF26	0.250A 250V	BB AC2
XF27	0.250A 250V	Spare AC2
XF28	0.250A 250V	TEOM Bypass AC2

Table 6–21. Probe Temp Controller Board Status LEDs

Designator	Color	Desciption
D8	Green	Processor Status (1Y)
D9	Green	Processor Status (2Y)
D16	Green	+24V Power In

Table 6–22. Probe Temp Controller Board Fuses

Designator	Value	Desciption
F1	1.00 Amp 125V	+24V Power In

Table 6–23. Probe Temp Controller Board Test Points

Designator	Color	Desciption
TP1	Red	+5V
TP2	Brown	+3.3V
TP3	Green	D Gnd
TP4	White	A Gnd
TP5	Black	+15V
TP6	Yellow	+2.5V Ref
TP7	Blue	-15V

Table 6–24. TEOM Head Controller Board Status LEDs

Designator	Color	Desciption
D3	Green	+24V Power In
D6	Green	+24V for 5V PS
D12	Green	Detects Transducer EPROM
D13	Red	Fault
D14	Green	Detects Transducer K0 (In Range)

Table 6–25. TEOM Head Controller Board Fuses

Designator	Value	Desciption
F1	5A 250V	Power In
F2	3.15A 250V	Case Heater
F3	3.15A 250V	Air Tube Heater

Table 6–26. TEOM Head Controller Board Test Points

Designator	Color	Desciption
TP2	Red	+5V
TP3	Purple	+2.5V Ref

Designator	Color	Desciption
TP4	Black	+10V
TP5	Brown	+3.3V
TP6	Orange	+5v Ref
TP7	Green	A Gnd
TP8	Blue	-10V
TP9	Grey	D Gnd

Service Locations

For additional assistance, service is available from exclusive distributors worldwide. Contact one of the phone numbers below for product support and technical information or visit us on the web at www.thermo.com/aqi.

1-866-282-0430 Toll Free

1-508-520-0430 International

Chapter 7
Servicing

This chapter explains how to replace the Model 3880*i* subassemblies. It assumes that a subassembly has been identified as defective and needs to be replaced (or is an "expendable" item not covered under warranty). Expendable items are indicated by an asterisk (*) in the "Model 3880i Replacement Parts" table.

For fault location information refer to the "Preventive Maintenance" chapter and the "Troubleshooting" chapter in this manual.

The service mode, described in the "Operation" chapter, includes parameters and functions that are useful when making adjustments or diagnosing problems.

For additional service assistance, see "Service Locations" at the end of this chapter.

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

CAUTION Carefully observe the instructions in each procedure. ▲

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 (Figure 7–1). 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. ▲

DO NOT point the photomultiplier tube at a light source. This can permanently damage the tube.

Handle all printed circuit boards by the edges.

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. ▲

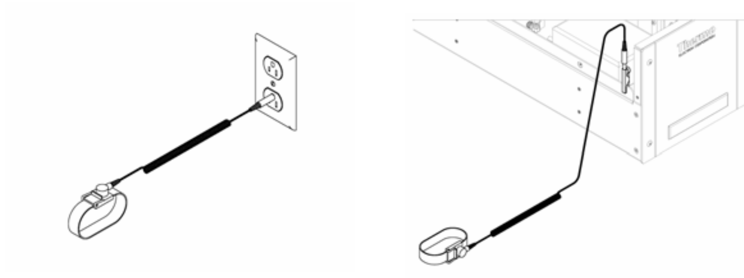

Figure 7–1. Properly Grounded Antistatic Wrist Strap

Firmware Updates

The firmware can be updated by the user in the field via the serial port or over the Ethernet. This includes both the main processor firmware and the firmware in all low-level processors. Refer to the *iPort* manual for the firmware update procedure.

Replacement Parts List

Table 7–1 lists the replacement parts for the Model 3880*i* major subassemblies. Refer to Figure 7-x to identify the component location.

Table 7–1. Model 3880*i* Replacement Parts

Part Number	Description
100480-00	Front Panel Pushbutton Board
110570-00	Processor (Arcturus) Board
109141-00	Motherboard Assembly
100539-00	Digital Output Board
102340-00	Front Panel Connector Board
102496-00	Front Panel Display
102014-00	I/O Expansion Board
112156-00	Measurement Interface Board Assembly
114031-00	Step Down Transformer Assembly
114879-00	Pump, External
59-007837	Pump Rebuild Kit (Bypass)
113278-00	Pump Cord
101688-00	Ambient Temperature Connector with Thermistor
100907-00	Fan, 24VDC
8630	Filter Guard Assembly (w/foam)*
113547-00	Sample Check Valve Assembly

Part Number	Description
101681-00	Power Supply Assembly, 24VDC, Controller
101055-00	AC Receptacle Assembly
110143-00	Fuse, 250V, 3AG, Slow Blow .250A (SSR)
103674-00	Fuse, 250V, GLS tube, Time Delay 4Amp (SSR)
114271-00	Fuse, 250V, 5x20mm, 10A, Slow Blow*
56-011830	Dilution Control Assembly (MFC)
116950-00	Mass Flow Controller, Dilution (MFC Only)
112057-00	Mass Flow Assembly 0–5 LPM
115830-00	Mass Flow Controller, 0–5 LPM (MFC Only)
113109-00	Mass Flow Controller Assembly, Bypass/Return
115831-00	Mass Flow Controller, Bypass/Return (MFC Only)
115286-00	Mems Sensor Assembly
112304-00	Regulator Assembly, CDA
112241-00	Pressure Board Assembly
109992-00	SSR Board Assembly
111418-00	AC Distribution Board Assembly
102564-00	146*i* Connection Board Assembly
107339-00	Pressure Regulator, 0–45 psi, w/Gauge
54-011760	Nephelometer Assembly
55-011695	Heated Bench Assembly
56-011870	Valve Manifold Assembly
32-011859	Valve, 3 Way, 220VAC
112150-00	Thermocouple Board Assembly
55-012003	Actuator Assembly
10-011864	Power Supply, 24VDC, Monitor
56-011955	Sample Control Valve Assembly
120178-00	Mass Transducer Assembly
55-012004	Accumulator Assembly
56-012015	TEOM Bypass Air Tube Assembly
55-012044	Dilution Assembly (Mantle)
37-012045	Nozzle, Standard Wet
114175-00	Stack Temperature Thermocouple (5-feet Mantle) Kit
36-011936	Shroud, Dump Tube
56-011916-0060	Dilution Supply Assembly (5-feet Mantle)

Part Number	Description
56-011915-0060	Sample Tube Assembly (5-feet Mantle)
114173-00	Dilution Temperature Thermocouple (5-feet Mantle) Kit
59-012050	Leak Check Kit
115312-00	Coalescing 3 CFM SS Filter Assembly
115320-00	Controller Filter Assembly, Inline
59-012061	Consumable Kit PM CEMS
57-009727-0020	Box of 20 TEOM Filters (PDM 3600)
55-009885	Filter Tool (PDM 3600)
22-003078	Lubricant, Silver Goop
24-012020	Silicone Edge Trim Gasket
111023-00	TEOM Head Controller PCB
30-011552	Valve Assembly 24VDC
104141-00	4-inch Flange Gasket
14-011907-0100	Dilution Thermocouple 5ft mantle 1/16, 3-inch Inconel (TC Only)
14-011908-0100	Stack Thermocouple 5ft mantle 1/8, 12-inch Inconel (TC Only
56-011775	TEOM Mounting Assembly
56-011940	Power/Thermocouple Assembly
56-011956	Rear Panel Assembly
55-012013	Jumbo HEPA Filter Assembly
55-012005	Medium In-Line Filter Assembly-Probe Monitor

*Expendable item, not covered by warranty

Cable List

Table 7–2 describes the Model 3880*i* cables. See the "Troubleshooting" chapter for associated connection diagrams and board connector pin descriptions.

Table 7–2. Model 3880*i* Cables

103284-00	Mass Flow Controller Cable Assembly, Controller (Parker only)
112240-00	Check Flow Sensor Cable Assembly, Controller
111513-01	Dil-C to Gas C Cable Assembly, Controller
112143-00	RS485 / Heaters Cable Assembly, Controller
112146-00	Valves/Power Cable Assembly, Controller
113104-00	Pump Conn. Cable Assembly, Controller
101267-00	Fan Power Cable Assembly, Controller
106027-00	Pressure Transducer to MIB Cable Assembly, Controller
111506-00	MIB to SSR Board Cable Assembly, Controller, Controller
111507-00	MIB to SSR Ribbon Cable Assembly, Controller
111505-00	Power Distribution to SSR Board Cable Assembly, Controller
113826-00	Transformer LG to SSR Conn. Cable Assembly, Controller
111502-00	TEOM Internal Cable Assembly, Monitor
111515-00	TEOM/Nephelometer Internal Cable Assembly, Monitor
111684-00	Transducer Interface Cable Assembly, Monitor
112251-00	RS485/Heaters Cable Assembly, Monitor
115855-00	Mass Flow Controller Cable Assembly (Alicat only)
112145-00	Valves/Power Cable Assembly, Monitor
112253-00	Thermocouple Board, Nephelometer/TEOM Cable Assembly, Monitor
112252-00	24V TC Board Cable Assembly, Monitor

External Device Connection Components

Table 7–3 lists the standard and optional cables and components used for connecting external devices such as PCs and dataloggers to an *i*Series instrument.

Table 7–3. External Device Connection Components

Part Number	Description
102562-00	Terminal Block and Cable Kit (DB25) (optional)
102556-00	Terminal Block and Cable Kit (DB37) (optional)
102645-00	Cable, DB37M to Open End Cable, Six Feet (optional)
102646-00	Cable, DB37F to Open End, Six Feet (optional)
102659-00	Cable, DB25M to Open End, Six Feet (optional)
6279	Cable, RS-232, Six Feet (optional)
102888-00	Terminal Board PCB Assembly, DB37F (standard)
102891-00	Terminal Board PCB Assembly, DB37M (standard)
103084-00	Terminal Board PCB Assembly, DB25M (included with optional I/O Expansion Board)

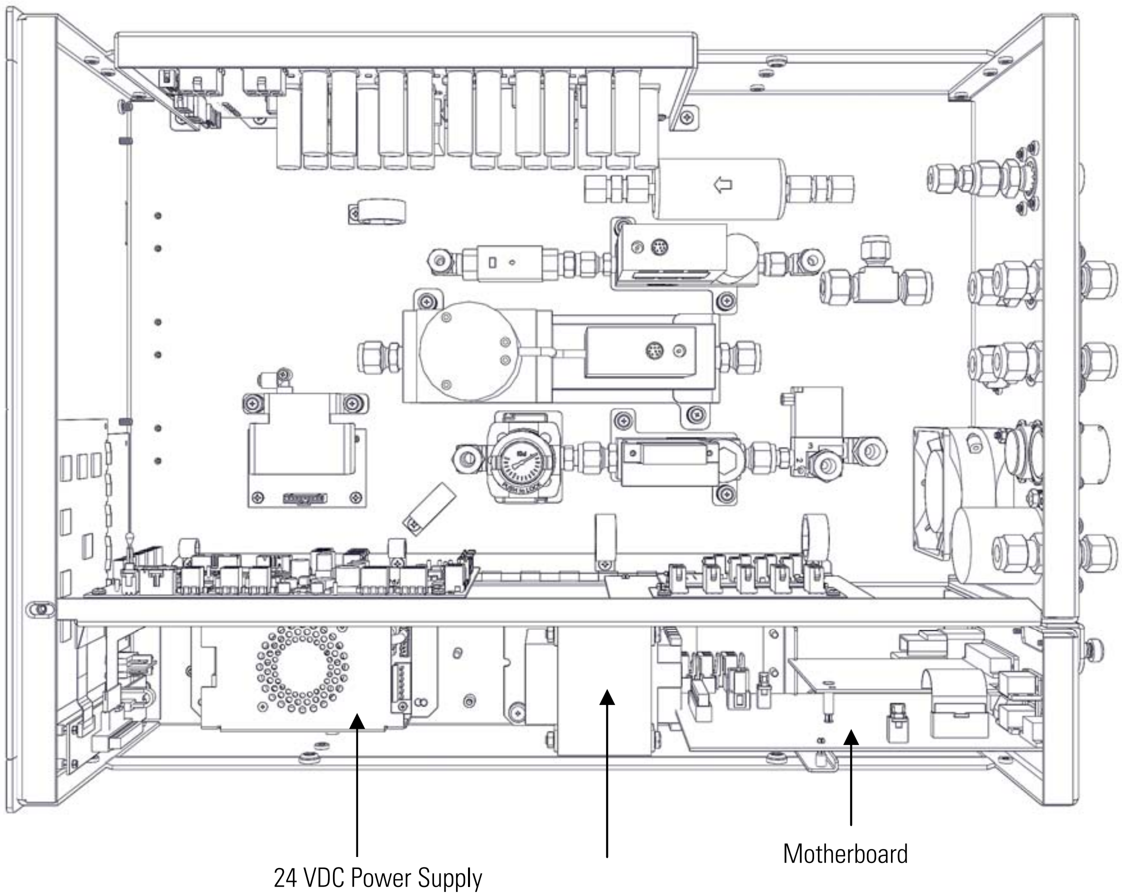

Figure 7–2. Probe Controller Component Layout Top View

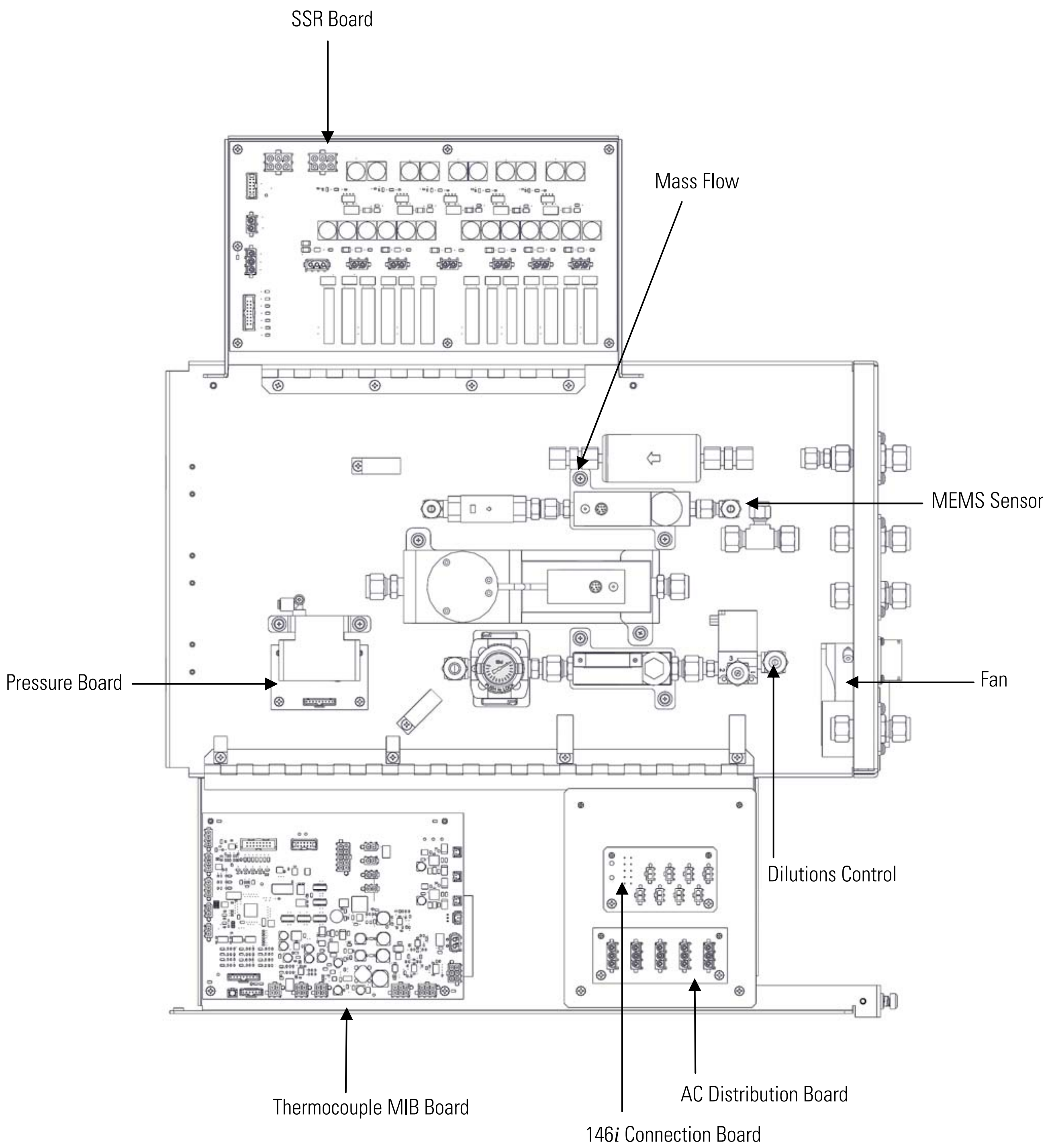

Figure 7–3. Probe Controller Component Layout Panel Down

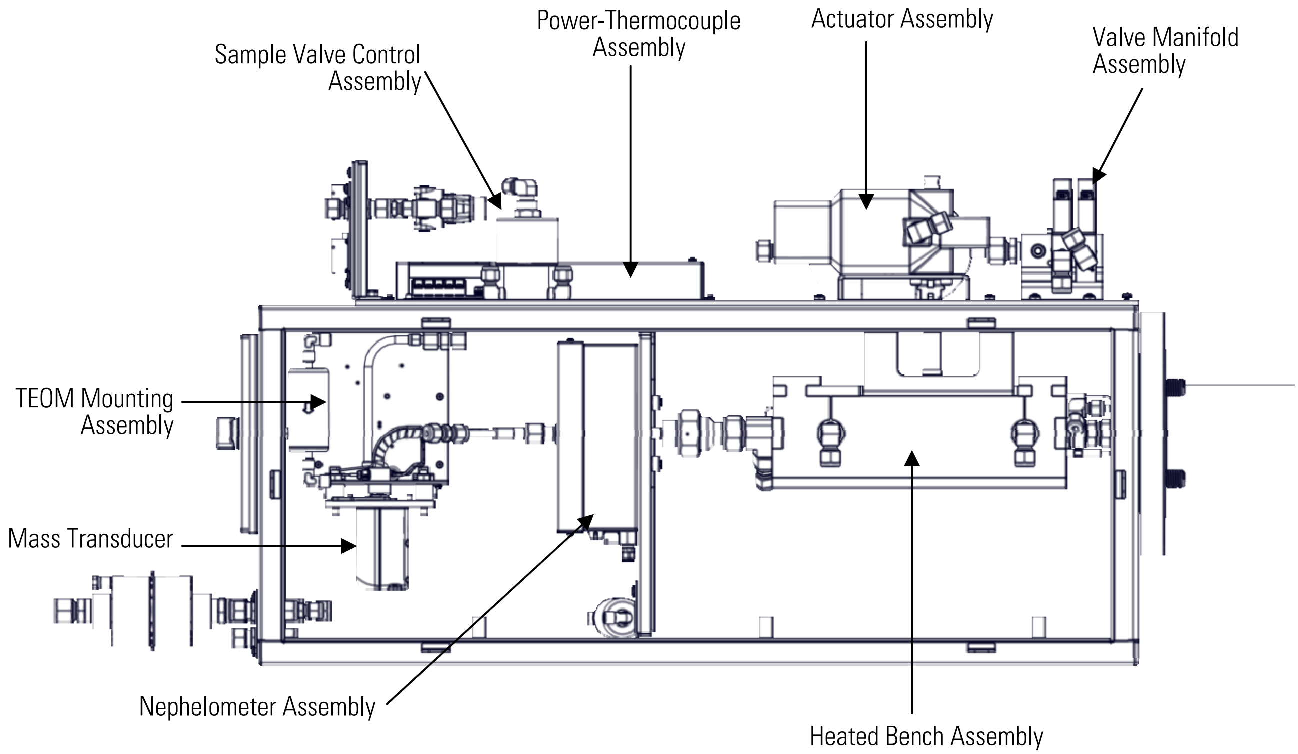

Figure 7–4. Probe Monitor Component Layout

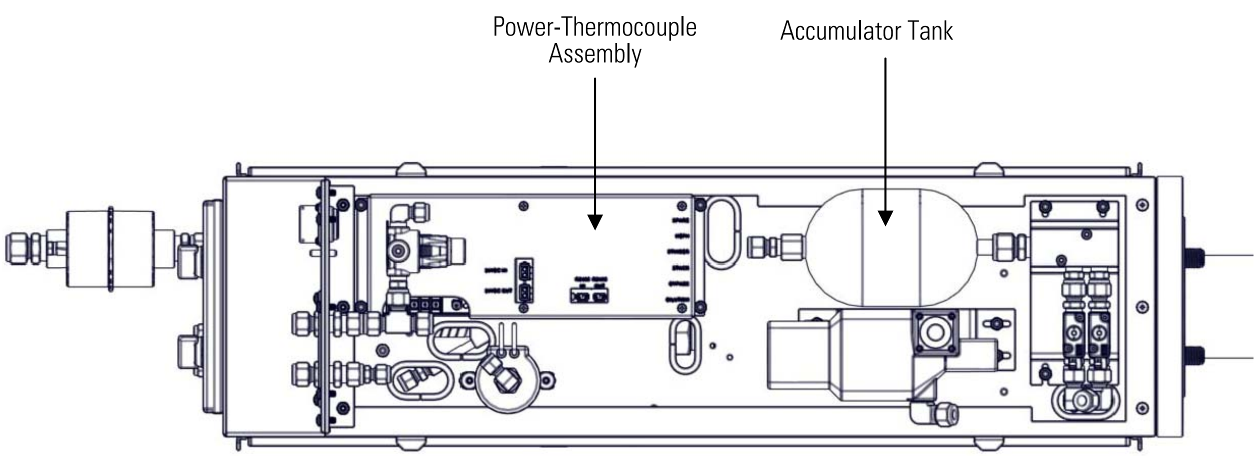

Figure 7–5. Probe Monitor Top View

Removing the Measurement Case Assembly and Lowering the Partition Panel

The measurement case assembly can be removed and the partition panel can be lowered to improve access to connectors and components. Refer to the following steps when a procedure requires lowering the partition panel (Figure 7–6).

