Model 80*i*

Instruction Manual
Hg Analyzer
Part Number 103194-00
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WEEE Compliance

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About This Manual

This manual provides information about installing, operating, maintaining, and servicing the Model 80*i*. It also contains important alerts to ensure safe operation and prevent equipment damage. The manual is organized into the following chapters and appendices to provide direct access to specific operation and service information.

- Chapter 1 “Introduction” provides an overview of the product features, describes the principle of operation, and lists the specifications.
- Chapter 2 “Installation” describes how to unpack, setup, and start-up the instrument.
- Chapter 3 “Operation” describes the front panel display, the front panel pushbuttons, and the menu-driven firmware.
- Chapter 4 “Calibration” provides the procedures for calibrating the instrument and describes the required equipment.
- Chapter 5 “Preventive Maintenance” provides maintenance procedures to ensure reliable and consistent instrument operation.
- Chapter 6 “Troubleshooting” presents guidelines for diagnosing instrument failures, isolating faults, and includes recommended actions for restoring proper operation.
- Chapter 7 “Servicing” presents safety alerts for technicians working on the instrument, 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.
- Chapter 9 “Optional Equipment” describes the optional equipment that can be used with this instrument.
- Appendix A “Warranty” is a copy of the warranty statement.
- Appendix B “C-Link Protocol Commands” provides a description of the C-Link protocol commands that can be used to remotely control an instrument 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 and Equipment Damage Alerts

This manual contains important information to alert you to potential safety hazards and risks of equipment damage. Refer to the following types of alerts you may see in this manual.

Safety and Equipment Damage Alert Descriptions

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

Safety and Equipment Damage Alerts in this Manual

Alert	Description
WARNING	If the equipment is operated in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired. ▲
	The service procedures in this manual are restricted to qualified service personnel only. ▲
	The Model 80*i* is supplied with a three-wire grounding cord. Under no circumstances should this grounding system be defeated. ▲
Equipment Damage	Do not attempt to lift the instrument by the cover or other external fittings. ▲
	Some internal components can be damaged by small amounts of static electricity. A properly ground antistatic wrist strap must be worn while handling any internal component. 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. ▲
	This adjustment should only be performed by an instrument service technician. ▲
	Handle all printed circuit boards by the edges only. ▲

Alert	Description
	Do not remove the panel or frame from the LCD module. ▲
	The LCD module polarizing plate is very fragile, handle it carefully. ▲
	Do not wipe the LCD module polarizing plate with a dry cloth, it may easily scratch the plate. ▲
	Do not use Ketonics solvent or aromatic solvent to clean the LCD module, 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.thermo.com/aqi.

1-866-282-0430 Toll Free

1-508-520-0430 International

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Chapter 1
Introduction

The Model 80*i* Hg Analyzer combines proven detection technology, easy to use menu-driven firmware, and advanced diagnostics to offer unsurpassed flexibility and reliability. The Model 80*i* has the following features:

- 320 x 240 graphics display
- Menu-driven firmware
- Field programmable ranges
- Multiple user-defined analog outputs
- Analog input options
- High sensitivity
- Fast response time
- Linearity through all ranges
- Totally self contained
- User-selectable digital input/output capabilities
- Standard communications features include RS-232/485 and Ethernet
- C-Link, MODBUS, streaming data, and NTP (Network Time Protocol) protocols. Simultaneous connections from different locations over Ethernet

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

- "Principle of Operation" on page 1-2 describes the Model 80*i* operating principles.
- "Specifications" on page 1-4 lists of the instrument's performance specifications.

Thermo Fisher Scientific is pleased to supply this Hg analyzer. 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.

Principle of Operation

The Model 80*i* is normally configured as one component of an integrated Hg Continuous Emission Monitoring System (CEMS). Thermo Fisher Scientific’s Mercury Freedom System is comprised of a Hg analyzer (Model 80*i*), a Hg calibrator (Model 81*i*), a Hg probe controller (Model 82*i*), and a Hg probe (Model 83*i*) along with additional peripheral components, such as a zero air supply, umbilical, and instrument rack. However, the Model 80*i* is also available as a stand-alone instrument.

The Model 80*i* Analyzer is based on the principle that Hg atoms absorb ultraviolet (UV) light at 254 nm, become excited, then decay back to the ground energy state, emitting (fluorescing) UV light at the same wavelength. Specifically,

$$Hg + h\nu(254nm) \rightarrow Hg^* \rightarrow Hg + h\nu(254nm)$$

The sample from the Hg probe (Model 83*i*) is introduced to the rear panel of the instrument as either Total Hg or Elemental Hg from the appropriate probe umbilical connection (see **Figure 1–1**). When the Model 80*i* is sampling Total Hg, the total sample is routed into the fluorescence chamber via Solenoids S1 (NO state) and S3 (NO state). During this time, the Elemental Hg sample bypasses the chamber via Solenoid S2 (NO state).

When the Model 80*i* is sampling Elemental Hg, the elemental sample is routed via Solenoids S2 (normally closed (NC) state) and S3 (normally open (NO) state) into the fluorescence chamber. During this time, the Total Hg sample bypasses the chamber via Solenoid S1 (NC state). As the monitored sample (Total or Elemental) leaves the optical chamber, it passes through a flow sensor, then to an external pump. The external pump is used to draw the sample through the instrument and to create the instrument vacuum which is measured with the pressure transducer.

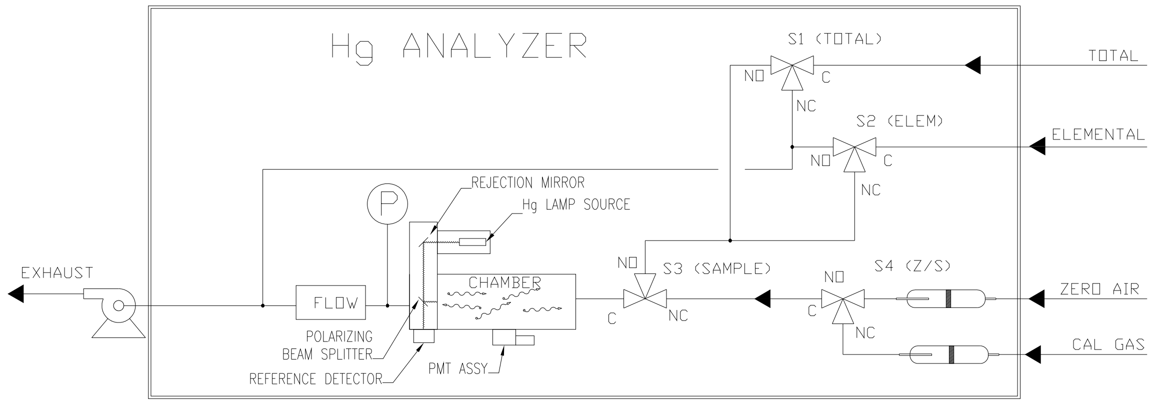


Figure 1–1. Model 80*i* Flow Schematic

Either the Total or Elemental sample is introduced into the fluorescence chamber, where UV light from a high energy Hg line source lamp excites the Hg atoms. The UV light is directed to the fluorescence chamber by a rejection mirror/beam splitter combination. A reference detector monitors the lamp intensity by viewing the transmitted light from the beam splitter.

As the excited Hg atoms decay back to the ground energy state, they emit UV light that is proportional to the Hg concentration. The Hg fluorescence is monitored by a solar blind photomultiplier tube (PMT) placed at a right angle to the exciting radiation. The PMT detects the UV light emission from the decaying Hg atoms.

Calibration gas from the Hg calibrator (Model 81*i*) is plumbed to the zero air and cal gas bulkheads on the rear panel of the Model 80*i*. The zero or span gas is routed through an internal critical orifice, through either the NO or NC port of Solenoid S4, through the NC port of Solenoid S3 and into the fluorescence chamber. During this time, both Total and Elemental Hg samples bypass the chamber and are sent to the external pump exhaust.

The Model 80*i* outputs the Total Hg or Elemental Hg concentration to the front panel display, the analog outputs, and also makes the data available over the serial or Ethernet connection.

Specifications

Table 1–1. Model 80*i* Specifications

Preset ranges	1.5, 3, 6, 15, 30, 60, 150, 300 µg/m^3
Zero noise	1 ng/m^3 RMS (300 second averaging time)
Lower detectable limit	2 ng/m^3 (300 second averaging time) 0.4 ng/m^3 with as a carrier gas
Zero drift (24 hour)	< 5 ng/m^3
Span drift	± 1% full-scale
Response time	30 sec (10 second averaging time) 110 sec (60 second averaging time) 320 sec (300 second averaging time)
Linearity	± 1% of full-scale
Sample flow rate	0.25 LPM
Operating temperature	15–35 °C (may be safely operated in the range of 0–45 °C)
Power requirements	100 VAC @ 50/60 Hz 115 VAC @ 50/60 Hz 220-240 VAC @ 50/60 Hz 165 watts
Physical dimensions	16.75" (W) X 8.62" (H) X 23" (D)
Weight	Approximately 48 lbs.
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
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

*In non-condensing environments. Performance specifications basaed on operation within 20-30 °C range.

Chapter 2
Installation

Installation of the Model 80*i* Hg Analyzer 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" on page 2-1
- "Unpacking and Inspection" on page 2-1
- "Setup Procedure" on page 2-3
- "Connecting External Devices" on page 2-7
- "Startup" on page 2-11

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 80*i* is shipped complete in two containers. One container includes the 80*i* instrument; 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**).

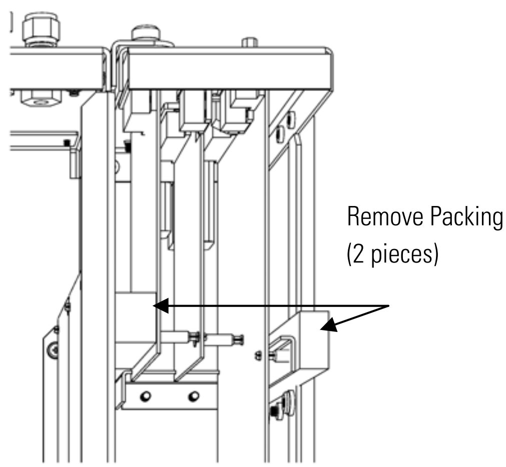


Figure 2–1. Remove the Packing Material

4. Remove the Packing Material

5. Check for possible damage during shipment.

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

7. Install the two glass orifices **Figure 2–2**) so that pre-filters are first in the flow path (closest to the rear panel) .

8. Re-install the cover.

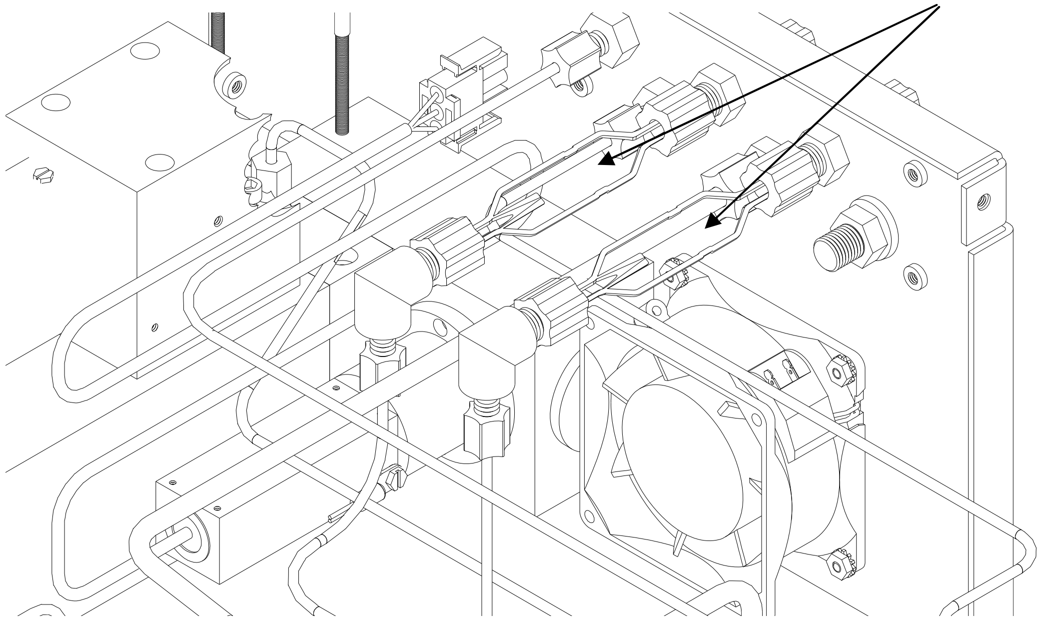


Figure 2–2. Installing the Orifices

Setup Procedure

The Model 80*i* is capable of measuring elemental mercury from a laboratory instrument source (such as the Model 81*i* Calibrator), or elemental and total mercury as emitted from a coal-fired boiler or incinerator.

The procedure for setting up the Model 80*i* will vary depending on the particular configuration where the Model 80*i* is used, for example:

- in an integrated Hg Continuous Emission Monitoring System (CEMS), such as the Thermo Fisher Scientific Mercury Freedom System, or a Hg CEMS from another source
- as a stand-alone instrument used with a Thermo Fisher Scientific Model 81*i* Hg Calibrator, or as a stand-alone instrument used with a Hg calibrator from another source.

If the Model 80*i* is used to measure Hg from another source, refer to the setup procedure in the manual from that source.

If the Model 80*i* is used in a Mercury Freedom System CEMS or as a stand-alone instrument used with a Model 81*i*, use the setup procedure that follows.

When the Model 80*i* will be interconnected with a Model 81i, always make the connections to the Model 80*i* first, and then make the connections to the Model 81i.

WARNING The Model 80*i* is supplied with a three-wire grounding cord. Under no circumstances should this grounding system be defeated. ▲

Note All tubing should be constructed of PFA Teflon® with an OD of 1/4-inch and a minimum ID of 1/8-inch. ▲

Stand-Alone Installation

Use the following procedure to install a stand-alone instrument.

1. Add a 250 cc glass orifice (**Figure 2–3**) to the Hg TOTAL connection on the rear panel (**Figure 2–4**).

2. Connect the mercury sample line to the glass orifice installed in Step 1 using a Teflon union or similar connection (**Figure 2–3**) .

3. Cap the Hg ELEMENTAL bulkhead fitting (**Figure 2–3**).

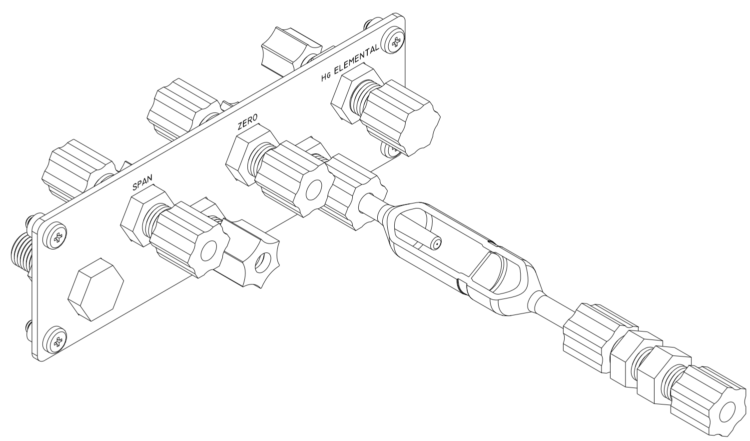


Figure 2–3. Connect Glass Orifice for Stand-Alone Configuration

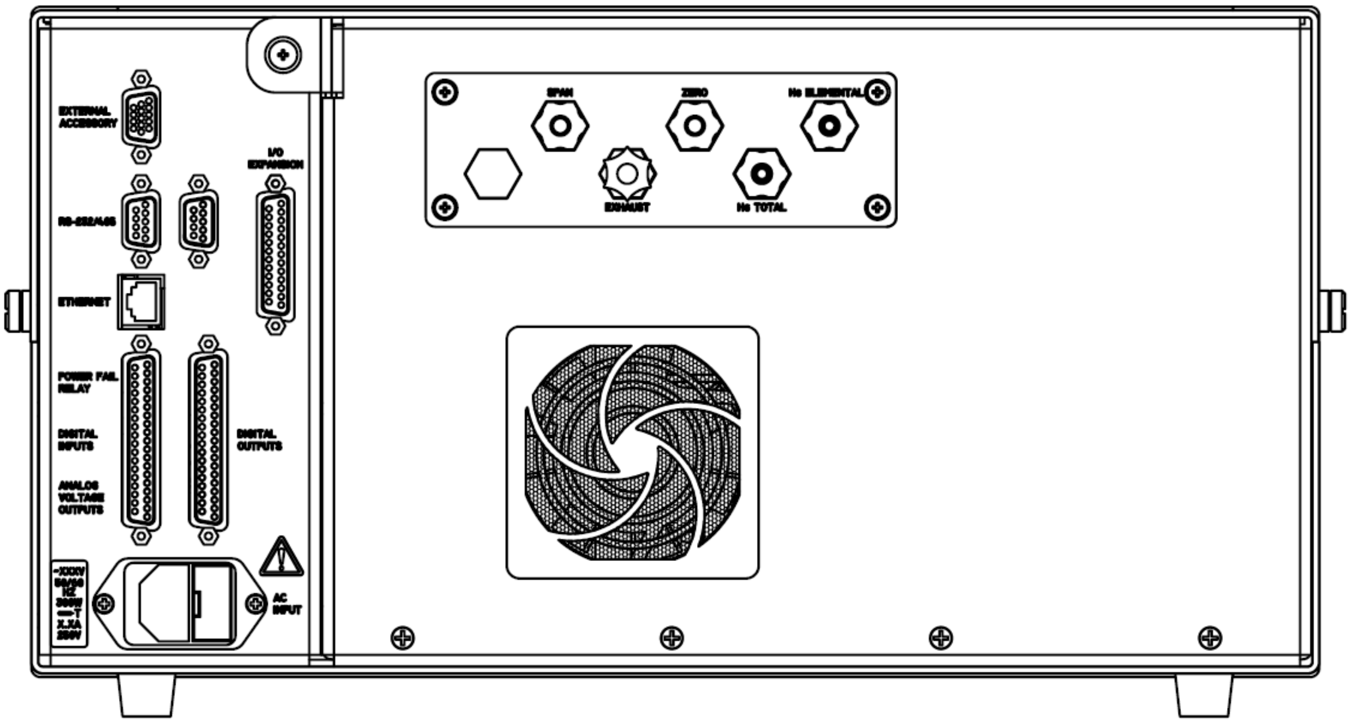


Figure 2–4. Model 80*i* Rear Panel

System Installation

Use the following procedure to install the Model 80*i* Analyzer in an emissions monitoring application.

1. Connect the Hg ELEMENTAL LINE #2 from the Model 83*i* Extraction Probe to the Model 80*i* Hg ELEMENTAL bulkhead (**Figure 2–5**).

2. Connect the Hg TOTAL LINE #1 from the Model 83*i* Extraction Probe to the Model 80*i* Hg TOTAL bulkhead (**Figure 2–5**).

3. Connect the Model 80*i* VACUUM bulkhead to the inlet (vacuum) side of the sample pump (**Figure 2–5**). The exhaust line should be 1/4-inch OD with a minimum ID of 1/8-inch. The length of the exhaust line should be less than 10 feet. Verify that there is no restriction in this line.

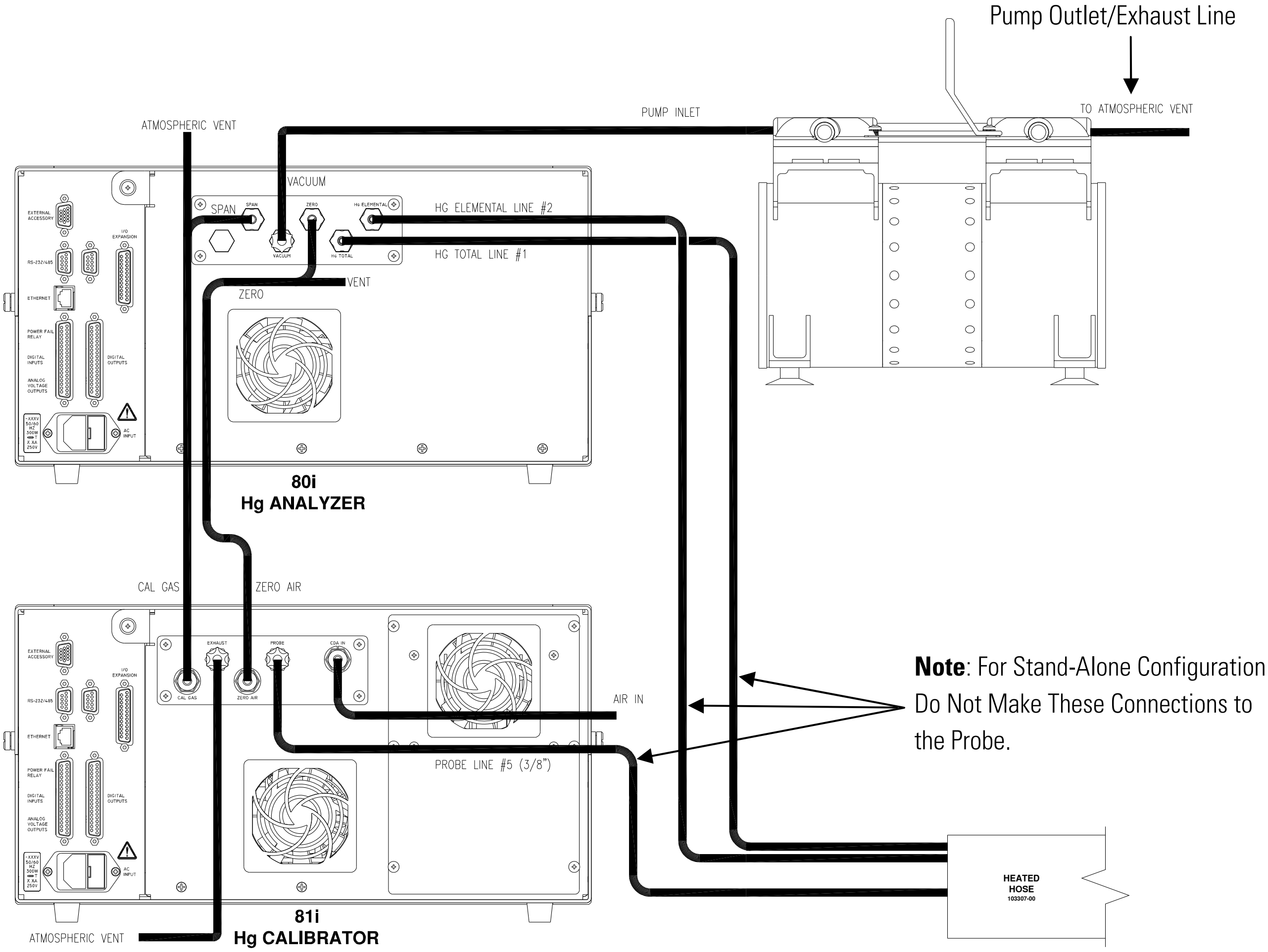


Figure 2–5. 80*i* and 81*i* Plumbing Connections

4. Connect the outlet of the sample pump to a vent suitable for mercury or to a suitable scrubber.

5. Connect the Model 80*i* SPAN bulkhead to the 81i CAL GAS bulkhead with an atmospheric dump (**Figure 2–6**).

6. Connect the ZERO bulkhead to the 81i ZERO AIR bulkhead with an atmospheric dump (**Figure 2–6**).

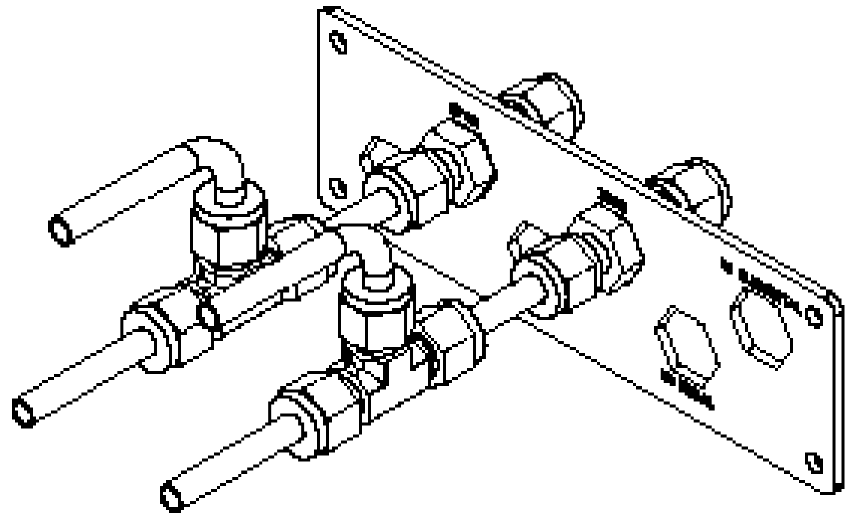


Figure 2–6. Model 80*i* Bypass Dump Connections

7. Connect a suitable recording device to the rear panel connector. See “Instrument Controls > I/O Configuration” in the “Operation” chapter for more information about the rear panel pin-outs.

8. Plug the instrument 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” in the “Servicing” chapter.

Terminal Board PCB Assemblies

The terminal board PCB assembly is a circuit board with a D-Sub connector on one side and a series of screw terminals on the other. This assembly provides 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 I/O Expansion Board)

I/O Terminal Board

Figure 2–7 shows the recommended method for attaching the customer-supplied 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 this terminal board, if more I/O is desired, an alternative means of connection is required. ▲

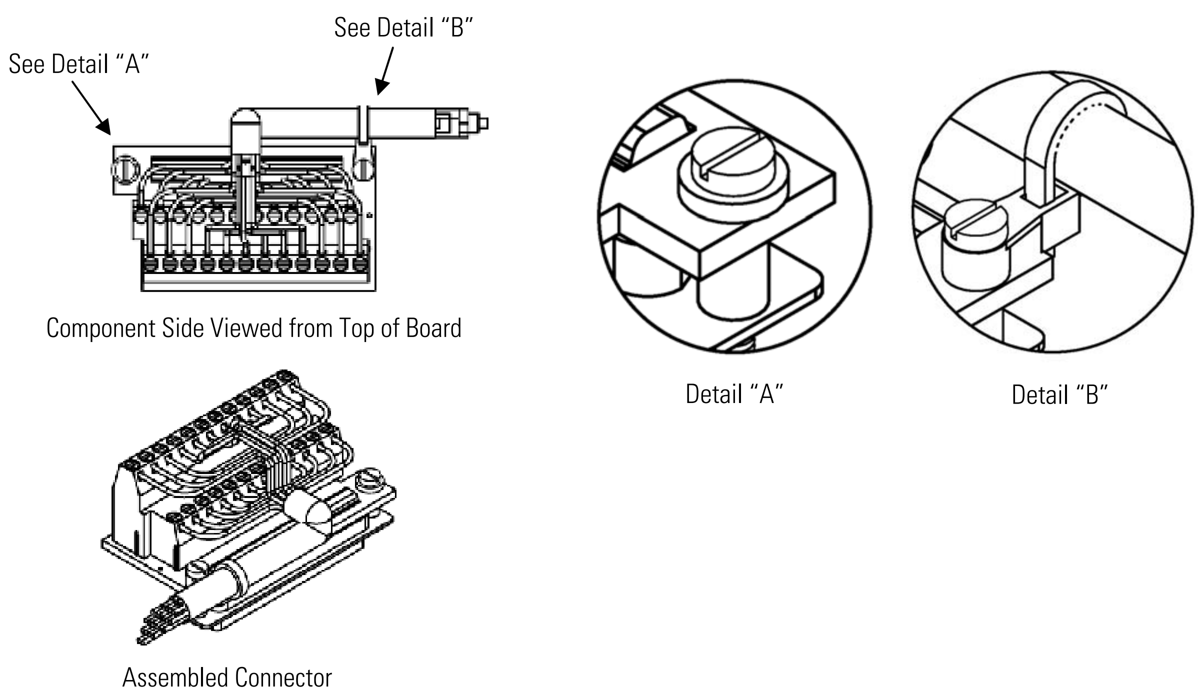


Figure 2–7. I/O Terminal Board Views

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

Pin	Signal Description	Pin	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 2–8 shows the recommended method for attaching the cable to the D/O terminal board using the included tie-down and spacer. **Table 2–2** identifies the connector pins and associated signals.

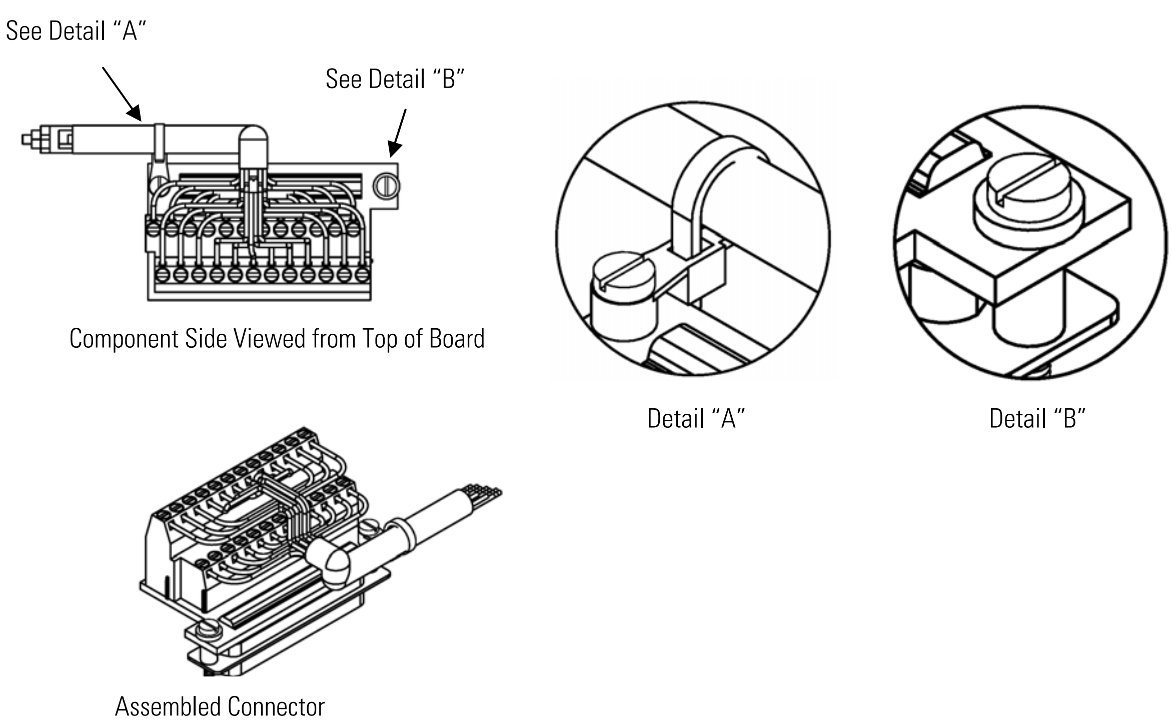


Figure 2–8. D/O Terminal Board Views

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

Pin	Signal Description	Pin	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 I/O Expansion Board.

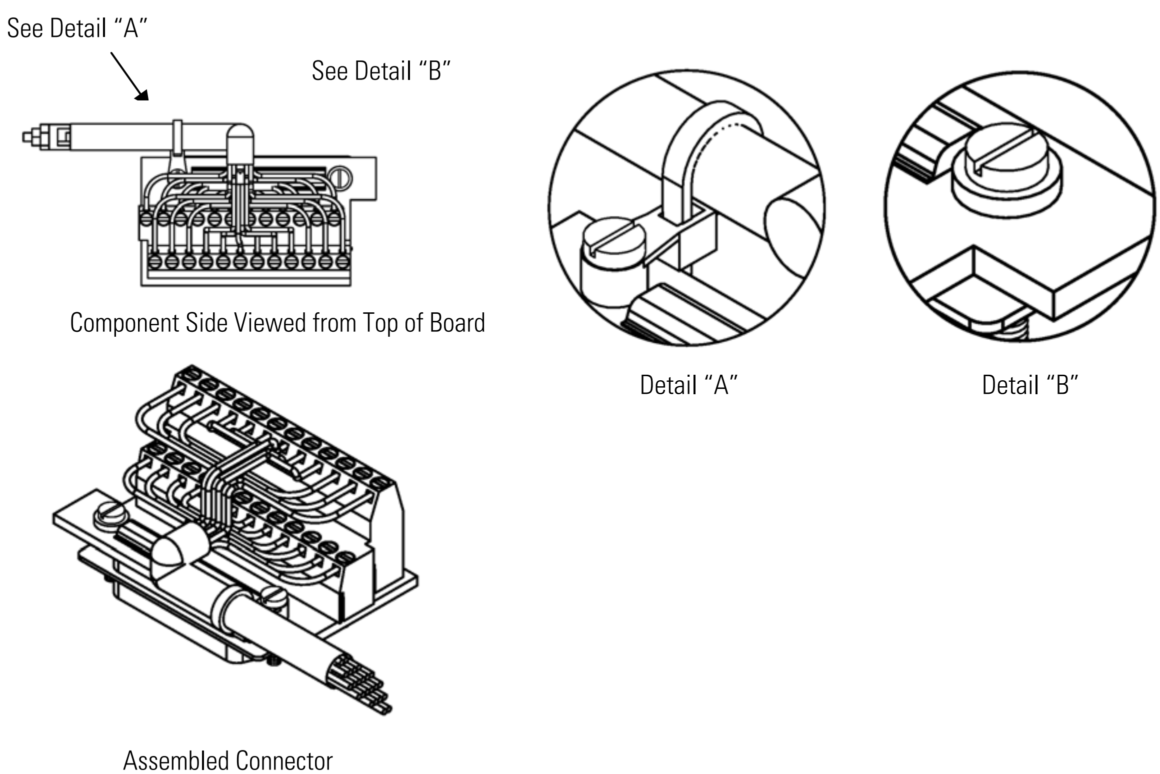


Figure 2–9. 25-Pin Terminal Board Views

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

Pin	Signal Description	Pin	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

Startup

Use the following procedure when starting the instrument.

Note The correct startup sequence is to start the 82*i*, the 81*i*, and the 80*i*. If the 81*i* and the 80*i* are ON, turn them OFF before starting the 82*i*. ▲

1. Turn the power ON.

2. Allow one hour for the instrument to stabilize.

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

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

Chapter 3
Operation

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

- "Display" on page 3-2
- "Pushbuttons" on pageon page 3-3
- "Firmware Overview" on page 3-4
- "Range Menu" on page 3-8
- "Averaging Time" on page 3-9
- "Calibration Factors Menu" on page 3-10
- "Calibration Menu" on page 3-13
- "Instrument Controls Menu" on page 3-18
- "Diagnostics Menu" on page 3-59
- "Alarms Menu" on page 3-69
- "Service Menu" on page 3-87
- "Password" on page 3-104

Display

The 320 x 240 graphics liquid-crystal display (LCD) (**Figure 3–1**) 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.

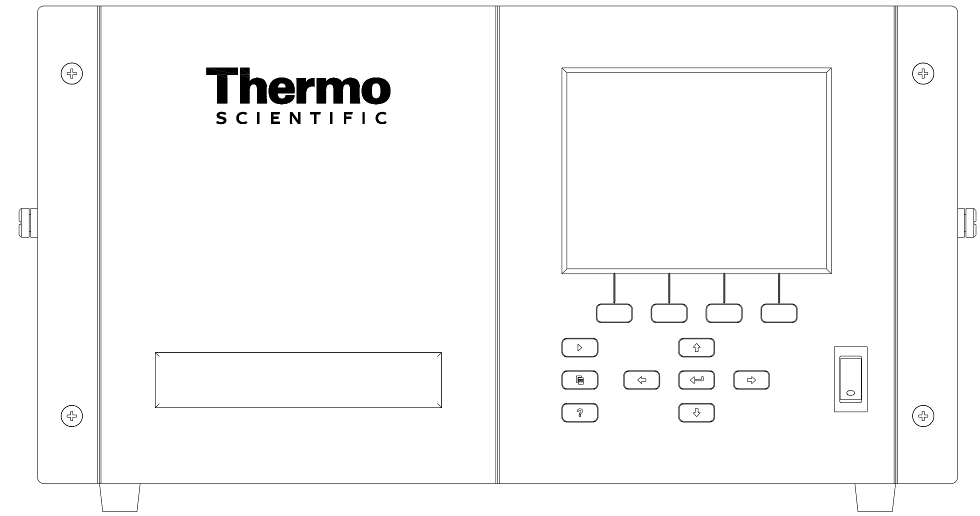


Figure 3–1. Front Panel Display

CAUTION If the LCD panel breaks, do not to 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 (**Figure 3–2**) allow the user to traverse the various screens/menus. **Table 3–1** lists the front panel pushbuttons and their functions.

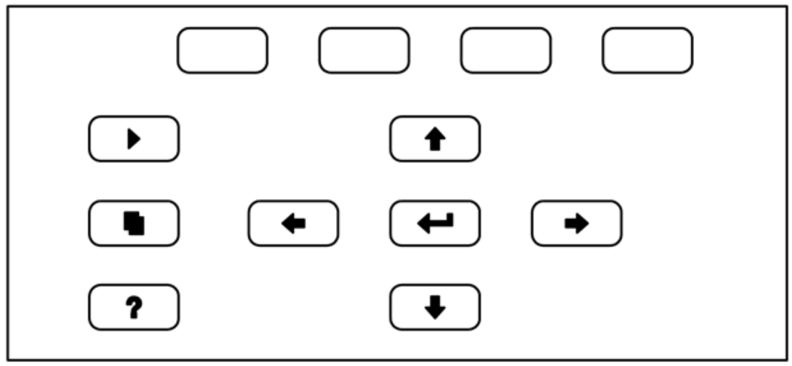


Figure 3–2. Front Panel Pushbuttons

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".
= Run	The is used to display the Run screen. The Run screen normally displays the Hg^0, Hg^{2+}, and Hg^t concentrations.
= 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. To exit a help screen, press or ? to return to the previous screen, or to return to the Run 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 at any moment. The function of the soft keys allows immediate access to the menu structure and most often used menus and screens. They are located directly underneath the display and as the keys' functions change this is indicated by user-defined labels in the lower part of the display, so that the user knows what the keys are to be used for.

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 for 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. ▲

```
EDIT SOFT KEY PROMPT:
 CURRENTLY:RANGE
           RANGE
     ABCDEFGHIJKLMN  BKSP
     OPQRSTUVWXYZ    PAGE
     0123456789 ./-  SAVE

 RANGE  AVG  DIAGS ALARM
```

Firmware Overview

The Model 80*i* 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 is the normal operating screen. It displays the Hg^0, Hg^{2+}, and Hg^r concentrations, depending on the operating mode. 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.

Note The values shown in the displays in this document are FOR REFERENCE ONLY and should not be used for operating an instrument. ▲

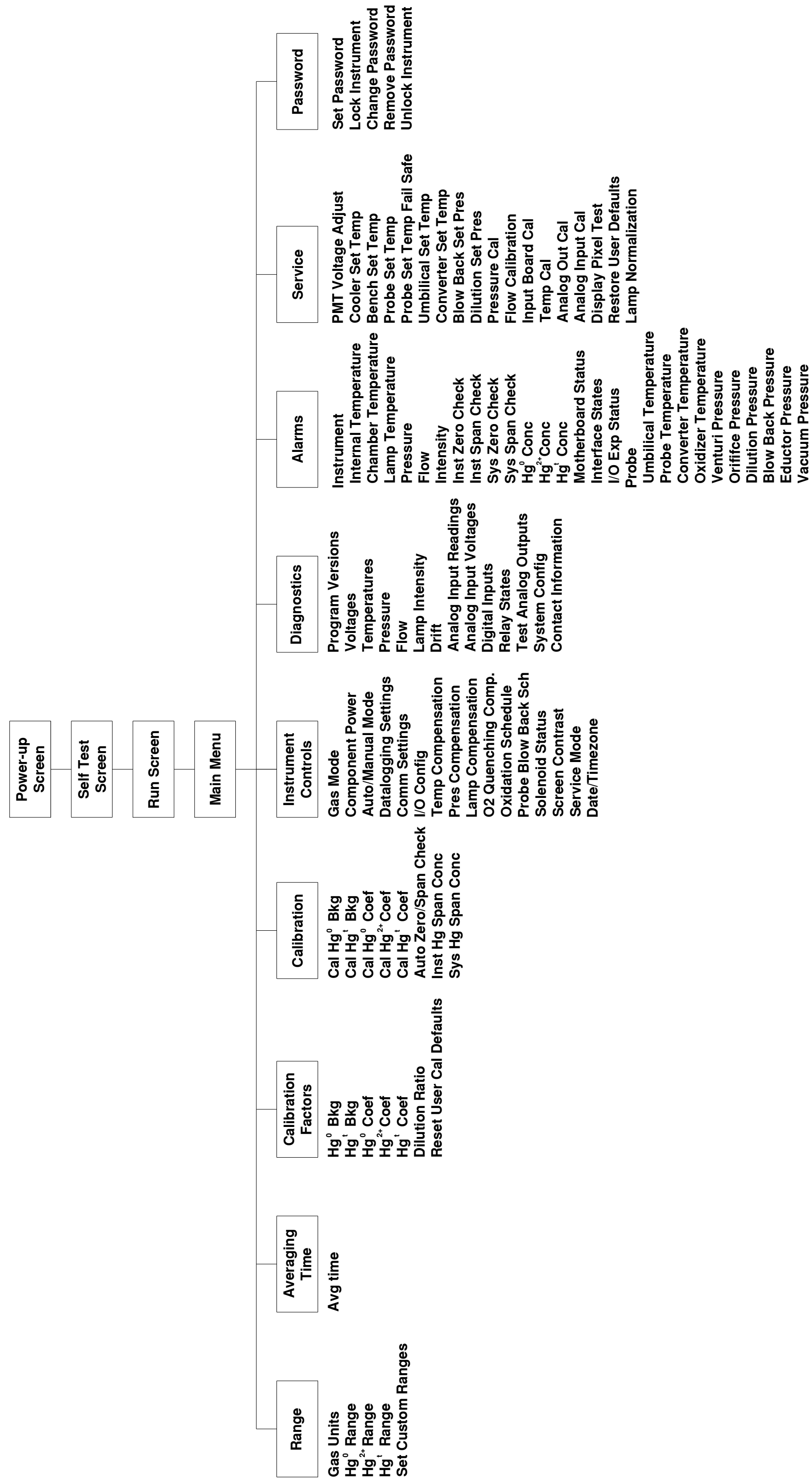


Figure 3–3. Flowchart of Menu-Driven Firmware

Power-Up Screen

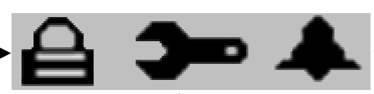
The Power-Up screen is displayed on power up of the Model 80*i*. The Self-Test is displayed while the internal components are warming up and diagnostic checks are performed.

Run Screen

The Run screen displays the Hg^0 (elemental), Hg^{2+} (oxidized), and Hg^T (total) concentrations. The status bar displays the gas mode, time, the password (lock) icon, service (wrench) icon, alarm (bell) icon. The word "SAMPLE" on the bottom left of the display indicates the instrument is in "SAMPLE" mode. For more information about the gas modes, see "Gas Modes" in this chapter.

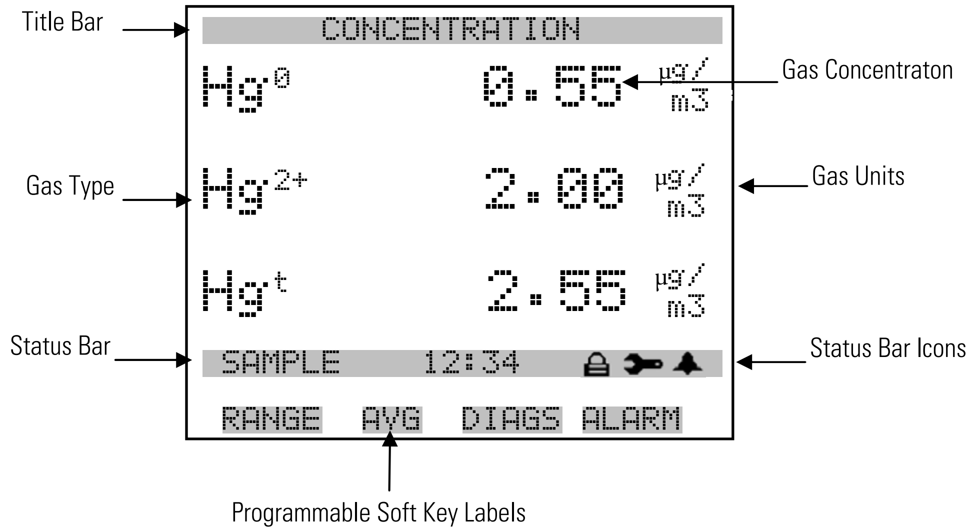
Status Bar Icons

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.

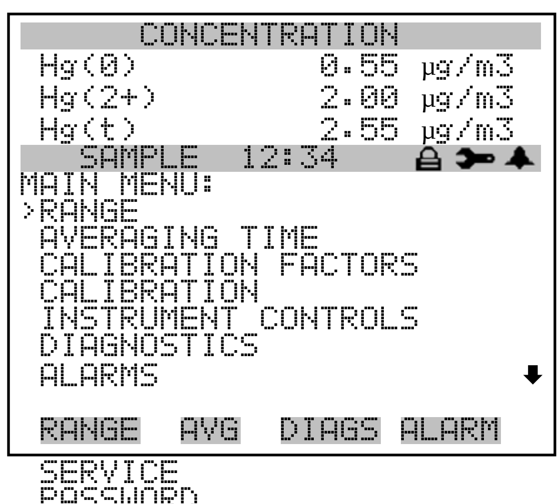
The service (wrench) icon indicates that the instrument is in the service mode.



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 select a choice.
- Press ■ to return to the Main Menu or ► to return to the Run screen.



Range Menu

The Range menu allows the operator to view the gas units (always in μg/m^3), to select the Hg^0-Hg^{2+}-Hg^t ranges, and to set the custom ranges.

- In the Main Menu, choose **Range**

```
RANGE:
>GAS UNITS                 μg/m3
 Hg(0) RANGE                 600
 Hg(2+) RANGE                600
 Hg(t) RANGE                 600
 SET CUSTOM RANGES


 RANGE  AVG  DIAGS ALARM
```

Hg^0, Hg^{2+}, and Hg^t Ranges

The Hg^0, Hg^{2+}, and Hg^t Ranges screen define the concentration range of the analog outputs. For example, an Hg^{2+} range of 0–30 μg/m^3 restricts the analog output to concentrations between 0 and 30 μg/m^3. Available operating ranges include: 1.5, 3.0, 6.0, 15.0, 30, 60, 150, 300, and 600 μg/m^3.

