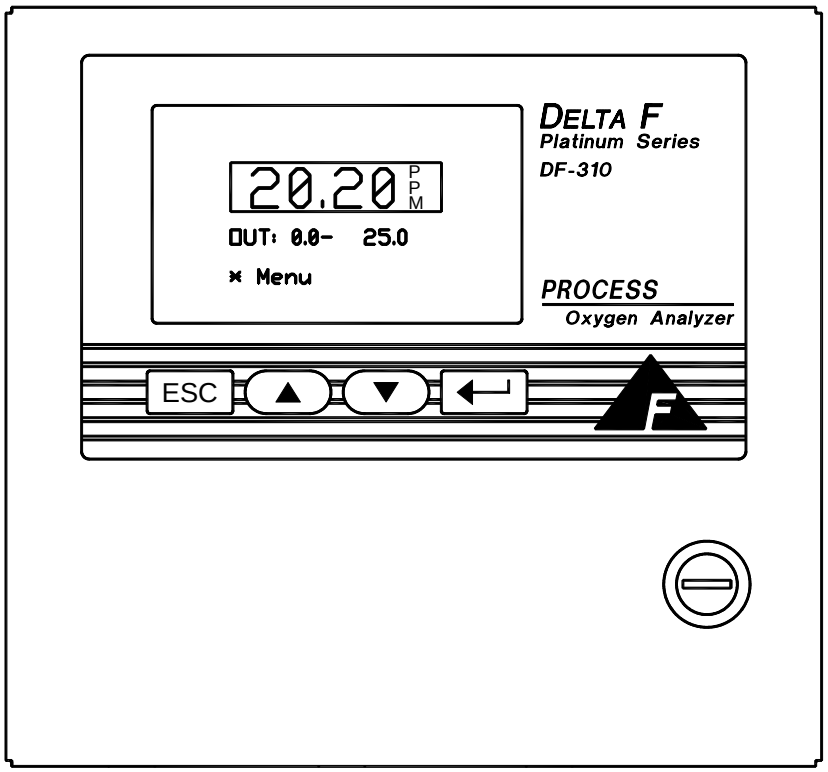
Platinum Series
Process Oxygen Analyzer

Model DF-330



Instruction Manual

Firmware Version 1.29

DELTA F CORPORATION
4 Constitution Way, Woburn, MA 01801-1087
Telephone: (781) 935-4600 FAX: (781) 938-0531

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The Delta F Difference

Your Process Oxygen Analyzer has been designed, manufactured and is supported under ISO-9001 controls, thus helping to insure the highest possible standards of quality.
Every analyzer that Delta F manufactures is tested and operated on a variety of gas concentrations to insure that it functions properly when you receive it. The certificate of calibration assures your analyzer has been calibrated on gases that are traceable to NIST standards. With proper maintenance, your analyzer should remain calibrated for years.
For a fast and successful startup, please read this manual carefully. There are important cautions and a number of helpful hints to help you to optimize the operation of your analyzer.
If you have questions, please do not hesitate to call Delta F Service Line at (781) 935-5808, use our Service FAX Line at (781) 932-0053 or e-mail us at service@delta-f.com.

Read Me First…

Unpacking Procedure

Follow the procedure below to unpack your Process Oxygen Analyzer.

1. Examine the condition of the packaging and its contents. If any damage is apparent, immediately notify the carrier and Delta F. Do not proceed with the installation.

2. Check the contents against the packing slip to make sure the shipment is complete. Unattached equipment may be shipped with the analyzer in supplemental packaging. Shortages should be reported to Delta F immediately.

3. All DF-330 analyzers are shipped with the following:

Item	Delta F Part Number
Power Cord with 115VAC connector NOTE - No power cord is supplied with 220 VAC or DC powered units	59017300
Instruction Manual	99000039

4. Open the analyzer door, remove any shipping materials and verify that nothing has come loose during transit.

5. Save the original container in the event you may need to ship the analyzer to another location or back to the factory (see Shipping in the Service section).

Installation and Maintenance

The DF-330 Process Oxygen Analyzer will provide years of accurate and dependable service if it is set up, operated and maintained properly. It is essential to make a careful and complete installation as outlined in the *Installation and Setup* section of this manual

Thank You

Thank you for selecting the model DF 330 Process Oxygen Analyzer. Delta F designs, manufactures, exhaustively tests, and supports every analyzer under ISO-9001 control. You should expect every Delta F analyzer to arrive in perfect working order and, with good maintenance, provide years of trouble-free service. Please call the Service Phone Line at (781) 935-5808 if you need assistance or if you have suggestions, or use our Service Fax Line at (781) 932-0053 or e-mail us at Service@Delta-F.com.

1 Table of Contents

1.1 Table of Figures

2 Cautions

There are a number of warnings and cautions that must be observed to avoid damage to the analyzer as well to insure the safety of its users. The analyzer must be operated in a manner specified in this manual. Delta F cannot be responsible for direct or consequential damages that result from installing or operating the analyzer in a manner not described in this manual. Importantly, the analyzer has been designed for use with inert, non-toxic, non-combustible sample gases only. Delta F cannot be responsible for direct or consequential damages that result from using the analyzer with these gases.

2.1 Symbols and Explanations

Following is a list of the various symbols used throughout this manual and their definitions.

CAUTION

This symbol alerts the user to the presence of physically hazardous conditions that may be dangerous to individuals or equipment.

NOTE

This symbol alerts the user to the presence of important operations and/or maintenance information.

2.2 Important Warnings

CAUTION

Do not setup or operate the Oxygen Analyzer without a complete understanding of the instructions in this manual. Do not connect this Analyzer to a power source until all signal and plumbing connections are made.

CAUTION

This analyzer must be operated in a manner consistent with its intended use and as specified in this manual.

EMI DISCLAIMER

This Analyzer generates and uses small amounts of radio frequency energy. There is no guarantee that interference to radio or television signals will not occur in a particular installation. If interference is experienced, turn-off the analyzer. If the interference disappears, try one or more of the following methods to correct the problem:
Reorient the receiving antenna.
Move the instrument with respect to the receiver.
Place the analyzer and receiver on different AC circuits.

3 Specifications

PERFORMANCE

ACCURACY
± 2% of Full Scale.

RESPONSE TIME
Typically less than 10 seconds to read 90% of a step change. Equilibrium time depends on the specific conditions.

OXYGEN SENSITIVITY
.1% of FS

OVERALL OPERATING TEMPERATURE RANGE
Gas sample: 32°F to 122°F (0°C to 50°C)
Sensor Temperature: 32°F to 113°F (0°C to 45°C)
Electronics Temperature:
w/sensor in enclosure: 32°F to 113°F (0°C to 45°C)
w/remote sensor: 32°F to 122°F (0°C to 50°C)

STORAGE TEMPERATURE
Not to exceed 160°F (70°C)

SENSOR TYPE
Solid State Coulometric

SENSOR WARRANTY
Two Years

ELECTRICAL, ALARMS & DISPLAY

ELECTRONICS
Microprocessor-based

DISPLAY
1.3 in (33mm) by 2.6 in (66mm) LCD graphics with backlighting

ALARMS
Audible and Displayed. Up to 7 optional alarms comprised of 4 oxygen, low flow.

OUTPUT
Software scalable, jumper selectable 0-1, 0-2, 0-5 or 0-10 VDC analog output. Minimum load resistance is 1K.
Fully isolated 4-20 mA output. Maximum loop resistance is 1K Ohms. (29-33 VDC loop compliance voltage provided)

ALARM RELAYS
Up to four, rated at 0.3 A, 30 VDC under resistive load. Set points independently adjustable. Contacts failsafe to alarm condition upon loss of power. Not designed to switch AC power.

POWER REQUIREMENTS
100 – 240 VAC, 1.3A, 50/60 Hz (Auto-switching) or
24 VDC (–2/+4VDC), 1A, 25 Watts; Optional Sample Pump 6 Watts additional

EMI SENSITIVITY
Meets CISPR – 11(90) Class B Group 1 Standard

CE Approved (if appropriately installed in approved enclosure)

CSA Approved to CAN/CSA 1010-C22.2 Standard, 1010.1-92, 1010.1B-97

GAS SAMPLE CONDITIONS

GAS CONNECTIONS
1/8" Compression inlet and outlet Standard
1/4" Metal-face-seal inlet (Optional)

SAMPLE INLET PRESSURE
80 PSI Max.

SAMPLE FLOW RATE
0.5 - 2.0 LPM (1.0 – 4.0 SCFH)

GAS COMPATIBILITY
Inflammable gas, for example, methane, alcohol and carbon monoxide, may cause an error in measurement. Not for use in gases containing the halogen atoms (F, Cl, Br etc.) such as the Freon. The sensor may be damaged by decomposition of the Freon, SO_x, H_2S and vapor of silicone and adhesives.

GAS SAMPLE MOISTURE CONTENT
0-90%

OIL/SOLVENT MIST
Remove dust and oil mist through the use of a filter.