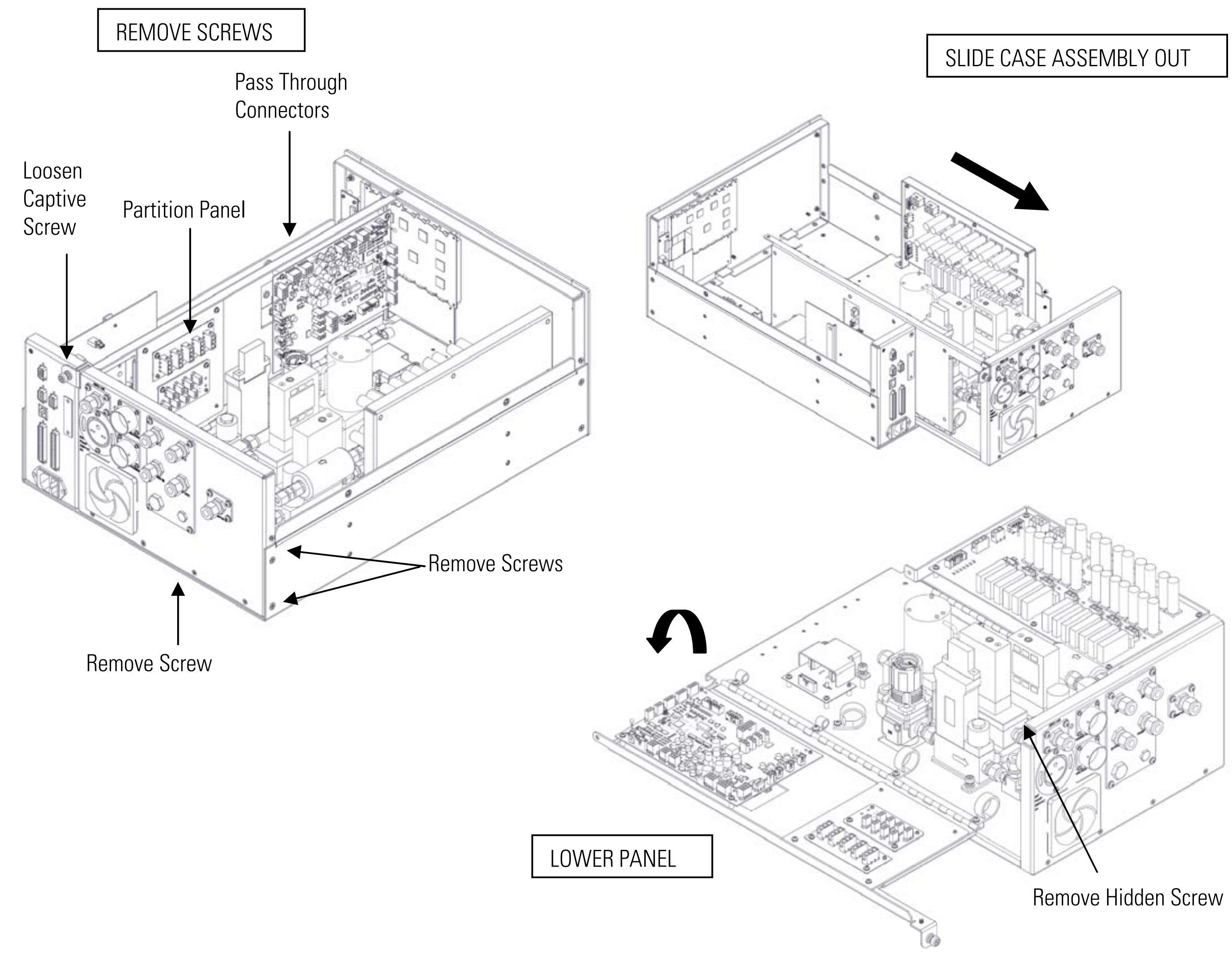

Figure 7–6. Removing the Measurement Case Assembly and Lowering the Partition Panel

Equipment Required:

Phillips screwdriver

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 (Figure 7–1). 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. ▲

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

2. If the instrument is mounted in a rack, remove it from the rack.

3. Remove the cover.

4. Disconnect the plumbing connections at the rear of the measurement case assembly.

5. Disconnect the connectors that pass through the center of the partition panel.

6. Remove two screws from the left side rear of the case (viewed from the front).

7. Remove one screw from the bottom rear of the case.

8. Remove one screw from the top front of the partition panel.

9. While holding the case securely, loosen the captive screw at the rear of the measurement case assembly, and pull the measurement case assembly from the rear of the case.

10. Remove the screw at the top rear of the partition panel that secures the top of the panel to the measurement case assembly, and lower the panel, being careful not to put excessive tension on the cables.

11. Replace the measurement case assembly by following the previous steps in reverse.

Accessing the Service Mode

If the Service menu is not displayed on the Main Menu, use the following procedure to display it.

1. From the Main Menu, choose Instrument Controls > **Service Mode**.

   The Service Mode screen appears.

2. Press ↵ to toggle the Service Mode to ON.

3. Press ◼ > ◼ to return to the Main Menu.

4. Return to the procedure.

Fuse Replacement

Use the following procedure to replace the fuse.

Equipment Required:

Replacement fuses – refer to the "Model 3880i Replacement Parts" on page 7-4.

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

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

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

4. Insert fuse drawer and re-connect power cord.

External Pump Replacement

Use the following procedure to replace the pump.

1. Remove power from the pump and remove the input and output lines.

2. Install a new pump by following the previous steps in reverse.

Fan Replacement

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

Equipment Required:

Fan

Phillips screwdriver

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 (Figure 7–1). 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. ▲

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

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

3. Pull the connectors off the fan.

4. Remove the four fan mounting screws and remove the fan.

5. Install a new fan following the previous steps in reverse.

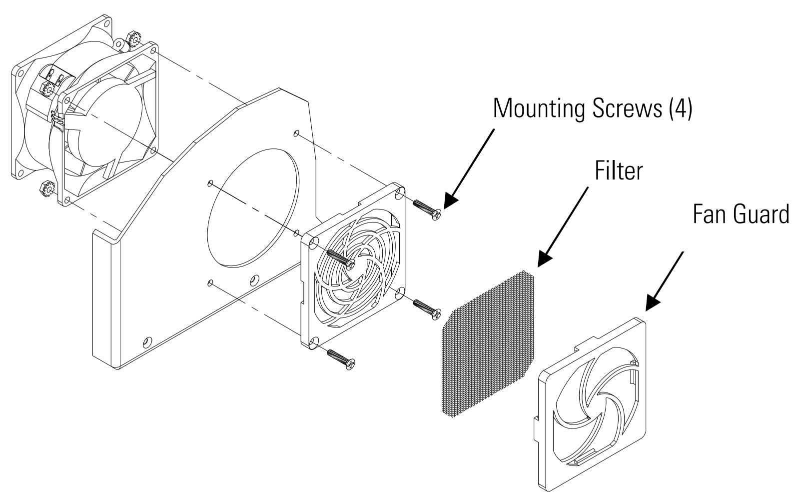

Figure 7–7. Replacing the Fan

Mass Flow (Sample) Assembly Replacement

Use the following procedure to replace the 0-5 LPM mass flow (sample) assembly (Figure 7–3). Refer to Figure 7–31 for plumbing connections and Figure 7–34 for electrical connections.

Equipment Required:

Mass flow assembly, 0-5 lpm

Wrench, 9/16-inch

Phillips screwdriver, #1 and #2

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

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

2. Remove the plumbing from the inlet and outlet of the assembly.

3. Disconnect the mass flow controller power cable.

4. Loosen the two captive screws on the assembly mounting plate and remove the assembly.

5. Install the new mass flow assembly by following the above directions in reverse.

6. After installation of replacement assembly, calibrate the instrument. Refer to "Sample MF" on page 4-3.

Bypass/Return Mass Flow Assembly Replacement

Use the following procedure to replace the bypass/mass flow controller assembly (Figure 7–3). Refer to Figure 7–31 for plumbing connections and Figure 7–34 for electrical connections.

Equipment Required:

Bypass/return mass flow assembly

Wrench, 11/16-inch

Phillips screwdriver, #1 and #2

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

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

2. Remove the plumbing from the inlet and outlet of the assembly.

3. Disconnect the mass flow controller power cable.

4. Loosen the two captive screws on the assembly mounting plate and remove the assembly.

5. Install the new mass flow assembly by following the above directions in reverse.

6. After installation of replacement assembly, calibrate the instrument. Refer to "Bypass MFC" on page 4-5.

Dilution Control Assembly Replacement

Use the following procedure to replace the bypass/mass flow controller assembly (Figure 7–3). Refer to Figure 7–31 for plumbing connections and Figure 7–34 for electrical connections.

Equipment Required:

Dilution control assembly

Wrench, 11/16-inch

Phillips screwdriver, #1 and #2

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

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

2. Remove the plumbing from the inlet and outlet of the assembly.

3. Disconnect the mass flow controller power cable.

4. Loosen the two captive screws on the assembly mounting plate and remove the assembly.

5. Install the new mass flow assembly by following the above directions in reverse.

6. After installation of replacement assembly, calibrate the instrument. Refer to "Dilution MFC" on page 4-4.

Pressure Board Replacement

Use the following procedure to replace the pressure board assembly (Figure 7–3). Refer to Figure 7–31 and Figure 7–32 for plumbing connections and Figure 7–33 for electrical connections.

Equipment Required:

Pressure board assembly

Phillips screwdriver, #2

Nut driver, 1/4-inch

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

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

2. Loosen the two captive screws on the pressure board protective cover and remove it.

3. Remove the cable from the board.

4. Follow the pressure sensor lines to their respective 1/8-inch union elbow fittings and remove the lines on the opposite side of the union. Ensure to label lines removed for proper installation of replacement assembly.

5. Remove the nuts from the five 1/8-inch union elbows and lift the unions off the threaded studs.

6. Remove the two screws on the pressure board.

7. Pop off the board from the two mounting studs and remove the assembly.

8. To install the new pressure board, follow previous steps in reverse.

9. After installation of replacement assembly, calibrate the instrument. Refer to "Pressure Sensors" on page 4-1.

Mems Sensor Replacement

Use the following procedure to replace the mems sensor assembly (Figure 7–3). Refer to Figure 7–31 for plumbing connections and Figure 7–34 for electrical connections.

Equipment Required:

Mems sensor assembly

2 wrentches

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

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

2. Remove the outlet line from the sensor.

3. Remove the assembly from the bulkhead fitting, using 2 wrenches.

4. Remove the cable from the sensor and remove sensor assembly.

5. To install the new mems sensor assembly, follow previous steps in reverse.

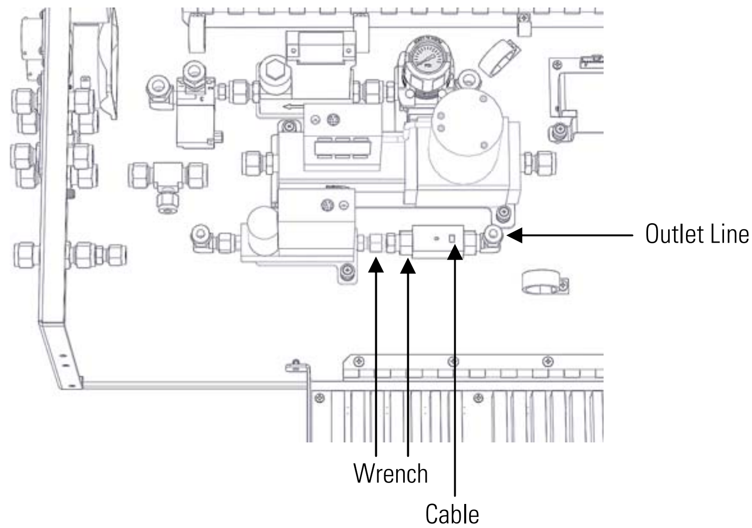

Figure 7–8. Mems Sensor Replacement

SSR Board Replacement

Use the following procedure to replace the SSR board (Figure 7–3). Refer to Figure 7–33 for electrical connections.

Equipment Required:

SSR board

Phillips screwdriver

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

1. Refer to "Removing the Measurement Case Assembly and Lowering the Partition Panel" in this chapter to lower the partition panel, then proceed to the next step.

2. Unplug all connectors. Note the locations of the connectors to facilitate reconnection.

3. Unscrew the seven screws that secure the SSR board to the side panel. Remove the SSR board.

4. To install the SSR board, follow previous steps in reverse.

5. Re-install the measurement case assembly. Refer to "Removing the Measurement Case Assembly and Lowering the Partition Panel" in this chapter.

DC Power Supply Replacement

Use the following procedure to replace the DC power supply (Figure 7–9).

Equipment Required:

DC power supply

Phillips screwdriver

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

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

2. Disconnect all the power supply electrical connections. Note connector locations to facilitate re-connection.

3. Loosen the captive screw securing the power supply to the chassis plate and lift out the power supply.

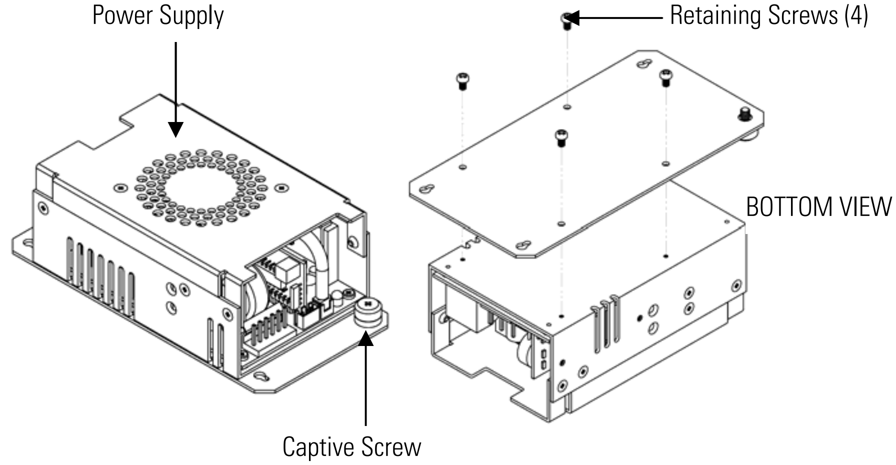

Figure 7–9. Replacing the DC Power Supply

4. Turn the power supply upside down and remove the four retaining screws securing the power supply to the power supply plate and remove the power supply.

5. To install the DC power supply, follow the previous steps in reverse.

Analog Output Testing

The analog outputs should be tested if the concentration value on the front panel display disagrees with the analog outputs. To check the analog outputs, connect a meter to an analog output channel (voltage or current) and compare the meter reading with the output value set on the Test Analog Outputs screen.

Equipment Required:

Multimeter

Use the following procedure to test the analog outputs.

1. Connect a meter to the channel to be tested. Figure 7–10 shows the analog output pins and Table 7–4 identifies the associated channels.

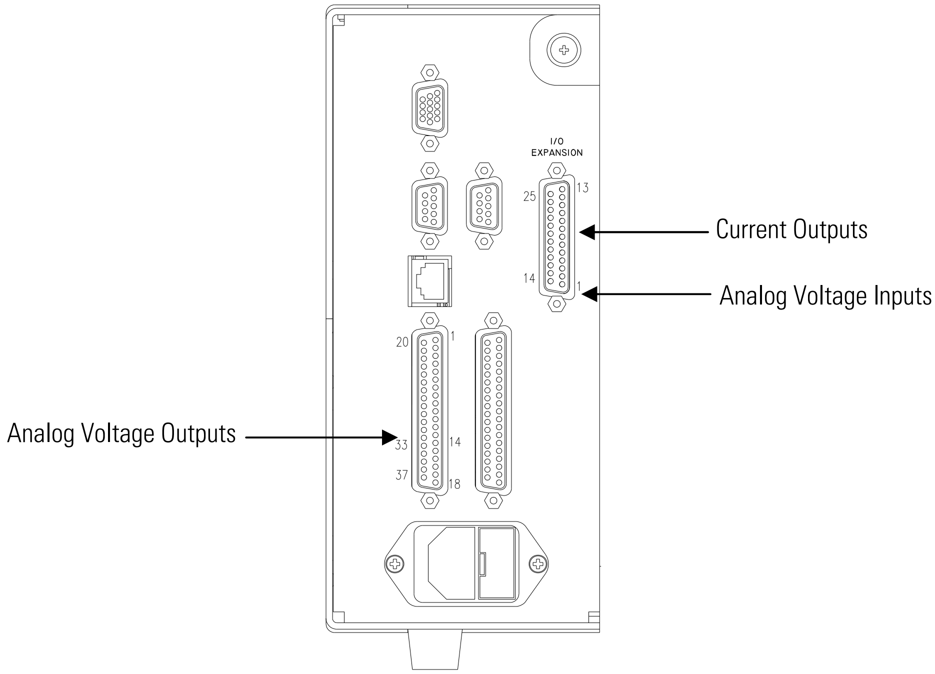

Figure 7–10. Rear Panel Analog Input and Output Pins

2. From the Main Menu, choose Diagnostics > **Test Analog Outputs**.

   The Test Analog Outputs screen appears.

3. Press ⬇ to scroll to the desired channel corresponding to the rear panel terminal pins where the meter is connected, and press ↵.

   The Set Analog Outputs screen appears.

4. Press ⬇ to set the output to zero.

   The Output Set To line displays Zero.

5. Check that the meter is displaying the zero value. If the meter reading differs by more than one percent of the full-scale output, the analog outputs should be adjusted. Refer to the "Analog Output Calibration" procedure that follows.

6. Press ⬆ to set the output to full-scale.

   The Output Set To line displays Full-Scale.

7. Check that the meter is displaying a full-scale value. If the meter reading differs by more than one percent of the full-scale output, the analog outputs should be adjusted. Refer to the "Analog Output Calibration" procedure that follows.

8. Press ↵ to reset the analog outputs to normal.

Table 7–4. Analog Output Channels and Rear Panel Pin Connections

Voltage Channel	Pin	Current Channel	Pin
1	14	1	15
2	33	2	17
3	15	3	19
4	34	4	21
5	17	5	23
6	36	6	25
Ground	16, 18, 19, 35, 37	Current Output Return	13, 16, 18, 20, 22, 24

Analog Output Calibration

Use the following procedure to calibrate the analog outputs if a meter reading in the "Analog Output Testing" procedure differed by more than one percent or after replacing the optional I/O expansion board.

Equipment Required:

Multimeter

1. Connect a meter to the channel to be adjusted and set to voltage or current as appropriate. Figure 7–10 shows the analog output pins and Table 7–4 identifies the associated channels.

2. From the Main Menu, choose Service > **Analog Out Cal**.

   The Analog Output Cal screen appears.

Note If Service Mode is not displayed, refer to "Accessing the Service Mode" on page 7-14 , then return to the beginning of this step. ▲

3. At the Analog Output Cal menu, press ↓ to scroll to the desired voltage channel or current channel corresponding to the rear panel terminal pin where the meter is connected, then press ↵.

4. With the cursor at Calibrate Zero, press ↵.

   The Analog Output Cal line displays Zero.

Note When calibrating the analog output, always calibrate zero first and then calibrate full-scale. ▲

5. Use ↑ ↓ until the meter reads the value shown in the Set Output To line (0.0 V, or 0.0 or 4.0 mA), then press ↵ to save the value.

6. Press ■ to return to the previous screen.

7. Press ↓ ↵ to select Calibrate Full-Scale.

8. Use ↑ ↓ until the meter reads the value shown in the Set Output To line, then press ↵ to save the value.

Analog Input Calibration

Use the following procedures to calibrate the analog inputs after replacing the optional I/O expansion board. These procedures include selecting analog input channels, calibrating them to zero volts, and then calibrating them to full-scale using a known voltage source.

Calibrating the Input Channels to Zero Volts

Use the following procedure to calibrate the input channels to zero volts.

1. From the Main Menu, choose Service > **Analog Input Cal**.

   The Analog Input Cal screen appears.

Note If Service Mode is not displayed, refer to "Accessing the Service Mode" on page 7-14, then return to the beginning of this step. ▲

2. At the Analog Input Cal screen, press ↓ to scroll to a channel, and press ↵.

3. With the cursor at Calibrate Zero, press ↵.

   The screen displays the input voltage for the selected channel.

4. Make sure that nothing is connected to the channel input pins and press ↵ to calibrate the input voltage on the selected channel to zero volts.

   The screen displays 0.00 V as the voltage setting.

5. Press ■ > ■ to return to the Analog Input Cal screen and repeat Steps 2 through 4 to calibrate other input channels to zero as necessary.

6. Continue with the "Calibrating the Input Channels to Full-Scale" procedure that follows.

Calibrating the Input Channels to Full-Scale

Use the following procedure to calibrate the input channels to full-scale by applying a known voltage to the channels.

Equipment Required:

DC voltage source (greater than 0 volts and less than 10 volts)

1. Connect the known DC voltage source to the input channel (1-8) to be calibrated. Figure 7–10 shows the analog input pins and Table 7–5 identifies the associated channels.

2. From the Main Menu, choose Service > **Analog Input Cal**.

   The Analog Input Cal screen displays input channels 1-8.

3. At the Analog Input Cal screen, press ↓ to scroll to the channel selected in Step 1, and press ↵.

4. Press ↓ to scroll to Calibrate Full-scale, and press ↵.

   The screen displays the input voltage for the selected channel.

5. Use ← → and ↑ ↓ to enter the source voltage, and press ↵ to calibrate the input voltage for the selected channel connected to the source voltage.

6. Press ■ > ■ to return to the input channels display and repeat Steps 3-5 to calibrate other input channels to the source voltage as necessary.

Note If Service Mode is not displayed, refer to "Accessing the Service Mode" on page 7-14, then return to the beginning of this step. ▲

Table 7–5. Analog Input Channels and Rear Panel Pin Connections

Input Channel	Pin
1	1
2	2
3	3
4	5
5	6
6	7
7	9
8	10
Ground	4, 8, 11, 14

I/O Expansion Board Replacement

Use the following procedure to replace the I/O expansion board (Figure 7–11).

Note After replacing the I/O expansion board, calibrate the current outputs and the analog voltage inputs. See the "Analog Output Calibration" procedure and the "Analog Input Calibration" procedure in this chapter. ▲

Equipment Required:

I/O expansion board

Nut driver, 3/16-inch

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

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

2. Unplug the I/O expansion board cable from the EXPANSION BD connector on the motherboard.

3. Remove the two standoffs holding the I/O expansion board connector to the rear panel (Figure 7–12).

4. Pop the board off of the mounting studs and remove the board.

5. To install the I/O expansion board, follow the previous steps in reverse.

6. Calibrate the analog current outputs and analog voltage inputs as defined earlier in this chapter.

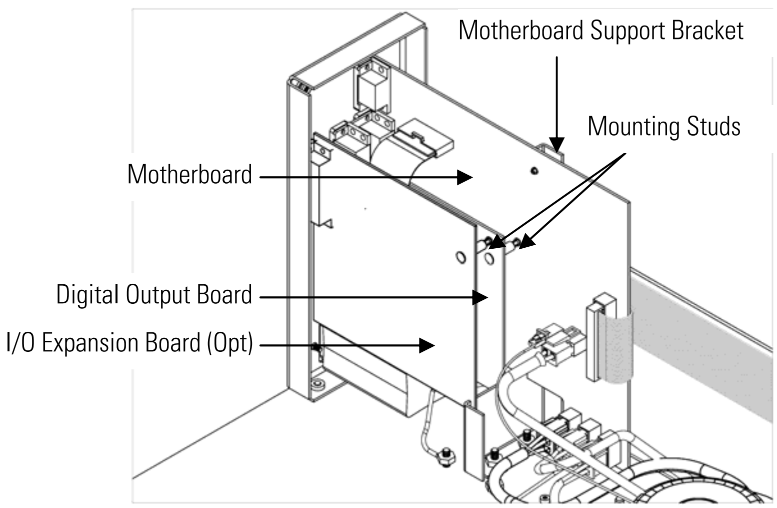

Figure 7–11. Replacing the I/O Expansion Board

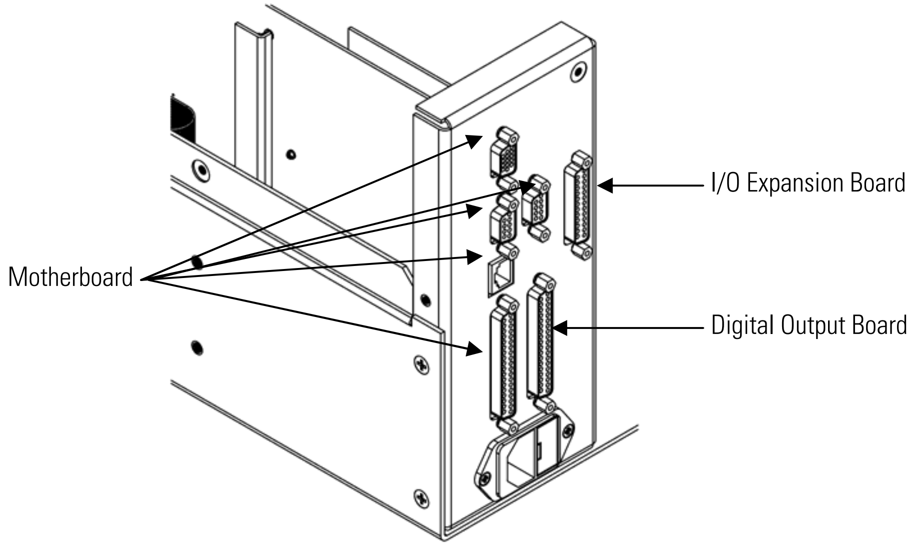

Figure 7–12. Rear Panel Board Connectors

Digital Output Board Replacement

Use the following procedure to replace the digital output board (Figure 7–11).

Equipment Required:

Digital output board

Nut driver, 3/16-inch

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

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

2. Remove the I/O expansion board (optional), if used. See the "I/O Expansion Board Replacement" procedure in this chapter.

3. Disconnect the digital output board ribbon cable from the motherboard.

4. Using the nut driver, remove the two standoffs securing the board to the rear panel (Figure 7–12).

5. Pop the digital output board off of the mounting studs and remove the board.

6. To install the digital output board, follow the previous steps in reverse.

Motherboard Replacement

Use the following procedure to replace the motherboard (Figure 7–11).

