Model 4430 Photoionization Detector (PID) Operator's Manual

O·I·Analytical

151 Graham Road · P.O. Box 9010 · College Station, Texas 77842-9010
Telephone (979) 690-1711 · FAX (979) 690-0440 · www.oico.com · oimail@oico.com

Notice

The information contained in this document may be revised without notice.

OI Analytical shall not be liable for errors contained herein or for incidental or consequential damages in connection with the furnishing, performance, or use of this material.

Rev. 3.2 — July 2009

OI Analytical Part Number 252320

Printed in the U.S.A.
Publication 07780709

Limited Warranty

OI Analytical warrants each Model 4430 Photoionization Detector (PID) against defects in materials and workmanship under normal use and service for a period of one (1) year. Equipment installed by OI Analytical is warranted from the installation date; all other equipment is warranted from the ship date. If purchaser schedules or delays installation more than 90 days after delivery, then warranty period starts on the 91st day from date of shipment. This warranty extends only to the original purchaser.
OI Analytical will, at its option, repair or replace equipment that proves defective during the warranty period, provided the equipment is returned to OI Analytical at the expense of the purchaser.

Consumables, columns, lamps, and high temperature furnaces are warranted for 30 days (parts only) and are not available for coverage under extended warranties or service contracts.

This warranty shall not apply to defects originating from:

- Improper maintenance or operation by purchaser.
- Purchaser-supplied accessories or consumable.
- Modification or misuse by purchaser.
- Operation outside of the environmental and electrical products specifications.
- Improper or inadequate site preparation.
- Purchaser-induced contamination or leaks.

THE FOREGOING WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO ANY WARRANTY OF MERCHANTABILITY, FITNESS, OR ADEQUACY FOR ANY PARTICULAR PURPOSE OR USE. OI ANALYTICAL SHALL NOT BE LIABLE FOR ANY SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES, WHETHER IN CONTRACT, TORT, OR OTHERWISE.

Direct any service requests or questions to the OI Analytical Technical Support Department at (800) 336-1911 or (979) 690-1711.

Table of Contents

Chapter 1 Introduction

The Model 4430 Photoionization Detector (PID) installs into a standard detector port of an Agilent® Technologies 7890 or 6890 Series gas chromatograph (GC). It integrates with the GC using the GC's electrometer, signal output circuit, hydrogen and makeup gas flow modules, detector base heater, and external event relay for the vent valve. The detector assembly contains an ionizing chamber, UV lamp, and column makeup adapter, and uses a standalone, high-voltage power supply for the UV lamp. The PID typically detects selective aromatic and olefinic hydrocarbons in the presence of alkanes and other saturated hydrocarbons.

Operating Principles

The sample stream flows through the detector's ionizing chamber where high-energy ultraviolet light continuously irradiates the sample. The UV lamp produces radiation in the UV spectrum, typically 10.0 eV and 10.6 eV. The UV light's energy level determines the detection selectivity for ionizable components. Compounds with lower ionization potentials than the irradiation energy become ionized.

$$\text{Compound} + \text{Photon} = \text{Compound}^{+} + \text{Electron}^{-}$$

Polarizing voltage accelerates ions onto a collector. The collected ions produce current proportional to the compound mass. The GC's electrometer amplifies and measures the ion current.

Features

The PID offers the operator these features:

- The PID fits onto the Agilent 7890 or 6890 GC and fully integrates with the GC by using standard Agilent GC components and features.
- The PID mounts in an Agilent 7890 or 6890 detector pallet, which holds both the detector and electrometer, permitting easy exchange of detectors.
- The PID uses the Agilent 7890 or 6890 manual and electronic pneumatic control (EPC) gas flow modules.
- The PID operates with the Model 5220/5320 Electrolytic Conductivity Detector (ELCD), the Model 4410 Flame-Ionization Detector (FID), or the Model 5360 Halogen Specific Detector (XSD™) as tandem detectors, while occupying only one detector port.
    - The PID, XSD, and ELCD install and operate separately.
    - Each detector operates independently when installed together.
    - The PID, XSD, and ELCD operate together or separately when installed in separate detector ports.

- Installing the PID with the ELCD, FID, or XSD reactors together enhances capillary performance by minimizing dead volume. This design eliminates peak broadening caused by long transfer lines between nontandem detectors.
- The unique tandem design uses ELCD or FID reaction gas as the PID sweep gas, which vents the injection solvent and column bakeout from the PID as well as the ELCD.
- A unique UV lamp Window Sweep™ gas feature minimizes window surface contamination during column conditioning and ramping to high column temperatures. This feature also prevents polymerization reactions of GC effluents from tarnishing the lamp window.
- Custom GC interfaces provided for each GC model make installation quick and simple and enhances component compatibility.
- Using GC-supplied electronics enhances system component compatibility.
- The PID accepts megabore capillary columns without using makeup gas.
- A 10.0-eV lamp is standard, but others (8.3, 9.5, 11.7 eV) are available for more universal or selective response.
- Exclusive Lampsaver™ circuit automatically turns the lamp off, if desired, to lengthen lamp life. Automatically restart the lamp with a manual or remote signal.
- The vent valve directs column effluent away from the detector at any time during the analysis or while conditioning columns.
- Set the lamp current from the front panel (up to ten settings). Lamp current is proportional to lamp output intensity.

Specifications

General Specifications

Dimensions (Lamp Power Supply)

- 5.75" H x 2.75" W x 9" D
- 14.5 cm H x 6.9 cm W x 23 cm D

Weight

- 5.5 lbs (3 kg)

Environmental Conditions

- Altitude: Up to 2000 m
- Temperature: 5°–40°C
- Maximum relative humidity: 80% for ≤31°C, decreasing linearly to 50%

Construction Materials

- Inlet: Glass-lined stainless steel
- Ion chamber: Gold-plated stainless steel

Performance Specifications

Dynamic Range

- $>10^6$

Linear Range

- $>10^6$

Sensitivity

- <40 pg (benzene)

Maximum Operating Temperature

- 275° C

Detector Volume

- Approximately 50 μL

Solvent Vent Valve

- Remotely controlled

Lamp Current

- 0–1.60 mA in 0.15 mA steps

Lampsaver Time

- 0.5–2 hours, reset by external contact

Requirements

Gas Requirements

- Helium (99.999%)

Power Requirements

- 105–125 (±10%) VAC; 220–240 (±10%) VAC
- 48–62 Hz, Line ~50 VA
- Fuses: Type AGC (fast-acting), 0.5 A

Safety Information

The OI Analytical Model 4430 PID meets the following International Certification when tested in typical configuration:

LVD 73/23/EEC:1974
IEC 1010-1: 1990 + A1/EN 61010-1: 1993

The Model 4430 PID also meets the following Electromagnetic Compliance Certification:

Directive 89/336/EEC: 1989
EN50082-1: 1992
IEC 801-2/EN61000-4-2
IEC 801-3/EN61000-4-3
IEC 801-4/EN61000-4-4
CISPR 11:1990/EN55011 (1991)

OI Analytical designed and tested the Model 4430 PID in accord with recognized safety standards and designed for use indoors. Using the instrument in a manner not specified by the manufacturer may impair the instrument's safety protection. If the safety protection of the Model 4430 PID is compromised, disconnect the instrument from all power sources and secure the instrument against unintended operation.

Operator Precautions

For operator safety, pay attention to ***WARNING*** and ***CAUTION*** statements throughout the manual.

- A ***WARNING*** indicates a condition or possible situation that could result in physical injury to the operator.
- A ***CAUTION*** indicates a condition or possible situation that could damage or destroy the product or the operator's work.

Warnings and precautions in this manual or on the instrument must be followed during operation, service, and repair of the instrument. Failure to follow these warnings and precautions violates the safety design standards and intended use of the instrument. OI Analytical is not be liable for the operator's failure to comply with these warnings and precautions.

Connect the PID to a dedicated AC power supply through a three-conductor power cord with the third wire firmly connected to an electrical ground at the power outlet**. Any interruption of the grounding conductor or disconnection of the protective earth terminal could cause a shock that could result in personal injury.**

General Precautions

- Disconnect the AC power cord before removing covers.
- Replace or repair faulty or frayed insulation on power cords.
- Perform periodic leak checks on supply lines, fittings, and pneumatic plumbing.
- Arrange gas lines so they cannot become kinked, punctured, or otherwise damaged, and do not impede walkways.
- Turn off the main power switch and disconnect the main power cord before using a liquid solution to locate leaks.
- Wear safety glasses to prevent possible eye injury.
- Do not perform unauthorized modifications or substitute parts to the instrument that are not OI Analytical original parts. Any unauthorized modifications or substitutions void the warranty.
- Verify all heated areas have cooled before handling or wear adequate hand protection to prevent burns.
- Do not restrict airflow on the back or bottom of the unit. This can cause overheating within the unit.
- Maintain a static-safe area when handling all electronic parts and assemblies. Use a static-control wrist strap that is connected through a one megaohm resistor to an appropriate earth ground. Store all electrical parts and equipment in static-protective containers.
- Turn off all heated zones and allow time for cooling before working on the GC or the detector.
- Do not replace blown fuses inside the lamp power supply. Only trained service personnel should access the interior of the lamp power supply.

Compressed Gas Cylinder Precautions

- Store and handle compressed gases in strict accord with relevant safety codes.
- Fasten all cylinders securely to an immovable structure or permanent wall.
- Store or move cylinders only in a vertical position. Do not move or transport cylinders with the regulators attached.
- Use only approved regulators and tubing connections.
- Connect cylinders to instruments with pressure ratings that are significantly greater than the highest outlet pressure from the regulator.

WARNING:

Hydrogen is highly flammable and may cause an explosion if it is allowed to build up in an enclosed area, such as in the GC oven. Exercise great care when handling hydrogen. Check all gas fittings periodically for leaks and keep open flames and other sources of ignition clear of the detector.

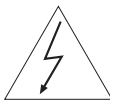
- Hydrogen is extremely flammable and is identified as an asphyxiant. Handle and store this gas and the cylinders containing it in a manner consistent with OSHA regulations. Do not bring hydrogen into contact with open flames and easily ignited materials except under approved, controlled conditions by the analyst. Maintain adequate ventilation in areas where this material is used and stored. Avoid prolonged exposure to high concentrations of this gas. In any application using hydrogen, turn off the supply at its source before working on the GC or the detector.
- Nitrogen and helium are identified as asphyxiants. Handle and store these gases and the cylinders containing them in a manner consistent with OSHA regulations. Maintain adequate ventilation in areas where using and storing these materials. Avoid prolonged exposure to high concentrations of these gases.
- Oxygen is identified as an oxidizer. Handle and store these gases and the cylinders containing them in a manner consistent with OSHA regulations. Maintain adequate ventilation in areas where these materials are used and stored. Avoid prolonged exposure to high gas concentrations.

Safety Symbols

The following symbols may be located on the instrument:

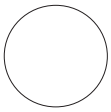
Warning/Caution, see accompanying instruction for more information.

Indicates a hot surface.



Indicates hazardous voltages.

Indicates earth (ground) terminal.



Indicates the OFF position on the power switch.

Indicates the ON position on the power switch.

Chapter 2 Instrument Components

This chapter defines the various PID components and their functions. Major components are identified and labeled on one or more drawings. Each component's function is also described, along with pertinent notes and cautions.

Model 4430 Detector Assembly

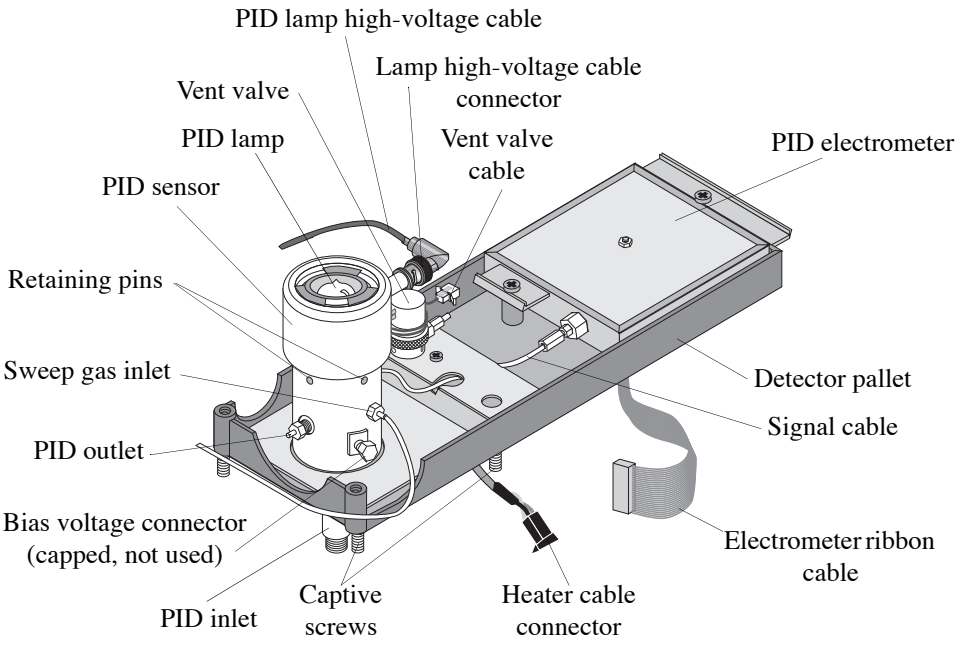


Figure 2.1. Model 4430 detector assembly

Captive screws attach the detector pallet to the GC.

Electrometer processes the detector signal.

Electrometer ribbon cable connects the electrometer to the FID interface board.

Heater cable connector connects the heater cable to the Agilent GC. The heater cable supplies power to the PID heater and also contains the temperature sensor (PRT).

PID outlet acts as the PID's exit port. Tandem FID, ELCD, or XSD detectors attach to the PID outlet using the appropriate fitting(s).

PID sensor assembly houses the lamp, the ionizing chamber, ion collector, and ports for the various gas inputs. It quickly and easily mounts on an available Agilent 7890 or 6890 detector port without modifying the GC.

Signal cable carries the PID signal to the electrometer.

Sweep gas inlet uses a 1/16" Valco®-type compression seal for the sweep gas to enter the ionization chamber. The sweep gas protects the lamp window from the GC effluent so that contaminants do not accumulate on its surface or polymerize.

Vent valve directs unwanted column effluents away from the detector before they move into the ionizing chamber. Use the vent valve when conditioning new columns, venting solvent peaks, and selecting against components eluting within specific retention time windows. The vent valve opens on command from the GC to vent unwanted effluents as described above. When the vent valve is open, flow can be measured though its barbed outlet fitting. The flow should be adjusted using the needle valve to allow 35-40 mL/min to exit. To vent solvents, typically set the valve to open for the first minute or two of the run, depending on the solvent retention time.

Vent valve cable connects to the GC-timed events cable to operate the vent valve from the GC-timed events control.

Model 4430 Lamp Power Supply, Front View

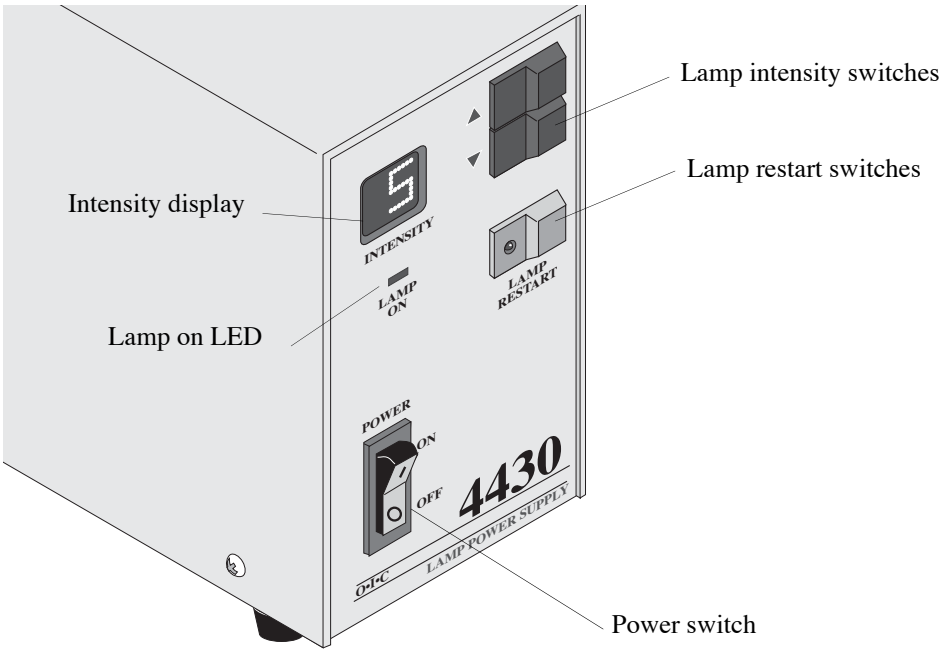


Figure 2.2. Model 4430 lamp power supply, front view

Intensity display shows the lamp current settings in steps from 0 to 9. The 0 setting applies no power. Each successive step increases the lamp current by 0.15 mA, with the exception of the first step being 0.4 mA. The current applied to the lamp ranges from 0 to 1.60 mA. The lamp intensity is proportional to the lamp current. Higher settings shown in the intensity display yield a higher detector response and baseline.

Lamp intensity switches increment the lamp intensity up or down in steps from 0 to 9, as indicated by the intensity display. The intensity setting proceeds through 9 to 0 with continued stepping of either of the lamp intensity switches.

Lamp on LED lights when the voltage and current to the UV lamp are within operating range, indicating that the lamp is on. The indicator turns off in the case of an open or shorted circuit, or a failed lamp.

Lamp restart switch restarts the lamp after it is turned off by the Lampsaver timer circuit. Pressing this switch restarts the lamp and the Lampsaver timer.

Power switch activates lamp power. A neon lamp on the power switch indicates power status.

Model 4430 Lamp Power Supply, Back View

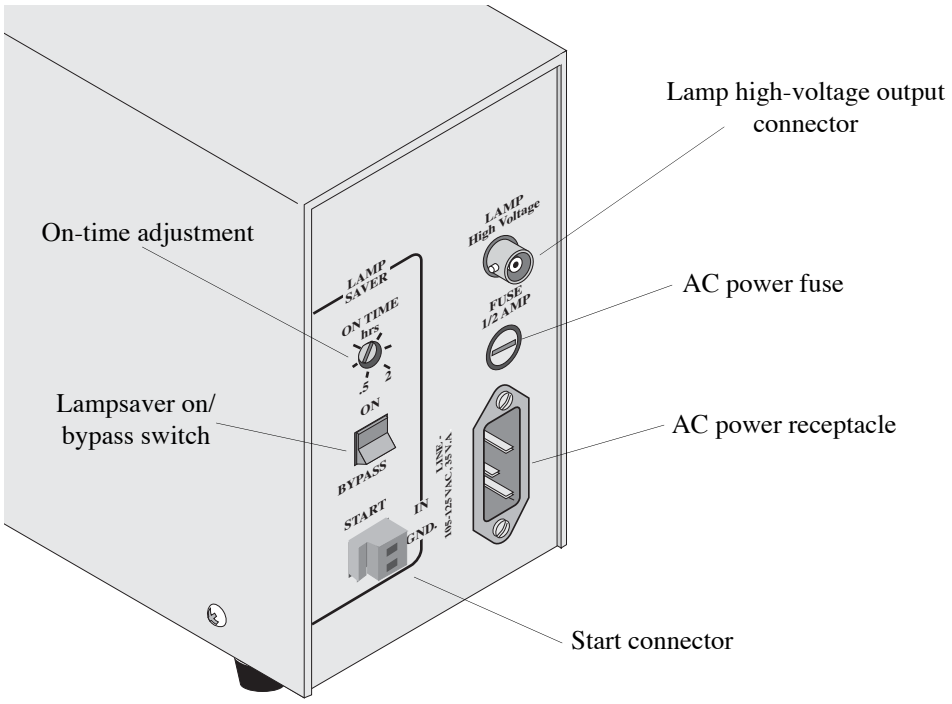


Figure 2.3. Model 4430 lamp power supply, back view

CAUTION:
Voltage requirement ranges from 105 to 120 VAC (210 to 240 VAC), 50 to 60 Hz only.