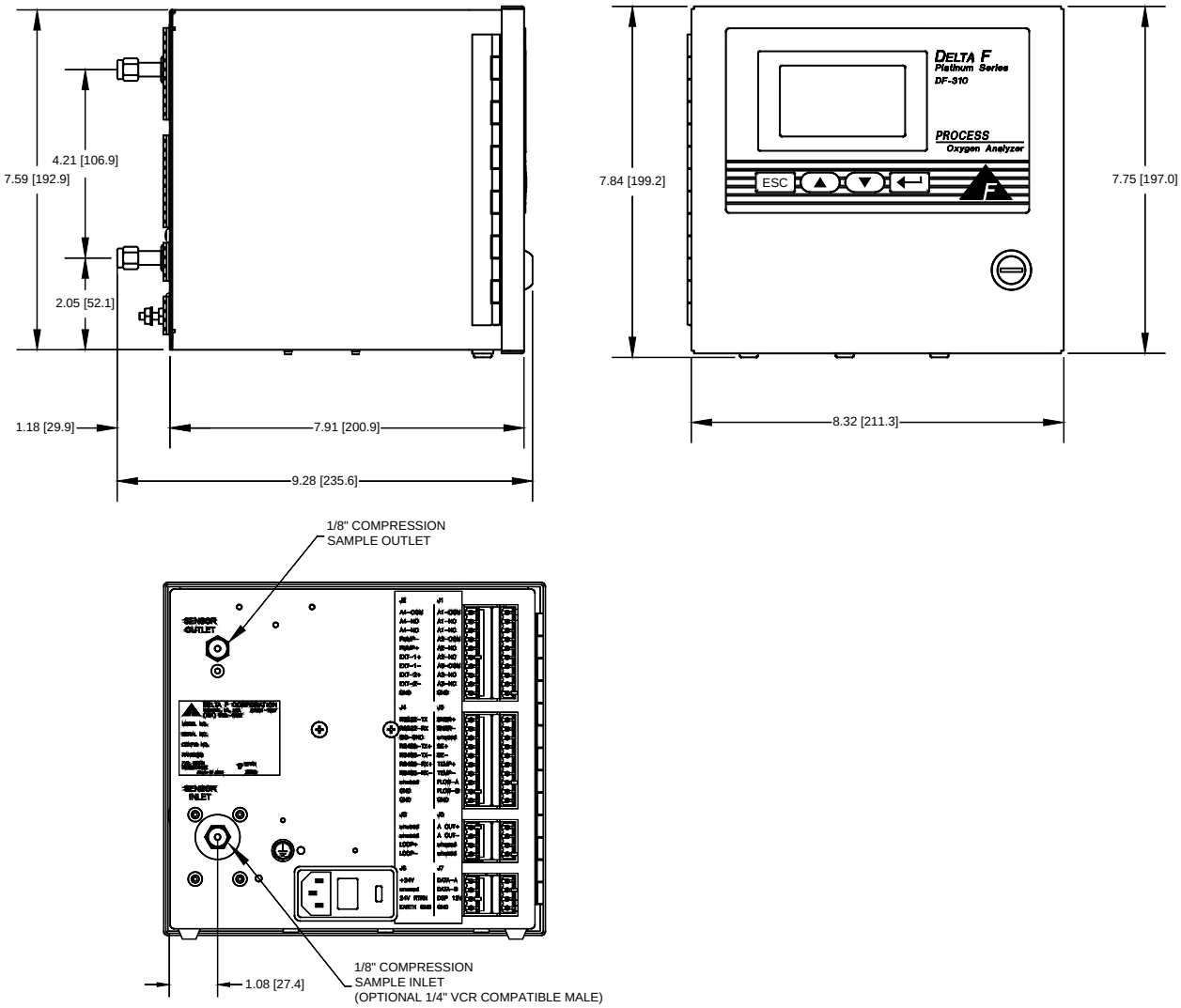

Figure 1: DF-330 Oxygen Analyzer

4 Installation and Setup

This procedure describes installation of the analyzer without options and with the voltage output set to 0-10 VDC. Options may affect the setup procedure described in this section. If your analyzer is equipped with options, refer to the appropriate section to determine changes to the setup.

NOTE

The screens shown in this manual have values that may not match the actual values displayed during your setup.

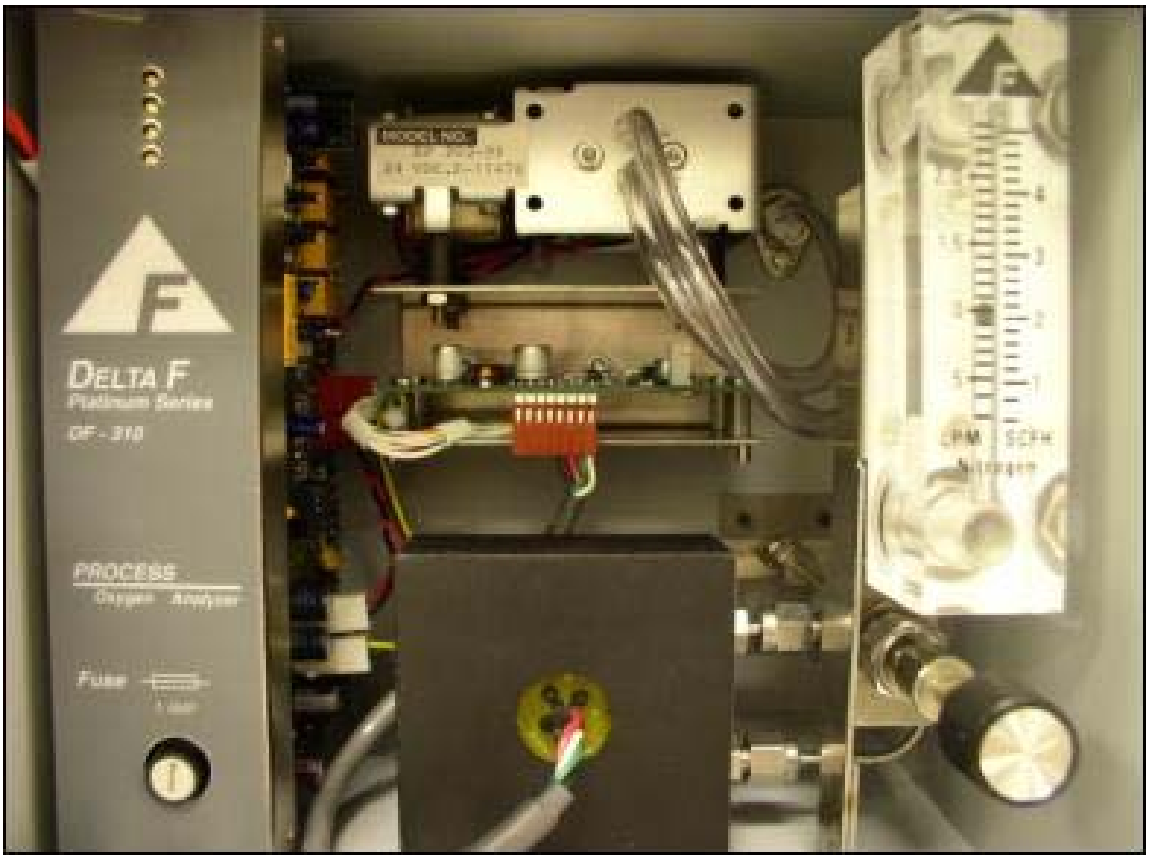

Figure 2: Major Internal Components

4.1 Sample Gas Connections

The sample gas inlet and outlet lines at the back of the instrument have stainless steel 1/8th inch compression bulkhead fittings (unless equipped with the optional VCR inlet). Before connecting any gas line to the analyzer, fully install the supplied gas nut and compression ferrule on your tubing. Connect the inlet and outlet lines to the bulkhead fittings at the back of the analyzer. A backup wrench is not needed since anti-torque plates inside the cabinet secure the bulkhead fittings. Do not over-tighten the fittings.
Supply the analyzer with an N_2 sample that is as low in O_2 as possible.
If the analyzer outlet is at atmospheric pressure, a regulator can be used to set the flow rate to 2.0 standard cubic feet per hour (scfh).

4.2 Electrical Power Connections

4.2.1 AC Input Voltage

Make sure the power switch is in the OFF position. Plug the supplied power cord into the connector on the rear of the analyzer. (Note, a power cord is not supplied with 220VAC units) Verify the operating voltage is set properly as indicated on the switch next to the AC input connector.

4.2.2 DC Input Voltage

Make sure the remote 24 VDC, 1A power source is turned off as the analyzer does not include a power control switch. Using 20 gauge wire, attach the power supply leads to the power connector J8 on the rear of the instrument. Pin 1 is positive (+24V) and Pin 3 is negative (24V RTRN). See Figure 3 below.

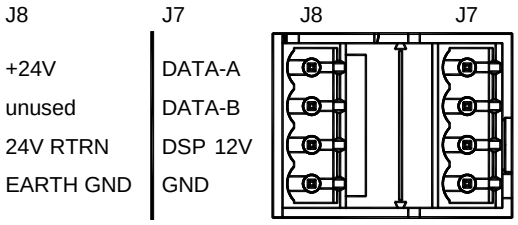

Figure 3: DC Power Connector – J8

4.3 Powering Up

The method of power control is determined by whether the analyzer is powered by AC or DC voltage.

4.3.1 Power Control

AC Powered Units - Open the front door, locate the power switch (see Figure 2) and turn it on.
DC Powered Units - Turn on the remote 24 VDC power source.