Equipment Required:

Motherboard

Phillips screwdriver

Nut driver, 3/16-inch

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

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

2. Remove the I/O expansion board (optional), if used. See the "I/O Expansion Board Replacement" procedure in this chapter.

3. Remove the digital output board. See the "Digital Output Board Replacement" procedure in this chapter.

4. Unplug all connectors from the motherboard. Note connector locations to facilitate re-connection.

5. Using the nut driver, remove the six standoffs securing the board to the rear panel (Figure 7–12).

6. Pop the motherboard off of the support bracket, and remove the motherboard.

7. To install the motherboard, follow the previous steps in reverse.

8. Calibrate the analog voltage outputs as defined earlier in this chapter (all ranges).

Measurement Interface Board Replacement

Use the following procedure to replace the measurement interface board (Figure 7–3). Refer to Figure 7–33 and Figure 7–34 for electrical connections.

Equipment Required:

Measurement interface board

Phillips screwdriver

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

1. Lower the partition panel, then proceed to the next step below. Refer to "Removing the Measurement Case Assembly and Lowering the Partition Panel" in this chapter.

2. Unplug all connectors from the measurement interface board. Note the locations of the connectors to facilitate re-connection.

3. Unscrew the two screws at the top of the measurement interface board. Pop the measurement interface board off from the two bottom mounting studs and remove the board.

4. To install the measurement interface board, follow the previous steps in reverse.

5. Re-install the measurement case assembly. Refer to "Removing the Measurement Case Assembly and Lowering the Partition Panel" in this chapter.

Front Panel Connector Board Replacement

Use the following procedure to replace the front panel connector board (Figure 7–13).

Equipment Required:

Front panel connector board

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

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

2. Remove the three ribbon cables and the two-wire connector from the front panel connector board.

3. Pop the board off of the two top mounting studs and remove the board by lifting it up and off the slotted bottom support.

4. Replace the front panel connector board by following the previous steps in reverse.

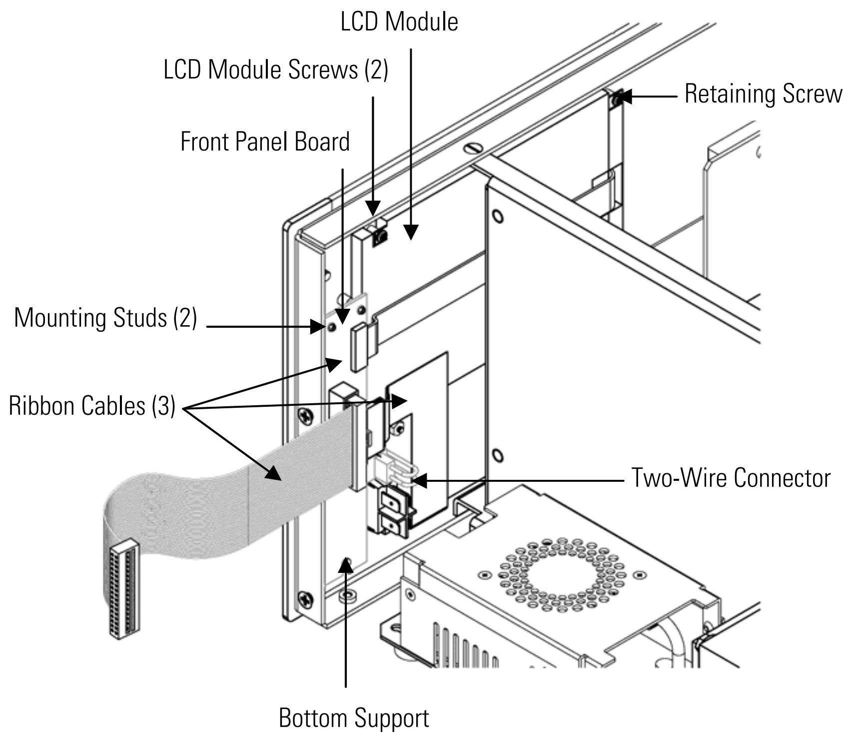

Figure 7–13. Replacing the Front Panel Board and the LCD Module

LCD Module Replacement

Use the following procedure to replace the LCD module (Figure 7–13).

Equipment Required:

LCD module

Phillips screwdriver

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 it off immediately using soap and water. ▲

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

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. ▲

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

2. Disconnect the ribbon cable and the two-wire connector from the front panel board.

3. Remove the four screws at the corners of the LCD module.

4. Slide the LCD module out towards the center of the instrument.

5. Replace the LCD module by following the previous steps in reverse.

Note The optimal contrast will change from one LCD screen to another. After replacing the LCD screen, the contrast may need to be reset. If the content on the screen is visible, select Instrument Controls > **Screen Contrast** and adjust the screen contrast. If the content on the screen is not visible, use the "set contrast 10" C-Link command to set screen contrast to mid range, then optimize the contrast. See the "C-Link Protocol Commands" appendix for more information on this command. ▲

Nephelometer Assembly Replacement

Use the following procedure to replace the nephelometer assembly (Figure 7–14).

Equipment Required:

Nephelometer Assembly

Wrench, 11/16-inch

Phillips screwdriver, #2

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

1. At the probe controller, turn the instrument OFF and unplug the power cord.

2. Remove the side doors of the probe monitor to access internal components.

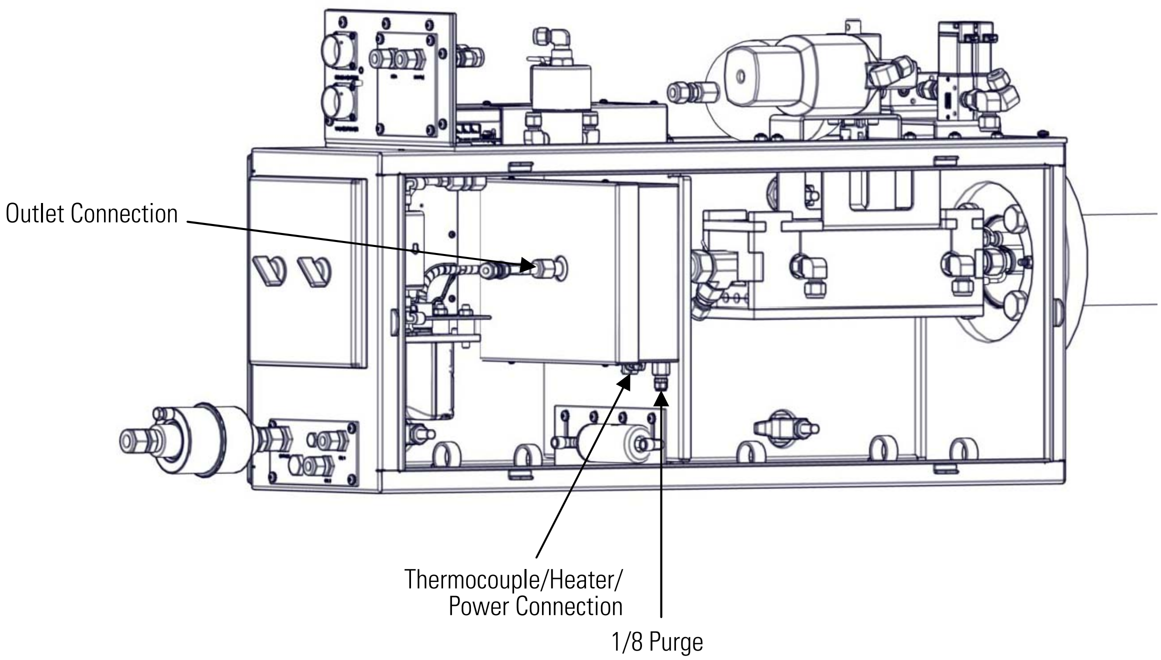

Figure 7–14. Replacing the Nephelometer Assembly

3. Loosen the inlet and outlet connections.

4. Unplug the 1/8-inch purge line.

5. Disconnect the thermocouple, heater and power connections (Figure 7–15).

6. Loosen the four captive screws on the nephelometer mounting plate and remove the nephelometer.

7. Loosen nephelometer inlet and outlet fitting.

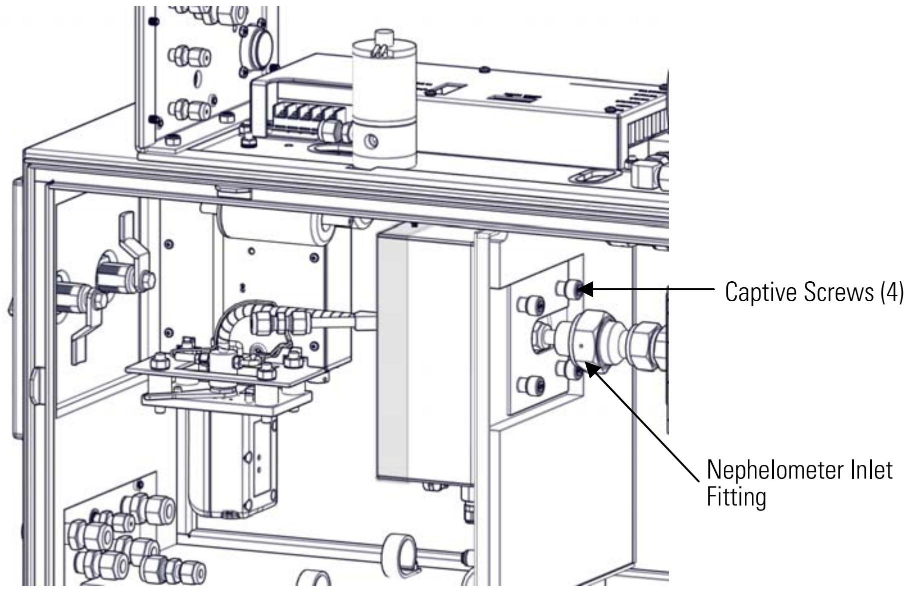

Figure 7–15. Nephelometer Connections

8. Install the new nephelometer by following the previous steps in reverse.

Heated Bench Replacement

Use the following procedure to replace the heated bench assembly (Figure 7–16).

Equipment Required:

Heated bench assembly

Wrench, 1-inch, 1 1/2-inch, and 11/16-inch

Phillips screwdriver, #2

Nut driver, 3/8-inch

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

1. At the probe controller, turn the instrument OFF and unplug the power cord.

2. Remove the top cover of the probe monitor to access internal components.

CAUTION When removing the top cover, remove the three screws at the front of the cover before loosening or removing screws at the bulkhead. ▲

3. Remove the side doors of the probe monitor to access internal components.

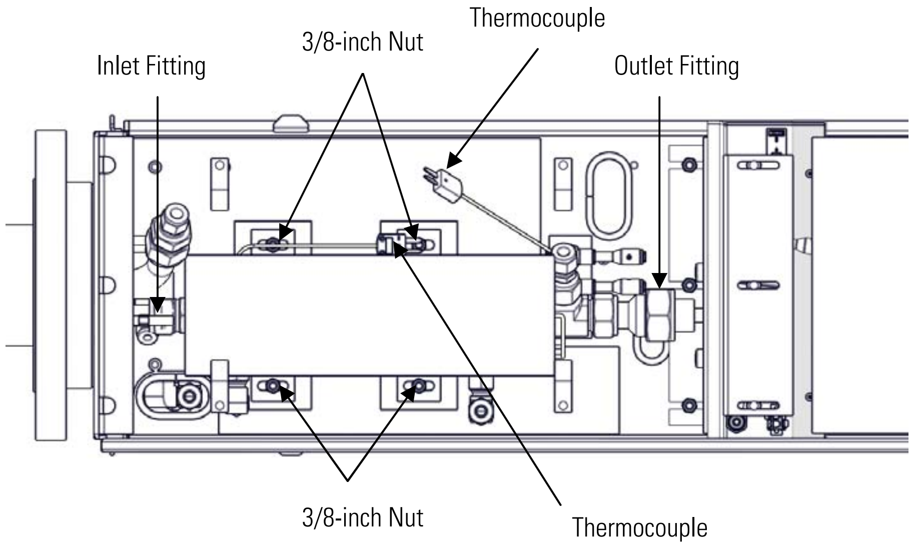

Figure 7–16. Heated Bench Upside-Down View

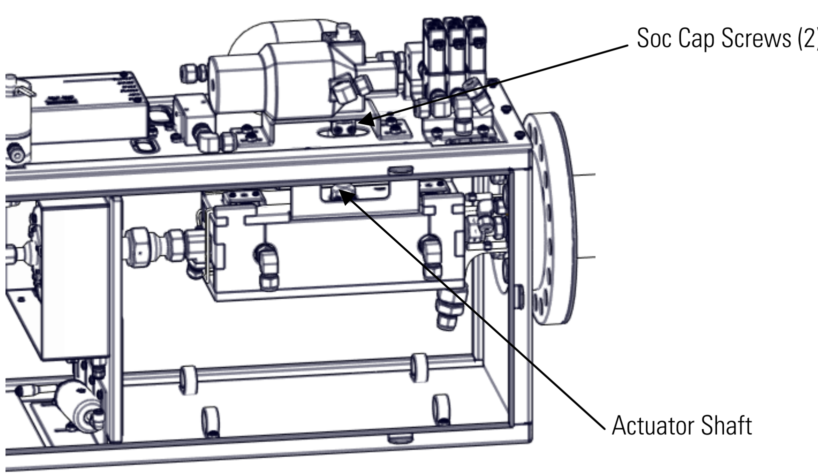

Figure 7–17. Heated Bench Removed

4. Loosen the inlet and outlet connections.

5. Disconnect the three 3/8-inch pneumatic fittings.

6. Unplug the heater connector.

7. Unplug the thermocouple connector.

8. Remove the four 3/8-inch nuts from the mounting bracket and remove the heated bench assembly. Use caution when removing the heated bench as the actuator shaft and spring are not fixed to the assembly and can drop out during the removal process. Note ball valve orientation.

9. Install the new heated bench assembly by following the previous steps in reverse. Use caution to ensure the actuator shaft and spring are properly aligned with the actuator when reinstalling the heated bench back into the system. Verify that the ball valve is in the close position and matches the removal orientation.

Valve Manifold Replacement

Use the following procedure to replace the valve manifold assembly (Figure 7–13).

Equipment Required:

Valve manifold assembly

Wrench, 7/8-inch and 11/16-inch

Phillips screwdriver, #2

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

1. At the probe controller, turn the instrument OFF and unplug the power cord.

2. Remove the top cover of the probe monitor to access internal components.

CAUTION When removing the top cover, remove the three screws at the front of the cover before loosening or removing screws at the bulkhead. ▲

3. Remove connection to the accumulator.

4. Remove the three 3/8-inch pneumatic lines.

5. Unplug power connections to the three valves.

6. Remove the four mounting nuts on the under side of the assembly and remove the valve manifold.

7. Install the new valve manifold assembly by following the previous steps in reverse.

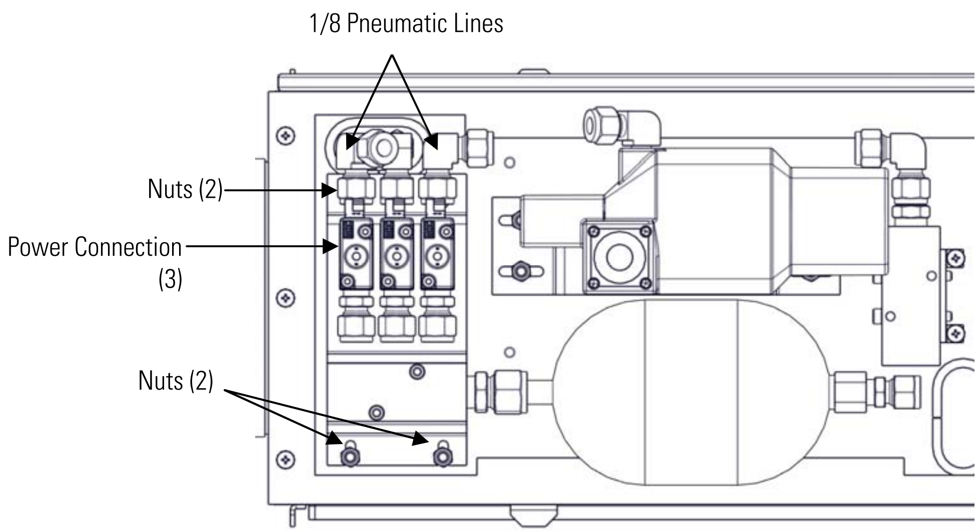

Figure 7–18. Replacing the Valve Manifold

TEOM Head Controller Board Replacement

Use the following procedure to replace the TEOM head controller board.

Equipment Required:

TEOM head controller board

Wrench, 11/16-inch

Phillips screwdriver, #2

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

1. At the probe controller, turn the instrument OFF and unplug the power cord.

2. Remove the side doors of the probe monitor to access internal components.

3. Disconnect the two 1/8 pneumatic lines. The DP high line is connected to the base of the TEOM tube and the DP low is connected to the tee reducer on the output line of the TEOM transducer. Label the lines for reinstallation.

4. Loosen the TEOM tube VCO connection at the nephelometer and lift the TEOM tube straight up until it separates from the TEOM transducer inlet and move the assembly aside to access the TEOM board housing cover. Note tubing orientation when reinstalling new board.

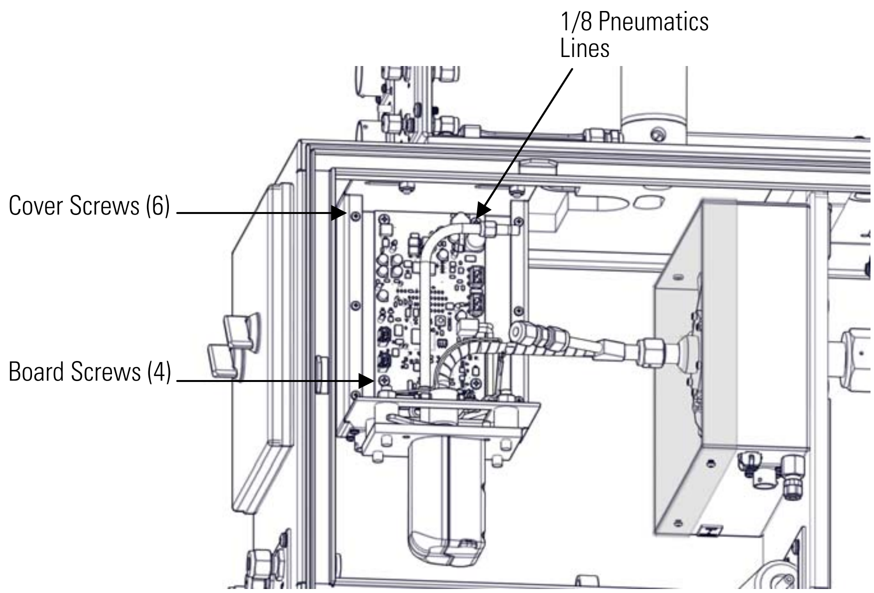

Figure 7–19. Replacing the TEOM Head Controller Board

5. Remove the six screws on the housing cover and remove the cover.

6. Remove all connections from the TEOM board and label connectors as needed for reassembly.

7. Remove the four mounting screws on the TEOM board and remove the assembly.

8. Install the new TEOM board by following the previous steps in reverse.

Actuator Replacement

Use the following procedure to replace the actuator assembly.

Equipment Required:

Actuator assembly

Wrench, 11/16-inch and 3/8-inch

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

1. At the probe controller, turn the instrument OFF and unplug the power cord.

2. Remove the top cover of the probe monitor to access internal components.

CAUTION When removing the top cover, remove the three screws at the front of the cover before loosening or removing screws at the bulkhead. ▲

3. Remove the plumbing line from the actuator.

4. Remove the four 3/8-inch nuts from the mounting bracket.

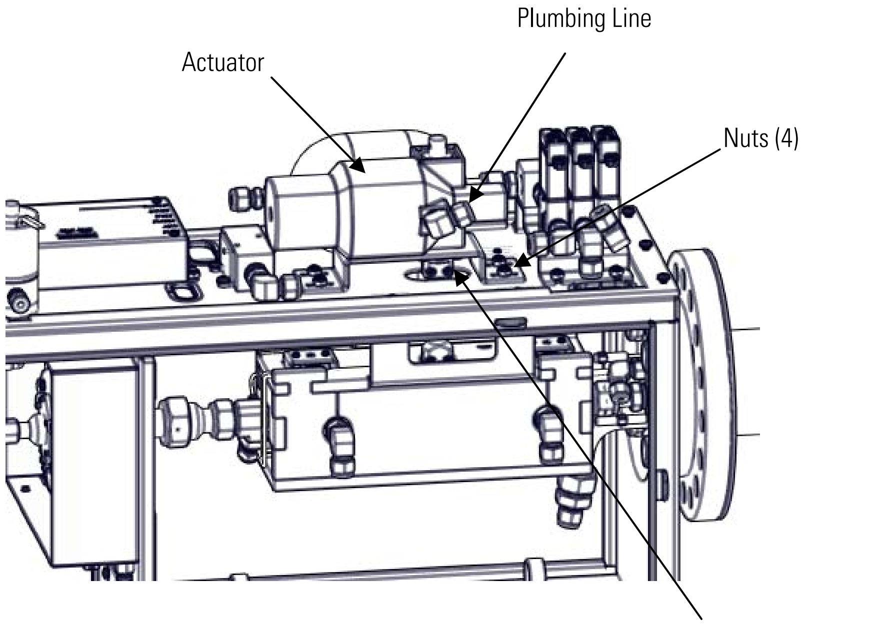

Figure 7–20. Removing the Actuator Assembly

5. Lift the actuator assembly straight up to clear the mounting studs and the ball valve shaft coupling.

6. Install the new actuator assembly by following the previous steps in reverse. Ensure that the heated block ball valve is in the closed position before reinstalling the actuator assembly.

Sample Control Valve Replacement

Use the following procedure to replace the sample control valve.

Equipment Required:

Sample control valve assembly

Wrench, 9/16-inch

Phillips screwdriver, #2

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

1. At the probe controller, turn the instrument OFF and unplug the power cord.

2. Remove the top cover of the probe monitor to access internal components.

CAUTION When removing the top cover, remove the three screws at the front of the cover before loosening or removing screws at the bulkhead. ▲

3. Remove the side doors of the probe monitor to access internal components.

4. Remove the three plumbing lines.

5. Remove the power connector.

6. From under side of the assembly, remove the two Phillips head mounting screws.

7. Install the new sample control valve assembly by following the previous steps in reverse.

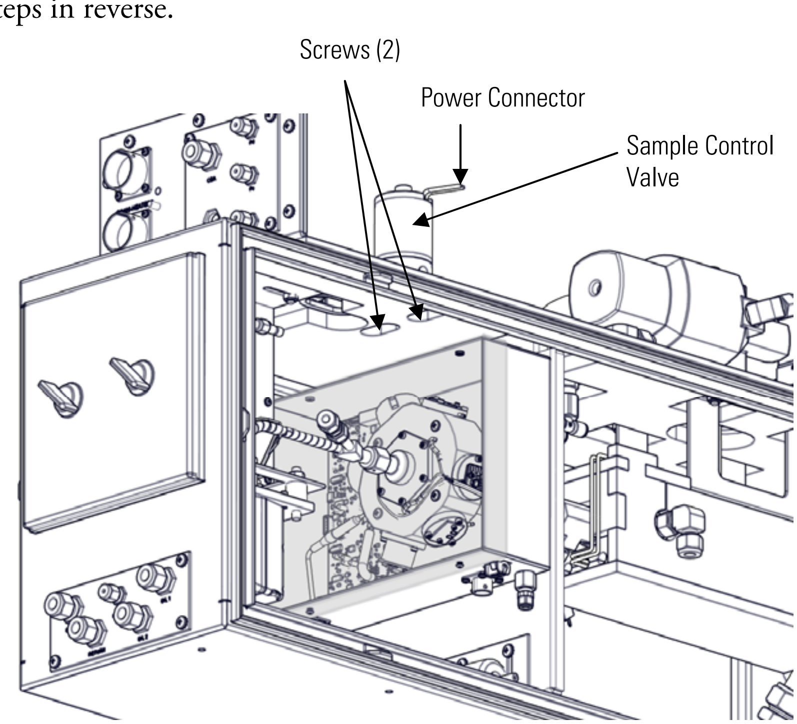

Figure 7–21. Replacing the Sample Control Valve

DC Power Supply (Monitor) Replacement

Use the following procedure to replace the DC power supply assembly.