The display shows the current Hg^0 range. The next line of the display is used to change the range.

C1, C2, and C3 are custom ranges. For more information about custom ranges, see "Set Custom Ranges" that follows.

- In the Main Menu, choose Range > **Range**.

```
Hg(0) RANGE:
 CURRENTLY:              600
    SET TO:              1.5 ?

             ↑↓ CHANGE VALUE
              ↵ SAVE VALUE

 RANGE  AVG  DIAGS ALARM
```

Set Custom Ranges

The Custom Ranges Menu lists three custom ranges: C1, C2, and C3. Custom ranges are user-defined ranges. In the standard range mode, any value between 1.5 and 600 μg/m^3 can be specified as a range.

- In the Main Menu, choose Range > **Set Custom Ranges**.

```
CUSTOM RANGES:
>CUSTOM RANGE 1        55.6
 CUSTOM RANGE 2        75.0
 CUSTOM RANGE 3       125.0



 RANGE  AVG  DIAGS ALARM
```

Custom Ranges

The Custom Ranges screen is used to define the custom ranges.

The display shows the current custom range. The next line of the display is used to set the range. To use the custom full-scale range, be sure to select it (Custom range 1, 2, or 3) in the Hg^0, Hg^{2+}, and Hg^t Range screen. For more information about selecting ranges, see "Hg^0, Hg^{2+}, and Hg^t Ranges".

- In the Main Menu, choose Range > Set Custom Ranges > **Custom range 1, 2,** or **3**.

```
CUSTOM RANGE 1:
 CURRENTLY:          55.6
    SET TO:      000055.7 ?

          ←→ MOVE CURSOR
 ↑↓ CHANGE VALUE    ↵ SAVE

 RANGE  AVG  DIAGS ALARM
```

Averaging Time

The Averaging Time defines a time period (60 to 300 seconds) during which Hg^0, Hg^{2+}, and Hg^t measurements is taken. The average concentration of the Hg^0, Hg^{2+}, and Hg^t readings are calculated for that time period. The front panel display and analog outputs are updated every 10 seconds regardless of the averaging time. An averaging time of 300 seconds means that the moving average concentration of the last 300 seconds will be output every 10 seconds. The lower the averaging time the faster the front panel display and analog outputs respond to concentration changes. Longer averaging times are typically used to smooth output data.

The following averaging times are available: 60, 90, 120, 180, 240, and 300 seconds. Additional averaging times are available in manual Hg^0 and manual Hg^t modes: 1, 2, 5, 10, 20, and 30 seconds. For more information about the manual modes, see "Auto/Manual Mode" later in this chapter.

- In the Main Menu, choose **Averaging Time**.

```
AVERAGING TIME:
 CURRENTLY:         60 SEC
    SET TO:        120 SEC ?

             ↑↓ CHANGE VALUE
              ↵ SAVE VALUE

 RANGE  AVG  DIAGS ALARM
```

Calibration Factors Menu

Calibration factors are used to correct the Hg^0, Hg^{2+}, and Hg^t concentration readings that the instrument generates using its own internal calibration data. The Calibration Factors menu displays the calibration factors.

Note There are two sets of backgrounds and coefficients. One set is for the instrument and is displayed while in instrument zero or span mode. The other set for system is displayed while in sample, orifice, zero/span, and system zero/span modes. ▲

Normally, the instrument is calibrated automatically using the Calibration menu described in "Calibration Menu" later in this chapter. However, the instrument can also be calibrated manually using the Calibration Factors menu.

To manually calibrate the instrument, see "Hg^0 and Hg^t Backgrounds" and "Hg^0, Hg^{2+}, and Hg^t Coefficients" that follows for more information.

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

```
CALIBRATION FACTORS:
>Hg(0) BKG              0.00
 Hg(t) BKG              0.00
 Hg(0) COEF            1.000
 Hg(2+) COEF           1.000
 Hg(t) COEF            1.000
 DILUTIOIN RATIO
 RESET USER CAL DEFAULTS

 RANGE  AVG  DIAGS ALARM
```

Hg^0 and Hg^t Backgrounds

The Hg^0 and Hg^t background corrections are determined during zero calibration. The Hg^0 background is the amount of signal read by the instrument while sampling zero air. The background signal is a combination of electrical noise, dark current, and scattered light. Before the instrument sets the Hg^0 reading to zero, it stores this value as the Hg^0 background correction.

The Hg^0 Background screen is used to perform a manual zero calibration of the instrument or system. As such, the instrument should sample zero air until stable readings are obtained. The first line of the display shows the current Hg^0 reading. This reading is the Hg^0 background signal. The second line of the display shows the Hg^0 background correction that is stored in memory and is being used to correct the Hg^0 reading. That is, the Hg^0 background correction is subtracted from the Hg^0 reading.

In the example that follows, the instrument is reading 0.5 µg/m^3 of Hg^0 while sampling zero air. The Hg^0 background correction is 0.0 µg/m^3. That is, the instrument is not applying a zero background correction. The question mark is used as a prompt to change the background correction. In this case the background correction must be increased to 0.5 µg/m^3 in order for the Hg^0 reading to be at 0 µg/m^3.

To set the Hg^0 reading in the example that follows to zero, use ⬆ to increment the Hg^0 background correction to 0.5 µg/m^3. As the Hg^0 background correction is increased, the Hg^0 concentration is decreased. At this point, however, no real changes have been made. To escape this screen without making any changes, press ■ to return to the Calibration Factors menu or ▶ to return to the Run screen. Press ↵ to actually set the Hg^0 reading to 0 µg/m^3 and store the background correction of 0.5 µg/m^3.

- In the Main Menu, choose Calibration Factors > **Hg(0)** or **Hg(t) Bkg**.

```
Hg(0) BACKGROUND:
      Hg(0):          0.5
 SET BKG TO:          0.0 ?

          ⬆⬇ INC/DEC
           ↵ SAVE VALUE

 RANGE  AVG  DIAGS ALARM
```

Hg^0, Hg^{2+}, and Hg^t Coefficients

The Hg^0, Hg^{2+}, and Hg^t span coefficients are usually calculated by the instrument processor during calibration. The span coefficients are used to correct the Hg^0, Hg^{2+}, and Hg^t readings and normally have a value near 1.000.

Note The Hg^0 coefficient is applied to both the Hg^0/Hg^t reading. The Hg^t coefficient is only applied to the Hg^t reading. ▲

The Hg^0, Hg^{2+}, and Hg^t Coefficient screens allows the Hg^0, Hg^{2+}, and Hg^t span coefficients to be manually changed while sampling span gas of known concentration. The Hg^0, Hg^{2+}, and Hg^t coefficient screens operate the same way. Therefore, the following description of the Hg^0 coefficient screen applies to the Hg^{2+} and Hg^t coefficient screens as well.

Note The concentration value will show "ERROR" if the measured concentration is not a valid span value (either higher than the selected range, or 0 or lower). ▲

The display shows the current Hg^0 concentration reading. The next line of the display shows the Hg^0 span coefficient that is stored in memory and is being used to correct the Hg^0 concentration. Notice that as the span coefficient value is changed, the current Hg^0 concentration reading above also changes. However, no real changes are made until ↵ is pressed.

- In the Main Menu, choose Calibration Factors > **Hg(0)**, **Hg(2+)**, or **Hg(t) Coef**.

```
Hg(0) COEFFICIENT:
       Hg(0):          1.4
 SET COEF TO:        1.000

          ↑↓ INC/DEC
           ↵ SAVE VALUE

 RANGE  AVG  DIAGS ALARM
```

Dilution Ratio

The Dilution Ratio screen allows the user to view and set the dilution ratio. Acceptable values are 1–500: 1. The default is 1:1. When this value is set, the dilution ratio is applied to the following modes: Sample, Orifice Zero, Orifice Span, System Zero, System Span, and not to: Analyzer Zero, Analyzer Span mode.

- In the Main Menu, choose Calibration Factors > **Dilution Ratio**.

```
DILUTION RATIO:
 CURRENTLY:     001.0 :1
    SET TO:     001.0 :1 ?

          ←→ MOVE CURSOR
 ↑↓ CHANGE VALUE    ↵ SAVE

 RANGE  AVG  DIAGS ALARM
```

Reset User Calibration Default

The Reset User Calibration Default screen allows the user to reset the calibration configuration values to factory defaults.

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

```
RESTORE DEFAULT CAL:
                ↵ RESTORE



 RANGE   AVG   DIAGS ALARM
```

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

 RANGE   AVG   DIAGS ALARM
```

Calibration Menu

The Calibration menu is used to calibrate the instrument or system, including zero backgrounds, the Hg^0, Hg^{2+}, and Hg^t coefficients.

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

```
CALIBRATION:
>CAL Hg(0) BACKGROUND
 CAL Hg(t) BACKGROUND
 CAL Hg(0) COEFFICIENT
 CAL Hg(0) COEFFICIENT
 CAL Hg(0) COEFFICIENT
 AUTO ZERO/SPAN CHECK
 INST Hg SPAN CONC

 RANGE   AVG   DIAGS ALARM

 SYS Hg SPAN CONC
```

Calibrate Hg^0 and Hg^t Backgrounds

The Calibrate Hg^0 and Hg^t Background screens are used to automatically adjust the background, or perform a "zero calibration". Be sure the instrument samples zero air for at least 10 minutes for an instrument zero and 15 minutes for a system zero. The display shows the current Hg^0 or Hg^t reading.

It is important to note the averaging time when calibrating. The longer the averaging time, the more accurate the calibration will be. To be most accurate, use the 300-second averaging time. For more information about calibration, see Chapter 4, "Calibration".

- In the Main Menu, choose Calibration > **Cal Hg(0)** or **Hg(t) Background**.

```
Hg(0) BACKGROUND:
     Hg(0):              1.4
 CURRENTLY:              0.0 ?

        ↵ SET CO TO ZERO

 RANGE   AVG   DIAGS ALARM
```

Calibrate Hg^0, Hg^{2+}, and Hg^t Coefficients

The Calibrate Hg^0 Coefficient screen is used to automatically adjust the Hg^0 span concentration while sampling span gas of known concentration. All calibration screens operate the same way. Therefore, the following description of the Hg^0 calibration screen applies to the Hg^{2+} and Hg^t calibration screens as well.

The display shows the current Hg^0 concentration reading and the current Hg^0 range. The next line of the display is where the Hg^0 calibration gas concentration is entered.

It is important to note the averaging time when calibrating. The longer the averaging time, the more precise the calibration will be. For the most precise calibration, use the 300-second averaging time. For more information about calibration, see Chapter 4, "Calibration".

- In the Main Menu, choose Calibration > **Cal Hg(0), Hg(2+),** or **Hg(t) Coefficient**.

```
CALIBRATE Hg(0):
     Hg(0):              3.2
 SPAN CONC:     0003.400 ?

           ←→ MOVE CURSOR
 ↑↓ CHANGE VALUE    ↵ SAVE

 RANGE   AVG   DIAGS ALARM
```

Auto Zero/Span Check

The Auto Zero/Span Check menu is used to program the instrument to perform fully automated zero and span check or adjustments. For more information about the manual modes, see "Auto/Manual Mode" later in this chapter.

- In the Main Menu, choose Calibration > Auto **Zero/Span Check**.

```
AUTO ZERO/SPAN CHECK:
>NEXT TIME 01Jan07 12:00
 PERIOD HR              24
 INST ZERO DURAT MIN     1
 INST SPAN DURAT MIN    30
 INST ZERO CAL RESET    30
 INST SPAN CAL RESET    30
 INST Hg SPAN CONC      30 ↓

 RANGE   AVG   DIAGS ALARM

 SYS ZERO DURAT MIN     30
 SYS SPAN DURAT MIN     60
 SYS ZERO CAL RESET    OFF
 SYS SPAN CAL RESET    OFF
 SYS Hg SPAN CONC      OFF
 PURGE DURATION MIN      1
 ZERO/SPAN AVE SEC
```

Next Time

The Next Time screen is used to view and set the next zero/span check date and time. Once the initial zero/span check is performed, the date and time of the next zero/span check is calculated and displayed.

- In the Main Menu, choose Calibration > Auto Zero/Span Check > **Next Time**.

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



 RANGE   AVG   DIAGS ALARM
```

```
NEXT DATE AND TIME:
 19 MAR 2005  12:34:56

 SETTING: DAYS
           → SET MONTHS
          ↑↓ CHANGE VALUE
           ↵ SAVE VALUE
 RANGE   AVG   DIAGS ALARM
```

Period Hours

The Zero/Span Period Hours screen defines the period or interval between zero/span checks. Periods between 0 and 999 hours are acceptable. To turn the zero/span check off, set the period to 0.

- In the Main Menu, choose Calibration > Auto Zero/Span Check > **Period Hours**.

```
ZERO/SPAN PERIOD:
 CURRENTLY:       024 HRS
    SET TO:       024 HRS ?

          ←→ MOVE CURSOR
 ↑↓ CHANGE VALUE    ↵ SAVE

 RANGE  AVG  DIAGS ALARM
```

Instrument/System Zero/Span Duration Minutes

The Instrument Zero Duration Minutes screen defines how long zero air is sampled by the instrument. The System Zero Duration Minutes screen defines how long zero air is sampled by the probe and the instrument. The span duration screens look and function the same way as the zero duration screen, and are used to set how long the span gas and sample gas are sampled by the instrument. Durations between 0 and 60 minutes are acceptable. Each time a zero/span check occurs the zero check is done first, followed by the span check. To perform just a zero check, set the span and purge duration screen to 0 (off). The same applies to perform just a span or purge check.

- In the Main Menu, choose Calibration > Auto Zero/Span Check > **Inst Zero/Inst Span Durat Min, Sys Zero/Sys Span Durat Min,** or **Purge Duration Min**.

```
ZERO DURATION:
 CURRENTLY:        30 MIN
    SET TO:        31 MIN ?

          ←→ MOVE CURSOR
 ↑↓ CHANGE VALUE    ↵ SAVE

 RANGE  AVG  DIAGS ALARM
```

Instrument/System Zero/Span Calibration Reset

The Instrument Zero Calibration Reset and System Zero Calibration Reset functions are used to toggle the associated calibration reset either on or off. For example, if the Resets are off, the system will perform a "check." If the Resets are on, the system will adjust the background and coefficients.

- In the Main Menu, choose Calibration > Auto Zero/Span Check > **Inst Zero/Inst Span Cal Reset** or **System Zero/System Span Cal Reset**.

Zero/Span Averaging Time

The Zero/Span Averaging Time screen allows the user to adjust the zero/span averaging time. The zero/span averaging time is used by the instrument only when performing an automatic zero or span check. The instrument's averaging time is used for all other functions. The following averaging times are available: 1, 2, 5, 10, 20, 30, 60, 90, 120, 180, 240, and 300 seconds.

- In the Main Menu, choose Calibration > Auto Zero/Span Check > **Zero/Span Avg Sec**.

```
ZERO/SPAN AVERAGING TIME:
 CURRENTLY:       60 SEC
    SET TO:       90 SEC ?

           ↑↓ CHANGE VALUE
            ↵ SAVE VALUE
 RANGE  AVG  DIAGS ALARM
```

Instrument Hg Span Concentration

The Instrument Hg Span Conc screen is used to set the automatic instrument calibration concentration. Once the span valve is entered, this value will be requested by the instrument to the Model 81*i* Calibrator, the next time an automatic instrument calibration is performed.

- In the Main Menu, choose Calibration > Auto Zero/Span Check > **Instrument Hg Span Conc**.

```
INST HG SPAN CONC:
   CURRENT:      SPAN 1
    SET TO:      SPAN 2 ?

           ↑↓ CHANGE VALUE
            ↵ SAVE VALUE
 RANGE  AVG  DIAGS ALARM
```

System Hg Span Concentration

The System Hg Span Concentration screen is used to set the automatic system calibration concentration. Once the span valve is entered, this value will be requested by the instrument to the Model 81*i* Calibrator, the next time an automatic orifice or system calibration is performed.

- In the Main Menu, choose Calibration > Auto Zero/Span Check > **System Hg Span Conc**.

```
SYS Hg SPAN CONC:
   CURRENT:      SPAN 1
    SET TO:      SPAN 2 ?

          ↑↓ CHANGE VALUE
           ↵ SAVE VALUE

 RANGE  AVG  DIAGS ALARM
```

Instrument Controls Menu

The Instrument Controls menu contains a number of items. The firmware controls listed in this menu enable control of the listed instrument functions.

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

```
INSTRUMENT CONTROLS:
>GAS MODE
 COMPONENT POWER
 AUTO/MANUAL MODE
 DATALOGGING SETTINGS
 COMMUNICATION SETTINGS
 I/O CONFIGURATION
 TEMPERATURE COMPENSATION↓

 RANGE  AVG  DIAGS ALARM

 PRESSURE COMPENSATION
 LAMP COMPENSATION
 O2 QUENCHING COMP
 OXIDATION SCHEDULE
 PROBE BLOWBACK SCHEDULE
 SOLENOID STATES
 SCREEN CONTRAST
 SERVICE MODE
 DATE/TIME
 TIMEZONE
```

Gas Mode

The Gas Mode screen is used to set the Model 80*i*, or entire Hg Freedom System into sample mode, various calibration states, or blow back modes. The selected item is shown by "<--" after it.

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

```
GAS MODE:
>SAMPLE                    <--
 INSTRUMENT ZERO
 INSTRUMENT SPAN
 ORIFICE ZERO
 ORIFICE SPAN
 SYSTEM ZERO
 SYSTEM SPAN                 ↓

 RANGE  AVG  DIAGS ALARM

 OXIDIZER HG CAL
 BLOW BACK SYSTEM
 BLOW BACK STINGER
```

Component Power

The Component Power menu is used to apply power to various components in the Mercury Freedom System. This screen allows the user to toggle power either on or off.

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

```
COMPONENT POWER:
>LAMP SUPPLY
 PMT SUPPLY
 UMBILICAL 1 POWER
 UMBILICAL 2 POWER
 PROBE POWER
 STINGER POWER
 CONVERTER POWER             ↓

 RANGE  AVG  DIAGS ALARM

 EDUCTOR VALVE POWER
 OXIDIZER POWER
```

Lamp Supply

The Lamp Supply screen is used to turn the Lamp Supply on or off.

- In the Main Menu, choose Instrument Controls > Component Power > **Lamp Supply**.

```
LAMP SUPPLY:
 CURRENTLY:              ON
    SET TO:             OFF ?

           ↵ TOGGLE VALUE

 RANGE  AVG  DIAGS ALARM
```

PMT Supply

The PMT Supply screen is used to turn the PMT power supply on or off. This is useful in a troubleshooting situation.

- In the Main Menu, choose Instrument Controls > Component Power > **PMT Supply**.

```
PMT SUPPLY:
 CURRENTLY:          OFF
    SET TO:           ON ?
           ↵ TOGGLE VALUE

 RANGE  AVG  DIAGS ALARM
```

Umbilical 1 and 2 Power

The Umbilical 1 Power screen is used to turn the umbilical 1 power on or off. The Umbilical 2 Power screen functions the same way.

- In the Main Menu, choose Instrument Controls > Component Power > **Umbilical 1** or **Umbilical 2 Power**.

```
UMBILICAL 1 POWER:
 CURRENTLY:           ON
    SET TO:          OFF ?
           ↵ TOGGLE VALUE

 RANGE  AVG  DIAGS ALARM
```

Probe Power

The Probe Power screen is used to turn the probe power on or off.

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

```
PROBE POWER:
 CURRENTLY:           ON
    SET TO:          OFF ?
           ↵ TOGGLE VALUE

 RANGE  AVG  DIAGS ALARM
```

Stinger Power

The Stinger Power screen is used to turn the stinger power on or off.

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

```
STINGER POWER:
 CURRENTLY:            ON
    SET TO:           OFF ?

             ↵ TOGGLE VALUE

 RANGE   AVG   DIAGS ALARM
```

Converter Power

The Converter Power screen is used to turn the converter power on or off.

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

```
CONVERTER POWER:
 CURRENTLY:            ON
    SET TO:           OFF ?

             ↵ TOGGLE VALUE

 RANGE   AVG   DIAGS ALARM
```

Eductor Valve Power

The Eductor Valve Power screen is used to turn the eductor valve power on or off.

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

```
EDUCTOR VALVE POWER:
 CURRENTLY:            ON
    SET TO:           OFF ?

             ↵ TOGGLE VALUE

 RANGE   AVG   DIAGS ALARM
```

Auto/Manual Mode

The Auto/Manual screen allows selection of the automatic mode (Hg^0/Hg^t, Hg^0 mode (manual Hg^0), or Hg^t mode (manual Hg^t). The auto mode switches the mode solenoid valve automatically on a 60 second cycle so that Hg^0, Hg^{2+}, and Hg^t concentrations are determined. The manual Hg^0 mode puts the mode solenoid valve into the open position so that the sample gas bypasses the Hg^{2+}-to- Hg^0 converter. Therefore, only the Hg^0 concentration is determined. The manual Hg^t mode puts the mode solenoid valve into the closed position so that the sample gas passes through the Hg^{2+}-to- Hg^0 converter. Therefore, only the Hg^t concentration is determined. In the manual modes, additional averaging time of 1, 2, 5, 10, 20, and 30 are available from the Averaging Time screen.

- In the Main Menu, choose Instrument Controls > **Auto/Manual Mode**.

```
MODE:
 CURRENTLY: MANUAL Hg(0)
    SET TO: MANUAL Hg(t) ?

           ↑↓ CHANGE VALUE
            ↵ SAVE VALUE

 RANGE   AVG   DIAGS ALARM
```

Datalogging Settings

The *i*Series instruments include a built-in data logging 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 can be interleaved. For example, an srec containing just the current concentration level could be generated every five 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, concentration and error flags, the analyzer can store data once each minute for four months (>190,000 records).

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

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

 RANGE  AVG  DIAGS ALARM
```

Select SREC/LREC

The Select SREC/LREC is used to select short record or long record format 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

 RANGE  AVG  DIAGS ALARM
```

View Logged Data

The View Logged Data screen is used to select the start point to view the logged data by number of records or date and time.

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

```
SELECT START POINT BY:

    SET TO: # OF RECS


   ↑↓ CHANGE     ↵ ACCEPT
 RANGE  AVG  DIAGS ALARM
```

Number of Records

The Number of Records screen is used to select the starting point to display the number of records back to view.

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

          ←→ MOVE CURSOR
 ↑↓ CHANGE VALUE   ↵ SAVE

 RANGE  AVG  DIAGS ALARM
```

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

```
time    date    flags
 10:01 06/20/05  70088900
 10:02 06/20/05  70088900
 10:03 06/20/05  70088900
 10:04 06/20/05  70088900
  ↑↓ PGUP/DN   ←→ PAN L/R

 RANGE  AVG  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 JUN 2005 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 JUN 2005 10:01”.

```
DATE AND TIME:
 20 JUN 2005  10:00
 ↑↓ CHG   DAYS
 → SET CURSOR TO MONTHS
 ↵ ACCEPT AS SHOWN

 RANGE  AVG  DIAGS ALARM
```

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

```
time    date    flags
 10:01 06/20/05  70088900
 10:02 06/20/05  70088900
 10:03 06/20/05  70088900
 10:04 06/20/05  70088900
  ↑↓ PGUP/DN   ←→ PAN L/R

 RANGE   AVG   DIAGS ALARM
```

Erase Log

The Erase Log is used to erase all saved data for the selected record type (not all short records and long records).

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

```
ERASE LREC LOG FILE DATA?

                ↵ ERASE




 RANGE   AVG   DIAGS ALARM
```

```
ERASE LREC LOG FILE DATA?

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

 RANGE   AVG   DIAGS ALARM
```

Select Content

The Select Content menu displays a list of 32 record fields to use and a submenu list of the analog output signal group choices to choose from. Choices are Concentrations, Other Measurements, and Analog Inputs. This is 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, as the format of the stored data is changed.

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

```
LREC FIELDS:
>FIELD 1              HG
 FIELD 2             HG2
 FIELD 3             HGT
 FIELD 4           RGHG0
 FIELD 5           RGHG2
 FIELD 6           RGHGT
 FIELD 7           RFINT ↓

 RANGE   AVG   DIAGS ALARM
```

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




 RANGE  AVG  DIAGS ALARM
```

Concentrations

The Concentrations screen allows the user to select the output signal that is tied to the selected field item. 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" that follows.

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

```
CONCENTRATIONS:
>NONE
 Hg(0)                <--
 Hg(2+)
 Hg(t)
 Hg(0) RANGE
 Hg(2+) RANGE
 Hg(t) RANGE             ↓

 RANGE  AVG  DIAGS ALARM

 PROBE SPAN
 Hg(0) SPAN
 Hg(t) SPAN
 Hg(0) COEFF
 Hg(t) COEFF
 PROBE FSAFE
```

Other Measurements

The Other Measurements screen allows the user to select the output signal that is tied to the selected field item. 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" that follows.

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

```
OTHER MEASUREMENTS:
>NONE
 INTENSITY
 INT TEMP
 CHAMBER TEMP
 PROBE TEMP
 CONV TEMP
 UMB TEMP                        ↓

 RANGE  AVG  DIAGS ALARM
 VENTURI PRES
 ORIFICE PRES
 DIL AIR PRES
 BLOWBCK PRES
 EDUCTOR PRES
 VACUUM PRES
 FLOW
 PMT VOLTS
 CHAMBER PRES
 DIL FACTOR
```

Analog Inputs

The Analog Inputs screen allows the user to select the output signal (none or analog inputs 1-8) that is tied to the selected field item. 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" that follows.

- 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                     ↓

 RANGE  AVG  DIAGS ALARM
```

Commit Content

The Commit Content screen is used to save the selected output signal that is tied to the selected field item. If no changes have been made "NO CHANGES TO RECORD LIST!" will appear. For more information about selecting the analog output signal group choices, see "Select Content" described previously.

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

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




 RANGE   AVG   DIAGS ALARM
```

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


 RANGE   AVG   DIAGS ALARM
```

Reset to Default Content

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

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

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




 RANGE   AVG   DIAGS ALARM
```

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


 RANGE   AVG   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



 RANGE  AVG  DIAGS ALARM
```

Logging Period Min

The Logging Period Min screen is used to select the logging period in minutes for the 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:        60 MIN
    SET TO:       OFF MIN

 ↑↓ CHANGE VALUE    ↵ SAVE

 RANGE  AVG  DIAGS ALARM
```

Memory Allocation Percent

The Memory Allocation Percent screen is used to select the percentage of each record type for both short records and long records. Percentages between 0 and 100% are available in increments of 10. Changing this value results in log erasure for both short records and long records.

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

```
SET PERCENT LRECS:
 CURRENTLY:           50%
    SET TO:           60% ?

 ↑↓ CHANGE VALUE    ↵ SAVE

 RANGE  AVG  DIAGS ALARM
```

Data Treatment

The Data Treatment screen is used to select the data type for the selected record: whether the data should be averaged over the interval, the minimum or maximum used, or the current value logged. 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.

- 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

 RANGE  AVG  DIAGS ALARM
```

Communication Settings

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

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

```
COMMUNICATION SETTINGS:
>SERIAL SETTINGS
 INSTRUMENT ID
 COMMUNICATION PROTOCOL
 STREAMING DATA CONFIG
 TCP/IP SETTINGS

 RANGE  AVG  DIAGS ALARM
```

Serial Settings

The Serial Settings screen 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

 RANGE   AVG    DIAGS ALARM
```

Baud Rate The Baud Rate screen is used to set the RS-232/RS485 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 > **Baud Rate**.

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

             ↑↓ CHANGE VALUE
              ↵ SAVE VALUE

 RANGE   AVG   DIAGS ALARM
```

Data Bits The Data Bits Screen is used to set the number of serial data bits. Selections of 7 or 8 are available (defaults to 8).

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

             ↑↓ CHANGE VALUE
             ↵ SAVE VALUE

 RANGE   AVG   DIAGS ALARM
```

Parity The Parity screen is used to select the parity bit for the serial port. Selections of NONE, EVEN, or ODD are available (defaults to NONE).

```
PARITY:
 CURRENTLY:      NONE
    SET TO:      NONE

          ↑↓ CHANGE VALUE
          ↵ SAVE VALUE

 RANGE  AVG  DIAGS ALARM
```

Stop Bits The Stop Bits screen is used to select the number of stop bits for the serial port. Selections of 1 and 2 are available (defaults to 1).

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

          ↑↓ CHANGE VALUE
          ↵ SAVE VALUE

 RANGE  AVG  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 RS-232 and RS-485 selection to prevent damage to any equipment currently connected to the instrument. ▲

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

```
RS-232/RS-485 SELECTION:
 CURRENTLY:       RS-232
    SET TO:       RS-485 ?
MAKE SURE THAT THE CABLE
IS OFF: PRESS ➡ TO CONFIRM
           ↵ TOGGLE VALUE
 RANGE  AVG  DIAGS ALARM
```

Instrument ID The Instrument ID screen allows the operator to edit the instrument ID. 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 of the same instruments are connected to one computer. Valid Instrument ID numbers are from 0 to 127. The Model 80*i* has a default Instrument ID of 80. For more information about the Instrument ID, see Appendix B "C-Link Protocol Commands" or Appendix C "MODBUS Protocol".

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

```
INSTRUMENT ID:
 CURRENTLY:             80
    SET TO:             85 ?

           ↑↓ CHANGE VALUE
            ↵ SAVE VALUE

 RANGE  AVG  DIAGS ALARM
```

Communication Protocol

The Communication Protocol screen is used to change the instrument communication protocol for serial communications.

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

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

           ↑↓ CHANGE VALUE
            ↵ SAVE VALUE

 RANGE  AVG  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 Item Signal submenu displays a list of the analog output signal group choices to choose from. Choices are Concentrations, Other Measurements, and Analog Inputs.

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

```
STREAMING DATA CONFIG
>INTERVAL          10 SEC
 ADD LABELS            NO
 PREPEND TIMESTAMP    YES
 ADD FLAGS            YES
 ITEM 1                HG
 ITEM 2              INTT
 ITEM 3              RCTT ↓

 RANGE  AVG  DIAGS ALARM
```

```
CHOOSE STREAM DATA:
>CONCENTRATIONS
 OTHER MEASUREMENTS
 ANALOG INPUTS




 RANGE  AVG  DIAGS ALARM
```

Concentrations

The Concentrations screen allows the user to select the output signal that is tied to the selected streaming data item. The selected item is shown by "<--" after it.

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

```
CONCENTRATIONS:
>NONE
 Hg(0)                 <--
 Hg(2+)
 Hg(t)
 Hg(0) RANGE
 Hg(2+) RANGE
 Hg(t) RANGE              ↓

 RANGE  AVG  DIAGS ALARM

 PROBE SPAN
 Hg(0) SPAN
 Hg(t) SPAN
 Hg(0) BKG
 Hg(t) BKG
 Hg(0) COEFF
 Hg(t) COEFF
 PROBE FSAFE
 Hg(0) DICONC
 Hg(0) DTIME
 Hg(t) DICONC
 Hg(t) DTIME
 Hg(0) DSCONC
 Hg(0) DSTIME
```

```
Hg(t) DSCONC
Hg(t) DSTIME
Hg81  ACTUAL
```

Other Measurements

The Other Measurements screen allows the user to select the output signal that is tied to the selected streaming data item. The selected item is shown by "<--" after it.

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

```
OTHER MEASUREMENTS:
>NONE
 INTENSITY
 INT TEMP
 CHAMBER TEMP
 PROBE TEMP
 CONV TEMP
 UMB TEMP                        ↓

 RANGE  AVG  DIAGS ALARM
 VENTURI PRES
 ORIFICE PRES
 DIL AIR PRES
 BLOWBCK PRES
 EDUCTOR PRES
 VACUUM PRES
 FLOW
 PMT VOLTS
 CHAMBER PRES
 DIL FACTOR
 LAMP TEMP
 OXID TEMP
```

Analog Inputs

The Analog Inputs screen allows the user to select the analog input signal (none or analog inputs 1-8) that is tied to the selected streaming data item. The selected item is shown by "<--" after it.

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

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

 RANGE  AVG  DIAGS ALARM
```

Streaming Data Interval

The Streaming Data Interval screen is used to adjust the streaming data interval. 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

 RANGE  AVG  DIAGS ALARM
```

TCP/IP Settings

The TCP/IP Settings menu is used for defining TCP/IP settings

Note The instrument power must be cycled after this parameter has 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       192.168.1.15
 NETMASK      255.255.255.0
 GATEWAY        10.209.42.1
 HOST NAME          ISERIES
 NTP SVR       192.168.1.15

 RANGE  AVG  DIAGS ALARM
```

Use DHCP

The Use DHCP screen is used to specify whether to use DHCP or not. DHCP on utilizes a dynamic IP address; DHCP off utilizes a static IP address.

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

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

           ↵ TOGGLE VALUE
CYCLE POWER TO CHANGE DHCP

 RANGE  AVG  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 on. For more information on DHCP, see “Use DHCP” described previously.

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

```
IP ADDRESS:
 CURRENT: 192.168.1.15
  SET TO: 192.168.1.15
          ←→ MOVE CURSOR
          ↑↓ CHANGE VALUE
           ↵ SAVE VALUE

 RANGE  AVG  DIAGS ALARM
```

Netmask

The Netmask screen is used to edit the netmask.

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

```
NETMASK:
 CURRENT: 255.255.255.0
  SET TO: 255.255.255.000
          ←→ MOVE CURSOR
          ↑↓ CHANGE VALUE
           ↵ SAVE VALUE

 RANGE  AVG  DIAGS ALARM
```

Default Gateway

The Default Gateway screen is used to edit the gateway 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

 RANGE  AVG  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

 RANGE  AVG  DIAGS ALARM
```

Network Time Protocol (NTP) 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 Server**.

```
NTP SERVER IP ADDRESS:
 CURRENT: 192.168.1.20
  SET TO: 192.168.001.010
          ←→ MOVE CURSOR
          ↑↓ CHANGE VALUE
           ↵ SAVE

 RANGE  AVG   DIAGS ALARM
```

I/O Configuration

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

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

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

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



 RANGE  AVG  DIAGS ALARM
```

Output Relay Settings

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

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

```
OUTPUT RELAY SETTINGS:
>1   NOP            NONE
 2   NOP         SERVICE
 3   NOP        Hg0 MODE
 4   NOP        Hgt MODE
 5   NOP    Hg0/Hgt MODE
 6   NOP     SAMPLE MODE
 7   NOP  INST ZERO MODE ⬇
 RANGE  AVG  DIAGS ALARM
```

Logic State

The Logic State screen is used to change the I/O relay to either normally open or normally closed.

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

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




 RANGE  AVG  DIAGS ALARM
```

Instrument State

The Instrument State menu allows the user to select the instrument state that is tied to the selected relay output. A menu lists signal types of either alarm 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
 NON-ALARM




 RANGE  AVG  DIAGS ALARM
```

Alarms

The Alarms status screen allows the user to select the alarm status for the selected relay output. The 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
 INT TEMP
 CHAMB TEMP
 CHAMB PRES
 SAMPLE FLOW
 INTENSITY              ↓
 RANGE  AVG  DIAGS ALARM

 Hg(0) CONC MAX
 Hg(0) CONC MIN
 Hg(2+) CONC MAX
 Hg(2+) CONC MIN
```

```
Hg(t) CONC MAX
Hg(t) CONC MIN
MB STATUS
MIB STATUS
I/O BD STATUS
ZERO CHK CAL
SPAN CHK CAL
SYS DILUTION
SYS ZERO CHK/CAL
GEN PROBE ALARM
```

Non-Alarm

The Non-Alarm status screen allows the user to select the non-alarm status for the selected relay output. The 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
 LOCAL/REMOTE
 SERVICE
 Hg0 MODE
 Hgt MODE
 Hg0/Hgt MODE
 SAMPLE MODE
 INST ZERO MODE          ↓

 RANGE  AVG  DIAGS ALARM
```

```
 INST SPAN MODE
 ORIF ZERO MODE
 ORIF SPAN MODE
 SYS ZERO MODE
 SYS SPAN MODE
 BLOWBACK MODE
 LOCAL/REMOTE
 OXIDIZER BASE
 O2 QUENCHING STATUS
 SPIKING MODE
 OXIDIZER C1
 OXIDIZER PURGE
 PRM SPAN MODE
 84i CONNECT A
 84i CONNECT B
 OXIDIZER STATUS
```

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. ▲

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. ▲

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

```
DIGITAL INPUT SETTINGS:
>1   NOP         Hg0 MODE
 2   NOP         Hgt MODE
 3   NOP     Hg0/Hgt MODE
 4   NOP   INST ZERO MODE
 5   NOP   INST SPAN MODE
 6   NOP   PROB ZERO MODE
 7   NOP              NONE ↓

 RANGE  AVG  DIAGS ALARM
```

Logic State

The Logic State screen is used to change the 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. If nothing is connected to the digital input pin, the state should be left at open to prevent the action from being triggered.

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

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




 RANGE  AVG  DIAGS ALARM
```

Instrument Action

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

Note If the "SYS Span 1–6" instrument actions are triggered during an oxidation sequence, the span level will be changed to the corresponding span number. The span level will remain at this setting for the remainder of the System Integrity Test unless otherwise changed again. This is to facilitate multi-level integrity checks. ▲

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

```
CHOOSE ACTION:
>NONE
 Hg0 MODE                  <--
 Hgt MODE
 Hg0/Hgt MODE
 INST ZERO MODE
 INST SPAN MODE
 ORIFICE ZERO MODE          ↓

 RANGE  AVG  DIAGS ALARM
 ORIFICE SPAN MODE
 SYS ZERO MODE
 SYS SPAN MODE
 BLOWBACK SYS
 BLOWBACK STING
 SET BACKGROUND
 SET SPAN COEF
 SYS SPAN 1
 SYS SPAN 2
 SYS SPAN 3
 SYS SPAN 4
 SYS SPAN 5
 SYS SPAN 6
 OXI CAL
 INST SPAN 1
 INST SPAN 2
 INST SPAN 3
 HYDRATOR ALARM
 EXT ALARM
 THC ZERO MODE
 THC SPAN MODE
 THC BLOWBACK
 PERM SPAN
 84i CONNECT B
 SET HG0 SPAN
 SET HGT SPAN
```

Analog Output Configuration

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, voltage channels 1-6, and current channels 1-6. Configuration choices include selecting range, setting minimum/maximum values, and choosing signal to output.

- 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
 VOLTAGE CHANNEL 5          ↓

 RANGE  AVG  DIAGS ALARM
```

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



 RANGE  AVG  DIAGS ALARM
```

Allow Over/Under Range

The Allow Over/Under Range screen, in Analog Output Configuration under I/O Configuration, 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:          OFF
    SET TO:           ON  ?

           ↵ TOGGLE VALUE

 RANGE  AVG  DIAGS ALARM
```

Select Output Range

The Select Output 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, 0-10 V.

- 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:    0-5V  ?

 ↑↓ CHANGE VALUE    ↵ SAVE

 RANGE  AVG  DIAGS ALARM
```

Minimum and Maximum Value

The Minimum Value screen is used to edit the zero (0) to full-scale (100) value in percentages for the selected analog output channel. See **Table 3–2** for a list of choices. The minimum and maximum output value screens function the same way. The example that follows shows the set minimum value screen.

- In the Main Menu, choose Instrument Controls > IO 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

 RANGE  AVG  DIAGS ALARM
```

Table 3–2. Analog Output Zero to Full-Scale Table

Output	Zero % Value	Full-Scale 100% Value
Hg^0	Zero (0)	Range Setting
Hg^{2+}	Zero (0)	Range Setting
Hg^t	Zero (0)	Range Setting
Hg^0 Range	Zero (0)	Range Setting
Hg^{2+} Range	Zero (0)	Range Setting
Hg^t Range	Zero (0)	Range Setting
Probe Span	Zero (0)	Range Setting
Hg^0 Span	Zero (0)	Range Setting
Hg^t Span	Zero (0)	Range Setting
Hg^0 Background	Zero (0)	Range Setting
Hg^t Background	Zero (0)	Range Setting
Hg^0 Coefficient	Zero (0)	Range Setting

Output	Zero % Value	Full-Scale 100% Value
Hg^t Coefficient	Zero (0)	Range Setting
Intensity	User-set alarm min value	User-set alarm max value
Internal Temperature	User-set alarm min value	User-set alarm max value
Chamber Temperature	User-set alarm min value	User-set alarm max value
Probe Temperature	User-set alarm min value	User-set alarm max value
Converter Temperature	User-set alarm min value	User-set alarm max value
Umbilical Temperature	User-set alarm min value	User-set alarm max value
Venturi Pressure	User-set alarm min value	User-set alarm max value
Orifice Pressure	User-set alarm min value	User-set alarm max value
Dil Air Pressure	User-set alarm min value	User-set alarm max value
Blowback Pressure	User-set alarm min value	User-set alarm max value
Eductor Pressure	User-set alarm min value	User-set alarm max value
Vacuum Pressure	User-set alarm min value	User-set alarm max value
Flow	User-set alarm min value	User-set alarm max value
PMT Volts	Zero	User-set alarm max value
Chamber Pressure	User-set alarm min value	User-set alarm max value
Dil Factor	User-set alarm min value	User-set alarm max value

Choose Signal to Output

The Choose Signal Type to Output screen displays a menu list of the analog output signal group choices. Group choices are Concentrations, Other Measurements, and Analog Inputs. This allows the user to select the output signal to the selected output channel. See **Table 3–3** 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 -     CONC
 SELECTED OUTPUT:    V1
 CURRENTLY: NONE
    SET TO: HG(o)       ?

 ↑↓ CHANGE VALUE    ↵ SAVE

 RANGE  AVG  DIAGS ALARM
```

Table 3–3. Signal Type Group Choices

Concentrations	Other Measurements	Analog Inputs
None	None	None
Hg^0	Intensity	Analog Input 1
Hg^{2+}	Internal Temperature	Analog Input 2
Hg^t	Chamber Temperature	Analog Input 3
Hg^0 Range	Probe Temperature	Analog Input 4
Hg^{2+} Range	Converter Temperature	Analog Input 5
Hg^t Range	Umbilical Temperature	Analog Input 6
Probe Span	Venturi Pressure	Analog Input 7
Hg^0 Span	Orifice Pressure	Analog Input 8
Hg^t Span	Dil Air Pressure	
Hg^0 Background	Blowback Pressure	
Hg^t Background	Eductor Pressure	
Hg^0 Coefficient	Vacuum Pressure	
Hg^t Coefficient	Flow	
	PMT Volts	
	Chamber Pressure	
	Dil Factor	
	Lamp Temp	
	Oxid Temp	
	Ext Alarms	
	P-G Ratio	
	Perm Oven Gas	
	Perm Oven Htr	
	Capillary HT	
	84*i* Pressure	

Analog Input Configuration

The Analog Input Configuration menu displays a list of the 8 analog input channels available for configuration. Configuration includes entering 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↓

 RANGE  AVG  DIAGS ALARM
```

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


 RANGE  AVG  DIAGS ALARM
```

Descriptor

The Descriptor screen allows the user to enter the descriptor 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

 RANGE  AVG  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

 RANGE  AVG  DIAGS ALARM
```

Decimal Places

The Decimal Places screen allows the user to select how many digits are displayed to the right of the decimal, 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

 RANGE  AVG  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. 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
 RANGE  AVG  DIAGS ALARM
```

Table Point

The Table Point menu 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 2-10**.

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




 RANGE  AVG  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.

- 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
 RANGE  AVG  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 -999.9 to 999.9. 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.

- 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

 RANGE   AVG   DIAGS ALARM
```

Temperature Compensation

Temperature compensation provides compensation for any changes to the instrument's output signal due to internal instrument temperature variations. The effects of internal instrument temperature changes on the instrument's subsystems and output have been empirically determined. This empirical data is used to compensate for any changes in temperature.

When temperature compensation is on, the display shows the current internal instrument temperature (measured by a thermistor on the Interface board). When temperature compensation is off, the display shows the factory standard temperature of 30 °C.

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

```
TEMPERATURE COMPENSATION:
 COMP TEMP:        30.0 °C
 CURRENTLY:            OFF
    SET TO:             ON ?

            ↵ TOGGLE VALUE

 RANGE   AVG   DIAGS ALARM
```

Pressure Compensation

Pressure compensation provides compensation for any changes to the instrument's output signal due to reaction chamber pressure variations. The effects of optical chamber pressure changes on the instrument's subsystems and output have been empirically determined. This empirical data is used to compensate for any change in reaction chamber pressure.

When pressure compensation is on, the first line of the display represents the current pressure in the optical chamber. When pressure compensation is off, the first line of the display shows the factory standard pressure of 50 mmHg.

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

```
PRESSURE COMPENSATION:
 COMP PRES:     50.0 mmHg
 CURRENTLY:           OFF
    SET TO:            ON ?

              ↵ TOGGLE VALUE

 RANGE  AVG   DIAGS ALARM
```

Lamp Compensation

Lamp compensation provides compensation for drift in lamp intensity.

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

```
LAMP COMPENSATION:
 LAMP AVG INT  80000 Hz
 CURRENTLY:           OFF
    SET TO:            ON ?

              ↵ TOGGLE VALUE

 RANGE  AVG   DIAGS ALARM
```

Oxygen Quencing Compensation

For instruments utilizing fluorescence, such as the 80*i* Mercury Analyzer, changes in oxygen concentration will affect mercury concentration readings. A decrease in stack oxygen concentration will increase the fluorescence, which will increase the apparent mercury concentration. A decrease in stack oxygen concentration will decrease the apparent mercury concentration. By enabling the Oxygen Compensation feature, mercury concentrations will be normalized regardless of stack oxygen fluctuations. This feature can be used for systems using nitrogen gas as dilution. There is not a need to enable this feature if the Mercury System is running house air for dilution.

The installation and procedure for reading and calibrating the Stack Oxygen concentration is as follows. The user will need to provide the 80*i* with real time readings of stack oxygen concentration using a 3rd party oxygen sensor. The oxygen sensor should be connected to an unused Analog Input connection located in the back of the 80*i* instrument.

Note After the oxygen compensation is setup properly and enabled, the user should recalibrate the mercury system. ▲

- In the Main Menu, choose Instrument Controls > **O2 Quencing Comp**.

```
O2 QUENCHING COMPENSATION:
 COMPENSATION MODE
 DILUTION O2 PERCENT
 STACK O2 INPUT CHANNEL
 MANUAL O2 PERCENT
 O2 COMPENSATION COEFFS


 RANGE  AVG  DIAGS ALARM
```

Compensation Mode

This screen allows the user to turn On/Off the Oxygen Quenching Compensation mode. There are 3 choices: Off, Manual, and Auto.

Dilution O_2 Percent

The user will need to measure the oxygen percentage in their nitrogen diluent. To do this, the user should put the instrument into System Zero gas mode. Measure the oxygen percentage at the 81*i* probe outlet. Enter this value at the screen, Instrument Controls>O2 Quenching Comp>Dilution O2 %.