4.3.2 Startup Process

After power up, the analyzer will undergo a series of Diagnostic Procedures. After approximately 5 seconds, the Delta F Corporation logo is displayed. After 30 seconds, a WAIT message appears for 1.5 minutes. A display then appears that is similar to Figure 4 (values shown are only representative). The analyzer may display OVER RANGE for the first couple of minutes. This is normal even if the actual O2 concentration is within the range of the analyzer. It should take less than 2 minutes for the analyzer to come on scale. The concentration of oxygen is shown in percent (%) or parts per million (ppm) and will slowly approach the current oxygen level. NOTE: If it takes longer than 30 minutes to come on scale the sensor polarization voltage will automatically be turned off. (See page 46 for additional information)

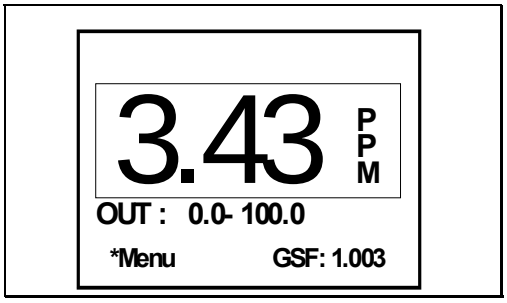

Figure 4: Data Display Screen

4.4 Standard Outputs

An output signal indicating oxygen concentration can be sent to other instruments by using the fully-isolated 4-20 mA output or the 0-10 VDC analog voltage output at the back of the analyzer. The analyzer is delivered with the required mating connectors which are keyed to prevent accidental interchange. The analog output connections are made through the Port J5 and J6 on the rear panel.

The fully-isolated 4-20 mA output is completely isolated from all other analog outputs and from earth ground. The maximum loop resistance is 1KΩ. The 29-33 VDC compliance voltage is provided.
Connections are made at pins J6-3 (LOOP+) and J6-4 (LOOP-) at the back of the instrument. See page 32 for additional information.

The analog voltage output is connected to pins J5-1 (AOUT+) and J5-2 (AOUT-). The full scale analog output is set by a jumper as described on page 33.

5 Options

5.1 Pump

The On-board Pump allows the analyzer to operate on gas sample streams between 2.0 psig vacuum and 2.0 psig positive pressure.
If the analyzer has a pump, it will also have a downstream Flow Control Valve mounted in the bottom of the flow meter. When using the pump, always use this downstream valve to control the gas flow rate and leave all up stream valves wide open.

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If the pump is not in use, (positive pressure application) always control the gas flow with an upstream valve or regulator and leave all down stream valves wide open.

CAUTION

Do not use an upstream valve to control flow if the analyzer is operating on a pump.

5.1.1 Pump Control

The on-board pump, if equipped, can be controlled from the Controls Menu. See page 45 for additional information.

In addition the following options are available:

If factory configured, Delta F will supply the standard pump that the user may install remotely and power through the PUMP A(-), B(+24VDC) connections on the rear panel connector J2. Control would be accomplished in the same manner as an internal pump.

OR

If factory configured, a switch closure rated at 1A/30VDC can be supplied between the PUMP A, B connections on the rear panel connector J2. The contacts can be used to send a signal indicating the status of the internal pump or to control an external, Delta F supplied pump that is powered from a separate source.

OR

If factory configured the pump may be controlled remotely through the EXT signal on the J2 connector. See the section on Remote Controls on page 35 for additional information.

5.2 Low Flow Alarm

The optional low flow alarm includes a flow switch that is located in the enclosure on the right side. It is connected with vinyl tubing to the outlet of the flowmeter. The option sounds an alarm when flow drops below a factory-set value. The switch can also be used with an optional alarm relay. If the stainless steel outlet option is ordered with a low flow alarm, the flow switch is mounted in the sample outlet line as part of the sensor assembly. A 2-pin connector is used to disconnect the switch from the analyzer.

5.3 Flow Control Valve

The upstream flow control valve is mounted behind the door and below the Flow Indicator. It may be used to control the gas flow rate in positive pressure installations where the inlet pressure is less than 5 psi. In addition, it may be shut off to isolate the analyzer from the gas stream.

5.4 Filter

The filter assembly is installed at the factory when ordered with the Analyzer. However, a filter assembly may be purchased later and installed by the user. It is mounted externally on the back panel as shown in Figure 5. The option includes a bracket and preformed tube with fittings to connect the filter outlet to the Analyzer inlet. The back panel of the Analyzer has three PEM nuts for mounting the filter bracket. Use the screws supplied with the PEM nuts.

Two grades of filter elements are available for the filter:

Fine grade (BQ) (< 1 micron)
Course grade (DQ) (> 1 micron)

The course grade is normally supplied. See page 70 for ordering information.

Note: The filter has two ports labeled 1 and 2. For particulate removal plumb the filter with port 2 connected to the Analyzer's sample inlet fitting. For mist coalescing and collection for draining, plumb the filter with port 1 connected to the Analyzer's sample inlet fitting.

5.5 Pressure Regulator

The gas pressure regulator is installed at the factory when ordered with the Analyzer. However, a gas pressure regulator may be purchased later and installed by the user. It is mounted on the back panel as shown in Figure 6. The option also includes a preformed tube with fittings to connect the regulator outlet to the Analyzer inlet. The back panel of the Analyzer has three PEM nuts for mounting the regulator bracket. Use the supplied screws with the PEM nuts. NOTE: For additional information on the proper purging regulators after installation see page 24

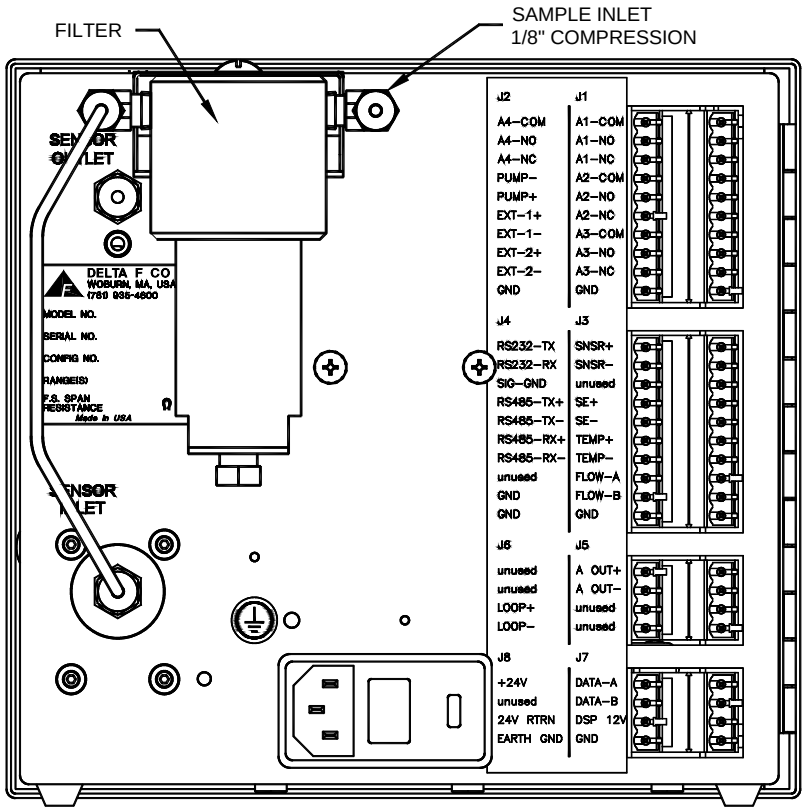


Figure 5: Filter Installation

5.6 Combined Filter/Pressure Regulator

The gas filter and regulator are installed by the factory when ordered with the Analyzer. However, the gas filter and regulator may be ordered later and installed by the user. They are supplied as a unit with one mounting bracket and mounting screws. The option also includes a preformed tube with fittings to connect the regulator outlet to the Analyzer inlet. These should be mounted on the back panel as shown in Figure 3-4 using the supplied screws.

Note: The filter has two ports labeled 1 and 2. For particulate removal plumb the filter with port 2 connected to the Analyzer's sample inlet fitting. For mist coalescing and collection for draining, plumb the filter with port 1 connected to the Analyzer's sample inlet fitting.

NOTE: For additional information on the proper purging regulators after installation see page 24

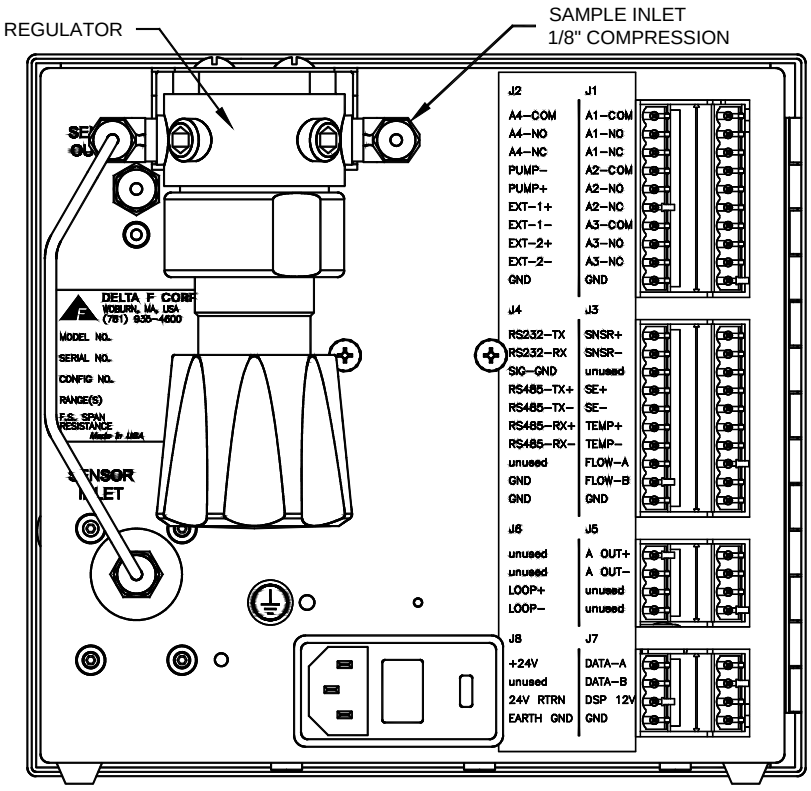


Figure 6: Regulator Installation

5.7 Stainless Steel Outlet Tubing

Analyzers can be equipped with a 1/8-inch compression stainless steel outlet tube. When this option is provided, the analyzer cannot be equipped with the quick-disconnect fitting at the flowmeter outlet. Because of the rigid outlet tube, the Sensor Assembly can only be removed after both inlet and outlet bulkhead retainer nuts are removed. A 7/16-inch wrench is needed for the inlet nut; and a ½-inch wrench is used on the outlet nut. When reinstalling the sensor, make sure both bulkhead fitting hex sections are oriented to seat in the retainer blocks on the inside rear of the enclosure.