Equipment Required:

DC power supply assembly

Phillips screwdriver, #1 and #2

Nut driver, 1/4-inch

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

1. At the Probe Controller, turn the instrument OFF and unplug the power cord.

2. Remove the top cover of the probe monitor to access internal components.

CAUTION When removing the top cover, remove the three screws at the front of the cover before loosening or removing screws at the bulkhead. ▲

3. Remove the RS-485 and power connections.

4. Remove the thermocouple connections from thermocouple board.

5. Remove electrical connections from the power supply.

6. Remove four mounting screws from thermocouple/power supply assembly.

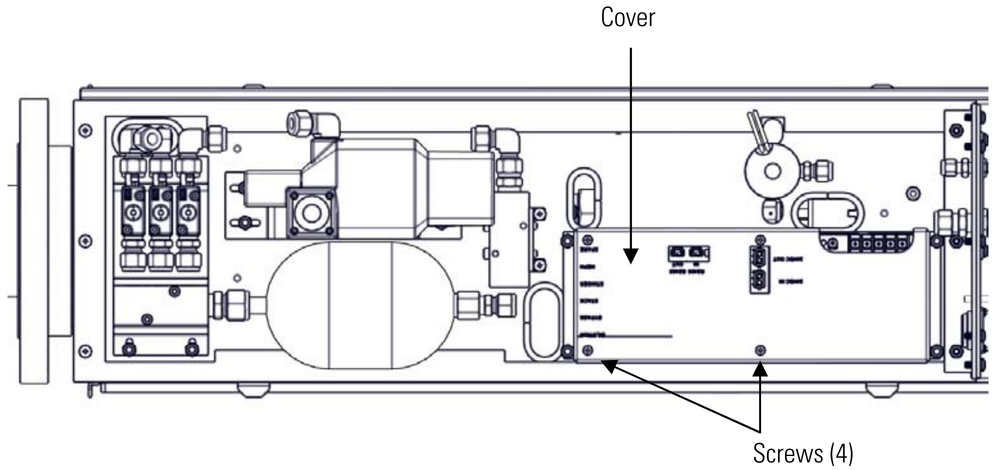

Figure 7–22. Removing DC Power Supply Cover

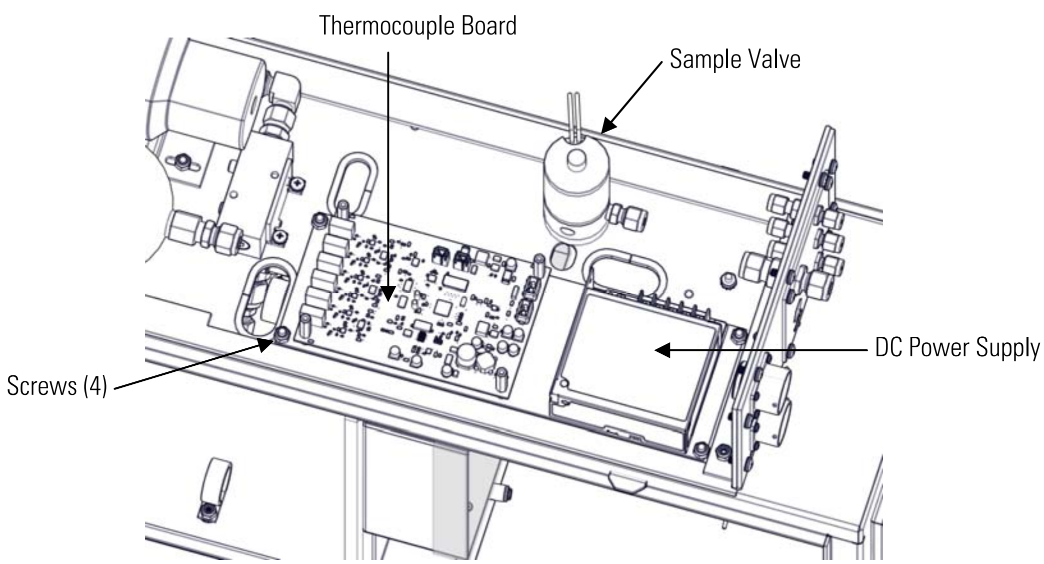

Figure 7–23. Thermocouple/Power Supply Assembly Top View

7. Remove four nuts.

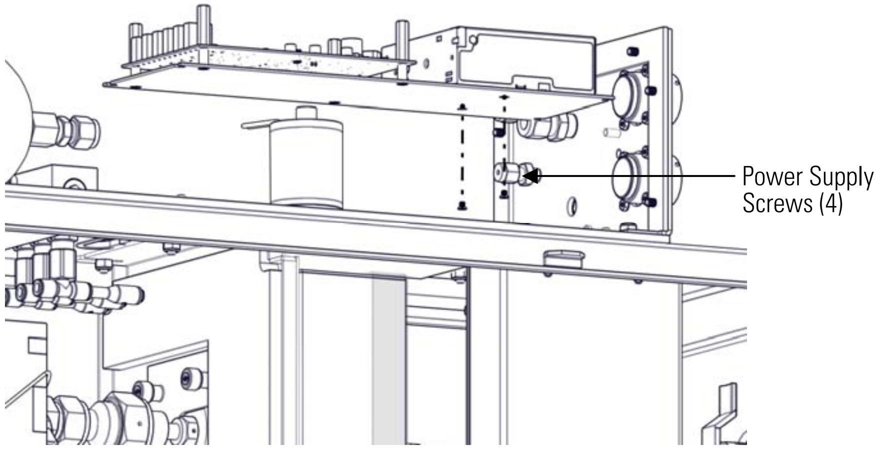

Figure 7–24. Thermocouple/Power Supply Bottom View

8. Remove two power supply mounting screws from underside of assembly.

9. Install the new DC power supply by following the previous steps in reverse.

Thermocouple Board Replacement

Use the following procedure to replace the DC power supply assembly.

Equipment Required:

Thermocouple board assembly

Phillips screwdriver

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

1. At the probe controller, turn the instrument OFF and unplug the power cord.

2. Remove the top cover of the probe monitor to access internal components.

CAUTION When removing the top cover, remove the three screws at the front of the cover before loosening or removing screws at the bulkhead. ▲

3. Remove the RS485 and power connections on the top of the assembly.

4. Remove the cover of the assembly.

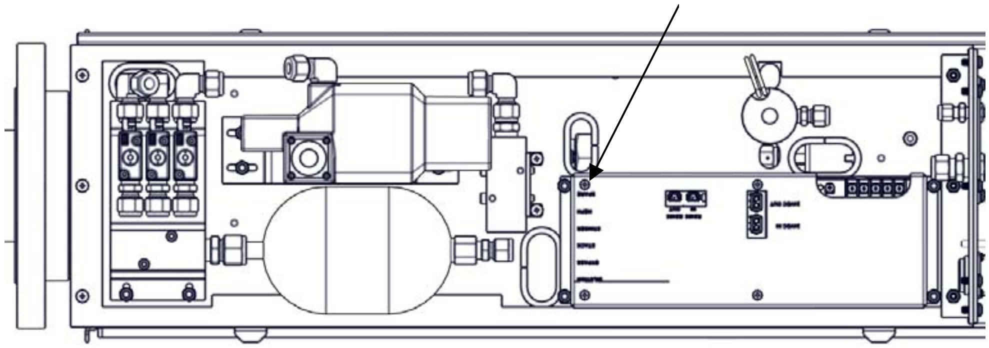

Figure 7–25. Removing the Thermocouple Board Cover

5. Remove the thermocouple connections.

6. Remove the four standoffs on the corners of the assembly.

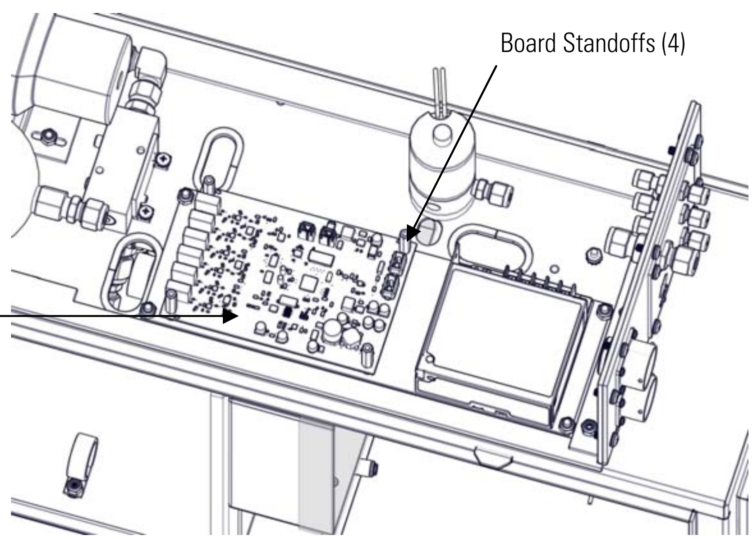

Figure 7–26. Thermocouple Board Assembly

7. Remove the thermocouple board.

8. Install the new thermocouple board by following the previous steps in reverse.

Thermocouple Temperature Probe Calibration

The thermocouple PCBA has five individual port connectors that monitor the thermocouple readings. In the event of a loss of power or communications with a thermocouple the heater will turn off. To complete this calibration it is recommended to use a thermocouple calibrator and reader. (eg; Tegam model 840A) Refer to Figure 7–27 for thermocouple placement.

Equipment needed:

Thermocouple calibrator/reader. (eg; Tegam model 840A)

Thermocouple cable male to male

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

1. Remove the side cover of the Probe Monitor to access internal components.

2. Under Instrument Controls menu; Place system into Service Mode

3. Service Menu: Temperature Calibration

4. Select NEPH BLK OFFSET (Nephelometer Block Thermocouple).
   a. Set the Thermocouple Calibrator to 100 °C and disconnect the Thermocouple cable from the port on the Nephelometer.
   b. Connect to the Nephelometer Thermocouple cable from the Thermocouple PCBA.
   c. Set the OFFSET on the calibration screen so the Temperature reading matches the Thermocouple Calibrator “100°C”.
   d. Reconnect the Thermocouple cable to the Nephelometer port and verify the temperature reading ±1 °C.

5. Select DILUTION OFFSET (Dilution Thermocouple).

   a. Set the Thermocouple Calibrator to 100 °C and Disconnect the Thermocouple from the extension cable labeled “Dilution”.

   b. Connect to the Thermocouple extension cable from the Thermocouple PCBA.

   c. Set the OFFSET on the calibration screen so the Temperature reading matches the Thermocouple Calibrator “100°C”.

   d. Reconnect the Thermocouple extension cable to the Dilution Thermocouple and verify the temperature reading ±1 °C.

6. Select STINGER OFFSET (Stinger Thermocouple).

   a. Set the Thermocouple Calibrator to 100 °C and disconnect the Thermocouple from the extension cable labeled “Stinger” located on the Herter Block Assembly.

   b. Connect to the Thermocouple extension cable from the Thermocouple PCBA.

   c. Set the OFFSET on the calibration screen so the temperature reading matches the Thermocouple Calibrator “100°C”.

   d. Reconnect the Thermocouple extension cable to the Stinger Thermocouple and verify the Temperature reading ±1 °C.

7. Select BYPASS OFFSET (Dilution Thermocouple).

   a. Set the Thermocouple Calibrator to 100 °C and Disconnect the Thermocouple from the extension cable labeled “Bypass”.

   b. Connect to the Thermocouple extension cable from the Thermocouple PCBA.

   c. Set the OFFSET on the calibration screen so the Temperature reading matches the Thermocouple Calibrator “100°C”.

   d. Reconnect the Thermocouple extension cable to the Bypass Thermocouple and verify the Temperature reading ±1 °C.

8. Select STACK OFFSET (Dilution Thermocouple).

   a. Set the Thermocouple Calibrator to 100 °C and disconnect the Thermocouple from the extension cable labeled “Stack”.

   b. Connect to the Thermocouple extension cable from the Thermocouple PCBA.

c. Set the OFFSET on the calibration screen so the Temperature reading matches the Thermocouple Calibrator "100°C".

d. Reconnect the Thermocouple extension cable to the Stack Thermocouple and verify the Temperature reading ±1 °C.

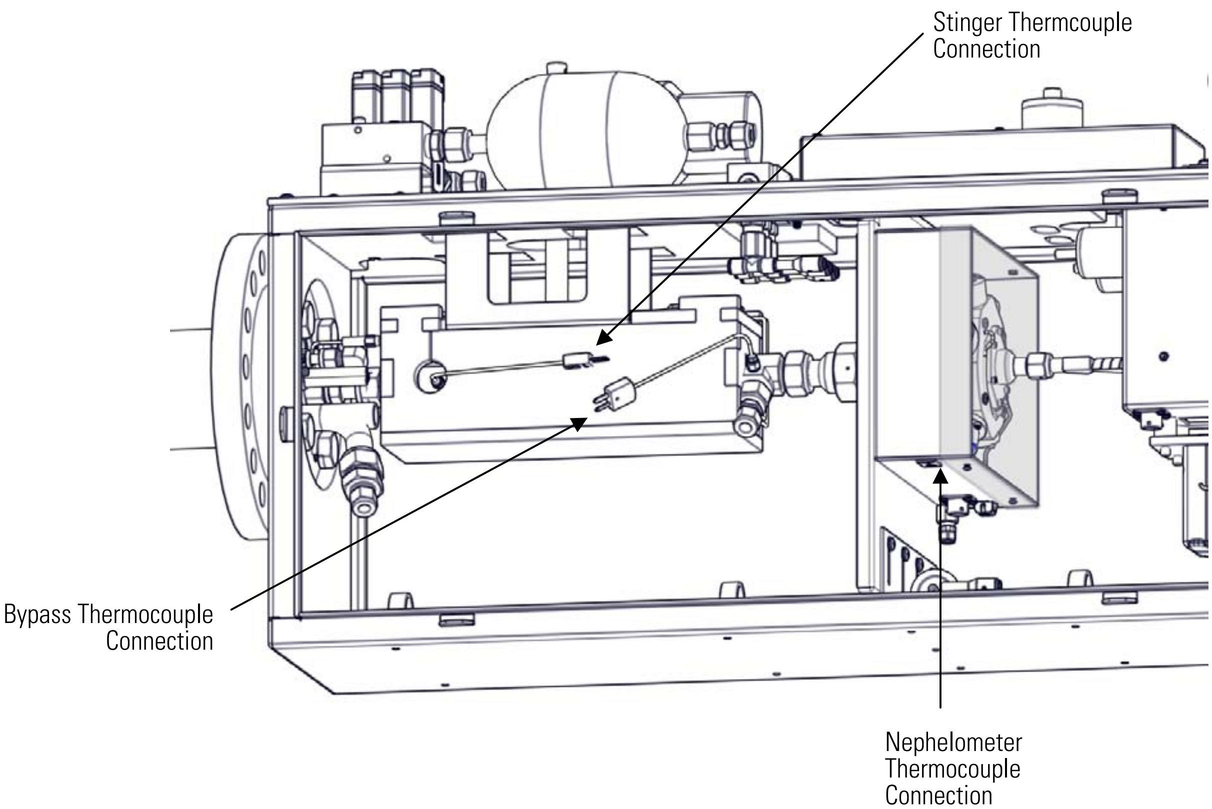

Figure 7–27. Thermocouple Placement

Note Both the stack and dilution thermocouple connections are on the floor of the probe monitor. They are from the mantle assembly. ▲

Mantle Removal

Use the following procedure to remove the mantle assembly.

Equipment Required:

Wrench, 9/16-inch, 15/16-inch, 1-inch, 1 1/16-inch and 1 1/8-inch

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

1. At the probe controller, turn the instrument OFF and unplug the power cord.

2. Remove the side covers of the probe monitor to access internal components.

3. Remove the stinger, dilution and stack thermocouple connections.

4. Remove the dilution and stinger heater connections.

5. Remove the 1/4-inch dilution line at the elbow connection.

6. Loosen the 3/4-inch dump line at the reducer connection. Do not completely remove this nut as the ferrules are PTFE and can fall off during the removal process.

7. Support the mantle assembly and remove the four 15/16-inch mounting bolts.

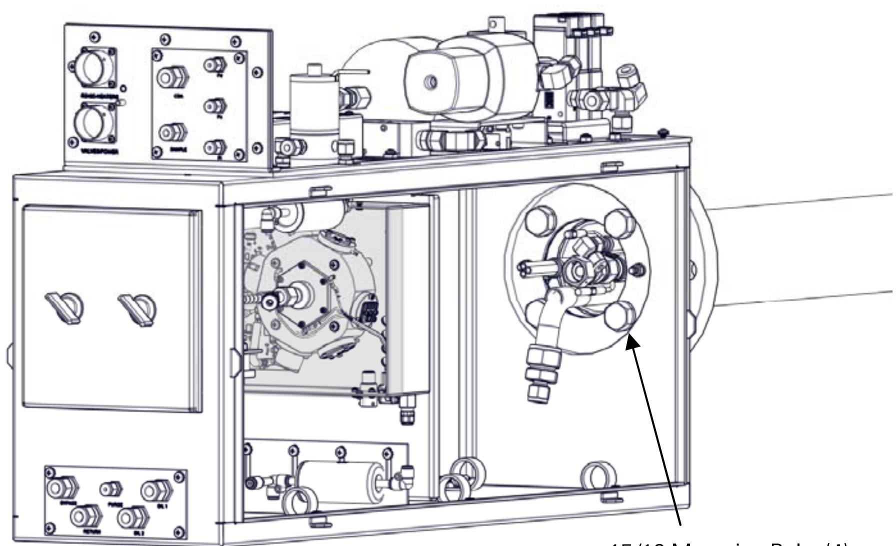

Figure 7–28. Removing the Mantle Assembly

8. Slowly slide the mantle forward taking care not to damage the electrical or air lines.

9. Reinstall the mantle following the previous steps. When reinstalling mantle, remove the rest of the line can be tilted down to clear the heated bench for reconnection.

Dilution Supply Assembly Removal

Use the following procedure to remove the dilution supply assembly (Figure 7–29).

Equipment Required:

Replacement dilution supply assembly

Open end wrench, 9/16-inch and 1-inch

Adjustable wrench

Allen wrench, 5/32-inch

Silver goop (thread lubricant)

Stiff bristle nylon brush

Pick or awl

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

1. At the probe controller, turn the instrument OFF and unplug the power cord.

2. At the Probe Monitor, remove the monitor from the stack by removing the stack flange bolts, then gently slide the Probe Monitor out of the stack taking caution not to damage the nozzle or stack thermocouple mounted on the end of the mantle. Place Monitor on a flat work surface and support the Mantle assemble to prevent damage to the Monitor chassis. Allow time for the mantle to cool before starting disassembly.

3. Disconnect the two Monitor side covers.

4. Disconnect the Dilution and Stack thermocouple connections.

5. Disconnect the Dilution and Stinger heater connections.

6. Disconnect the 1/4-inch Dilution 1 line at the elbow connection at the Mantle.

7. Loosen the 3/4-inch Dump line at the reducer connection. Do not completely remove this nut as the ferrules are PTFE and can fall off during the removal process.

8. Disconnect the Stinger Tube Face Seal fitting from the Heated Bench Assembly.

9. If needed, use a stiff nylon brush and a pick to clean off stack residue from the Mantle Cap socket head mounting screws. Using a 5/16-inch Allen wrench remove the Mantle Cap mounting screws.

10. Carefully dislodge the Mantle Cap from the Mantle Chassis and slowly pull the Mantle Cap with the internal assemblies straight out while guiding the cables and dump tube through the Mantle Chassis.

11. At the Mantle Cap, disconnect the 1/4-inch Swagelok Dilution Supply fitting and remove the assembly. Take note of the orientation of the dilution thermocouple for reinstallation of the new assembly.

12. Install the new Dilution Supply Assembly by following the previous steps in reverse. Use silver goop (thread lubricant) on the Mantle Cap mounting screws when reinstalling.

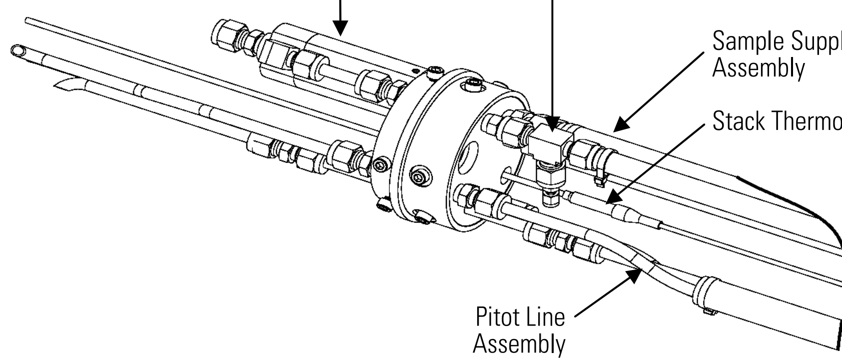

Figure 7–29. Mantle Cap Assembly with Connections

Sample Line Assembly Removal

Use the following procedure to remove the sample line assembly.

Equipment Required:

Replacement sample line assembly

Open end wrench, 9/16-inch, 7/8-inch and 1-inch

Adjustable wrench

Allen wrench, 5/32-inch

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

1. At the probe controller, turn the instrument OFF and unplug the power cord.

2. At the Probe Monitor, remove the monitor from the stack by removing the stack flange bolts, then gently slide the Probe Monitor out of the stack taking caution not to damage the nozzle or stack thermocouple mounted on the end of the mantle. Place Monitor on a flat work surface and support the Mantle assemble to prevent damage to the Monitor chassis. Allow time for the mantle to cool before starting disassembly.

3. Disconnect the two Monitor side covers.

4. Disconnect the Dilution and Stack thermocouple connections.

5. Disconnect the Dilution and Stinger heater connections.

6. Disconnect the 1/4-inch Dilution 1 line at the elbow connection at the Mantle.

7. Loosen the 3/4-inch Dump line at the reducer connection. Do not completely remove this nut as the ferrules are PTFE and can fall off during the removal process.

8. Disconnect the Stinger Tube Face Seal fitting from the Heated Bench Assembly.

9. Disconnect the three Pitot lines from the Pitot Tube Manifold assembly.

10. If needed, use a stiff nylon brush and a pick to clean off stack residue from the Mantle Cap socket head mounting screws. Using a 5/16-inch Allen Wrench, remove the Mantle Cap mounting screws.

11. Carefully dislodge the Mantle Cap from the Mantle Chassis and slowly pull the Mantle Cap with the internal assemblies straight out while guiding the cables and dump tube through the Mantle Chassis.

12. At the Mantle Cap, disconnect the 1/2-inch Swagelok fitting of the Sample Line Assembly and remove the assembly.

13. Install the new Sample Line Supply Assembly by following the previous steps in reverse. Use silver goop (thread lubricant) on the Mantle Cap mounting screws when reinstalling.

Dilution Thermocouple Removal

Use the following procedure to remove the dilution thermocouple assembly (Figure 7–29).

Equipment Required:

Replacement dilution thermocouple kit

Open end wrench, 5/16-inch, 7/16-inch and 1-inch

Adjustable wrench

Allen wrench, 5/32-inch

Wrench, 9/16-inch

Silver goop (thread lubricant)

Stiff bristle nylon brush

Pick or awl

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

1. At the probe controller, turn the instrument OFF and unplug the power cord.

2. At the Probe Monitor, remove the monitor from the stack by removing the stack flange bolts, then gently slide the Probe Monitor out of the stack taking caution not to damage the nozzle or stack thermocouple mounted on the end of the mantle. Place Monitor on a flat work surface and support the Mantle assemble to prevent damage to the Monitor chassis. Allow time for the mantle to cool before starting disassembly.

3. Disconnect the two Monitor side covers.

4. Disconnect the Dilution and Stack thermocouple connections.

5. Disconnect the Dilution and Stinger heater connections.

6. Disconnect the 1/4-inch Dilution 1 line at the elbow connection at the Mantle.

7. Loosen the 3/4-inch Dump line at the reducer connection. Do not completely remove this nut as the ferrules are PTFE and can fall off during the removal process.

8. Disconnect the Stinger Tube Face Seal fitting from the Heated Bench Assembly.

9. If needed, use a stiff nylon brush and a pick to clean off stack residue from the Mantle Cap socket head mounting screws. Using a 5/16-inch Allen wrench remove the Mantle Cap mounting screws.