AC power fuse provides overall protection to the lamp power supply against damage due to electrical malfunction. Use a 0.5-amp fast-blow replacement fuse.

AC power receptacle receives 115 VAC (220 VAC) power using a modular power cord.

WARNING:
The high voltage cable connector and its cable carry up to 2,000 VDC.

Lamp high-voltage output connector (BNC connector) attaches to the cable that supplies power to the lamp. This cable connects to the lamp high-voltage connector on the PID sensor.

CAUTION:
Always match the polarity of all inputs of devices controlled by the same event signal. Typically, use a single event signal to simultaneously restart this timer, GC, and data system.

Lampsaver on/bypass switch activates the Lampsaver circuit. With the switch on, the lamp stays on only for the time controlled by its internal timer, then it automatically turns off to extend lamp life. The time the lamp stays on is adjustable using the on time adjustment. The lamp restarts by an external signal to the start connector or by pressing the lamp restart switch on the front panel. When restarting the lamp, the timer restarts as well as the lamp. The lamp remains on as long as the power supply receives another restart signal before the Lampsaver times out.

Setting the Lampsaver on/bypass switch to bypass disables the Lampsaver circuit, and the lamp stays on indefinitely.

On-time adjustment sets the amount of time the Lampsaver timer runs before it turns off the lamp. This setting continuously adjusts between 30 minutes and two hours.

Start connector accepts a switch or relay closure as well as an active-low TTL, 12 VDC, or 24 VDC event signal, to restart the lamp and Lampsaver timer by remote control.

Chapter 3 Installation

After opening the shipping container, unpack the instrument and check the contents against the component list. If any damage appears, notify the carrier immediately. Save all packing materials until verifying proper detector operation.

NOTE: Ship all instruments returned to OI Analytical for service or warranty repair in the instrument's original box with its packing material. For proper shipping materials, contact the OI Analytical Order Entry Department at (800) 336-1911 or (979) 690-1711.

Installing on an Agilent 7890 or Agilent 6890 GC

Preparing the GC

NOTE: A GC-specific signal cable for connecting the signal output of the detector to a data output device (using spade lug connectors) is included with the PID. Specific signal cables for different data handling devices may also be available but must be ordered separately.

Agilent 7890 or 6890 GC

1. Verify the Agilent 7890 GC's firmware is Revision A.01.05 or later.
2. Set up the GC according to the instructions in the GC operator's manual, if necessary.
3. Set the lamp power supply on the right side of the GC.

WARNING:
The GC electrical components contain high voltage. Turn the GC and the detector power OFF and disconnect all line power.

4. Turn off the GC power and unplug the power cord.
5. Allow the GC oven and any installed detectors and injectors to cool to room temperature.
6. After the heated zones cool, turn off any gas supplies at their sources.
7. Remove the GC detector cover, electronics compartment top and right side covers, the top back cover and metal RFI shield beneath it, and back metal cover. See the *Agilent 7890* or *Agilent 6890 Series Gas Chromatograph Operator's Manual*.

WARNING:
Detectors may be hot!

8. Allow the detector to cool if a detector is already in the desired detector port. Turn off and disconnect all associated gas lines, GC column, and electronics, and remove the detector according to the proper procedure described in the detector's operator's manual.

If no detector is installed, remove the circular port cover and insulation plug from the desired mounting position in the GC's detector area (Figure 3.1). Set the insulation plug aside for later use.

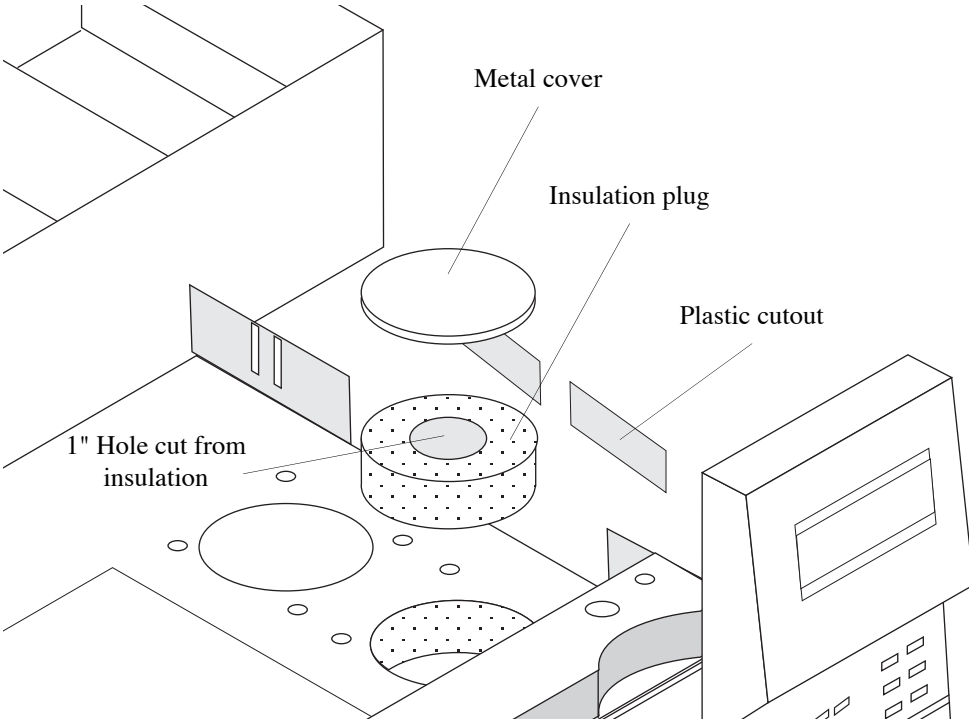


Figure 3.1. Preparing the GC detector port

9. Place a paper towel or tissue paper on the floor of the GC oven. From inside the GC oven, locate the hole on the GC oven top directly below the selected detector port. Cut away the oven wall insulation in the hole.

CAUTION:
Reinstall the insulation plug into the detector port to ensure proper PID heating.

10. Cut a corresponding hole (approximately 1" in diameter) in the insulation plug (removed in step 6). Center the hole cut in the insulation plug over the hole cut in the oven wall insulation in the detector port. Return the insulation plug to its original position in the detector port. After cutting away the insulation, carefully remove all the insulation material debris and paper towel.

11. Remove the appropriate plastic cutout(s) on the GC's top-right side for mounting the detector pallet(s).

Installing the Agilent Electrometer Interface Board

Use the Agilent Electrometer interface board to interface the PID/FID electrometer board to the Agilent 7890 GC logic board (Figure 3.6) or Agilent 6890 GC motherboard (Figure 3.5).

Agilent 7890 GC

1. Remove the electrometer interface board from its static control bag.

2. Position the electrometer interface board in the frame directly under the detector position; see Figure 3.2.

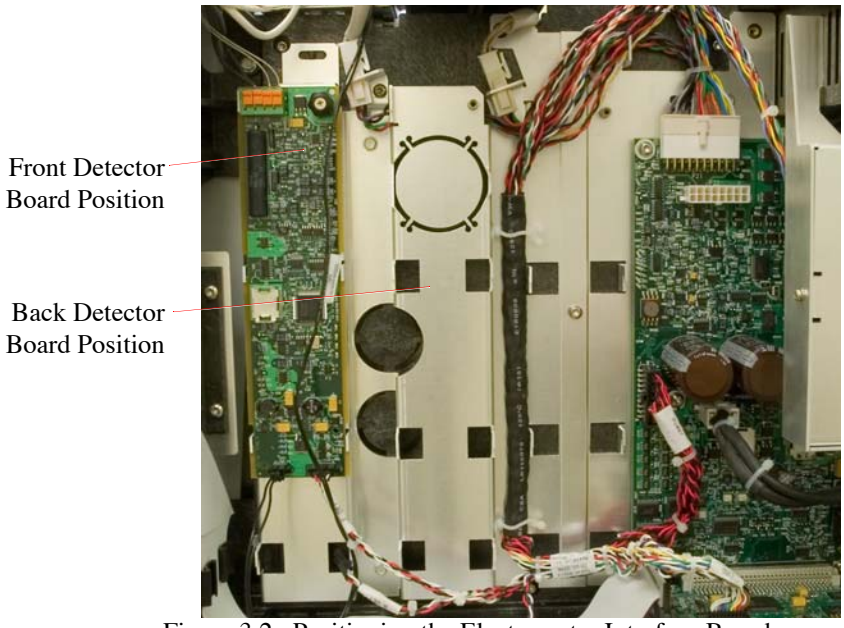


Figure 3.2. Positioning the Electrometer Interface Board

3. Align the electrometer interface board with the frame so that the captive thumbscrew is in the upper right-hand corner and the circuits are facing out. See Figure 3.3.

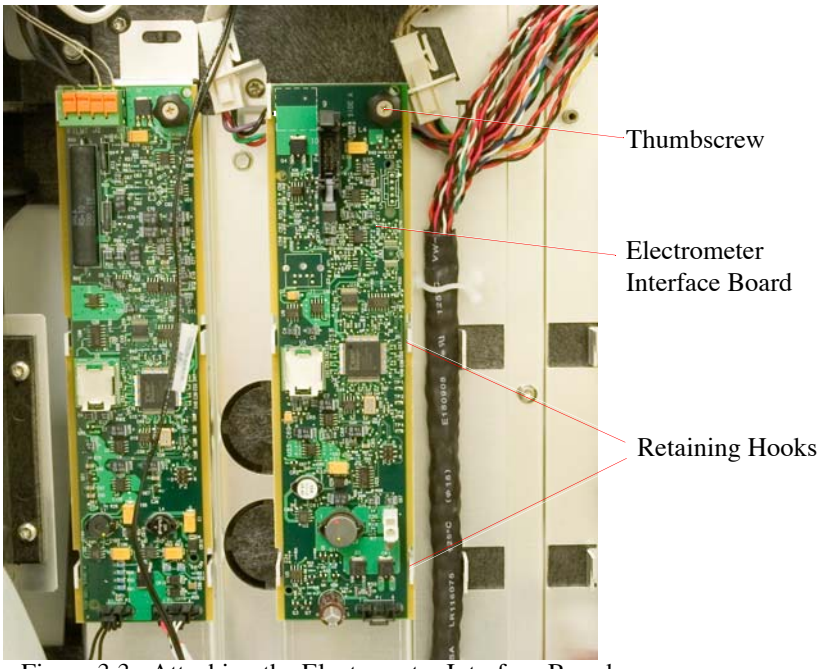


Figure 3.3. Attaching the Electrometer Interface Board

4. Starting with the board notches below the retaining hooks on the GC frame, slide the board up so that all slots engage all hooks, the board lies flat and evenly on the frame, and the captive thumbscrew aligns directly over the screw hole. See Figure 3.3.

5. Tighten the thumbscrew.

6. Locate the GC communication wire and connect it to the communication connector on the electrometer interface board. The communication cable for the front detector

location is labeled F-DET and the cable for the back detector location is labeled B-DET. Refer to Figure 3.4.

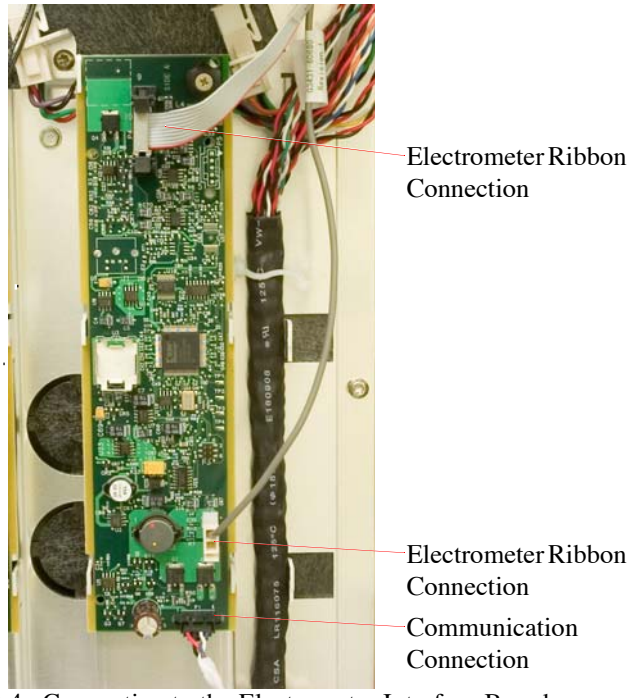


Figure 3.4. Connecting to the Electrometer Interface Board

Agilent 6890 GC

1. Remove the board from its static control bag and slide it into the "Front Detector" or "Back Detector" slot on the main board in the electronics compartment on the right side of the GC until it is plugged in. Tighten the screw on the interface board with a T-20 Torx® screwdriver.

2. Plug the electrometer ribbon cable into the appropriate connector on the interface board (Figure 3.5). Push the connector until the plug is firmly in place. Lock the

connector by moving the tabs to the center of the connector until they click into place.

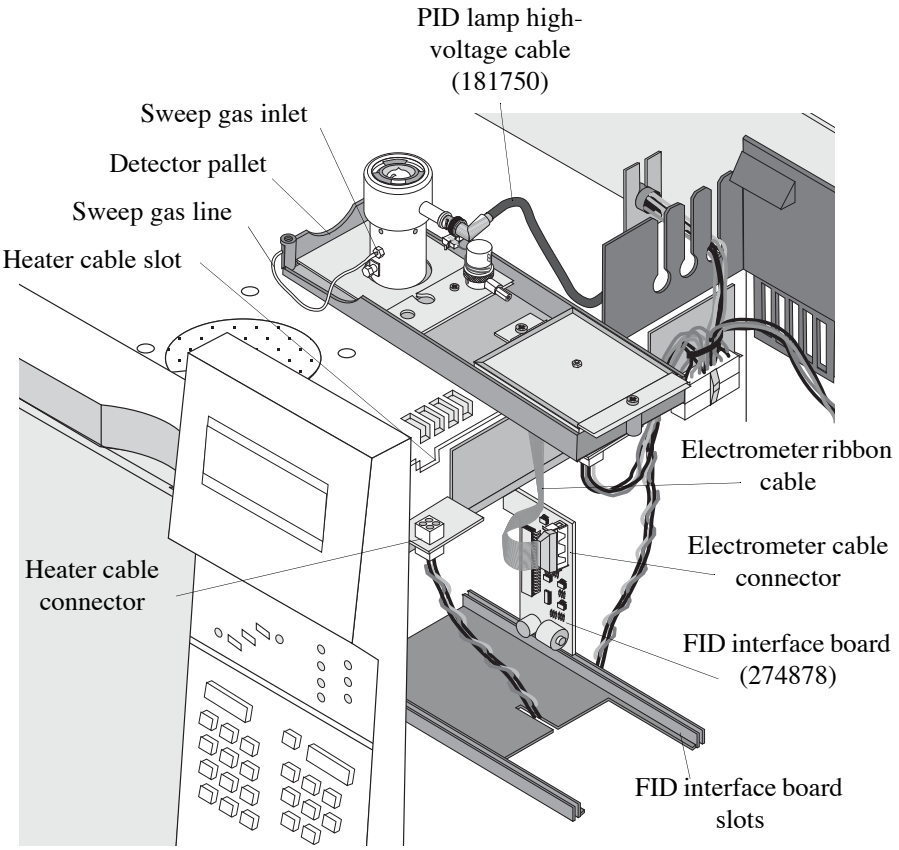


Figure 3.5. Agilent 6890 GC electronics compartment

Installing the PID Detector Pallet

Agilent 7890 or 6890 GC

1. Carefully remove the detector pallet assembly from its packaging.

2. While holding the detector pallet assembly, attach the heater cable connector to the matching connector on the bracket located above the GC motherboard above the electrometer interface board on the Agilent 7890 (Figure 3.6) or on the right side of the Agilent 6890 (Figure 3.5).

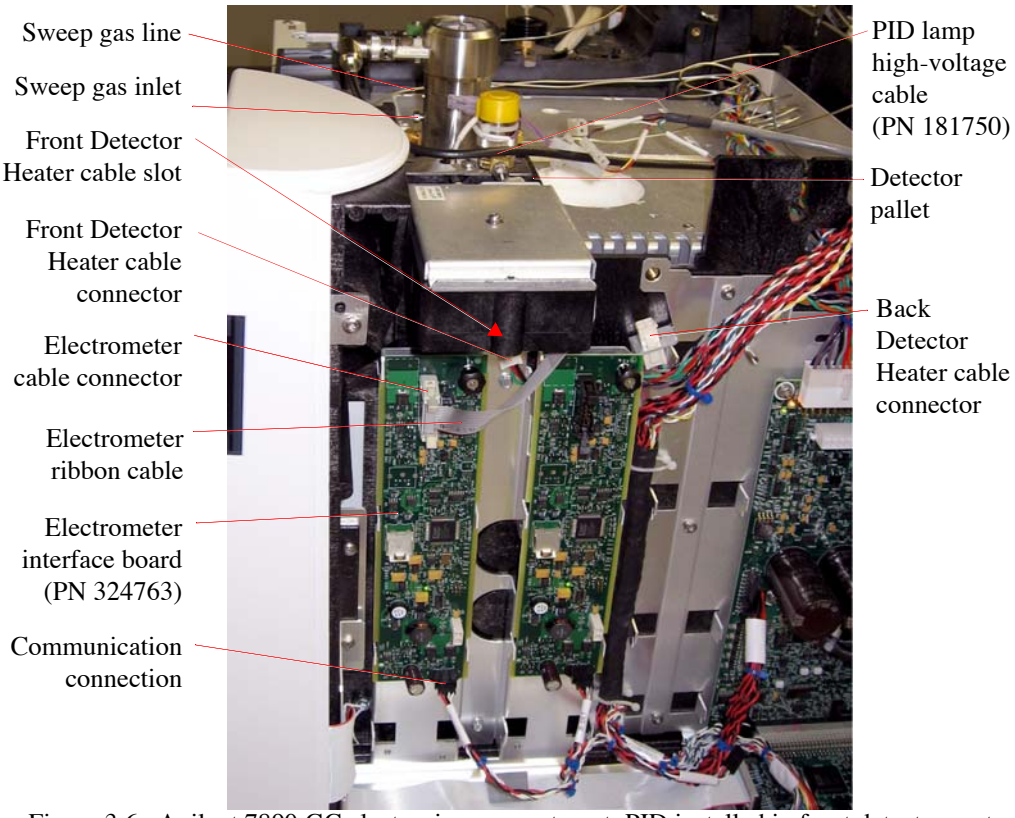


Figure 3.6. Agilent 7890 GC electronics compartment: PID installed in front detector port

3. Place the detector pallet assembly into the appropriate detector port. Do not remove the ¼" plug nut on the PID inlet until ready to install the makeup gas connector (see “Installing the Makeup Gas” on page 32 in this chapter). The heater cable rests in the small notch or slot under the pallet. Verify the insulation is properly installed as described in the previous section.