5.8 Key Lock

An optional key lock can be installed in the door of the analyzer to prevent access to the power switch and other internal components. The lock is supplied with two keys.

If the analyzer is operating, the key lock does not prevent adjustments from the front panel. Password Protection, described in the *User Interface* section under *Setup Analyzer Menu*, must be used to lockout front panel control changes.

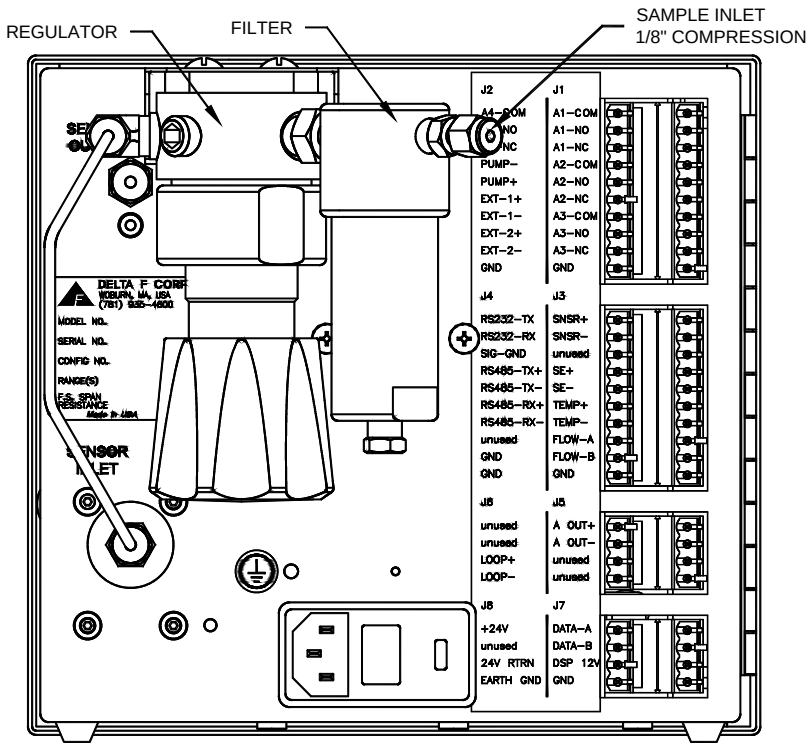


Figure 7: Combined Filter/Regulator Assembly

5.9 Relays

Up to four optional form C (SPDT) relays (contact closures) are available to assign to alarms or system status flags. One or more alarms or status flags can be assigned to one or more relays. The contacts are rated at 0.3A, 30 VDC under a resistive load. Pin assignments provide relay connecting details. See page 32 for additional information.

5.10 Comm Ports

Either of two communication ports are available at the time of order: RS232C or RS485. This option allows interfacing between the analyzer and other operating systems. A "C" language software library package is available for customized development of communication software. See page 31 for additional information.

5.11 Panel Mount

A panel mount option is available for the analyzer. See Figure 8 and Figure 9 for dimension and cut-out details.