Stack O_2 Input Channel (Auto mode)

1. At the screen Instrument Controls>O2 Quenching Comp>Stack O2 Input Channel, select an unused Analog Input channel. To see which channels are available go to the screen, Diagnostics>Analog Input Readings and choose an input that is not actively reading voltage.

2. On the rear panel of the 80*i* connect your Analog In wire to the correct channel on the I/O expansion board.

Note Calibrate the Analog Input Channel. Refer to chapter 7 of this manual to locate and calibrate the Analog Input channel under the subheading “Analog Input Calibration”. ▲

Note Configure the Analog Input Channel. Refer to chapter 3 of this manual to configure the Analog Input Channel under the subheading “Analog Input Configuration”. When configuring the channel do not use “decimal percentage” values for the User Values. In other words, if you are calibrating the channel with 5.0% oxygen, then enter a User Value of 5.0 and not 0.05. ▲

Note To use this feature the user should set the Compensation Mode to Auto. ▲

Manual O_2 Percent

If the user is unable to measure the stack oxygen percent and if the stack oxygen percent is stable, he may forego the real time readings of the stack oxygen percent. Enter the stack oxygen percent in this menu.

Note To use this feature the user should set the Compensation Mode to Manual. ▲

O_2 Compensation Coefficients

This menu lists the coefficients used for in the oxygen quenching algorithm. These values have been tested at the factory.

X3 Coefficient	-0.0032
X2 Coefficient	0.0374
X Coefficient	-0.1585
Y Intercept	1.3938

Alarms Associated with the Oxygen Sensor

There are 2 alarms, in the Alarms menu, associated with the Oxygen Sensor.

- External Alarm
  - The Oxygen Sensor can be connected to an unassigned Digital Input on the rear panel of the 80*i* Mercury Analyzer. Next, this Digtial Input can be assigned to a variable called EXT Alarm. The logic can be normally open or normally closed. For instance, if the Digital Input is grounded with Normally Open logic, then the alarm will be active and displayed in the alarms menu.
    - This alarm will output FAIL if the O_2 Sensor is OFF or not connected, provided that the device has a status output.
    - The EXT Alarm can be datalogged and streamed (binary digit 0 or 1)
    - The EXT Alarm is in the Alarm menu found at the screen Alarms>Instrument
    - The EXT Alarm can be assigned as a Digital Output
    - The EXT Alarm is tied to the Alarm Bell display on the status bar
- O_2 Quenching Status Alarm

- This alarm will FAIL if one or both of the following conditions are met
  - External Alarm is in the FAIL state.
  - The assigned Analog Input is reporting a voltage less than 0.05V
- More information about this alarm
  - The O_2 Quenching Status Alarm is in the Alarm menu found at the screen Alarms>Instrument
  - This alarm will only function if the Oxygen Quenching mode is set to "Auto".
  - This alarm can be assigned as a Digital Output
  - This Alarm is tied to the Alarm Bell display on the status bar
  - This Alarm cannot be datalogged or streamed. However the Analog Input reading (O_2 percent reading) can be datalogged and streamed.

Oxidation Schedule

The Oxidation Schedule menu is discussed in the *Mercuric Chloride Generator Manual*, part number 105648-00.

Probe Blow Back Schedule

The Probe Blow Back Schedule screen allows the user to program frequency and duration of both filter and stinger blow backs.

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

```
PROBE BLOW BACK SCHEDULE:
>NEXT TIME 01Jan05 12:00
 PERIOD HR            24
 TOTAL DURATION HR   1.5
 SYSTEM DURATION SEC  30
 STINGER DURATION SEC 30



 RANGE  AVG  DIAGS ALARM
```

Next Time

The Next Time screen is used to view and set the next Probe Blow Back Schedule date and time.

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

```
NEXT DATE AND TIME:
 19 MAR 2005  12:34
 PRESS ← TO EDIT



 RANGE  AVG  DIAGS ALARM
```

```
NEXT DATE AND TIME:
 19 MAR 2005  12:34:56
 SETTING: DAYS
            → SET MONTHS
           ↑↓ CHANGE VALUE
            ↵ SAVE VALUE
 RANGE  AVG  DIAGS ALARM
```

Period

The Period screen defines the period or interval between probe blow backs. Periods between 0 and 999 hours are acceptable. To turn the probe blow backs off, set the period to 0.

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

```
BLOW BACK PERIOD:
 CURRENTLY: 4 HRS  2 MIN
    SET TO: 05HRS 50 MIN ?

            SETTING MINUTES
↑↓ CHANGE VALUE    ↵ SAVE

 RANGE  AVG  DIAGS ALARM
```

System/Stinger Duration Seconds

The System Duration Seconds screen defines the amount of time the system will be in blow back mode. The Stinger Duration Seconds screen looks and functions the same way. Durations between 0 and 999 seconds are acceptable.

- In the Main Menu, choose Instrument Controls > Probe Blow Back Schedule > **System** or **Stinger Duration Sec**.

```
SYSTEM DURATION:
 CURRENTLY:       30 SEC
    SET TO:      09█ MIN ?

          ←→ MOVE CURSOR
 ↑↓ CHANGE VALUE   ↵ SAVE

 RANGE  AVG  DIAGS ALARM
```

Solenoid States

The Solenoid State screen displays the state of the 10 digital outputs and allows toggling of the state to either on (1) or off (0). 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↓
 RANGE  AVG  DIAGS ALARM
```

Screen Contrast

The Screen Contrast screen is used to change the contrast of the display. Values 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.

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

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

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 screen contrast to mid range, then optimize the contrast. See "Contrast Levels" in the "C-Link Protocol Commands" appendix for more information on this command. ▲

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

```
SCREEN CONTRAST:
 CURRENTLY:       50 %
    SET TO:       60 % ?

          ↑↓ CHANGE VALUE
           ↵ SAVE VALUE
 RANGE  AVG  DIAGS ALARM
```

Service Mode

The Service Mode screen is used to turn the service mode on or off. The service mode locks out any remote actions and includes parameters and functions that are useful when making adjustments or diagnosing the

Model 80*i*. For more information about the service mode, see "Service Menu" later in this chapter.

Note The service mode prevents remote operation and should be turned off when finished. ▲

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

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

           ↵ TOGGLE VALUE
 RANGE  AVG  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



 RANGE  AVG  DIAGS ALARM
```

```
DATE AND TIME:
 19 MAR 2005  12:34:56   ?
 SETTING: DAYS
           ➡ SET MONTHS
          ⬆⬇ CHANGE VALUE
           ↵ SAVE VALUE
 RANGE  AVG  DIAGS ALARM
```

Timezone

The Timezone screen is used to set the timezone for the NTP time 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 CLINK "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)

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

```
TIMEZONE FOR TIMESERVER:
 CURRENTLY: UTC (GMT)
    SET TO: UTC (GMT)

            ↑↓ CHANGE VALUE
             ↵ SAVE VALUE

 RANGE  AVG   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
 VOLTAGES
 TEMPERATURES
 PRESSURE
 FLOW
 LAMP INTENSITY
 DRIFT                    ↓

 RANGE  AVG   DIAGS ALARM
 ANALOG INPUT READINGS
 ANALOG INPUT VOLTAGES
 DIGITAL INPUTS
 RELAY STATES
 TEST ANALOG OUTPUTS
 SYSTEM CONFIGURATION
 CONTACT INFORMATION
```

Program Versions

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

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

```
PROGRAM VERSION:
   PRODUCT:    MODEL 80i
   VERSION: 00.05.68.192
  FIRMWARE:       10.13.77



 RANGE  AVG   DIAGS ALARM
```

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 80i
 INTERFACE BOARD 82i
 I/O BOARD




 RANGE  AVG  DIAGS ALARM
```

Motherboard Voltages

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

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

```
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



 RANGE  AVG  DIAGS ALARM
```

Interface Board 80*i*

The Interface Board 80*i* screen (read only) is used to display the current voltage readings on the Model 80*i* interface board.

- In the Main Menu, choose Diagnostics > Voltages > **Interface Board 80*i***.

```
INTERFACE BRD80 VOLTAGES:
>  PMT SUPPLY      600.0 V
   3.3 SUPPLY        3.3 V
   5.0 SUPPLY        5.0 V
  15.0 SUPPLY       15.0 V
 P15.0 SUPPLY       15.0 V
  24.0 SUPPLY       24.0 V
 -15.0 SUPPLY      -15.0 V

 RANGE  AVG  DIAGS ALARM
```

Interface Board 82*i*

The Interface Board 82*i* screen (read only) is used to display the current voltage readings on the Model 82*i* interface board.

- In the Main Menu, choose Diagnostics > Voltages > **Interface Board 82*i***.

```
INTERFACE BRD82 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



 RANGE  AVG  DIAGS ALARM
```

I/O Board Voltages

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

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

```
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




 RANGE  AVG  DIAGS ALARM
```

Temperatures

The Temperatures menu displays the current temperature readings for instrument and the probe.

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

```
TEMPERATURES:
 ANALYZER
 PROBE



 RANGE  AVG  DIAGS ALARM
```

Analyzer

The Temperatures Analyzer screen (read only) displays the current internal temperature, chamber temperature, and lamp temperature. The internal temperature is the air temperature measured by a sensor located on the interface board.

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

```
TEMPERATURES ANALYZER:
 INTERNAL          34.6  °C
 CHAMBER           49.7  °C
 LAMP              49.0  °C



 RANGE  AVG  DIAGS ALARM
```

Probe

The Temperatures Probe screen (read only) displays the current umbilical temperature, probe temperature, oxidizer, and converter temperature.

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

```
TEMPERATURES PROBE:
 UMBILICAL          150.0  °C
 PROBE              200.0  °C
 CONVERTER          760.0  °C
 OXIDIZER           400.0  °C



 RANGE   AVG   DIAGS ALARM
```

Pressure

The Pressure menu displays the current pressure readings for instrument and the probe.

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

```
PRESSURES:
 ANALYZER
 PROBE





 RANGE   AVG   DIAGS ALARM
```

Analyzer

The Pressure Analyzer screen (read only) displays the current chamber pressure reading. The pressure is measured by a pressure transducer.

- In the Main Menu, choose Diagnostics > Pressure > **Analyzer**.

```
PRESSURE ANALYZER:
 CHAMBER           50.1  mmHg






 RANGE   AVG   DIAGS ALARM
```

Probe

The Pressures Probe screen (read only) displays the current pressure readings.

- In the Main Menu, choose Diagnostics > Pressure > **Probe**.

```
PRESSURES PROBE:
 VENTURI         1.2 INH2O
 ORIFICE          0.4 PSIG
 DILUTION        13.0 PSIG
 BLOW BACK       60.0 PSIG
 EDUCTOR         13.0 PSIG
 VACUUM          21.0 INHG

 RANGE  AVG  DIAGS ALARM
```

Note Venturi pressure is not visible when the 80*i* is configured to work with the 83 GC probe. ▲

Flow

The Flow screen (read only) displays the flow rate. The flow is measured by internal flow sensors. For more information, see Chapter 1, "Introduction".

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

```
FLOW:            1.250 LPM



 RANGE  AVG  DIAGS ALARM
```

Lamp Intensity

The Lamp Intensity screen (read only) displays the lamp intensity (in Hertz). The lamp intensity reading should be about 100,000 Hertz.

- In the Main Menu, choose Diagnostics > **Lamp Intensity**.

```
LAMP INTENSITY: 101326 Hz



 RANGE  AVG  DIAGS ALARM
```

Drift

The Drift screen (read only) displays the amount of drift in concentrations over the displayed time period.

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

```
DRIFT:
CONC          DRIFT    PERIOD
               (%)      (HR)
 INST HG(0)   0.00     0.00
 INST HG(T)   0.00     0.00
 SYS HG(0)    0.00     0.00
 SYS HG(T)    0.00     0.00

 RANGE  AVG  DIAGS ALARM
```

Analog Input Readings

The Analog Input Readings screen (read only) displays the 8 current 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 ↓

 RANGE  AVG  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↓

 RANGE  AVG  DIAGS ALARM
```

Digital Inputs

The Digital Inputs screen (read only) displays the state of the 16 digital inputs. Pull-ups are provided on all the inputs, so if nothing is connected 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↓

 RANGE  AVG  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**.

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

 RANGE  AVG  DIAGS ALARM
```

Test Analog Outputs

The Test Analog Outputs menu contains a number of digital to analog converter (DAC) calibration items. 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       ↓

 RANGE  AVG  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 normal operation. The example that follows shows the selected output state “ALL” is set to normal.

- 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

 RANGE  AVG  DIAGS ALARM
```

System Configuration

The System Configuration menu displays information on the configuration of the system.

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

```
SYSTEM CONFIGURATION:
>81i CAL ENABLED      YES
 81i IP
 PROBE TYPE       83I/85I
 PERMEATION          NONE
 ENHANCED GAIN         NO


 RANGE  AVG  DIAGS ALARM
```

81*i* Cal Enabled

The 81*i* Calibration Enabled is a toggle item that changes between yes or no when selected. If the Model 80*i* is used in conjunction with a Model 81*i*, “81*i* CAL ENABLED” should be set to “YES”.

81*i* TCPIP

If the Model 80*i* is used with a Model 81*i*, the 81*i* TCPIP Address screen is used to enter the IP address of the connecting Model 81*i*. The IP address can only be changed when DHCP is on. For more information on DHCP, see “Use DHCP” in this chapter.

Note The IP Address must be left justified. ▲

- In the Main Menu, choose Diagnostics > System Configuration > **81i IP**.

```
81i IP ADDRESS:
 CURRENT: 192.168.1.15
  SET TO: 192.168.1.15
          ←→ MOVE CURSOR
          ↑↓ CHANGE VALUE
           ↵ SAVE VALUE
 RANGE  AVG  DIAGS ALARM
```

Probe Type

The Probe Type screen displays the type of probe currently being used.

- In the Main Menu, choose Diagnostics > System Configuration > **Probe Type**.

```
PROBE TYPE

 CURRENTLY:          83I
    SET TO:          83IGC?

           ↵ TOGGLE VALUE
 RANGE  AVG  DIAGS ALARM
```

Permeation

The Permeation Screen allows the user to view the menu screens associated with the Model 84*i* Permeation Source instrument. See the 84*i* manual, Thermo part number 114051-00, for more information.

```
PERMEATION OPTION:
 CURRENTLY:          NONE
    SET TO:          NONE?

 ↑↓ CHANGE VALUE   ↵ SAVE
 RANGE  AVG  DIAGS ALARM
```

Enhanced Gain

For applications measuring high levels of mercury concentrations (greater than 80 µg/m^3), the user can change the gain algorithm to the "Enhanced Gain" setting. Using the enhanced gain setting will not affect measurement sensitivity, linearity, or repeatability. All 80*i* specifications remain the same whether or not the enhanced gain setting is chosen.

Note Changing the Enhanced Gain setting will set backgrounds to 0.00 and coefficients to 1.000. A full PMT calibration, Instrument calibration, and System calibration will be required. ▲

```
  CHANGING WILL REQUIRE
  POWER CYCLE, PMT CAL,
   AND FULL SYSTEM CAL
      ARE YOU SURE?
 PRESS ➡ TO CONFIRM
 PRESS ⎗ TO CANCEL

 RANGE  AVG  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

 RANGE  AVG  DIAGS ALARM
```

Alarms Menu

The Alarms menu displays the alarm values for the instrument and the probe.

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

```
ALARMS:
>INSTRUMENT
 PROBE



 RANGE  AVG  DIAGS ALARM
```

Instrument

The Alarms Instrument menu displays a list of items that are monitored by the instrument. 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.

To see the actual reading of an item and its minimum and maximum limits, move the cursor to the item and press ↵.

Zero and span check are visible only if "CAL RESET" is not enabled, and Zero and span autocal are visible only if "CAL RESET" is enabled. The motherboard status, interface board status, and I/O expansion board status indicate that the power supplies are working and connections are successful. There are no setting screens for these alarms.

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

```
ALARMS INSTRUMENT:
 ALARMS DETECTED          0
>INTERNAL TEMP           OK
 CHAMBER TEMP            OK
 LAMP TEMP               OK
 PRESSURE                OK
 FLOW                    OK
 INTENSITY               OK↓

 RANGE  AVG  DIAGS ALARM
```

```
 INST ZERO CHECK         OK
 INST SPAN AUTOCAL       OK
 SYS ZERO CHECK          OK
 SYS SPAN CHECK          OK
 Hg(0) CONCENTRATION     OK
 Hg(2+) CONCENTRATION    OK
 Hg(t) CONCENTRAITON     OK
 EXTERNAL ALARMS         OK
 O2 QUENCHING STATUS     OK
 MOTHERBOARD STATUS      OK
 INTERFACE STATUS        OK
 I/O EXP STATUS          OK
```

Internal Temperature

The Internal Temperature screen displays the current internal temperature and sets the minimum and maximum alarm limits. Acceptable alarm limits range from 15 to 45 °C. If the internal temperature reading goes beyond either the minimum or maximum alarm limit, an alarm is activated. The word “ALARM” appears in the Run screen and in the Main Menu.

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

```
INTERNAL TEMPERATURE:
 ACTUAL            30.1 °C
>MIN               15.0 °C
 MAX               45.0 °C




 RANGE  AVG  DIAGS ALARM
```

Min and Max Internal Temperature Limits

The Minimum Internal Temperature alarm limit screen is used to change the minimum internal temperature alarm limit. The minimum and maximum internal temperature screens function the same way.

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

```
INTERNAL TEMPERATURE:
 ACTUAL MIN:      15.0 °C
 SET MIN TO:      18.0 °C ?

           ↑↓ INC/DEC
            ↵ SAVE VALUE
 RANGE  AVG  DIAGS ALARM
```

Chamber Temperature

The Chamber Temperature screen displays the current chamber temperature and sets the minimum and maximum alarm limits. Acceptable alarm limits range from 41 to 51 °C. If the chamber temperature reading goes beyond either the minimum or maximum limit, an alarm is activated. The word “ALARM” appears in the Run screen and in the Main Menu.

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

```
CHAMBER TEMPERATURE:
 ACTUAL           48.4 °C
>MIN              47.0 °C
 MAX              51.0 °C




 RANGE  AVG  DIAGS ALARM
```

Min and Max Chamber Temperature Limits

The Minimum Chamber Temperature alarm limit screen is used to change the minimum chamber temperature alarm limit. The minimum and maximum chamber temperature screens function the same way.

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

```
CHAMBER TEMPERATURE:
 ACTUAL MIN:      47.0 °C
 SET MIN TO:      48.0 °C ?

           ↑↓ INC/DEC
            ↵ SAVE VALUE
 RANGE  AVG  DIAGS ALARM
```

Lamp Temperature

The Lamp Temperature screen displays the current lamp temperature and sets the minimum and maximum alarm limits. Acceptable alarm limits range from 45 to 50 °C. If the lamp temperature reading goes beyond either the minimum or maximum limit, an alarm is activated. The word "ALARM" appears in the Run screen and in the Main Menu.

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

```
LAMP TEMPERATURE:
 ACTUAL            49.0 °C
>MIN               45.0 °C
 MAX               50.0 °C




 RANGE  AVG  DIAGS ALARM
```

Min and Max Lamp Temperature Limits

The Minimum Lamp Temperature alarm limit screen is used to change the minimum lamp temperature alarm limit. The minimum and maximum lamp temperature screens function the same way.

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

```
LAMP TEMPERATURE:
 ACTUAL MIN:       45.0 °C
 SET MIN TO:       46.0 °C ?

            ↑↓ INC/DEC
             ↵ SAVE VALUE
 RANGE  AVG  DIAGS ALARM
```

Pressure

The Pressure screen displays the current reaction chamber pressure reading and sets the minimum and maximum alarm limits. Acceptable alarm limits range from 25 to 300 mmHg. If the pressure reading goes beyond either the minimum or maximum limit, an alarm is activated. The word "ALARM" appears in the Run screen and in the Main Menu.

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

```
PRESSURE:
 ACTUAL          50.0 mmHg
>MIN             25.0 mmHg
 MAX            300.0 mmHg



 RANGE   AVG   DIAGS ALARM
```

Min and Max Pressure Limits

The Minimum Pressure alarm limit screen is used to change the minimum temperature alarm limit. The minimum and maximum pressure screens function the same way.

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

```
PRESSURE:
 ACTUAL MIN:      25.0 mmHg
 SET MIN TO:      30.0 mmHg?

            ↑↓ INC/DEC
             ↵ SAVE VALUE
 RANGE   AVG   DIAGS ALARM
```

Flow

The Flow screen displays the current sample flow reading and sets the minimum and maximum alarm limits. Acceptable alarm limits range from 0.000 to 1.000 lpm. If the sample flow reading goes beyond either the minimum or maximum limit, an alarm is activated. The word "ALARM" appears in the Run screen and in the Main Menu.

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

```
SAMPLE FLOW:
 ACTUAL           0.251 LPM
>MIN              0.100 LPM
 MAX              0.300 LPM



 RANGE   AVG   DIAGS ALARM
```

Min and Max Flow Limits

The Minimum Flow alarm limit screen is used to change the minimum sample flow alarm limit. The minimum and maximum sample flow screens function the same way.

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

```
SAMPLE FLOW:
 ACTUAL MIN:    0.350 LPM
 SET MIN TO:    0.360 LPM ?

          ↑↓ INC/DEC
           ↵ SAVE VALUE

 RANGE  AVG  DIAGS ALARM
```

Intensity

The Intensity screen displays the current lamp intensity reading and sets the minimum and maximum alarm limits. Acceptable alarm limits range from 10,000 hertz minimum to 200,000 hertz maximum. If the lamp intensity reading goes beyond either the minimum or maximum limit, an alarm is activated. The word “ALARM” appears in the Run screen and in the Main Menu.

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

```
INTENSITY:
 ACTUAL          101327 Hz
>MIN              60000 Hz
 MAX             200000 Hz




 RANGE  AVG  DIAGS ALARM
```

Min and Max Intensity Limits

The Minimum Intensity alarm limit screen is used to change the minimum lamp intensity alarm limit. The minimum and maximum intensity screens function the same way.

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

```
INTENSITY:
 ACTUAL MIN:      60000 Hz
 SET MIN TO:      60100 Hz?

          ↑↓ INC/DEC
           ↵ SAVE VALUE

 RANGE  AVG  DIAGS ALARM
```

Zero and Span Auto Calibration

The Zero and Span Auto Calibration screens (read only) allow the user to view the status of the most recent auto background calibration or span calibrations. The zero and span auto calibration screens are visible only if the zero/span check option is enabled and the zero or span cal reset function is enabled.

- In the Main Menu, choose Alarms > Instrument > **Zero** or **Span Autocal**.

```
ZERO AUTO CALIBRATION:
      ALARM:            OK
   RESPONSE:           5.0






 RANGE  AVG  DIAGS ALARM
```

Zero/Span/Probe Zero Check

The Zero and Span Check screen allows the user to view the status of the most recent zero/span checks and set the maximum check offsets. An alarm will be triggered if a zero or span check indicates drift that exceeds the offset value. The zero and span check screens are visible only if the zero/span check option is enabled. Their functions are similar.

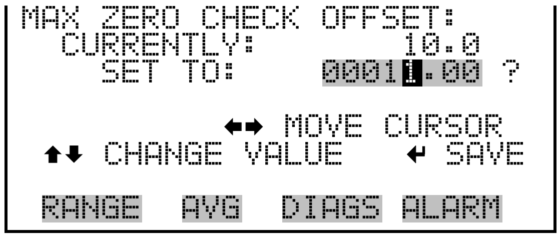
- In the Main Menu, choose Alarms > Instrument > **Zero, Span** or **Probe Zero Check**.

```
ZERO CHECK:
     ALARM:            OK
  RESPONSE:           0.0
>MAX OFFSET          10.0





 RANGE  AVG  DIAGS ALARM
```

Max Zero/Span/Probe Zero Offset

The Max Zero Check Offset screen is used to change the maximum zero check offset. The maximum zero, span, and probe zero offset screens function the same way.

- In the Main Menu, choose Alarms > Instrument > Zero, Span, or Probe Zero Check > **Max Offset**.



Probe Dilution Factor

The Probe Dilution Factor screen displays the current probe dilution factor reading and sets the minimum and maximum alarm limits. Acceptable alarm limits range from 10 minimum to 100 maximum. If the probe dilution factor reading goes beyond either the minimum or maximum limit, an alarm is activated. The word “ALARM” appears in the Run screen and in the Main Menu.

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

Min and Max Probe Dilution Factor Limits

The Minimum Probe Dilution Factor alarm limit screen is used to change the minimum probe dilution factor alarm limit. The minimum and maximum probe dilution factor screens function the same way.

- In the Main Menu, choose Alarms > Instrument > Probe Dilut Factor > **Min** or **Max**.

```
DILUTION FACTOR:
 ACTUAL MIN:    30.0
 SET MIN TO:    30.5       ?

          ↑↓ INC/DEC
           ↵ SAVE VALUE

 RANGE   AVG   DIAGS ALARM
```

Hg^0, Hg^{2+}, and Hg^t Concentration

The Hg^0 Concentration screen displays the current Hg^0 concentration and sets the minimum and maximum alarm limits. Acceptable alarm limits range from 0 to 600 µg/m^3. The minimum alarm may be programmed as a floor trigger (alarm is triggered when the concentration falls below the minimum value) or a ceiling trigger (alarm is triggered when the concentration goes above the minimum value). If the Hg^0 concentration goes beyond either the minimum or maximum limit, an alarm is activated. The word "ALARM" appears in the Run screen and in the Main Menu. The Hg^0, Hg^{2+}, and Hg^t concentration screens function the same way.

- In the Main Menu, choose Alarms > Instrument > **Hg(0), Hg(2+),** or **Hg(t) Concentration**.

```
CONCENTRATION:
 ACTUAL                58.3
>MIN                    0.0
 MAX                  20000
 MIN TRIGGER        CEILING



 RANGE   AVG   DIAGS ALARM
```

Min and Max Hg^0, Hg^{2+}, and Hg^t Concentration Limits

The Minimum Hg^0 Concentration alarm limit screen is used to change the minimum Hg^0 concentration alarm limits. The minimum and maximum Hg^0, Hg^{2+}, and Hg^t concentration screens function the same way.

- In the Main Menu, choose Alarms > Instrument > Hg(0), Hg(2+), or Hg(t) Concentration > **Min** or **Max**.

```
CONCENTRATION:
 ACTUAL MIN:            0.0
 SET MIN TO:     00001.00 ?

          ←→ MOVE CURSOR
 ↑↓ INC/DEC    ↵ SAVE VALUE

 RANGE   AVG   DIAGS ALARM
```

Min Trigger

The Minimum Trigger screen allows the user to view and set the concentration alarm trigger type to either floor or ceiling. The minimum alarm may be programmed as a floor trigger (alarm is triggered when the concentration falls below the minimum value) or a ceiling trigger (alarm is triggered when the concentration goes above the minimum value).

- In the Main Menu, choose Alarms > Instrument > Select Concentration > **Min Trigger**.

```
MIN TRIG(CEILING/FLOOR):
ACTUAL TRIGGER:  CEILING
SET TRIGGER TO:    FLOOR ?

 ↵ TOGGLE AND  SAVEVALUE
 RANGE  AVG  DIAGS ALARM
```

Probe

The Alarms Probe menu displays a list of items that are monitored by the probe. 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.

To see the actual reading of an item and its minimum and maximum limits, move the cursor to the item and press ↵.

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

```
ALARMS PROBE:
 ALARMS DETECTED       0
>UMBILICAL TEMP        OK
 PROBE TEMP            OK
 CONVERTER TEMP        OK
 OXIDIZER TEMP         OK
 VENTURI PRESSURE      OK
 ORIFICE PRESSURE      OK↓
 RANGE  AVG  DIAGS ALARM

 DILUTION PRESSURE     OK
 BLOW BACK PRESSURE    OK
 EDUCTOR PRESSURE      OK
 VACUUM PRESSURE       OK
```

Umbilical Temperature

The Umbilical Temperature screen displays the current umbilical temperature and sets the minimum and maximum alarm limits. Acceptable alarm limits range from 10.0 °C minimum to 200.0 °C maximum. If the umbilical temperature reading goes beyond either the minimum or maximum alarm limit, an alarm is activated. The word “ALARM” appears in the Run screen and in the Main Menu.

- In the Main Menu, choose Alarms > Probe > **Umbilical Temp**.

```
UMBILICAL TEMPERATURE:
 ACTUAL          175.0 °C
>MIN              70.0 °C
 MAX             190.0 °C



 RANGE   AVG   DIAGS ALARM
```

Min and Max Umbilical Temperature Limits

The Minimum Umbilical Temperature alarm limit screen is used to change the minimum umbilical temperature alarm limit. The minimum and maximum umbilical temperature screens function the same way.

- In the Main Menu, choose Alarms > Probe > Umbilical Temp > **Min** or **Max**.

```
UMBILICAL TEMPERATURE:
 ACTUAL MIN:      70.0 °C
 SET MIN TO:     100.1 °C ?

            ↑↓ INC/DEC
             ↵ SAVE VALUE
 RANGE   AVG   DIAGS ALARM
```

Probe Temperature

The Probe Temperature screen displays the current probe temperature and sets the minimum and maximum alarm limits. Acceptable alarm limits range from 0.0 °C minimum to 250 °C maximum. If the probe temperature reading goes beyond either the minimum or maximum alarm limit, an alarm is activated. The word “ALARM” appears in the Run screen and in the Main Menu.

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

```
PROBE TEMPERATURE:
 ACTUAL           0.0 °C
>MIN            160.0 °C
 MAX            230.0 °C




 RANGE  AVG  DIAGS ALARM
```

Min and Max Probe Temperature Limits

The Minimum Probe Temperature alarm limit screen is used to change the minimum probe temperature alarm limit. The minimum and maximum probe temperature screens function the same way.

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

```
PROBE TEMPERATURE:
 ACTUAL MIN:    160.0 °C
 SET MIN TO:    162.0 °C ?

           ↑↓ INC/DEC
            ↵ SAVE VALUE
 RANGE  AVG  DIAGS ALARM
```

Converter Temperature

The Converter Temperature screen displays the current converter temperature and sets the minimum and maximum alarm limits. Acceptable alarm limits range from 0.0 °C minimum to 900 °C maximum. If the converter temperature reading goes beyond either the minimum or maximum alarm limit, an alarm is activated. The word “ALARM” appears in the Run screen and in the Main Menu.

- In the Main Menu, choose Alarms > Probe > **Converter Temp**.

```
CONVERTER TEMPERATURE:
 ACTUAL         760.0 °C
>MIN            600.0 °C
 MAX            850.0 °C




 RANGE  AVG  DIAGS ALARM
```

Min and Max Converter Temperature Limits

The Minimum Converter Temperature alarm limit screen is used to change the minimum converter temperature alarm limit. The minimum and maximum converter temperature screens function the same way.

- In the Main Menu, choose Alarms > Probe > Converter Temp > **Min** or **Max**.

```
CONVERTER TEMPERATURE:
 ACTUAL MIN:     600.0  °C
 SET MIN TO:     700.0  °C ?

           ↑↓ INC/DEC
            ↵ SAVE VALUE

 RANGE   AVG   DIAGS ALARM
```

Oxidizer Temperature

The Oxidizer Temperature screen displays the current oxidizer temperature and sets the minimum and maximum alarm limits. Acceptable alarm limits range from 200.0 °C minimum to 450 °C maximum. If the oxidizer temperature reading goes beyond either the minimum or maximum alarm limit, an alarm is activated. The word “ALARM” appears in the Run screen and in the Main Menu.

- In the Main Menu, choose Alarms > Probe > **Oxidizer Temp**.

```
OXIDIZER TEMPERATURE:
 ACTUAL          300.0  °C
>MIN             200.0  °C
 MAX             400.0  °C




 RANGE   AVG   DIAGS ALARM
```

Min and Max Oxidizer Temperature Limits

The Minimum Oxidizer Temperature alarm limit screen is used to change the minimum oxidizer temperature alarm limit. The minimum and maximum oxidizer temperature screens function the same way.

- In the Main Menu, choose Alarms > Probe > Oxidizer Temp > **Min** or **Max**.

```
OXIDIZER TEMPERATURE:
 ACTUAL MIN:     275.0 °C
 SET MIN TO:     350.0 °C ?

           ↑↓ INC/DEC
            ↵ SAVE VALUE

 RANGE  AVG  DIAGS ALARM
```

Venturi Pressure

The Venturi Pressure screen displays the current venturi pressure and sets the minimum and maximum alarm limits. Acceptable alarm limits range from 0.0 in H_20 minimum to 10.0 in H_20 maximum. If the venturi pressure reading goes beyond either the minimum or maximum alarm limit, an alarm is activated. The word "ALARM" appears in the Run screen and in the Main Menu.

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

```
VENTURI PRESSURE:
 ACTUAL          -3.1 INH2O
>MIN              0.0 INH2O
 MAX              4.0 INH2O




 RANGE  AVG  DIAGS ALARM
```

Min and Max Venturi Pressure Limits

The Minimum Venturi Pressure alarm limit screen is used to change the minimum venturi pressure alarm limit. The minimum and maximum venturi pressure screens function the same way.

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

```
VENTURI PRESSURE:
 ACTUAL MIN:    0.0 INH2O
 SET MIN TO:    0.1 INH2O ?

           ↑↓ INC/DEC
            ↵ SAVE VALUE

 RANGE  AVG  DIAGS ALARM
```

Orifice Pressure

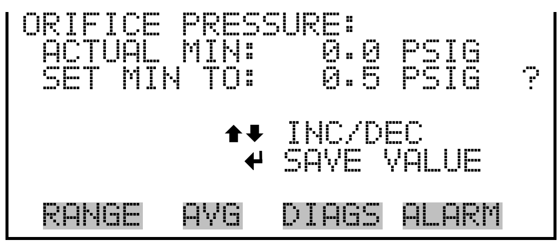
The Orifice Pressure screen displays the current orifice pressure and sets the minimum and maximum alarm limits. Acceptable alarm limits range from -3.0 psig minimum to 3.0 psig maximum. If the orifice pressure reading goes beyond either the minimum or maximum alarm limit, an alarm is activated. The word "ALARM" appears in the Run screen and in the Main Menu.

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

Min and Max Orifice Pressure Limits

The Minimum Orifice Pressure alarm limit screen is used to change the minimum orifice pressure alarm limit. The minimum and maximum orifice pressure screens function the same way.

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



Dilution Pressure

The Dilution Pressure screen displays the current dilution pressure and sets the minimum and maximum alarm limits. Acceptable alarm limits range from 0.0 psig minimum to 70.0 psig maximum. If the dilution pressure reading goes beyond either the minimum or maximum alarm limit, an alarm is activated. The word "ALARM" appears in the Run screen and in the Main Menu.

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

```
DILUTION PRESSURE:
 ACTUAL          0.0 PSIG
>MIN            40.0 PSIG
 MAX            65.0 PSIG




 RANGE  AVG  DIAGS ALARM
```

Min and Max Dilution Pressure Limits

The Minimum Dilution Pressure alarm limit screen is used to change the minimum dilution pressure alarm limit. The minimum and maximum dilution pressure screens function the same way.

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

```
DILUTION PRESSURE:
 ACTUAL MIN:   40.0 PSIG
 SET MIN TO:   40.1 PSIG ?

          ↑↓ INC/DEC
           ↵ SAVE VALUE
 RANGE  AVG  DIAGS ALARM
```

Blow Back Pressure

The Blow Back Pressure screen displays the current blow back pressure and sets the minimum and maximum alarm limits. Acceptable alarm limits range from 0.0 psig minimum to 70.0 psig maximum. If the blow back pressure reading goes beyond either the minimum or maximum alarm limit, an alarm is activated. The word “ALARM” appears in the Run screen and in the Main Menu.

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

```
BLOW BACK PRESSURE:
 ACTUAL          0.0 PSIG
>MIN            40.0 PSIG
 MAX            65.0 PSIG




 RANGE  AVG  DIAGS ALARM
```

Min and Max Blow Back Pressure Limits

The Minimum Blow Back Pressure alarm limit screen is used to change the minimum blow back pressure alarm limit. The minimum and maximum blow back pressure screens function the same way.

- In the Main Menu, choose Alarms > Probe > Blow Back Pressure > **Min** or **Max**.

```
BLOW BACK PRESSURE:
 ACTUAL MIN:    40.0 PSIG
 SET MIN TO:    40.1 PSIG ?

            ↑↓ INC/DEC
             ↵ SAVE VALUE

 RANGE  AVG  DIAGS ALARM
```

Eductor Pressure

The Eductor Pressure screen displays the current eductor pressure and sets the minimum and maximum alarm limits. Acceptable alarm limits range from 0.0 psig minimum to 30.0 psig maximum. If the eductor pressure reading goes beyond either the minimum or maximum alarm limit, an alarm is activated. The word “ALARM” appears in the Run screen and in the Main Menu.

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

```
EDUCTOR PRESSURE:
 ACTUAL            0.0 PSIG
>MIN               5.0 PSIG
 MAX              20.0 PSIG




 RANGE  AVG  DIAGS ALARM
```

Min and Max Eductor Pressure Limits

The Minimum Eductor Pressure alarm limit screen is used to change the minimum eductor pressure alarm limit. The minimum and maximum eductor pressure screens function the same way.

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

```
EDUCTOR PRESSURE:
 ACTUAL MIN:      5.0 PSIG
 SET MIN TO:      5.1 PSIG ?

          ↑↓ INC/DEC
           ↵ SAVE VALUE

 RANGE  AVG  DIAGS ALARM
```

Vacuum Pressure

The Vacuum Pressure screen displays the current Vacuum pressure and sets the minimum and maximum alarm limits. Acceptable alarm limits range from 0.0 psig minimum to 29.0 InHg maximum. If the Vacuum pressure reading goes beyond either the minimum or maximum alarm limit, an alarm is activated. The word "ALARM" appears in the Run screen and in the Main Menu.

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

```
VACUUM PRESSURE:
 ACTUAL             0.0 INHG
>MIN               19.0 INHG
 MAX               25.0 INHG




 RANGE  AVG  DIAGS ALARM
```

Min and Max Vacuum Pressure Limits

The Minimum Vacuum Pressure alarm limit screen is used to change the minimum Vacuum pressure alarm limit. The minimum and maximum Vacuum pressure screens function the same way.

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

```
VACUUM PRESSURE:
 ACTUAL MIN:     19.0 INHG
 SET MIN TO:     19.1 INHG ?

          ↑↓ INC/DEC
           ↵ SAVE VALUE

 RANGE  AVG  DIAGS ALARM
```

Service Menu

The Service menu appears only when the instrument is in the service mode. 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:
>PMT VOLTAGE ADJUSTMENT
 SET TEMPERATURES
 SET PRESSURES
 PRESSURE CALIBRATION
 FLOW CALIBRATION
 INPUT BOARD CALIBRATION
 TEMPERATURE CALIBRATION ↓

 RANGE  AVG  DIAGS ALARM

 ANALOG OUT CALIBRATION
 ANALOG INPUT CALIBRATION
 DISPLAY PIXEL TEST
 RESTORE USER DEFAULTS
 LAMP NORMALIZATION
```

PMT Voltage Adjustment

The PMT Voltage Adjustment screen is used to manually adjust the PMT supply voltage. This 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.

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

- In the Main Menu, choose Service > **PMT Voltage Adjustment**.

```
SET PMT VOLTAGE - MANUAL:
 CURRENTLY:          700 V
    SET TO:         2332 ?

           ↑↓ CHANGE VALUE
            ↵ SAVE VALUE

 RANGE  AVG  DIAGS ALARM
```

Set Temperatures

The Set Temperatures menu is used with its associated screens to set temperatures for the bench, probe, probe failsafe, umbilical, converter, and oxidizer. It 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 > **Set Temperatures**.

```
SET TEMPERATURES:
>BENCH SET TEMP
 PROBE SET TEMP
 PROBE SET TEMP FAILSAFE
 UMBILICAL SET TEMP
 CONVERTER SET TEMP
 OXIDIZER SET TEMP
 LAMP TEMPERATURE (Deg C)

 RANGE  AVG  DIAGS ALARM
```

Bench Set Temperature

The Bench Set Temperature screen is used to change the bench set temperature. The bench set temperature 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.

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

- In the Main Menu, choose Service > Set Temperatures > **Bench Set Temp**.

```
SET BENCH TEMP:
 CURRENTLY:       45.0 °C
    SET TO:       50.0 °C ?

           ↑↓ INC/DEC
            ↵ SAVE VALUE

 RANGE  AVG  DIAGS ALARM
```

Probe Set Temperature

The Probe Set Temperature screen is used to change the probe set temperature. The probe set temperature 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.

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

- In the Main Menu, choose Service > Set Temperatures > **Probe Set Temp**.

```
SET PROBE TEMP:
 CURRENTLY:        190 °C
    SET TO:        200 °C ?

           ↑↓ INC/DEC
            ↵ SAVE VALUE

 RANGE   AVG   DIAGS ALARM
```

Probe Set Temperature Failsafe

The Probe Set Temperature Failsafe screen is used to change the probe set temperature failsafe. If the probe temperature drops below the probe failsafe temperature, the eductor and dilution air will be automatically shut off to keep stack gas from being drawn into a "COLD" probe. The probe set temperature failsafe 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.

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

- In the Main Menu, choose Service > Set Temperatures > **Probe Set Temp Failsafe**.

```
SET PROBE TEMP FAILSAFE:
 CURRENTLY:        150 °C
    SET TO:        160 °C ?

           ↑↓ INC/DEC
            ↵ SAVE VALUE

 RANGE   AVG   DIAGS ALARM
```

Umbilical Set Temperature

The Umbilical Set Temperature screen is used to change the umbilical set temperature. The umbilical set temperature 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.

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

- In the Main Menu, choose Service > Set Temperatures > **Umbilical Set Temp**.

```
SET UMBILICAL TEMP:
 CURRENTLY:      160 °C
    SET TO:      170 °C ?

           ↑↓ INC/DEC
            ↵ SAVE VALUE

 RANGE  AVG  DIAGS ALARM
```

Converter Set Temperature

The Converter Set Temperature screen is used to change the converter set temperature. The converter set temperature reading is updated every second. The converter set temperature 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.

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

- In the Main Menu, choose Service > Set Temperatures > **Converter Set Temp**.

```
SET CONVERTER TEMP:
 CURRENTLY:      750 °C
    SET TO:      760 °C ?

           ↑↓ INC/DEC
            ↵ SAVE VALUE

 RANGE  AVG  DIAGS ALARM
```

Oxidizer Set Temperature

The Oxidizer Set Temperature screen is used to change the oxidizer set temperature. The oxidizer set temperature reading is updated every second. The oxidizer set temperature 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.

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

- In the Main Menu, choose Service > Set Temperatures > **Oxidizer Set Temp**.

```
SET OXIDIZER TEMP:
 CURRENTLY:        750 °C
    SET TO:        760 °C ?

           ↑↓ INC/DEC
            ↵ SAVE VALUE

 RANGE  AVG  DIAGS ALARM
```

Lamp Set Temperature

The Lamp Set Temperature screen is used to change the lamp set temperature. The lamp set temperature 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.

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

- In the Main Menu, choose Service > Set Temperatures > **Lamp Set Temp**.

```
SET LAMP TEMP:
 CURRENTLY:       49.0 °C
    SET TO:       48.0 °C ?

           ↑↓ INC/DEC
            ↵ SAVE VALUE

 RANGE  AVG  DIAGS ALARM
```

Set Pressures

The Set Pressures menu is used with its associated screens to set blow back, eductor and dilution pressures. This 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.

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

- In the Main Menu, choose Service > **Set Pressures**.

```
SET PRESSURES:
>BLOW BACK SET PRESS
 EDUCTOR SET PRESS
 DILUTION SET PRESS



 RANGE  AVG  DIAGS ALARM
```

Blow Back Set Pressure

The Blow Back Set Pressure screen is used to change the blow back set pressure. The blow back set pressure 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.

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

- In the Main Menu, choose Service > Set Pressures > **Blow Back Set Pres**.

```
SET BLOW BACK PRES:
   SET PRESS: 60.0    psig
      COUNTS:    2000

           ↑↓ INC/DEC
            ↵ SAVE VALUE
 RANGE  AVG  DIAGS ALARM
```

Eductor Set Pressure

The Eductor Set Pressure screen is used to change the eductor set pressure. The eductor pressure is proportional to how much sample is pulled into the probe. The eductor set pressure 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.

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

- In the Main Menu, choose Service > Set Pressures > **Eductor Set Pres**.

```
SET EDUCTOR PRES:
   SET PRES:     12.0  psig
     COUNTS:       2000

           ↑↓ INC/DEC
            ↵ SAVE VALUE

 RANGE   AVG   DIAGS ALARM
```

Dilution Set Pressure

The Dilution Set Pressure screen is used to change the dilution set pressure. The dilution set pressure 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.

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

- In the Main Menu, choose Service > Set Pressures > **Dilution Set Pres**.

```
SET DILUTION PRES:
   SET PRES:    55.0  psig
     COUNTS:       2000

           ↑↓ INC/DEC
            ↵ SAVE VALUE

 RANGE   AVG   DIAGS ALARM
```

Pressure Calibration

The Pressure Calibration screen is used to calibrate the pressure sensor to zero, span, or restore factory default values. The pressure calibration is visible only when the instrument is in service mode. For more information on the service mode, see "Service Mode" earlier in this chapter.

The pressure sensor's zero counts and span slope are displayed on the menu.

Note These adjustments should only be performed by an instrument service technician. ▲

- In the Main Menu, choose Service > **Pressure Calibration**.

```
PRESSURE SENSOR CAL:
>ZERO                    72
 SPAN                1.1416
 SET DEFAULTS



 RANGE  AVG  DIAGS ALARM
```

Calibrate Pressure Zero

The Calibrate Pressure Zero screen calibrates the pressure sensor at zero pressure.

Note A pump capable of a vacuum of less than 1 torr absolute must be connected to the pressure sensor before performing the zero calibration. ▲

- In the Main Menu, choose Service > Pressure Calibration > **Zero**.

```
CALIBRATE PRESSURE ZERO:
 CURRENTLY:   753.0 mmHg
    SET TO:     0.0 mmHg

 CONNECT VACUUM PUMP AND
   ↵ SAVE ZERO PRESSURE
 RANGE  AVG  DIAGS ALARM
```

Calibrate Pressure Span

The Calibrate Pressure Span screen allows the user to view and set the pressure sensor calibration span point.

Note The plumbing going to the pressure sensor should be disconnected so the sensor is reading ambient pressure before performing the span calibration. The operator should use an independent, NIST traceable, barometer to measure the ambient pressure and enter the value on this screen before calibrating. ▲

- In the Main Menu, choose Service > Pressure Calibration > **Span**.