4. Align the holes of the detector pallet assembly with the holes in the top of the GC. Tighten the four captive screws on the detector pallet (Figure 2.1) using a T-20 Torx screwdriver to secure the pallet assembly to the top of the GC.

5. Plug in the electrometer ribbon cable to the electrometer interface board.

6. Attach the right-angled connector of the PID lamp high-voltage cable (PN 181750) to the lamp high-voltage cable connector on the PID (Figure 3.6 for Agilent 7890, Figure 3.5 for Agilent 6890). Orient the right-angled connector so the cable leads toward the back of the Agilent GC. Route the cable along the right side of the

Agilent GC to the back. Attach the other end of the lamp high-voltage cable to the lamp high-voltage output connector on the back of the lamp power supply.

7. Verify the PID vent valve is screwed on securely. Plug in the PID vent valve cable to the VLV 5 or VLV 6 connector of the external events cable remote start cable (PN 252569). Route the cable along the top of the Agilent GC to the back of the GC. Extend the cable out the right side or back so the end of the cable is available after reinstalling the covers. Connect the free end of the external events cable to the EXT EVNT connector on the back left side of the Agilent GC. Ensure the VLV 5 or VLV 6 (whichever is used) is configured to switching mode and is in the ON position. See the *Agilent 7890* or *Agilent 8890 Series Gas Chromatograph Operator's Manual* for instructions on valve configuration.

8. If using Agilent Chemstation, connect the LAN cable to the GC for Agilent Chemstation. See the *Chemstation Operator's Manual* for more information.

9. If using data handling software other than Agilent Chemstation, use the analog output on the back of the GC; the analog output cable (PN 22521) must be ordered separately.

10. Plug the GC signal cable into the SIG 1 or SIG 2 analog signal connector on the back of the Agilent 7890 or 6890. Using the Agilent 7890 or 6890 GC keypad, ensure the selected detector location and analog signal output are correctly connected (usually, the SIG 1 output is used for the front detector position, and the SIG 2 output for the back detector position). Connect the free end of the signal cable into the appropriate data handling device.

Installing the Gas Control Module

Agilent 7890

The pressure control manifold is the gas flow control device that connects the main gas source and the PID. The preferred gas supply option for the Model 4430 PID is the open interface module (OIM) pressure control manifold (PN 324768), which mounts in the back of the Agilent 7890 GC in one of the EPC ports marked "EPC3" (front detector) or "EPC4" (back detector); see Figure 3.8 and Figure 3.8.

NOTE: The OIM pressure control manifold requires well-regulated gas supplies to operate the PID. Pressure in the 50–70 (maximum 90) psi range is acceptable.

NOTE: All gas line tubing must be chromatography quality to prevent detector noise and instability during operation.

Table 3.1. Gas supplies for the Model 4430 PID and PID tandem detector configurations

Detector Model	Electronic Pressure Control Configuration	Gas Connections		
		Gas Inlet Port Labels		
		H2	Makeup[1]	Air
Model 4430 PID	1 x OIM	H_2[2] *PIDSweep*	He *Makeup*	— *Not Used*
Model 4450 PID/FID	1 x OIM	H_2 *PIDSweep*	He *Makeup*	Air *FID Air*
Model 5350 PID/ELCD	1 x OIM	— *Not Used*	He *Makeup*	H_2[3] *ELCD H2*
Model 5390 PID/XSD	1 x OIM	He *PIDSweep*	He *Makeup*	Air *XSD Air*

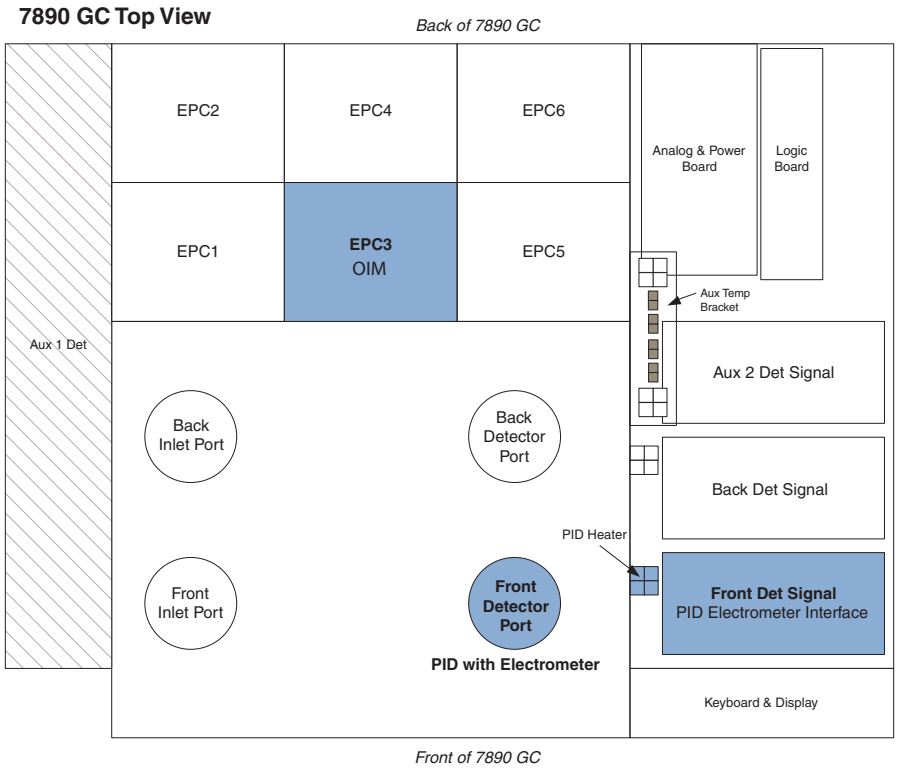
1 Nitrogen can replace He for makeup gas.
2 Helium can replace H_2 for the PID sweep gas.
3 Plumb H_2 through the air channel to ensure delivery of enough H_2. This results in actual H_2 flow values approximately two times the set value.

Install the OIM pressure control manifold into the Agilent 7890 and the gas supply from the OIM to the PID using following procedure.

1. Remove the EPC module bracket by loosening the captive screws and lifting off the brackets (Figure 3.7).

Figure 3.7. Locating the EPC Module Brackets

2. Locate the correct mounting slot for the EPC module. The slot labeled EPC3 is for the front detector position, and the slot labeled EPC4 is for the back detector position (Figure 3.8 and Figure 3.9).



Agilent 7890 GC Detector Configuration Selections
Front Det: CPDET FID, Htr, EPC

Figure 3.8. Agilent 7890 Top Detector Locations, Typical Configuration for PID

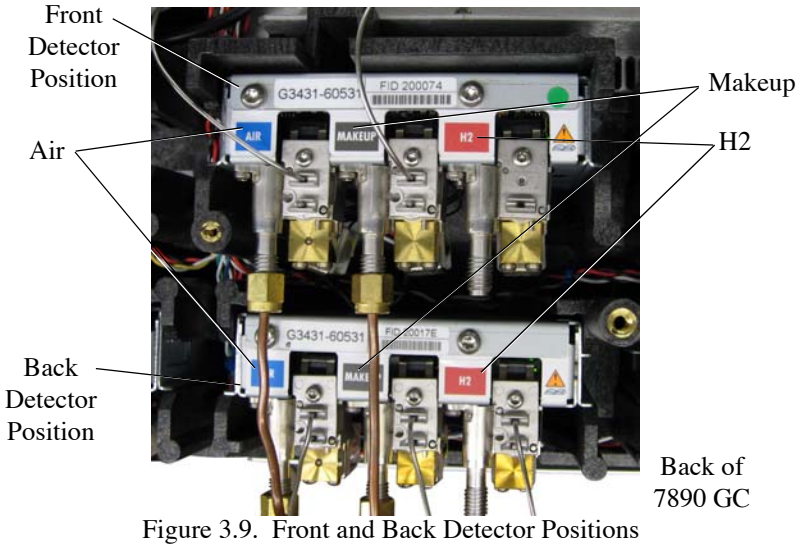


Figure 3.9. Front and Back Detector Positions

3. Attach the communication cable to the EPC module (Figure 3.10).

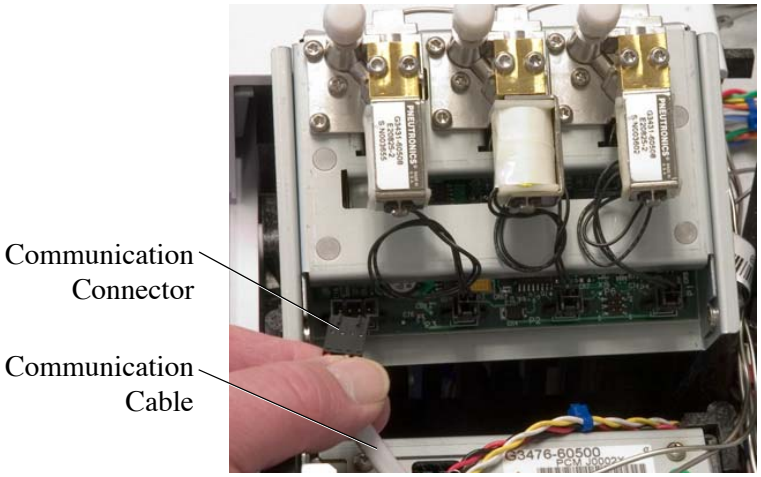


Figure 3.10. Attaching the communication cable to the EPC module

4. Slide the module into the vertical slot tracks. Arrange the cable to prevent it from being pinched by the EPC module (Figure 3.11).

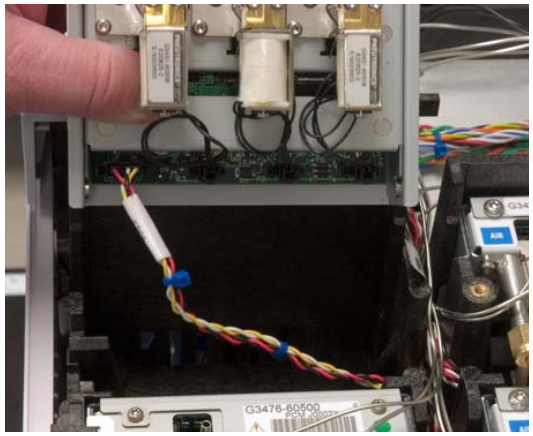


Figure 3.11. Installing the EPC module

5. Remove the protective caps from the appropriate gas inlets using Table 3.1 and Figure 3.13 (for standalone PID), Figure 3.14 (for PID/FID), Figure 3.15 (for PID/XSD), or Figure 3.16 (for PID/ELCD).

6. Connect the appropriate gas supplies to the inlets using ⅛" brass nuts and ferrules (Figure 3.17).

7. Remove the appropriate tubing connector blanks (Figure 3.12) from the EPC module to expose the O-rings and restrictors.

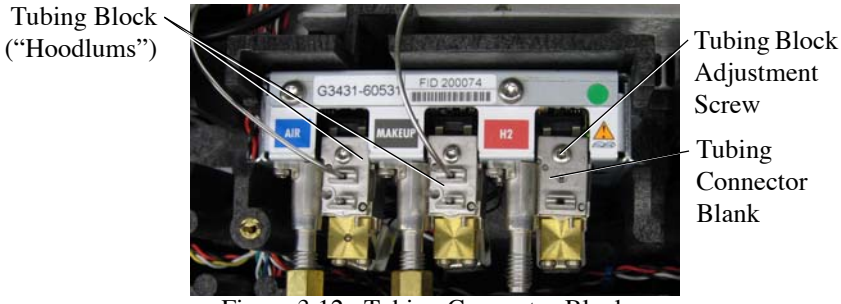


Figure 3.12. Tubing Connector Blanks

8. Attach the tubing blocks (hoodlum block assembly with integrated ⅛" stainless steel lines) to the appropriate manifolds and tighten each screw (see Table 3.1).

9. Cut off the ⅛" welded nibs on the end of the lines.

10. Route the tubing through the channel between the EPC slots to reach the detector area. Keep the tubing away from the EPC module bracket area.

11. If installing a standalone PID, PID/FID, or PID/XSD, attach the sweep gas supply line (the hoodlum assembly connected to the "H2" outlet on the OIM gas outlet block) to the sweep gas inlet on the side of the PID using the supplied 1/16" nut (PN 196311) and ferrule (PN 196246). See Figure 3.5 and Figure 3.13 (for standalone PID), Figure 3.14 (for PID/FID), or Figure 3.15 (for PID/XSD).

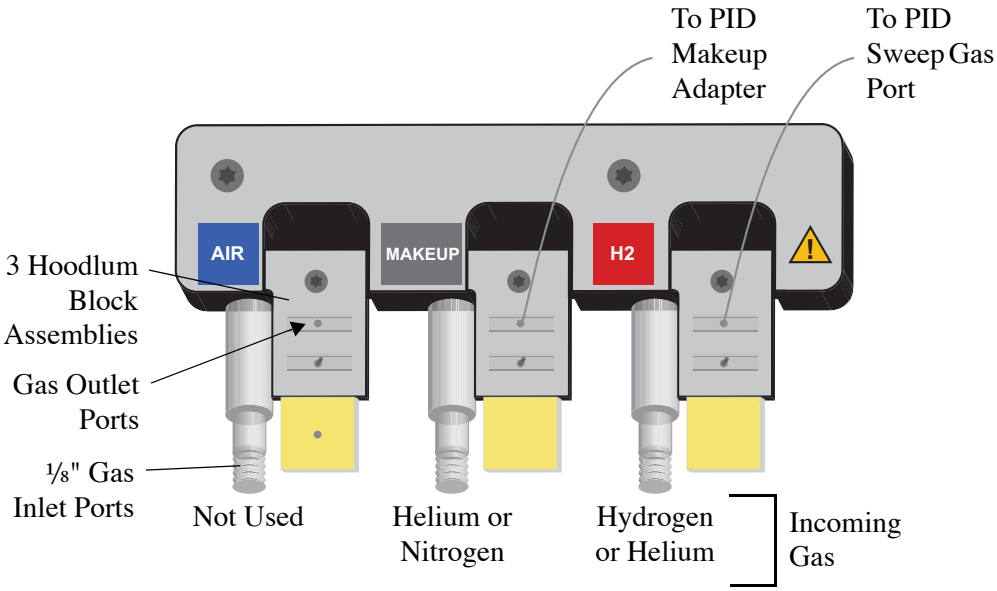


Figure 3.13. OIM Module Plumbing for Standalone PID

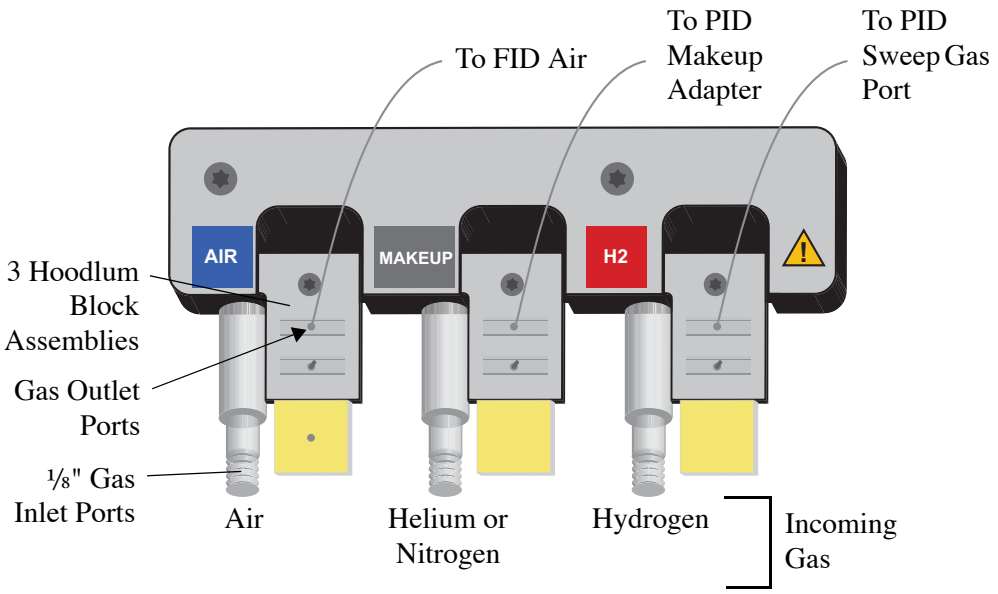


Figure 3.14. OIM Module Plumbing for PID/FID

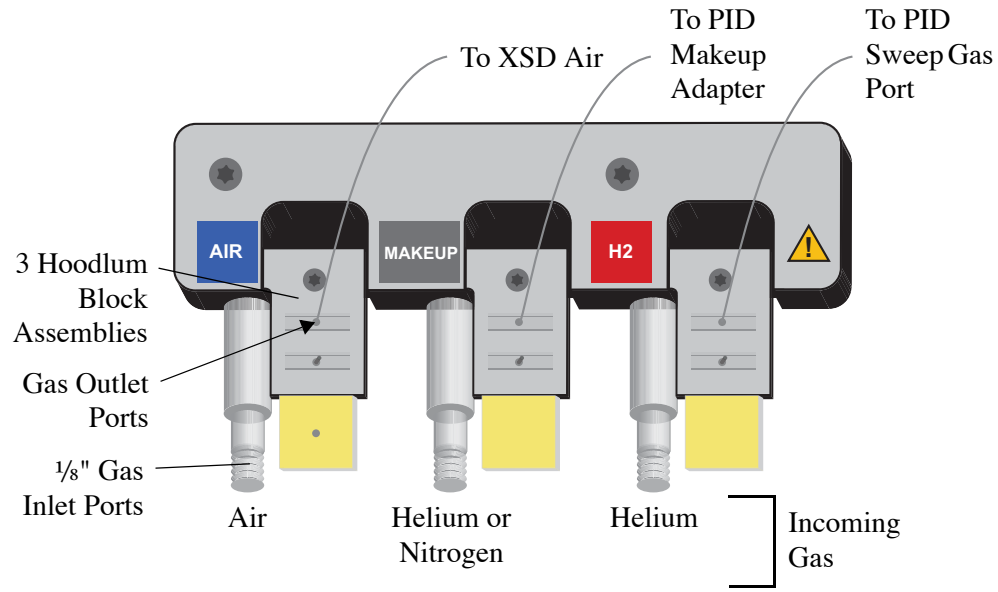


Figure 3.15. OIM Module Plumbing for PID/XSD

12. If installing a PID/ELCD, attach the H_2 gas supply line (the one connected to the "Air" outlet on the OIM gas outlet block) to the sweep gas inlet on the side of the PID using the supplied 1/16" nut (PN 196311) and ferrule (PN 196246). See Figure 3.5 and Figure 3.16.