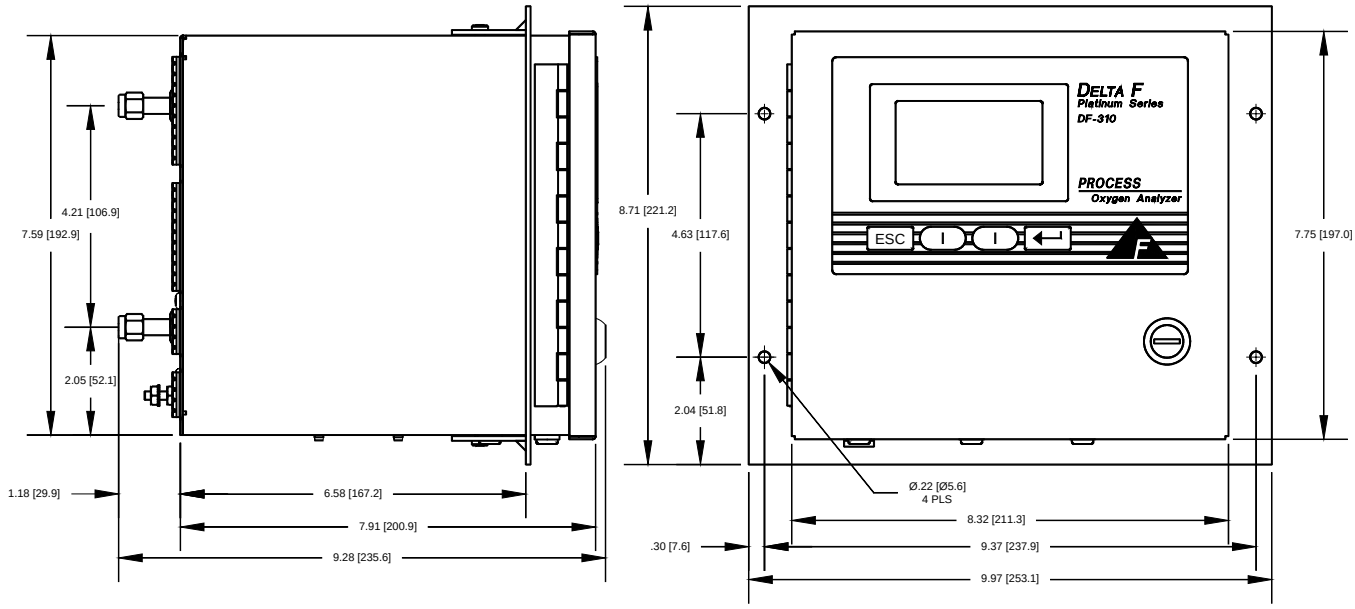


Figure 8: Panel Mount Configuration

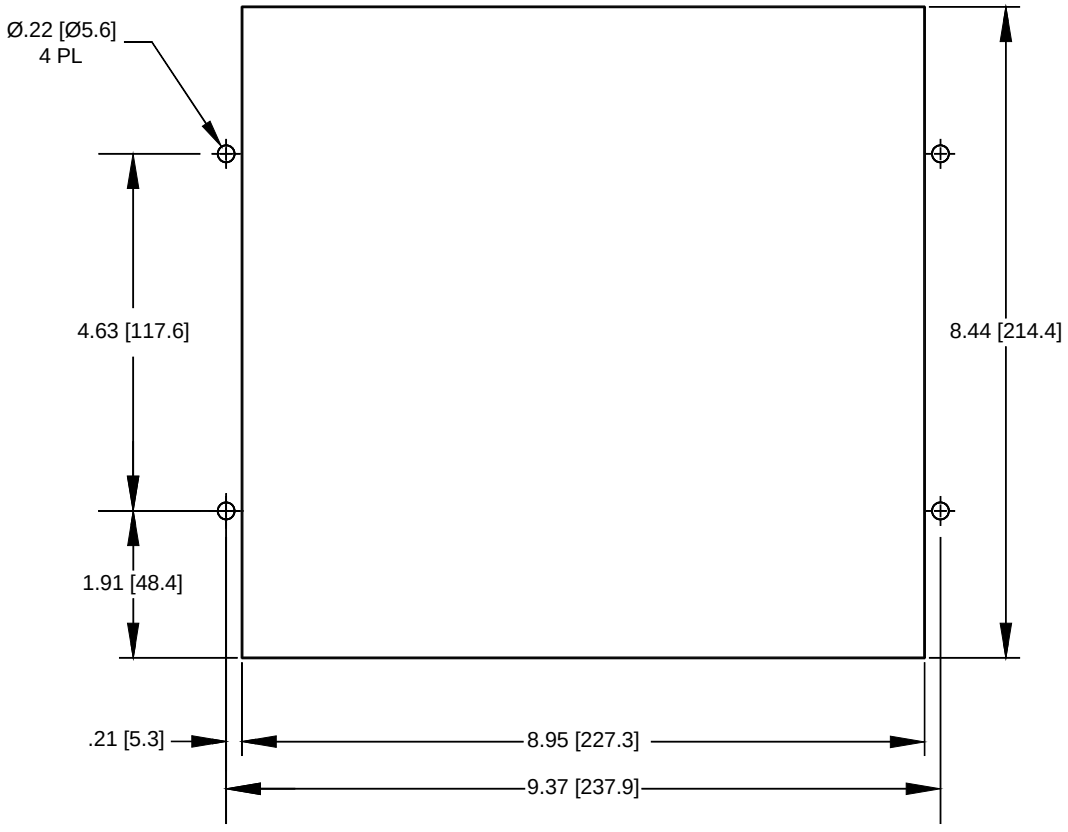


Figure 9: Cutout Dimensions for Panel Mount

5.12 Rack Mount

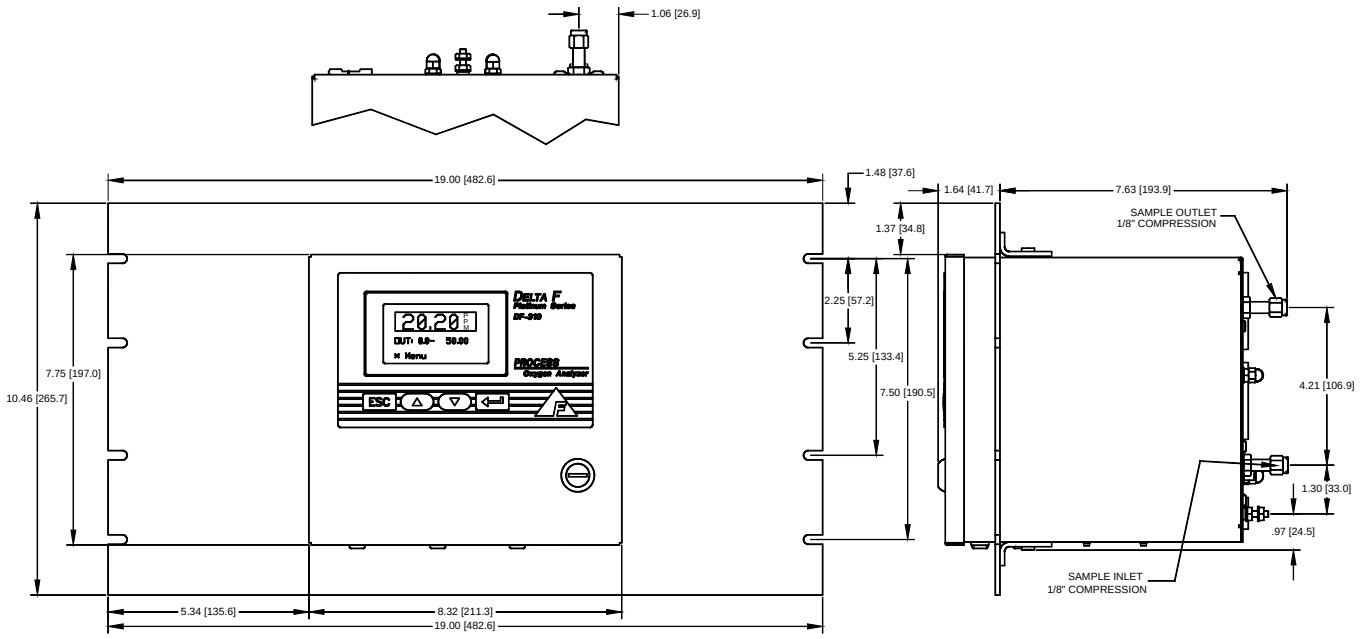


Figure 10: Rack Mount

5.13 Dual Rack Mount

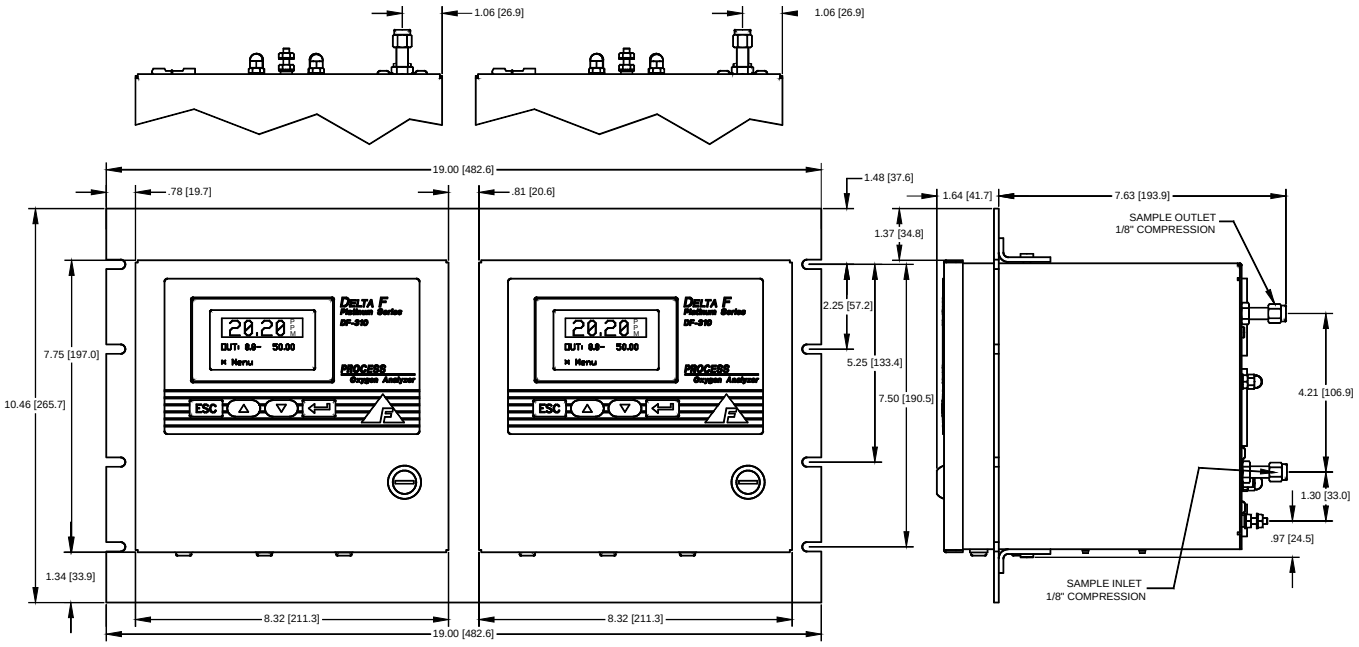


Figure 11: Dual Rack Mount

6 Sample Gas Preparation and Delivery

6.1 Sample Flow Rate and Pressure

The analyzer is factory calibrated at a flow rate of 2.0 scfh, in N_2, and should be operated at that level for optimal accuracy. However, the Delta F Sensor is relatively unaffected by gas sample flow rate, within limits. Sample flow rate should be maintained within the recommended range of 1.0 to 3.0 scfh. The analyzer can be operated at flow rates outside that range, but it should be recalibrated at that different flow rate to maintain optimal accuracy.
The analyzer has a small pressure drop (0.2 to 0.5 psi), so relatively small changes in inlet or outlet pressure causes dramatic changes in flow rate. Consequently, it is preferable to vent the outlet to atmosphere so that outlet pressure remains constant, leaving inlet pressure as the only variable to control.

6.1.1 Flow Rate Effects on Sensor Performance

Assuming a leak-tight system, higher flow rates may cause O_2 readings to increase by a few percent of reading above the level that would be displayed if flow was within the recommended 1.0 to 3.0 scfh range. Lower flow rates similarly cause O_2 readings to decrease by a few percent of reading. Very low flow rates (below 0.2 scfh) should be avoided as the sample inside of the sensor is no longer representative of the actual sample.
The insensitivity to flow rate changes is the basis for the sample system leak detection described below. The sensor output should be virtually constant for readings between 0.5 and 4.0 scfh. Therefore, if O_2 readings become higher at lower flows, then ambient O_2 is leaking into the sample system, or venting from a dead space (closed pocket with trapped higher O_2 level gas) in the sample system. A higher flow rate dilutes the O_2 entering the sample system decreasing the reading. O_2 readings in a leak free sample system should not go up or down significantly with flow changes between 0.5 and 4.0 scfh.

6.1.2 Checking for Plumbing Leaks using Flow Rate Effects

Significant measurement error can be caused by leaks in the plumbing system. A simple test can be performed to identify oxygen intrusion leaks.
Observe the analyzer readout at two flow levels: 0.5 and 3.0 scfh. Only a slight increase, if any, in readout will occur in a tight system as the flow is increased. If leakage in the plumbing system exists, then the increased flow results in a substantial decrease in oxygen readout -- typically dropping by 25

to 50 percent.
When flow sensitivity is observed, check the plumbing system for leaks. Once proficient with this test, the user can estimate the distance to the leak based on the response time of the reading changes.

6.1.3 Background Gas Effects on Indicated Flow Rate

If the molecular weight of the background gas is much different from N_2, the flowmeter reading is not accurate. The Rotameter type is calibrated for use in air (or N_2). Most other gases have molecular weights within ± 25 percent of air. Since the required flow rate is not extremely critical most gases produces reasonably correct readings. The exceptions are light gases such as Helium and Hydrogen whose flow rates should be set to approximately one-third that of Nitrogen or .6 scfh.

6.1.4 Regulator Requirements

If the pressure in the sample line varies, but does not drop below 2.0 psig, use a regulator to drop the pressure to approximately 1.0 psig. Set final flow rate with the sensor flow control valve.
If a regulator is not used, the flow rate changes when the pressure at the inlet of the flow control valve changes. As long as this pressure variation does not bring the flow rate out of the recommended flow range (1.0 - 3.0 scfh) no regulator is required. A flow change of ±1.0 scfh may result in a small change to the oxygen reading.
If a pressure change causes the flow rate to move outside the recommended range, an adjustment of the flow control valve must be made. If the adjustment is not made, and the flow rate remains outside the recommended range, the analyzer may not be operating within its stated accuracy.

6.1.5 Pressure Regulator Purge

Regulators used on bottled calibration standards are typically equipped with 2 Bourdon pressure gauges, one to measure the cylinder pressure, and the other to measure the outlet pressure. The regulator must have a metal (preferably stainless steel) diaphragm. It is good practice to install a flow control valve to adjust the flow after the regulator.
All user-added upstream plumbing should be consistent with the instrument gas delivery components so that the highest level of integrity can be maintained. All connections should be welded or include metal face-seal components.
Pressure gauges are not recommended on regulators used on process sample lines because they add measurement delay time and offer opportunities for leaks.