```
CALIBRATE PRESSURE SPAN:
 CURRENTLY:    753.0 mmHg
    SET TO:    760.0 mmHg ?

          ←→ MOVE CURSOR
 ↑↓ CHANGE VALUE    ↵ SAVE

 RANGE  AVG  DIAGS ALARM
```

Restore Default Calibration

The Restore Default Calibration screen allows the user to reset the pressure calibration configuration values to factory defaults.

- In the Main Menu, choose Service > Pressure Calibration > **Set Defaults**.

```
RESTORE DEFAULT CAL:
                ↵ RESTORE



 RANGE  AVG  DIAGS ALARM
```

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

 RANGE  AVG  DIAGS ALARM
```

Flow Calibration

The Flow Calibration menu is used to calibrate the flow sensor to zero, span, or restore factory default values. The flow calibration is visible only when the instrument is in service mode. For more information on the service mode, see “Service Mode” earlier in the chapter.

Note These adjustments should only be performed by an instrument service technician. ▲

- In the Main Menu, choose Service > **Flow Calibration**.

```
FLOW SENSOR CAL:
>ZERO                  121
 SPAN               1.0000
 SET DEFAULTS





 RANGE  AVG  DIAGS ALARM
```

Calibrate Flow Zero

The Calibrate Flow Zero screen calibrates the flow sensor at zero flow.

Note The pump must be disconnected before performing the zero calibration. ▲

- In the Main Menu, choose Service > Flow Calibration > **Zero**.

```
CALIBRATE FLOW ZERO:
 CURRENTLY:    1.139 LPM
    SET TO:    0.000 LPM ?

   DISCONNECT PUMP AND
   ↵ SAVE CURRENT FLOW

 RANGE  AVG  DIAGS ALARM
```

Calibrate Flow Span

The Calibrate Flow Span screen allows the user to view and set the flow sensor calibration span point.

Note An independent flow sensor is required to read the flow, then the operator enters the flow value on this screen to perform the calibration. ▲

- In the Main Menu, choose Service > Flow Calibration > **Span**.

```
CALIBRATE FLOW SPAN:
 CURRENTLY:    1.139 LPM
    SET TO:    1.141 LPM ?

          ←→ MOVE CURSOR
 ↑↓ CHANGE VALUE    ↵ SAVE

 RANGE  AVG  DIAGS ALARM
```

Restore Default Calibration

The Restore Default Calibration screen allows the user to reset the flow calibration configuration values to factory defaults.

- In the Main Menu, choose Service > Flow Calibration > **Set Defaults**.

```
RESTORE DEFAULT CAL:
                 ↵ RESTORE



 RANGE   AVG   DIAGS ALARM
```

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


 RANGE   AVG   DIAGS ALARM
```

Input Board Calibration

The Input Board Calibration menu is used to initiate calibration of the input A/D stages. The input board calibration menu is visible only when the instrument is in service mode. For more information on the service mode, see "Service Mode" earlier in the chapter.

Note These adjustments should only be performed by an instrument service technician. ▲

- In the Main Menu, choose Service > **Input Board Calibration**.

```
INPUT BOARD CALIBRATION:
>MANUAL INPUT CAL
 AUTOMATIC INPUT CAL
 INPUT REQUENCY DISP




 RANGE   AVG   DIAGS ALARM
```

Manual Input Calibration

The Manual Input Calibration screen is used to do a manual calibration of the input board A/D stages.

Note The measurement system and the PMT are both shut off inside this screen. ▲

1. In the Main Menu, choose Service > Input Board Calibration > **Manual Input Cal**.

2. Press ↵ to leave the warning screen.

3. Make a note of the frequency at gain of 1.

4. Use ← and → to change the gain between 10 and 100.

5. Use ↑ and ↓ to increment or decrement the D/A counts so the frequency at gain 100 is equal to the frequency at gain 1.

```
INPUT BOARD CALIBRATION:
          ↵ TO CALIBRATE
      ** WARNING **
 THIS ACTION MAY REQUIRE
  RECALIBRATION OF THE
ENTIRE MEASUREMENT SYSTEM!

 RANGE  AVG  DIAGS ALARM
```

```
GAIN 1     - MANUAL:
     FREQ =   4500
      D/A =    N/A  ?

 ↔ CHG GAIN
          ↵ SAVE VALUES

 RANGE  AVG  DIAGS ALARM
```

Automatic Input Calibration

The Automatic Input Calibration screen is used to do an automatic calibration of the input board A/D stages.

Note The measurement system and the PMT are both shut off inside this screen. ▲

1. In the Main Menu, choose Service > Input Board Calibration > **Automatic Input Cal**.

2. Press ↵ to leave the warning screen and begin automatic calibration.

```
INPUT BOARD CALIBRATION:
          ↵ TO CALIBRATE
      ** WARNING **
 THIS ACTION MAY REQUIRE
  RECALIBRATION OF THE
ENTIRE MEASUREMENT SYSTEM!

 RANGE  AVG  DIAGS ALARM
```

```
INPUT BOARD CALIBRATION:
    ** IN PROGRESS **
D/A    =   2047
TARGET =      0
FREQ   =      0      0
ZERO   =      0 CNT =  1

 RANGE  AVG  DIAGS ALARM
```

Input Frequency Display

The Input Frequency Display screen is used to manually adjust the input board gain. This may be used as a troubleshooting tool for the input board. The gain setting and test mode are reset upon exiting this screen.

1. In the Main Menu, choose Service > Input Board Calibration > **Frequency Disp**.

2. Press ↵ to leave the warning screen.

3. Use ↑ and ↓ to toggle the test signal and bypass the PMT.

4. Use ← and → to change the gain between 1, 10, and 100.

```
INPUT BOARD CALIBRATION:
           ↵ TO CALIBRATE
      ** WARNING **
CONCENTRATION CALCULATION
    IS HALTED INSIDE
      THIS SCREEN!

 RANGE   AVG   DIAGS ALARM
```

```
INPUT BOARD TEST:
     GAIN = 1
     TEST = OFF
     FREQ = 5000
 ←→ CHG GAIN ↑↓ TEST MODE

 RANGE   AVG   DIAGS ALARM
```

Temperature Calibration

The Temperature Calibration screen allows the user to view and set the ambient temperature sensor calibration. The temperature calibration 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.

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

- In the Main Menu, choose Service > **Temperature Calibration**.

```
CALIBRATE AMBIENT TEMP:
 CURRENTLY:      32.0 °C
    SET TO:      32.1 °C ?

          ←→ MOVE CURSOR
 ↑↓ CHANGE VALUE    ↵ SAVE

 RANGE   AVG   DIAGS ALARM
```

Analog Output Calibration

The Analog Output Calibration menu is a selection of 6 voltage channels and 6 current channels to calibrate, and allows the user to select the calibration action zero or span. The analog output calibration is visible only when the instrument is in service mode. For more information on the service mode, see “Service Mode” earlier in the chapter.

Note These adjustments 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          ↓

 RANGE  AVG  DIAGS ALARM
```

```
ANALOG OUTPUT CAL:
>CALIBRATE ZERO
 CALIBRATE FULL SCALE




 RANGE  AVG  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 meter to the output and adjust the output until it reads 0.0 V on the meter.

- In the Main Menu, choose Service > Analog Out Calibration > 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

 RANGE  AVG  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 meter to the output and adjust output until it reads the value shown in the set output to: field.

- In the Main Menu, choose Service > Analog Out Calibration > Select Channel > **Calibrate Full Scale**.

```
ANALOG OUTPUT CAL:    SPAN
 CONNECT METER TO OUTPUT!
  SELECTED OUTPUT:     V1
  SET TO:            6397
 ↵ SAVE VALUE   ↑↓ INC/DEC
 SET OUTPUT TO:      10 V

 RANGE   AVG   DIAGS ALARM
```

Analog Input Calibration

The Analog Input Calibration menu is a selection of 8 analog inputs to calibrate, and allows the user to select the calibration action zero or span. The analog input calibration is visible only when the instrument is in service mode. For more information on the service mode, see "Service Mode" earlier in the chapter.

Note These adjustments 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         ↓

 RANGE   AVG   DIAGS ALARM
```

```
ANALOG INPUT CAL:
>CALIBRATE ZERO
 CALIBRATE FULL SCALE






 RANGE   AVG   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 Calibration > Select Channel > **Calibrate Zero**. (Hook up a voltage source of 0 V to the analog input channel.)

```
ANALOG INPUT CAL:    ZERO
DISCONNECT SELECTED INPUT!
 SELECTED INPUT:    INPUT1
 CURRENTLY:        6.24 V ?

 ↵ CALIBRATE INPUT TO ZERO

 RANGE  AVG  DIAGS ALARM
```

Analog Input Calibrate Full-Scale

The Analog Input Calibration 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 Calibration > 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:    INPUT1
 CURRENTLY:        6.24 V
    SET TO:       10.00 V ?
 ↵ CALIBRATE INPUT TO ZERO

 RANGE  AVG  DIAGS ALARM
```

Display Pixel Test

The Display Pixel Test is used to test the LCD display. The display pixel test is visible only when the instrument is in service mode. For more information on the service mode, see “Service Mode” earlier in the chapter.

- In the Main Menu, choose Service > **Display Pixel Test**.

```
DISPLAY PIXEL TEST:
DURING TEST PRESS ⎘ OR ►
TO EXIT, ↵ TO TOGGLE

       ↵ BEGIN TEST
       ⎘ GO BACK TO MENU

 RANGE  AVG  DIAGS ALARM
```

Restore User Defaults

The Restore User Defaults screen is used to reset the user calibration and configuration values to factory defaults. The restore default user is visible only when the instrument is in service mode. For more information on the service mode, see "Service Mode" earlier in the chapter.

- In the Main Menu, choose Service > **Restore User Defaults.**

```
RESTORE USER DEFAULTS:

                ↵ RESTORE



 RANGE  AVG  DIAGS ALARM
```

```
RESTORE USER DEFAULTS:

                ↵ RESTORE
ARE YOU SURE YOU WANT TO?
PRESS ➡ TO CONFIRM RESTORE

 RANGE  AVG  DIAGS ALARM
```

Password

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. 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


 RANGE  AVG  DIAGS ALARM
```

Set Password

The Set Password screen is used to set the password to unlock the front panel. The set password is shown if the instrument is unlocked and the password is set.

- In the Main Menu, choose Password > **Set Password**

```
ENTER NEW PASSWORD:

     ABCDEFGHIJKLMN  BKSP
     OPQRSTUVWXYZ    PAGE
     0123456789 ./-  SAVE

 RANGE  AVG  DIAGS ALARM
```

Lock Instrument

The Lock Instrument screen is used to lock the instrument's front panel so users can not change any settings from the front panel. The lock instrument is shown if the instrument is unlocked and the password is set.

If the instrument keyboard is locked via the front panel using Password > Lock Instrument, the instrument reports being in Remote mode. In this mode, the keypad is locked, data 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 data can be changed from the front panel.

Refer to the "C-Link Protocol Commands" appendix for detailed information about "mode", "allow mode", and "power up mode" commands.

- 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

 RANGE  AVG  DIAGS ALARM
```

Change Password

The Change Password screen is used to change the password used to unlock the instrument's front panel. The change password is shown if the instrument is unlocked.

- In the Main Menu, choose Password > **Change Password**

Remove Password

The Remove Password screen is used to erase the current password and disable password protection. The remove password is shown if the instrument is unlocked and the password set.

- In the Main Menu, choose Password > **Remove Password**

Unlock Instrument

The Unlock Instrument screen is used to enter the password to unlock the front panel. The unlock instrument is shown if the instrument is locked.

- In the Main Menu, choose Password > **Unlock Instrument**

Chapter 4
Calibration

This chapter describes procedures for performing a calibration of the Model 80*i*.

The following sections discuss the required apparatus and procedure for calibrating the instrument.

- "Equipment Required" on page 4-1
- "Pre-Calibration"on page 4-2
- "Calibration" on page 4-3

Note There are two sets of backgrounds and coefficients within the 80*i* firmware. One set is for 80*i* calibration and the other is for system calibration. The background and coefficient displayed under Main Menu > Calibration Factors applies only to the mode in which the instrument is currently operating. For example, if the system is in the Instrument Zero or Instrument Span mode, the background and coefficient values displayed apply to the 80*i* calibration. If the system is in Sample, Orifice Zero, Orifice Span, System Zero or System Span mode, the background and coefficient values displayed are for system calibration. ▲

- "Zero and Span Check" on page 4-6

Equipment Required

The following equipment is required to calibrate the instrument:

- Model 81*i* Calibrator

Zero Gas Generator

A zero air source is required for feed gas to the 81*i* calibrator.

Drying

Several drying methods are available. Passing the compressed air through a bed of silica gel, using a heatless air dryer, or removing water vapor with a permeation dryer are three possible approaches. Any air dryer should be preceded by an oil/water coalesces.

Scrubbing

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

Table 4–1. Scrubbing Materials

To Remove	Use
Hydrocarbons	Molecular Sieve (4A), Activated Charcoal
O_3, Hg^0 and SO_2	Activated charcoal

Pre-Calibration

Perform the following pre-calibration procedure before calibrating the Model 80*i*. For detailed information about the menu parameters and the icons used in these procedures, see the "Operation" chapter.

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

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

1. Allow the instrument to warm up and stabilize overnight.

2. Check to see that there are no alarms.

3. If the Model 80*i* is being used as a stand-alone unit, plumb a 250 sccm orifice to the Hgt bulkhead connector on the rear panel and cap the Hg ELEMENTAL bulkhead connector.

Note When the Model 80*i* is part of a system, the Hg0 and Hgt orifices are located in the Model 83*i* probe. ▲

4. Be sure the instrument is in the auto mode, that is, Hg0, Hg2+, and Hgt measurements are being displayed on the front panel display. If the instrument is not in auto mode:
   a. Press [■] to display the Main Menu, then choose Instrument Controls > Auto/Manual Mode.
   b. Select Hg(0)/Hg(t), and press [↵].
   c. Press [↵] to return to the Main Menu.

5. From the Main Menu, select Averaging Time to display the Averaging Time screen. It is recommended that a higher averaging time be used for best results. For more information about the ranges or averaging time, see the "Operation" chapter.

Note During an auto calibration, the averaging time should be less than the zero duration and less than the span duration. ▲

Calibration

The following procedure calibrates the Model 80*i* analyzer using the 81*i* calibrator.

Connect 80*i* to 81*i*

Connect the CAL GAS from the 81*i* to the SPAN port on the 80*i*. Ensure that an atmospheric dump is present. Connect the ZERO AIR from the 81*i* to the ZERO port on the 80*i*.

Adjust Instrument Gain

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

- Setting the Hg0 and Hgt background to zero
- Calibrating the Hg0 channel to the Hg0 calibration gas
- Calibrating the Hgt channel to the Hg0 calibration gas

Set Hg^0 and Hg^t Background to Zero

The Hg0 and Hgt background corrections are determined during zero calibration. The background signal is the combination of electrical offsets, PMT dark current, and trace substances undergoing fluorescence. For more detailed information, see "Hg0 and Hgt Background Corrections" in the "Operation" chapter.

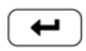
Use the following procedure to set the Hg0 background. Both the Hg0 and Hgt Background screens operate the same way, and the following procedure also applies to the Hgt background screen.

Note The Hg0 channel should be calibrated first followed by the Hgt channel. ▲

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

1. Put the Model 80*i* in Inst Zero mode.

Note If the Model 80*i* and the Model 81*i* are configured together as part of a system, setting the 80*i* to any gas mode will automatically put the Model 81*i* in the same mode (via the Ethernet connection). ▲

2. Put the Model 81*i* in Analyzer Zero mode.
   a. Allow the instrument to sample zero air until the Hg0, Hgt and Hg2+ responses stabilize.
   b. After the responses have stabilized, from the Main Menu, choose Calibration > Cal Hg(0) Background.
   c. Press  to set the Hg(0) reading to zero.
   d. Press  to return to the Calibration menu and repeat this procedure to set the Hgt background to zero.
   e. If desired, record the stable zero air responses as ZHg0, ZHgt, and ZHg2+ (recorder response, percent scale or use Excel).

3. Set the 81*i* (or the 80*i* when used in a system) to Analyzer Span mode and set the desired calibration concentration using one of the six preset span values in the 80*i* (Calibration > Inst Hg Span Conc).

4. Set the 80*i* to Analyzer Span mode.

Calibrate the Hg^0 Channel to the Hg^0 Calibration Gas

Use the following procedure to calibrate the Hg0 channel to the Hg0 calibration gas.

1. Allow the instrument to sample the Hg0 calibration gas until the Hg0, Hgt and Hg2+ readings stabilize.

2. When the responses stabilize, from the Main Menu, choose Calibration > **Calibrate Hg0 Coefficient**.

The Hg(0) line of the Calibrate Hg(0) screen displays the current Hg0 concentration. The SPAN CONC line of the display is where you enter the Hg0 calibration gas concentration (the output conc at the Model 81*i*).

Use ← → to move the cursor left and right and use ↑ ↓ to increment and decrement the numeric character at the cursor.

Calibrate the Hgt Channel

Use the following procedure to calibrate the Hgt channel to the Hg0 calibration gas.

Note Since the Hg2+ converter is located in the Model 83*i*, Hg0 cal gas should be used to calibrate the Model 80*i* if it is used as a stand-alone unit. Do not introduce Hg2+ gas directly into the 80*i* without running it through a converter. ▲

1. Press ◼ to return to the Calibration menu, and choose Cal Hg(t) Coefficient.

   The Hgt line of the Calibrate Hgt screen displays the current Hgt concentration. The SPAN CONC line of the display is where you enter the Hg0 calibration gas concentration (from the 81*i*).

   Use ← → to move the cursor left and right and use ↑ ↓ to increment and decrement the numeric character at the cursor.

2. Press ↵ to calculate and save the new Hgt coefficient based on the entered span concentration.

3. If desired, record the Hgt concentration and the instrument's Hgt response.

Note There are two sets of backgrounds and coefficients within the 80*i* firmware. One set is for 80*i* calibration and the other is for system calibration. The background and coefficient displayed under Main Menu > Calibration Factors applies only to the mode in which the instrument is currently operating. For example, if the system is in the Instrument Zero or Instrument Span mode, the background and coefficient values displayed apply to the 80*i* calibration. If the system is in Sample, Orifice Zero, Orifice Span, System Zero or System Span mode, the background and coefficient values displayed are for system calibration. ▲

Zero and Span Check

The instrument requires initial and periodic calibration according to the procedures outlined in this manual. Initially, the frequency of the calibration procedure should be determined by the stability of the zero and span checks, which may be run daily.

Typically you should recalibrate when zero and span checks indicate a shift in instrument gain of more than 5 percent of full scale from that determined during the most recent calibration. You can adjust the frequency of calibration and even zero and span checks appropriately as you gain confidence with the instrument.

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

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

1. Allow the instrument to sample zero gas until a stable reading is obtained on the Hg0, Hgt, and Hg2+ channels then record the zero readings.

2. Attach a supply of known concentration of Hg0 to the sample port (Hg TOTAL or Hg ELEMENTAL) or SPAN bulkhead.

3. Allow the instrument to sample the calibration gas until a stable reading is obtained on the Hg0, Hgt, and Hg2+ channels.

4. When the calibration check has been completed, record the Hg0, Hgt, and Hg2+ values. This check can be repeated for the system using system zero/system span gas modes. Stabilization time will vary.

Chapter 5
Preventive Maintenance

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

This chapter includes the following maintenance information and replacement procedures:

- "Safety Precautions" on page 5-1
- "Replacement Parts" on page 5-2
- "Cleaning the Outside Case" on page 5-2
- "Visual Inspection and Cleaning" on page 5-2
- "Cleaning the Mirror" on page 5-2
- "Critical Orifice Inspection and Replacement" on page 5-2
- "Fan Filter Inspection and Cleaning" on page 5-4
- "Lamp Voltage and Frequency Check" on page 5-5
- "Leak Test" on page 5-5

Safety Precautions

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

WARNING 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 ground 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. ▲

Replacement Parts

See the "Servicing" chapter for a list of replacement parts.

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

Cleaning the Outside Case

Clean the outside case using a damp cloth, being careful not to damage the labels on the case.

Equipment Damage Do not use solvents or other cleaning products to clean the outside case. ▲

Visual Inspection and Cleaning

The instrument should be inspected occasionally for obvious visible defects, such as loose connectors, loose fittings, cracked or clogged Teflon lines, and excessive dust or dirt accumulation. Dust and dirt can accumulate in the instrument and can cause overheating or component failure. Dirt on the components prevents efficient heat dissipation and may provide conducting paths for electricity. The best way to clean the inside of the instrument is to first carefully vacuum all accessible areas and then blow away the remaining dust with low pressure compressed air. Use a soft paint brush or cloth to remove stubborn dirt.

Cleaning the Mirror

The mirror located in the optical bench does not come in contact with the sample gas and DOES NOT need cleaning. Read the Equipment Damage warning that follows.

Equipment Damage DO NOT attempt to clean the mirrors in the optical bench. These mirrors do not come in contact with the sample gas and should not be cleaned. Cleaning the mirrors can damage the mirrors. ▲

Critical Orifice Inspection and Replacement

The 80*i* uses two 250 sccm glass critical orifices to control both zero and calibration gas flows through the measurement bench. The orifices normally only require inspection when instrument performance indicates that there may be a flow problem.

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

Use the following procedure to inspect and replace either critical orifices.

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

2. Remove the instrument cover.

3. Locate the critical orifices at the inside of the rear panel (**Figure 5–1**) and loosen the Teflon fittings.

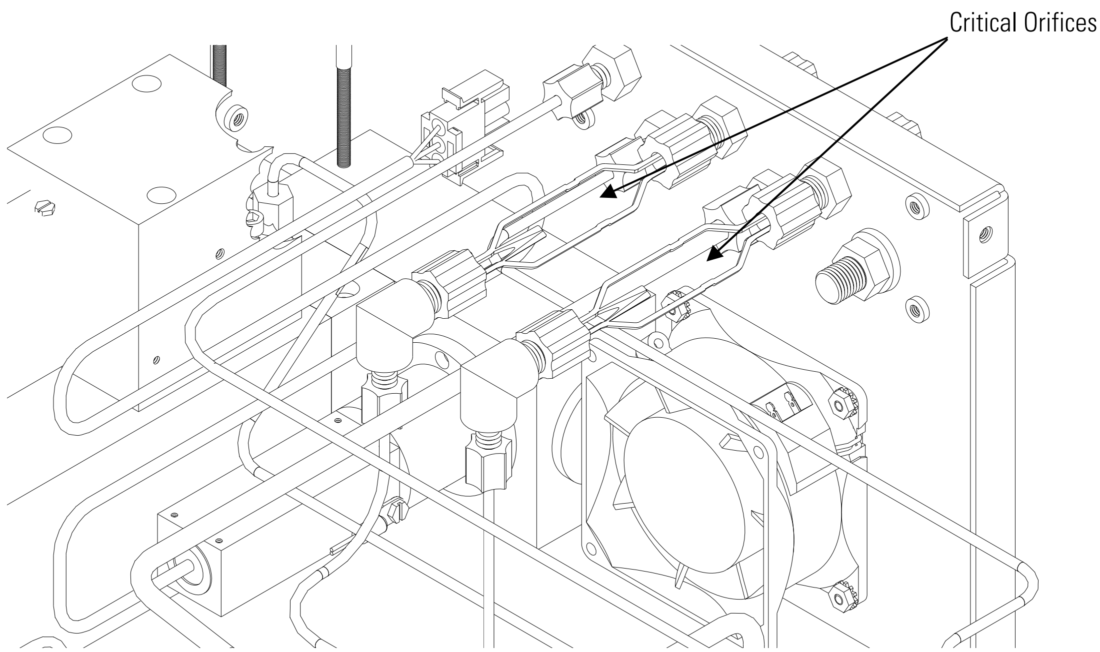


Figure 5–1. Inspecting and Replacing the Orifices

4. Remove the critical orifice. Refer to "Replacement Parts" in the "Servicing" chapter.

5. Check orifice frit filter for particulate deposits. Replace the orifice as necessary. Cleaning is not recommended because the cleaning solvent may interact with the mercury sample and skew the results.

6. Repeat Steps 3 through 5 for the opposite channel.

7. Re-install the cover.

Connect the power cord and turn the instrument ON.

Verify that the flow in both channels meet the minimum performance specifications.

Fan Filter Inspection and Cleaning

Use the following procedure to inspect and clean the fan filter (**Figure 5–2**).

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

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

4. Re-install the filter and fan guard.

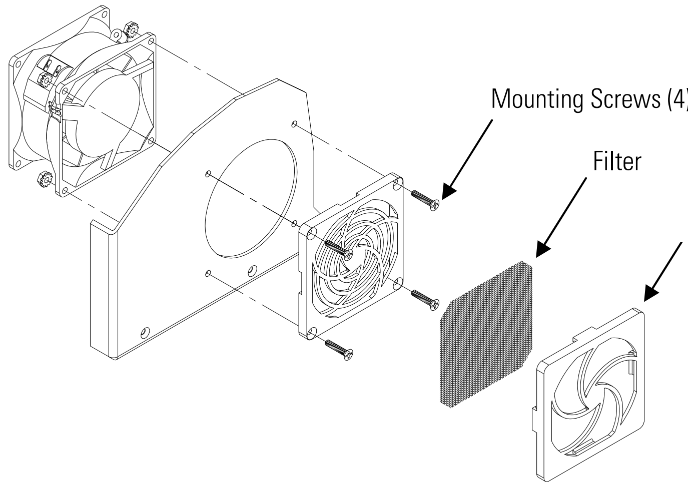


Figure 5–2. Inspecting and Cleaning the Fan

Lamp Voltage and Frequency Check

Use the following procedure to check the lamp voltage.

1. Press [■] to display the Main Menu.

2. From the Main Menu, select Diagnostics > Lamp Intensity, and press [↵] to display the Lamp Intensity screen.

3. Check the lamp intensity. If this intensity is <10 kHz, either adjust the lamp voltage control circuit or replace the lamp.

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

Leak Test

A normal flow rate is approximately 0.25 LPM. If the flow rate is greater than 0.35 LPM, use the following procedure to perform a leak test.

1. Block the Hg ELEMENTAL and Hg TOTAL bulkhead connectors with leak-tight caps.

2. Press [↓] to move the cursor to Instrument Controls and press [↵] to display the Instrument Controls menu.

3. Press ↵ to select Gas Modes and press ↓ to select Sample mode.

4. Wait two minutes.

5. Press ■ to display the Main Menu.

6. Press ↓ to move the cursor to Diagnostics and press ↵ to display the Diagnostics menu.

7. Press ↓ to move the cursor to Flow and press ↵ to display the Flow screen. The reading should indicate zero flow. If not, check to see that all fittings are tight and the input lines are not cracked or broken. For detailed information about this screen, refer to the "Operation" chapter.

8. If the instrument passes the leak test, but still has low flow, check the critical orifices for blockage.

9. If the flow drops to zero during the flow check, but the pressure is above 100 mmHg, the pump may need to be replaced.

Chapter 6
Troubleshooting

This instrument has been designed to achieve a high level of reliability. In the event of problems or failure, the troubleshooting guidelines, board-level connection diagrams, connector pin descriptions, and testing procedures presented in this chapter should be helpful in isolating and identifying problems.

For additional fault location information, refer to the "Preventive Maintenance" 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. The Service menu includes some of the same information found in the Diagnostic menu, however, readings are updated every second in the service mode compared with every 10 seconds in the Diagnostics menu.

The Technical Support Department at Thermo Fisher Scientific can also be consulted in the event of problems. See "Service Locations" at the end of this chapter for contact information. In any correspondence with the factory, please note both the serial number and program number of the instrument.

This chapter provides the following troubleshooting information:

- "Safety Precautions" on page 6-2
- "Troubleshooting Guides" on page 6-2
- "Board-Level Connection Diagrams" on page 6-9
- "Connector Pin Descriptions" on page 6-10
- "Service Locations" on page 6-23

Safety Precautions

Read the safety precautions in the Preface and the "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, **Table 6–2**, and **Table 6–3** provide general troubleshooting information and indicate the checks that you should perform if you experience an instrument problem.

Table 6–4 lists all the alarm messages you may see on the display and provides recommendations about how to resolve the alarm condition.

Table 6–1. Troubleshooting - Power-Up Failures

Malfunction	Possible Cause	Action
Does not start - the light on power switch does not come on.	No power or wrong power configuration	Check the line to confirm that power is available and that it matches the voltage and frequency configuration of the instrument.
	Main fuse is blown or missing.	Unplug the power cord, open the fuse drawer on the back panel, and check the fuses visually or with a multimeter.
	Bad switch or wiring connection	Unplug the power cord, disconnect the switch and check operation with a multimeter.
Display does not come on - light on power switch does come on.	DC power supply failure	Check the green LED on the back edge of the power supply. If the LED is off, the supply has failed.
	DC power distribution failure	Check surface mount LEDs labeled "24V PWR" on the motherboard and the interface board. If lit, power is OK.
	Display failure	If possible, check instrument function through RS-232 or Ethernet.
		Reboot instrument.
		Contact Thermo Fisher Scientific Service Department.

Table 6–2. Troubleshooting - Calibration Failures

Malfunction	Possible Cause	Action
Cannot zero instrument or there is a high background signal when sampling zero air. (Zero air should produce a reading equivalent to less than 1 µg/m^3.)	Zero air system is faulty, needs new scrubbers or requires maintenance.	Test against an ultra-zero cylinder from a reputable scientific gas supplier or check effect of a new chromatography grade activated charcoal scrubber installed at the instrument inlet.
	Zero air flow rate is inadequate.	Verify that the zero air system is providing adequate flow.
	Instrument is not drawing in zero or span gas.	Check sample flow and pressure readings (Diagnostics menu).
		Ensure that zero/span valves are functioning.
		Use an independent flow meter to check flows at the zero inlet and exhaust bulkheads (they should match).
		Perform a leak test, as described in the “Preventive Maintenance”chapter.
	Internal or external lines, filters, and other sample handling equipment are contaminated or dirty.	Replace inlet filter (if installed) and as much of the tubing as possible with clean Teflon only.
	High scattered light	Go to Instrument Controls, select Lamp Compensation and toggle to OFF. If the previously high signal drops to zero or less when the lamp is off, the problem may be caused by scattered light from dust in the optical bench.
	Input board failure	Disconnect the input board from the interface board by unplugging ribbon cable labeled “INPUT.” The instrument reading should drop to zero or to a negative value.
	External pump failure	Replace the external pump.
Instrument appears to zero, but there is weak or no response to span gas.	Span source expired/empty	Check the source pressure or calibration.
	Calibration system failure	Check solenoids or other hardware to be sure that span gas is being delivered.

Malfunction	Possible Cause	Action
	Flow rate of the diluted span mix is inadequate.	Verify that the zero air system is providing adequate flow.
	Instrument is not drawing in span gas.	Check sample flow and pressure readings (Diagnostics menu).
		Use an independent flow meter to check flows at the span inlet and exhaust bulkheads (they should match).
		Perform a leak test, as described in the "Preventive Maintenance"chapter.
	Hg is being absorbed by tubing, filters, or dirt in the calibration system.	Replace any lines made of vinyl or other plastics with fresh Teflon. Replace Teflon filter membranes that look dirty. Remove any filters that are not Teflon membranes.
	Lamp has failed.	Check the lamp intensity (Diagnostics menu) and voltage.
	PMT or input board has failed.	With previous coefficients and PMT voltage known, introduce a known concentration of span gas.
Zero or Span will not stabilize.	Flow rate of the diluted span mix is inadequate.	Verify that the zero air system is providing adequate flow.
	Instrument is not drawing in span gas.	Check sample flow and pressure readings (Diagnostics menu).
		Use an independent flow meter to check flows at the span inlet and exhaust bulkheads (they should match).
		Perform a leak test, as described in the "Preventive Maintenance"chapter.
	Hg is being absorbed or released by dirt in the tubing or filters of the calibration system, or contamination inside the instrument.	Replace any lines made of vinyl or other plastics with fresh Teflon. Replace Teflon filter membranes that look dirty. Remove any filters that are not Teflon membranes.
	External pump failure	Replace the external pump.
	Averaging time is not set correctly.	Check the Averaging Time (Main Menu). If too high, the unit will be slow to stabilize. If too low, the signal may appear noisy. Set Averaging Time to one minute.

Table 6–3. Troubleshooting - Measurement Failures

Malfunction	Possible Cause	Action
Reduced response or no response to sample gas with alarm(s) indicated.	Undefined electronic failure or external pump failure	Check alarm screens and the diagnostic voltage screen to localize fault.
		Check the response to known span gas.
	Instrument is not drawing in sample as expected.	Check sample flow and pressure readings (Diagnostics menu).
		Use an independent flow meter to check flows at the Hg(0) or Hg(t) inlet and exhaust bulkheads (they should match). Instrument should be in Manual mode with either Hg(0) or Hg(t) selected.
		Perform a leak test, as described in the “Preventive Maintenance” chapter.
		Use an independent flow meter to check flows at the Hg(0) or Hg(t) inlet and exhaust bulkheads (they should match). Instrument should be in Manual mode with either Hg(0) or Hg(t) selected.
		Perform a leak test, as described in the “Preventive Maintenance”chapter.
		Check the external plumbing for leaks or other problems.
		Check all external plumbing and the source of the sample to verify that the Hg is not being adsorbed by the sampling system. Lines carrying Hg must be made from clean Teflon.
	Instrument is not properly calibrated.	Go to the Calibration Factors menu and verify that the Hgt Background and Hgt Coefficient are set appropriately.
	Input board malfunction	Go to Service menu and select Input Board Calibration > Input Frequency Display (ignore warning), and press Enter (leave Test off).
		At Gain = 1; Frequency = approx. 12 kHz.
		At Gain = 10; Frequency = approx. 80 kHz.
		At Gain = 100; Frequency = approx. 400 kHz.
	Signal cable failure	Go to Service menu and select Input Board Calibration > Input Frequency Display (ignore warning), and press Enter (leave Test off).
		Change Gain to 100. Frequency should be

Malfunction	Possible Cause	Action
		approx. 400 kHz. Unplug PMT signal cable. Frequency should drop to approx. 6 kHz.
	PMT failure	Check that the PMT voltage is approx. 750V (Service menu or Diagnostics menu).
	Lamp assembly failure	Check that the lamp intensity is approx. 80 kHz (Diagnostics menu).
Excessive noise or spikes on analog outputs	Defective or low sensitivity PMT	With previous coefficients and PMT voltage known, introduce a known concentration of span gas.
	Defective input board or BNC connection	Identify the defective component and replace.
	Noise pick-up by recorder or data logger	Check analog cable shielding and grounding.
		Try to localize source of noise by comparing analog signal to data collected through RS-232 or Ethernet.
Poor linearity	Problem with calibrator	Verify accuracy of the multipoint calibration system with an independent flow meter.
	Problem with input board range switching	Go to Service menu and select Input Board Calibration > Input Frequency Display (ignore warning), and press Enter (leave Test off).
		At Gain = 1; Frequency = approx. 12 kHz.
		At Gain = 10; Frequency = approx. 80 kHz.
		At Gain = 100; Frequency = approx. 400 kHz.
		Stay on the Input Frequency Disp screen, and while holding instrument on the lowest gain, step the calibrator through all Hg levels.
		Manually plot signal vs. concentration to verify linearity.
Excessive response time	Averaging time is not set correctly.	Go to Averaging Time (Main Menu) and verify setting. Should be one minute.
	Instrument is not drawing in sample at normal flow rate.	Check sample flow and pressure readings (Diagnostics menu).
		Use an independent flow meter to check flows at the Hg(0) or Hg(t) inlet and exhaust bulkheads (they should match). Instrument should be in Manual mode with either Hg(0) or Hg(t) selected.
		Perform a leak test, as described in the “Preventive Maintenance” chapter.
	Hg is being absorbed and/or released by dirt	Replace any lines made of vinyl or other plastics with fresh Teflon. Replace Teflon

Malfunction	Possible Cause	Action
	in the tubing or filters of the sampling system, or inside the instrument.	filter membranes that look dirty. Remove any filters that are not Teflon membranes.
Analog signal doesn't match expected value.	Firmware has not been configured.	Verify that the selected analog output has been properly configured to match the data system. Refer to "Analog Output Testing" in the "Servicing" chapter.
	Analog output goes above full-scale value or below zero	By default, a 5% over and underrange on the analog outputs is provided. If this is not desirable due to system restrictions, it may be turned off in the INSTRUMENT CONTROLS > I/O CONFIGURATION > ANALOG OUTPUT CONFIG screens.
	Recorder is drawing down output.	Verify that the recorder or data logger input impedance meets minimum requirements.

Table 6–4. Troubleshooting - Alarm Messages

Alarm Message	Possible Cause	Action
Alarm - Internal Temp	Instrument overheating	Replace fan if not operating properly.
		Clean or replace foam filter, refer to the "Preventive Maintenance" chapter in this manual.
Alarm - Chamber Temp	Chamber temperature below set point	Check 10K thermistor, replace if bad.
		Check temperature control board to ensure the LEDs are coming on. If not, temperature control circuit could be defective.
	Heaters failed	Check connector pins for continuity.
Alarm - Pressure	High pressure indication	Remove line from pressure transducer. The pressure reading should go to ambient. Calibrate the pressure transducer if necessary.
		Check input of external pump with vacuum gauge and repair or replace pump as necessary. Vacuum should be approx. 20-30 mmHg. or pump repair, refer to the manual for the pump.
		Check flow system for leaks.
Alarm - Flow	Flow low	Check Model 80*i* Analyzer and Model 83*i* Probe critical orifices.
		Make sure the sample particulate filter in the Model 83*i* Probe is not blocked. Disconnect lines from the

Alarm Message	Possible Cause	Action
		sample bulkheads, if flow increases, replace the filter.
Alarm - Intensity	Low - lamp is failing	Replace lamp.
Alarm –Zero Check	Check coefficients. Also refer to pages 6-3 and 6-4.	
Alarm –Span Check	Check coefficients. Also refer to pages 6-3 and 6-4.	
Alarm –Zero Autocal	Check coefficients. Also refer to pages 6-3 and 6-4.	
Alarm –Span Autocal	Check coefficients. Also refer to pages 6-3 and 6-4.	
Alarm - Probe Dilut Factor	Refer to the “Troubleshooting” chapter in the “Model 83*i* Instruction Manual.”	
Alarm - Umbilical Temp	Low or at ambient temp	Check voltages and continuity.
	High temp	Check set point.
Alarm - Probe Temp	Low or at ambient temp	Check that eductor air is OFF.
	High temp	Check set point.
Alarm - Converter Temp	Low or at ambient temp	Check voltages and continuity.
	High temp	Check set point.
Alarm - Venturi Pressure	Low pressure - leak	Check eductor.
Alarm - Orifice Pressure	Low pressure – system leak	Perform a leak test.
	High pressure – blocked orifice	Check orifice.
Alarm - Dilution Pressure	Low pressure - leak	Perform a leak test.
	High pressure	Check dilution pressure set point.
Alarm - Blow Back Pressure	Low pressure - leak	Perform a leak test.
	High pressure	Check blow back pressure set point.
Alarm - Eductor Pressure	Low pressure - leak	Perform a leak test.
	High pressure	Check eductor pressure set point.
Alarm - Vacuum Pressure	Low pressure - leak	Perform a leak test.

Alarm Message	**Possible Cause**	**Action**
	High pressure - blockage	Check system for blockage.
The following board related alarms only occur during power up or reboot.		
Alarm - Motherboard Status	Internal cables not connected properly	Check that all internal cables are connected properly. Cycle AC power to instrument. If still alarming, change board.
Alarm - Interface Status	Defective board	
Alarm - I/O Exp Status		

Board-Level Connection Diagrams

Figure 6–1 is a board-level connection diagram for the common electronics and measurement system. This illustration can be used along with the connector pin descriptions in **Table 6–5** through **Table 6–10** to troubleshoot board-level faults.

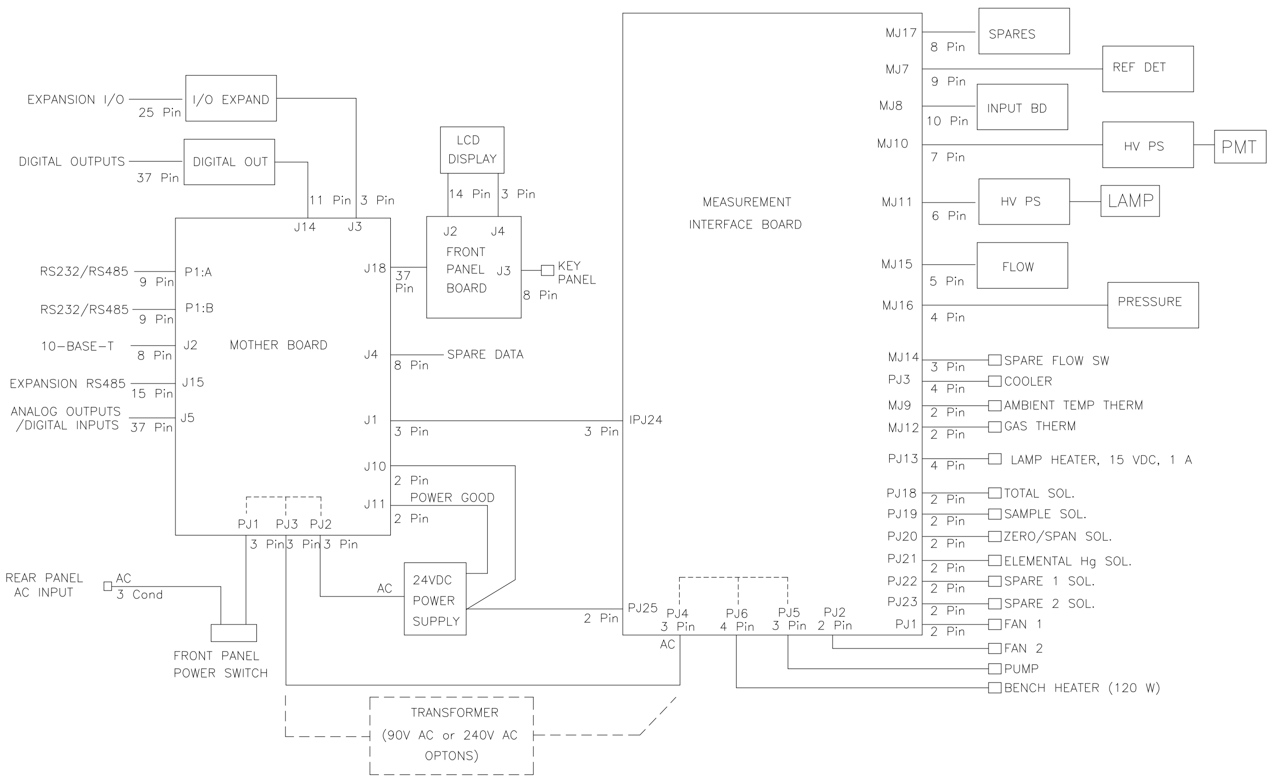


Figure 6–1. Board-Level Connection Diagram

Connector Pin Descriptions

The connector pin descriptions in **Table 6–5** through **Table 6–10** can be used along with **Figure 6–1** to troubleshoot board-level faults.