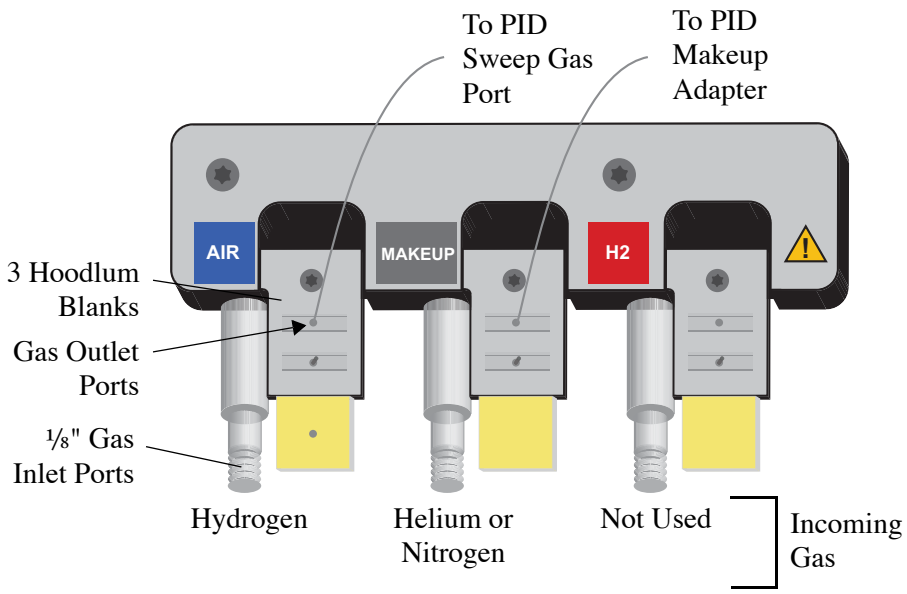


Figure 3.16. OIM Module Plumbing for PID/ELCD

13. Reattach the EPC module brackets using the previously removed screws.

14. Attach the makeup gas supply line to the tee fitting at the base of the PID as described in “Installing the Makeup Gas” on page 32 in this chapter.

Agilent 6890

The pressure control manifold is the gas flow control device that connects the main gas source and the PID. The preferred gas supply option for the Model 4430 PID is the open interface module (OIM) pressure control manifold (PN 285049), which mounts in the back of the Agilent 6890 GC in one of the pneumatics carrier ports marked “Front Detector” or “Back Detector.” OI Analytical programs the OIM pressure control manifold in the factory for the desired detector configuration. See Table 3.2 for the gas inlet and outlet configurations that apply when using the OIM pressure control manifold. Alternatively, supply gas to the PID through an AUX pressure control manifold (PN 275974), which mounts in the pneumatics carrier port marked “AUX.” Refer to the *Agilent 6890 GC Auxiliary Pressure Manifold Installation* for further information.

NOTE: Both the OIM and AUX pressure control manifolds require well-regulated gas supplies to operate the PID. Pressure in the 50–70 (maximum 90) psi range is acceptable.

NOTE: All gas line tubing must be chromatography quality to prevent detector noise and instability during operation.

Table 3.2. Gas supplies for the Model 4430 PID and PID tandem detector configurations

Detector Model Showing	Pressure Control Manifold Configuration	Gas Inlet and Outlet Port Showing		
OIM Detector Title		OIM Detector Gas Labels		
		H2	Makeup[1]	Air
Model 4430 PID *OI4430*	1 x OIM	H_2[2] *PIDSweep*	He *Makeup*	— *Not Used*
Model 4450 PID/FID *OI4450*	1 x OIM	H_2 *PIDSweep*	He *Makeup*	Air *FID Air*
Model 5350 PID/ELCD *OI5350*	1 x OIM	— *Not Used*	He *Makeup*	H_2[3] *ELCD H2*
Model 5390 PID/XSD *OI5390*	1 x OIM	He *PIDSweep*	He *Makeup*	Air *XSD Air*

1 Nitrogen can replace He for makeup gas.
2 Helium can replace H_2 for the PID sweep gas.
3 Plumb H_2 through the air channel to ensure delivery of enough H_2. This results in actual H_2 flow values approximately two times the set value.

Install the OIM pressure control manifold into the Agilent 6890 and the gas supply from the OIM to the PID using following procedure. The required parts are included in the supplied detector gas kit (PN 251892).

1. Ensure all gas supply lines used with the PID pneumatic system are turned off.

2. Remove the Agilent gas outlet block attached to the front upper right corner of the OIM pressure control manifold by unscrewing the Torx T-20 outlet block attachment screw (PN 185561). Leave the three O-rings in place (Figure 3.17).

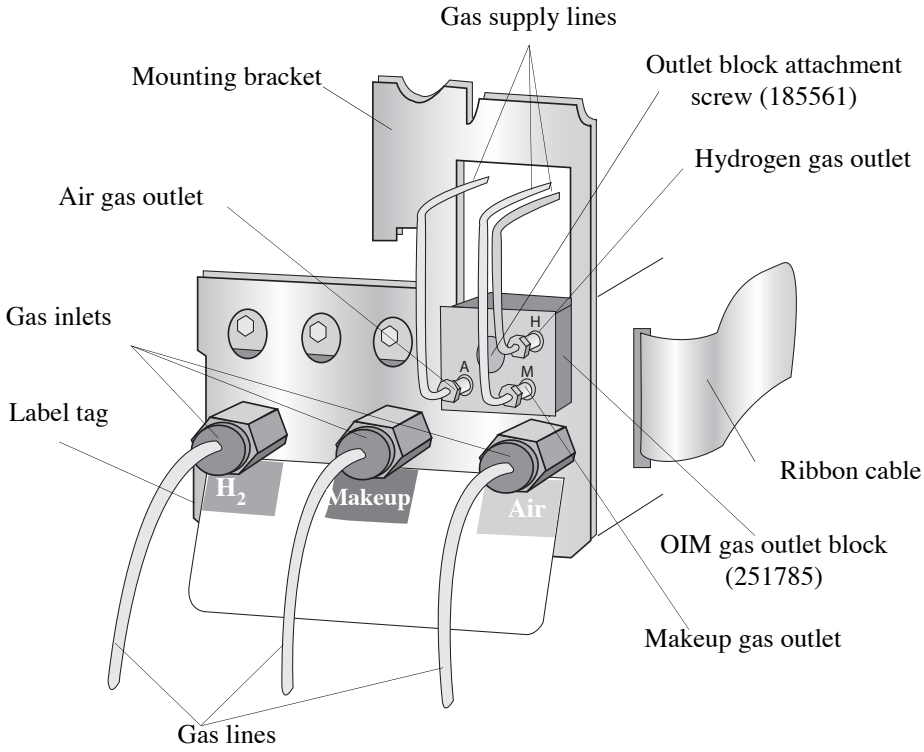


Figure 3.17. OIM gas flow module configured for PID/XSD or PID/FID

3. Remove the protective caps from the gas inlets.

4. Slip the label tag through the bottom slot of the mounting bracket. Align the mounting bracket over the OIM pressure control manifold.

5. Place the 7/16" hex nuts provided on the gas inlets. Do not tighten the hex nuts.

6. With the three O-rings in place, attach the OIM gas outlet block (PN 251785) to the OIM pressure control manifold using the outlet block attachment screw. Ensure the OIM gas outlet block is flush with the OIM pressure control manifold.

7. Tighten the 7/16" hex nuts on the gas inlets and secure the mounting bracket to the OIM pressure control manifold. Replace the protective caps on the gas inlets.

8. Route the ribbon cable behind the OIM pressure control manifold.

9. Slide the OIM pressure control manifold into the appropriate “Front Detector” or “Back Detector” slot on the back of the GC until the bracket aligns flush with the carrier rails.

NOTE: If installing a PID/FID, place the OIM pressure control manifold in the “Front Detector” slot.

10. Connect the ribbon cable to the appropriate connector on the electronic board. Push until firmly in place. Lock the connector by moving the tabs to the center of the connector until they click into place. Ensure the ribbon cable is away from the valves and is not being pressed against the OIM pressure control manifold.

11. Secure the OIM pressure control manifold by tightening the captive Torx T-20 screw on the pneumatics compartment wall.

12. Route the gas supply lines from the OIM gas outlet block behind the OIM pressure control manifold, over the top of the chassis, and through the slot. Cover the end of the makeup gas supply line with a plastic plug and route it down into the GC oven through the opening in the oven lining.

13. Plug any unused gas outlets with the 1/16" ferrules and nuts provided.

Agilent 6890 GC Plumbing

1. Use 1/8" brass nuts and ferrules to attach the appropriate supply gases to the OIM. Refer to Table 3.2 and Figure 3.18 or Figure 3.21.

2. Prepare gas delivery lines by cutting section(s) of 1/16" stainless steel tubing (PN 193409, supplied in the detector gas kit) long enough to reach from the OIM pressure control manifold to the appropriate detector ports.

3. If installing a standalone PID, PID/FID, or PID/XSD, attach the sweep gas supply line to the “H” outlet on the OIM gas outlet block using a 1/16" nut (PN 223057) and ferrule (PN 216366); refer to Figure 3.18 for PID, Figure 3.19 for PID/FID,or Figure 3.20 for XSD.

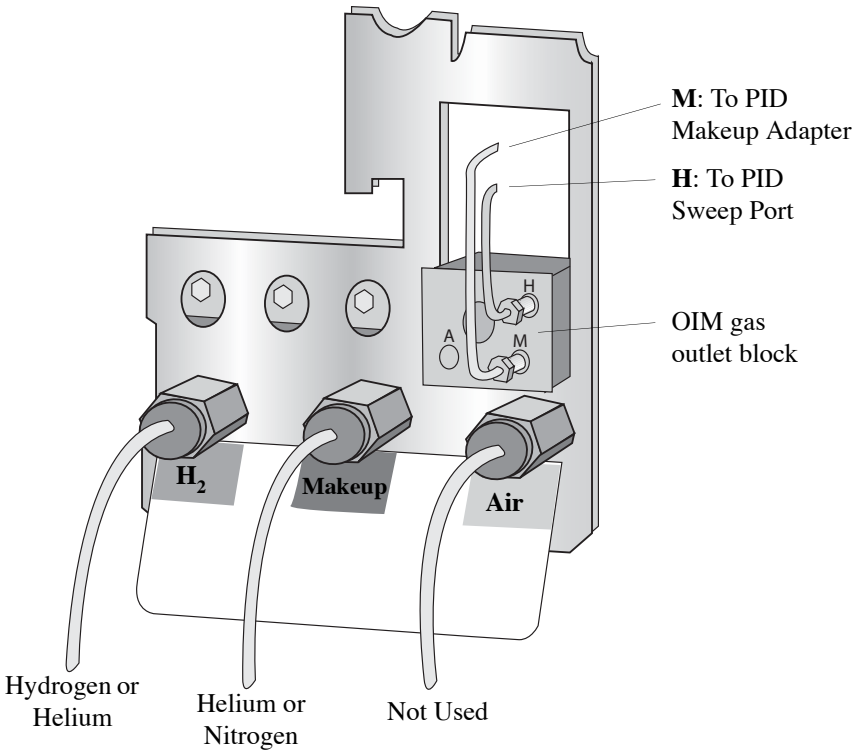


Figure 3.18. OIM Module Plumbing for PID Standalone

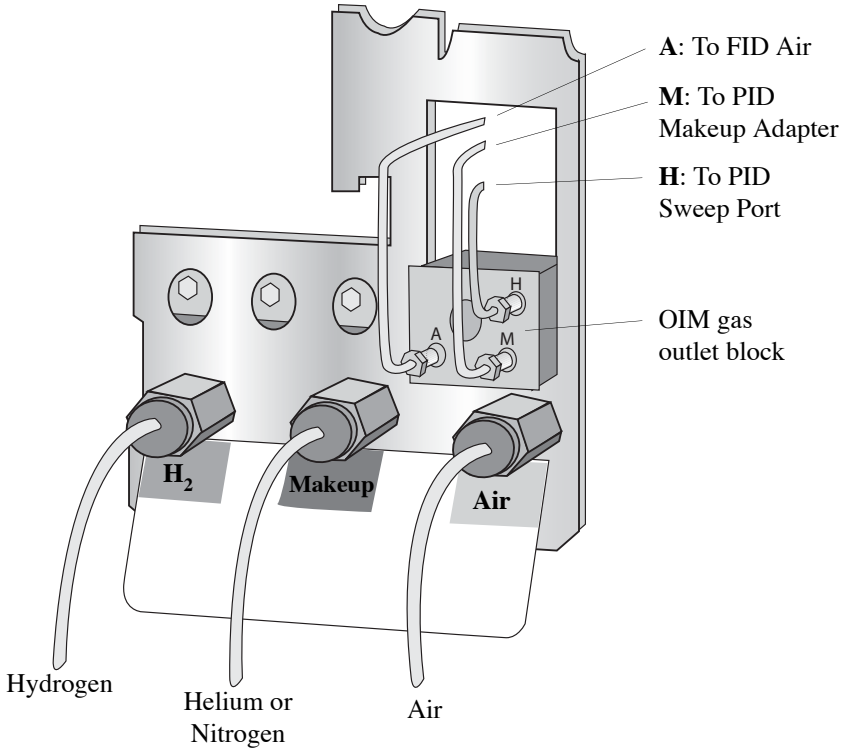


Figure 3.19. OIM Module Plumbing for PID/FID

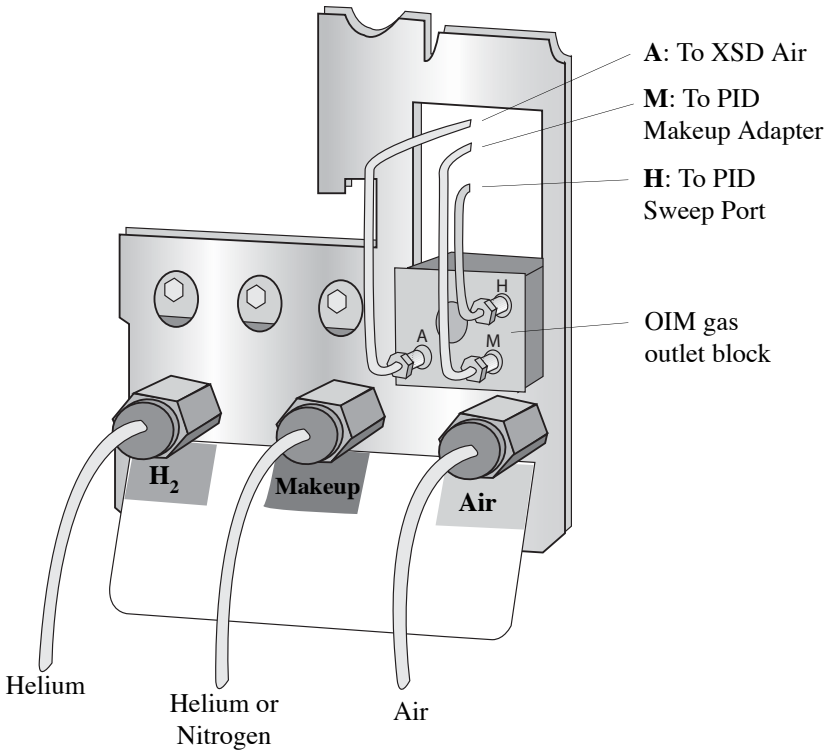


Figure 3.20. OIM Module Plumbing for PID/XSD

4. Connect the other end to the sweep gas inlet on the side of the PID using the supplied 1/16" nut (PN 196311) and ferrule (PN 196246). See Figure 3.5.

5. If installing a PID/ELCD, attach the sweep gas supply line to the "A" outlet on the OIM gas outlet block using a 1/16" nut (PN 223057) and ferrule (PN 216366); refer to Figure 3.21.

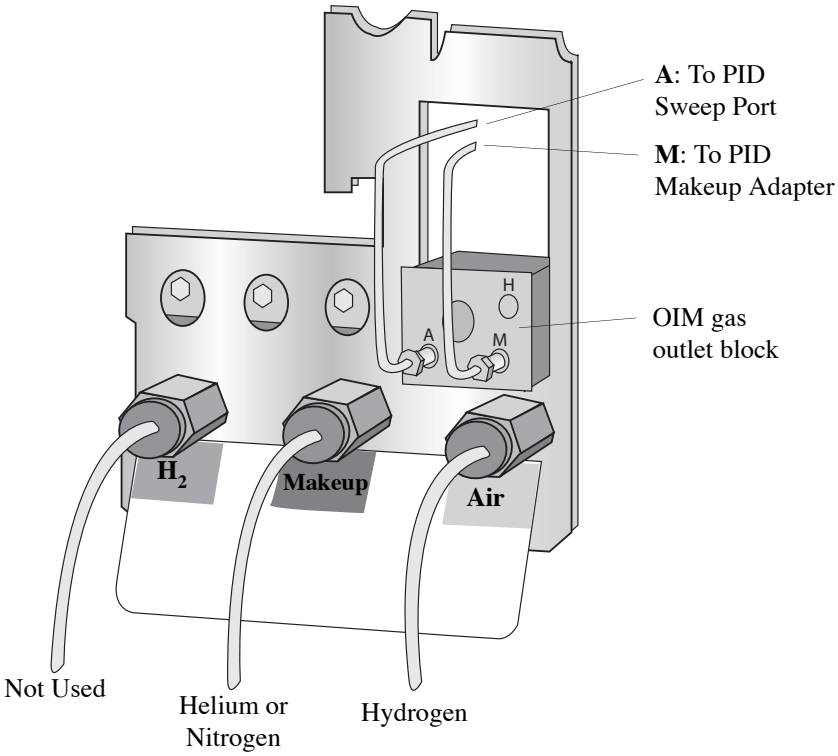


Figure 3.21. OIM Module Plumbing for PID/ELCD

6. Connect the other end to the sweep gas inlet on the side of the PID using the supplied 1/16" nut (PN 196311) and ferrule (PN 196246). See Figure 3.5.

7. Attach the makeup gas line to the "M" outlet on the OIM gas outlet block using a ferrule (PN 216366) and 1/16" nut (PN 223057).

8. Attach the other end of the makeup gas supply line to the tee fitting at the base of the PID as described in "Installing the Makeup Gas" on page 32 in this chapter.

9. Remove the appropriate detector cutout from the GC's top back panel using needle-nosed pliers.

10. Replace the GC's top back panel.

Installing the Makeup Gas

Agilent 7890 or 6890 GC

1. Remove the PID makeup gas adapter (PN 186338) from its packaging and the ¼" nut (PN 169682) and ¼" ferrule (PN 222794) from the PID kit (Figure 3.22).