6.1.5.1 Regulator Purge Procedure

Before the gas is connected to the analyzer follow the procedure listed below to purge ambient air from the regulator**:**
After securely attaching the regulator to the cylinder,

1. Open the regulator flow control valve slightly.

2. Open the cylinder valve.
3. Set the regulator to its maximum delivery pressure.
4. Adjust the flow control valve to allow a modest flow rate (hissing sound).
5. Close the cylinder valve until the cylinder pressure falls to zero. If equipped with gauges, allow the secondary (output) gauge to approach zero. Otherwise wait for the hissing to nearly stop.
6. Immediately open the cylinder valve to restore full delivery pressure.
7. Repeat steps 5 and 6 five to ten times to thoroughly purge the regulator and gauges.
8. Close the shut off valve on the outlet side of the regulator to isolate the purged regulator from atmospheric contamination.

Set the delivery pressure to 5 psig (15 psi for welded sample line with VCR connection.

The above procedure insures that any ambient air trapped in the pressure gauges and cavities of the regulator is purged prior to use. Once the regulator is mounted, do not remove it from the cylinder until a fresh cylinder is required.

6.1.6 Pressure Effects on Sensor Performance

If the analyzer is not vented to atmosphere, the sensor pressure is influenced by the conditions downstream of the analyzer. A recalibration under your operating conditions may be desirable to remain within the stated accuracy specifications. However, in most cases the error introduced is relatively small, and may not affect the process application.

NOTE

It is not recommended that gauges be installed upstream of the analyzer. The presence of a gauge increases response times and introduces potential leaks to ambient.

Sample gas line lengths, fittings and bends should be kept to a minimum to maintain low pressure drops. Larger diameter tubing and fittings reduce pressure drop and also lengthen response time. In general, 1/8-inch tubing should be limited to 15-foot runs; longer runs should be made with 1/4-inch tubing.

6.1.7 Sample Outlet Backpressure Effects

It is always recommended to vent the analyzer to atmospheric pressure. However, if a sample vent or return line is used, attention must be given to maintain a low and consistent backpressure so as not to affect the flow rate. The allowable backpressure on the sensor is ±1 psig. If variations in the vent line pressure are expected, a sub-atmospheric backpressure regulator should be installed on the vent line to maintain an even backpressure on the analyzer. Consider the regulator's pressure drop (typically 1 psi) when designing the

sample vent system in order to stay within the ±1 psig pressure limits at the sensor.
When not venting the analyzer to atmosphere, it is also suggested to install a fairly high resolution pressure gauge immediately at the analyzer outlet.

NOTE

If a regulator or gauge is installed on the analyzer outlet, the Stainless Steel Downstream Plumbing option should be installed.

6.2 Sample Gas Compatibility

There are a wide range of considerations in determining the gas sample compatibility of the Process Oxygen Analyzer. Delta F attempts to identify all pertinent application details prior to quoting and order processing. All non-typical applications concerning gas sample compatibility must be reviewed by our in-house Application Engineers. It is impossible to accurately predict all of the chemical tolerances under the variety of process gases and process conditions that exist.

6.2.1 Condensation

The analyzer should be installed and operated with a sample gas that is preconditioned (if necessary) to avoid condensation in the gas lines. Several methods are available to minimize the possibility of condensation. If the sample gas is a hydrocarbon, maintain the gas temperature 20° F to 40° F above its dew point. In some applications, it may be necessary to chill the sample gas before it enters the analyzer so that the hydrocarbons can be condensed, collected, and removed. It is good practice to pitch the sample gas lines to allow condensables to drain away from the analyzer. Gas sample delivery lines that contain sample gases with high moisture content must not be exposed to temperatures below the dew point.

6.2.2 Flammable Sample Gas

There is nothing within the analyzer sample system that can ignite a flammable sample gas. However, it is critical to ensure that the sample gas does not escape from the sample system into the analyzer enclosure, or the room, where ignition is possible. Stainless steel plumbing should be used throughout the entire sample system if the sample gas is flammable.
Also, the analyzer enclosure can be purged with nitrogen, or the entire Analyzer can be mounted in a purged enclosure, so that any sample gas that escapes the plumbing is diluted.

6.2.3 Sample Gas Temperature

Gas temperature should not exceed 50 °C (122° F), nor should it fall below 0° C (32° F). Gas temperature can be controlled by passing the gas through 5 to 10 feet of metal tubing that is within the recommended sample temperature.

Because of its low thermal mass, the gas sample quickly reaches the gas sample line temperature.

Ideally, the analyzer should be operated at a nominal temperature of 70° F. Calibration temperature should be close to operating temperature. If the analyzer is to be operated at an average ambient temperature outside 65° F to 80° F, it should be recalibrated at the operating temperature for optimal performance.

6.2.4 Protecting the Analyzer from Process Upsets

The analyzer should be protected from extended exposure to high concentrations of oxygen or hostile gases. Automatically solenoid controlled valves should be installed to switch the analyzer over to an N_2 purge when the process reaches some identifiable condition.
Gas line maintenance operations must also be examined for their effect on the analyzer. For example, in many pipeline process or normal gas applications the plumbing system is cleaned with either a liquid solvent or detergent solution. Since either causes damage to the sensor, switch the analyzer over to a N_2 bypass purge, or shut off sample flow and power to the analyzer prior to initiating the potentially hazardous process.

6.3 Calibration Gas Considerations

Calibrations performed from a bottled, calibrated sample gas, may introduce additional issues that could adversely affect the analyzer calibration.

6.3.1 Calibration Standards

Certified calibration standards are available from gas manufacturers. These standards are available in steel and aluminum cylinders. Steel cylinders are less expensive but do not dependably maintain a stable oxygen concentration for long periods of time.
Calibration standards in aluminum cylinders are recommended. Delta F has found that calibration standards in aluminum cylinders are very stable for long periods of time (between 6 and 24 months) where steel cylinders should be recalibrated every three months.

6.3.2 Calibration Cylinder Regulators

Regulators used on bottled calibration standards are typically equipped with two Bourdon pressure gauges, one to measure the cylinder pressure, and the other to measure the outlet pressure. The regulator must have a metal (preferably stainless steel) diaphragm. Install a flow control valve after the regulator to adjust the flow.

6.3.3 Purge Procedure

Before the calibration gas is connected to the analyzer follow the procedure

listed below to purge ambient air from the regulator which prevents contamination of the gas in the cylinder rendering it useless:
After securely attaching the regulator to the cylinder,

9. Open the regulator flow control valve slightly.
10. Open the cylinder valve.
11. Set the regulator to its maximum delivery pressure.
12. Adjust the flow control valve to allow a modest flow rate (hissing sound).
13. Close the cylinder valve until the cylinder pressure falls to zero. If equipped with gauges, allow the secondary (output) gauge to approach zero. Otherwise wait for the hissing to nearly stop.
14. Immediately open the cylinder valve to restore full delivery pressure.
15. Repeat steps 5 and 6 five to ten times to thoroughly purge the regulator and gauges.
16. Close the shut off valve on the outlet side of the regulator to isolate the purged regulator from atmospheric contamination.
17. Set the delivery pressure to 5 psig (15 psi for welded sample line with VCR connection.

Once the regulator is mounted and purged, do not remove it from the cylinder until a fresh cylinder is required.

6.3.4 Sample Gas Delivery and Vent Pressure during Calibration

The most accurate calibration is obtained when the analyzer is plumbed into the gas sample system so that the analyzer is under actual process operating conditions. But when the process sample is being delivered to the analyzer under Vacuum conditions, or being returned from the sample outlet under either positive pressure or Vacuum conditions the operating pressure at the sensor is likely to be quite different than under factory calibration conditions. For systems where the gas sample is not vented to atmosphere, the analyzer outlet should remain connected in the same manner during calibration, if possible. This ensures that downstream pressure effects on the sensor are the same during calibration and process monitoring.
Use the flow control valve on the regulator to meter the calibration gas to the analyzer at the suggested 2.0 scfh flow. By leaving the analyzer's flow controls untouched from when the analyzer is used on process, the calibration pressure duplicates the process sampling pressure.

6.3.5 Background Gas Effects on Calibration

6.3.5.1 Flow rate

Ideally, the calibration gas and the sample gas have the same gas composition, and as a result, the indicated flow rate during calibration and process sampling are identical. However, if the composition of the calibration and sample gases are not the same, the flow rate indicated on the rotameter may need to be adjusted. Light gases, such as H_2 and He, have a higher flow rate than is

indicated on the flowmeter. As a result, the flow rate of the light gas should be set to one third of the flow specifications found in this manual. For example: The recommended flow rate for N_2 is 1.0 to 3.0 scfh. In H_2 or He service, the recommended flow rate (***as indicated on the analyzer***) should be 0.3 to 1.0 scfh.

Background Gas	Flowmeter Setting (scfh)
Argon	2.4
Ethylene	2.0
Nitrogen or Air	2.0
Carbon Monoxide	2.0
Methane	1.5
Hydrogen	0.5
Helium	0.7

Table 1: Flowmeter Settings vs Background Gas

7 Connecting to External Devices

The analyzer can be interfaced to a variety of external devices via the ports on the rear panel. Alarm contacts, voltage, and current outputs, and serial communications are supported.