10. Carefully dislodge the Mantle Cap from the Mantle Chassis and slowly pull the Mantle Cap with the internal assemblies straight out while guiding the cables and dump tube through the Mantle Chassis.

11. At the Mantle Cap, disconnect the 1/4-inch Swagelok Dilution Supply fitting and remove the assembly. Take note of the orientation of the dilution thermocouple for reinstallation of the new assembly.

12. At the Dilution Supply assembly disconnect the 1/16-inch Swagelok fitting of the Dilution Thermocouple and remove the assembly.

13. Insert the new Dilution Thermocouple and Swagelok cap and ferrules into the Dilution Supply assembly, but do not tighten down the cap. Insert the thermocouple into the fitting until it bottoms out on the ID of the Dilution tube. Mark the thermocouple at the Swagelok cap and then move the thermocouple out 1/8-inch from the mark and tighten down the Swagelok cap.

14. Using the old thermocouple as a template bend the new thermocouple lead to a 90 degree angle to properly fit within the Mantle Housing. Mount the Dilution assembly back into the Mantle Cap with the Dilution Thermocouple connection pointing in towards the center on the Mantle Cap.

15. Reinstall the Dilution Supply Assembly by following the previous steps 1 through 11 in reverse. Use silver goop (thread lubricant) on the Mantle Cap mounting screws when reinstalling.

Stack Thermocouple Removal

Use the following procedure to remove the stack thermocouple assembly (Figure 7–29).

Equipment Required:

Replacement stack thermocouple kit

Open end wrench, 9/16-inch, 7/16-inch and 1-inch

Adjustable wrench

Allen wrench, 5/32-inch

Large wire cutters

Silver goop (thread lubricant)

Stiff bristle nylon brush

Pick or awl

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

1. At the probe controller, turn the instrument OFF and unplug the power cord.

2. At the Probe Monitor, remove the monitor from the stack by removing the stack flange bolts, then gently slide the Probe Monitor out of the stack taking caution not to damage the nozzle or stack thermocouple mounted on the end of the mantle. Place Monitor on a flat work surface and support the Mantle assemble to prevent damage to the Monitor chassis. Allow time for the mantle to cool before starting disassembly.

3. Disconnect the two Monitor side covers.

4. Disconnect the Dilution and Stack thermocouple connections.

5. Disconnect the Dilution and Stinger heater connections.

6. Disconnect the 1/4-inch Dilution 1 line at the elbow connection at the Mantle.

7. Loosen the 3/4-inch Dump line at the reducer connection. Do not completely remove this nut as the ferrules are PTFE and can fall off during the removal process.

8. Disconnect the Stinger Tube Face Seal fitting from the Heated Bench Assembly.

9. If needed, use a stiff nylon brush and a pick to clean off stack residue from the Mantle Cap socket head mounting screws. Using a 5/16-inch Allen wrench remove the Mantle Cap mounting screws.

10. Carefully dislodge the Mantle Cap from the Mantle Chassis and slowly pull the Mantle Cap with the internal assemblies straight out while guiding the cables and dump tube through the Mantle Chassis.

11. At the Mantle Cap, disconnect the 1/8-inch Swagelok fitting of the Stack Thermocouple Assembly and pull the thermocouple out enough to get cutters in behind the Swagelok cap and ferrules. Cut the thermocouple and pull the main part of the assembly back through the Mantle Cap.

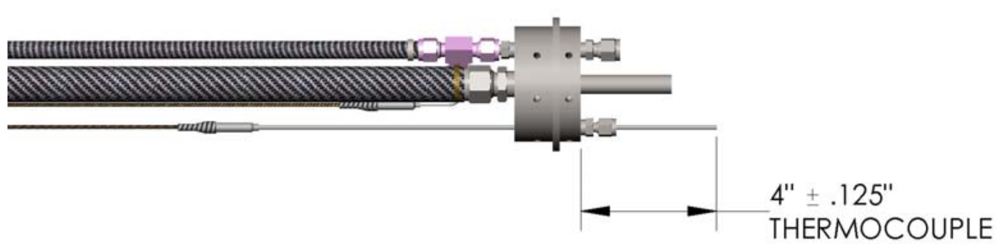

Figure 7–30. Stack Thermocouple Length

12. Insert the new Stack Thermocouple Assembly in the Mantle Cap and install the new Swagelok cap and ferrules, but do not tighten. Adjust the length of the thermocouple by measuring from the end (stack side) of the Mantle Cap to the tip of the Stack Thermocouple. The length should measure 9 inches ±125 inches. When the thermocouple is

adjusted to the proper length tighten down the Swagelok Cap. Refer to Figure 7–30.

13. Reassembly the assembly by following the previous steps in reverse. Use Silver Goop (Thread Lubricant) on the Mantle Cap mounting screws when reinstalling.

System Drawings

Refer to the following Figure 7–31 through Figure 7–36 for plumbing and electrical connections for the probe controller and probe monitor.

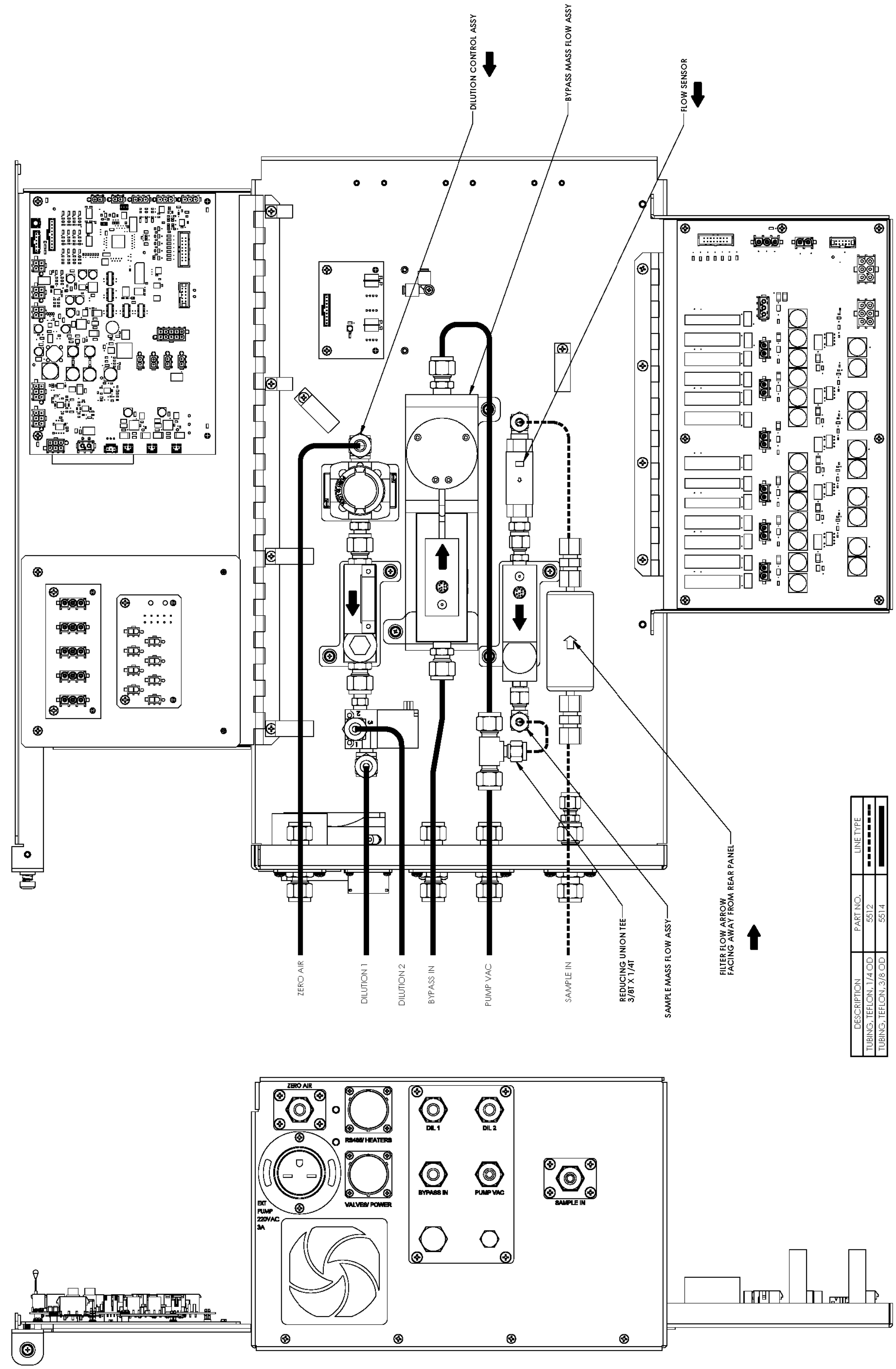

Figure 7–31. Probe Controller Plumbing Sheet 1

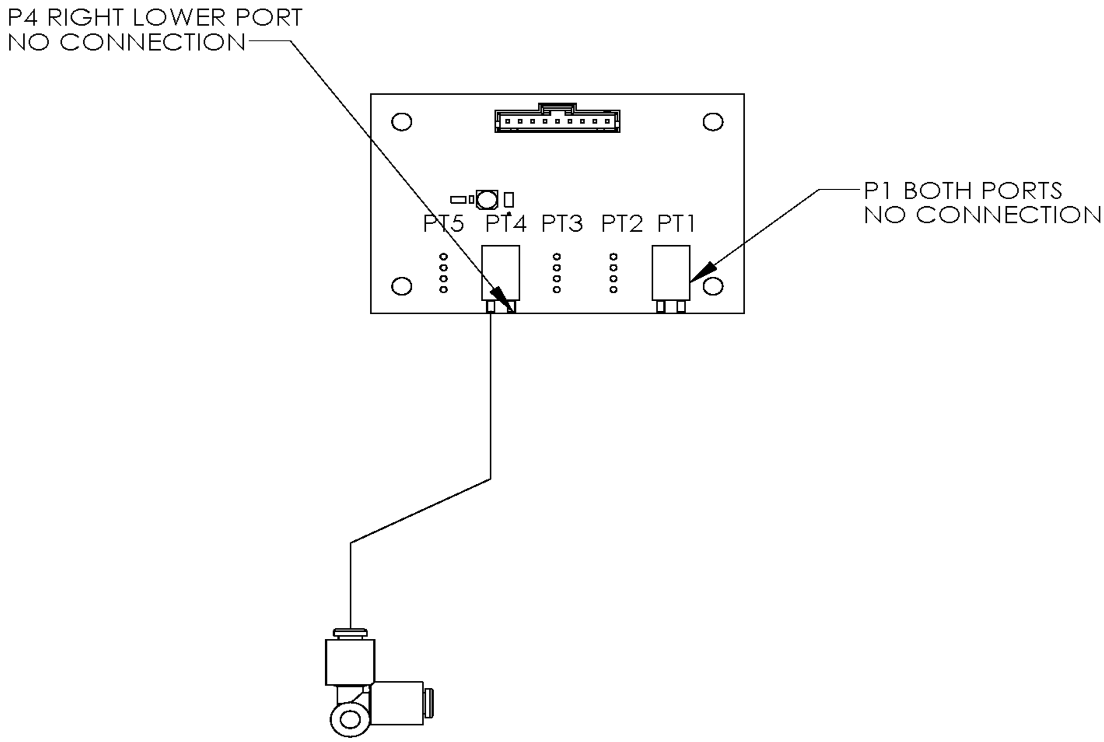

Figure 7–32. Probe Controller Plumbing Sheet 2

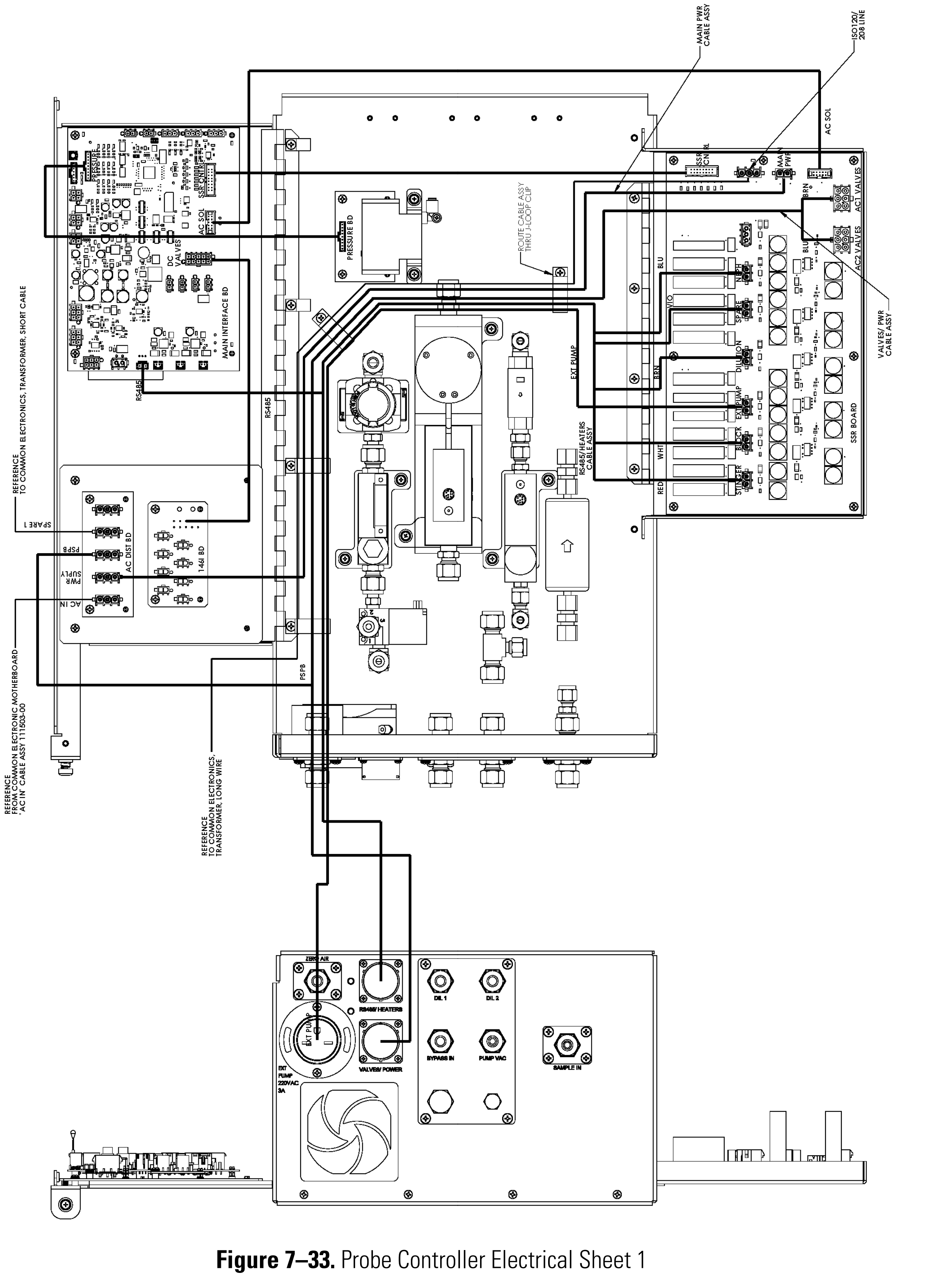

Figure 7–33. Probe Controller Electrical Sheet 1

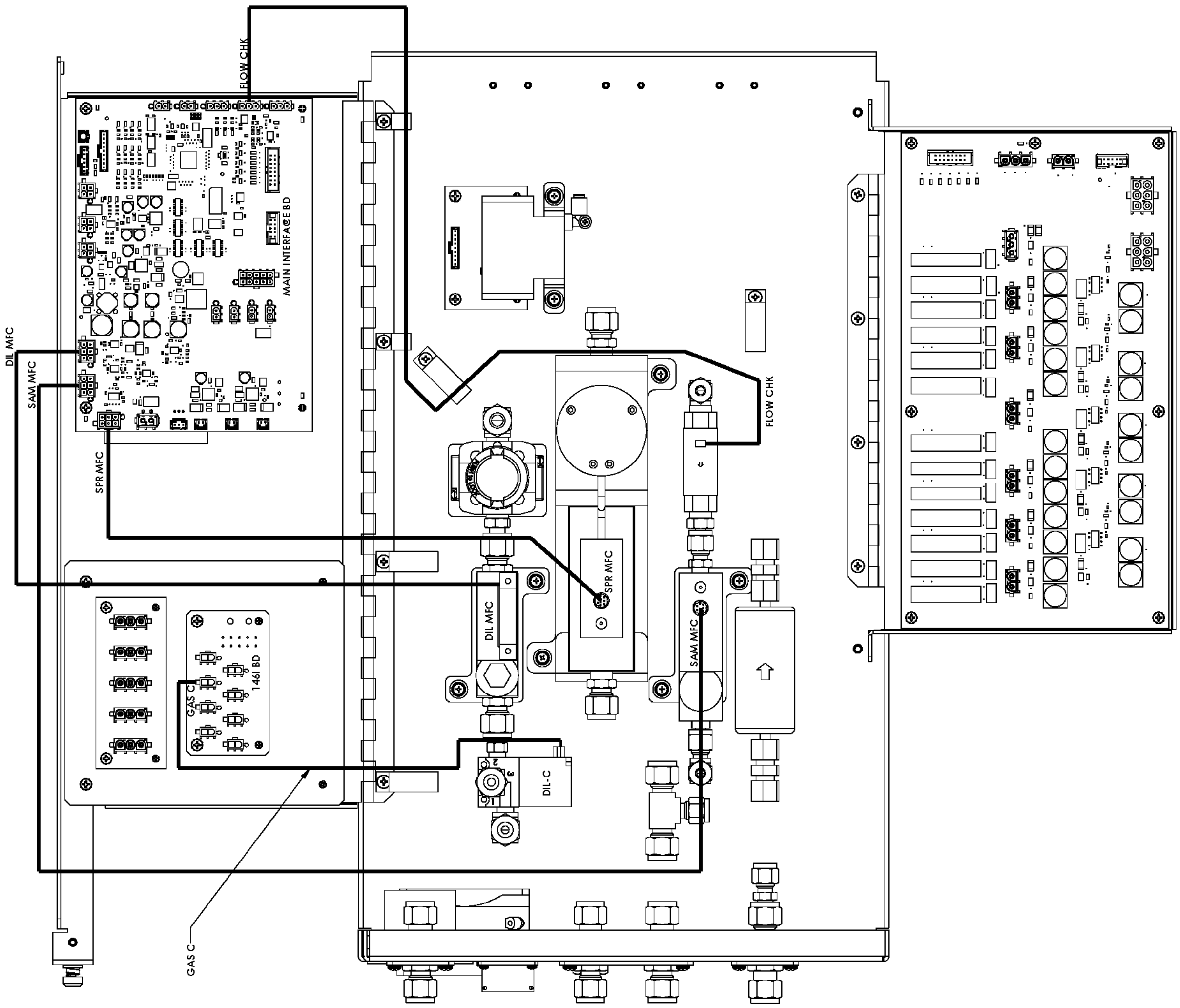

Figure 7–34. Probe Controller Electrical Sheet 2

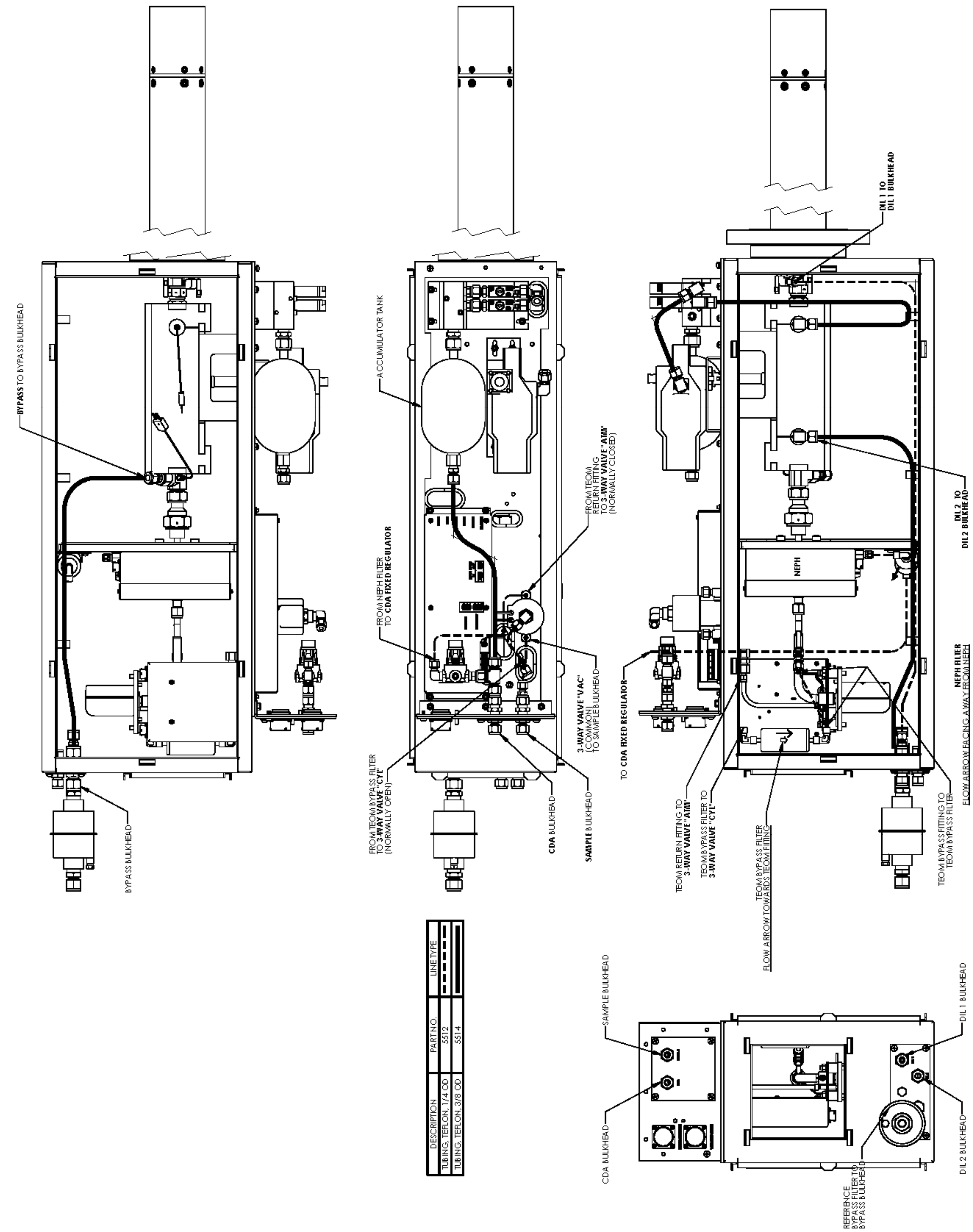

Figure 7–35. Probe Monitor Plumbing

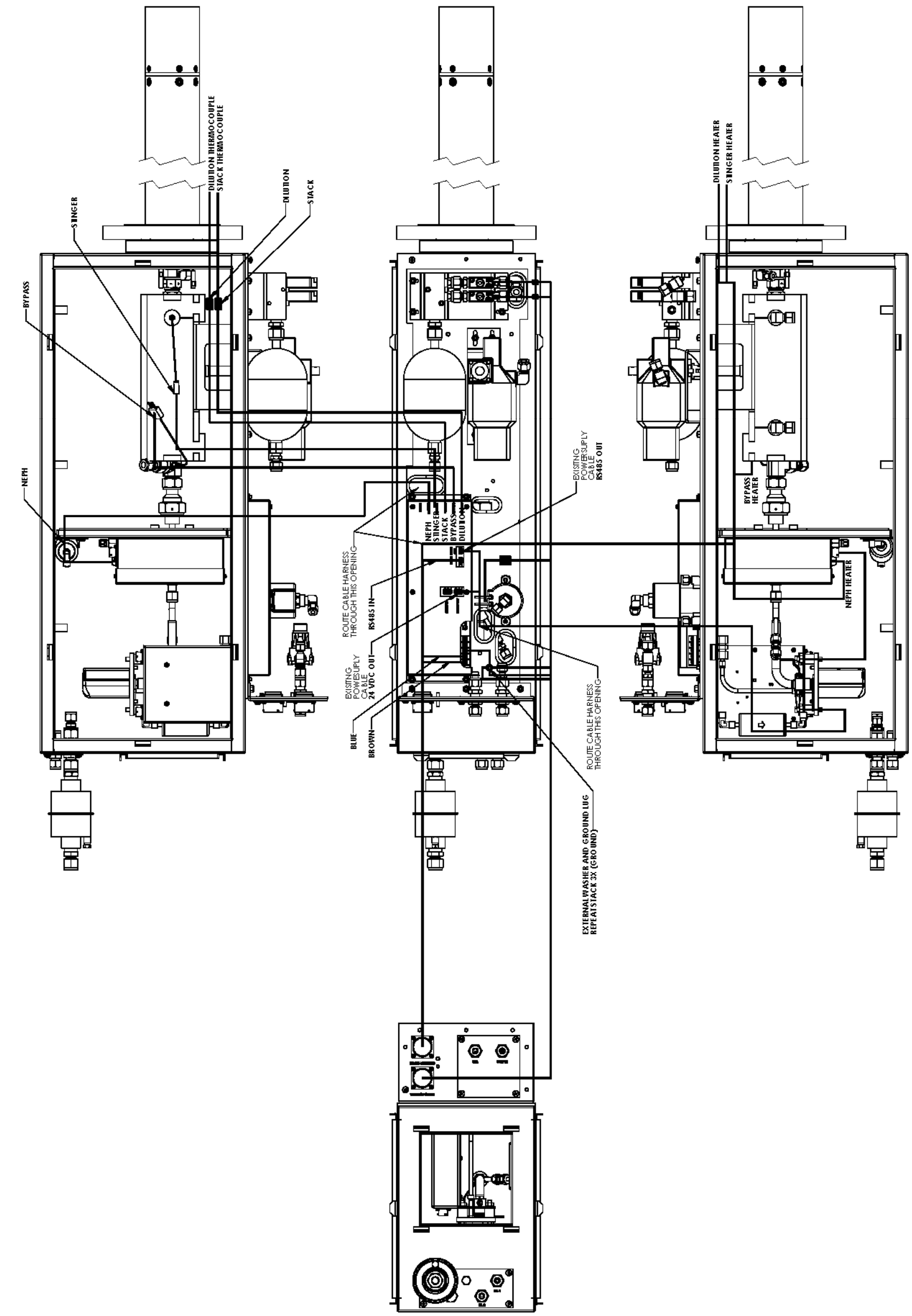

Figure 7–36. Probe Monitor Electrical

Service Locations

For additional assistance, service is available from exclusive distributors worldwide. Contact one of the phone numbers below for product support and technical information or visit us on the web at www.thermo.com/aqi.