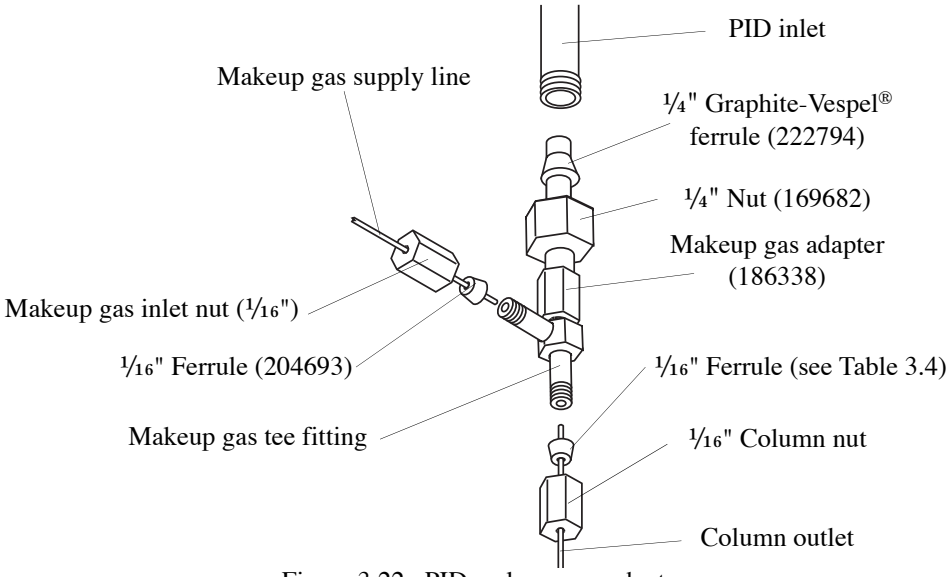


Figure 3.22. PID makeup gas adapter

2. Slide the nut and then the ferrule over the ¼" end of the makeup gas adapter. See Figure 3.22 for the orientation of the ferrule.

3. Remove the ¼" plug nut from the PID inlet from inside the GC oven.

4. Slide the makeup gas adapter into the PID inlet as far as it can go (Figure 3.22).

5. While pushing up gently on the makeup gas adapter, tighten the ¼" nut until it is secure. Orient the makeup gas inlet nut so it points to the left.

6. Attach the free end of the makeup gas line previously routed into the GC oven to the makeup gas tee fitting using the supplied 1/16" nut and ferrule (PN 204693).

7. Check all gas line connections for leaks.

Table 3.3 provides the PID gas flow requirements.

Table 3.3. PID gas supply requirements

Gas Requirement	Species	Required Flow Rate
PID makeup gas	N_2 or He	10–30 mL/min
PID sweep gas	H_2 or He	20–40 mL/min

Installing the Column

Install 0.53-mm or smaller I.D. capillary columns into the PID base using the following steps:

Agilent 7890 or 6890 GC

1. Open the GC oven door. From inside the GC oven, remove the 1/16" column nut from the bottom of the makeup gas adapter.

2. Slide the column nut and the appropriate 1/16" graphite-Vespel ferrule onto the column with the tapered end of the ferrule facing into the column nut. See Table 3.4 for the appropriate ferrule.

Table 3.4. Column ferrules used with the PID

Base	Column	Ferrule I.D.	Material I.D.	PN
1/16"	0.53	0.8 mm	Graphite-Vespel	196105
1/16"	0.32	0.5 mm	Graphite-Vespel	196113
1/16"	<0.32	0.4 mm	Graphite-Vespel	208330

3. Cut a small section off the end of the column using a proper column cutting tool to remove any foreign particles that may have lodged in the column's open end. Verify a clean, straight cut.

4. With the ferrule and nut on the column, push the column up into the inlet at the base of the PID until the column outlet extends approximately 98 mm from the bottom (back) of the column nut to the end of the column. For 0.53-mm columns, push the column until it stops and pull back 0.5 mm. Be careful to NOT extend the column beyond 98 mm. With the other hand, fingertighten the 1/16" nut in a clockwise direction. If the column is not secure, use a 9/16" wrench to tighten the nut sufficiently. Do not overtighten. Pull down lightly to verify the column is not broken.

5. Check the connection for leaks.

6. After installing the column, replace all of the GC covers and panels.

Configure the GC

Agilent 7890

1. Power on the GC.
2. Unlock the keyboard by pressing **Options** and selecting **Keyboard & Display**.
3. Scroll to **Hard Configuration lock**.
4. Press **Off/No**.

Configure the Detector

Standalone PID Configuration

1. Press **Config** and then either **Front Det** or **Back Det**, depending upon your configuration.
2. Press **Mode/Type**.
3. Scroll to the selection **CPDET FID, Htr, EPC*** and press **Enter**.
4. Soft power-cycle the GC as follows:
   a. Press **Options**.
   b. Scroll to **Communications** and press **Enter**.
   c. Scroll to **Reboot GC**.
   d. Select **On/Yes** twice.
5. Once the GC has restarted, press **Config** and then **Front Det** or **Back Det**, depending upon your configuration.
6. Configure the makeup gas:
   a. Scroll to **Makeup Gas Type**.
   b. Press **Mode/Type**.
   c. Select the appropriate gas type and hit **Enter**.
7. Turn off the GC.

Other Detector Configurations

For other detector configurations, refer to “Installing PID Tandem Detectors” on page 35 and Chapter 7, “Location of EPC Modules, Signals, and Heaters for an Agilent 7890” on page 54.

* Other detector configuration selections are listed in Figure 7.2 through Figure 7.7 starting on page 55.

Installing PID Tandem Detectors

The following provides instructions for installing the Model 4410 FID, Model 5320 ELCD, or Model 5360 XSD onto the side of the Model 4430 PID, assuming the PID is correctly installed. For detailed descriptions of the operating procedures and for troubleshooting guidelines of the FID, ELCD, or XSD, refer to the relevant operator’s manual.

Refer to “Installing the Gas Control Module” on page 19 of this chapter for details on installing the OIM pressure control manifold in the pneumatics compartment of the Agilent 7890 or 6890. See Table 3.1 or Table 3.2 for the gas inlet and outlet configurations that apply when using the OIM pressure control manifold.

Installing the Model 4410 FID onto the PID

The Model 4450 Tandem Detector consists of the Model 4410 FID mounted on the Model 4430 PID. See Table 3.2 for the gas supply connections at the OIM pressure control manifold for the Model 4450 PID/FID. See the *Model 4410 Flame-Ionization Detector Operator’s Manual* for installing, operating, and troubleshooting the Model 4410 FID. Also refer to the Model 4410 manual for installing the second electrometer required for operating the PID/FID.

WARNING:
Ensure the PID is cool, to avoid burns, etc.

Agilent 7890 or 6890 GC

1. Remove the fitting, short tube, and graphite reducing ferrule from the PID outlet on the side of the PID sensor.

CAUTION:
Verify the Allen set screw is completely removed to avoid damaging the O-rings on the FID base fitting.

2. Remove the FID base fitting from the FID body by loosening the Allen set screw using a 0.050" Allen wrench (Figure 3.23).

3. Slide the supplied graphite/vespel ferrule (PN 232314) onto the FID jet.

4. Screw the FID base fitting (with the two installed O-rings) over the jet (with the graphite/vespel ferrule) into the exhaust port of the PID (Figure 3.23). Verify the jet is firmly seated against the recess in the PID exhaust port. Carefully tighten the base with a 5/16" wrench.

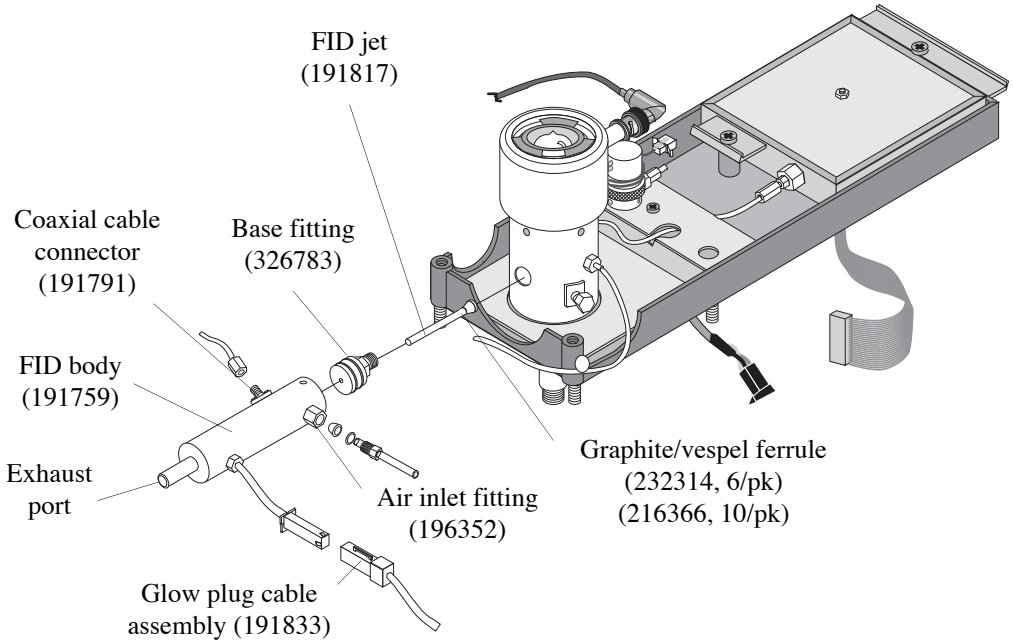


Figure 3.23. Model 4450 PID/FID assembly

5. Slide the FID body over the FID base fitting. Reinstall the Allen set screw.

6. Attach the FID body to the base of the FID by tightening the Allen set screw. Carefully check the tightness of the set screw.

7. Remove the protective cap from the gas inlet marked “Air” on the front of the OIM pressure control manifold and attach the air supply line to this inlet using a 1/8" brass nut and ferrule (not supplied). See Figure 3.9 (Agilent 7890 GC) or Figure 3.17 (Agilent 6890 GC).

8. Ensure the gas lines push into their respective connectors as far as they can go before tightening the nut onto the connector. Securely tighten each 1/8" nut using a 7/16" wrench.

Agilent 7890 GC

1. Install the hoodlum assembly, provided with the OIM, in the Air position (see Figure 3.24).

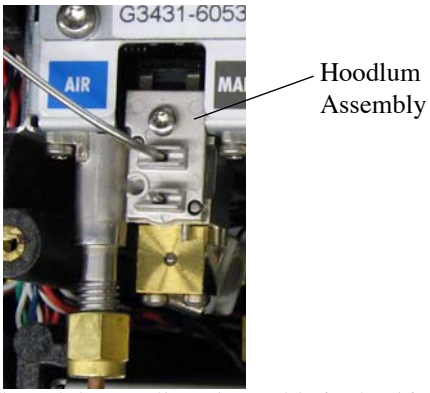


Figure 3.24. Aux EPC Module Hoodlum Assembly in the Air Position

2. Cut the ⅛" nib off the end of the hoodlum assembly.

Agilent 6890 GC

1. Prepare an air delivery line by cutting a section of 1⁄16" stainless steel tubing (PN 193409, supplied in the detector gas kit) long enough to reach from the OIM pressure control manifold to the air inlet fitting on the side of the FID (Figure 3.25).

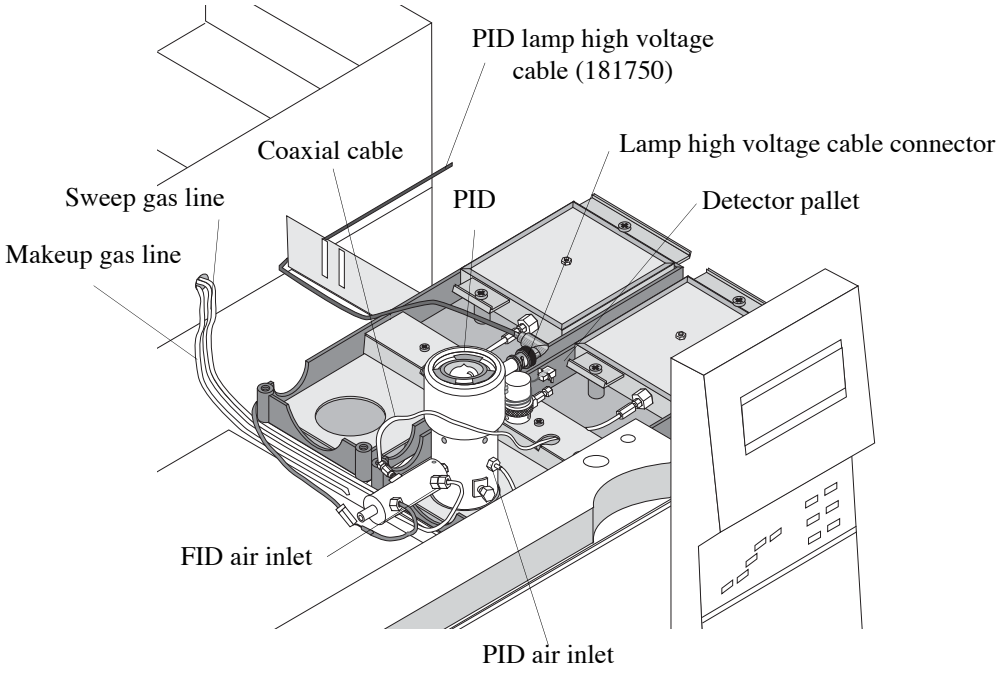


Figure 3.25. PID/FID mounted on an Agilent 6890 GC

2. Remove the plug from the outlet marked “A” on the gas outlet block on the OIM pressure control manifold.

3. Using a 1/16" nut (PN 223057) and ferrule (PN 216366), attach one end of the stainless steel tubing to the outlet marked "A."

4. Ensure the air delivery line pushes into the gas outlet block as far as it can go before tightening the nuts into the gas outlet block. Securely tighten the nuts using a 5/16" wrench.

Agilent 7890 or 6890 GC

1. Route the air delivery line to the back of the GC and through the appropriate hole in the pneumatics carrier. Align it with the H_2 and makeup gas lines in the tubing guide on the top of the GC to the detector area.

2. Attach the free end of the air gas line to the air inlet fitting (PN 196352) on the FID (Figure 3.25).

3. Check all gas line connections for leaks.

4. Disconnect the 5" electrometer cable (PN 252544) from the PID and the PID's (front) electrometer board. Connect one end of the 6.5" electrometer cable provided in the FID startup kit (PN 206110) to the PID. Connect the other end to the electrometer board back (Figure 3.25).

5. Connect the 9" electrometer cable (PN 285908) to the FID's coaxial connector (Figure 3.23) and to the front electrometer board (Figure 3.25).

NOTE: The FID flame does not stay lit if the electrometer cables are not connected properly.

Table 3.5 provides gas flow requirements for the Model 4450 PID/FID.

Table 3.5. Gas supply requirements for the Model 4450 Tandem PID/FID

Gas Requirement	Species	Required Flow Rate
PID makeup gas	N_2 or He	20 ±5 mL/min
PID sweep gas	H_2	35 ±3 mL/min
FID air	Air	170 ±15 mL/min

Installing the Model 5320 ELCD onto the PID

The Model 5350 PID/ELCD consists of the Model 5320 ELCD mounted on the Model 4430 PID. Table 3.1 and Figure 3.16 (for Agilent 7890) or Table 3.2 and Figure 3.21 (for Agilent 6890) summarize the gas supply connections at the OIM pressure control manifold for the Model 5350 PID/ELCD. See the *Model 5320 Electrolytic Conductivity Detector Operator's Manual* for installing, operating, and troubleshooting the Model 5320 ELCD. Also refer to the Model 5320 manual for installing electrical connections between the ELCD and the Model 5300 Detector Controller.

Agilent 7890 or 6890 GC

1. Remove the fitting, tube, and graphite reducing ferrule from the PID outlet on the side of the PID sensor. Ensure no pieces of the graphite ferrule remain seated in the outlet.

2. Slide the supplied 1/16" ferrule (PN 223776 for halogen and nitrogen mode, PN 216366 for sulfur mode) and the supplied reactor base adapter (PN 223743) onto the Model 5320 reaction tube (PN 260323 for nickel tube for halogen mode, PN 217182 for nitrogen mode or fluoride analyzer, PN 217208 for alumina tube for sulfur mode) (Figure 3.26).

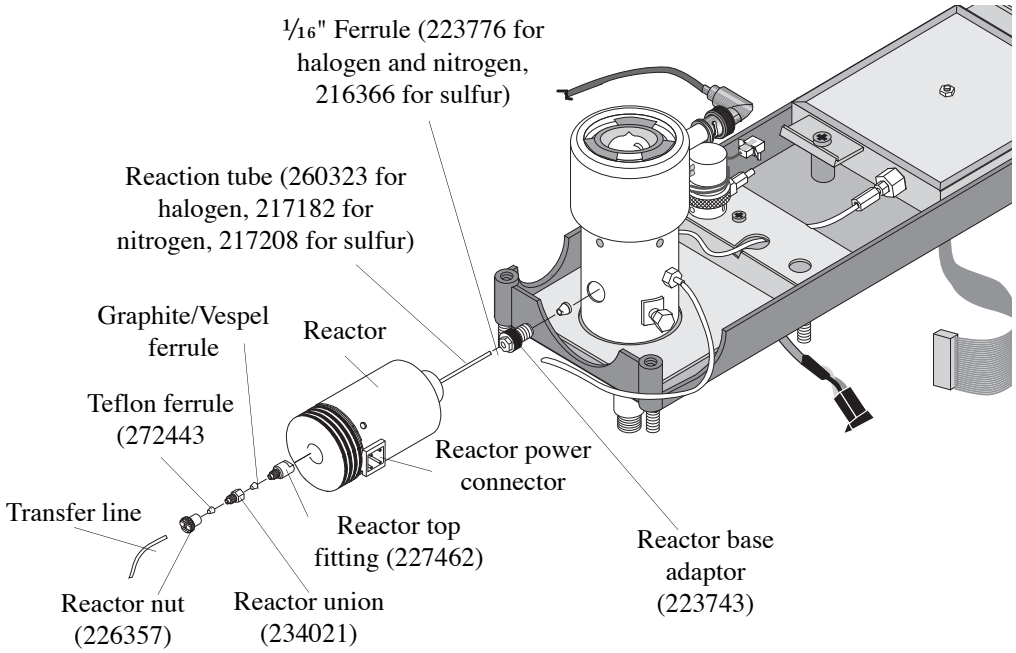


Figure 3.26. Model 5350 PID/ELCD assembly

3. Screw the reactor base adapter and reaction tube into the PID outlet. Carefully tighten the base with a 5/16" wrench.

4. Slide the ELCD reactor over the reactor base adapter located on the PID outlet. Verify the ELCD reactor firmly seats over the adapter fitting.

5. If the PID had been previously setup for 4430 or 4450, move the incoming ⅛" inlet hydrogen line to the Air port and move the 1/16" sweep gas line to the Air port now plumbed with H_2. The H_2 port is not used in the tandem PID/ELCD configuration. Refer to Table 3.1 and Figure 3.16 (for Agilent 7890) or Table 3.2 and Figure 3.21 (for Agilent 6890).

6. Check all gas line connections for leaks.

Table 3.6 provides the gas flow requirements for the Model 5350.