7.1 The Comm Port

The optional Comm port is used for communication via RS-232C or RS-485 protocol. Up to 32 units may be accessed via RS-485. Operating parameters are 8 bits, no parity, and one stop bit. Baud rate may be selected from the menu on the display.
A library of interface functions, written in C, is available to allow programmers to create custom interface program for accessing the communication port. The *Interface C Library Reference Manual* comes with a disk containing Microsoft and Borland versions of the object code.
The Comm port (J4) terminals are defined as follows:

J4-1	RS232-TX	Data transmitted by the analyzer to the device (RS-232)
J4-2	RS232-RX	Data received by the analyzer from the device (RS-232)
J4-3	SID-GND	Ground
J4-4	RS485-TX +	Data transmitted by the analyzer to the device (RS-485)
J4-5	RS485-TX -	Data transmitted by the analyzer to the device (RS-485)
J4-6	RS485-RX +	Data received by the analyzer from the device (RS-485)
J4-7	RS485-RX -	Data received by the analyzer from the device (RS-485)
J4-8	UNUSED	Key
J4-9	UNUSED	Key
J4-10	GND	Ground

Table 2: Comm Port (J4) Connector Pinout

NOTE

To avoid ground-loop conflicts when using RS-232C or RS-485 for communications, make connections to external recorders or data acquisition systems through a differential input, or a single-ended input that is not referenced to Earth Ground.

When connecting the Process Oxygen Analyzer to a computer via an RS-232 or RS-485 communication cable, a Ferrite Sleeve is required around the cable in a single-turn configuration. It is recommended that the proper Delta F cable be used for this purpose.

7.2 Relay Ports

Four optional form C (SPDT) relays (contact closures) are provided on the analyzer. These are used in conjunction with up to seven alarms. The contacts are rated at 0.3A, 30 VDC under a resistive load. They are not designed to switch AC power.
The relay contacts can be programmed for up to four Oxygen Alarms, plus Temperature, Low Flow, Electrolyte Condition alarms. A relay can be assigned to any alarm through the display menu.
The Normally Open (No alarm) contact connects to common when an alarm occurs or when power to the instrument is lost.

J1-1	A1-COM	Alarm 1 Common
J1-2	A1-NO	Alarm 1 Normally Open
J1-3	A1-NC	Alarm 1 Normally Closed
J1-4	A2-COM	Alarm 2 Common
J1-5	A2-NO	Alarm 2 Normally Open
J1-6	A2-NC	Alarm 2 Normally Closed
J1-7	A3-COM	Alarm 3 Common
J1-8	A3-NO	Alarm 3 Normally Open
J1-9	A3-NC	Alarm 3 Normally Closed
J1-10	GND	Ground
J2-1	A4-COM	Alarm 4 Common
J2-2	A4-NO	Alarm 4 Normally Open
J2-3	A4-NC	Alarm 4 Normally Closed
J2-4	PUMP A	Pump Control
J2-5	PUMP B	Pump Control
J2-6	EXT-1A	
J2-7	EXT-1B	
J2-8	EXT-2A	
J2-9	EXT-2B	
J2-10	GND	Ground

Table 3: Relay Port Connectors (J1, J2) Pin Out

7.3 Analog Outputs

Connector J5 is provided to make connections to the analog voltage output signal (0 to 1, 0-2 , 0 to 5, or 0 to 10 VDC, selectable). For details regarding how to switch the full scale output see section 7.3.1 below.
Connections to the 4-20mA analog loop current circuit are made through the J6 connector.
The alignment procedure for both analog outputs is found in section 7.3.2 below.
See section 4.4 for information on wiring both outputs.

J5-1	AOUT+	Voltage Output +
J5-2	AOUT-	Voltage Output -
J5-3	unused	
J5-4	unused	

Table 4: Analog Voltage Output Connector (J5) Pin Out

J6-1	unused	Voltage Output +
J6-2	unused	Voltage Output -
J6-3	LOOP +	4-20 mA Output +
J6-4	LOOP -	4-20 mA Output -

Table 5: 4-20 mA Analog Current Loop Connector (J6) Pin Out

7.3.1 Procedure to change the Full Scale Analog Output Voltage

The following procedure should be used to change the full scale analog output voltage. The options are 1.0, 2.0, 5.0 and 10.0 VDC.

1. Shut-off and disconnect all power from the analyzer.
2. Label and remove all connections from the rear of the analyzer.
3. Open the door and disconnect the sensor and display cables.
4. Unscrew the two thumbscrews which hold the circuit boards in place and remove the board assembly.
5. Lay the assembly on its left side and remove the two screws that hold the black plastic cover in place. Remove the cover and set aside.
6. Locate jumpers # JP7, JP8 and JP9 in the center, directly below the relays in the upper third of the board.
7. Using the information in Table 6, place a jumper (short) between the appropriate pins to obtain the desired full scale output.
8. Reassemble and install the circuit boards back into the analyzer.
9. Reconnect all cables and power up the analyzer.
10. From the Diagnostics Menu, select Test Output, and set the output to 100% full scale.
11. With a DVM, confirm that the analog output voltage is proper. If it needs to be adjusted slightly, use the potentiometer located third from the top on the front of the circuit board, above the Delta F symbol.

Full Scale Output Voltage	Jumper Number
1.0 VDC	7
2.0 VDC	8
5.0 VDC	9
10.0 VDC	None

Table 6: Analog Output Voltage Jumpers

7.3.2 Alignment Procedure for Analog Voltage and Current Loop Outputs

All output connections should be made before the alignment is started. It is assumed for the purpose of this alignment that the full-scale analog voltage output is 10 VDC.
Use the Test Outputs screen as described on page 65 to set the output to the desired level after which the alignment adjustments are made as follows:

1. Set the output to 0%
2. Adjust the analog voltage output (1) to 0.000 V +/- 1mV, adjust the current loop output (2) to 4.00mA +/- .01mA
3. Set the output to 100%
4. Adjust the analog voltage output (3) to 10.000 V +/- 1 mV, and adjust the current loop output (4) to 20.00mA +/- .01mA

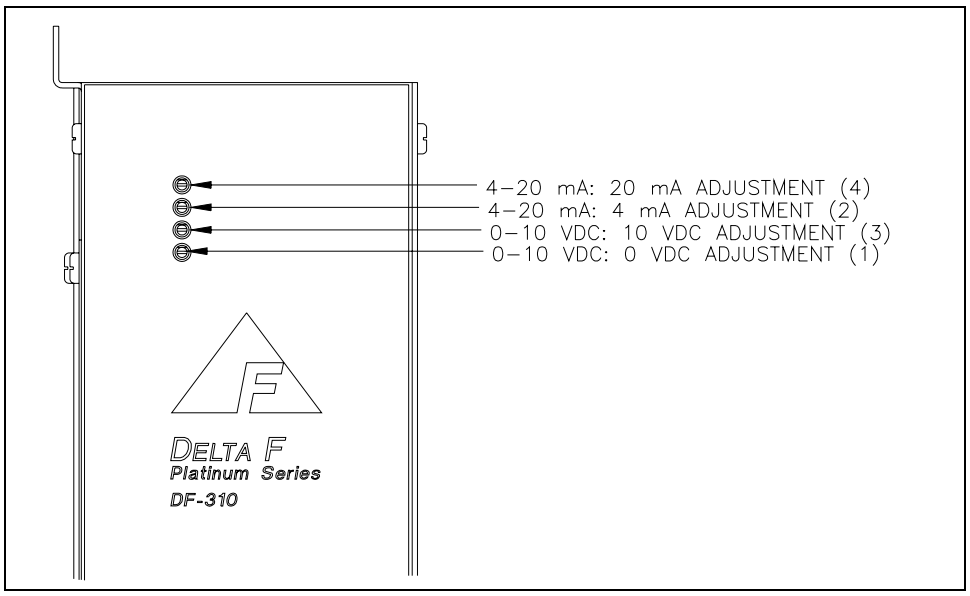


Figure 12: Analog Output/4-20mA Adjustments

7.4 Remote Controls

7.4.1 Remote Sensor Control – J2 Connector

If equipped, the oxygen sensor can be turned on and off remotely through the pins labeled EXT A and EXT B on the J2 connector. If equipped, the EXT Functions screen, see page 66, will indicate to what set of EXT contacts this option is assigned, either 1 or 2.

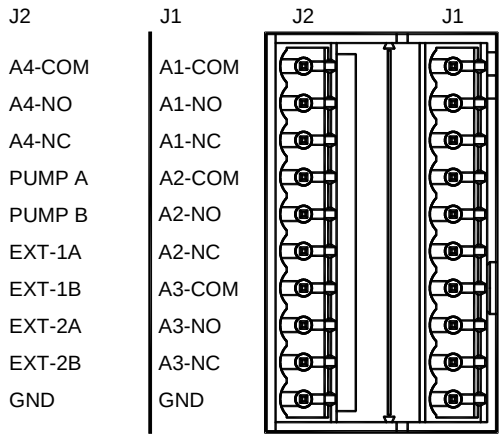


Figure 13: External Control Connector – J2

While the display is in the normal O2 mode, a voltage of 24 VDC applied to the contacts labeled EXT A (+) and EXT B (-) will turn the sensor off. The oxygen sensor will stay off until this potential is removed.
NOTE: Turning the sensor off in this way will make control of the sensor from the keypad impossible.
NOTE: The audible alarm normally associated with the sensor off function is disabled with this option.

7.4.2 Remote Pump Control – J2 Connector

The pump enables the analyzer to operate on gas sample streams between 2.0 psig vacuum and 2.0 psig positive pressure.
If the analyzer has a pump, it will also have a downstream Flow Control Valve mounted in the bottom of the flow meter. When using the pump, always use this downstream valve to control the gas flow rate and leave all up stream valves wide open.
If the pump is not in use, (positive pressure application) always control the gas flow with an upstream valve or regulator and leave all down stream valves wide open.

CAUTION

Do not use an upstream valve to control flow if the analyzer is operating on a pump.