1-866-282-0430 Toll Free

1-508-520-0430 International

Chapter 8
System Description

This chapter describes the function and location of the system components, provides an overview of the firmware structure, and includes a description of the system electronics and input/output connections and functions.

Hardware

Model 3880*i* PM CEMS hardware components include:

- Probe Monitor
  - Dilution Nozzle
  - Mantle
  - Heated Block
  - Nephelometer
  - TEOM
  - Pneumatic Controls
  - Temperature Control
  - Power Supply
- Probe Controller
  - Diluton MFC
  - Bypass MFC
  - Sample MFC
  - Bypass Pump
- Pneumatic Umbilical
- Electrical Umbilical

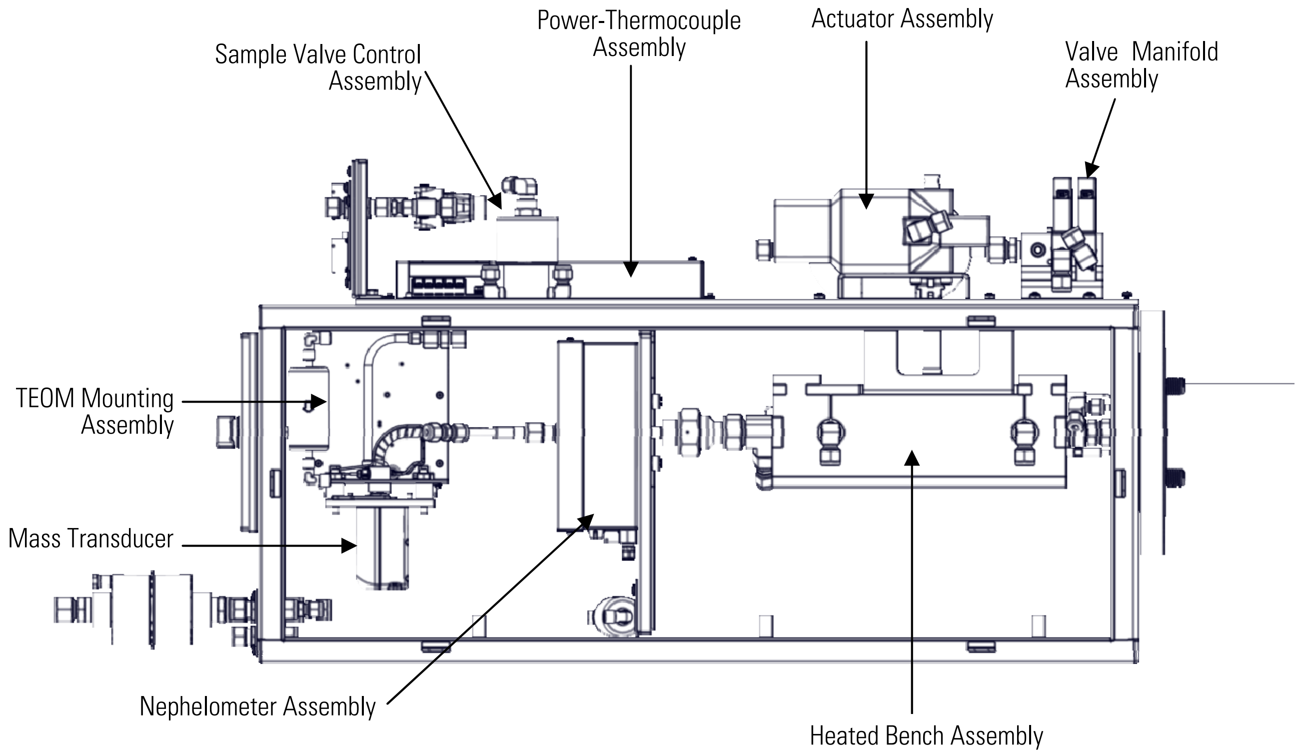

Figure 8–1. Probe Monitor Hardware Components

Probe Monitor

The probe monitor is typically installed into an industrial source emission point through a 4-inch or 6-inch flange. Most sample measurements are made within this probe monitor high-level assembly and are controlled by the probe controller.

Dilution Nozzle

The dilution nozzle is the point of the instrument that extracts and dilutes the particulate sample to be measured.

Mantle

The mantle houses the dilution air heater and delivery tube in addition to a heated sample tube (stinger) and thermocouple lines.

Heated Block

The heated block transports the diluted sample from the mantle towards the nephelometer and TEOM. The mantle also includes a pneumatically controlled ball valve, a blow-back port, a secondary dilution air port, and two thermocouples to measure the incoming sample temperature from the stinger and the outgoing sample temperature towards the bypass flow port.

Nephelometer

The nephelometer is downstream of the heated block. A slip-stream of diluted sample is introduced to the nephelometer through a mini-stinger probe from the heated block outlet. The nephelometer measures the scattering of light in the presence of a particulate matter sample. It includes a self-zeroing and auto-span feature and is heated to a constant temperature.

TEOM

The TEOM is a tapered element oscillating microbalance and is positioned downstream of the nephelometer. On a scheduled basis, the sample is sent towards the TEOM through a heated sample tube. The TEOM includes a filter for sample collection and this filter needs to be replaced periodically.

Pneumatic Controls

On the top side of the probe monitor are a series of valves that control the blow back of stinger tube, the actuator to drive the ball valve, and a three-way valve that directs the sample flow to and away from the TEOM. All valves are powered through umbilical connections.

Temperature Control

A dedicated thermocouple circuit board is located on the top side of the probe monitor. It permits the measurement of the stack source, dilution, stinger, bypass and nephelometer temperatures.

Power Supply

On the top side of the probe monitor is a power supply that provides the 24 VDC necessary to operate the thermocouple, PCB, nephelometer, and TEOM.

Probe Controller

The probe controller handles the communication to and from the probe monitor. It manages the heated zones and pneumatic controls of the probe monitor. It also manages all flow control for the entire system in addition to storing all data and managing all I/O of the system. The probe controller is the main interface to the 3880*i* PM CEMS.

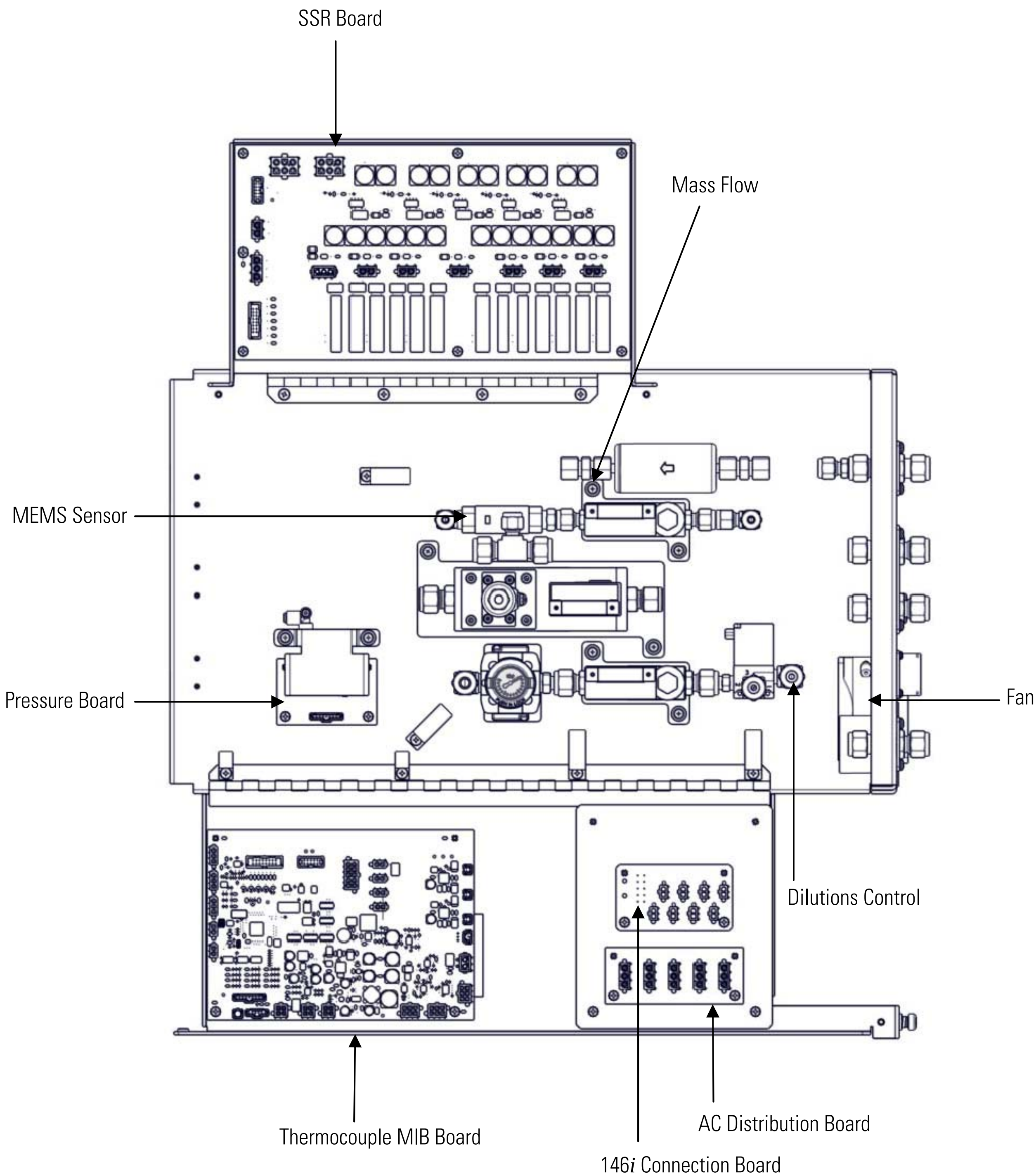

Figure 8–2. Probe Controller Components

Dilution MFC

The diluction mass flow controller (MFC) is used to measure and control the dilution air through the dilution nozzle assembly.

Bypass MFC

The bypass mass flow controller (MFC) is used to measure and control the diluted sample flow through the stinger and heated block.

Sample MFC

The sample mass flow controller (MFC) is used to measure and control the gas flow through the nephelometer and TEOM.

Bypass Pump

The external bypass pump is used to draw the bypass flow through the instrument.

Pneumatic Umbilical

The pneumatic umbilical delivers the dilution air to the dilution nozzle assembly and transports the sample and bypass flows to the probe controller.

Electrical Umbilicals

The electrical umbilicals are paired to power the probe monitor and handle communications via RS-485.

Firmware

The processor firmware tasks are organized into four areas:

- Instument Control
- Monitoring Signals
- Measurement Calculations
- Output Communication

Instrument Control

Low-level embedded processors are used to control the various functions on the boards, such as analog and digital I/O, and heater control. These processors are controlled over a serial interface with a single high-level processor that also controls the front-panel user interface. The low-level processors all run common firmware that is bundled with the high-level firmware and loaded on power-up if a different version is detected.

Each board has a specific address that is used to identify to the firmware what functions are supported on that board. This address is also used for the communications between the low-level processors and the high-level processor.

Every tenth of a second the frequency counters, analog I/O, and digital I/O are read and written to by the low-level processor. The counters are accumulated over the past second and the analog inputs are averaged over that second. The high-level processor polls the low-level processors once per second to exchange the measurement and control data.

Monitoring Signals

Signals are gathered from the low-level processors once per second, and then processed by the high-level processor to produce the final measurement values. The one-second accumulated counts are accumulated for the user-specified averaging time. In continuous mode, if this averaging time is greater than five seconds, the measurement is updated every 10 seconds. In switching mode, the measurement is updated every 60 seconds. The one-second average of the other analog inputs are reported directly (no additional signal conditioning is performed by the high-level processor).

Measurement Calculations

The calculation begins by subtracting the appropriate electronic offset from the count accumulation. Following this correction, the raw accumulated counts are scaled according to the gain setting of the input board.

Next, the uncorrected values are determined according to a unique averaging algorithm which minimizes errors resulting from rapidly changing gas concentrations. This algorithm results in values which are stored in RAM in a circular buffer that holds all the data. This data is averaged over the selected time interval, which can be, in switching mode, any multiple of sixty between 60 and 300 (the continuous modes have additional intervals of 1, 2, 5, 10, 20, 30, and 90 seconds).

Note In switching mode, the averaging times are: 60, 120, 180, 240, and 300 seconds. ▲

Output Communication

The background values, which are corrected for temperature, are subtracted from their respective averages. The reading is corrected by the stored span factor and by the temperature factor.

The front panel display, serial and Ethernet data ports, and analog outputs are the means of communicating the results of the above calculations. The front panel display presents the Hg concentrations. The display is updated every 60 seconds in the switching mode. In the continuous mode, the display is updated every 1-10 seconds depending on the averaging time.

The analog output ranges are user selectable via firmware. The analog outputs are defaulted based on the measurement range. The defaults are calculated by dividing the data values by the full-scale range for each of the three parameters and then multiplying each result by the user-selected output range. Negative concentrations can be represented as long as they are within -5% of full-scale. The zero and span values may be set by the user to any desired value.

Electronics

All electronics operate from a universal switching supply, which is capable of auto-sensing the input voltage and working over the entire operating range.

The external pump and heaters all operate on 110VAC. An optional transformer is required if operating on the 210-250VAC or 90-110VAC ranges.

An on/off switch controls all power to the instrument, and is accessible on the front panel.

Motherboard

The motherboard contains the main processor, power supplies, a sub-processor and serves as the communication hub for the instrument.

The motherboard receives operator inputs from the front panel mounted function key panel and/or over I/O connections on the rear panel and sends commands to the other boards to control the functions of the instrument and to collect measurement and diagnostic information.

The motherboard outputs instrument status and measurement data to the front-panel mounted graphics display and to the rear-panel I/O.

The motherboard also contains I/O circuitry and the associated connector to monitor external digital status lines and to output analog voltages that represent the measurement data.

Connectors located on the motherboard include:

- External connectors
- Internal connectors

External Connectors

External connectors include:

- External Accessory
- RS-232/485 Communications (two connectors)
- Ethernet Communications
- I/O connector with Power Fail Relay, 16 Digital Inputs, and 6 Analog Voltage Outputs.

Internal Connectors

Internal connectors include:

- Function key panel and Display
- Measurement Interface Board Data
- I/O Expansion Board Data
- Digital Output Board
- AC distribution

Measurement Interface Board

The measurement interface board serves as a central connection area for all measurement electronics in the instrument. It contains power supplies and interface circuitry for sensors and control devices in the measurement system. It sends status data to the motherboard and receives control signals from the motherboard.

Measurement Interface Board Connectors

Connectors located on the measurement interface board include:

- Data communication with the motherboard
- 24V power supply inputs
- Fan and solenoid outputs
- Flow and pressure sensors
- Ambient temperature sensor
- Input board

SSR Board

The solid state relay (SSR) board is used to control all AC-powered components, such as pumps, heaters and valves.

Pressure Sensor Assembly

The pressure sensor assembly consists of a board containing a series of pressure transducers with a gas input fitting. The pressure transducer output is produced by measuring the pressure difference between the sample gas pressure and ambient air pressure.

Digital Output Board

The digital output board connects to the motherboard and provides solenoid driver outputs and relay contact outputs to a connector located on the rear panel of the instrument. Ten relay contacts normally open (with power off) are provided which are electrically isolated from each other. Eight solenoid driver outputs (open collector) are provided along with a corresponding +24VDC supply pin on the connector.

Front Panel Connector Board

The front panel connector board interfaces between the motherboard and the front panel mounted function key panel and graphics display. It serves as central location to tie the three connectors required for the function key panel, the graphics display control lines, and the graphics display backlight to a single ribbon cable extending back to the motherboard. This board also includes signal buffers for the graphics display control signals and a high voltage power supply for the graphics display backlight.

I/O Expansion Board

The I/O expansion board connects to the motherboard and adds the capability to input external analog voltage inputs and to output analog currents via a connector located on the rear panel of the instrument. It contains local power supplies, a DC/DC isolator supply, a sub-processor and analog circuits. Eight analog voltage inputs are provided with an input voltage range of 0V to10VDC. Six current outputs are provided with a normal operating range of 0 to 20 mA.

I/O Components

External I/O is driven from a generic bus that is capable of controlling the following devices:

- Analog output (voltage and current)
- Analog input (voltage)
- Digital output (TTL levels)
- Digital input (TTL levels)

Note The instrument has spare solenoid valve drivers and I/O support for future expansion. ▲

Analog Voltage Outputs

The instrument provides six analog voltage outputs. Each may be firmware configured for any one of the following ranges, while maintaining a minimum resolution of 12 bits:

- 0-100mV
- 0-1V
- 0-5V
- 0-10V

The user can calibrate each analog output zero and span point through firmware. At least 5% of full-scale over and under range are also supported, but may be overridden in firmware if required.

The analog outputs may be assigned to any measurement or diagnostic channel with a user-defined range in the units of the selected parameter. The voltage outputs are independent of the current outputs.

Analog Current Outputs

The I/O Expansion board includes six isolated current outputs. These are firmware configured for any one of the following ranges, while maintaining a minimum resolution of 11 bits:

- 0-20 mA
- 4-20 mA

The user can calibrate each analog output zero and span point through firmware. At least 5% of full-scale over and under range are also supported, but may be overridden in firmware if required.

The analog outputs may be assigned to any measurement or diagnostic channel with a user-defined range in the units of the selected parameter. The current outputs are independent of the voltage outputs. The current outputs are isolated from the instrument power and ground, but they share a common return line (Isolated GND).

Analog Voltage Inputs

Eight analog voltage inputs are used to gather measurement data from third-party devices. The user may assign a label, unit, and a conversion table (2 to 10 points). Each point in the conversion table consists of an analog input voltage value (0-10.5 V) and a corresponding user-defined reading value. Only two points are necessary for linear inputs, however a larger number of points may be used to approximate non-linear inputs. All voltage inputs have a resolution of 12 bits over the range of 0 to 10.5 volts.

Digital Output Relays

The instrument includes one power fail relay on motherboard and ten digital output relays on the digital output board. These are reed relays rated for at least 500 mA @ 200VDC.

The power fail relay is Form C (both normally opened and normally closed contacts). All other relays are Form A (normally opened contacts) and are used to provide alarm status and mode information from the instrument, as well as remote control to other devices, such as for controlling valves during calibration. The user may select what information is sent out each relay and whether the active state is opened or closed.

Digital Inputs

Sixteen digital inputs are available which may be programmed to signal instrument modes and special conditions including:

- Zero Gas Mode
- Span Gas Mode

The actual use of these inputs will vary based on instrument configuration.

The digital inputs are TTL level compatible and are pulled up within the instrument. The active state can be user defined in firmware.

Serial Ports

Two serial ports allow daisy chaining so that multiple instruments may be linked using one PC serial port.

The standard bi-directional serial interface can be configured for either RS-232 or RS-485. The serial baud rate is user selectable in firmware for standard speeds from 1200 to 19,200 baud. The user can also set the data bits, parity, and stop bits. The following protocols are supported:

- C-Link
- Streaming Data
- Modbus Slave

The Streaming Data protocol transmits user-selected measurement data via the serial port in real-time for capture by a serial printer, data logger, or PC.

RS-232 Connection

A null modem (crossed) cable is required when connecting the instrument to an IBM Compatible PC. However, a straight cable (one to one) may be required when connecting the instrument to other remote devices. As a general rule, when the connector of the host remote device is female, a straight cable is required and when the connector is male, a null modem cable is required.

Data Format:

1200, 2400, 4800, 9600, 19200, 38400, 57600, or 115200 BAUD

8 data bits

1 stop bit

no parity

All responses are terminated with a carriage return (hex 0D)

Refer to Table 8–1 for the DB9 connector pin configuration.

Table 8–1. RS-232 DB9 Connector Pin Configurations

DB9 Pin	Function
2	RX
3	TX
7	RTS
8	CTS
5	Ground

RS-485 Connection

The instrument uses a four wire RS-485 configuration with automatic flow control (SD). Refer to Table 8–2 for the DB9 connector pin configuration.

Table 8–2. RS-485 DB9 Connector Pin Configuration

DB9 Pin	Function
2	+ receive
8	- receive
7	+ transmit
3	- transmit
5	ground

Ethernet Connection

An RJ45 connector is used for the 10Mbs Ethernet connection supporting TCP/IP communications via standard IPV4 addressing. Up to three simultaneous connections are allowed per protocol. The IP address may be configured for static addressing or dynamic addressing (set using a DHCP server).

Any serial port protocols may be accessed over Ethernet in addition to the serial port.

Chapter 9
Optional Equipment

The Model 3880*i* is available with the following options:

- "Terminal Block and Cable Kits" on page 9-1
- "Mounting Options" on page 9-3
- "Mantle Material Options" on page 9-8

Terminal Block and Cable Kits

The optional terminal block and cable kits provide a convenient way to connect devices to the instrument. These kits break out the signals on the rear panel connector to individual numbered terminals.

Two types of terminal block and cable kits are available. One kit is for the DB37 connectors and can be used for either the analog output connector or the relay output connector. The other kit is for the DB25 connector and can be used for the optional I/O expansion board. For associated part numbers, refer "External Device Connection Components" on page 7-8.

Each kit consists of:

- one six-foot cable
- one terminal block
- one snap track

Note Supporting all of the connections on units with the optional I/O expansion board requires:

- two DB37 kits
- one DB25 kit

Cables

Table 9–1 identifies the optional individual cables that are available for the instrument and Table 9–2 provides the cable color codes. For associated part numbers, refer to "External Device Connection Components" on page 7-8.