Table 3.6. Gas supply requirements for the Model 5350 PID/FID

Gas Requirement	Species	Required Flow Rate
PID makeup gas	N_2 or He	10–30 mL/min
PID sweep/ELCD reaction gas	H_2	100 mL/min*

*100 mL/min or enough H_2 to give a total gas flow of at least 135–160 mL/min

Installing the Model 5360 XSD onto the PID

The Model 5390 PID/XSD consists of the Model 5360 XSD mounted on the Model 4430 PID. Table 3.2 summarizes the gas supply connections at the OIM pressure control manifold for the Model 5390 PID/FID. See the *Model 5360 Halogen Specific Detector Operator's Manual* for installating, operating, and troubleshooting the Model 5360 XSD. Also see the Model 5360 manual for installing electrical connections between the XSD and the Model 5300 Detector Controller.

Agilent 7890 or 6890 GC

1. Remove the attached fitting from the PID outlet on the side of the PID sensor.

2. Slide a ⅛" x 1⁄16" I.D. ferrule (PN 216366) onto the XSD jet tube (PN 245621) (Figure 3.27)

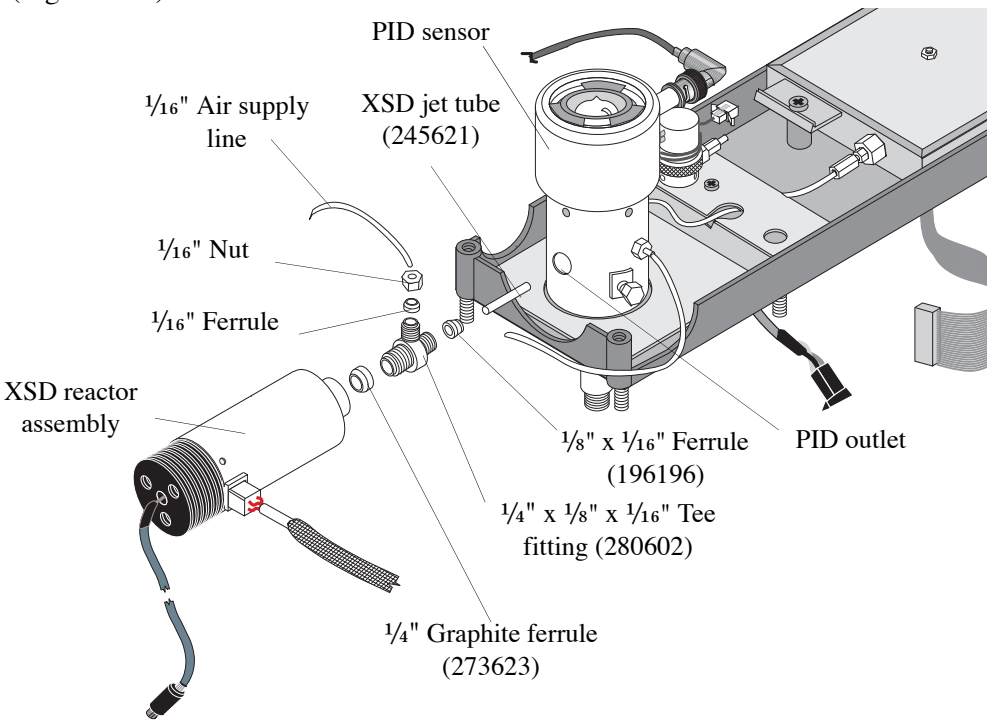


Figure 3.27. Model 5390 PID/XSD assembly

3. Place the jet tube and ferrule into the PID outlet, ensuring the jet tube enters the small recess in the back of the PID outlet.

4. Tighten the ⅛" end of the tee fitting (PN 280602) into the PID outlet. Apply light pressure to the jet tube to hold it in place while tightening.

5. Carefully slide the ¼" graphite ferrule (PN 273623) onto the ceramic tube in the base of the XSD reactor assembly. Ensure the tapered end of the ferrule faces toward the reactor.

6. Screw the XSD reactor assembly onto the ¼" side of the tee fitting. Tighten securely, but do not overtighten.

7. Remove the protective cap from the gas inlet marked “Air” on the front of the OIM pressure control manifold. Attach the air supply line to this inlet using a ⅛" brass nut and ferrule (not supplied). See Figure 3.22.

8. Ensure the gas line is pushed into the connector as far as it can go before tightening the nut onto the connector. Securely tighten each ⅛" nut using a 7⁄16" wrench.

Agilent 7890

1. Install the hoodlum assembly, provided with the OIM, in the Air position (see Figure 3.28).

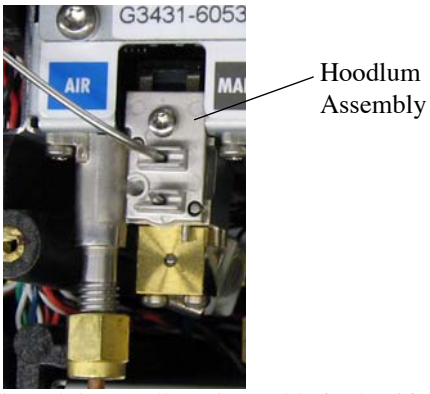


Figure 3.28. Aux EPC Module Hoodlum Assembly in the Air Position

2. Cut the ⅛" nib off the end of the hoodlum assembly.

Agilent 6890

1. Cut a length of 1⁄16" stainless steel tubing (PN 193409, supplied in the detector gas kit) that is long enough to reach from the pneumatics compartment to the tee fitting between the PID and XSD. Route the tubing parallel to the PID makeup and sweep gas lines from the pneumatics compartment along the tubing guides on the top of the GC to the detector area.

2. Attach one end of the stainless steel tubing to the outlet marked “A” on the gas outlet block of the OIM pressure control manifold (Figure 3.17) using a 1⁄16" nut (PN 223057) and ferrule (PN 216366).

3. Ensure the stainless steel tubing is pushed into the gas outlet block as far as it can go before tightening the nut into the gas outlet block. Securely tighten the nuts using a 5⁄16" wrench.

Agilent 7890 or 6890 GC

1. Slide the 1⁄16" nut from the tee fitting and a ferrule (PN 216366) onto the free end of the 1⁄16" stainless steel air line that extends from the OIM pressure control manifold. Ensure the tapered end of the ferrule faces into the nut.

2. Turn on the gas supplies and check the connections for leaks.

Table 3.7 provides the gas supply requirements for the Model 5390 PID/XSD.

Table 3.7. Gas supply requirements for the Model 5390 PID/XSD

Gas Requirement	Species	Required Flow Rate
PID makeup gas	N_2 or He	10–30 mL/min
PID sweep gas	N_2 or He	20–35 mL/min
XSD reaction gas	Air	20–40 mL/min

Installing the Lamp Power Supply

Agilent 7890 or 6890 GC

1. Plug the power cable into the back of the lamp power supply.
2. Plug the power cable into the standard 110 VAC power outlet (or 220 VAC).
3. For PID tandem detector configurations, refer to the operator's manual for the detector mounted on the PID for instructions on electrical connections to the Detector Controller.

Chapter 4 Operation

This chapter discusses detector operation. Because the detector electronics are so integrated into the existing GC components, operating the PID closely resembles operating the GC's standard flame-ionization detector (FID). For this reason, OI Analytical recommends the operator review FID operation in the *Agilent 7890* or *Agilent 6890 Series Gas Chromatograph Operator's Manual*. Operators must understand how to:

- Heat the detector base and display its temperature,
- Turn on the detector electronics and display its output,
- Transfer a signal output from the detector to a recorder or data system,
- Operate a vent valve (if desired) using the 24 VDC output from the Agilent GC main board.

Primary Operating Steps

Operating the PID primarily consists of the following steps:

1. Attach the GC column to the base of the PID (see Chapter 3, "Installing the Column" on page 24).

2. Connect the PID to the signal handling device.

3. Connect the PID lamp power cable to the lamp power supply and set the lamp intensity.

4. Turn on the lamp power supply.

5. After the lamp is turned on, ensure the lamp is lit and a baseline output signal records.

6. Inject a sample into the GC injector and run the analysis.

Recommended Settings for General Operation

Base Temperature	200 °C or 20 °C above the highest column temperature, 275 °C maximum
Range on GC	2^4
Attenuation on GC	2^0 (does not affect output used)
Zero Offset on GC	0.0
Signal Output Scale	0–1 volt (for integrator)
Lamp Intensity Setting	5
Sweep Gas Flow	The sweep gas used for the PID is either H_2 or He. The detector configuration determines the appropriate flow rate (Table 4.1).
Makeup Gas Flow	The makeup gas used for the PID is either He or N_2 and the average flow rate for standalone or tandem detector configuration is 20 mL/min (if column flow is less than 10 mL/min).

*100 mL/min or enough H_2 to give a total gas flow of at least 135–160 mL/minute.

General Operation

CAUTION:
If for any reason the GC loses power when operating a PID/ELCD, the solvent from the ELCD flows through the system, causing system damage. Turn off the solvent pump immediately!

1. Verify column, sweep gas, and any makeup gas flows are set correctly.
2. Set the detector to the desired temperature (i.e., about 20°C above the highest column temperature) on the Agilent 7890 or 6890 keypad.

NOTE: The flows set using the electronic pneumatic control (EPC) modules depend on ambient conditions, tubing, and other restrictions in line. Actual flow rates may vary from those programmed in the Agilent GC. Verify actual flows using a flow meter. Once established these flow set points should be reproducible and reliable.

CAUTION:
If the GC and PID/ELCD lose power, losing gas flow causes solvent to siphon back.

3. Turn on the lamp power and confirm the lamp is producing a bluish or purple light.
4. Verify the baseline is at an acceptable level.
5. Proceed with the chromatographic analysis.

Chapter 5 Maintenance and Troubleshooting

Cleaning the Lamp Window

Use the PID lamp window polishing kit (PN 214924) to prevent deposits forming on the outer PID lamp window. Window deposits may also include residue from the O-ring, which should be cleaned with methanol and a lab tissue.

Removing the PID Lamp

CAUTION:

If an ELCD is installed in tandem with the PID, make sure the solvent pump is off. Failure to do so damages the reaction tube, PID, and column.

1. Turn off the lamp power. If an ELCD is installed on the PID, turn the solvent pump off.
2. Disconnect the lamp high-voltage cable from the PID sensor (Figure 5.1).

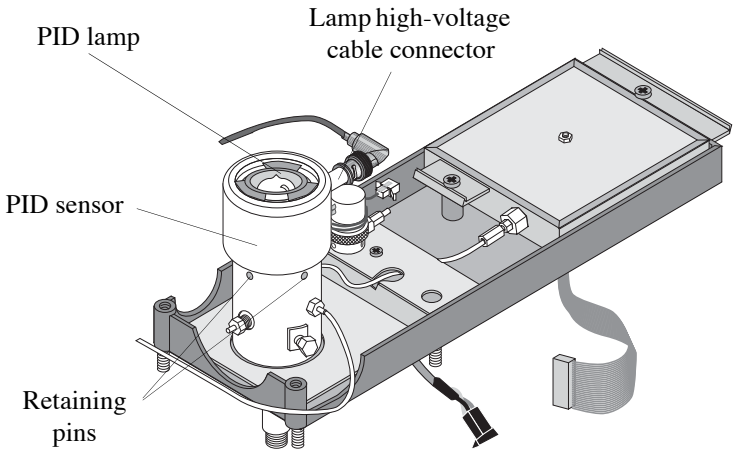


Figure 5.1. PID sensor assembly

3. Remove the PID sensor by pressing the two small retaining pins on the base.
4. Carefully remove the PID lamp to expose the lamp window.

Cleaning the Window

1. Open the lamp window polishing kit, and remove the cleaning compound and cotton swabs.

NOTE: If the lamp window polishing kit is not available, polish the lamp window using a jeweler's rouge or toothpaste and water.

2. Dampen the lamp window with reagent water.
3. Moisten a cotton swab and dip the swab tip into the cleaning compound until well coated.

4. Swab the lamp window using light pressure.

5. Rinse the lamp window thoroughly with reagent water. Dry before reinstalling the lamp by blowing clean air on the lamp window or wiping it dry using a clean laboratory tissue.

6. Dissolve specific contaminates using diluted acids or methanol, as necessary.

   Clean lamp sealing O-ring residue with methanol and a laboratory tissue.

7. Reinstall the lamp. Replace the lamp sealing O-ring (PN 255679). Reinstall the PID sensor into the base, verifying all seals, washers, and springs are reinstalled properly (Figure 5.2).

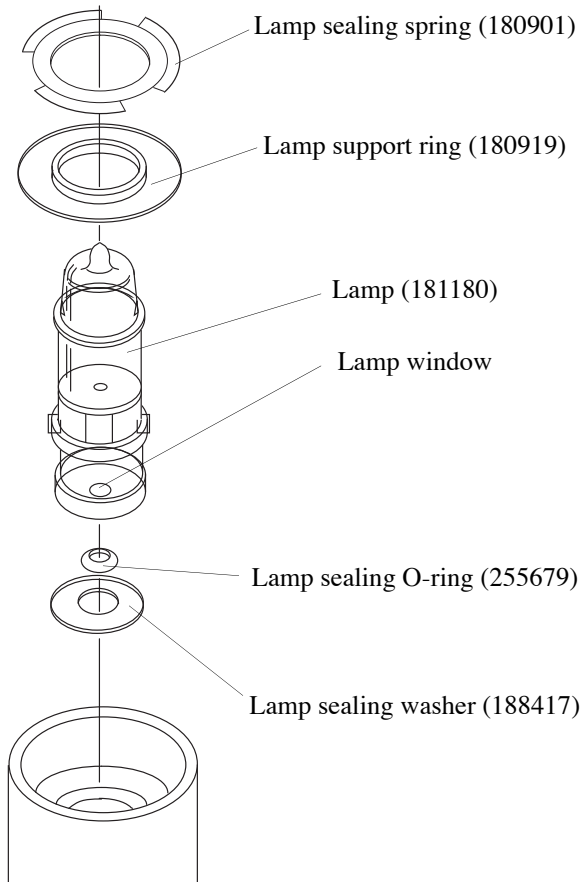


Figure 5.2. PID lamp assembly

8. Reconnect the lamp high-voltage cable.

9. Once the PID is installed and operating properly, note the detector signal and record a typical baseline with zero offset on a strip chart recorder or data system. Retain a copy of a typical chromatogram to compare with future responses.

Cleaning the PID Sensor with the Hexane Boiling Procedure

1. Cool the PID base to 80°C.
2. Cool the detectors mounted in tandem with the PID.
3. Turn off the lamp power supply.
4. Disconnect the cable from the PID sensor. Remove the sensor, PID lamp, O-ring, and washer. Turn off the sweep gas (hydrogen) and column makeup gas (helium).

CAUTION:
Do not remove the six hex nuts from the PID sensor base. Removing these nuts render the sensor inoperative.

5. Drip hexane into the center opening of the PID sensor base until the cavity is full. Raise the PID base temperature to 100°C and clean up all particles and contamination with a paper towel. Repeat as many times as necessary until the paper towel no longer shows any discoloration or particles.

CAUTION:
Hexane vapors can be explosive. Use extreme care when using this solvent.

6. Reassemble the PID and restore all gas flows. If using a tandem detector, ensure the sidemounted detector (e.g., XSD, FID, or ELCD) points to the left side of the GC.
7. Raise the PID base temperature to 200°C. Monitor the PID baseline to see if the signal drops below the level prior to cleaning.
8. If the signal drops rapidly, allow the PID to bake and stabilize.
9. If the signal is still at or near its original level, no additional cleaning may be necessary.

Additional Cleaning

1. If contamination is severe, lower the GC oven temperature to ambient (30°C) and remove the column for additional cleaning.
2. Mark the column at the column nut.
3. Disconnect the column, column adapter, and makeup gas tee.
4. Clean the column adapter and makeup gas tee externally either by sonicating or soaking with a squeeze bottle of hexane.
5. Inspect the column end under magnification for particles or other contamination.
6. Cut off the column at the point where it appears clean and mark the distance from the old column end to the mark to maintain the correct insertion depth.
7. Reconnect the column, column adapter, and makeup gas tee, then proceed with baking the column.

Chapter 6 Replacement Parts

This chapter provides a list of replacement parts and support items for the PID. An asterisk indicates replacement parts that are considered expendable (XPN). Replace expendable parts regularly, since they may become deformed or broken. Keep a supply of expendable parts in stock.

Table 6.1. Boards

Product	Unit	PN	XPN
Electrometer board for Agilent 6890	each	274860	
Electrometer board for Agilent 7890	each	324762	
Electrometer interface board for Agilent 6890	each	274878	
Electrometer interface board for Agilent 7890	each	324763	
Lamp power supply main board	each	180620	
PID display board	each	180497	

Table 6.2. Cables

Product	Unit	PN	XPN
Analog signal cable for Agilent 7890 or 6890 (spades)	each	252551	
Electrometer cable for Agilent 7890 or 6890	each	252544	
External events cable for Agilent 7890 or 6890	each	252569	
Lamp high-voltage cable	each	181750	
Power cord, 110 VAC	each	116038	
Remote start lamp cable	each	185843	

Table 6.3. Fittings and ferrules

Product	Size	Unit	PN	XPN
Adapter, brass/nickel	1/16" tube x 10–32	5/pk	196352	
Adapter, PID makeup gas kit	—	each	186338	
Connector assembly, SMA, PID	—	each	194027	
Ferrule, back, brass	1/16" tube	5/pk	196162	*
Ferrule, front, brass	1/16" tube	5/pk	196170	*
Ferrule, graphite	1/8"x 1/16" tube	5/pk	196196	*
Ferrule, graphite	1/16" tube	10/ pk	204693	*
Ferrule, graphite	1/16" tube	10/ pk	204693	*
Ferrule, graphite-Vespel	1/4" tube	10/ pk	222794	*
Ferrule, graphite-Vespel	1/16" tube	10/ pk	216366	
Ferrule, graphite-Vespel	1/16" x 0.8 mm I.D.	10/ pk	196105	
Ferrule, graphite-Vespel	1/16" x 0.5 mm I.D.	10/ pk	196113	
Ferrule, graphite-Vespel	1/16" x 0.4 mm I.D.	10/ pk	208330	
Ferrule, graphite-Vespel	1/16" x 0.0 mm I.D.	10/ pk	197079	
Ferrule, stainless steel	1/16" tube	5/pk	196246	*
Heater/sensor cartridge assembly	—	each	252429	
Mounting gasket for detector plate	—	each	182501	
Nut, female, stainless steel	1/4"	each	169682	*
Nut, male, brass-nickel	1/16"	5/pk	196303	*
Nut, male, stainless steel	1/8"	each	112458	*
Nut, male, stainless steel	1/16"	5/pk	196311	*
Nut, male, stainless steel	1/16"	each	223057	*

Table 6.3. Fittings and ferrules

Product	Size	Unit	PN	XPN
Outlet restrictor nut, stainless steel	—	each	188490	*
Sensor tower assembly	—	each	181867	
Vent valve assembly, 24 VDC	—	each	182154	
Vent valve, two-way, 24 VAC, brass-nickel	—	each	183939	