Note For associated I/O terminal board pin descriptions, refer to **Table 2–1.** I/O Terminal Board Pin Descriptions. ▲

Table 6–5. Motherboard Connector Pin Descriptions

Connector Label	Reference Designator	Pin	Signal Description
INTF DATA	J1	1	Ground
		2	+RS485 to Interface Board
		3	-RS485 to Interface Board
10-BASE-T	J2	1	Ethernet Output (+)
		2	Ethernet Output (-)
		3	Ethernet Input (+)
		4	NC
		5	NC
		6	Ethernet Input (-)
		7	NC
		8	NC
EXPANSION BD	J3	1	+5V
		2	+24V
		3	+24V
		4	Ground
		5	Ground
		6	Ground
		7	+RS485 to Expansion Board
		8	-RS485 to Expansion Board
SPARE DATA	J4	1	+5V
		2	+24V
		3	+24V
		4	Ground
		5	Ground
		6	Ground
		7	+RS485 to Spare Board
		8	-RS485 to Spare Board

Connector Label	Reference Designator	Pin	Signal Description
Note For associated I/O terminal board pin descriptions, refer to **Table 2–1**. ▲			
I/O	J5	1	Power Fail Relay N.C. Contact
		2	Ground
		3	TTL Input 1
		4	TTL Input 2
		5	Ground
		6	TTL Input 5
		7	TTL Input 7
		8	TTL Input 8
		9	TTL Input 10
		10	Ground
		11	TTL Input 13
		12	TTL Input 15
		13	Ground
		14	Analog Voltage Output 1
		15	Analog Voltage Output 3
		16	Ground
		17	Analog Voltage Output 5
		18	Ground
		19	Ground
		20	Power Fail Relay COM
		21	Power Fail Relay N.O. Contact
		22	Ground
		23	TTL Input 3
		24	TTL Input 4
		25	TTL Input 6
		26	Ground
		27	TTL Input 9
		28	TTL Input 11
		29	TTL Input 12
		30	TTL Input 14
		31	TTL Input 16
		32	Ground
		33	Analog Voltage Output 2
		34	Analog Voltage Output 4

Connector Label	Reference Designator	Pin	Signal Description
		35	Ground
		36	Analog Voltage Output 6
		37	Ground
SER EN	J7	1	Serial Enable Jumper
		2	+3.3V
24V IN	J10	1	+24V
		2	Ground
DIGITAL I/O	J14	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
EXT. RS485	J15	1	-RS485 to Rear Panel
		2	+RS485 to Rear Panel
		3	+5V
		4	+5V
		5	+5V
		6	Ground
		7	Ground
		8	Ground
		9	NC
		10	NC
		11	+24V
		12	+24V
		13	+24V
		14	+24V
		15	+24V
24V MONITOR	J17	1	24V Power Monitor

Connector Label	Reference Designator	Pin	Signal Description
		2	Ground
FRONT PANEL BD	J18	1	Ground
		2	Ground
		3	LCLK – LCD Signal
		4	Ground
		5	Ground
		6	LLP – LCD Signal
		7	LFLM – LCD Signal
		8	LD4 – LCD Signal
		9	LD0 – LCD Signal
		10	LD5 – LCD Signal
		11	LD1 – LCD Signal
		12	LD6 – LCD Signal
		13	LD2 – LCD Signal
		14	LD7 – LCD Signal
		15	LD3 – LCD Signal
		16	LCD Bias Voltage
		17	+5V
		18	Ground
		19	Ground
		20	LCD_ONOFF – LCD Signal
		21	Keypad Row 2 Input
		22	Keypad Row 1 Input
		23	Keypad Row 4 Input
		24	Keypad Row 3 Input
		25	Keypad Col 2 Select
		26	Keypad Col 1 Select
		27	Keypad Col 4 Select
		28	Keypad Col 3 Select
		29	Ground
		30	Ground
		31	Ground
		32	Ground
		33	+24V

Connector Label	Reference Designator	Pin	Signal Description
		34	+24V
RS232/RS485:A	P1:A	1	NC
		2	Serial Port 1 RX (-RS485 IN)
		3	Serial Port 1 TX (-RS485 OUT)
		4	NC
		5	Ground
		6	NC
		7	Serial Port 1 RTS (+RS485 OUT)
		8	Serial Port 1 CTS (+RS485 IN)
		9	NC
RS232/RS485:B	P1:B	1	NC
		2	Serial Port 2 RX (-RS485 IN)
		3	Serial Port 2 TX (-RS485 OUT)
		4	NC
		5	Ground
		6	NC
		7	Serial Port 2 RTS (+RS485 OUT)
		8	Serial Port 2 CTS (+RS485 IN)
		9	NC
AC IN	PJ1	1	AC-HOT
		2	AC-NEUT
		3	AC-Ground
AC 24VPWR	PJ2	1	AC-HOT
		2	AC-NEUT
		3	AC-Ground
AC INTF BD	PJ3	1	AC-HOT
		2	AC-NEUT
		3	AC-Ground

Table 6–6. Measurement Interface Board Connector Pin Descriptions

Connector Label	Reference Designator	Pin	Signal Description
DATA	J24	1	Ground
		2	+RS485 from Motherboard
		3	-RS485 from Motherboard
PRES	J16	1	Pressure Sensor Input
		2	Ground
		3	+15V
		4	-15V
INPUT BD	J8	1	+15V
		2	Ground
		3	-15V
		4	+5V
		5	Ground
		6	Measurement Frequency Output
		7	Amplifier Zero Adjust Voltage
		8	SPI Output
		9	SPI Clock
		10	SPI Board Select
AMB TEMP	J9	1	Ambient Temperature Thermistor
		2	Ground
HVPS	J10	1	HV Power Supply Voltage Adjust
		2	Ground
		3	HV Power Supply On/Off
		4	Ground
		5	HV Power Supply Voltage Monitor
		6	Ground
		7	Ground
FLOW SW	J14	1	NC
		2	Ground
		3	Oz. Flow OK Switch
FLOW	J15	1	Flow Sensor Input
		2	Ground
		3	+15V

Connector Label	Reference Designator	Pin	Signal Description
		4	-15V
		5	Ground
AC BENCH	J6	1	Bench Temperature Input
		2	Ground
		3	AC-HOT
		4	Bench Heater AC Neut
24V IN	J25	1	+24V
		2	Ground
PROV INPUT	J7	1	Ground
		2	Ground
		3	+15V
		4	-15V
		5	Ground
		6	Ground
		7	Spare Frequency Input
		8	Ground
		9	Ground
AC PUMP	J5	1	AC-HOT
		2	AC-NEUT
		3	AC-Ground
FAN 1	J1	1	+24V
		2	Ground
FAN 2	J2	1	+24V
		2	Ground
AC IN	J4	1	AC-HOT
		2	AC-NEUT
		3	AC-Ground
COOLER	J3	1	Cooler Thermistor
		2	Ground
		3	+15V_PWR
		4	Cooler On/Off Control
VALVE 1	J18	1	+24V
		2	Total Solenoid Control
VALVE 2	J19	1	+24V

Connector Label	Reference Designator	Pin	Signal Description
		2	Sample Solenoid Control
VALVE 3	J20	1	+24V
		2	Zero/Span Solenoid Control
VALVE 4	J21	1	+24V
		2	Elem Hg Solenoid Control
VALVE 5	J22	1	+24V
		2	Spare 1 Solenoid Control
VALVE 6	J23	1	+24V
		2	Spare 2 Solenoid Control
PERM OVEN	J13	1	Perm Oven Heater On/Off
		2	+15V_PWR
		3	Perm Oven Thermistor
		4	Ground
LAMP HVPS	J11	1	HVPS Voltage Adjust
		2	+24V
		3	HVPS ON/OFF
		4	SPARE ON/OFF
		5	Ground
		6	Ground
SPARES	J17	1	Spare Analog Input
		2	Spare Temp Input
		3	Spare Analog Output
		4	Spare ON/OFF 2
		5	+15 V
		6	-15 V
		7	Ground
		8	Ground

Table 6–7. Front Panel Board Connector Pin Diagram

Connector Label	Reference Designator	Pin	Signal Description
MOTHER BOARD	J1	1	Ground
		2	Ground
		3	LCLK – LCD Signal
		4	Ground
		5	Ground
		6	LLP – LCD Signal
		7	LFLM – LCD Signal
		8	LD4 – LCD Signal
		9	LD0 – LCD Signal
		10	LD5 – LCD Signal
		11	LD1 – LCD Signal
		12	LD6 – LCD Signal
		13	LD2 – LCD Signal
		14	LD7 – LCD Signal
		15	LD3 – LCD Signal
		16	LCD Bias Voltage
		17	+5V
		18	Ground
		19	Ground
		20	LCD_ONOFF – LCD Signal
		21	Keypad Row 2 Input
		22	Keypad Row 1 Input
		23	Keypad Row 4 Input
		24	Keypad Row 3 Input
		25	Keypad Col 2 Select
		26	Keypad Col 1 Select
		27	Keypad Col 4 Select
		28	Keypad Col 3 Select
		29	Ground
		30	Ground
		31	Ground
		32	Ground

Connector Label	Reference Designator	Pin	Signal Description
		33	+24V
		34	+24V
LCD DATA	J2	1	LFLM_5V – LCD Signal
		2	LLP_5V – LCD Signal
		3	LCLK_5V – LCD Signal
		4	LCD_ONOFF_5V – LCD Signal
		5	+5V
		6	Ground
		7	LCD Bias Voltage
		8	LD0_5V – LCD Signal
		9	LD1_5V – LCD Signal
		10	LD2_5V – LCD Signal
		11	LD3_5V – LCD Signal
		12	LD4_5V – LCD Signal
		13	LD5_5V – LCD Signal
		14	LD6_5V – LCD Signal
		15	LD7_5V – LCD Signal
		16	Ground
KEYBOARD	J3	1	Keypad Row 1 Input
		2	Keypad Row 2 Input
		3	Keypad Row 3 Input
		4	Keypad Row 4 Input
		5	Keypad Col 1 Select
		6	Keypad Col 2 Select
		7	Keypad Col 3 Select
		8	Keypad Col 4 Select
LCD BACKLIGHT	J4	1	LCD Backlight Voltage 1
		2	NC
		3	NC
		4	LCD Backlight Voltage 2

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
		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
		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

Connector Label	Reference Designator	Pin	Signal Description
		8	-RS485 to Motherboard

Table 6–9. Digital Output Board Connector Pin Descriptions

Connector Label	Reference Designation	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
		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

Connector Label	Reference Designation	Pin	Signal Description
		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. Input Board Connector Pin Descriptions

Connector Label	Reference Designator	Pin	Signal Description
PMT IN	J1	1	PMT Input
		2	Ground
INTF BD	J2	1	+15V
		2	Ground
		3	-15V
		4	+5V
		5	Ground
		6	Measurement Frequency Output
		7	Amplifier Zero Adjust Voltage
		8	SPI Input
		9	SPI Clock
		10	SPI Board Select

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.

1-866-282-0430 Toll Free

1-508-520-0430 International

Chapter 7
Servicing

This chapter explains how to replace the Model 80*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 80*i* 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.

This chapter includes the following parts information and component replacement procedures.

- "Safety Precautions" on page 7-2
- "Firmware Updates" on page 7-4
- "Replacement Parts List" on page 7-4
- "Cable List" on page 7-5
- "External Device Connection Components" on page 7-5
- "Removing the Measurement Bench and Lowering the Partition Panel" on page 7-7
- "Accessing the Service Mode" on page 7-8
- "Fuse Replacement" on page 7-9
- "External Pump Replacement" on page 7-9
- "Fan Replacement" on page 7-9
- "Optical Bench Replacement" on page 7-10
- "Lamp Replacement" on page 7-12
- "Lamp HVPS Assembly Replacement" on page 7-13

- "Lamp Reference Detector Assembly Replacement" on page 7-13
- "Photomultiplier Tube Replacement" on page 7-14
- "PMT High Voltage Power Supply Replacement" on page 7-16
- "PMT Voltage Adjustment" on page 7-17
- "DC Power Supply Replacement" on page 7-18
- "Analog Output Testing" on page 7-19
- "Analog Output Calibration" on page 7-21
- "Analog Input Calibration" on page 7-22
- "Pressure Transducer Assembly Replacement" on page 7-24
- "Pressure Transducer Calibration" on page 7-26
- "Flow Transducer Replacement" on page 7-27
- "Flow Transducer Calibration" on page 7-28
- "Heater Assembly Replacement" on page 7-30
- "Thermistor Replacement" on page 7-31
- "Input Board Replacement" on page 7-33
- "Input Board Calibration" on page 7-35
- "I/O Expansion Board Replacement" on page 7-35
- "Digital Output Board Replacement" on page 7-37
- "Motherboard Replacement" on page 7-38
- "Measurement Interface Board Replacement" on page 7-39
- "Front Panel Board Replacement" on page 7-40
- "LCD Module Replacement" on page 7-41
- "Service Locations" on page 7-42

Safety Precautions

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

WARNING The service procedures in this manual are restricted to qualified 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 ground 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, it may easily scratch the plate. ▲

Do not use alcohol, acetone, MEK or other Ketone based or aromatic solvents to clean the LCD module, 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. ▲

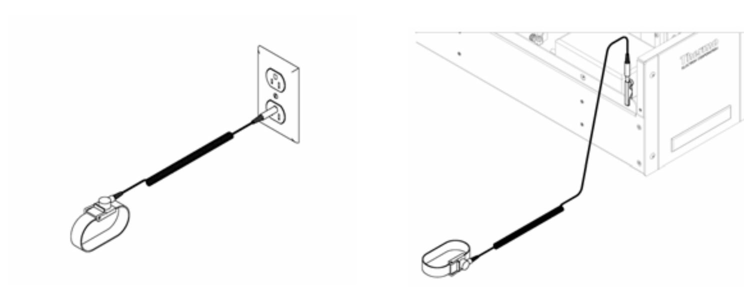


Figure 7–1. Properly Grounded Antistatic Wrist Strap

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 80*i* major subassemblies. Refer to **Figure 7–2** to identify the component location.

Table 7–1. Model 80*i* Replacement Parts

Part Number	Description
100480-00	Front Panel Pushbutton Board
101491-21	Processor Board
100533-00	Motherboard Assembly
100539-00	Digital Output Board
102340-00	Front Panel Connector Board
102496-00	Front Panel Display
102014-00	I/O Expansion Board
102599-00	Measurement Interface Board Assembly
100545-00	Input Board Assembly
101023-00	Pressure Transducer Assembly
101021-00	Flow Transducer
112980-01	Replacement Kit, Mercury Lamp
102841-00	Mercury High Voltage Lamp Supply
103453-00	Photomultiplier Tube (PMT)
101024-00	PMT High Voltage Power Supply
2126.051	Glass Orifice, 250 ml/min
2126.052	Glass Orifice, 500 ml/min
101104-00	Optical Bench Assembly
101390-00	Solenoid Assembly
101399-00	Stepdown Transformer Assembly
103408-00	Pump, External
101055-00	AC Receptacle Assembly
104235-00	Fuse Kit*
101681-00	Power Supply Assembly, 24VDC, w/Base Plate and Screws
101688-00	Ambient Temperature Connector with Thermistor

Part Number	Description
102148-00	Bench Heater/Thermistor Assembly
100907-00	Fan, 24VDC
8630	Filter Guard Assembly (w/foam)*
102841-00	High Voltage Lamp Supply

*Expendable item not covered by warranty.

Cable List

Table 7–2 describes the Model 80*i* cables. See the "Troubleshooting" chapter for associated connection diagrams and board connector pin descriptions.

Table 7–2. Model 80*i* Cables

Part Number	Description
101036-00	DC Power Supply, 24V Output
101037-00	115VAC Supply to Measurement Interface Board
101048-00	RS-485/Data
101038-00	Motherboard
101364-00	DC Power Supply
101054-00	Motherboard to Front Panel Board
101035-00	DC Power Supply AC Input
101033-00	AC from Receptacle
101377-00	AC to Power Switch
101355-00	Signal Output Ribbon
103275-00	Interface to Lamp HV Supply
101055-00	Main AC Receptacle Assembly
101267-00	Fan Power Cable
103397-00	Detector Extension

External Device Connection Components

Table 7–3 lists the standard and optional cables and components used for connecting external devices such as PCs and data loggers to an iSeries 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)

Part Number	Description
102646-00	Cable, DB37F to Open End, Six Feet (optional)
102659-00	Cable, DB25M to Open End, Six Feet (optional)
6279	Cable, RS-232 (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 I/O Expansion Board)

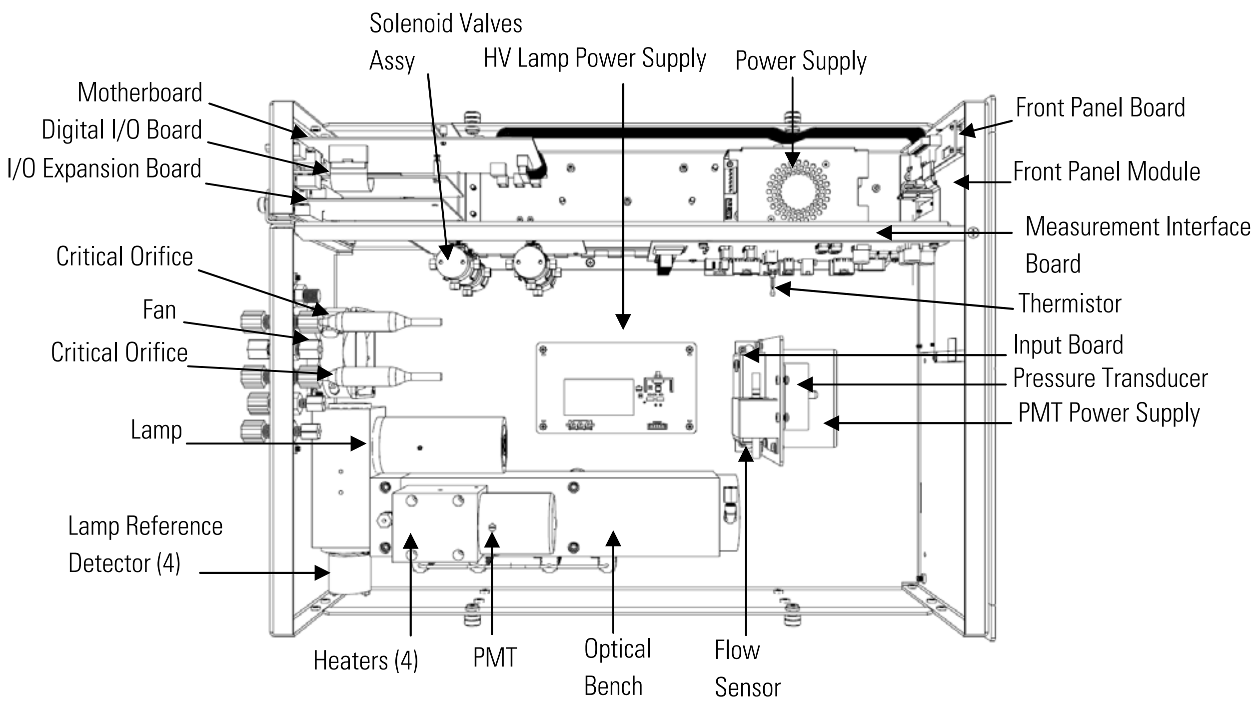


Figure 7–2. Model 80*i* Component Layout

Removing the Measurement Bench and Lowering the Partition Panel

The measurement bench 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 (see **Figure 7–3**).

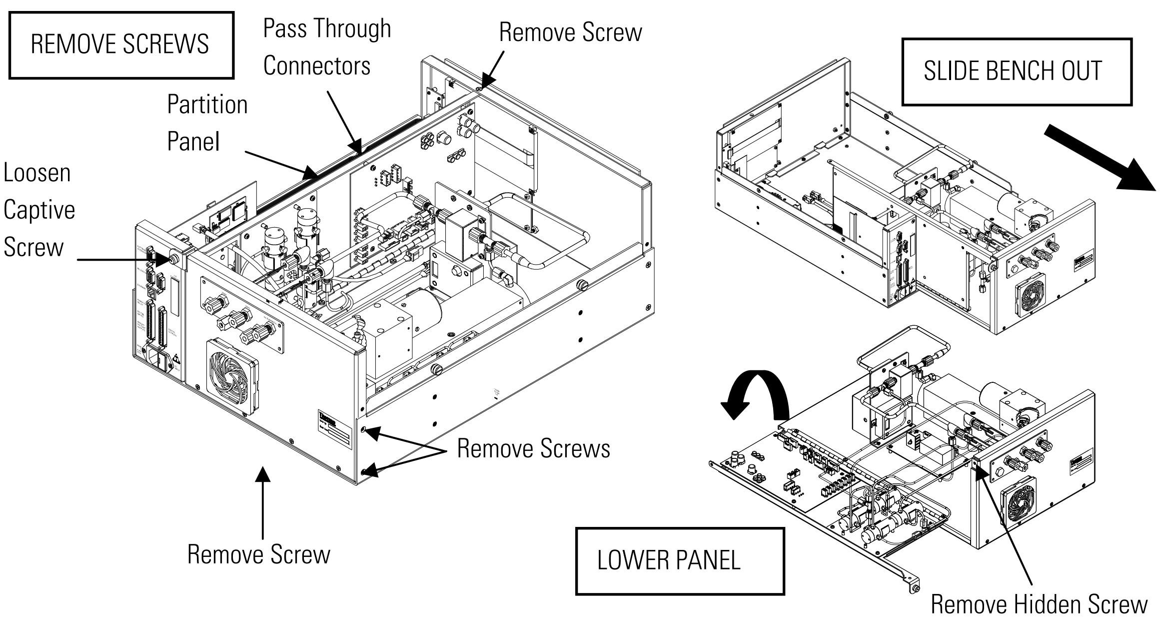


Figure 7–3. Removing the Measurement Bench and Lowering the Partition Panel

Equipment Required:

Philips screwdriver

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

5. Disconnect the connectors that pass through the center of the partition panel.

6. Remove two screws from the left side of the case.

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 bench, and pull the measurement bench from the rear of the case.

10. Remove the screw at the top rear of the partition panel securing the top of partition panel to the measurement bench, and lower the panel being, careful not to put excessive tension on the cables.

11. Replace the measurement bench by following previous steps in reverse.

Accessing the Service Mode

If the Service is not displayed on the Main Menu, use the following procedure to display it.

1. At the Main Menu, press ↓ to scroll to Instrument Controls > press ↵ > ↓ to scroll to **Service Mode** > and press ↵.

   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 "Replacement Parts List" on page 7-4.

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

External Pump Replacement

To replace the external pump, remove power from the pump and remove the input and output lines.

Fan Replacement

Use the following procedure to replace the fan (**Figure 7–4**).

Equipment Required:

Fan

Philips screwdriver

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

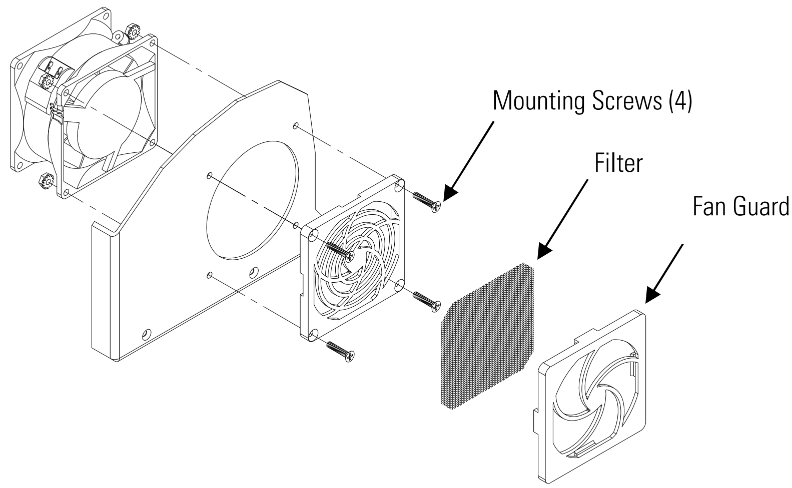


Figure 7–4. Replacing the Fan

Optical Bench Replacement

Use the following procedure to replace the optical bench (**Figure 7–5**).

Equipment Required:

Allen wrench, 5/32-inch

Philips screwdriver

Equipment Damage Some internal components can be damaged by small amounts of static electricity. A properly ground antistatic wrist strap must be worn while handling any internal component. 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 instrument OFF, unplug the power cord, and remove the cover.

2. Disconnect the electrical cables from the optical bench:

   a. Lamp connector on the Lamp HVPS board

   b. Heater cable from AC BENCH connector on the measurement interface board

   c. PMT BNC cable from the input board connector

d. PMT power cable from the HVPS

e. Reference detector from the REF DET connector on the measurement interface board

3. Disconnect the optical bench plumbing.

4. Using a 5/32-inch Allen wrench, remove the four optical bench retaining screws, and lift the optical bench off the floor plate.

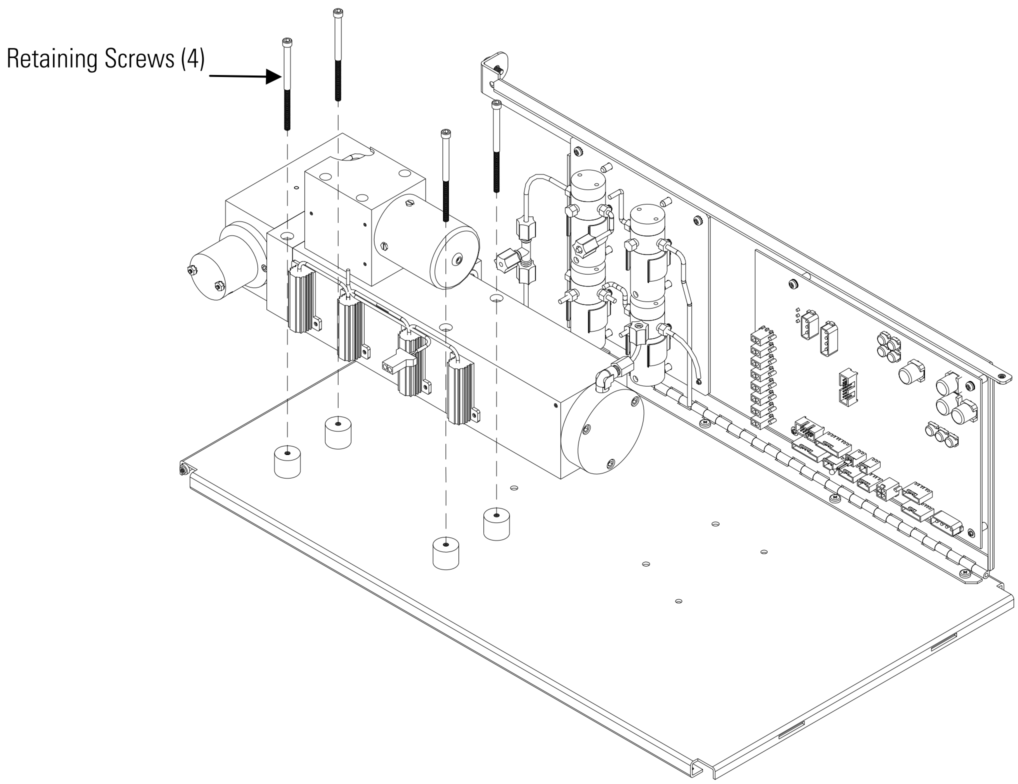


Figure 7–5. Replacing the Optical Bench

5. Replace the optical bench by following the previous steps in reverse order.

6. Calibrate the instrument. Refer to the “Calibration” chapter in this manual.

Lamp Replacement

Use the following procedure to replace the lamp (**Figure 7–6**).

Equipment Required:

Lamp

Allen Wrench, 7/64-inch

Equipment Damage Some internal components can be damaged by small amounts of static electricity. A properly ground antistatic wrist strap must be worn while handling any internal component. 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 instrument OFF, unplug the power cord, and remove the cover.

2. Disconnect the LAMP connector from the lamp HVPS.

3. Loosen the retaining screw on the top of the lamp housing and pull out the socket assembly and lamp.

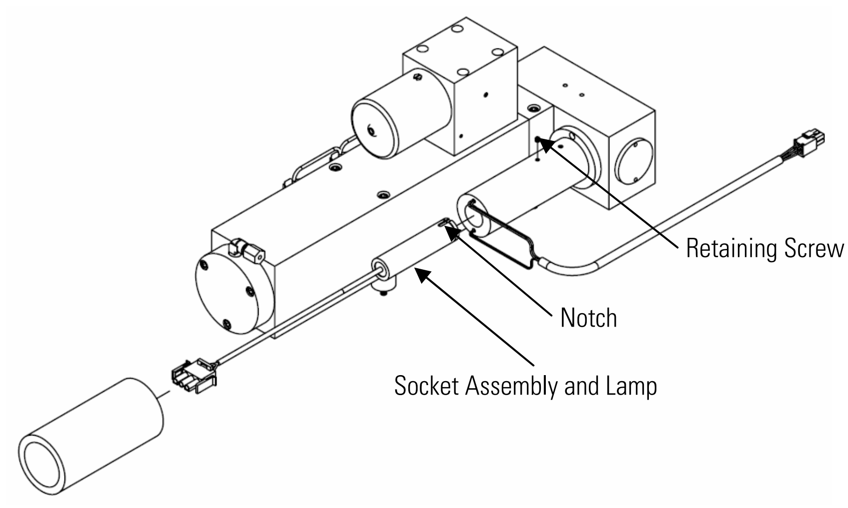


Figure 7–6. Replacing the Lamp

4. Remove the old lamp from the socket assembly by pulling straight out and insert the new lamp into the lamp housing with notch in 12:00

position (**Figure 7–6**), tighten the retaining screw, and reconnect the trigger cable.

Lamp HVPS Assembly Replacement

Use the following procedure to replace the lamp HVPS assembly (**Figure 7–6**).

Equipment Required:

Lamp HVPS assembly

Philips screwdriver, #1

Equipment Damage Some internal components can be damaged by small amounts of static electricity. A properly ground antistatic wrist strap must be worn while handling any internal component. 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 instrument OFF, unplug the power cord, and remove the cover.

2. Disconnect the INTF and LAMP electrical connectors

3. Remove the four screws securing the power supply to the floor plate and remove the power supply.

4. Install the new power supply following the previous steps in reverse.

Lamp Reference Detector Assembly Replacement

Use the following procedure to replace the lamp reference detector assembly.

Equipment Required:

Reference detector

Allen wrench, 5/32-inch

Equipment Damage Some internal components can be damaged by small amounts of static electricity. A properly ground antistatic wrist strap must be worn while handling any internal component. 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 instrument OFF, unplug the power cord, and remove the cover.

2. Disconnect the reference detector cable from the REF DET connector on the measurement interface board.

3. Using a 5/32-inch Allen wrench, remove the four optical bench retaining screws, and lift the bench enough to pull out the reference detector.

4. Grasp the reference detector and pull straight out (**Figure 7–7**).

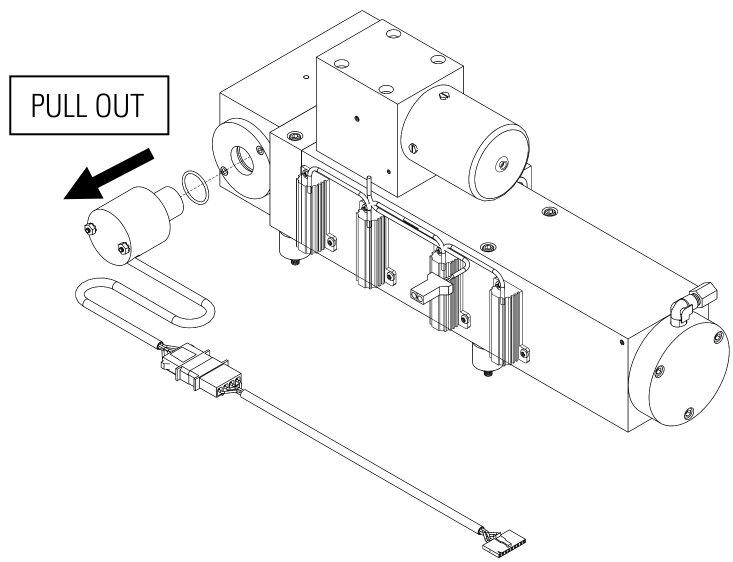


Figure 7–7. Replacing the Reference Detector Assembly

5. Install the new reference detector by following this procedure in reverse.

Photomultiplier Tube Replacement

Use the following procedure to replace the photomultiplier tube.

Equipment Required:

Photomultiplier tube

Philips screwdriver, #1

Equipment Damage Some internal components can be damaged by small amounts of static electricity. A properly ground antistatic wrist strap must be worn while handling any internal component. 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 instrument OFF, unplug the power cord, and remove the cover.

2. Disconnect the high voltage cable from the PMT power supply cable connector and unplug the BNC cable from the input board connector.

3. Remove the three retaining screws holding the PMT cover to the PMT housing, and pull back the cover to access the two PMT base retaining screws (**Figure 7–8**).

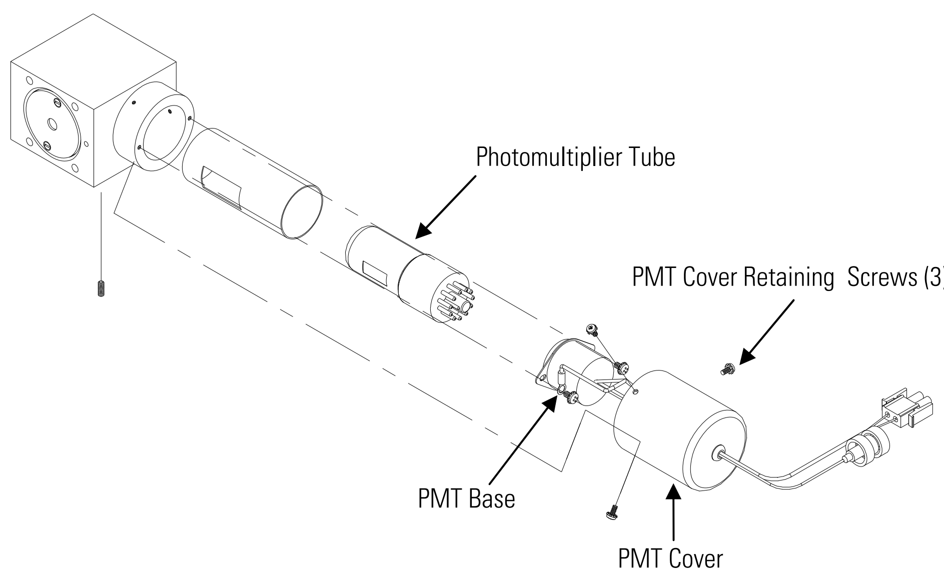


Figure 7–8. Replacing the PMT

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

4. Pull PMT and PMT base from the PMT housing by twisting it slightly back and forth.

5. To install a new PMT, follow previous steps in reverse.

6. Recalibrate the instrument. Refer to the “Calibration” chapter.

PMT High Voltage Power Supply Replacement

Use the following procedure to replace the PMT high voltage power supply (**Figure 7–9**).

Equipment Required:

PMT high voltage power supply

Nut driver, 1/4-inch

Philips screwdriver, #2

Equipment Damage Some internal components can be damaged by small amounts of static electricity. A properly ground antistatic wrist strap must be worn while handling any internal component. 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 instrument OFF, unplug the power cord, and remove the cover.

2. Disconnect the two PMT high voltage supply cables.

3. Disconnect the BNC signal cable and the ribbon cable.

4. Loosen the two retaining screws securing the power supply bracket to the floor plate and slide the power supply towards the rear slightly and lift it off the base screws (**Figure 7–9**).

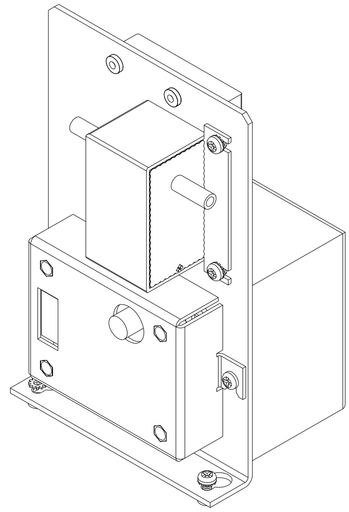


Figure 7–9. Replacing the PMT High Voltage Power Supply (HVPS)

5. Loosen two screws on the input box assembly and lift off the input box assembly.

6. Remove the four screws securing the power supply to the bracket (not shown) and remove the power supply.

7. To install the power supply, follow the previous steps in reverse.

8. Recalibrate the instrument. Refer to the calibration procedures in the “Calibration” chapter.

PMT Voltage Adjustment

Use the following procedure to adjust the PMT voltage after switching from standard to extended ranges or vice versa.

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

1. Connect the calibration gas and allow the instrument to sample calibration gas until the reading stabilizes.

2. From the Main Menu, press ⬇ to scroll to Service > press ↵ > ⬇ to scroll to PMT Voltage Adjustment > and press ↵.

   The Set PMT Voltage - Manual screen appears.

Note If Service is not displayed, refer to “Accessing the Service Mode” on page 7-8, then return to the beginning of this step. ▲

3. At the Set PMT Voltage - Manual screen, use ↑ ↓ to increment/decrement the counts until the instrument displays the calibration gas concentration value.

4. Press ↵ to store the value.

DC Power Supply Replacement

Use the following procedure to replace the DC power supply (**Figure 7–10**).

Equipment Required:

DC power supply

Philips screwdriver

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

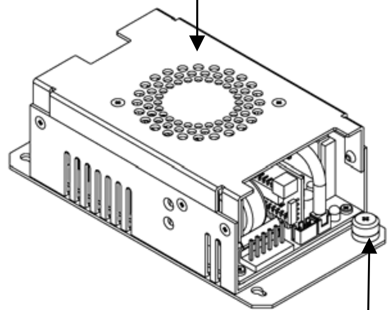


Figure 7–10. Replacing the DC Power Supply

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, you connect a meter to an analog output channel (voltage or current) and compare the meter reading with the output value displayed 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 7–11** shows the analog output pins and **Table 7–4** identifies the associated channels.

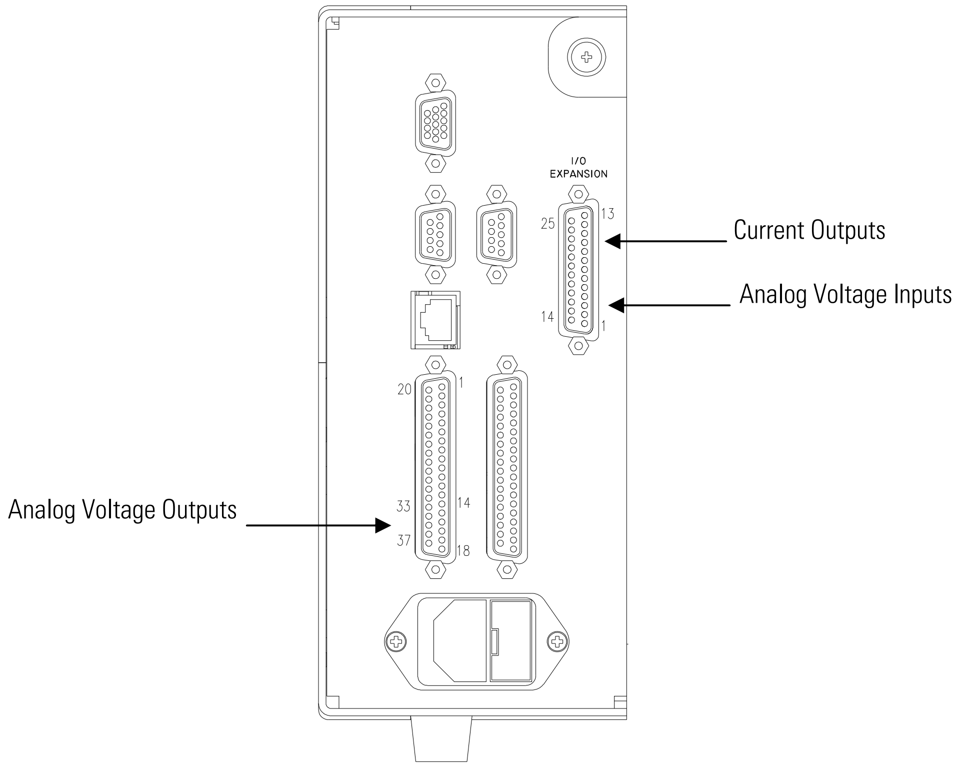


Figure 7–11. Rear Panel Analog Input and Output Pins

2. From the Main Menu, press ↓ to scroll to Diagnostics, press ↵ > ↓ to scroll to Test Analog Outputs, and press ↵.

   The Test Analog Outputs screen displays.

3. Press ↓ to scroll to the channel corresponding to the rear panel terminal pins where the meter is connected, and press ↵.

   The Set Analog Outputs screen displays.

4. Press ↓ to set the output to zero.

   The Output Set To line displays Zero.

5. Check that the meter is displaying a zero value. If the meter reading differs by more than one percent, 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 the full scale value. If the meter reading differs by more than one percent, 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	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 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 7–11** shows the analog output pins and **Table 7–4** identifies the associated channels.

2. From the Main Menu, press [↓] to scroll to Service, press [↵] > [↓] to scroll to Analog Out Calibration, and press [↵].

   The Analog Output Cal screen displays.

Note If Service is not displayed, refer to “Accessing the Service Mode” on page 7-8, then return to the beginning of this step. ▲

3. At the Analog Output Cal screen, press [↓] to scroll to the voltage channel or current channel corresponding to the rear panel terminal pins 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, 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 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, press [↓] to scroll to Service, press [↵] > [↓] to scroll to Analog Input Calibration, and press [↵].

   The Analog Input Cal screen displays.

Note If Service is not displayed, refer to "Accessing the Service Mode" on page 7-8, 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 7–11** shows the analog input pins and **Table 7–5** identifies the associated channels.

2. From the Main Menu, press ↓ to scroll to Service, press ↵ > ↓ to scroll to Analog Input Calibration, and press ↵.

   The Analog Input Cal screen displays input channels 1-8.

Note If Service is not displayed, refer to “Accessing the Service Mode” on page 7-8, 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

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 current 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 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.

Pressure Transducer Assembly Replacement

Use the following procedure to replace the pressure transducer assembly (**Figure 7–12**).

Equipment Required:

Pressure transducer assembly

Philips screwdriver

Equipment Damage Some internal components can be damaged by small amounts of static electricity. A properly ground antistatic wrist strap must be worn while handling any internal component. 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 instrument OFF, unplug the power cord, and remove the cover.

2. Disconnect plumbing from the pressure transducer assembly. Note the plumbing connections to facilitate reconnection.

3. Disconnect the pressure transducer cable from the measurement interface board.

4. Remove the two pressure transducer assembly retaining screws and remove the pressure transducer assembly.

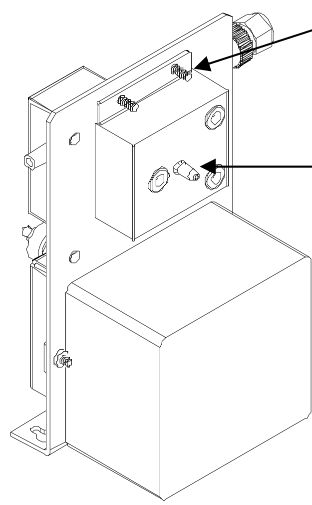


Figure 7–12. Replacing the Pressure Transducer Assembly

5. To install the pressure transducer assembly, follow the previous steps in reverse.

6. Calibrate the pressure transducer. Refer to the "Pressure Transducer Calibration" procedure that follows.

Pressure Transducer Calibration

Use the following procedure to calibrate the pressure transducer.

Notes An error in the zero setting of the pressure transducer does not introduce a measurable error in the output concentration reading. Therefore, if only a barometer is available and not a vacuum pump, adjust only the span setting. ▲

A rough check of the pressure accuracy can be made by obtaining the current barometric pressure from the local weather station or airport and comparing it to the pressure reading. However, since these pressures are usually corrected to sea level, it may be necessary to correct the reading to local pressure by subtracting 0.027 mmHg per foot of altitude. ▲

Do not try to calibrate the pressure transducer unless the pressure is known accurately. ▲

Equipment Required:

Vacuum pump

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

2. Disconnect the tubing from the pressure transducer and connect a vacuum pump known to produce a vacuum less than 1 mmHg.

3. From the Main Menu, press [↓] to scroll to Service > press [↵] > [↓] to scroll to Pressure Calibration > and press [↵].

   The Pressure Sensor Cal screen appears.

Note If Service is not displayed, refer to “Accessing the Service Mode” on page 7-8, then return to the beginning of this step. ▲

4. At the Pressure Sensor Cal screen, press ↵ to select Zero.

   The Calibrate Pressure Zero screen appears.

5. Wait at least 30 seconds for the zero reading to stabilize, then press ↵ to save the zero pressure value.

6. Disconnect the pump from the pressure transducer.

7. Press ■ to return to the Pressure Sensor Cal screen.

8. At the Pressure Sensor Cal screen, press ↓ ↵ to select Span.

   The Calibrate Pressure Span screen appears.

9. Wait at least 30 seconds for the ambient reading to stabilize, use ← → and ↑ ↓ to enter the known barometric pressure, and press ↵ to save the pressure value.

10. Reconnect the instrument tubing to the pressure transducer.

11. Install the cover.

Flow Transducer Replacement

Use the following procedure to replace the flow transducer (**Figure 7–13**).

Equipment Required:

Flow transducer

Philips screwdriver

Equipment Damage Some internal components can be damaged by small amounts of static electricity. A properly ground antistatic wrist strap must be worn while handling any internal component. 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 instrument OFF, unplug the power cord, and remove the cover.

2. Disconnect the plumbing connections from the flow transducer. Note the plumbing connections to facilitate reconnection.

3. Disconnect the flow transducer cable from the FLOW connector on the measurement interface board.

4. Remove the two screws securing the flow transducer to the bracket and remove the flow transducer.

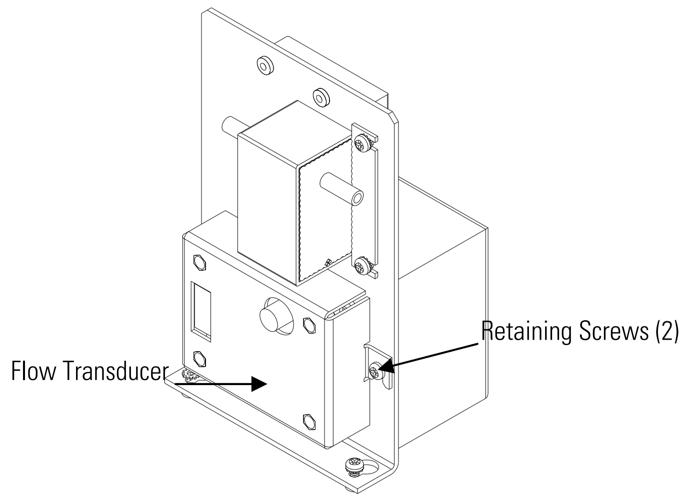


Figure 7–13. Replacing the Flow Transducer

5. Install the new flow transducer following the previous steps in reverse.

6. Calibrate the flow transducer. Refer to the “Flow Transducer Calibration” procedure that follows.

Flow Transducer Calibration

Use the following procedure to calibrate the flow transducer.

Equipment Required:

Calibrated flow sensor

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

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 ground 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 cover.

2. Shut off the external pump.

3. Cap the Hg ELEMENTAL port.

4. From the Main Menu, press ⬇ to scroll to Service > press ↵ > ⬇ to scroll to Flow Calibration > and press ↵.

   The Flow Sensor Cal screen appears.

Note If Service is not displayed, refer to "Accessing the Service Mode" on page 7-8, then return to the beginning of this step. ▲

5. At the Flow Sensor Cal screen, press ↵ to select Zero.

   The Calibrate Flow Zero screen appears.

6. Wait at least 30 seconds for the zero reading to stabilize, then press ↵ to save the zero flow value.

7. Power up the external pump.

8. Connect a calibrated flow sensor at the Hg TOTAL bulkhead on the rear panel via a 250 sccm critical orifice.

9. Press ▮ to return to the Flow Sensor Cal screen.

10. At the Flow Sensor Cal screen, press ⬇ ↵ to select Span.

    The Calibrate Flow Span screen appears.

11. Wait at least 30 seconds for the reading to stabilize, use [←] [→] and [↑] [↓] to enter the flow sensor reading, and press [↵] to save the value.

12. Install the cover.

Heater Assembly Replacement

Use the following procedure to replace the heater assembly (**Figure 7–14**).

Equipment Required:

Heater assembly

Heat sink grease

Flatblade screwdriver

Allen wrench, 5/32-inch

Equipment Damage Some internal components can be damaged by small amounts of static electricity. A properly ground antistatic wrist strap must be worn while handling any internal component. 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 instrument OFF, unplug the power cord, and remove the cover.

2. Disconnect heaters from the AC BENCH cable.

3. Using the 5/32-inch wrench, remove the four screws securing the optical bench to the floor plate. (**Figure 7–5**)

4. Lift the optical bench from the floor plate to gain access to the heater assembly.

5. Remove two retaining screws and washers from each heater and remove the heaters.

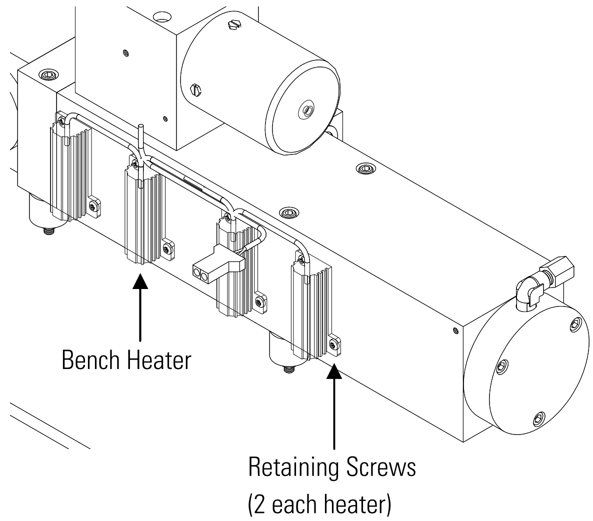


Figure 7–14. Replacing the Heater Assembly

6. Apply heat sink grease to the new heaters as appropriate.

7. Fasten each heater with the two retaining screws and washers.

8. Secure the optical bench to the floor plate with the four screws.

9. Connect the heaters to the AC BENCH cable.

10. Replace the cover and plug in the power cord.

Thermistor Replacement

Use the following procedure to replace the thermistor (**Figure 7–15**).