Note Table 9–2 provides the color coding for both 25-pin cables and 37-pin cables. Color codes for pins 1-25 are for 25-pin cables; color codes for pins 1-37 are for 37-pin cables. ▲

Table 9–1. Cable Options

Description	Cable Length
DB37M to open end	Six feet
DB37F to open end	Six feet
DB25M to open end	Six feet
RS-232	Six feet

Table 9–2. Color Codes for 25-Pin and 37-Pin Cables

Pin	Color	Pin	Color
1	BLACK	20	RED/BLACK
2	BROWN	21	ORANGE/BLACK
3	RED	22	YELLOW/BLACK
4	ORANGE	23	GREEN/BLACK
5	YELLOW	24	GRAY/BLACK
6	GREEN	25	PINK/BLACK
7	BLUE	End color codes for 25-pin cables continue for 37-pin cables.	
8	VIOLET	26	PINK/GREEN
9	GRAY	27	PINK/RED
19	WHITE	28	PINK/VIOLET
11	PINK	29	LIGHT BLUE
12	LIGHT GREEN	30	LIGHT BLUE/BROWN
13	BLACK/WHITE	31	LIGHT BLUE/RED
14	BROWN/WHITE	32	LIGHT BLUE/VIOLET
15	RED/WHITE	33	LIGHT BLUE/BLACK
16	ORANGE/WHITE	34	GRAY/GREEN
17	GREEN/WHITE	35	GRAY/RED
18	BLUE/WHITE	36	GRAY/VIOLET
19	VIOLET/WHITE	37	LIGHT GREEN/BLACK

Mounting Options

The analyzer can be installed in the configuration described in Table 9–1 and shown in Figure 9–1 through Figure 9–4.

Table 9–1. Mounting Options

Mounting Type	Description
Bench	Positioned on bench, includes mounting feet, and front panel side-trim handles.
EIA rack	Mounted in an EIA-style rack, includes mounting slides, and front panel EIA-rack mounting handles.
Retrofit rack	Mounted in an EIA-style rack, includes mounting slides and front panel EIA-rack mounting handles. This configuration is intended for direct replacement of a C-series instrument in an existing rack. The rail mounting location is lower on the case and the front mounting screw slots are in non-standard EIA locations.

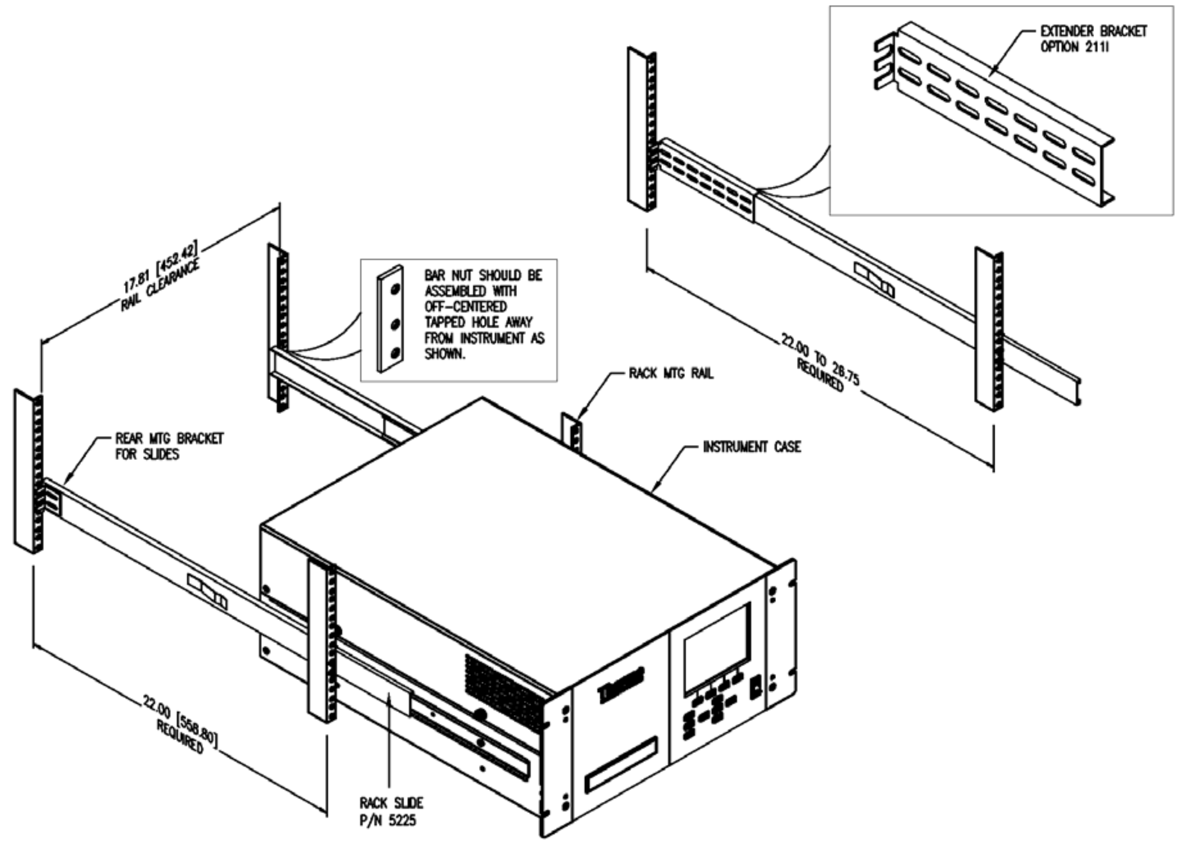

Figure 9–1. Rack Mount Option Assembly

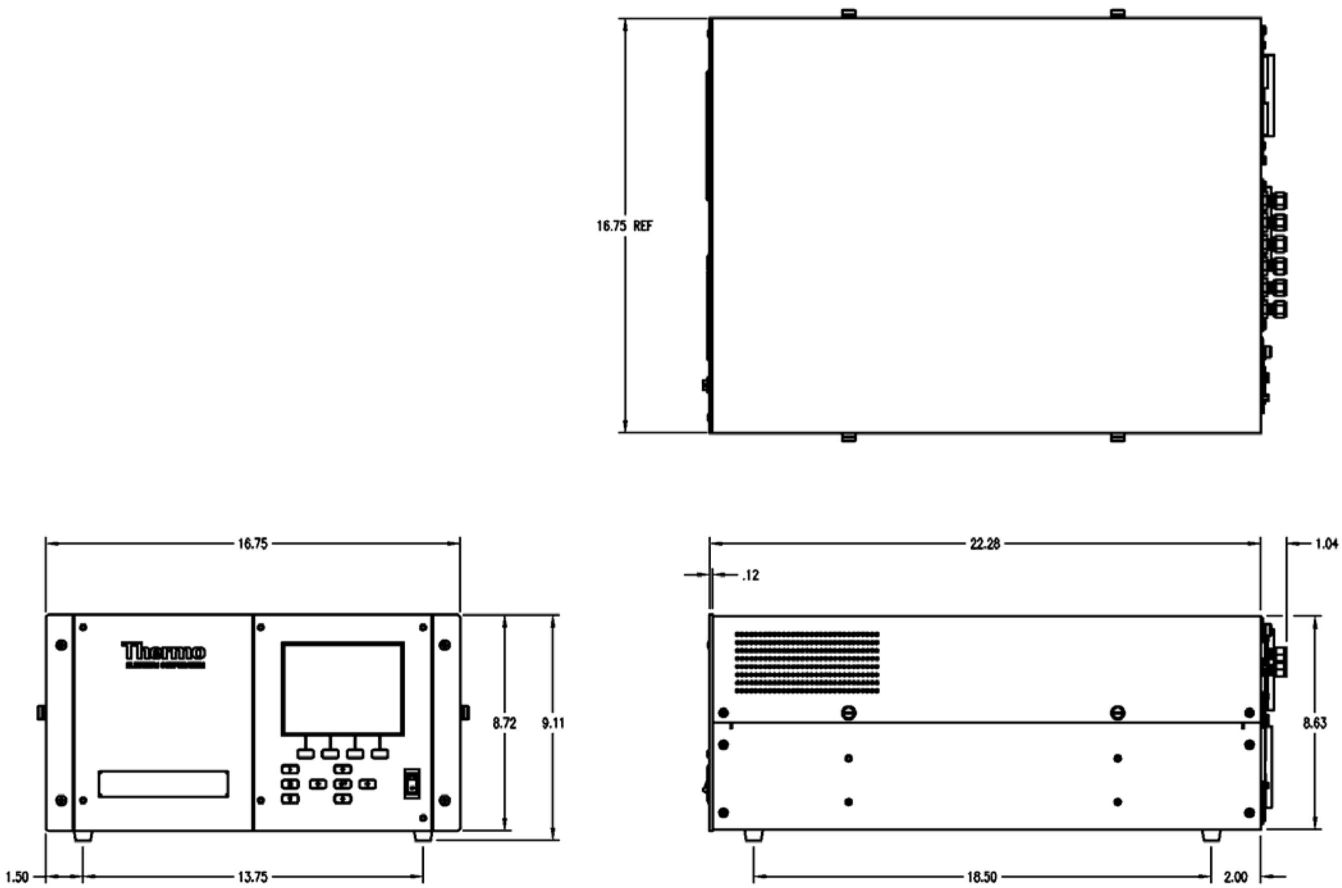

Figure 9–2. Bench Mounting

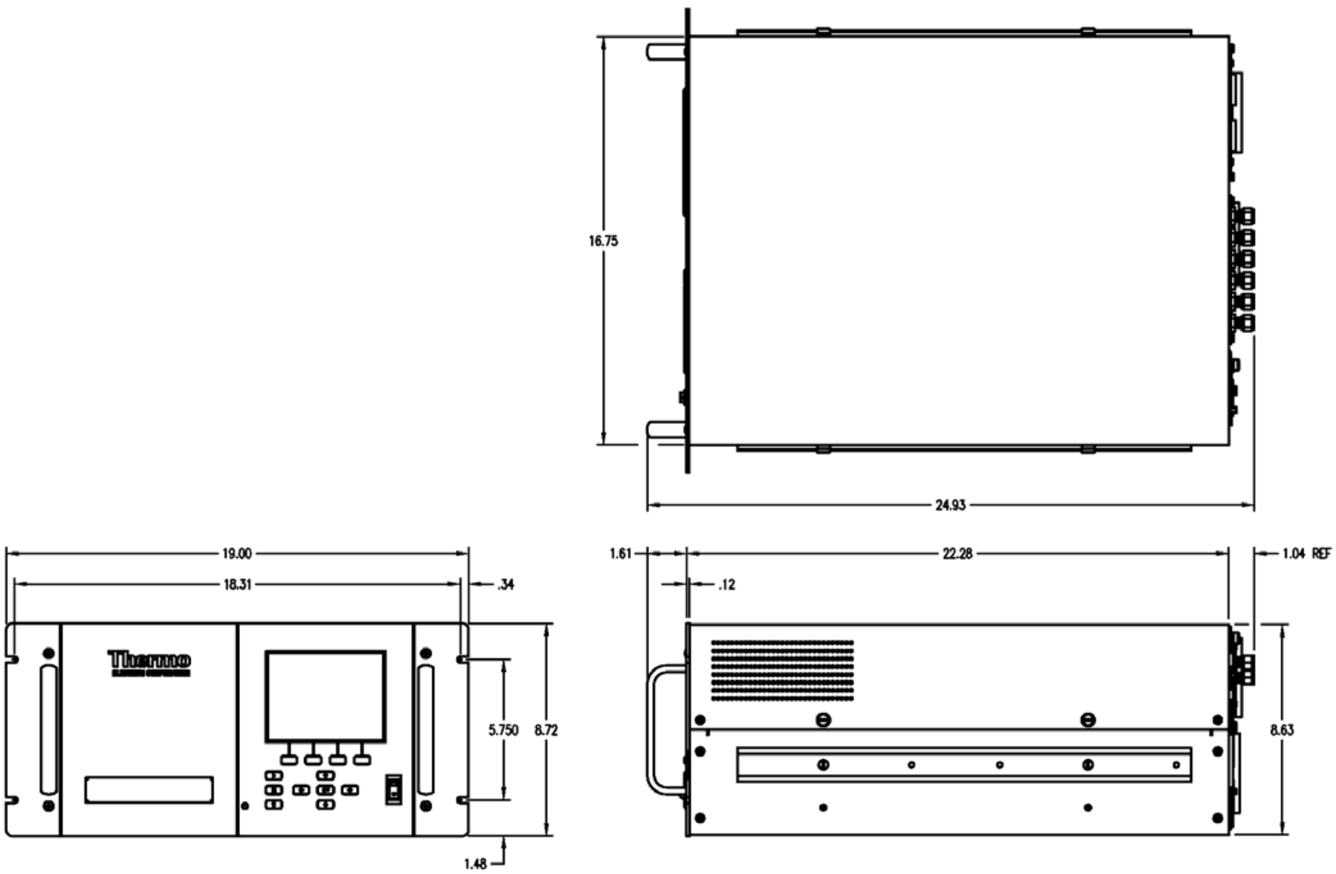

Figure 9–3. EIA Rack Mounting

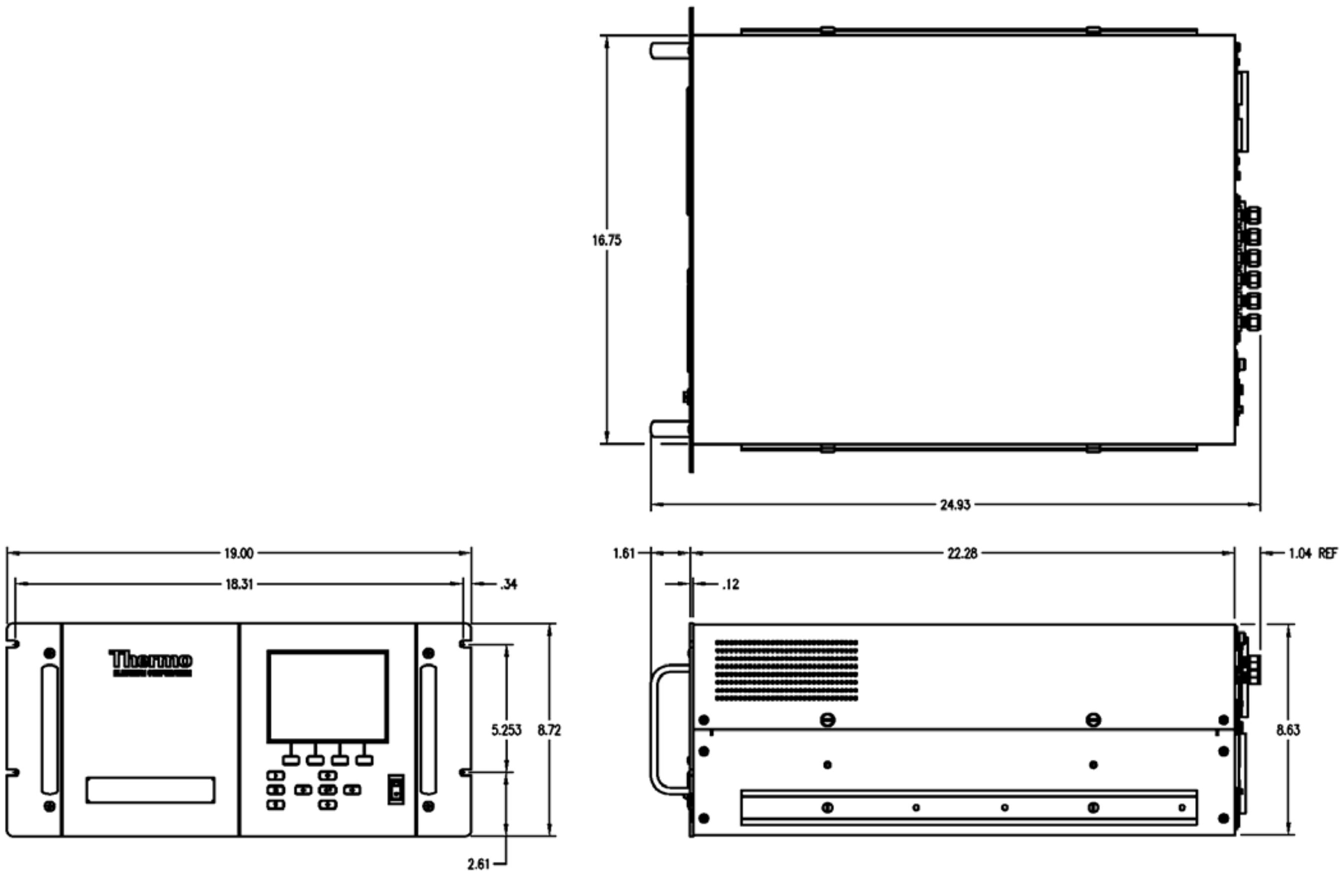

Figure 9–4. Retrofit Rack Mounting

Mantle Material Options

Material options for the mantle include: Hastalloy, PTFE, or Stainless Steel. See Figure 9–5 for dimensions.

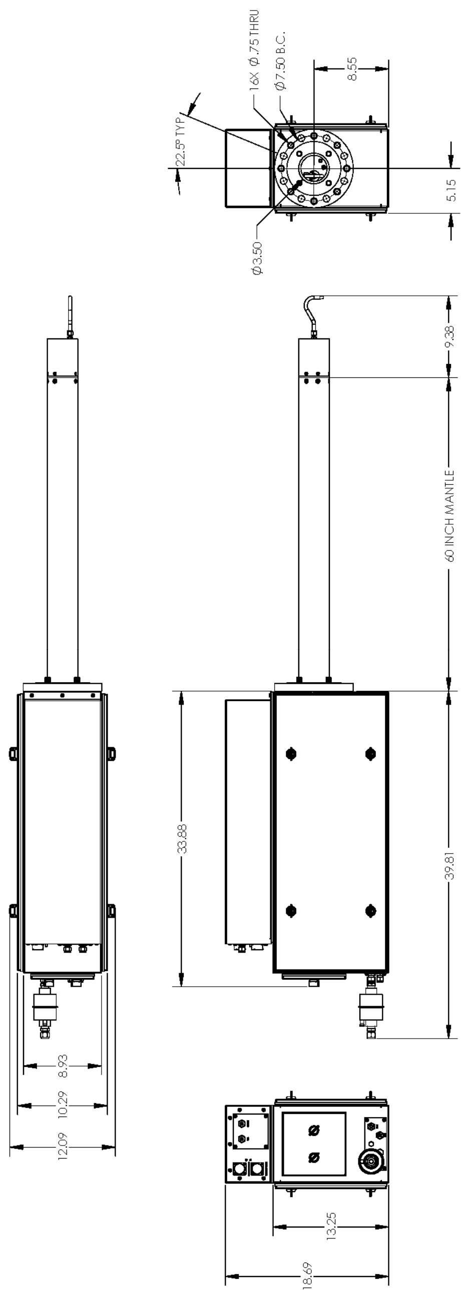

Figure 9–5. Mantle Material Options

Appendix A
Warranty

Seller warrants that the Products will operate or perform substantially in conformance with Seller's published specifications and be free from defects in material and workmanship, when subjected to normal, proper and intended usage by properly trained personnel, for the period of time set forth in the product documentation, published specifications or package inserts. If a period of time is not specified in Seller's product documentation, published specifications or package inserts, the warranty period shall be one (1) year from the date of shipment to Buyer for equipment and ninety (90) days for all other products (the "Warranty Period"). Seller agrees during the Warranty Period, to repair or replace, at Seller's option, defective Products so as to cause the same to operate in substantial conformance with said published specifications; provided that (a) Buyer shall promptly notify Seller in writing upon the discovery of any defect, which notice shall include the product model and serial number (if applicable) and details of the warranty claim; (b) after Seller's review, Seller will provide Buyer with service data and/or a Return Material Authorization ("RMA"), which may include biohazard decontamination procedures and other product-specific handling instructions; and (c) then, if applicable, Buyer may return the defective Products to Seller with all costs prepaid by Buyer. Replacement parts may be new or refurbished, at the election of Seller. All replaced parts shall become the property of Seller. Shipment to Buyer of repaired or replacement Products shall be made in accordance with the Delivery provisions of the Seller's Terms and Conditions of Sale. Consumables, including but not limited to lamps, fuses, batteries, bulbs and other such expendable items, are expressly excluded from the warranty under this warranty.

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

In no event shall Seller have any obligation to make repairs, replacements or corrections required, in whole or in part, as the result of (i) normal wear and tear, (ii) accident, disaster or event of force majeure, (iii) misuse, fault or negligence of or by Buyer, (iv) use of the Products in a manner for which they were not designed, (v) causes external to the Products such as, but not limited to, power failure or electrical power surges, (vi) improper storage and handling of the Products or (vii) use of the Products in combination with equipment or software not supplied by Seller. If Seller determines that Products for which Buyer has requested warranty services are not covered by the warranty hereunder, Buyer shall pay or reimburse Seller for all costs of investigating and responding to such request at Seller's then prevailing time and materials rates. If Seller provides repair services or replacement parts that are not covered by the warranty provided in this warranty, Buyer shall pay Seller therefor at Seller's then prevailing time and materials rates. ANY INSTALLATION, MAINTENANCE, REPAIR, SERVICE, RELOCATION OR ALTERATION TO OR OF, OR OTHER TAMPERING WITH, THE PRODUCTS PERFORMED BY ANY PERSON OR ENTITY OTHER THAN SELLER WITHOUT SELLER'S PRIOR WRITTEN APPROVAL, OR ANY USE OF REPLACEMENT PARTS NOT SUPPLIED BY SELLER, SHALL IMMEDIATELY VOID AND CANCEL ALL WARRANTIES WITH RESPECT TO THE AFFECTED PRODUCTS.

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

Appendix B
C-Link Protocol Commands

This appendix provides a description of the C-Link protocol commands that can be used to remotely control a Model 3880*i* using a host device such as a PC or a datalogger. C-Link protocol may be used over RS-232, RS-485, or Ethernet. C-Link functions can be accessed over Ethernet using TCP/IP port 9880.

Streaming data is sent out the serial port or the Ethernet port on a user-defined periodic basis. Streaming data over Ethernet is only generated when a connection is made on TCP port 9881.

Up to three simultaneous connections per protocol may be made over Ethernet.

Instrument Identification Number

Each command sent to the analyzer over the serial port must begin with the American Standard Code for Information Interchange (ASCII) symbol or byte value equivalent of the instrument's identification number plus 128. For example, if the instrument ID is set to 25, then each command must begin with the ACSII character code 153 decimal. The analyzer ignores any command that does not begin with its instrument identification number. If the instrument ID is set to 0, then this byte is not required. For more information on changing Instrument ID, see Chapter 3, "Operation".

Commands

The analyzer must be in the remote mode in order to change instrument parameters via remote. However, the command "set mode remote" can be sent to the analyzer to put it in the remote mode. Report commands (commands that don't begin with "set") can be issued either in the remote or local mode. For information on changing modes, see Chapter 3, "Operation".

The commands can be sent in either uppercase or lowercase characters. Each command must begin with the proper instrument identification number (ASCII) character. The command in the example below begins with the ASCII character code 166 decimal, which directs the command to the Model 3880*i*, and is terminated by a carriage return "CR" (ASCII character code 13 decimal).

<ASCII 166>	T	I	M	E	<CR>

Many of the commands have two forms. One form reads parameter from the instrument's memory, and the other writes, or updates, a parameter. The syntax for a write command adds the word "set" in front of the command and provides an argument. Command responses are generally echoed with a data element appended.

Note If the Service Mode is active, C-Link "set" commands are not allowed. This is to prevent parameters from being changed remotely while the unit is being serviced locally. ▲

If an incorrect command is sent, an error message is generated. The list of error responses is shown in Table B–1. The following example sends the incorrect command "set unit vout range" instead of the correct command "set analog vout range."

```
Send:        set unit vout range
Receive:     set unit vout range bad cmd
```

Table B–1. Error Response Messages

Command Response	Description
bad cmd	Command is not recognized
too high	Supplied value is higher than the upper limit
too low	Supplied value is lower than the lower limit
invalid string	Supplied string invalid (typically because a letter was detected when the value should be numeric)
data not valid	Supplied value is not acceptable for entered command
can't, wrong settings	Command not allowed for current measurement mode
can't, mode is service	Command not allowed while instrument is in service mode

The "save" and "set save params" commands (duplicated for backward compatibility) store parameters in FLASH memory. It is important that this command be sent each time instrument parameters are changed. If changes are not saved, they will be lost in the event of a power failure.

Commands List

Table B–2 lists the Model 3880*i* C-Link protocol commands. The interface will respond to the command strings outlined below.