Table 6.4. Miscellaneous PID parts

Product	Unit	PN	XPN
Attachment screw for gas outlet block	each	185561	*
Detector gas kit for Model 4430 for Agilent 6890	each	251892	
Detector pallet for Agilent 7890 or 6890	each	252296	
Fuse, 0.5 amp	each	115469	
Gas outlet block for auxiliary EPC for Agilent 6890	each	251900	
Gas outlet block for OIM EPC for Agilent 6890	each	251785	
OIM EPC for Agilent 6890	each	285049	
OIM EPC for Agilent 7890	each	324768	
Standard for Detector, 100 ppm MeOH	each	218966	
Torx screw, M4 x 10	each	252585	*
Torx screw, M4 x 20	each	252361	*
Vent valve needle valve	each	195461	

Table 6.5. PID lamp parts

Product	Unit	PN	XPN
Lamp O-ring, Viton®	5/pk	255679	*
Lamp window polishing kit	each	214924	
Lamp power supply	each	181727	
Lamp sealing spring	each	180901	
Lamp sealing washer	each	188417	*
Lamp support ring	each	180919	
Lamp, 10.0 eV	each	181180	

Table 6.6. Tubing and tube assemblies

Product	Size	Unit	PN	XPN
Outlet restrictor tube, stainless steel	—	each	188482	*
Tubing, copper	⅛" x .070 I.D.	ft	111427	
Tubing, stainless steel	1/16" x .020 I.D.	ft	111732	
Tubing, stainless steel	1/16" x .030 I.D.	ft	193409	

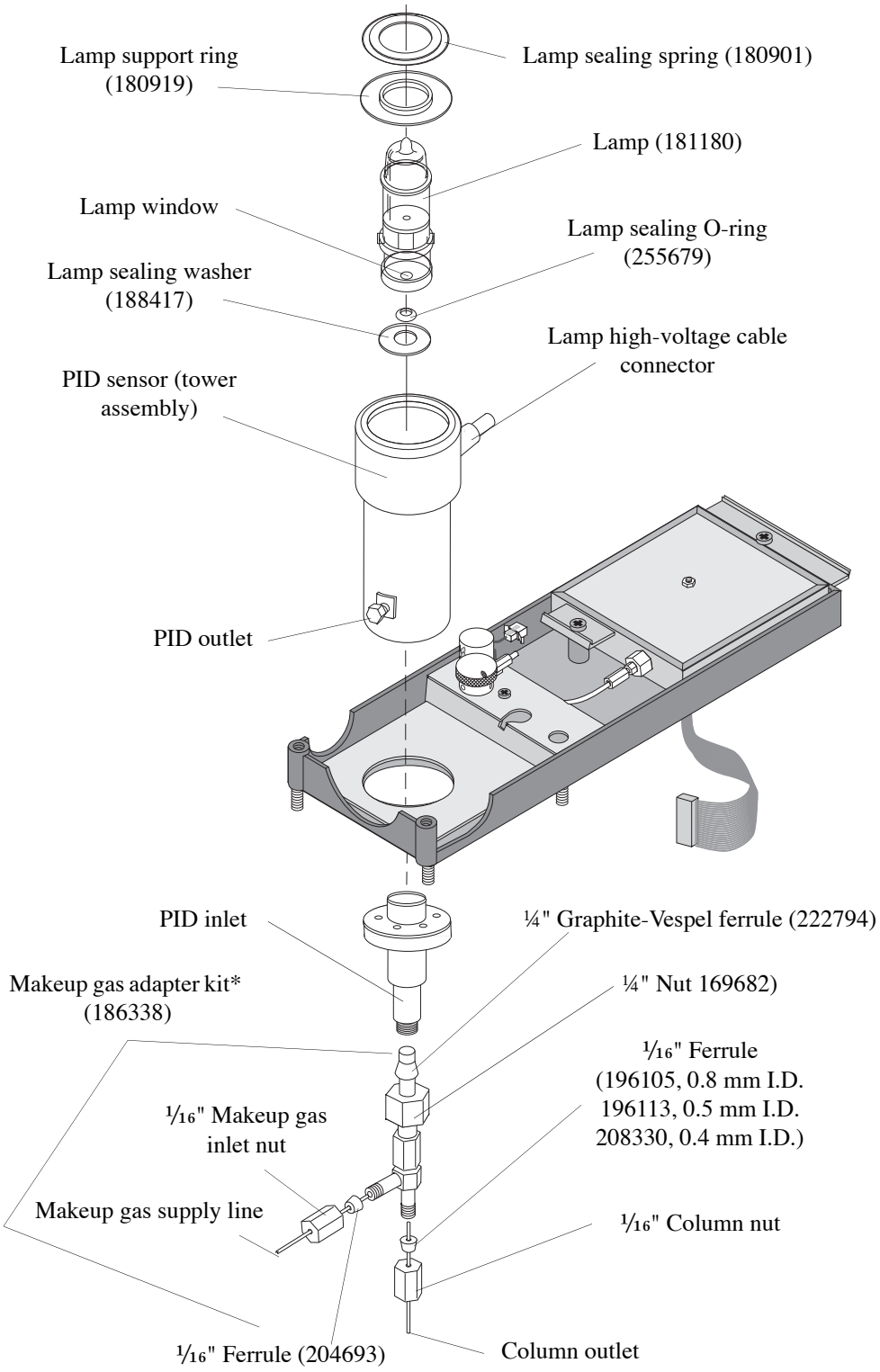


Figure 6.1. PID assembly

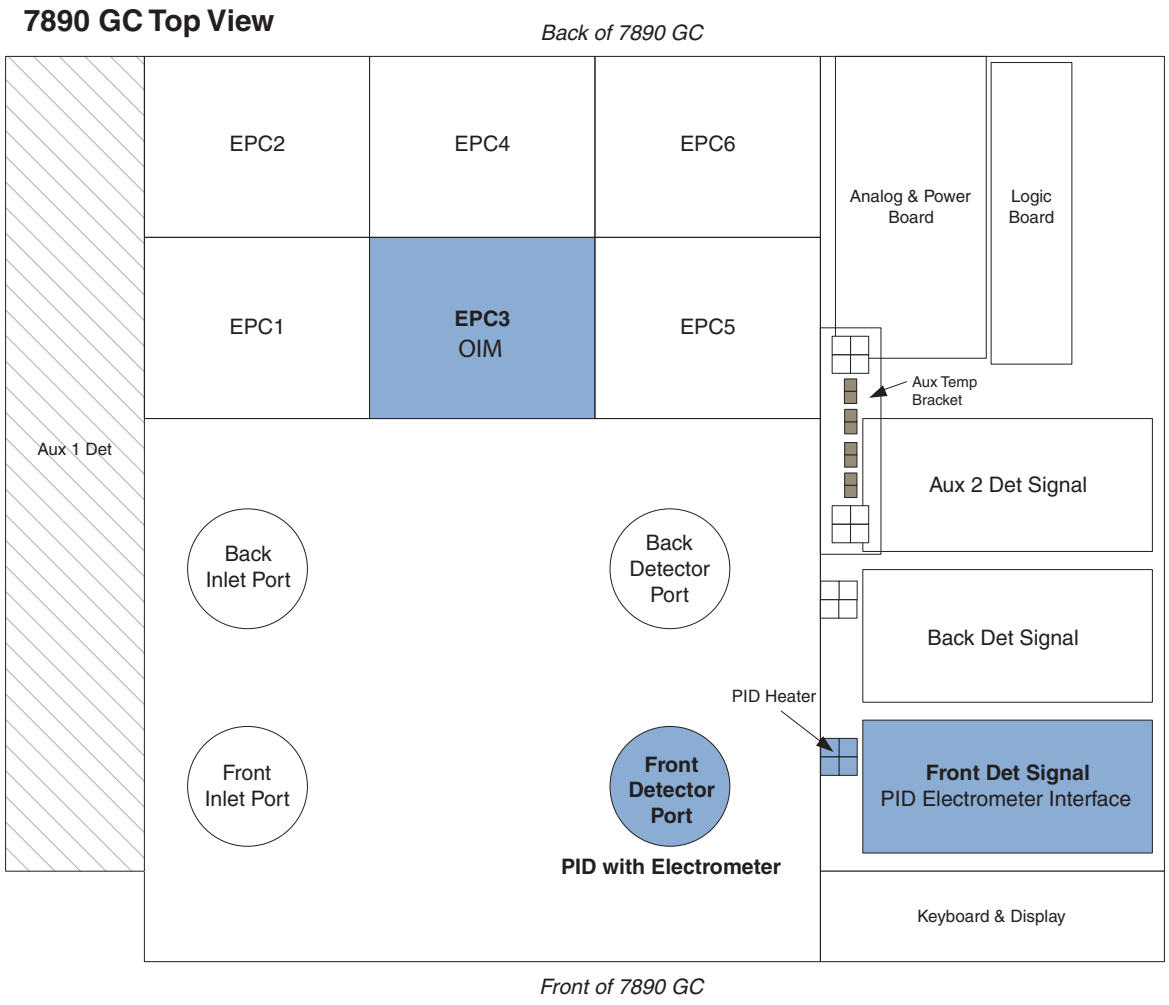
*Makeup gas adapter kit includes all parts as indicated except the ¼" nut (PN 169682).

Chapter 7 Appendix

Location of EPC Modules, Signals, and Heaters for an Agilent 7890

Use the following figures and table to determine the appropriate location of the various components on an Agilent 7890.

PID Standalone Configurations



Agilent 7890 GC Detector Configuration Selections
Front Det: CPDET FID, Htr, EPC

Figure 7.1. PID Standalone - Front Detector Configuration

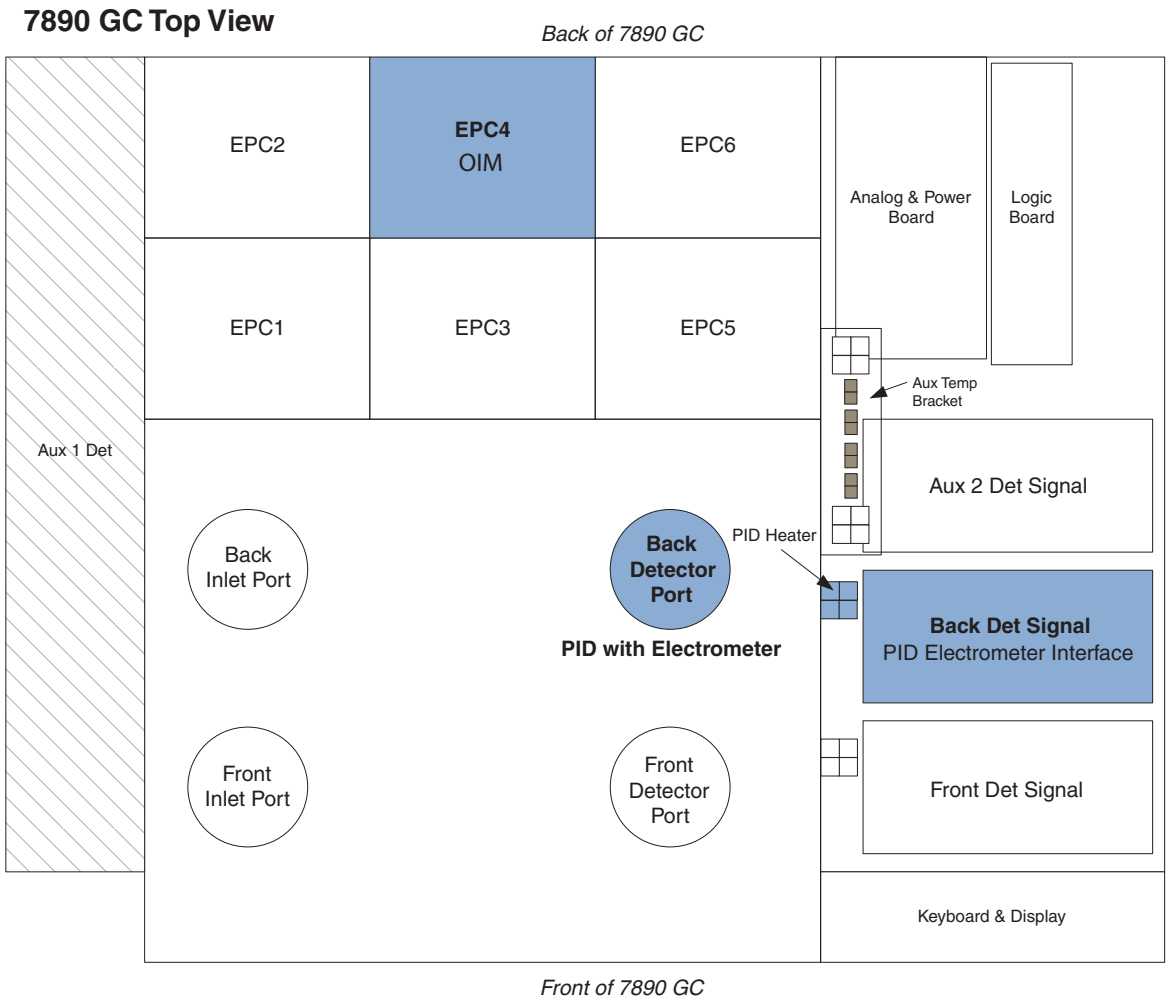
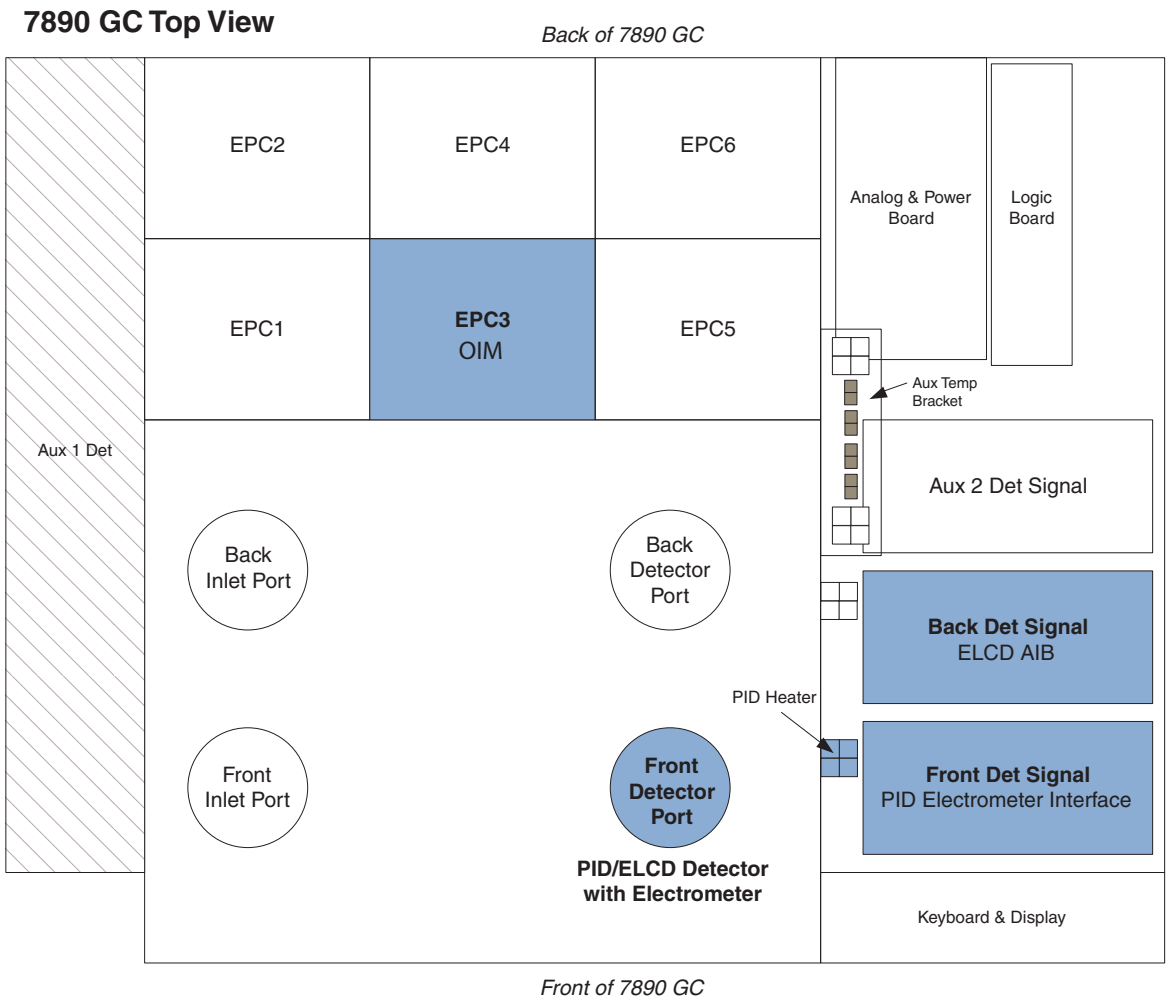


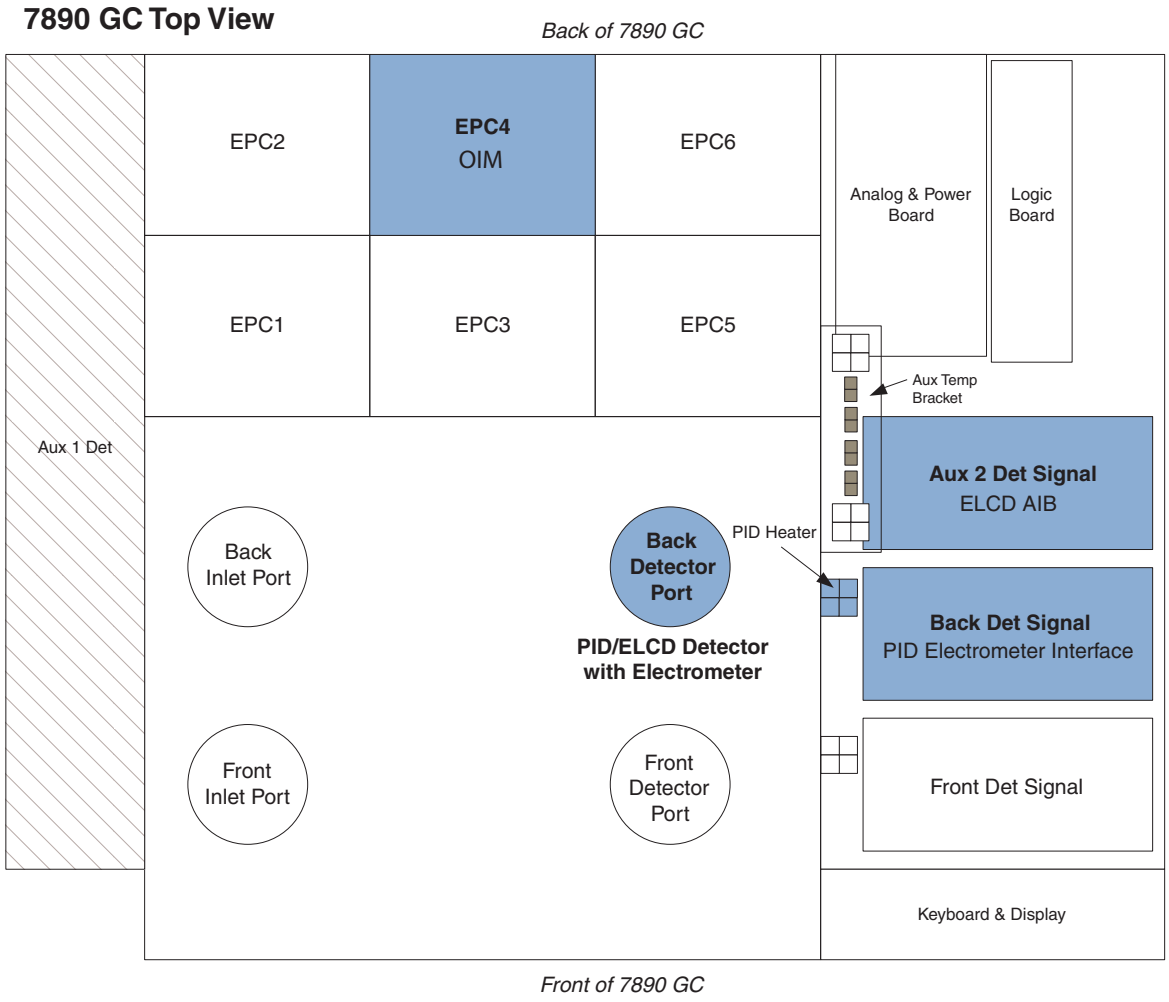
Figure 7.2. PID Standalone - Back Detector Configuration