Equipment Required:

Thermistor

Equipment Damage Some internal components can be damaged by small amounts of static electricity. A properly ground antistatic wrist strap must be worn while handling any internal component. 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 instrument OFF, unplug the power cord, and remove the cover.

2. Squeeze the Thermistor latch and pull the Thermistor from the AMB TEMP connector.

3. Snap the new Thermistor into the AMB TEMP connector.

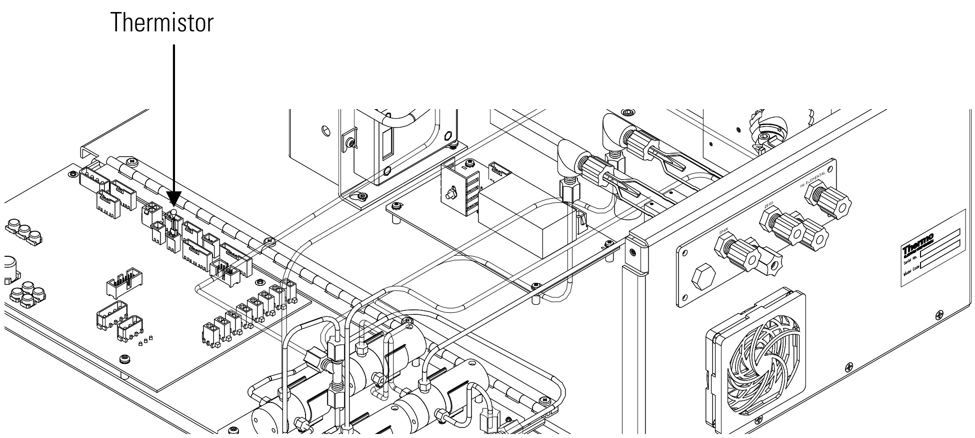


Figure 7–15. Replacing the Thermistor

Ambient Temperature Calibration

Use the following procedure to calibrate the ambient internal temperature for the instrument.

Equipment Required:

Calibrated thermometer or 10K ±1% resistor

WARNING The service procedures in this manual are restricted to qualified representatives. 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 ground 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 instrument cover.

2. Tape the thermistor plugged into the measurement interface board (**Figure 7–15**) to a calibrated thermometer.

Note Since the thermistors are interchangeable to an accuracy of ±0.2 °C, and have a value of 10K ohms at 25 °C, an alternate procedure is to connect an accurately known 10K resistor to the thermistor input (AMB TEMP) on the measurement interface board, and enter the temperature reading. ▲

A 1 °C change corresponds to a ±5% change in resistance, thus this alternative procedure can be quite accurate as a check; however, it clearly is not NIST traceable. ▲

3. From the Main Menu, press [↓] to scroll to Service > press [↵] > [↓] to scroll to Temperature Calibration > and press [↵].

   The Calibrate Ambient Temperature screen appears.

Note If Service is not displayed, refer to "Accessing the Service Mode" on page 7-8, then return to the beginning of this step. ▲

4. Wait at least 30 seconds for the ambient reading to stabilize, use [←] [→] and [↑] [↓] to enter the known temperature, and press [↵] to save the temperature value.

5. Install the cover.

Input Board Replacement

Use the following procedure to replace the input board (**Figure 7–16**).

Equipment Required:

Input board

Philips screwdriver

Equipment Damage Some internal components can be damaged by small amounts of static electricity. A properly ground antistatic wrist strap must be worn while handling any internal component. 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 instrument OFF, unplug the power cord, and remove the cover.

2. Disconnect the BNC signal cable and the ribbon cable.

3. Loosen the two screws securing the power supply bracket to the floor plate, slide the power supply towards the rear slightly, and lift it off the base screws.

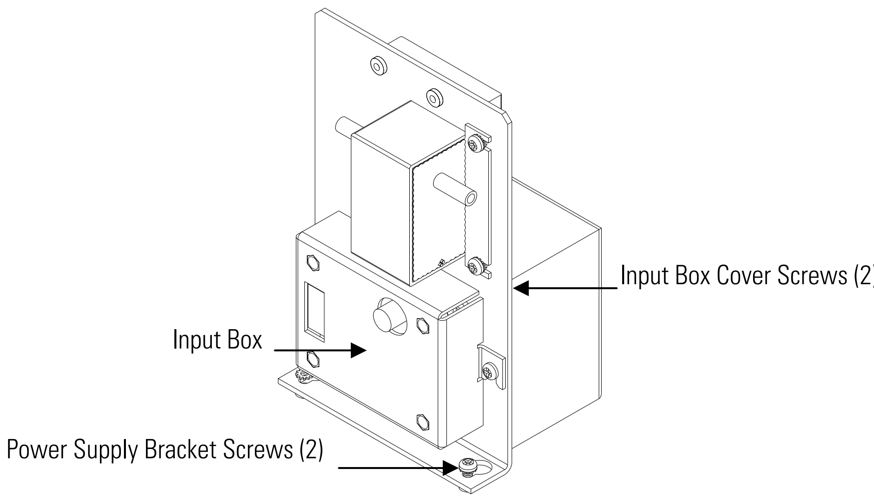


Figure 7–16. Replacing the Input Board

4. Loosen the two input box cover screws and remove the cover.

5. Remove the four input board screws (not shown) holding the input board to the input box and remove the input board.

6. Install the input board by following the previous steps in reverse.

7. Perform an input board calibration. See "Input Board Calibration" procedure that follows.

Input Board Calibration

After replacing the input board, use the following procedure to calibrate the input board.

WARNING The service procedures in this manual are restricted to qualified representatives. If the equipment is operated in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired. ▲

1. From the Main Menu, press ↓ to scroll to Service > press ↵ > ↓ to scroll to Input Board Calibration > and press ↵.

   The Input Board Calibration screen appears.

Note If Service is not displayed, refer to “Accessing the Service Mode” on page 7-8, then return to the beginning of this step. ▲

2. At the Input Board Calibration screen, press ↵ to select Manual Input Cal, and press ↵ to calibrate.

   The screen displays the frequency at GAIN 1.

3. Make a note of the FREQ value displayed at GAIN 1, then press ← or → to change the GAIN to 100.

4. At the GAIN 100 screen, use ↑ ↓ to increment the D/A counts until the FREQ value matches or is slightly above (within 50 counts) the value noted in the previous step.

5. Press ↵ to store the value.

   The screen flashes Calculating - Please Wait! and Done - Values Saved! messages.

I/O Expansion Board Replacement

Use the following procedure to replace the I/O expansion board (**Figure 7–17**).

Note After replacing the optional 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 static electricity. A properly ground 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 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 7–18**).

4. Pop off the board from the mounting studs and remove the board.

5. To install the I/O expansion board, follow previous steps in reverse.

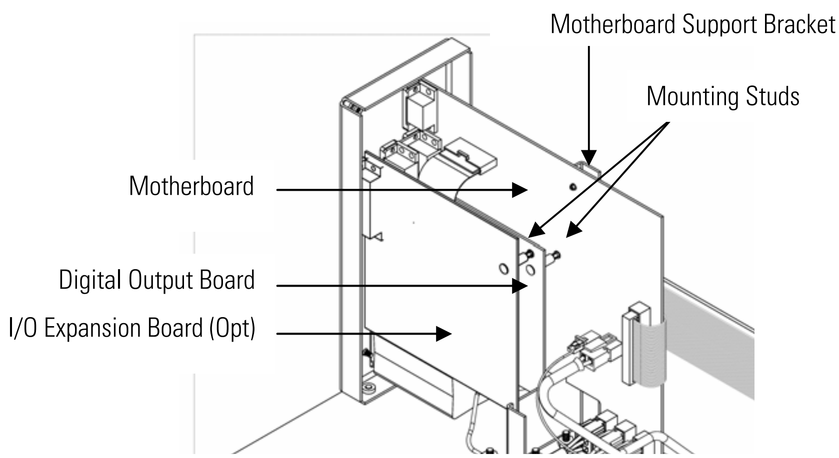


Figure 7–17. Replacing the I/O Expansion Board (Optional)

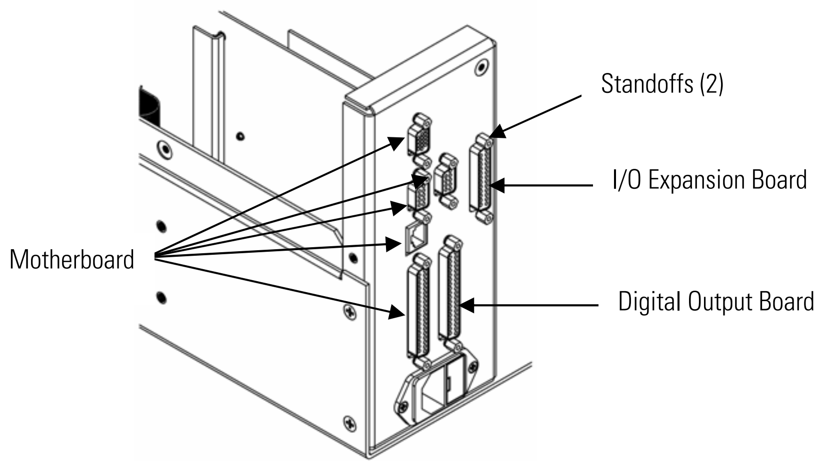


Figure 7–18. Rear Panel Board Connectors

Digital Output Board Replacement

Use the following procedure to replace the digital output board (**Figure 7–17**).

Equipment Required:

Digital output board

Nut driver, 3/16-inch

Equipment Damage Some internal components can be damaged by small amounts of static electricity. A properly ground antistatic wrist strap must be worn while handling any internal component. 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 instrument OFF, unplug the power cord, and remove the cover.

2. Remove the I/O expansion board, 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 7–18**).

5. Pop off the digital output board from the mounting studs and remove the board.

6. To install the digital output board, follow previous steps in reverse.

Motherboard Replacement

Use the following procedure to replace the motherboard (**Figure 7–17**).

Equipment Required:

Motherboard

Philips screwdriver

Nut driver, 3/16-inch

Equipment Damage Some internal components can be damaged by small amounts of static electricity. A properly ground antistatic wrist strap must be worn while handling any internal component. 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 instrument OFF, unplug the power cord, and remove the cover.

2. Remove the I/O expansion board, 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 reconnection.

5. Using the nut driver, remove the standoffs securing the board to the rear panel.

6. Pop off the motherboard from motherboard support bracket, and remove the motherboard.

7. To install the motherboard, follow previous steps in reverse.

Measurement Interface Board Replacement

Use the following procedure to replace the measurement interface board (**Figure 7–19**).

Equipment Required:

Measurement interface board

Philips screwdriver

Equipment Damage Some internal components can be damaged by small amounts of static electricity. A properly ground antistatic wrist strap must be worn while handling any internal component. 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. Refer to "Removing the Measurement Bench 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 two screws at the top of the measurement interface board. Pop off the measurement interface board from the two bottom mounting studs and remove the board.

4. To install the measurement interface board, follow previous steps in reverse.

5. Re-install the measurement bench. Refer to "Removing the Measurement Bench and Lowering the Partition Panel" in this chapter.

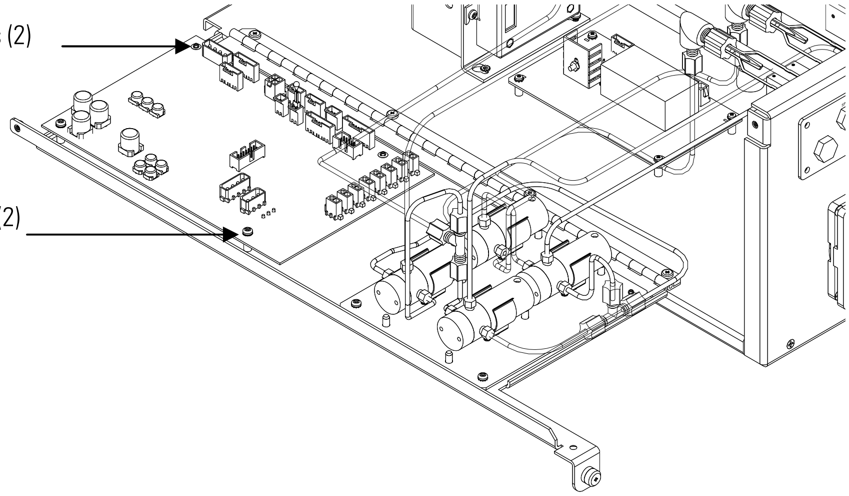


Figure 7–19. Replacing the Measurement Interface Board

Front Panel Board Replacement

Use the following procedure to replace the front panel board (**Figure 7–20**).

Equipment Required:

Front panel board

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

3. Pop off the board from the two top mounting studs and remove the board by lifting it up and off the slotted bottom support.

4. Replace the front panel board by following previous steps in reverse.

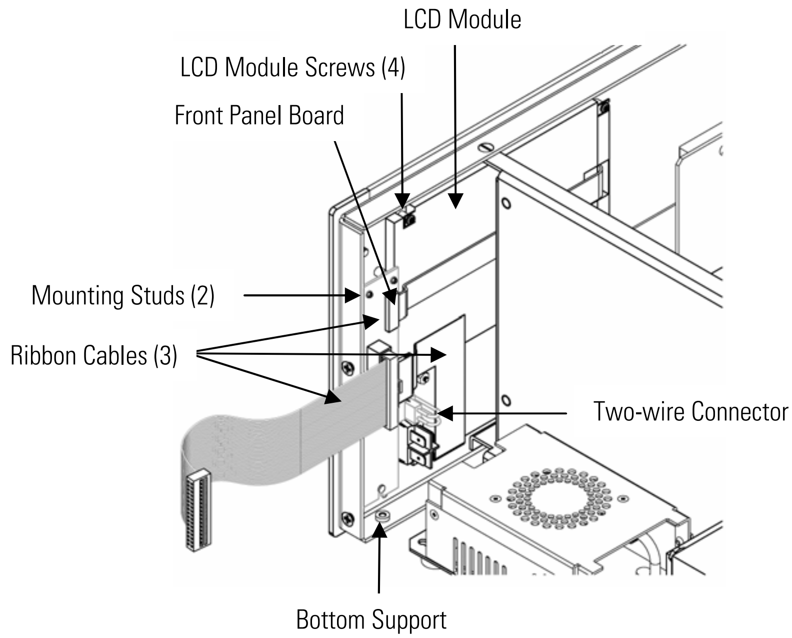


Figure 7–20. Replacing the Front Panel Board and the LCD Module

LCD Module Replacement

Use the following procedure to replace the LCD module (**Figure 7–20**).

Equipment Required:

LCD module

Philips screwdriver

CAUTION If the LCD panel breaks, do not to 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 static electricity. A properly ground 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. ▲

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, it may easily scratch the plate. ▲

Do not use alcohol, acetone, MEK or other Ketone based or aromatic solvents to clean the module, 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 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 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. ▲

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.

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" on page 8-1
- "Electronics" on page 8-5
- "I/O Components" on page 8-8

Hardware

Model 80*i* hardware components (**Figure 8–1**) include:

- Optics
  - Lamp
  - Rejection mirror
  - Colluminating lens
  - Beam splitter
- Fluorescence chamber
- Photomultiplier tube
- Lamp reference detector
- Flow sensor
- Pressure transducer
- Critical orifices
- Vacuum pump

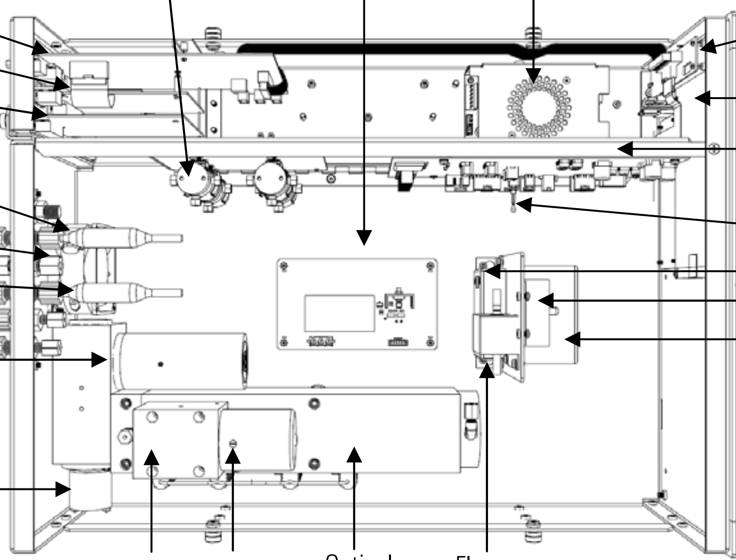


Figure 8–1. Hardware Components

Optics

The optics section contains the light source and optimizes the excitation wavelength using a rejection/mirror beam splitter combination.

Lamp

The lamp provides the ultraviolet light that excites the Hg atoms.

Fluorescence Chamber

In the fluorescence chamber, UV light from the lamp excites the Hg atoms. A condenser lens collects and focuses light from fluorescing Hg atoms inside the chamber.

Photomultiplier Tube (PMT)

The PMT detects the UV light emission from the decaying Hg atoms and converts the optical energy from the reaction to an electrical signal. This signal is sent to the input board which transmits it to the processor.

Input Board

The input board accepts the current signal from the PMT and converts it to a voltage, which is scaled by a factor of approximately 1, 10, or 100 depending on the full-scale range of the Hg channel. The scaled voltage signal is converted to a frequency and sent to the microprocessor.

The input board includes a test signal that can be activated under firmware control. The test signal is injected at the first stage of the input board in parallel with the PMT input. This allows the input board and the connection to the processor system to be tested and calibrated without using the PMT.

Lamp Reference Detector

The lamp reference detector is part of the fluorescence chamber and monitors the lamp intensity by viewing the transmitted light from the beam splitter.

Flow Sensor

The flow sensor is used for measuring the flow of sample gas in the measurement system.

Pressure Transducer

The pressure transducer measures the fluorescence chamber pressure. The pressure transducer output is produced by measuring the pressure difference between the sample gas pressure and ambient air pressure.

Critical Orifices

The critical orifices are used to control zero and calibration gas flow into the instrument and to balance the bench pressure.

External Pump

The external pump is used to draw the sample through the instrument and to create the instrument vacuum

Firmware

The processor firmware tasks are organized into four areas:

- Instrument 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 and 120VAC power supply inputs
- Fan and solenoid outputs
- 120VAC output for the optical bench temperature control
- Flow and pressure sensors
- Ambient temperature sensor
- PMT high voltage supply
- Input board
- Lamp intensity
- Lamp high voltage supply

Flow Sensor Assembly

The flow sensor assembly consists of a board containing an instrumentation amplifier and a flow transducer with input and output gas fittings. The flow transducer output is produced by measuring the pressure difference across a precision orifice. This unit is used for measuring the flow of sample gas in the measurement system.

Pressure Sensor Assembly

The pressure sensor assembly consists of a board containing an instrumentation amplifier and a pressure transducer 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.

Temperature Control

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

Lamp Power Supply Assembly

The lamp power supply assembly produces a high voltage to vaporize the Hg in the lamp, then switches to a constant current mode which is adjustable from approximately 10-18mA.

PMT Power Supply Assembly

The PMT power supply produces high voltage to operate the photomultiplier tube used in the measurement system. The output voltage is adjustable from approximately 600 to 1200 volts under firmware control.

Input Board

The input board accepts the current signal from the PMT and converts it to a voltage, which is scaled by a factor of approximately 1, 10, or 100 depending on the full-scale range of the Hg channel. The scaled voltage signal is converted to a frequency and sent to the microprocessor.

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.

External Accessory Connector

The external accessory connector port is used in to communicate with smart external devices, such as the 82*i* Probe Controller. These devices may be mounted hundreds of feet from the instrument using an RS-485 electrical interface.

Chapter 9
Optional Equipment

The Model 80*i* is available with the following options:

- "Terminal Block and Cable Kits" on page 9-1
- "Mounting Options" on page 9-3

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 I/O expansion board. For associated part numbers, refer to "External Device Connection Components" in the "Servicing" chapter.

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

25-Pin Terminal Board Assembly

The 25-pin terminal board assembly is included with the I/O expansion board. Refer "Terminal Board PCB Assemblies" in the "Installation" chapter for information on attaching the cable to the connector board. For associated part numbers, refer to "External Device Connection Components" in the "Servicing" chapter.

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" in the "Servicing" chapter.

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	

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

Pin	Color	Pin	Color
17	GREEN/WHITE	35	GRAY/RED
18	BLUE/WHITE	36	GRAY/VIOLET
19	VIOLET/WHITE	37	LIGHT GREEN/BLACK

Mounting Options

The instrument can be installed in the configuration described in **Table 9–3** and shown in **Figure 9–1** through **Figure 9–4**.

Table 9–3. 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	The rail mounting location is lower on the case and the front mounting screw slots are in non-standard EIA locations.

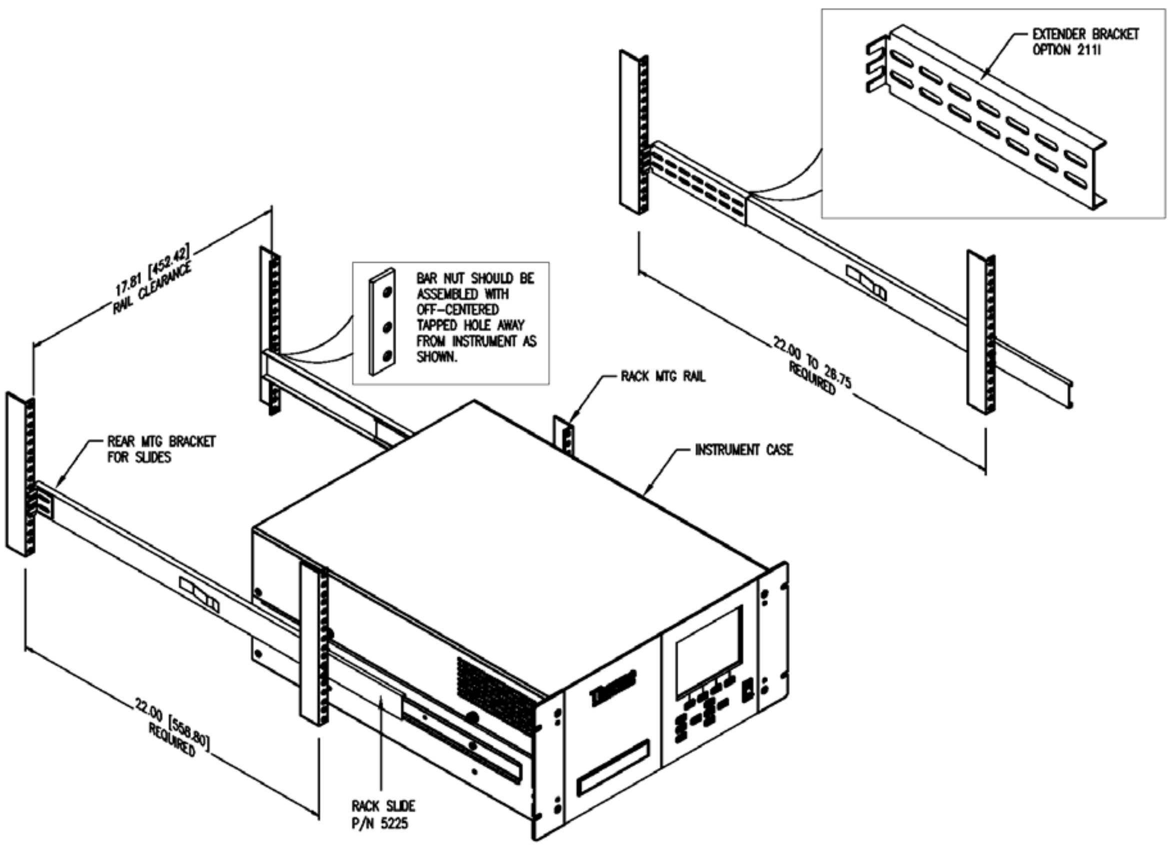


Figure 9–1. Rack Mount Option Assembly

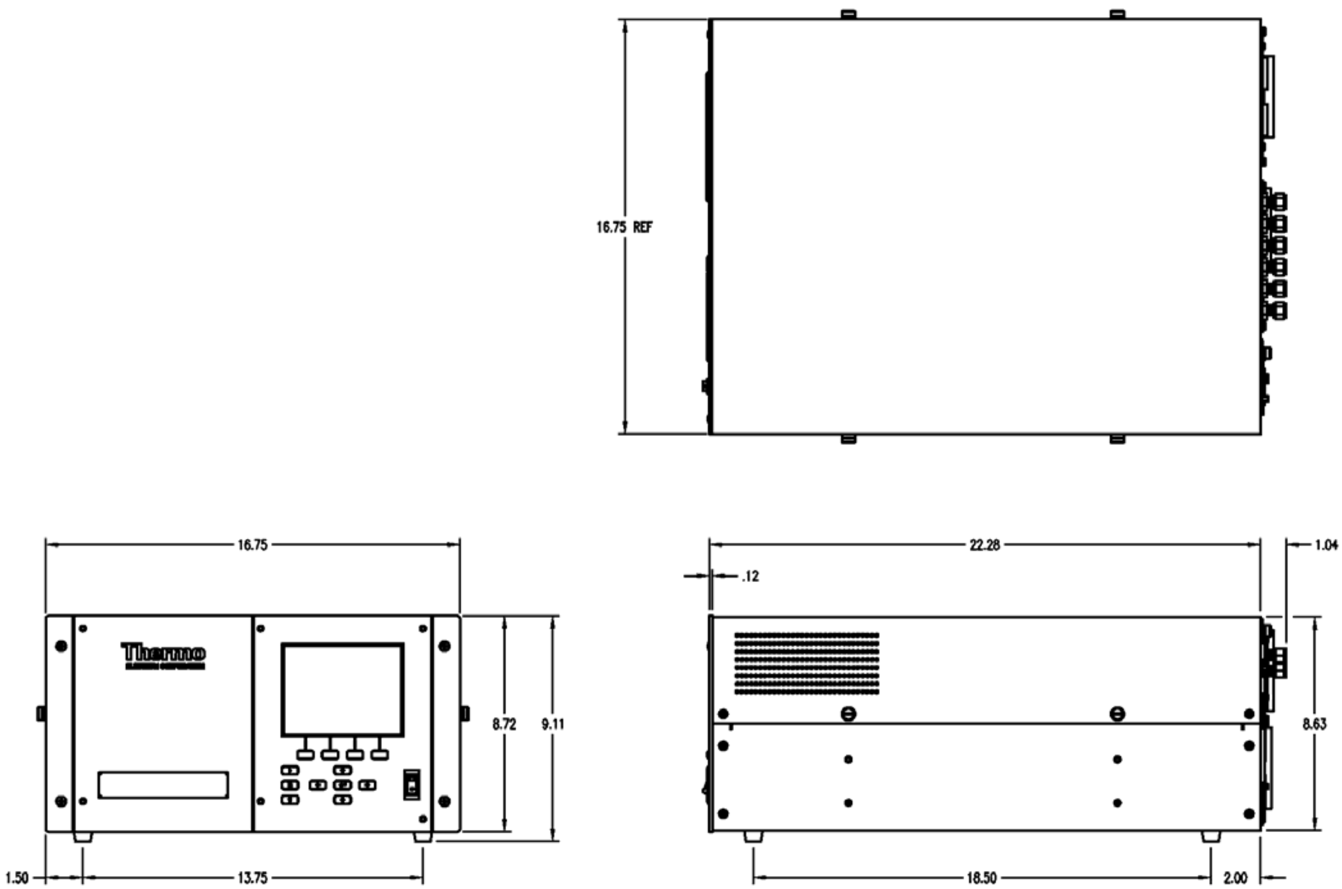


Figure 9–2. Bench Mounting

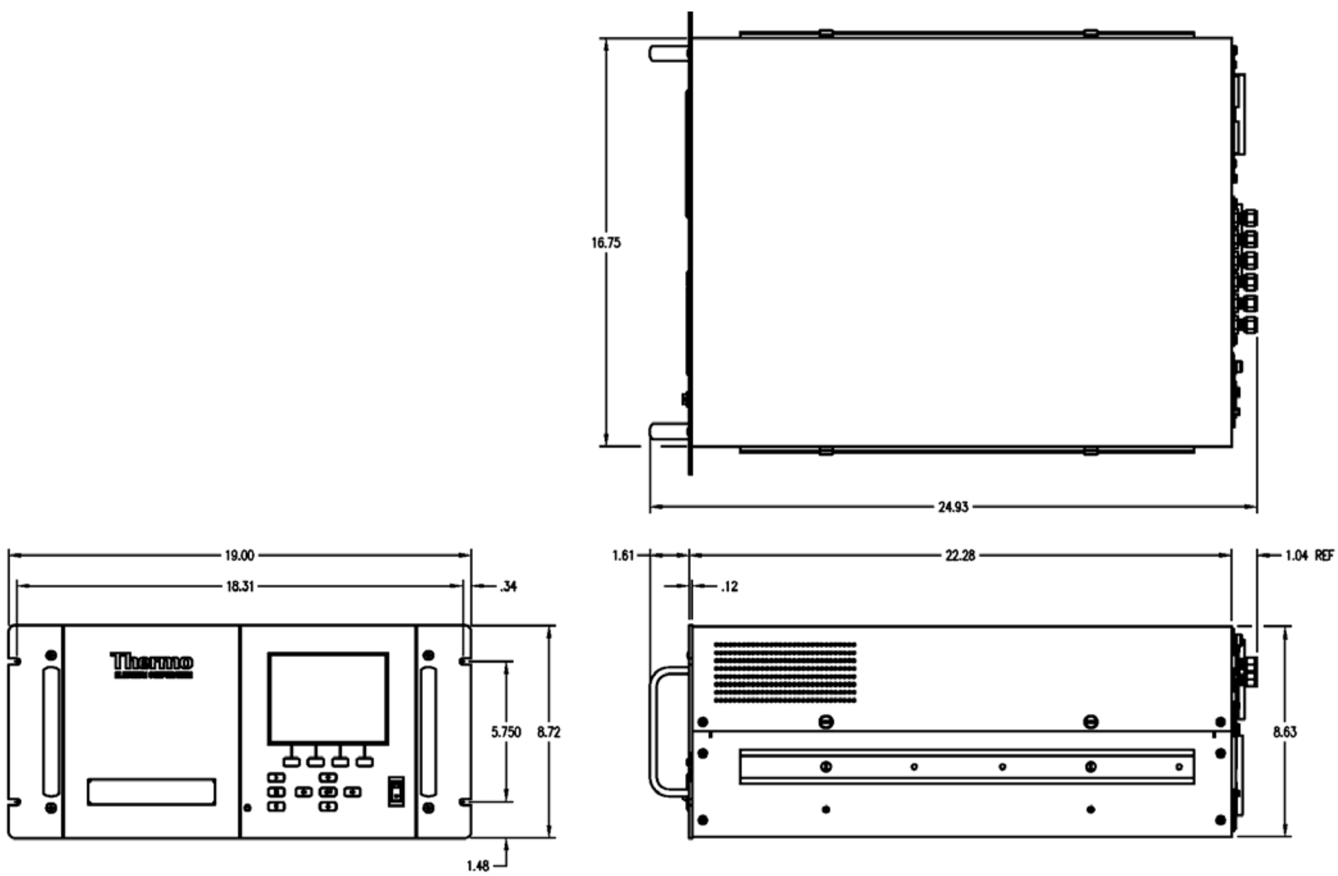


Figure 9–3. EIA Rack Mounting

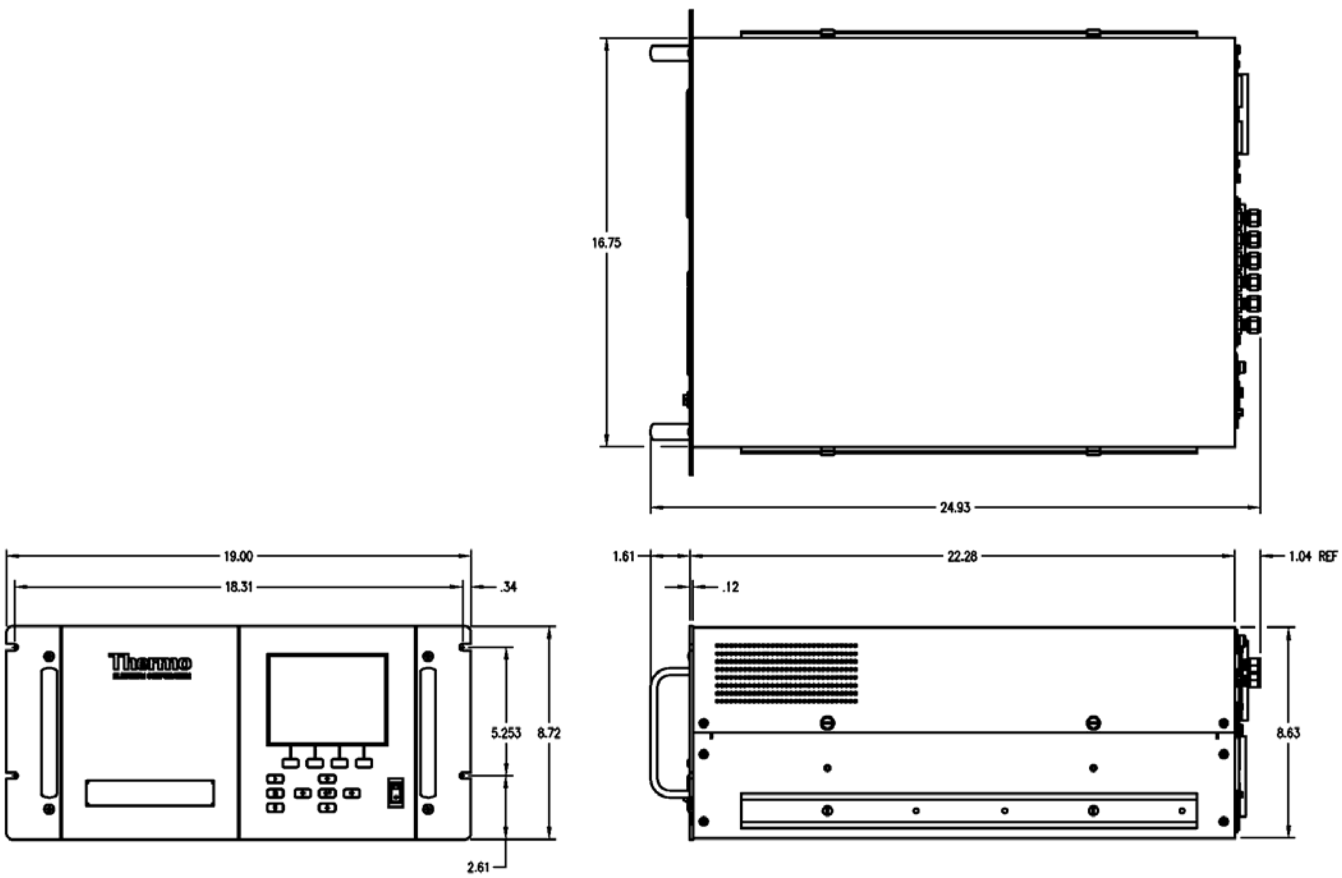


Figure 9–4. Retrofit Rack Mounting

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.

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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 80*i* analyzer 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 may be accessed over Ethernet using TCP/IP port 9881. Up to three simultaneous connections are allowed per protocol.

- "Instrument Identification Number" on page B-1
- "Commands" on page B-2
- "Accessing Streaming Data" on page B-3
- "Service Mode" on page B-3
- "Commands List" on page B-4
- "Measurements" on page B-12
- "Alarms" on page B-15
- "Diagnostics" on page B-23
- "Datalogging" on page B-24
- "Calibration" on page B-31
- "Keys/Display" on page B-33
- "Measurement Configuration" on page B-35
- "Hardware Configuration" on page B-49
- "Communications Configuration" on page B-51
- "I/O Configuration" on page B-58
- "Record Layout Definition" on page B-62

Instrument Identification Number

Each command sent to the instrument 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 instrument 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 instrument 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 instrument 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 that follows begins with the ASCII character code 208 decimal, which directs the command to the Model 80*i,* and is terminated by a carriage return "CR" (ASCII character code 13 decimal).

<ASCII 208>	T	I	M	E	<CR>

If an incorrect command is sent, a "bad command" message will be received. The example that follows sends the incorrect command "set alarm eductor pres max" instead of the correct command "set alarm eductor pres max 20.0."

```
Send:         set alarm eductor pres max
Receive:      set alarm eductor pres max bad cmd
```

Table B–1 provides a description of the command response errors.

Table B–1. Command Response Error Descriptions

Command Response	Description
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 store parameters in FLASH. 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.

Accessing Streaming Data

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 are allowed per protocol.

Service Mode

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.

Commands List

Table B–2 lists the 80*i* C-Link protocol commands. The interface will respond to the associated command strings.

Table B–2. C-Link Protocol Commands

Command	Description	Page
1	Simulates pressing soft key 1 pushbutton	B-33
2	Simulates pressing soft key 2 pushbutton	B-33
3	Simulates pressing soft key 3 pushbutton	B-33
4	Simulates pressing soft key 4 pushbutton	B-33
addr dns	Reports/sets domain name server address	B-51
addr gw	Reports/sets default gateway address	B-51
addr ip	Reports/sets IP address	B-52
addr nm	Reports/sets netmask address	B-52
addr ntp	Reports the IP address for the NTP time server	B-52
alarm blow back pres max	Reports/sets blow back alarm maximum value	B-15
alarm blow back pres min	Reports/sets blow back alarm minimum value	B-15
alarm chamber temp max	Reports/sets chamber temperature alarm maximum value	B-15
alarm chamber temp min	Reports/sets chamber temperature alarm minimum value	B-15
alarm conc hg0 max	Reports/sets current Hg0 concentration alarm maximum value	B-16
alarm conc hg0 min	Reports/sets current Hg0 concentration alarm minimum value	B-16
alarm conc hg2+ max	Reports/sets current Hg2+ concentration alarm maximum value	B-16
alarm conc hg2+ min	Reports/sets current Hg2+ concentration alarm minimum value	B-16
alarm conc hgt max	Reports/sets current Hgt concentration alarm maximum value	B-16
alarm conc hgt min	Reports/sets current Hgt concentration alarm minimum value	B-16
alarm converter temp max	Reports/sets current converter temperature alarm maximum value	B-16
alarm converter temp min	Reports/sets current converter temperature alarm minimum value	B-16

Command	Description	Page
alarm cooler temp	Reports/sets current lamp alarm on/off	B-17
alarm dilution pres max	Reports/sets current dilution pressure alarm maximum value	B-17
alarm dilution pres min	Reports/sets current dilution pressure alarm minimum value	B-17
alarm eductor pres max	Reports/sets current eductor pressure alarm maximum value	B-18
alarm eductor pres min	Reports/sets current eductor pressure alarm minimum value	B-18
alarm flow max	Reports/sets current sample flow alarm maximum value	B-18
alarm flow min	Reports/sets current sample flow alarm minimum value	B-18
alarm internal temp max	Reports/sets internal temperature alarm maximum value	B-19
alarm internal temp min	Reports/sets internal temperature alarm minimum value	B-19
alarm orifice pres max	Reports/sets current orifice pressure alarm maximum value	B-19
alarm orifice pres min	Reports/sets current orifice pressure alarm minimum value	B-19
alarm pressure max	Reports/sets pressure alarm maximum value	B-20
alarm pressure min	Reports/sets pressure alarm minimum value	B-20
alarm probe temp max	Reports/sets current probe temperature alarm maximum value	B-20
alarm probe temp min	Reports/sets current probe temperature alarm minimum value	B-20
alarm trig conc hg0	Reports/sets current Hg0 concentration alarm trigger sense	B-21
alarm trig conc hg2+	Reports/sets current Hg2+ concentration alarm trigger sense	B-21
alarm trig conc hgt	Reports/sets current Hgt concentration alarm trigger sense	B-21
alarm umblical temp max	Reports/sets current umbilical temperature alarm maximum value	B-21
alarm umblical temp min	Reports/sets current umbilical temperature alarm minimum value	B-21
alarm vacuum pres max	Reports/sets current vacuum pressure alarm maximum value	B-22

Command	Description	Page
alarm vacuum pres min	Reports/sets current vacuum pressure alarm minimum value	B-22
alarm venturi pres max	Reports/sets current venturi pressure alarm maximum value	B-22
alarm venturi pres min	Reports/sets current venturi pressure alarm minimum value	B-22
allow mode cmd	Reports/sets the current allow mode setting which configures the instrument to either accept or ignore the "set mode local" and "set mode remote" commands	B-55
analog iout range	Reports/sets analog current output range per channel	B-58
analog vin	Retrieves analog voltage input data per channel	B-58
analog vout range	Reports/sets analog voltage output range per channel	B-59
avg time	Reports/sets averaging time	B-12
baud	Reports/sets current baud rate	B-53
bb filter	Sets system gas mode to filter	B-35
bb period	Reports/sets the blow back frequency	B-35
bb set pres	Reports blow back pressure in psig	B-35
bb set pres counts	Reports/sets blow back pressure in counts	B-35
bb stinger	Reports/sets system gas mode to blow back stinger	B-36
bb stinger duration	Reports/sets blow back stinger duration seconds	B-36
bb system duration	Reports/sets blow back filter duration seconds	B-36
bench set temp	Reports/sets bench temperature	B-22
cal hg0 bkg	Sets/auto-calibrates Hg0 background	B-21
cal hg0 coef	Sets/auto-calibrates Hg0 coefficient	B-21
cal hg2+ coef	Sets/auto-calibrates Hg2+ coefficient	B-22
cal hgt bkg	Sets/auto-calibrates Hgt background	B-21
cal hgt coef	Sets/auto-calibrates Hgt coefficient	B-21
cal pres	Sets current measured pressure as pressure during calibration (for pressure compensation)	B-24
chamber temp	Reports the temperature of the optical chamber	B-37
clr lrecs	Clears away only long records that have been saved	B-24
clr records	Clears away all logging records that have been saved	B-15
clr srecs	Clears away only short records that have been saved	B-15
contrast	Reports/sets current screen contrast	B-49

Command	Description	Page
conv set temp	Reports/sets converter set temperature	B-37
conv temp	Reports converter temperature	B-37
copy lrec to sp	Sets/copies current lrec selection into the scratch pad	B-29
copy sp to lrec	Sets/copies current selections in scratch pad into lrec list	B-29
copy sp to srec	Sets/copies current selections in scratch pad into srec list	B-29
copy sp to stream	Sets/copies current selections in scratch pad into stream list	B-29
copy srec to sp	Sets/copies current srec selection into the scratch pad	B-29
copy stream to sp	Sets/copies current streaming data selection into the scratch pad	B-29
custom	Reports/sets defined custom range concentration	B-42
date	Reports/sets current date	B-50
default params	Sets parameters to default values	B-50
dhcp	Reports/sets state of use of DHCP	B-53
diag volt iob	Reports diagnostic voltage level for optional I/O expansion board	B-23
diag volt mb	Reports diagnostic voltage level for motherboard	B-23
diag volt mib	Reports diagnostic voltage level for measurement interface board	B-23
diag volt probe	Reports diagnostic voltage level for 82*i* measurement interface board	B-23
dig in	Reports status of the digital inputs	B-59
dilution ratio	Reports/sets dilution ratio	B-38
dilution set pres	Reports dilution pressure in psig	B-38
dilution set pres counts	Reports/sets dilution pressure in counts	B-38
din	Reports/sets digital input channel and active state	B-59
do (down)	Simulates pressing down pushbutton	B-33
dout	Reports/sets digital output channel and active state	B-60
dtoa	Reports outputs of the digital to analog converters per channel	B-60
eductor set pres	Reports eductor pressure in psig	B-39
eductor set pres counts	Reports/sets eductor pressure in counts	B-39
en (enter)	Simulates pressing enter pushbutton	B-33
er	Returns a brief description of the main operating conditions in the format specified in the commands	B-25
erec	Returns a snapshot of the main operating conditions (measurements and status) in the specified format	B-25
erec format	Reports/sets erec format (ASCII or binary)	B-27

Command	Description	Page
erec layout	Reports current layout of erec data	B-28
flags	Reports 8 hexadecimal digits (or flags) that represent the status of the PMT, gas mode, and alarms	B-14
flow	Reports current measured flow	B-13
format	Reports/sets current reply termination format	B-54
gas mode	Reports current mode of sample, zero, or span	B-42
he (help)	Simulates pressing help pushbutton	B-33
hg0	Reports current Hg0 concentration	B-13
hg0 bkg	Reports/sets current Hg0 background	B-32
hg0 coef	Reports/sets current Hg0 coefficient	B-32
hg0 gas	Reports/sets Hg0 span gas concentration	B-32
hg2+	Reports current Hg2+ concentration	B-13
hg2+ coef	Reports/sets current Hg2+ coefficient	B-32
hg2+ gas	Reports/sets Hg2+ span gas concentration	B-32
hgt	Reports current Hgt concentration	B-13
hgt bkg	Reports/sets current Hgt background	B-32
hgt coef	Reports/sets current Hgt coefficient	B-32
hgt gas	Reports/sets Hgt span gas concentration	B-32
host name	Reports/sets host name string	B-54
instr name	Reports instrument name	B-54
instrument id	Reports/sets instrument id	B-55
internal temp	Reports current internal instrument temperature	B-13
isc (iscreen)	Retrieves framebuffer data used for the display	B-33
lamp comp	Reports/sets lamp compensation on/off	B-39
lamp intensity	Reports lamp intensity	B-41
layout ack	Disables stale layout/layout changed indicator ('*')	B-57
le (left)	Simulates pressing left pushbutton	B-33
list din	Lists current selection for digital input	B-24
list dout	Lists current selection for digital output	B-24
list lrec	Lists current selection lrec logging data	B-24
list sp	Lists current selection in the scratchpad list	B-24
list srec	Lists current selection srec logging data	B-24
list stream	Lists current selection streaming data output	B-24
list var aout	Reports list of analog output, index numbers, and variables	B-61