Table B–2. C-Link Protocol Commands

Command	Description
1	Simulates pressing soft key 1 pushbutton
2	Simulates pressing soft key 2 pushbutton
3	Simulates pressing soft key 3 pushbutton
4	Simulates pressing soft key 4 pushbutton
addr dns	Reports/sets domain name server address for Ethernet port
addr gw	Reports/sets default gateway address for Ethernet port
addr ip	Reports/sets IP address for Ethernet port
addr nm	Reports/sets netmask address for Ethernet port
addr ntp	Reports the IP address for network time protocol server
allow mode cmd	Reports/sets the current set allow mode command
analog iout range	Reports/sets analog current output range per channel
analog vin	Retrieves analog voltage input data per channel
analog vout range	Reports/sets analog voltage output range per channel
avg time	Reports/sets averaging time
baud	Reports/sets current baud rate
bb period	Reports/sets blow back frequency
clr lrecs	Clears away only long records that have been saved
clr records	Clears away all logging records that have been saved
clr srecs	Clears away only short records that have been saved
contrast	Reports/sets current screen contrast
copy lrec to sp	Sets/copies current lrec selection into the scratch pad
copy sp to lrec	Sets/copies current selections in scratch pad into lrec list
copy sp to srec	Sets/copies current selections in scratch pad into srec list
copy sp to stream	Sets/copies current selections in scratch pad into stream list
copy srec to sp	Sets/copies current srec selection into the scratch pad
copy stream to sp	Sets/copies current streaming data selection into the scratch pad
data treatment lrec	Reports/sets data treatment for concentrations values in long records
data treatment srec	Reports/sets data treatment for concentrations values in short records

Command	Description
date	Reports/sets current date
default params	Sets parameters to default values
dhcp	Reports/sets state of use of DHCP
diag volt iob	Reports diagnostic voltage level for I/O expansion board
diag volt mb	Reports diagnostic voltage level for motherboard
diag volt mib	Reports diagnostic voltage level for measurement interface board
diag volt neph	Reports diagnostic voltage level for dual nephelometer board
dig in	Reports status of the digital inputs
dilution ratio	Reports/sets dilution ratio
din	Reports/sets digital input channel and active state
do (down)	Simulates pressing down pushbutton
dout	Reports/sets digital output channel and active state
dtoa	Reports outputs of the digital to analog converters per channel
en (enter)	Simulates pressing enter pushbutton
er	Returns a brief description of the main operating conditions in the format specified in the commands
erec	Returns a snapshot of the main operating conditions (measurements and status) in the specified format
erec format	Reports/sets erec format (ASCII or binary)
erec layout	Reports current layout of erec data
flags	Reports 8 hexadecimal digits (or flags) that represent the status of the ozonator, PMT, gas mode, and alarms
flow dilution	Reports current measured dilution flow
flow sample	Reports current measured sample flow
format	Reports/sets current reply termination format
func mode	Reports/sets current functional mode of the system
he (help)	Simulates pressing help pushbutton
instr name	Reports instrument name
instrument id	Reports/sets instrument id
internal temp	Reports current internal instrument temperature
isc (iscreen)	Retrieves framebuffer data used for the display
K0	Reports K0 factor of the TEOM transducer
layout ack	Disables stale layout/layout changed indicator ('*')
le (left)	Simulates pressing left pushbutton
list din	Lists current selection for digital input

Command	Description
list dout	Lists current selection for digital output
list lrec	Lists current selection lrec logging data
list sp	Lists current selection in the scratchpad list
list srec	Lists current selection srec logging data
list stream	Lists current selection streaming data output
list var aout	Reports list of analog output, index numbers, and variables
list var din	Reports list of digital input, index numbers, and variables
list var dout	Reports list of digital output, index numbers, and variables
lr	Outputs long records in the format specified in the command
lrec	Outputs long records
lrec format	Reports/sets output format for long records (ASCII or binary)
lrec layout	Reports current layout of lrec data
lrec mem size	Reports maximum number of long records that can be stored
lrec per	Reports/sets long record logging period
malloc lrec	Reports/sets memory allocation for long records
malloc srec	Reports/sets memory allocation for short records
me (menu)	Simulates pressing menu pushbutton
mm dur	Reports current mass mode duration time setting
mm purge	Reports current mass mode purge time setting
mode	Reports operating mode in local, service, or remote
neph bkg a	Reports current background of the zero value for the forward (a) of the nephelometer
neph bkg b	Reports current background of the zero value for the back (b) of the nephelometer
neph conc	Reports concentration of the forward (a) and backward (b) of the nephelometer
neph gain	Reports current value of the gains for the forward (a) and backward (b) of the nephelometer
neph ired	Reports source current of the nephelometer
neph mode	Reports/sets current operating mode of the nephelometer
neph offsets	Resets backgrounds of the zero values for the forward (a) and backward (b) of the nephelometer
neph raw conc	Reports current NEPH raw concentration
neph refv	Reports reference detector voltage of the nephelometer
neph rh	Reports reference detector voltage of the nephelometer

Command	Description
neph rh offset	Reports/sets offset used to calibrate the RH sensor in the nephelometer
neph scatterv	Nephelometer scatter voltage
neph sired	Reports span source current of the nephelometer
neph span conc 1	Reports/sets individual span source concentration 1
neph span conc 2	Reports/sets individual span source concentration 2
neph span conc 3	Reports/sets individual span source concentration 3
neph span conc 4	Reports/sets individual span source concentration 4
neph spsrc level	Reports/sets level on the span source (hot)
neph src level	Reports/sets level set to obtain 65 mA on the source (cold)
neph srefv	Reports span reference detector voltage of the nephelometer
neph temp	Reports PCB temperature of the nephelometer
neph temp offset	Reports/sets offset used to calibrate the temp sensor in the nephelometer optics chamber
no of lrec	Reports/sets number of long records stored in memory
no of srec	Reports/sets number of short records stored in memory
pm factor	Reports current pm factor
pm hist	Reports/sets current pm factor history
pm threshold	Reports current pm threshold
power up mode	Reports/sets the power up mode as local or remote
program no	Reports analyzer program number
push	Simulates pressing a key on the front panel
relay stat	Reports/sets relay logic status to for the designated relay(s)
ri (right)	Simulates pressing right pushbutton
ru (run)	Simulates pressing run pushbutton
save	Stores parameters in FLASH
sc (screen)	C-series legacy command that reports a generic response (Use iscreen instead)
sp field	Reports/sets item number and name in scratch pad list
span duration	Reports/sets span duration times during system check
span src	Reports level on the span source (hot)
span src 1	Reports/sets individual span source level on span source 1
span src 2	Reports/sets individual span source level on span source 2
span src 3	Reports/sets individual span source level on span source 3
span src 4	Reports/sets individual span source level on span source 4

Command	Description
sr	Reports last short record stored
srec	Reports maximum number of short records
srec format	Reports/sets output format for short records (ASCII or binary)
srec layout	Reports current layout of short record data
srec mem size	Reports maximum number of short records
srec per	Reports/sets short record logging period
stream per	Reports/sets current set time interval for streaming data
stream time	Reports/sets a time stamp to streaming data or not
sys check udc	Reports the last forward span drift values for all four span levels
sys check	Reports results of last system check
target flow dilution	Reports/sets current set point for dilution flow
target flow sample	Reports/sets current set point for sample flow
target temp bypass	Reports/sets current target (set to) bypass temperature
target temp neph block	Reports/sets current target (set to) NEPH block temperature
target temp stinger	Reports/sets current target (set to) stinger temperature
target temp teom case	Reports/sets current target (set to) TEOM case temperature
target temp teom tube	Reports/sets current target (set to) TEOM tube temperature
temp bypass	Reports/sets current bypass temperature
temp dilution	Reports/sets current dilution temperature
temp neph block	Reports current NEPH block temperature
temp stinger	Reports current stinger temperature
temp teom case	Reports/sets current target (set to) TEOM case temperature
temp teom tube	Reports current TEOM tube temperature
time	Reports/sets current time (24-hour time)
total mass	Reports current total mass reading of the TEOM transducer
tz	Reports/sets the timezone string for the network time protocol server
up	Simulates pressing up pushbutton
velocity	Reports current velocity reading

Appendix C
MODBUS Protocol

This appendix provides a description of the MODBUS Protocol Interface and is supported both over RS-232/485 (RTU protocol) as well as TCP/IP over Ethernet.

The MODBUS Commands that are implemented are explained in detail in this document. The MODBUS protocol support for the *i*Series enables the user to perform the functions of reading the various concentrations and other analog values or variables, read the status of the digital outputs of the analyzer, and to trigger or simulate the activation of a digital input to the instrument. This is achieved by using the supported MODBUS parameters listed below.

For details of the Model 3880*i* MODBUS Protocol specification, see the following topics:

- "Serial Communication Parameters" on page C-1
- "TCP Communication Parameters" on page C-2
- "Application Data Unit Definition" on page C-2
- "Function Codes" on page C-3
- "MODBUS Parameters Supported" on page C-8

Additional information on the MODBUS protocol can be obtained at http://www.modbus.org. References are from MODBUS Application Protocol Specification V1.1a MODBUS-IDA June 4, 2004.

Serial Communication Parameters

The following are the communication parameters that are used to configure the serial port of the *i*Series to support MODBUS RTU protocol.

Number of Data bits	: 7 or 8
Number of Stop bits	: 1 or 2
Parity	: None, Odd, or Even
Data rate	: 1200 to 115200 Baud (9600 is default)

TCP Communication Parameters

*i*Series Instruments support the MODBUS/TCP protocol. The register definition is the same as for the serial interface. Up to three simultaneous connections are supported over Ethernet.

TCP connection port for MODBUS : 502

Application Data Unit Definition

Here are the MODBUS ADU (Application Data Unit) formats over serial and TCP/IP:

Serial:	Slave Address	Function Code	Data	Error Check
TCP/IP:	MBAP Header	Function Code	Data	

Slave Address

The MODBUS save address is a single byte in length. This is the same as the instrument ID used for C-Link commands and can be between 1 and 127 decimal (i.e. 0x01 hex to 0x7F hex). This address is only used for MODBUS RTU over serial connections.

Note Device ID '0' used for broadcast MODBUS commands, is not supported. Device IDs 128 through 247 (i.e. 0x80 hex to 0xF7 hex) are not supported because of limitations imposed by C-Link. ▲

MBAP Header

In MODBUS over TCP/IP, a MODBUS Application Protocol Header (MBAP) is used to identify the message. This header consists of the following components:

Transaction Identifier	2 Bytes	0x0000 to 0xFFFF (Passed back in response)
Protocol Identifier	2 Bytes	0x00 (MODBUS protocol)
Length	2 Bytes	0x0000 to 0xFFFF (Number of following bytes)
Unit Identifier	1 Byte	0x00 to 0xFF (Passed back in response)

A Slave address is not required in MODBUS over TCP/IP because the higher-level protocols include device addressing. The unit identifier is not used by the instrument.

Function Code

The function code is a single byte in length. The following function codes are supported by the instrument:

Read Coils	:	0x01
Read Inputs	:	0x02
Read Holding Registers	:	0x03
Read Input Registers	:	0x04
Force (Write) Single Coil	:	0x05
Read Exception Status	:	0x06

If a function code is received that is not in this list, an invalid function exception is returned.

Data

The data field varies depending on the function. For more description of these data fields, see "Function Codes" below.

Error Check

In MODBUS over Serial an error check is included in the message. This is not necessary in MODBUS over TCP/IP because the higher-level protocols ensure error-free transmission. The error check is a two-byte (16 bit) CRC value.

Function Codes

This section describes the various function codes that are supported by the Model 3880*i*.

(0x01/0x02) Read Coils / Read Inputs

Read Coils / Inputs read the status of the digital outputs (relays) in the instrument. Issuing either of these function codes will generate the same response.

These requests specify the starting address, i.e. the address of the first output specified, and the number of outputs. The outputs are addressed starting at zero. Therefore, outputs numbered 1–16 are addressed as 0–15.

The outputs in the response message are packed as one per bit of the data field. Status is indicated as 1 = Active (on) and 0 – Inactive (off). The LSB of the first data byte contains the output addressed in the query. The other outputs follow toward the high end of this byte, and from low order to high order in subsequent bytes. If the returned output quantity is not a multiple of eight, the remaining bits in the final data byte will be padded with zeros (toward the high order end of the byte). The Byte Count field specifies the quantity of complete bytes of data.

Note The values reported may not reflect the state of the actual relays in the instrument, as the user may program these outputs for either active closed or open. ▲

Request

Function code	1 Byte	0x01 or 0x02
Starting Address	2 Bytes	0x0000 to maximum allowed by instrument
Quantity of outputs	2 Bytes	1 to maximum allowed by instrument
Unit Identifier	1 Byte	0x00 to 0xFF (Passed back in response)

Response

Function code	1 Byte	0x01 or 0x02
Byte count	1 Byte	N*
Output Status	n Byte	N = N or N+1

*N = Quantity of Outputs / 8, if the remainder not equal to zero, then N=N+1

Error Response

Function code	1 Byte	0x01 or 0x02
Exception code	1 Byte	01=Illegal Function, 02=Illegal Address,
		03=Illegal Data, 04=Slave Device Failure

Here is an example of a request and response to read outputs 2–15:

Request

Field Name	*(Hex)*
Function	0x01
Starting Address Hi	0x00
Starting Address Lo	0x02
Quantity of Outputs Hi	0x00
Quantity of Outputs Lo	0x0D

Response

Field Name	*(Hex)*
Function	0x01
Byte Count	0x03
Output Status 2–10	0xCD
Output Status 11–15	0x0A

The status of outputs 2–10 is shown as the byte value 0xCD, or binary 1100 1101. Output 10 is the MSB of this byte, and output 2 is the LSB. By convention, bits within a byte are shown with the MSB to the left, and the LSB to the right. Thus, the outputs in the first byte are '10 through 2', from left to right. In the last data byte, the status of outputs 15-11 is shown as the byte value 0x0A, or binary 0000 1010. Output 15 is in the fifth bit position from the left, and output 11 is the LSB of this byte. The four remaining high order bits are zero filled.

(0x03/0x04) Read Holding Registers / Read Input Registers

Read holding / input registers reads the measurement data from the instrument. Issuing either of these function codes will generate the same response. These functions read the contents of one or more contiguous registers.

These registers are 16 bits each and are organized as shown below. All of the values are reported as 32-bit IEEE standard 754 floating point format. This uses 2 sequential registers, least significant 16 bits first.

The request specifies the starting register address and the number of registers. Registers are addressed starting at zero. Therefore, registers numbered 1–16 are addressed as 0–15. The register data in the response message are packed as two bytes per register, with the binary contents right justified within each byte. For each register, the first byte contains the high order bits and the second contains the low order bits.

Request

Function code	1 Byte	0x03 or 0x04
Starting Address	2 Bytes	0x0000 to maximum allowed by instrument
Quantity of Registers	2 Bytes	1 to maximum allowed by instrument

Response

Function code	1 Byte	0x03 or 0x04
Byte count	1 Byte	2 x N*
Register value	N* x 2 Bytes	N = N or N+1

*N = Quantity of Registers

Error Response

Function code	1 Byte	Function code + 0x80
Exception code	1 Byte	01=Illegal Function, 02=Illegal Address, 03=Illegal Data, 04=Slave Device Failure

Here is an example of a request and response to read registers 10–13:

Request

Field Name	*(Hex)*
Function	0x03
Starting Address Hi	0x00
Starting Address Lo	0x09
No. of Registers Hi	0x00
No. of Registers Lo	0x04

Response

Field Name	*(Hex)*
Function	0x03
Byte Count	0x06
Register value Hi (10)	0x02
Register value Lo (10)	0x2B
Register value Hi (11)	0x00
Register value Lo (11)	0x00

Register value Hi (12)	0x00
Register value Lo (12)	0x64
Register value Hi (13)	0x00
Register value Lo (13)	0x64

The contents of register 10 are shown as the two byte values of 0x02 0x2B. Then contents of registers 11–13 are 0x00 0x00, 0x00 0x64 and 0x00 0x64 respectively.

(0x05) Force (Write) Single Coil

The force (write) single coil function simulates the activation of the digital inputs in the instrument, which triggers the respective action.

This function code is used to set a single action to either ON or OFF. The request specifies the address of the action to be forced. Actions are addressed starting at zero. Therefore, action number 1 is addressed as 0. The requested ON/OFF state is specified by a constant in the request data field. A value of 0xFF00 requests the action to be ON. A value of 0x0000 requests it to be OFF. All other values are illegal and will not affect the output. The normal response is an echo of the request, returned after the state has been written.

Note This function will not work if the instrument is in service mode. ▲

Request

Function code	1 Byte	0x05
Starting Address	2 Bytes	0x0000 to maximum allowed by instrument
Output Value	2 Bytes	0x0000 or 0xFF00

Response

Function code	1 Byte	0x05
Starting Address	2 Bytes	0x0000 to maximum allowed by instrument
Output Value	2 Bytes	0x0000 or 0xFF00

Error Response

Function code	1 Byte	Function code + 0x80
Exception code	1 Byte	01=Illegal Function, 02=Illegal Address,
		03=Illegal Data, 04=Slave Device Failure

Here is an example of a request to write Coil 5 ON:

Request

Field Name	*(Hex)*
Function	05
Output Address Hi	00
Output Address Lo	05
Output Value Hi	FF
Output Value Lo	00

Response

Field Name	*(Hex)*
Function	05
Output Address Hi	00
Output Address Lo	05
Output Value Hi	FF
Output Value Lo	00

MODBUS Parameters Supported

Table C–1 through Table C–3 lists the MODBUS addresses supported for the Model 3880*i*.

IMPORTANT NOTE The addresses in the following tables are Protocol Data Unit (PDU) addresses. Verify the coil number on your MODBUS master to ensure that it matches the coil number on the instrument. ▲

Note Coil status 1 indicates active state. ▲

Table C–1. Read Coils for 3880*i*

Coil Number	Status
0	NONE
1	SERVICE
2	LOCAL/REMOTE
3	MONITOR MODE
4	MASS MODE
5	PURGE MODE
6	BLOW BACK MODE

Coil Number	Status
7	MANUAL MODE
8	NEPH ZERO MODE
9	NOT USED
10	SINGLE SPAN SYSTEM CHECK
11	MULTI SPAN SYSTEM CHECK
12	PURGE ZERO CHECK
13	PURGE SPAN 1 CHECK
14	PURGE SPAN 2 CHECK
15	PURGE SPAN 3 CHECK
16	PURGE SPAN 4 CHECK
17	GEN ALARM
18	TEMP STACK
19	TEMP DILUTION
20	TEMP STINGER
21	TEMP BYPASS
22	TEMP NEPH BLOCK
23	TEMP NEPH
24	TEMP NEPH PCB
25	TEMP TEOM CASE
26	TEMP TEOM TUBE
27	TEMP PROBE CONTROL
28	PRES BAROMETER
29	NOT USED
30	NOT USED
31	PRES TEOM DP
32	FLOW BYPASS
33	FLOW DILUTION
34	FLOW TEOM
35	FLOW NOZZLE
36	FLOW STINGER
37	FLOW DILUTION RATIO
38	SAMPLE FLOW PERCENT DRIFT
39	VELOCITY
40	PM WET

Coil Number	Status
41	PM DRY
42	PM FACTOR
43	NEPH FORWARD
44	NEPH BACK
45	NEPH FORWARD AVERAGE
46	NEPH SOURCE
47	NEPH REFERENCE DETECTOR
48	NEPH SPAN SOURCE
49	NEPH SPAN REFERENCE
50	NEPH RH
51	NEPH FORWARD PERCENT ZERO DRIFT
52	NEPH FORWARD PERCENT SPAN DRIFT
53	NEPH CONCENTRATION INST
54	TEOM
55	TEOM INST
56	TEOM FREQ
57	TEOM STANDARD DEVIATION
58	TEOM K0
59	MIB STATUS
60	I/O BOARD STATUS
61	THERMOCOUPLE BOARD STATUS
62	NEPH STATUS
63	TEOM STATUS
64	TEOM CASE TMP CRITICAL
65	NEPH REF DET CRITICAL
66	NEPH REL HUMIDITY CRITICAL
67	CRITICAL CONDITION

In addition to the coils listed in the Read Coils table, coils in the Write Coils table can also be read.

IMPORTANT NOTE The addresses in the following tables are Protocol Data Unit (PDU) addresses. Verify the register number on your MODBUS master to ensure that it matches the register number on the instrument. ▲

Note For additional information on how to read registers and interpret the data, refer to the "(0x03/0x04) Read Holding Registers / Read Input Registers" section in this appendix. ▲

Table C–2. Read Registers for 3880*i*

Register Number	Variable
0	NONE
1 & 2	PM WET
3 & 4	PM DRY
5 & 6	PM FACTOR
7 & 8	FORWARD CONC
9 & 10	BACK CONC
11 & 12	TEOM CONC
13 & 14	FORWARD CONC AVG
15 & 16	TEOM INSTANTANEOUS
17 & 18	TEMP STACK
19 & 20	TEMP DILUTION
21 & 22	TEMP STINGER
23 & 24	TEMP BYPASS
25 & 26	TEMP NEPH
27 & 28	TEMP NEPH BLOCK
29 & 30	TEMP NEPH PCB
31 & 32	TEMP TEOM TUBE
33 & 34	TEMP TEOM CASE
35 & 36	TEMP PROBE CONTROL
37 & 38	PRES BAROMETER
39 & 40	SPAN 4 CONC
41 & 42	SPAN 3 CONC
43 & 44	TEOM DP
45 & 46	FLOW NOZZLE
47 & 48	SPAN 2 CONC
49 & 50	FLOW DILUTION
51 & 52	FLOW BYPASS
53 & 54	FLOW SAMPLE

Register Number	Variable
55 & 56	FLOW SAMPLE CHECK
57 & 58	DILUTION RATIO
59 & 60	STACK VELOCITY
61 & 62	NEPH SOURCE
63 & 64	NEPH REFERENCE DETECTOR
65 & 66	NEPH SPAN SOURCE
67 & 68	NEPH SPAN REFERENCE
69 & 70	NEPH RH
71 & 72	TEOM FREQUENCY
73 & 74	TEOM STANDARD DEVIATION
75 & 76	TEOM K0
77 & 78	FORWARD ZERO DRIFT
79 & 80	FORWARD SPAN DRIFT
81 & 82	TOTAL MASS
83 & 84	NEPH GAINS
85 & 86	NEPH SAMPLE DRIFT
87 & 88	FORWARD INSTANTANEOUS
89 & 90	TEOM AVERAGE
91 & 92	AIR TUBE POWER
93 & 94	CASE POWER
95 & 96	ANALOG 1
97 & 98	ANALOG 2
99 & 100	ANALOG 3
101 & 102	ANALOG 4
103 & 104	ANALOG 5
105 & 106	ANALOG 6
107 & 108	ANALOG 7
109 & 110	ANALOG 8
111 & 112	TEOM CYCLES
113 & 114	REFERENCE CLOCKS
115 & 116	MAX SPAN
117 & 118	CS
119 & 120	NEPH BKG FLAG
121 & 122	NEPH OFFSET FLAG

Register Number	Variable
123 & 124	NEPH PURGE FLOW
125 & 126	TEOM F0

IMPORTANT NOTE The addresses in the following tables are Protocol Data Unit (PDU) addresses. Verify the coil number on your MODBUS master to ensure that it matches the coil number on the instrument. ▲

Note Writing 1 to the coil number shown in the following table will initiate the "action triggered" listed in the table. This state must be held for at least 1 second to ensure the instrument detects the change and triggers the appropriate action. ▲

Note The coils within each coil group in the following table are mutually exclusive and will not be triggered if there is conflict. Before you assert (1) one coil in a group, make sure the other coils in the group are de-asserted (0). ▲

Table C–3. Write Coils for 3880*i*

Coil Number	Action Triggered
101	MONITOR MODE
102	PURGE MODE
103	MANUAL MODE
104	MASS MODE
105	BLOWBACK MODE
106	NEPH ZERO MODE
107	SINGLE SPAN CHECK MODE
108	MULTI SPAN CHECK MODE
109	PURGE ZERO CHECK
110	PURGE SPAN 1 CHECK
111	PURGE SPAN 2 CHECK
112	PURGE SPAN 3 CHECK
113	PURGE SPAN 4 CHECK
114	NEPH AUTO CAL
115	NEPH CAL SAVE
116	NEPH CAL REST

Coil Number	Action Triggered
117	EXT ALARM

Reading a Write Coil

To read a write coil, issue a read coil command for that coil. For example, to view the state of write coil 101, issue a “read coil 101”.