PID/ELCD Configurations



Agilent 7890 GC Detector Configuration Selections
Front Det: CPDET FID, Htr, EPC
Aux Det 2: AIB

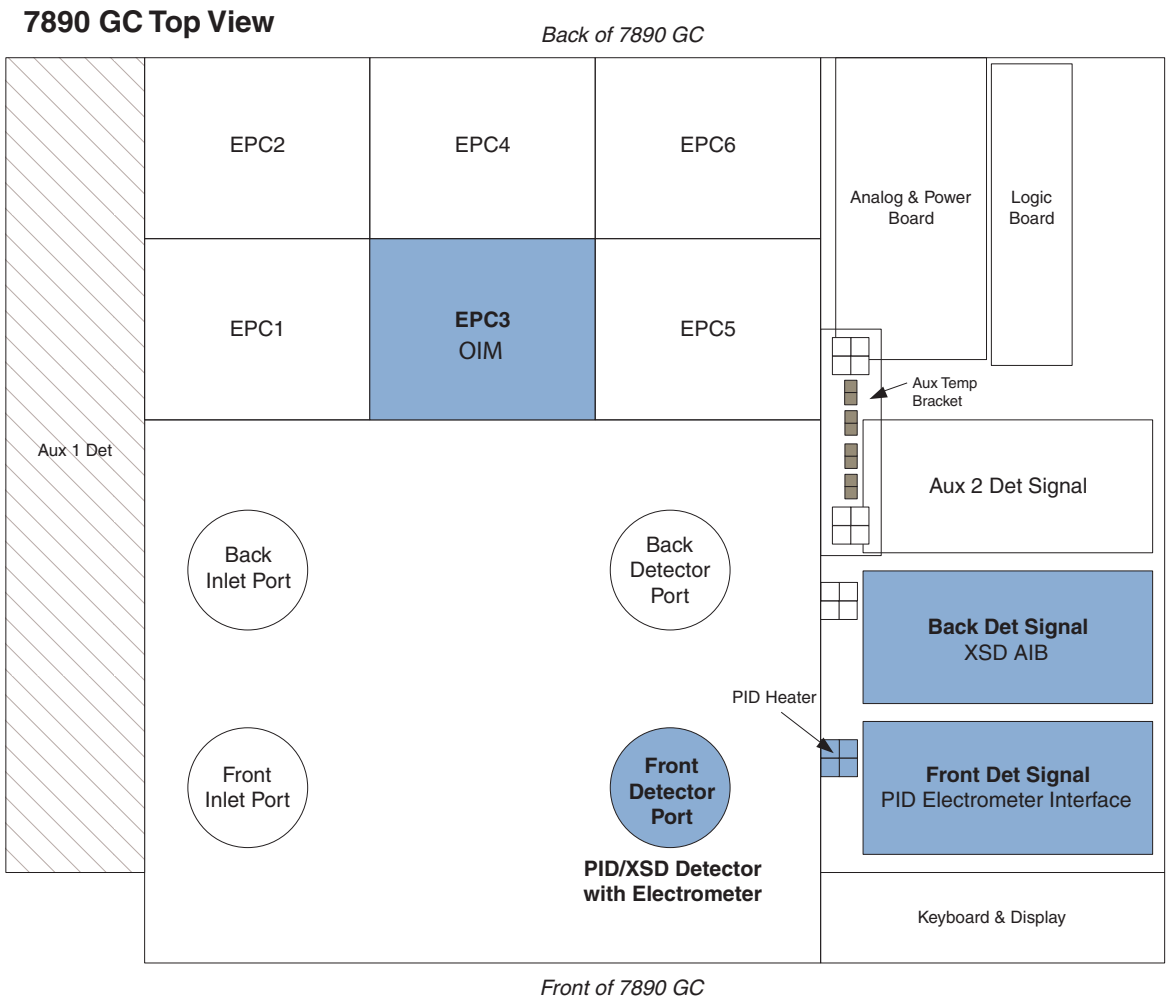
Figure 7.3. PID/ELCD - Front Detector Configuration



Agilent 7890 GC Detector Configuration Selections
Back Det: CPDET FID, Htr, EPC
Aux 2 Det: Install AIB with No Heater
OR
Back Det: CPDET FID&AIB, Htr, EPC

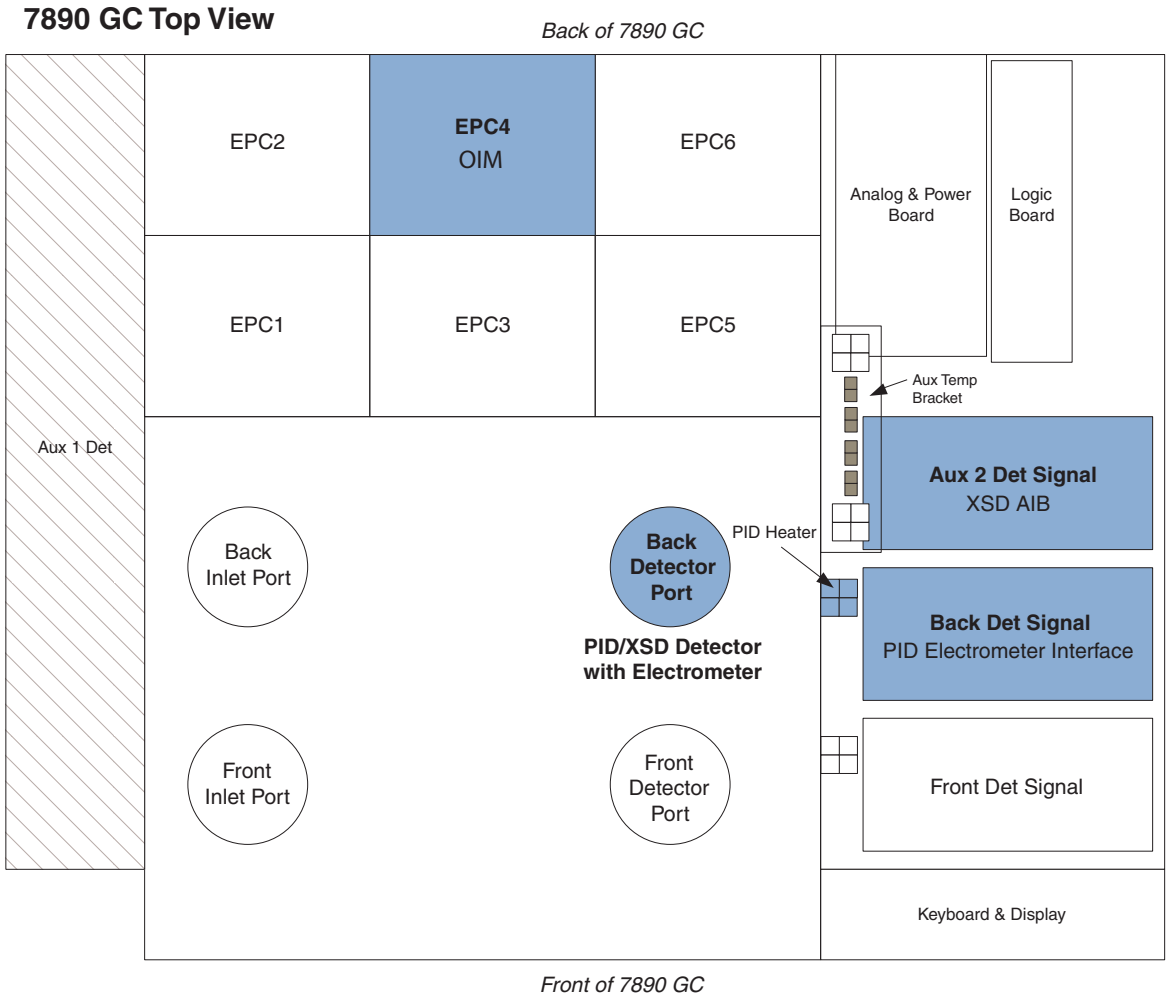
Figure 7.4. PID/ELCD - Back Detector Configuration

PID/XSD Configurations



Agilent 7890 GC Detector Configuration Selections
Front Det: CPDET FID, Htr, EPC
Aux Det 2: AIB

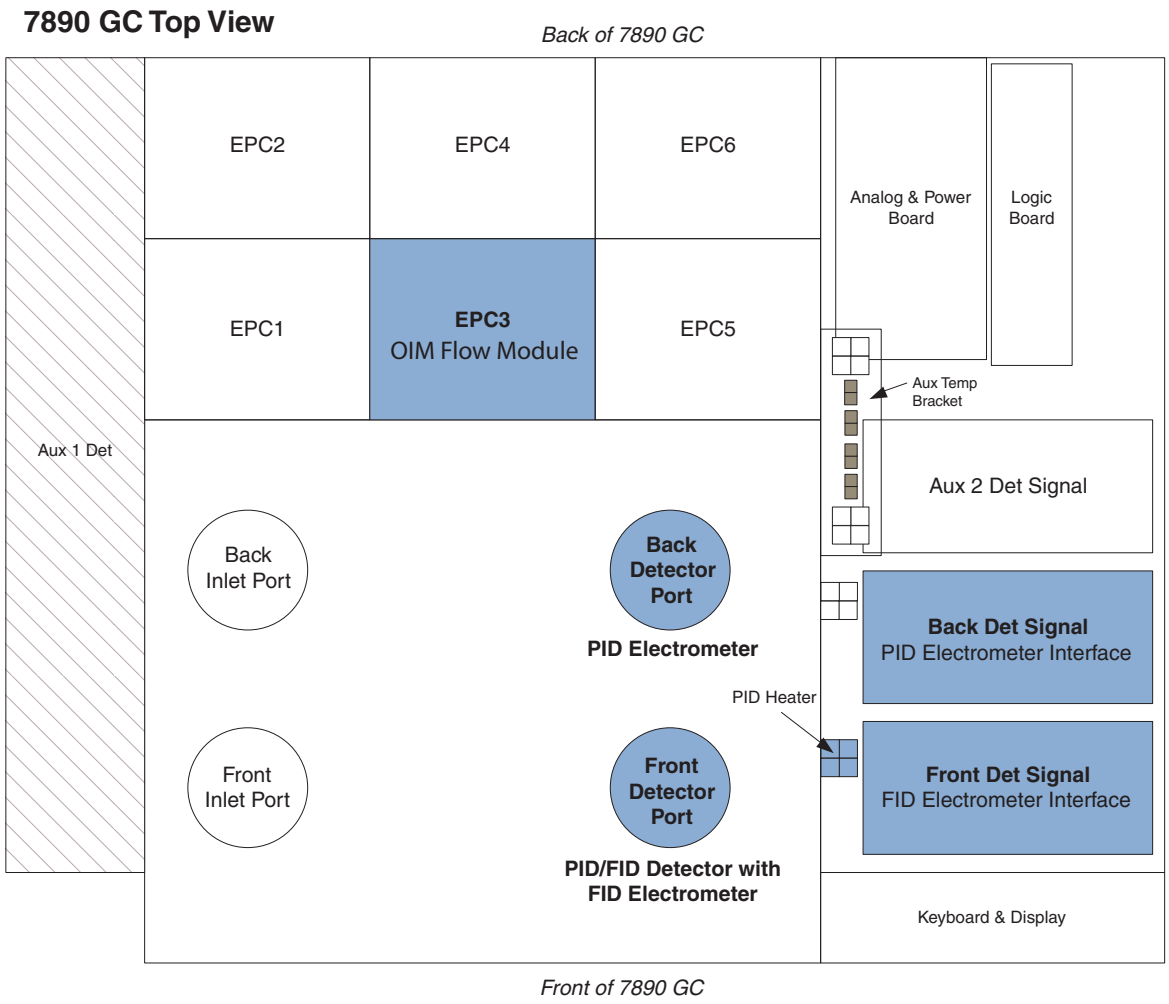
Figure 7.5. PID/XSD - Front Detector Configuration



Agilent 7890 GC Detector Configuration Selections
Back Det: CPDET FID, Htr, EPC
Aux 2 Det: Install AIB with No Heater
OR
Back Det: CPDET FID&AIB, Htr, EPC

Figure 7.6. PID/XSD - Back Detector Configuration

PID/FID Configuration



Agilent 7890 GC Detector Configuration Selections
Front Det: FID
Back Det: CPDET FID, No Htr, No EPC

Figure 7.7. PID/FID Configuration

Agilent 7890 Configuration Layout

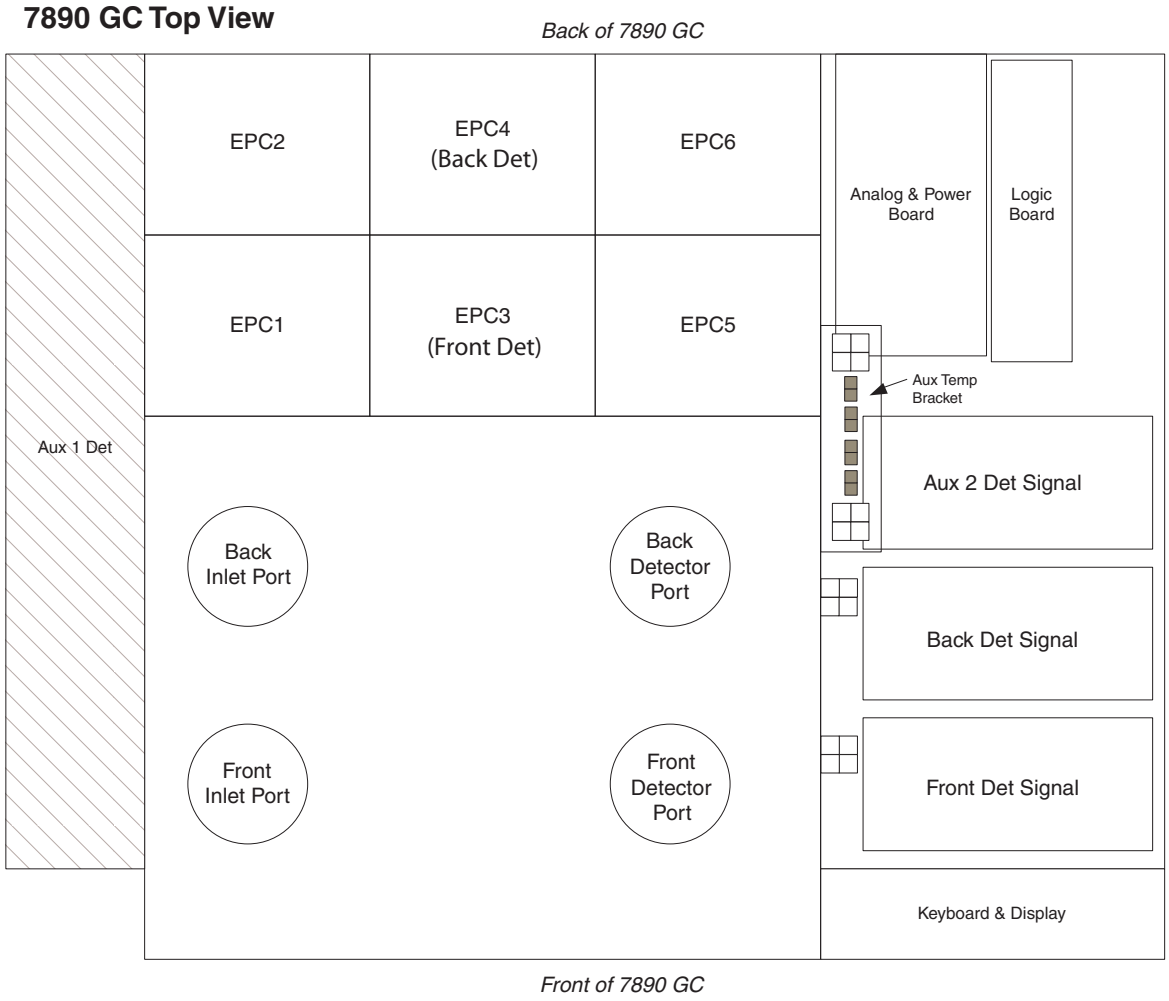


Figure 7.8. Agilent 7890 GC Configuration Layout

Table 7.1. Agilent 7890 Configurations and Settings for OI Analytical Detectors

OI Analytical Detector Configuration	Hardware Installed in Front Det				Hardware Installed in Back Det				Hardware Installed in Aux 2 Det				Detector Configuration
	FID Electrometer Set	AIB	OIM Flow Module	Heater	FID Electrometer Set	AIB	OIM Flow Module	Heater	FID Electrometer Set	AIB	Aux EPC Flow Module	Heater	
PID Standalone (Figure 7.1)	X		X	X									Front Det: CPDET FID, Htr, EPC
PID Standalone (Figure 7.2)					X		X	X					Back Det: CPDET FID, Htr, EPC
PID/ELCD (Figure 7.3)	X		X	X		X							Front Det: CPDET FID, Htr, EPC Aux Det 2: AIB
PID/ELCD (Figure 7.4)					X		X	X		X			Back Det: CPDET FID, Htr, EPC Aux Det 2: AIB **OR** Back Det: CPDET FID&AIB, Htr, EPC
PID/XSD (Figure 7.5)	X		X	X		X							Front Det: CPDET FID, Htr, EPC Aux Det 2: AIB
PID/XSD (Figure 7.6)					X		X	X		X			Back Det: CPDET FID, Htr, EPC Aux Det 2: AIB **OR** Back Det: CPDET FID&AIB, Htr, EPC
PID/FID (Figure 7.7)	X		X	X	X								Front Det: Install Detector (FID) Back Det: CPDET FID, No Htr, No EPC
PID w/Aux EPC	X			X							X		Front Det: CPDET FID & Htr, No EPC Aux EPC: Aux 1–3 or 4–6
PID w/Aux EPC					X			X			X		Back Det: CPDET FID & Htr, No EPC Aux EPC: Aux 1–3 or 4–6

Index

Numerics

A

B

C

D

E

F

G

H

I

L

M

O

P

R

S

T

V

W

X

Z