Command	Description	Page
list var din	Reports list of digital input, index numbers, and variables	B-61
list var dout	Reports list of digital output, index numbers, and variables	B-61
lr	Outputs long records in the format specified in the command	B-25
lrec	Outputs long records	B-26
lrec format	Reports/sets output format for long records (ASCII or binary)	B-27
lrec layout	Reports current layout of lrec data	B-27
lrec mem size	Reports maximum number of long records that can be stored	B-28
lrec per	Reports/sets long record logging period	B-28
malloc lrec	Reports/sets memory allocation for long records	B-28
malloc srec	Reports/sets memory allocation for short records	B-28
me (menu)	Simulates pressing menu pushbutton	B-33
meas mode	Reports/sets which measurement mode is active	B-43
mode	Reports operating mode in local, service, or remote	B-56
no of lrec	Reports/sets number of long records stored in memory	B-28
no of srec	Reports/sets number of short records stored in memory	B-28
o span	Sets system gas mode to orifice span	B-44
o zero	Sets system gas mode to orifice zero	B-44
o2 dilution pct	Returns/sets O_2 dilution percent	B-40
o2 quenching comp	Returns/sets O_2 compensation on/off	B-40
ox cal	Sets system gas mode to oxidizer calibration	B-44
pmt supply	Reports/sets PMT supply power on/off	B-46
pmt voltage	Reports current PMT voltage	B-13
power converter	Reports/sets converter power on/off for the selected probe	B-44
power eductor	Reports/sets eductor power on/off for the selected probe	B-45
power probe	Reports/sets probe power on/off for the selected probe	B-45
power stinger	Reports/sets stinger power on/off for the selected probe	B-45
power umblical1	Reports/sets umbilical1 power on/off for the selected probe	B-46
power umblical2	Reports/sets umbilical2 power on/off for the selected probe	B-46
power up mode	Reports/sets the power up mode which configures the instrument to power up in either the local/unlocked mode or the remote/locked mode.	B-56
pres	Reports current optical chamber pressure	B-13
pres cal	Reports/sets pressure used for calibration	B-33
pres comp	Reports/sets pressure compensation on or off	B-47

Command	Description	Page
probe no	Reports/sets probe number (hydra only)	B-47
probe set failsafe temp	Reports/sets probe failsafe temperature	B-47
probe set temp	Sets probe temperature	B-48
program no	Reports instrument program number	B-57
push	Simulates pressing a key on the front panel	B-33
range hg0	Reports/sets current Hg0 range	B-41
range hg2+	Reports/sets current Hg2+ range	B-41
range hgt	Reports/sets current Hgt range	B-41
range mode	Reports/sets current range mode	B-42
react temp	Reports current optical chamber temperature	B-14
ref intensity	Reports reference lamp intensity in Hz	B-48
relay	Reports relay logic status to for the designated relay(s)	B-61
relay stat	Sets relay logic status to for the designated relay(s)	B-61
ri (right)	Simulates pressing right pushbutton	B-33
ru (run)	Simulates pressing run pushbutton	B-33
s span	Sets system gas mode to system span	B-44
s zero	Sets system gas mode to system zero	B-44
sample	Sets zero/span valves to sample mode	B-42
save	Stores parameters in FLASH	B-50
save params	Stores parameters in FLASH	B-50
sc (screen)	C-series legacy command that reports a generic response (Use iscreen instead)	B-33
sp field	Reports/sets item number and name in scratch pad list	B-3
span	Sets zero/span valves to span mode	B-42
span inst	Reports/sets the instrument span level	B-43
span sys	Reports/sets the system span level	B-43
sr	Reports last short record stored	B-25
srec	Reports maximum number of short records	B-2
srec format	Reports/sets output format for short records (ASCII or binary)	B-27
srec layout	Reports current layout of short record data	B-27
srec mem size	Reports maximum number of short records	B-28
srec per	Reports/sets short record logging period	B-28
stack o2 channel	Returns/sets O2 analog input channel	B-40

Command	Description	Page
stream per	Reports/sets current set time interval for streaming data	B-30
stream time	Reports/sets a time stamp to streaming data or not	B-31
temp comp	Reports/sets temperature compensation on or off	B-48
time	Reports/sets current time (24-hour time)	B-50
tz	Reports the "tz" timezone string for the NTP server	B-57
umblical set temp	Reports/sets umbilical temperature	B-37
up	Simulates pressing up pushbutton	B-33
zero	Sets zero/span valves to zero mode	B-42

Measurements

avg time

This command reports the averaging time in seconds. The example that follows shows that the averaging time is 300 seconds, according to the following table.

```
Send:          avg time
Receive:       avg time 11:300 sec
```

set avg time *selection*

This command sets the averaging time according to **Table B–3**. The example that follows sets the averaging time to 120 seconds.

```
Send:          set avg time 8
Receive:       set avg time 8 ok
```

Table B–3. Averaging Times

Selection	Time, Hg0 Measure Mode, HGt Measure Mode (Seconds)	Time, Hg0/HGt Measure Mode (Seconds)
0	1	
1	2	
2	5	
3	10	
4	20	
5	30	
6	60	60
7	90	90
8	120	120
9	180	180
10	240	240

hg0
hg2+
hgt

These commands report the measured Hg0, Hg2+, and Hgt concentrations. The example that follows shows that the Hg0 concentration is 15.35.

```
Send:       hg0
Receive:    hg0 1.535E+01 ug/m3
```

flow

This command reports the current measured flow. The example that follows reports that the flow measurement is 0.391 lpm.

```
Send:       flow
Receive:    flow 0.391 lpm
```

internal temp

This command reports the current internal instrument temperature. The example that follows shows that the internal temperature is 30 °C.

```
Send:       internal temp
Receive:    internal temp 30 deg C, actual 33.5
```

pmt voltage

This command reports the current PMT voltage. The example that follows reports that the current PMT voltage is 799.2 volts.

```
Send:       pmt voltage
Receive:    pmt voltage 799.2
```

pres

This command reports the current Hg pressure. The example that follows shows that the actual Hg pressure is 42.8 mmHg.

```
Send:       pres
Receive:    pres 42.8 mm Hg
```

react temp

This command reports the current optical chamber temperature. The example that follows reports that the current optical chamber temperature is 45.0 °C.

```
Send:          react temp
Receive:       react temp 45.0 deg C
```

flags

This reports 8 hexadecimal digits (or flags) that represent status of the pressure and temperature compensation, gas mode, and alarms. To decode the flags, each hexadecimal digit is converted to binary as shown in the **Figure B–1**. It is the binary digits that define the status of each parameter. In the example that follows, the instrument is reporting that the password lock is ON, temperature compensation is OFF, pressure compensation is ON, measure mode is AUTO, gas mode is SAMPLE, converter power is ON, eductor power is OFF, umbilical 2 power is OFF, umbilical 1 power is OFF, probe power is OFF, and there are no alarms.

```
Send:          flags
Receive:       flags 28300000
```

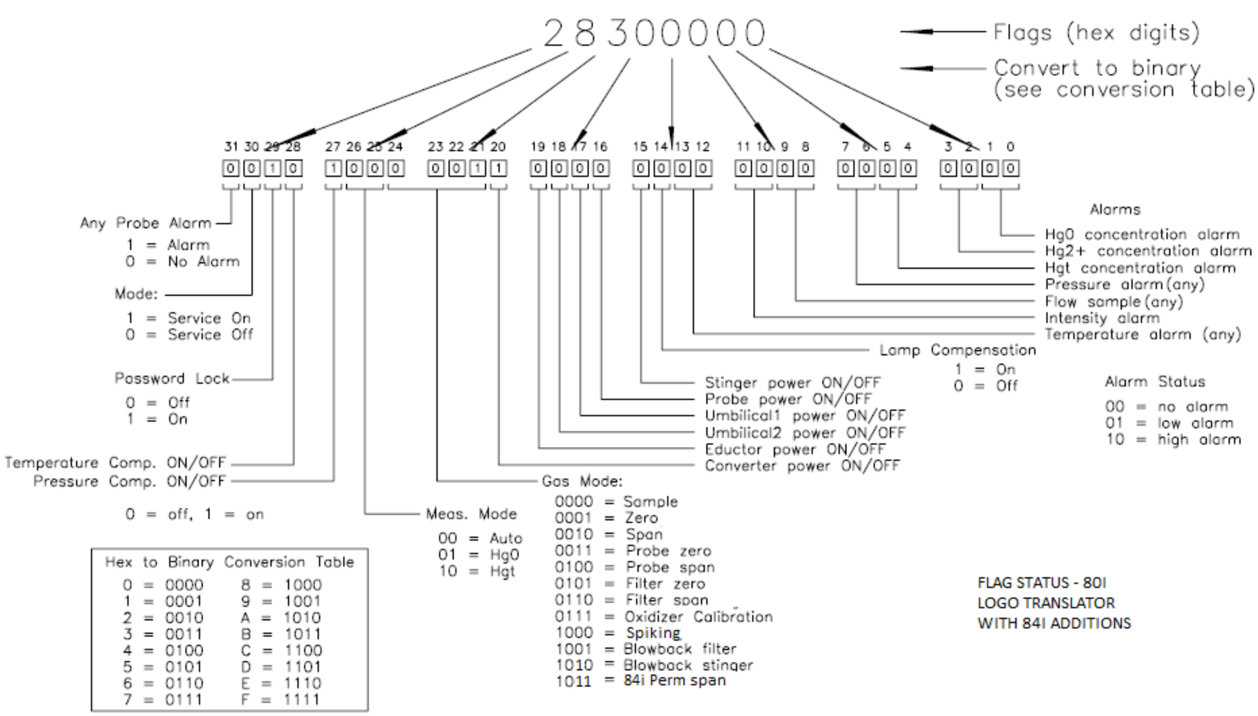

Figure B–1. Flag Status

Alarms

alarm blow back pres min
alarm blow back pres max

These commands report the blow back pressure alarm minimum and maximum value current settings. The example that follows reports that the blow back pressure alarm minimum value is 3.0 psig.

```
Send:        alarm blow back pres min
Receive:     alarm blow back pres min 3.0 psig
```

set alarm blow back pres min *value*
set alarm blow back pres max *value*

These commands set the blow back pressure alarm minimum and maximum values to *value*, where *value* is a floating-point number representing blow back pressure alarm limits in psig. The example that follows sets the blow back pressure alarm maximum value to 65 psig.

```
Send:        set alarm blow back pres max 65
Receive:     set alarm blow back pres max 65 ok
```

alarm chamber temp min
alarm chamber temp max

These commands report the chamber temperature alarm minimum and maximum value current settings. The example that follows reports that the chamber temperature alarm minimum value is 47.0 °C.

```
Send:        alarm chamber temp min
Receive:     alarm chamber temp min 47.0 deg C
```

set alarm chamber temp min *value*
set alarm chamber temp max *value*

These commands set the chamber temperature alarm minimum and maximum values to *value*, where *value* is a floating-point number representing chamber temperature alarm limits in degrees C. The example that follows sets the chamber temperature alarm maximum value to 50.0 °C.

```
Send:        set alarm chamber temp max 50.0
Receive:     set alarm chamber temp max 50.0 ok
```

alarm conc hg0 min
alarm conc hg2+ min
alarm conc hgt min
alarm conc hg0max
alarm conc hg2+ max
alarm conc hgt max

These commands report the Hg0, Hg2+, and Hgt concentrations alarm minimum and maximum value current setting. The example that follows reports that the Hg0 concentration minimum is 5.2 μg/m^3.

```
Send:        alarm conc hg0 min
Receive:     alarm conc hg0 min 5.2 ug/m3
```

set alarm conc hg0 min *value*
set alarm conc hg2+ min *value*
set alarm conc hgt min *value*
set alarm conc hg0 max *value*
set alarm conc hg2+ max *value*
set alarm conc hgt max *value*

These commands set the Hg0, Hg2+, and Hgt concentrations alarm minimum and maximum value to *value*, where *value* is a floating-point representation of the concentration alarm limits. The example that follows sets the Hg0 concentration alarm maximum value to 6.8 μg/m^3.

```
Send:        set alarm conc hg0 max 6.8
Receive:     set alarm conc hg0 max 6.8 ok
```

alarm converter temp min *probenumber*
alarm converter temp max *probenumber*

These commands report the converter alarm minimum and maximum value settings for a specified probe, where *probenumber* is the number of the specified probe (1-4). If a probe number is not specified, the value of the currently active probe is displayed. The example that follows reports that the converter temperature alarm minimum value is 47.0 °C for probe number 3.

```
Send:        alarm converter temp min 3
Receive:     alarm converter temp min 3 47.0 deg C
```

set alarm converter temp min *value probenumber*
set alarm converter temp max *value probnumber*

These commands set the converter temperature alarm minimum and maximum values for a specified probe number, where *value* is a floating-point number representing converter temperature alarm limits in degrees

C, and *probenumber* is the number of the specified probe (1-4). If a probe number is not specified, the value is applied to the currently active probe.

The example that follows sets the converter temperature alarm maximum value to 50.5 °C for probe number 2.

```
Send:         set alarm converter temp max 50.5 2
Receive:      set alarm converter temp max 50.5 2 ok
```

---

alarm cooler temp min
alarm cooler temp max
These commands report the lamp alarm minimum and maximum value current settings. The example that follows reports that the lamp temperature alarm minimum value is minus 10.0 °C.

```
Send:         alarm cooler temp min
Receive:      alarm cooler temp min -10.0 deg C
```

set alarm cooler temp min *value*
set alarm cooler temp max *value*
These commands set the lamp temperature alarm minimum and maximum values to *value*, where *value* is a floating-point number representing lamp temperature alarm limits in degrees C. The example that follows sets the lamp temperature alarm maximum value to minus 1.0 °C.

```
Send:         set alarm cooler temp max -1.0
Receive:      set alarm cooler temp max -1.0 ok
```

---

alarm dilution pres min *probenumber*
alarm dilution pres max *probenumber*
These commands report the dilution pressure alarm minimum and maximum value settings for a specified probe, where *probenumber* is the number of the specified probe (1-4). If a probe number is not specified, the value of the currently active probe is displayed. The example that follows reports that the dilution pressure alarm minimum value is 40.0 psig for probe number 2.

```
Send:         alarm dilution pres min 2
Receive:      alarm dilution pres min 2 40.0 psig
```

set alarm dilution pres min *value probenumber*
set alarm dilution pres max *value probenumber*
These commands set the dilution pressure alarm minimum and maximum values to *value*, where *value* is a floating-point number representing dilution pressure alarm limits in psig, and *probenumber* is the number of the specified probe (1-4). If a probe number is not specified, the value is applied to the currently active probe.

The example that follows sets the dilution pressure alarm maximum value to 65.0 psig for probe number 2.

```
Send:         set alarm dilution pres max 65.0 2
Receive:      set alarm dilution pres max 65.0 2 ok
```

alarm eductor pres min *probenumber*
alarm eductor pres max *probenumber*

These commands report the eductor pressure alarm minimum and maximum value settings for a specified probe, where *probenumber* is the number of the specified probe (1-4). If a probe number is not specified, the value of the currently active probe is displayed. The example that follows reports that the eductor pressure alarm minimum value is 5.0 psig for probe number 3.

```
Send:         alarm eductor pres min 3
Receive:      alarm eductor pres min 3 5.0 psig
```

set alarm eductor pres min *value probenumber*
set alarm eductor pres max *value probenumber*

These commands set the eductor pressure alarm minimum and maximum values to *value*, where *value* is a floating-point number representing dilution pressure alarm limits in psig, and *probenumber* is the number of the specified probe (1-4). If a probe number is not specified, the value is applied to the currently active probe.

The example that follows sets the eductor pressure alarm maximum value to 20.0 psig for probe number 2.

```
Send:         set alarm eductor pres max 20.0 2
Receive:      set alarm eductor pres max 20.0 2 ok
```

alarm flow min
alarm flow max

These commands report the sample flow alarm minimum and maximum value current settings. The example that follows reports that the sample flow alarm minimum value is 0.300 lpm.

```
Send:         alarm flow min
Receive:      alarm flow min 0.300 lpm
```

set alarm flow min *value*
set alarm flow max *value*

These commands set the sample flow alarm minimum and maximum values to *value*, where *value* is a floating-point number representing sample flow limits in psig. The example that follows sets the sample flow alarm maximum value to 0.600 lpm.

```
Send:         set alarm flow max 0.600
Receive:      set alarm flow max 0.600 ok
```

alarm internal temp min
alarm internal temp max

These commands report the internal temperature alarm minimum and maximum value settings. The example that follows reports that the internal temperature alarm minimum value is 15.0 °C.

```
Send:         alarm internal temp min
Receive:      alarm internal temp min 15.0 deg C
```

set alarm internal temp min *value*
set alarm internal temp max *value*

These commands set the internal temperature alarm minimum and maximum values to *value*, where *value* is a floating-point number representing internal temperature alarm limits in degrees C. The example that follows sets the internal temperature alarm maximum value to 45.0 °C.

```
Send:         set alarm internal temp max 45
Receive:      set alarm internal temp max 45 ok
```

alarm orifice pres min *probenumber*
alarm orifice pres max *probenumber*

These commands report the orifice pressure alarm minimum and maximum value settings for a specified probe, where *probenumber* is the number of the specified probe (1-4). If a probe number is not specified, the value of the currently active probe is displayed. The example that follows reports that the orifice pressure alarm minimum value is 0 psig for probe number 3.

```
Send:         alarm orifice pres min 3
Receive:      alarm orifice pres min 3 0 psig
```

set alarm orifice pres min *value probenumber*
set alarm orifice pres max *value probenumber*

These commands set the orifice pressure alarm minimum and maximum values to *value*, where *value* is a floating-point number representing orifice pressure alarm limits in psig, and *probenumber* is the number of the specified probe (1-4). If a probe number is not specified, the value is applied to the currently active probe.

The example that follows sets the orifice pressure alarm maximum value to 35.0 psig for probe number 2.

```
Send:         set alarm orifice pres max 35.0 2
Receive:      set alarm orifice pres max 35.0 2 ok
```

alarm pressure min
alarm pressure max

These commands report the pressure alarm minimum and maximum value current settings. The example that follows reports that the pressure alarm minimum value is 20.0 mmHg.

```
Send:         alarm pressure min
Receive:      alarm pressure min 20.0 mm Hg
```

set alarm pressure min *value*
set alarm pressure max *value*

These commands set the pressure alarm minimum and maximum values to *value*, where *value* is a floating-point number representing pressure alarm limits in millimeters of mercury. The example that follows sets the pressure alarm maximum value to 80 mmHg.

```
Send:         set alarm pressure max 80
Receive:      set alarm pressure max 80 ok
```

alarm probe temp min *probenumber*
alarm probe temp max *probenumber*

These commands report the probe alarm minimum and maximum value settings for a specified probe, where *probenumber* is the number of the specified probe (1-4). If a probe number is not specified, the value of the currently active probe is displayed. The example that follows reports that the probe temperature alarm minimum value is 3.0 °C for probe number 3.

```
Send:         alarm probe temp min 3
Receive:      alarm probe temp min 3 3.0 deg C
```

set alarm probe temp min *value probenumber*
set alarm probe temp max *value probenumber*

These commands set the probe temperature alarm minimum and maximum values for a specified probe number, where *value* is a floating-point number representing probe temperature alarm limits in degrees C, and *probenumber* is the number of the specified probe (1-4). If a probe number is not specified, the value is applied to the currently active probe.

The example that follows sets the probe temperature alarm maximum value to 230 °C for probe number 2.

```
Send:         set alarm probe temp max 230.0 2
Receive:      set alarm probe temp max 230.0 2 ok
```

alarm trig conc hg0
alarm trig conc hg2+
alarm trig conc hgt

These commands report the Hg0, Hg2+, and Hgt concentrations alarm trigger action for minimum alarm, current setting, to either floor or ceiling. The example that follows shows the Hg0 concentration minimum alarm trigger to ceiling, according to the following table.

```
Send:         alarm trig conc hg0
Receive:      alarm trig conc hg0 1
```

set alarm trig conc hg0 *value*
set alarm trig conc hg2+ *value*
set alarm trig conc hgt *value*

These commands set the Hg0, Hg2+, and Hgt concentrations alarm minimum value, where *value* is set to either floor or ceiling, according to the following table. The example that follows sets the Hg0 concentration minimum alarm trigger to ceiling.

```
Send:         set alarm trig conc hg0 1
Receive:      set alarm trig conc hg0 1 ok
```

Table B–4. Alarm Trigger Values

Value	**Alarm Trigger**
00	Floor
01	Ceiling

alarm umbilical temp min *probenumber*
alarm umbilical temp max *probenumber*

These commands report the umbilical alarm minimum and maximum value settings for a specified probe, where *probenumber* is the number of the specified probe (1-4). If a probe number is not specified, the value of the currently active probe is displayed. The example that follows reports that the umbilical temperature alarm minimum value is 70.0 °C for probe number 1.

```
Send:         alarm umbilical temp min 1
Receive:      alarm umbilical temp min 1 70.0 deg C
```

set alarm umbilical temp min *value probenumber*
set alarm umbilical temp max *value probenumber*

These commands set the umbilical temperature alarm minimum and maximum values for a specified probe number, where *value* is a floating-point number representing probe temperature alarm limits in degrees C, and *probenumber* is the number of the specified probe (1-4). If a probe number is not specified, the value is applied to the currently active probe.

The example that follows sets the umbilical temperature alarm maximum value to 190 °C for probe number 2.

```
Send:        set alarm umbilical temp max 190.0 2
Receive:     set alarm umbilical temp max 190.0 2 ok
```

alarm vacuum pres min *probenumber*
alarm vacuum pres max *probenumber*
These commands report the vacuum pressure alarm minimum and maximum value settings for a specified probe, where *probenumber* is the number of the specified probe (1-4). If a probe number is not specified, the value of the currently active probe is displayed. The example that follows reports that the vacuum pressure alarm minimum value is 19 in Hg for probe number 3.

```
Send:        alarm vacuum pres min 3
Receive:     alarm vacuum pres min 3 19.0 inhg
```

set alarm vacuum pres min *value probenumber*
set alarm vacuum pres max *value probenumber*
These commands set the vacuum pressure alarm minimum and maximum values for a specified probe number, where *value* is a floating-point number representing vacuum pressure alarm limits in psig, and *probenumber* is the number of the specified probe (1-4). If a probe number is not specified, the value is applied to the currently active probe.

The example that follows sets the vacuum pressure alarm maximum value to 25 in Hg for probe number 2.

```
Send:        set alarm vacuum pres max 25 2
Receive:     set alarm vacuum pres max 25 2 ok
```

alarm venturi pres min *probenumber*
alarm venturi pres max *probenumber*
These commands report the venturi pressure alarm minimum and maximum value settings for a specified probe (83*i* only, not 83 GC), where *probenumber* is the number of the specified probe (1-4). If a probe number is not specified, the value of the currently active probe is displayed. The example that follows reports that the venturi pressure alarm minimum value is 0 in H_2O for probe number 3.

```
Send:        alarm venturi pres min 3
Receive:     alarm venturi pres min 3 0 inh2o
```

set alarm venturi pres min *value probenumber*
set alarm venturi pres max *value probenumber*
These commands set the venturi pressure alarm minimum and maximum values to *value*, where *value* is a floating-point number representing venturi pressure alarm limits in psig and *probenumber* is the number of the specified probe (1-4). If a probe number is not specified, the value is applied to the currently active probe.

The example that follows sets the venturi pressure alarm maximum value to 4 in H_2O for probe number 3.

```
Send:        set alarm venturi pres max 4 3
Receive:     set alarm venturi pres max 4 3 ok
```

Diagnostics

diag volt mb
This command reports the diagnostic voltage measurements on the motherboard. The sequence of voltages is: positive 24, positive 15, positive 5, positive 3.3, and negative 3.3. Each voltage value is separated by a space.

```
Send:        diag volt mb
Receive:     diag volt mb 24.1 14.9 4.9 3.2 -3.2
```

diag volt mib
This command reports the diagnostic voltage measurements on the measurement interface board. The sequence of voltages is: positive 24, positive 15, negative 15, positive 5, positive 3.3, and positive 15. Each voltage value is separated by a space.

```
Send:        diag volt mib
Receive:     diag volt mb 24.1 14.9 -14.9 4.9 3.2 14.9
```

diag volt iob
This command reports the diagnostic voltage measurements on the optional I/O expansion board. The sequence of voltages is: positive 24, positive 5, positive 3.3, and negative 3.3. Each voltage value is separated by a space.

```
Send:        diag volt iob
Receive:     diag volt iob 24.1 4.9 3.2 -3.2
```

diag volt probe
This command reports the diagnostic voltage level measurements on the 82i measurement interface board. The sequence of voltages is: positive 24, positive 15, negative 15, positive 5, positive 3.3, and positive 15. Each voltage value is separated by a space.

```
Send:         diag volt probe
Receive:      diag volt probe 24.1 14.9 -14.9 4.9 3.2 14.9
```

Datalogging

clr records

This command will clear all long and short records that have been saved.

```
Send:         clr records
Receive:      clr records ok
```

set clr lrecs
set clr srecs

These commands will clear only the long records or only the short records that have been saved. The example that follows clears short records.

```
Send:         set clr srecs 1
Receive:      set clr srecs 1 ok
```

list din
list dout

These commands report the current selection for the digital outputs in the format: Output no Index number variable name active state. The active state for digital outputs is open or closed. The active state for digital inputs is high or low.

```
Send:         list dout
Receive:      list dout
output index variable state
1  2  HGO MODE open
2  3  HGT MODE open
3  4  HGO/HGT MODE open
4  5  SAMPLE MODE open
5  6  INST ZERO MODE open
```

list lrec
list srec
list stream
list sp

These commands report the list of current selections for long record logging data, short record logging data, streaming data output, or the scratch pad (sp) list. The example that follows shows the list for streaming data output.

The scratch pad is a temporary memory area which is used to set up lists of selections for lrec, srec, or streaming data items. The user can copy any of these lists to the scratch pad, modify individual elements in the list, then save the scratch pad back to the original list. Refer to the "sp field" command for information on how to edit the scratch pad.

```
Send:          list stream
Receive:       list stream
field index variable
 x  x time
 1  1 hg0
 2  2 hg2
 3  3 hgt
 4 30 dilf
```

---

er *xy*
lr *xy*
sr *xy*

x = | 0 | 1 | : Reply termination format (see "set format format" command)

y = | 0 | 1 | 2 | : Output format (see "set erec/lrec/srec format format" command)

These commands report the last long and short records stored or the dynamic data record. In the example that follows, the command requests a long record with no checksum, in ASCII format with text. For details on how to decode the flag fields within these records, see **Figure B–1** in the "flags" command.

```
Send:          lr01
Receive:       lr01
14:21 04-13-07  flags 5B2526 hg0 15.363 hg2 -1.327 hgt 14.035 rfint
5713.950 intt 33.522 rctt 44.908 prbt 204.762 cnvt 799.621 umbt
161.447 vntp 11.251 orfp 0.472 dilp 45.258 bbkp 20.805 edup 18.668 vac
21.338 smplf 0.369 pmtv 799.201 pres 41.646 dilf 30.000 hg81 15.000
obkg 1.288 tblg 1.106 ocoef 1.104 tcoef 0.860 hg0dic 31.483 hg0dit
503.438 hgtdic 86.136 hgtdit 188.385 hg0dsc 112.080 hg0dst 148.926
lampt 43.372 oxyt 0.000
```

---

erec

This command returns a snapshot of the main operating conditions (measurements and status) at the time the command is issued. The example that follows shows a typical response.

The format is defined by the current settings of the "format" and "erec format" commands. For details on erec formatting, see the "Record Layout Definition" section at the end of this appendix. For details on how to decode the flag fields within these records, see **Figure B–1** in the "flags" command.

```
Send:          erec
Receive:       erec
14:24 04-13-07 flags 5B2526 hg0 0.000 hgt 0.000 hg2+ 0.000  1 lohg0
15.380 lohgt 14.020 lohg2+ -1.360  1 pmtv 799.201 tempal 1 pres 47.938
flow 0.276 hiavgtime 60 loavgtime 60 hg0bkg 1.288 hgtbkg 1.106 hg0coef
```

```
1.000 hgtcoef 1.000 hg2+coef 1.000 lohg0coef 1.104 lohgtcoef 0.860
lohg2+coef 1.000 intt 33.498 chmbt 44.908 prbtmp 204.762 umbtmp
159.084 cnvtmp 795.684 venpr 11.232 orfpr 0.464 dilpr 45.258 blbpr
20.805 edupr 18.634 vacpr 21.327 dilfac 30.000 refint 5715.000 prbidx
1
```

lrec
srec
lrec *xxxx yy*
srec xxxx yy
lrec *aa:bb oo-pp-qq yy*
srec *aa:bb oo-pp-qq yy*
xxxx = the number of past records
yy = the number of records to return (1 to 10)
aa = hours (01 to 24)
bb = minutes (01 to 59)
oo = month (01 to 12)
pp = day (01 to 31)
qq = year

These commands output long or short records and dynamic data. The output format is determined by the "set lrec format", and "set srec format" commands. The logging time is determined by the "set lrec per" and "set srec per" commands. In Hg0 or Hgt only mode, the pertinent high value used, other concentrations are set to 0. Concentrations are stored in μg/m^3.

When the command lrec 100 2 is sent, the instrument counts back 100 records from the last record collected, and then returns 2 records. For details on how to decode the flag fields within these records, see **Figure B–1** in the "flags" command.

```
Send:         lrec 100 5
Receive:      lrec 100 5
12:46 04-13-07  flags 5B2784 hg0 2.922 hg2 -0.224 hgt 2.698 rfint
5730.030 intt 33.665 rctt 44.967 prbt 204.499 cnvt 801.197 umbt
159.084 vntp 11.232 orfp 0.464 dilp 45.258 bbkp 20.805 edup 18.634 vac
21.338 smplf 0.354 pmtv 799.201 pres 47.339 dilf 30.000 hg81 3.000
obkg 1.288 tblg 1.106 ocoef 1.104 tcoef 0.860 hg0dic 31.483 hg0dit
503.438 hgtdic 86.136 hgtdit 188.385 hg0dsc 112.080 hg0dst 148.926
lampt 43.377 oxyt 0.000
12:47 04-13-07  flags 5B2504 hg0 2.925 hg2 -0.231 hgt 2.694 rfint
5727.140 intt 33.665 rctt 45.062 prbt 204.499 cnvt 798.834 umbt
160.134 vntp 11.232 orfp 0.470 dilp 45.258 bbkp 20.805 edup 18.600 vac
21.348 smplf 0.415 pmtv 799.201 pres 41.347 dilf 30.000 hg81 3.000
obkg 1.288 tblg 1.106 ocoef 1.104 tcoef 0.860 hg0dic 31.483 hg0dit
503.438 hgtdic 86.136 hgtdit 188.385 hg0dsc 112.080 hg0dst 148.926
lampt 43.370 oxyt 0.000
```

erec format
srec format
lrec format

These commands report the output format for long and short records, and dynamic data in various formats such as ASCII without text, ASCII with text, or binary. The example that follows shows the output format for long records is ASCII with text, according to the following table.

```
Send:         lrec format
Receive:      lrec format 1
```

set erec format
set srec format
set lrec format

These commands set the output format for long and short records, and dynamic data, according to the following table. The example that follows sets the long record output format to ASCII with text.

```
Send:         set lrec format 1
Receive:      set lrec format 1 ok
```

Table B–5. Record Output Formats

Format	**Output Format**
0	ASCII no text
1	ASCII with text
2	binary data

erec layout
lrec layout
srec layout

These commands reports the layout (string indicating the data formats) for data that is sent out in response to the erec, lrec, srec, and related commands The example that follows shows a typical response. For details on how to interpret the strings, see "Record Layout Definition" later in this appendix.

```
Send:         lrec layout
Receive:      lrec layout
lrec layout %s %s %lx %f %f %f %f %f %f %f %f %f %f %f %f %f %f %f
%f %f %f %f %f %f %f %f %f %f %f %f %f %f %f %f
t D L f f f f f f f f f f f f f f f f f f f f f f f f f f f f f f f f
flags hg0 hg2 hgt rfint intt rctt prbt cnvt umbt vntp orfp dilp bbkp
edup vac smplf pmtv pres dilf hg81 obkg tblg ocoef tcoef hg0dic hg0dit
hgtdic hgtdit hg0dsc hg0dst lampt oxyt
```

lrec mem size
srec mem size

These commands report the number of lrecs and srecs that can be stored with the current settings and the number of blocks reserved for lrecs and srecs. The example that follows shows that 1075 blocks were reserved for lrecs and the maximum number of lrecs that can be stored in memory is 241979. Memory allocation can be changed using the malloc command.

```
Send:         lrec mem size
Receive:      lrec mem size 241979 recs, 1075 blocks
```

lrec per
srec per

These commands report the long and short records logging period. The example that follows shows that the short record logging period is 5 minutes.

```
Send:         srec per
Receive:      srec per 5 min
```

set lrec per *value*
set srec per *value*
value = | 1 | 5 | 15 | 30 | 60 |

These commands set the long and short records logging period to *value* in minutes. The example that follows sets the long record logging period to 15 minutes.

```
Send:         set lrec per 15
Receive:      set lrec per 15 ok
```

no of lrec
no of srec

These commands report the number of long and short records stored in the long and short records memory. The example that follows shows that 50 long records have been stored in the memory.

```
Send:         no of lrec
Receive:      no of lrec 50 recs
```

malloc lrec
malloc srec

These commands report the currently set memory allocation for long and short records in percent of total memory.

```
Send:         malloc lrec
Receive:      malloc lrec 70%
```

set malloc lrec *value*
set malloc srec *value*
value = 0 to 100

These commands set the percent of memory space allocated for long and short records to *value*, where *value* is a floating-point number representing percent. The example that follows sets the memory allocation for long records to 70.

Note Issuing these commands will clear all the logging data memory. All the existing records should be retrieved using appropriate commands, if required. ▲

```
Send:         set malloc lrec 70
Receive:      set malloc lrec 70 ok
```

---

set copy sp to lrec
set copy sp to srec
set copy sp to stream
These commands copy the current selections in scratch pad (sp) into the long record, short record, or streaming data list. The example that follows copies the current list in scratch pad into the long records list.

The scratch pad is a temporary memory area which is used to set up lists of selections for lrec, srec, or streaming data items. The user can copy any of these lists to the scratch pad, modify individual elements in the list, then save the scratch pad back to the original list. Refer to the "sp field" command for information on how to edit the scratch pad.

```
Send:         set copy sp to lrec
Receive:      set copy sp to lrec ok
```

---

set copy lrec to sp
set copy srec to sp
set copy stream to sp
These commands copy the current contents of the long record, short record, or streaming data list into the scratch pad (sp). These commands are useful in easy modification of current long record, short record, or streaming data lists. The example that follows copies the current list of long records into the scratch pad.

The scratch pad is a temporary memory area which is used to set up lists of selections for lrec, srec, or streaming data items. The user can copy any of these lists to the scratch pad, modify individual elements in the list, then save the scratch pad back to the original list. Refer to the "sp field" command for information on how to edit the scratch pad.

```
Send:         set copy lrec to sp
Receive:      set copy lrec to sp ok
```

sp field *number*
This command reports the variable *number* and name stored at index in the scratch pad list. The example that follows shows that the field 5 in the scratch pad is set to index number 21, which is for the pressure.

The scratch pad is a temporary memory area which is used to set up lists of selections for lrec, srec, or streaming data items. The user can copy any of these lists to the scratch pad, modify individual elements in the list, then save the scratch pad back to the original list. Refer to the "sp field" command for information on how to edit the scratch pad.

```
Send:         sp field 5
Receive:      sp field 5 21 pres
```

sp field *number value*
number = 1-32 is the maximum number of fields in long and short record lists.

number = 1-18 is for streaming data lists.

This command sets the scratch pad field *number* (item number in scratch pad list) to *value*, where *value* is the index number of a variable in the analog out variable list. Available variables and their corresponding index numbers may be obtained using the command "list var aout". The "set sp field" command is used to create a list of variables which can then be transferred into the long record, short record, or streaming data lists, using the "set copy sp to lrec", "set copy sp to srec", or "set copy sp to stream" commands.

```
Send:         set sp field 1 34
Receive:      set sp field 1 34 ok
```

stream per
This command reports the currently set time interval in seconds for streaming data.

```
Send:         stream per
Receive:      stream per 10 sec
```

set stream per *numbervalue*
numbervalue = | 1 | 2 | 5 | 10 | 20 | 30 | 60 | 90 |120 | 180 | 240 | 300 |
This command sets the time interval between two consecutive streaming data strings to *numbervalue* in seconds. The example that follows sets the number value to 10 seconds.

```
Send:         set stream per 10
Receive:      set stream per 10 ok
```

stream time
This command reports if the streaming data string will have a time stamp attached to it or not, according to the following table.

```
Send:         stream time
Receive:      stream time 1
```

set stream time *value*
This command enables *value*, where *value* is to attach or disable time stamp to streaming data string, according to the following table. The example that follows attaches a time stamp to streaming data.

```
Send:         set stream time 0
Receive:      set stream time 0 ok
```

Table B–6. Stream Time Values

Value	**Stream Time**
00	Attaches time stamp to streaming data string
01	Disables time stamp to streaming data string

Calibration

set cal hg0 coef
set cal hg2+ coef
set cal hgt coef
These commands will auto-calibrate the Hg0, Hg2+, and Hgt coefficients based on the Hg0, Hg2+, and Hgt span gas concentrations. The example that follows shows a successful auto-calibration of the Hg0 coefficient.

```
Send:         set cal hg0 coef
Receive:      set cal hg0 coef ok
```

set cal hg0 bkg
set cal hgt bkg
These commands will auto-calibrate the Hg0 and Hgt backgrounds. If the instrument is set to manual Hgt mode, the response to “set cal Hg0 bkg” will be “can’t, wrong settings”. The example that follows shows a successful auto-calibration of the Hg0 background.

```
Send:         set cal hg0 bkg
Receive:      set cal hg0 bkg ok
```

hg0 coef
hg2+ coef
hgt coef
These commands report the Hg0, Hg2+, and Hgt coefficients. The example that follows reports that the Hg0 coefficient is 1.000.

```
Send:          hg0 coef
Receive:       hg0 coef 1.000
```

set hg0 coef *value*
set hg2+ coef *value*
set hgt coef *value*
These commands set the Hg0, Hg2+, and Hgt coefficients to user-defined values, where *value* is a floating-point representation of the coefficient. The example that follows sets the Hg0 coefficient to 1.005.

```
Send:          set hg0 coef 1.005
Receive:       set hg0 coef 1.005 ok
```

hg0 gas
hg2+ gas
hgt gas
These commands report the Hg0, Hg2+, and Hgt span gas concentrations used to auto-calibrate Hg0, Hg2+, and Hgt coefficients. The example that follows shows that the Hg0 low span gas concentration is 10.0 µg/m^3.

```
Send:          hg0 gas
Receive:       hg0 gas 1.000E+01 ug/m3
```

set hg0 gas *value*
set hg2+ gas *value*
set hgt gas *value*
These commands set the Hg0, Hg2+, and Hgt span gas concentrations used by the auto-calibration routine to *value*, where *value* is a floating-point representation of the gas concentration in current selected units. The gas units are the same as those chosen by the user. The example that follows sets the Hg0 span gas concentration to 15.0 µg/m^3.

```
Send:          set hg0 gas 15.0
Receive:       set hg0 gas 15.0 ok
```

hg0 bkg
hgt bkg
These commands report the current Hg0 and Hgt backgrounds. The example that follows reports that the Hg0 background is 1.3 µg/m^3.

```
Send:          hg0 bkg
Receive:       hg0 bkg 1.300E+00 ug/m3
```

set hg0 bkg *value*
set hgt bkg *value*
These commands are used to set Hg0 and Hgt backgrounds to user-defined *value*, where *value* is a floating-point representation of the background in current selected units. The example that follows sets the Hg0 background to 2.0 µg/m^3.

```
Send:         set hg0 bkg 2.0
Receive:      set hg0 bkg 2.0 ok
```

pres cal
This command reports the pressure recorded at the time of calibration. The example that follows shows that the pressure at calibration is 150.0 mmHg.

```
Send:         pres cal
Receive:      pres cal 150.0 mm Hg
```

set pres cal
This command automatically sets the current pressure as the calibration pressure. The example that follows successfully sets the calibration pressure to 120.5 mmHg.

```
Send:         set pres cal 120.5
Receive:      set pres cal 120.5 ok
```

Keys/Display

push *button*
button = | do | down | en | enter | he | help | le | left | me | menu | ri | right | ru | run | up | 1 | 2 | 3 | 4 |
These commands simulates pressing the front panel pushbuttons. The numbers represent the front-panel soft keys, from left to right.

```
Send:         push enter
Receive:      push enter ok
```

isc
iscreen
This command retrieves the framebuffer data used for the display on the *i*Series instrument. It is 19200 bytes in size, 2-bits per pixel, 4 pixels per byte arranged as 320 by 240 characters. The data is sent in RLE encoded form to save time in transmission. It is sent as a type '5' binary c_link response with no checksum.

The RLE encoding consists of a 0 followed by an 8-bit count of consecutive 0xFF bytes. The following 'c' code will expand the incoming data.

```
void      unpackDisplay ( void far* tdib, unsigned char far* rlescreen )
{
int i,j,k;
unsigned char far *sc4bpp, *sc2bpp, *screen, *ptr;

   ptr = screen = (unsigned char far *)malloc(19200);
   //RLE decode the screen
   for (i=0; i<19200 && (ptr - screen) < 19200; i++)
   {
      *(ptr++) = *(rlescreen + i);
      if (*(rlescreen + i) == 0)
      {
         unsigned char rlecount = *(unsigned char *)(rlescreen + ++i);

         while (rlecount)
         {
            *(ptr++) = 0;
            rlecount--;
         }
      }
      else if (*(rlescreen + i) == 0xff)
      {
         unsigned char rlecount = *(unsigned char *)(rlescreen + ++i);

         while (rlecount)
         {
            *(ptr++) = 0xff;
            rlecount--;
         }
      }
   }
}
```

To convert this data into a BMP for use with windows, it needs to be turned into a 4BPP as that is the smallest windows can display. Also note that BMP files are upside down relative to this data, i.e. the top display line is the last line in the BMP.

---

sc
screen
This command is meant for backward compatibility on the C series. Screen information is reported using the "iScreen" command described previously.

```
Send:         screen
Receive:      screen This is an I series Instrument. Screen
Information not available
```

Measurement Configuration

set bb filter

This command sets the system gas mode to filter. The example that follows sets the system gas mode to filter.

```
Send:         set bb filter
Receive:      set bb filter ok
```

bb period

These commands report the blow back frequency setting. The example that follows reports the blow back frequency is four hours.

```
Send:         bb period
Receive:      bb period 4 00
```

set bb period min *hr min*

This command sets the blow back frequency to *hours* and *minutes*. The example that follows sets the blow back frequency to 6 hours.

```
Send:         set bb period 6 00
Receive:      set bb period 6 00 ok
```

bb set pres *probenumber*

This command reports the blow back pressure in psig, where *probenumber* is the number of the specified probe (1-4). If a probe number is not specified, the value of the currently active probe is displayed. The example that follows reports that the blow back pressure is 8.0 for probe number 3.

```
Send:         bb set pres 3
Receive:      bb set pres 3 8.0 psig
```

bb set pres counts *probenumber*

This command reports the blow back pressure in counts and *probenumber* is the number of the specified probe (1-4). If a probe number is not specified, the value is applied to the currently active probe.

The example that follows reports the the blow back pressure is 2000 counts.

```
Send:         bb set pres counts
Receive:      bb set pres counts 2000
```

set bb set pres counts *value probenumber*
This command sets the blow back pressure to *value*, where *value* represents blow back pressure in counts and *probenumber* is the number of the specified probe (1-4). If a probe number is not specified, the value is applied to the currently active probe.

The example that follows sets the blow back pressure to 2100 counts for probe 2.

```
Send:         set bb set pres counts 2100 2
Receive:      set bb set pres counts 2100 2 ok
```

---

set bb stinger
This command sets the system gas mode to blow back stinger. The example that follows sets the system gas mode to blow back stinger.

```
Send:         set bb stinger
Receive:      set bb stinger ok
```

---

bb stinger duration
This command reports the blow back stinger duration (seconds). The example that follows reports the blow back stinger duration as 15 seconds.

```
Send:         bb stinger duration
Receive:      bb stinger duration 15 sec
```

set bb stinger duration *seconds*
This command sets the blow back stinger duration in seconds. The example that follows sets the blow back stinger duration to 25 seconds.

```
Send:         set bb stinger duration 25
Receive:      set bb stinger duration 25 ok
```

---

bb system duration
This command reports the blow back filter duration (seconds). The example that follows reports the blow back filter duration is 15 seconds.

```
Send:         bb system duration
Receive:      bb system duration 15 sec
```

set bb system duration *seconds*
This command sets the blow back filter duration in seconds. The example that follows sets the blow back filter duration to 40 seconds.

```
Send:         set bb system duration 40
Receive:      set bb system duration 40 ok
```

bench set temp

This command reports the temperature of the optical bench in degrees C. The example that follows reports the bench temperature is 45.0 degrees C.

```
Send:         bench set temp
Receive:      bench set temp 45.0 deg C
```

set bench set temp *value*

This command sets the optical bench temperature to *value*, where *value* is the temperature in degrees C. The example that follows sets the optical bench temperature to 47 degrees C.

```
Send:         set bench set temp 47
Receive:      set bench set temp 47.0 ok
```

chamber temp

This command reports the chamber temperature in degrees C. The example that follows reports the chamber temperature is 116.6 degrees C.

```
Send:         chamber temp
Receive:      chamber temp 116.6 deg C
```

conv set temp

This command reports the converter set temperature in degrees C. The example that follows reports the converter temperature is 760 degrees C.

```
Send:         conv set temp
Receive:      conv set temp 760.0 deg C
```

set conv set temp *value*

This command sets the converter set temperature to *value*, where *value* is the temperature in degrees C. The example that follows sets the converter temperature to 800 degrees C.

```
Send:         set conv set temp 800
Receive:      set conv set temp 800.0 ok
```

conv temp

This command reports the converter temperature in degrees C. The example that follows reports the converter temperature is 760 degrees C.

```
Send:         conv temp
Receive:      conv temp 760.0 deg C
```

umblical set temp *probenumber*

This command reports the umbilical temperature in degrees C for the specified probe. If a probe number is not specified, the value of the currently active probe is displayed. The example that follows reports the umbilical temperature is 760 degrees C for probe 2.

```
Send:         umblical set temp 2
Receive:      umblical set temp 2 760.0 deg C
```

set umblical set temp *value probenumber*
This command sets the umbilical temperature to *value*, where *value* is the temperature in degrees C and *probenumber* is the number of the specified probe (1-4). If a probe number is not specified, the value of the currently active probe is displayed. The example that follows sets the umbilical temperature to 800 degrees C for probe 3.

```
Send:         set umblical set temp 800 3
Receive:      set umblical set temp 800.0 3 ok
```

---

dilution ratio
This command reports the dilution ratio. The example that follows reports the dilution ratio is 40.

```
Send:         dilution ratio
Receive:      dilution ratio 40
```

set dilution ratio
This command sets the dilution ratio. The example that follows sets the dilution ratio to 50.

```
Send:         set dilution ratio 50
Receive:      set dilution ratio 50 ok
```

---

dilution set pres *probenumber*
This command reports the dilution pressure in psig, where *probenumber* is the number of the specified probe (1-4). If a probe number is not specified, the value of the currently active probe is displayed. The example that follows reports the dilution pressure is 40.0 psig for probe 3.

```
Send:         dilution set pres 3
Receive:      dilution set pres 3 40.0 psig
```

---

dilution set pres counts *probenumber*
This command reports the dilution pressure in counts, where *probenumber* is the number of the specified probe (1-4). If a probe number is not specified, the value is applied to the currently active probe. The example that follows reports the dilution pressure is 2050 counts for probe 1.

```
Send:         dilution set pres counts 1
Receive:      dilution set pres counts 1 2050
```

set dilution set pres counts *value probenumber*
This command sets the dilution pressure *value*, where *value* is a number representing dilution pressure in counts and *probenumber* is the number of the specified probe (1-4). If a probe number is not specified, the value is applied to the currently active probe. The example that follows sets the dilution pressure to 2030 counts for probe 4.

```
Send:         set dilution set pres counts 2030 4
Receive:      set dilution set pres counts 2030 4 ok
```

---

eductor set pres *probenumber*
This command reports the eductor pressure in psig, where *probenumber* is the number of the specified probe (1-4). If a probe number is not specified, the value is applied to the currently active probe. The example that follows reports the eductor pressure is 1.6 psig for probe 3.

```
Send:         eductor set pres 3
Receive:      eductor set pres 3 1.6 psig
```

---

eductor set pres counts *probenumber*
This command reports the eductor pressure in counts, where *probenumber* is the number of the specified probe (1-4). If a probe number is not specified, the value is applied to the currently active probe. The example that follows reports the eductor pressure counts are 2100 for probe 3.

```
Send:         eductor set pres counts 3
Receive:      eductor set pres counts 3 2100
```

set eductor set pres counts *value probenumber*
This command sets the eductor pressure to *value*, where *value* is a number representing eductor pressure in counts and *probenumber* is the number of the specified probe (1-4). If a probe number is not specified, the value is applied to the currently active probe.

The example that follows sets the eductor set pressure to 2150 counts for probe 1.

```
Send:         set eductor set pres counts 2150 1
Receive:      set eductor set pres counts 2150 1 ok
```

---

lamp comp
This command reports the whether the lamp compensation is on or off. The following example reports that the lamp compensation is on.

```
Send:         lamp comp
Receive:      lamp comp on
```

set lamp comp *on/off*
This command sets the lamp compensation on or off. The example that follows sets the lamp compensation on.

```
Send:        set lamp comp on
Receive:     set lamp comp on ok
```

---

o2 quenching comp
This command returns the state of the O_2 quenching compensation: 0 if disabled, 1 if enabled and in Manual Mode or 2 if enabled and in Auto Mode.

```
Send:        o2 quenching comp
Receive:     o2 quenching comp 0
```

set o2 quenching comp *X*
This command sets the O_2 quenching compensation on or off, based on *X*: Set *X* to 0 to disable oxygen compensation, 1 to enable Manual oxygen compensation, or 2 to enable Auto oxygen compensation.

```
Send:        set o2 quenching comp 0
Receive:     set o2 quenching comp 0 ok
```

---

o2 dilution pct
This command returns the value of the O_2 dilution percent.

```
Send:        o2 dilution pct
Receive:     o2 dilution pct 3.00%
```

set o2 dilution pct *X.XX*
This command sets the O_2 dilution percent value to *X.XX*. The allowed range is 0.00% to 5.00%.

```
Send:        set o2 dilution pct 2.50
Receive:     set o2 dilution pct 2.50 ok
```

---

stack o2 channel
This command returns the current stack O_2 analog input channel.

```
Send:        stack o2 channel
Receive:     stack o2 channel 8
```

set stack o2 channel *X*
This command sets the stack O_2 analog input channel to *X*. The allowed range is 1 to 8.

```
Send:        set stack o2 channel 2
Receive:     set stack o2 channel 2 ok
```

lamp intensity

This command reports the lamp intensity in Hz. The following example reports that the lamp intensity is 59043 Hz.

```
Send:        lamp intensity
Receive:     lamp intensity 59043.0 Hz
```

range hg0
range hg2+
range hgt

These commands report the Hg0, Hg2+, and Hgt ranges according to the following table. The example that follows reports that the Hg0 range is 600.0 μg/m^3.

```
Send:        range hg0
Receive:     range hg0 0: 6.000E+2 ug/m3
```

set range hg0 *selection*
set range hg2+ *selection*
set range hgt *selection*

These commands select the Hg0, Hg2+, and Hgt full-scale ranges, according to the following table. The example that follows sets the Hgt full-scale to 15.0 μg/m^3.

```
Send:        set range hgt 3
Receive:     set range hgt 3 ok
```

Table B–7. Standard Ranges

Selection	μg/m^3
0	1.5
1	3.0
2	6.0
3	15.0
4	30.0
5	60.0
6	150.0
7	300.0
8	600.0
9	C1
10	C2
11	C3

custom *range*
range = | 1 | 2 | 3 |
This command reports the user-defined value of custom *range* 1, 2, or 3. The example that follows reports that custom range 1 is set to 600.0 μg/m³.

```
Send:        custom 1
Receive:     custom 1 6.000E+2 ug/m3
```

set custom *range value*
range = | 1 | 2 | 3 |
This command is used to set the maximum concentration for any of the three custom ranges 1, 2, or 3 to range *value*, where *value* is a floating-point number representing concentration in μg/m³. The example that follows sets the custom 1 range to 600.0 μg/m³.

```
Send:        set custom 1 600.0
Receive:     set custom 1 600.0 ok
```

---

range mode
This command reports the current range mode in single, dual, or auto. The example that follows reports the range mode is set to single.

```
Send:        range mode
Receive:     range mode single
```

set range mode *mode*
mode = | single | dual | auto |
This command sets the current range mode to single, dual, or auto. The example that follows sets the range mode to single.

```
Send:        set range mode single
Receive:     set range mode single ok
```

---

gas mode
This command reports the current mode of sample, zero, or span. The example that follows reports that the gas mode is sample.

```
Send:        gas mode
Receive:     gas mode sample
```

---

set sample
set zero
set span
These commands set the current gas mode to sample, zero, or span. The example that follows sets the instrument to span mode, that is, the instrument is sampling span gas.

```
Send:         set sample
Receive:      set sample ok
```

---

span inst
This command reports the instrument span level currently in effect. The example that follows reports the instrument span level is 3.

```
Send:         span inst
Receive:      span inst 3
```

set span inst *level*
This command sets the instrument span level to *level* where *level* is a number from 1-6. This command is used to tell the Model 81*i* which span level to use. The example that follows sets the instrument span level to 2.

```
Send:         set span inst 2
Receive:      set span inst 2 ok
```

---

span sys
This command reports the system span level currently in effect. The example that follows reports the system span level is 4.

```
Send:         span sys
Receive:      span sys 4
```

set span sys *level*
This command sets the system span level to *level* where *level* is a number from 1-6. This command is used to tell the Model 81*i* which span level to use. The example that follows sets the system span level to 6.

```
Send:         set span sys 6
Receive:      set span sys 6 ok
```

---

meas mode
This command reports which measurement mode (Hg0/Hgt, Hg0, Hgt) is active. The example that follows reports that the measurement mode is set to Hg0.

```
Send:         meas mode
Receive:      meas mode hg0
```

set meas mode *mode*
mode = | hg0/hgt | hg0 | hgt |
This command sets the instrument to Hg0/Hgt (auto) mode, manual Hg0 mode, or manual Hgt mode. The example that follows sets the instrument to the manual Hg0 mode.

```
Send:         set meas mode hg0
Receive:      set meas mode hg0 ok
```

set o span
This command sets the system gas mode to orifice span as shown in the following example.

```
Send:        set o span
Receive:     set o span ok
```

set o zero
This command sets the system gas mode to orifice zero as shown in the following example.

```
Send:        set o zero
Receive:     set o zero ok
```

set ox cal
This command sets the system gas mode to oxidizer cal as shown in the following example.

```
Send:        set ox cal
Receive:     set ox cal ok
```

set s span
This command sets the system gas mode to system span as shown in the following example.

```
Send:        set s span
Receive:     set s span ok
```

set s zero
This command sets the system gas mode to system zero as shown in the following example.

```
Send:        set s zero
Receive:     set s zero ok
```

power converter *probenumber*
This command reports the whether the converter power is on or off for the selected probe. The probe number must be included in the command. The following example reports that the converter power is off for probe 2.

```
Send:        power converter 2
Receive:     power converter 2 off
```

set power converter *on/off probenumber*
This command sets the converter power on or off for the selected probe. The probe number must be included in the command. The example that follows sets the converter power on for probe 1.

```
Send:         set power converter on 1
Receive:      set power converter on 1 ok
```

power eductor *probenumber*
This command reports the whether the eductor power is on or off for the selected probe. The probe number must be included in the command. The following example reports that the eductor power is on for probe 3.

```
Send:         power eductor 3
Receive:      power eductor 3 on
```

set power eductor *on/off probenumber*
This command sets the eductor power on or off for the selected probe. The probe number must be included in the command. The example that follows sets the eductor power on for probe 2.

```
Send:         set power eductor on 2
Receive:      set power eductor on 2 ok
```

power probe *probenumber*
This command reports the whether the probe power is on or off for the selected probe. The probe number must be included in the command. The following example reports that the probe power is off for probe 1.

```
Send:         power probe 1
Receive:      power probe 1 off
```

set power probe *on/off probenumber*
This command sets the probe power on or off for the selected probe. The probe number must be included in the command. The example that follows sets the probe power on for probe 3.

```
Send:         set power probe on 3
Receive:      set power probe on 3 ok
```

power stinger *probenumber*
This command reports the whether the stinger power is on or off for the selected probe. The probe number must be included in the command. The following example reports that the stinger power is on for probe 2.

```
Send:         power stinger 2
Receive:      power stinger 2 on
```

set power stinger *on/off probenumber*
This command sets the stinger power on or off for the selected probe. The probe number must be included in the command. The example that follows sets the stinger power off for probe 1.

```
Send:        set power stinger off 1
Receive:     set power stinger off 1 ok
```

---

power umblical1 *probenumber*
This command reports the whether the umbilical1 power is on or off for the selected probe. The probe number must be included in the command. The following example reports that the umbilical1 power is on for probe 3.

```
Send:        power umblical1 3
Receive:     power umblical1 3 on
```

set power umblical1 *on/off probenumber*
This command sets the umbilical1 power on or off for the selected probe. The probe number must be included in the command. The example that follows sets the umbilical1 power on for probe 4.

```
Send:        set power umblical1 on 4
Receive:     set power umblical1 on 4 ok
```

---

power umblical2 *probenumber*
This command reports the whether the umbilical2 power is on or off for the selected probe. The probe number must be included in the command. The following example reports that the umbilical2 power is off for probe 1.

```
Send:        power umblical2 1
Receive:     power umblical2 1 off
```

set power umblical2 *on/off probenumber*
This command sets the umbilical2 power on or off for the selected probe. The probe number must be included in the command. The example that follows sets the umbilical2 power on for probe 3.

```
Send:        set power umbilical2 on 3
Receive:     set power umbilical2 on 3 ok
```

---

pmt supply
This command reports whether the PMT supply is on or off as shown in the example that follows.

```
Send:        pmt supply
Receive:     pmt supply on
```

set pmt supply *on/off*
This command sets the PMT supply on or off. The example that follows sets the PMT supply on.

```
Send:        set pmt supply on
Receive:     set pmt supply on ok
```

pres comp
This command reports whether pressure compensation is on or off. The example that follows shows that pressure compensation is on.

```
Send:         pres comp
Receive:      pres comp on
```

set pres comp *onoff*
This command turns the pressure compensation on or off. The example that follows turns pressure compensation off.

```
Send:         set pres comp off
Receive:      set pres comp off ok
```

probe no
This command reports the number of the active probe (hydra only). The example that follows shows that probe 3 is the currently active probe.

```
Send:         probe no
Receive:      probe no 3
```

set probe no *probenumber*
This command selects the probe to use (hydra only). The example that follows selects probe 2 to be the active probe.

```
Send:         set probe no 2
Receive:      set probe no 2 ok
```

probe set failsafe temp *probenumber*
This command reports the probe failsafe temperature in degrees C for the specified probe (*probenumber)*. The example that follows reports the probe failsafe temperature is 760 degrees C for probe 1.

```
Send:         probe set failsafe temp 1
Receive:      probe set failsafe temp 1 760.0 deg C
```

set probe set failsafe temp *value probenumber*
This command sets the probe failsafe temperature to *value*, where *value* is the temperature in degrees C and *probenumber* is the number of the specified probe (1-4). The example that follows sets the probe failsafe temperature to 800 degrees C for probe 3.

```
Send:         set probe set failsafe temp 800 3
Receive:      set probe set failsafe temp 800.0 3 ok
```

probe set temp *probenumber*
This command reports the probe temperature in degrees C for the specified probe (*probenumber)*. The example that follows reports the probe temperature is 760 degrees C for probe 2.

```
Send:        probe set temp 2
Receive:     probe set temp 2 760.0 deg C
```

set probe set temp *value probenumber*
This command sets the probe temperature to *value*, where *value* is the temperature in degrees C and *probenumber* is the number of the specified probe (1-4). The example that follows sets the probe temperature to 800 degrees C for probe 3.

```
Send:        set probe set temp 800 3
Receive:     set probe set temp 800.0 3 ok
```

ref intensity
This command reports the reference intensity in Hz. The following example reports that the lamp intensity is 59061 Hz.

```
Send:        lamp intensity
Receive:     lamp intensity 59061 Hz
```

temp comp
This command reports whether temperature compensation is on or off. The example that follows shows the temperature compensation is off.

```
Send:        temp comp
Receive:     temp comp off
```

set temp comp *onoff*
These commands turn the temperature compensation on or off. The example that follows turns temperature compensation off.

```
Send:        set temp comp off
Receive:     set temp comp off ok
```

Hardware Configuration

contrast

This command reports the screen's level of contrast. The example that follows shows the screen contrast is 45%, according to the following table.

```
Send:          contrast
Receive:       contrast 9: 45%
```

set contrast *level*

This command sets the screen's *level* of contrast, according to the following table. The example that follows sets the contrast level to 50%.

```
Send:          set contrast 10
Receive:       set contrast 10 ok
```

Table B–8. Contrast Levels

Level	**Contrast Level**
0	0%
1	5%
2	10%
3	15%
4	20%
5	25%
6	30%
7	35%
8	40%
9	45%
10	50%
11	55%
12	60%
13	65%
14	70%
15	75%
16	80%
17	85%
18	90%
19	95%
20	100%

date
This command reports the current date. The example that follows reports the date as April 18, 2007.

```
Send:          date
Receive:       date 04-18-07
```

set date *mm-dd-yy*
mm = month
dd = day
yy = year

This command sets the date of the instrument's internal clock. The example that follows sets the date to March 19, 2005.

```
Send:          set date 03-19-05
Receive:       set date 03-19-05 ok
```

set default params
This command sets all the parameters to their default values. This does not affect the factory-calibrated parameters.

```
Send:          set default params
Receive:       set default params ok
```

save
set save params
These commands store all current 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. The example that follows saves the parameters to FLASH memory.

```
Send:          set save params
Receive:       set save params ok
```

time
This command reports the current internal time (24-hour time). The example that follows reports that the internal time is 2:15:30 pm.

```
Send:          time
Receive:       time 14:15:30
```

set time *hh:mm:ss*
hh = hours
mm = minutes
ss = seconds

This command sets the internal clock (24-hour time). The example that follows sets the internal time to 2:15 pm.

Note If seconds are omitted, the seconds default to 00. ▲

```
Send:         set time 14:15
Receive:      set time 14:15 ok
```

Communications Configuration

addr dns
This command reports the TCP/IP address for the domain name server.

```
Send:         addr dns
Receive:      addr dns 192.168.1.1
```

set addr dns address
This command sets the domain name server address, where address consists of four numbers ranging from 0-255 inclusive, separated by ".".

```
Send:         set addr dns 192.168.1.1
Receive:      set addr dns 192.168.1.1 ok
```

addr gw
This command reports the default TCP/IP gateway address.

Note This command cannot be used when DHCP is on. Refer to the DHCP command that follows for additional information. ▲

```
Send:         addr gw
Receive:      addr gw 192.168.1.1
```

set addr gw *address*
This command sets the default gateway *address*, where *address* consists of four numbers ranging from 0-255 inclusive, separated by ".".

```
Send:         set addr gw 192.168.1.1
Receive:      set addr gw 192.168.1.1 ok
```

addr ip
This command reports the IP address of the instrument.

Note This command cannot be used when DHCP is on. Refer to the DHCP command that follows for additional information. ▲

```
Send:         addr ip
Receive:      addr ip 192.168.1.15
```

set addr ip *address*

This command sets the instrument's IP *address*, where *address* consists of four numbers ranging from 0-255 inclusive, separated by ".".

```
Send:         set addr ip 192.168.1.15
Receive:      set addr ip 192.168.1.15 ok
```

addr nm
This command reports the TCP/IP netmask address.

Note This command cannot be used when DHCP is on. Refer to the DHCP command that follows for additional information. ▲

```
Send:         addr nm
Receive:      addr nm 255.255.255.0
```

set addr nm *address*
This command sets the netmask address, where address consists of four numbers ranging from 0-255 inclusive, separated by ".".

```
Send:         set addr nm 255.255.255.0
Receive:      set addr nm 255.255.255.0 ok
```

addr ntp
This command reports the IP address for the NTP time server. See "Network Time Protocol Server" in the "Communications Settings" section of the "Operation" chapter for more information.

```
Send:         addr ntp
Receive:      addr ntp 192.168.1.2
```

set addr ntp *address*
This command sets the NTP time server *address*, where *address* consists of four numbers ranging from 0-255 inclusive, separated by ".".

```
Send:         set addr ntp 192.168.1.2
Receive:      set addr ntp 192.168.1.2 ok
```

baud

This command reports the current baud rate for the serial port (RS232/RS485). The example that follows reports that the current baud rate is 9600.

```
Send:         baud
Receive:      baud 9600
```

set baud *rate*

rate = | 1200 | 2400 | 4800 | 9600 | 19200 | 38400 | 57600 | 115200 |

This command sets the instrument baud *rate*. The example that follows sets the instrument's baud rate to 115200.

Note After the command is sent, the baud rate of the sending device must be changed to agree with the instrument. ▲

```
Send:         set baud 115200
Receive:      set baud 115200 ok
```

dhcp

This command reports the current state of use of DHCP on or off. DHCP is used to assign an IP address to the instrument automatically. The example that follows shows that DHCP is on.

```
Send:         dhcp
Receive:      dhcp on
```

set dhcp *onoff*

This command enables (*on*) and disables (*off*) the DHCP service. When DHCP is set to on, the instrument gets the IP address, the netmask address, and the gateway address from a DHCP server. When DHCP is set to off, the instrument gets these addresses from system memory.

Note When changing the IP address, the netmask address, or the gateway address, you must cycle power to the instrument before the change takes effect. Until you cycle power, the address assigned by the DHCP server will still be used and reported as the current address. ▲

```
Send:         set dhcp on
Receive:      set dhcp on ok
```

format

This command reports the current reply termination format. The example that follows shows that the reply format is 00, which means reply with no checksum, according to the following table.

```
Send:         format
Receive:      format 00
```

set format *format*

This command sets the reply termination *format*, where *format* is set according to the following table. The example that follows sets the reply termination format to checksum.

```
Send:         set format 01
Receive:      set format 01 ok
```

Table B–9. Reply Termination Formats

Format	Reply Termination
00	<CR>
01	<NL> sum xxxx <CR>

where xxxx = 4 hexadecimal digits that represent the sum of all the characters (bytes) in the message

host name

This command reports the host name string.

```
Send:         host name
Receive:      host name analyzer01
```

set host name *string*

This command sets the host name *string*, where *string* is 1-13 alphanumeric characters.

```
Send:         set host name analyzer01
Receive:      set host name analyzer01 ok
```

instr name

This command reports the instrument name.

```
Send:         instr name
Receive:      instr name
Hg0-Hg2+-HgT Analyzer
Hg0-Hg2+-HgT Analyzer
```

instrument id
This command reports the instrument id.

```
Send:        instrument id
Receive:     instrument id 80
```

set instrument id *value*
This command sets the instrument id to *value*, where *value* is a decimal number between 0 and 127 inclusive.

Note Sending this command via RS-232 or RS-485 will require the host to use the new id for subsequent commands. ▲

```
Send:        set instrument id 50
Receive:     set instrument id 50 ok
```

allow mode cmd
This command reports the current allow mode setting: 1 = allow "set mode local" or "set mode remote" commands; 0 = ignore "set mode local" or "set mode remote" commands. Refer to **Table B–10**. The default value is 0; ignore the commands. The example that follows shows that the instrument is configured to ignore "set mode local" or "set mode remote" commands.

```
Send:        allow mode cmd
Receive:     allow mode cmd 0
```

set allow mode cmd *value*
This command is used to configure the instrument to *value,* where *value* is either 1 = accept or 0 = ignore the "set mode local" or "set mode remote" commands. Refer to **Table B–10**.

If the instrument is set to accept the commands (*value* = 1), the "set mode local" command will unlock the instrument and the keypad can be used to make changes via the front panel.

If the instrument is set to ignore the commands (*value* = 0), the instrument will respond with "ok" as if the command has been accepted and acted upon, **but will not change the instrument lock status** (this is for compatibility with systems expecting an "ok" response).

Note The instrument will always respond to the command "mode" with the status of the password lock as "mode local" or "mode remote" regardless of the above setting. ▲

The example that follows sets the instrument to accept the "set mode local" or "set mode remote" commands.

```
Send:         set allow mode cmd 1
Receive:      set allow mode cmd 1 ok
```

Table B–10. Allow Mode Command Values

Value	**Allow Mode Command**
0	Ignore (default)
1	Accept

mode
This command reports what operating mode the instrument is in: local, service, or remote. The example that follows shows that the instrument is in the remote mode.

```
Send:         mode
Receive:      mode remote
```

set mode local
set mode remote
These commands set the instrument to local or remote mode. The example that follows sets the instrument to the local mode.

```
Send:         set mode local
Receive:      set mode local ok
```

power up mode
This command reports the current power up mode setting, where *value,* is either 0 = local/unlocked or 1 = remote/locked, as shown in the following table. The default value is 0; power up in local/unlocked mode. The example that follows shows that the instrument is configured to power up in the remote/locked mode.

```
Send:         power up mode
Receive:      power up mode 1
```

set power up mode *value*
This command is used to configure the instrument to power up in the local/unlocked mode (*value* = 0) or the remote/locked mode (*value* = 1), as shown in the following table.

If the instrument is set to power up in the local/unlocked mode, the keypad can be used to make changes via the front panel. If the instrument is set to power up in the remote/locked mode, changes can not be made from the front panel. The example that follows sets the instrument to power up in remote/locked mode.

```
Send:          set power up mode 1
Receive:       set power up mode 1 ok
```

Table B–11. Power Up Mode Command Values

Value	**Power Up Mode Command**
0	Local/Unlocked (default)
1	Remote/Locked Mode

program no

This command reports the instrument's model information and program version number, which depends on the current version.

```
Send:          program no
Receive:       program no iSeries 80i 00.05.68.192
```

set layout ack *value*

This command disables the stale layout/layout change indicator (*) that is attached to each response if the erec layout has changed since the last time erec layout was requested, where *value* represents the function. Refer to **Table B–12**.

```
Send:          set layout ack 0
Receive:       set layout ack 0 ok
```

Table B–12. Set Layout Ack Values

Value	**Function**
0	Do nothing (default)
1	Append "*"

tz

This command reports the "tz" timezone string for the NTP server. See "Network Time Protocol Server" in the "Communications Settings" section of the "Operation" chapter for more information.

```
Send:          tz
Receive:       tz EST+5EDT
```

set tz *string*
This command sets the timezone *string* for the instrument for use with the NTP time server, where *string* is a standard timezone string. Common strings are listed in the timezone screen description in "Chapter 3."

```
Send:        set tz EST+5EDT
Receive:     set tz EST +5 EDT ok
```

I/O Configuration

analog iout range *channel*

This command reports the analog current output range setting for *channels*, where *channel* must be between 1 and 6, inclusive. The example that follows reports current output channel 4 to the 4-20 mA range, according to the following table. This command responds with "feature not enabled" if the optional I/O expansion board is not detected.

```
Send:        analog iout range 4
Receive:     analog iout range 4 2
```

set analog iout range *channel range*
This command sets analog current output *channel* to the *channel range* where *channel* is between 1 and 6 inclusive and range is set according to the following table. The example that follows sets current output channel 4 to the 0-20 mA range. This command responds with "feature not enabled" if the optional I/O expansion board is not detected.

```
Send:        set analog iout range 4 1
Receive:     set analog iout range 4 1 ok
```

Table B–13. Analog Current Output Range Values

Range	Output Range
1	0-20 mA
2	4-20 mA
0 [cannot be set to this, but may report]	Undefined

analog vin *channel*
This command retrieves the analog voltage input *channel* data, both the calculated value and the actual voltage. In the example that follows, the "calculated" value of channel 1 is 75.325 degrees F, volts are 2.796. This command responds with "feature not enabled" if the optional I/O expansion board is not detected.

```
Send:        analog vin 1
Receive:     analog vin 1 75.325 2.796
```

analog vout range *channel*
This command reports the analog voltage output *channel* range, where *channel* is between 1 and 6 inclusive, according to the following table.

```
Send:         analog vout range 2
Receive:      analog vout range 2 3
```

set analog vout range *channel range*
This command sets analog voltage output *channel* to the range, where *channel* is between 1 and 6 inclusive, and *range* is set according to the following table. The example that follows sets channel 2 to the 0-10 V range.

```
Send:         set analog vout range 2 3
Receive:      set analog vout range 2 3 ok
```

Table B–14. Analog Voltage Output Range Values

Range	Output Range
1	0-1 V
2	0-100 mV
3	0-10 V
4	0-5 V
0 [cannot be set to this, but may report]	Undefined

dig in
This command reports the status of the digital inputs as a 4-digit hexadecimal string with the most significant bit (MSB) being input 16.

```
Send:         dig in
Receive:      dig in 0xff7f
```

din *channel*
This command reports the action assigned to input *channel* and the corresponding active state. The example that follows reports the input 5 to be assigned an index number 5 corresponding to action of "instrument span mode" with the active state being high.

```
Send:         din 5
Receive:      din 5 5 INST SPAN MODE high
```

set din *channel index state*
This command assigns digital input *channel* (1-16) to activate the action indicated by *index* (1-35), when the input transitions to the designated *state* (high or low). Use "list din var" command to obtain the list of supported *index* values and corresponding actions.

```
Send:         set din 1 3 high
Receive:      set din 1 3 high ok
```

dout *channel*

This command reports the index number and output variable and the active state assigned to output *channel*. The example that follows reports the input 4 to be assigned an index number 5 corresponding to “sample mode” with the active state being open.

```
Send:         dout 4
Receive:      dout 4 5 SAMPLE MODE open
```

set dout *channel index state*

This command assigns digital output *channel* to be assigned to the action associated with *index*, and assigns it an active *state* of state (open or closed).

```
Send:         set dout 4 11 open
Receive:      set dout 4 11 open ok
```

dtoa *channel*

This reports the outputs of the 6 or 12 digital to analog converters, according to the following table. The example that follows shows that the DAC 1 is 97.7% full-scale.

```
Send:         dtoa 1
Receive:      dtoa 1 97.7%
```

Note All channel ranges are user definable. If any customization has been made to the analog output configuration, the default selections may not apply. ▲

Table B–15. Default Output Assignment

D to A	Function	Single Range
1	Voltage Output	Hg0
2	Voltage Output	Hg2+
3	Voltage Output	Hgt
4	Voltage Output	Not Assigned
5	Voltage Output	Not Assigned
6	Voltage Output	Not Assigned
7	Current Output	Hg0
8	Current Output	Hg2+
9	Current Output	Hgt

D to A	Function	Single Range
10	Current Output	Not Assigned
11	Current Output	Not Assigned
12	Current Output	Not Assigned

list var aout
list var dout
list var din

These commands report the list of index numbers and the variables (associated with that index number) available for selection in the current mode for analog output, digital output and digital inputs. The index number is used to insert the variable in a field location in a list using "set sp field index". The example that follows reports the list of analog output, index numbers, and variables.

```
Send:         list var aout
Receive:      list var aout

               1 hg0         17 edup         33 ain3
               2 hg2         18 vac          34 ain4
               3 hgt         19 smplf        35 ain5
               4 rghg0       20 pmtv         36 ain6
               5 rghg2       21 pres         37 ain7
               6 rghgt       22 pbspn        38 ain8
               7 rfint       23 anspn        40 hg0dic
               8 intt        24 anspn        41 hg0dit
               9 rctt        25 obkg         42 hgtdic
              10 prbt        26 tblg         43 hgtdit
              11 cnvt        27 ocoef        44 hg0dsc
              12 umbt        28 tcoef        45 hg0dst
              13 vntp        29 fsafe        46 hgtdsc
              14 orfp        30 dilf         47 hgtdst
              15 dilp        31 ain1         48 hg81
              16 bbkp        32 ain2         49 lampt
                                             50 oxyt
```

relay
relay stat

This command reports the current relay logic normally "open" or normally "closed," if all the relays are set to same state, that is all open or all closed.

Note The relay stat command is report only. ▲

The example that follows shows the status when all the relays logic are set to normally “open”.

```
Send:        relay
Receive:     relay open
```

Note If individual relays have been assigned different logic then the response would be a 4-digit hexadecimal string with the least significant byte (LSB) being relay no 1. ▲

For example:

```
Receive:   relay stat 0x0001 (indicates relay no 1 is set to normally
open logic, all others are normally closed)
Receive:   relay stat 0x0005 (indicates relay no 1 and 3 are set to be
normally open logic, all others are normally closed)
```

set relay *action*:*relaynumber*
action = open or closed
relaynumber = number of the selected relay
These commands set the relay logic to normally open or closed for relay number *relaynumber*, where *relaynumber* is the relay between 1 and 16. The example that follows sets the relay no 1 logic to normally open.

Note If the command is sent without an appended relay number then all the relays are assigned the set logic of normally open/closed. ▲

```
Send:        set relay open 1
Receive:     set relay open 1 ok
```

Record Layout Definition

The Erec, Lrec, and Srec Layouts contain the following:

- A format specifier for parsing ASCII responses
- A format specifier for parsing binary responses

In addition to these, the Erec Layout contains:

- A format specifier for producing the front-panel displays

In operation, values are read in using either the ASCII or binary format specifiers and converted to uniform internal representations (32-bit floats or 32-bit integers). These values are converted into text for display on the screen using the format specifier for the front-panel display. Normally, the specifier used to parse a particular datum from the input stream will be strongly related to the specifier used to display it (e.g., all of the floating point inputs will be displayed with an 'f' output specifier, and all of the integer inputs will be displayed with a 'd' specifier).

Format Specifier for ASCII Responses

The first line of the Layout response is the scanf-like parameter list for parsing the fields from an ASCII ERec response. Parameters are separated by spaces and the line is terminated by a \n (the normal line separator character). Valid fields are:

%s - parse a string

%d - parse a decimal number

%ld - parse a long (32-bit) decimal number

%f - parse a floating point number

%x - parse a hexadecimal number

%lx - parse a long (32-bit) hex number

%* - ignore the field

Note Signed versus unsigned for the integer values does not matter; it is handled automatically. ▲

Format Specifier for Binary Responses

The second line of the Layout response is the binary parameter list for parsing the fields from a binary response. Parameters MUST be separated by spaces, and the line is terminated by a '\n'. Valid fields are:

t - parse a time specifier (2 bytes)

D - parse a date specifier (3 bytes)

i - ignore one 8-bit character (1 byte)

e - parse a 24-bit floating point number (3 bytes: n/x)

E - parse a 24-bit floating point number (3 bytes: N/x)

f - parse a 32-bit floating point number (4 bytes)

c - parse an 8-bit signed number (1 byte)

C - parse an 8-bit unsigned number (1 byte)

n - parse a 16-bit signed number (2 bytes)

N - parse a 16-bit unsigned number (2 bytes)

m - parse a 24-bit signed number (3 bytes)

M - parse a 24-bit unsigned number (3 bytes) l - parse a 32-bit signed number (4 bytes)

L - parse a 32-bit unsigned number (4 bytes)

There is an optional single digit d which may follow any of the numeric fields which indicates that after the field has been parsed out, the resulting value is to be divided by 10^d. Thus the 16-bit field 0xFFC6 would be interpreted with the format specifier 'n3' as the number -0.058.

Format Specifier for Front-Panel Layout

The subsequent lines in the ERec Layout response describe the appearance of the full panel. The full instrument panel as it appears on the screen has two columns of lines. Each line is composed of three major components: (1) a text field, (2) a value field, and (3) a button. None of these three components is required. The text field contains statically displayed text.

The value field displays values which are parsed out of the response to a DATA/ERec command. It also displays, though background changes, alarm status. The button, when pressed, triggers input from either a dialog box or a selection list. There are five kinds of buttons, B, I, L, T, and N.

Each line in the layout string corresponds to one line on the display. The layout string describes each of the three major fields as well as translation mechanisms and corresponding commands.

Text

The first field in the layout string is the text. It is delimited by a ':'. The string up to the first ':' will be read and inserted in the text field of the line.

Value String

This is followed by a possible string, enclosed in quotes. This is used to place a string into the value field.

Value Source

The value source, which is the item (or word) number in the DATA/ERec response, appears next. This is followed by an optional bitfield designator. The datum identified by the value source can be printed as a string 's', hexadecimal 'x', decimal 'd', or floating point 'f', or binary 'b' number. Typically, bitfield extractions are only done for decimal or hexadecimal numbers.

Floating-point numbers can be followed with an optional precision specifier which will be used as an argument to printf's %f format (e.g., a field of '4' would be translated into the printf command of '%.3f'). Alternately, the special character '*' can precede the precision specifier; this causes an indirection on the precision specifier (which now becomes a field number).

This is useful when formatting, for example, numbers which have varying precision depending on the mode of the instrument.

Binary numbers can also have an optional precision specifier which is used to determine how many bits to print. For example, the specifier 'b4' will print the lowest four bits of the parsed number.

There are serious restrictions on where an 's' field may appear: currently sources 1 and 2 must be 's', and no others may be 's'.

Alarm Information

The value source is followed by optional alarm information, indicated by a commercial at sign '@' with a source indicator and a starting bit indicator. All alarm information is presumed to be two bits long (low and high). The bitfield extraction is performed on the integer part of the source. Typical alarm information would appear as '@6.4'.

Translation Table

Then, there appears an optional translation table within braces '{}'. This is a string of words separated by spaces. An example translation table would be '{Code_0 Code_1 Code_2 Code_3}'. The value, once extracted is used as a zero-based index into the translation table to determine the string to display.

Selection Table

Then there appears an optional selection table within parentheses '(...)'. This is a string of numbers separated by spaces '(0 1)'. The selection table lists the translation table entries which the user may select from when setting the parameter. This is not necessarily the same as the entries which may be displayed.

Button Designator

Then there appears an optional button designator. This will be one of 'B', 'I', 'L', 'T', or 'N'.

B- Indicates a button which pops up an input dialog prompting the user for a new value using the designated input format. The input format is specified from the 'B' through the subsequent semicolon.

I—Indicates a button which pops up a selection list with input translation. That is, the values read are translated before they are compared to the selection list options.

L—Indicates a button which pops up a selection list without any translation. The output value is number of the selected option.

T—Indicates a button which pops up a selection list with output translation. The number of the option selected is used as an index into the translation table to generate an output string.

N—Indicates a button which only sends the subsequent command to the instrument. No user-prompting happens.

The following string through an optional '|' or the end of the line is the command which is to be sent to the instrument upon the completion of the button selection. The command string should normally contain print-style formatting to include the user input. If a '|' is present, it indicates a command which is sent to the instrument upon successful completion of the button command to update the value field.

Examples Some examples ('\n' is the C syntax for an end-of-line character):

'Concentrations\n'

This is a single text-only line.

'\n'

This is a single blank line.

' hg0:3s\n'

This is a line which appears slightly indented. The text field is 'Hg0', the value is taken from the third element of the data response, and interpreted as a string.

' hg0:18sBd.ddd;set hg0 coef %s\n'

This is a line which also appears slightly indented. The next field is also 'Hg0', but the value is taken from the eighteenth element of the data response, again interpreted as a string. A button appears on this line which, when pressed, pops up an input dialog which will state "Please enter a new value for Hg0 using a d.ddd format." The string entered by the user is used to construct the output command. If the user enters, for example, '1.234', the constructed command will be 'set Hg0 coef 1.234'.

' hg0:21f{Code_0 Code_1 Code_2 Code_3 Code_4 Code_5 Code_6 Code_7 Code_8 Code_9 Code_10 Code_11}Lset range hg0 %d\n'

This is a line which appears slightly indented, the title is again 'Hg0', and the value the twenty-first element of the data response, interpreted as a floating-point number. There is a no-translation button which creates a selection list of twelve "Code nn" options. The number of the user selection is used to create the output command.

'Mode:6.12-13x{local remote service service}(0 1)Tset mode %s\n'

This is a line which has a title of 'Mode', and value taken from the sixth field of the data response. There is a bitfield extraction of bits 12 through 13 from the source (the value type is not important here because the value is being translated to an output string). Once the bits have been extracted, they are shifted down to the bit-zero position. Thus, the possible values of this example will be 0 through 3. The translation list shows the words which correspond to each input value, the zeroth value appearing first (0 -> local, 1 -> remote, etc.). The selection list shows that only the first two values, in this case, are to be shown to the user when the button is pressed. The 'T' button indicates full translation, input code to string, and user selection number to output string.

'\xC'

This is a line that starts a new column (the \xC or ^L),

' Comp:6.11x{off on}Tset temp comp %s\n'

This shows that the bitfield end (the second part of a bitfield specification) is optional. The bitfield will be one bit long, starting in this case at the eleventh bit.

'Background:7f*8Bd.ddd;set o3 bkg %s\n'

This shows the use of indirect precision specifiers for floating point displays. The background value is taken from the 7th element, and the precision specifier is taken from the 8th. If the asterisk were not present, it would indicate instead that 8 digits after the decimal point should be displayed.

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 instrument, and to trigger or simulate the activation of a digital input to the instrument. This is achieved by using the supported MODBUS commands listed that follows.

For details of the Model 80*i* MODBUS Protocol specification, see the following topics:

- "Serial Communication Parameters" on page C-2
- "TCP Communication Parameters" on page C-2
- "Application Data Unit Definition" on page C-2
- "Function Codes" on page C-3
- "MODBUS Addresses 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 slave 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	:	0x07

If a function code is received that is not in this list, and invalid function exception is returned.

Data

The data field varies depending on the function. For more description of these data fields, see "Function Codes" that follows.

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 80*i*.

(0x01/0x02) Read Coils / Read Inputs

Read Coils/Inputs reads 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 order 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 (N = Quantity of Outputs / 8, if the remainder not equal to zero, then N=N+1)
Output Status	n Byte	N = N or 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.

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.

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 (N = quantity of registers)
Register value	N* x 2 Bytes	N = N or N+1

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 Addresses Supported

Table C–1 through **Table C–3** list the MODBUS addresses supported for the Model 80*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 80*i*

Coil Number	Status
0	Invalid
1	SERVICE
2	Hg^0 MODE
3	Hgt MODE

Coil Number	Status
4	Hg^0/Hg^t MODE
5	SAMPLE MODE
6	INSTRUMENT ZERO MODE
7	INSTRUMENT SPAN MODE
8	ORIFICE ZERO MODE
9	ORIFICE SPAN MODE
10	SYSTEM ZERO MODE
11	SYSTEM SPAN MODE
12	BLOWBACK MODE
13	GENERAL ALARM
14	INTERNAL TEMPERATURE ALARM
15	CHAMBER TEMPERATURE ALARM
16	CHAMBER PRESSURE ALARM
17	SAMPLE FLOW ALARM
18	INTENSITY ALARM
19	Hg^0 CONCENTRATION, MAXIMUM ALARM
20	Hg^0 CONCENTRATION, MINIMUM ALARM
21	Hg2+ CONCENTRATION, MAXIMUM ALARM
22	Hg^{2+} CONCENTRATION, MINIMUM ALARM
23	Hg^t CONCENTRATION, MAXIMUM ALARM
24	Hg^t CONCENTRATION, MINIMUM ALARM
25	MOTHERBOARD STATUS ALARM
26	MEASUREMENT INTERFACE BOARD STATUS ALARM
27	I/O BOARD STATUS ALARM
28	81*i* STATUS
29	ZERO CHECK/CAL ALARM
30	SPAN CHECK/CAL ALARM
31	PROBE DILUTION ALARM
32	SYSTEM DILUTION ALARM
33	PROBE ZERO CHECK/CAL ALARM
34	SYSTEM ZERO CHECK/CAL ALARM
35	GENERAL PROBE ALARM
36	PROBE 1 SELECTED
37	Unused

Coil Number	Status
38	Unused
39	Unused
40	LOCAL/REMOTE
41	OXIDIZER CAL MODE
42	HYDRATOR
43	PROBE 1 STATUS
44	Unused
45	Unused
46	Unused
47	EXT ALARM
48	OXIDIZER Hg
49	OXIDIZER Cl2
50	OXIDIZER PURGE
51	THC ZERO MODE
52	THC SPAN MODE
53	PERMEATION SPAN MODE
54	84*i* CONNECT A
55	84*i* CONNECT B
56	84*i* GAS TEMP
57	84*i* OVEN TEMP
58	84*i* CAPILLARY TEMP
59	84*i* FLOW
60	84*i* PRESSURE
61	84*i* STATUS

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 80*i*

Register Number	Variable
0	Invalid
1&2	Hg^0
3&4	Hg^{2+}
5&6	Hg^t
7&8	Hg^0 RANGE
9&10	Hg^{2+} RANGE
11&12	Hg^t RANGE
13&14	INTENSITY
15&16	INTERNAL TEMPERATURE
17&18	CHAMBER TEMPERATURE
19&20	PROBE TEMPERATURE
21&22	CONVERTER TEMPERATURE
23&24	UMBILICAL TEMPERATURE
25&26	VENTURI PRESSURE
27&28	ORIFICE PRESSURE
29&30	DILUTION AIR PRESSURE
31&32	BLOWBACK PRESSURE
33&34	EDUCTOR PRESSURE
35&36	VACUUM PRESSURE
37&38	FLOW
39&40	PMT VOLTS
41&42	CHAMBER PRESSURE
43&44	PROBE SPAN
45&46	Hg^0 SPAN
47&48	Hg^t SPAN
49&50	Hg^0 BACKGROUND
51&52	Hg^t BACKGROUND
53&54	Hg^0 COEFFICIENT
55&56	Hg^t COEFFICIENT
57&58	PROBE FAILSAFE TEMPERATURE
59&60	DILUTION FACTOR
61&62	ANALOG IN 1
63&64	ANALOG IN 2

Register Number	Variable
65&66	ANALOG IN 3
67&68	ANALOG IN 4
69&70	ANALOG IN 5
71&72	ANALOG IN 6
73&74	ANALOG IN 7
75&76	ANALOG IN 8
77&78	PROBE NUMBER
79&80	Hg^0 INSTRUMENT DRIFT CONCENTRATION
81&82	Hg^0 INSTRUMENT DRIFT TIME
83&84	Hg^t INSTRUMENT DRIFT CONCENTRATION
85&86	Hg^t INSTRUMENT DRIFT TIME
87&88	Hg^0 SYSTEM DRIFT CONCENTRATION
89&90	Hg^0 SYSTEM DRIFT TIME
91&92	Hg^t SYSTEM DRIFT CONCENTRATION
93&94	Hg^t SYSTEM DRIFT TIME
95&96	CALIBRATOR ACTUAL CONCENTRATION
97&98	LAMP TEMPERATURE
99&100	OXIDIZER TEMPERATURE
101&102	OXIDATION
103&104	INTEGRITY
105&106	UMBILICAL TEMP 2
107&108	EXT ALARMS
109&110	84*i* PERM GEN RATIO
111&112	84*i* PERM GAS TEMP
113&114	84*i* PERM OVEN HEATER TEMP
115&116	84*i* CAPILLARY TEMP
117&118	84*i* PRESSURE

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 a conflict. Before you assert (1) one coil in a group, make sure the other coils in the group are de-asserted (0). ▲

Note If an item from the "System Span" Coil Group is triggered during an oxidation sequence, the span level will be changed to the corresponding span number. The span level will remain at this setting for the remainder of the System Integrity Test unless otherwise changed again. This is to facilitate multi-level integrity checks. ▲

Table C–3. Write Coils for 80*i*

Coil Number	Action Triggered	Coil Group
100	Invalid	
101	Hg^0 MODE	Measure Mode
102	Hg^t MODE	Measure Mode
103	Hg^0/Hg^t MODE	Measure Mode
104	INSTRUMENT ZERO MODE	Zero Span Mode
105	INSTRUMENT SPAN MODE	Zero Span Mode
106	ORIFICE ZERO MODE	Zero Span Mode
107	ORIFICE SPAN MODE	Zero Span Mode
108	SYSTEM ZERO MODE	Zero Span Mode
109	SYSTEM SPAN MODE	Zero Span Mode
110	BLOWBACK SYSTEM MODE	Zero Span Mode
111	BLOWBACK STINGER MODE	Zero Span Mode
112	SET BACKGROUND	
113	SET SPAN COEF	

Coil Number	Action Triggered	Coil Group
114	PROBE SELECT 1	Probe Select
115	PROBE SELECT 2	Probe Select
116	PROBE SELECT 3	Probe Select
117	PROBE SELECT 4	Probe Select
118	SYSTEM SPAN 1	System Span
119	SYSTEM SPAN 2	System Span
120	SYSTEM SPAN 3	System Span
121	SYSTEM SPAN 4	System Span
122	SYSTEM SPAN 5	System Span
123	SYSTEM SPAN 6	System Span
124	OXIDIZER CAL MODE	Zero Span Mode
125	SPIKING	
126	INSTRUMENT SPAN 1	Instrument Span
127	INSTRUMENT SPAN 2	Instrument Span
128	INSTRUMENT SPAN 3	Instrument Span
129	HYDRATOR ALARM	
130	EXT ALARM	
131	THC ZERO MODE	THC
132	THC SPAN MODE	THC
133	THC BLOWBACK	THC
134	PERM SPAN	84*i* Perm
135	Unused	
136	84*i* CONNECT B	84*i* Perm
137	SET Hg^0 SPAN	Measure Mode
138	SET Hg^t SPAN	Measure Mode

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