The on-board pump, if equipped, is controlled from the Controls Menu. See the User Manual for additional information.
Connections to power a remote pump are made through the PUMP A (-) and PUMP B (+24 VDC) pins on connector J2. The wires should be in a shielded cable (separate from the sensor signal) with the shield attached to the frame ground. The pump cable should be of sufficient size for the required run (see Table 7 below) and should not share the same conduit as the sensor cable.

Pump Cable (Must be separate from sensor cable)	
Distance in Feet	**Minimum Wire Size**
0 – 500	#20 AWG
500 – 1000	#18 AWG

Table 7: Pump Cable Specification

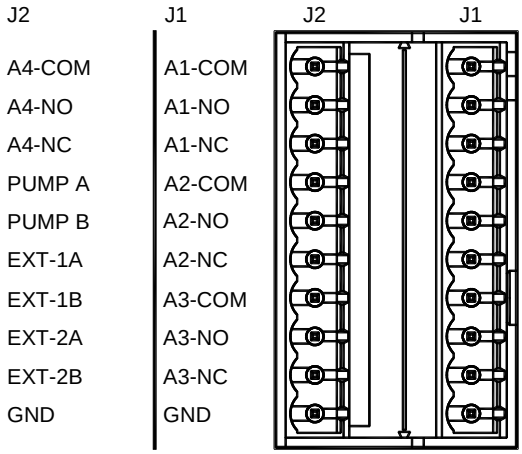


Figure 14: Pump Control Connector – J2

In addition, the following options are available:

If factory configured, Delta F will supply the standard pump that the user may install remotely and power through the PUMP A(-), B(+24VDC) connections on the rear panel connector J2. Control would be accomplished in the same manner as a standard pump.

OR

If factory configured, a switch closure rated at 1A/30VDC can be supplied between the PUMP A, B connections on the rear panel connector J2. The contacts can be used to control a Delta F supplied pump that is powered from a separate 24 VDC, .3 A source. Control of the pump would be accomplished in the same manner as a standard pump.

OR

If equipped, the pump may also be turned on and off remotely through the pins labeled EXT A and EXT B on the J2 connector. If equipped, the Diagnostics Screen will indicate to what set of EXT contacts this option is assigned, either 1 or 2.
While the display is in the normal O2 mode, a voltage of 24 VDC applied to the contacts labeled EXT A (+) and EXT B (-) will turn the pump off. The pump will stay off until this potential is removed.
NOTE: Turning the pump off in this way will make control of the pump from the keypad impossible.

7.5 Remote Sensor Installations

The oxygen sensor for a DF Series analyzer may be installed outside of the analyzer cabinet (if equipped with this option). Areas of high convected or radiated heat must be avoided.
Care must be taken to use high quality cable and techniques when making remote connections.
Contact Delta F for additional information on remote sensor installations.

7.5.1 Oxygen Sensor Mount

Drill a 7/16 inch (1.1 cm) clearance hole, leave the o-ring on the housing, pass the cable through the hole and thread the washer and nut on the housing. Tighten the nut to create a leak tight assembly by compressing the o-ring to 50% of its original thickness. The finished assembly will place the top of the sensor two inches from the mounting surface.

Figure 15: Remote Sensor Mount

7.5.2 Oxygen Sensor Electrical Connections – Connector J3

There are two pair of connections that must be made between the oxygen sensor and connector J3 on the electronics chassis. They are labeled S + and -, and H + and -. It is critical for proper operation, and to prevent damage to the sensor, that the proper polarity be maintained on all connections. *NOTE: The length of the cable attached to the oxygen sensor must not be adjusted.*

J4	J3
RS232-TX	S+ (WHT)
RS232-RX	S– (GRN)
SIG-GND	unused
RS485-TX +	H+ (RED)
RS485-TX -	H– (BLK)
RS485-RX +	unused
RS485-RX -	unused
unused	unused
GND	unused
GND	GND

Figure 16: Remote Sensor Connector – J3

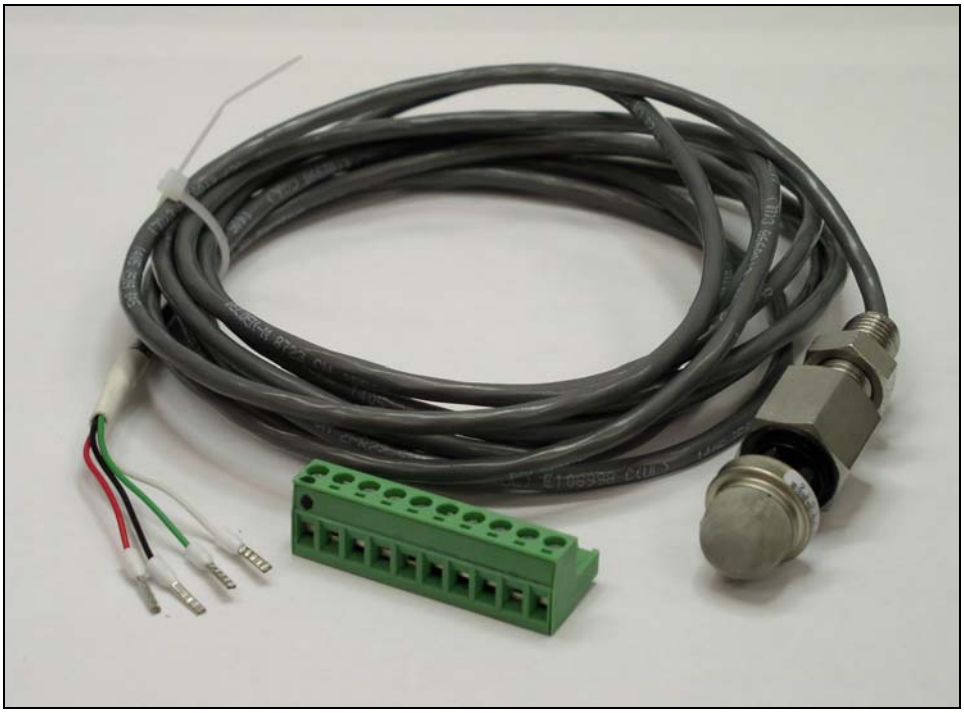


Figure 17: Remote oxygen sensor with cable and connector

7.5.3 Remote Pump Control

If the remote sensor is equipped with a pump, see the section on wiring and controlling a remote pump on page 35 for more information.

8 User Interface

8.1 The Data Display Screen

When the Platinum Series Process Oxygen Analyzer is powered up, it goes through a series of internal diagnostic tests which take about five seconds. After the tests, the Delta F logo appears for ten seconds. The display will then show the Data Display Screen as shown in Figure 18.

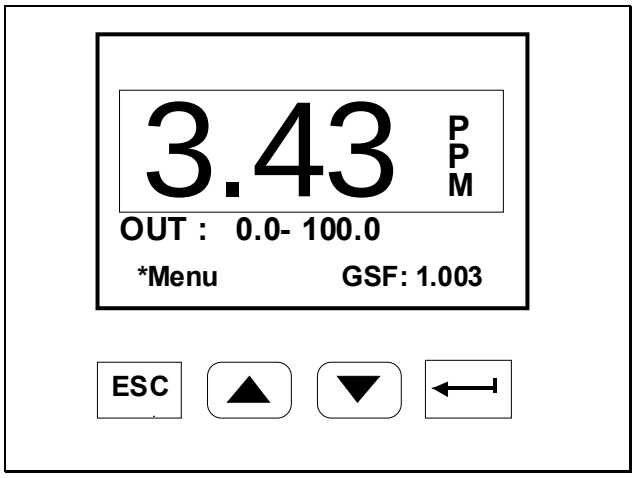


Figure 18: Data Display and Keypad

The numerical information shown is representative. Different values will probably be observed on the display.
There are four pressure sensitive keys below the display. The keys are used as follows:

ESC - Returns the display to the previous screen, or may be used to move to the left when within a data field selection.

▲ - Scrolls up in a menu or data selection.

▼ - Scrolls down in a menu or data selection.

↵ - Accepts the selected (asterisk) entry, allows data field selection, and may be used to move to the right when within a data field selection.

The **Annunciator Line** provides information about the status of the Analyzer, and alarm conditions. The Annunciator Line is displayed on the Main Menu Screen.

The **Data Line** indicates the measured oxygen concentration (e.g. 3.43 ppm). In this manual all concentrations will be shown in ppm O_2. For instruments that display data in percent (%) O_2 all actions are identical, but engineering units will be reported in percent (%).

Below the Data Line is a display of the **Analog Output Range** settings. The analog outputs are

scaled over the range displayed in this area. Factory standard analog outputs are 0-10 VDC and Isolated 4-20 mA. Setting the analog voltage output is described on page 50. If the Analyzer is equipped with the Expanded Range Scale option the Analog Output Range value will change from OUT: x-xxxx to XPOUT: x-xxxx, and will appear in reverse video, when the expanded range scale is active.

*** Menu** indicates that if ↵ is pressed, the Main Menu display, Figure 19, will appear.

GSF indicates the present Gas Scale Factor. The Gas Scale Factor option is not available on this analyzer.

The legend "**OVER RANGE**" will overwrite the Oxygen display if the instrument analog to digital converter reads a value which is over or under its full scale range. During an over range condition the oxygen information is not valid. The analog output will be at maximum (pegged). An "OVER RANGE" condition will result in a continuous alarm tone, which may be silenced by pressing ESC.

A reverse video overlay will appear over the center of the display for the following alarms: Oxygen (1,2,3,4) and Flow (F). The overlay appears and disappears at intervals so that the Oxygen reading is still visible. If there are several alarms in progress all of the alarm overlays will be displayed in sequence.

The overlay also indicates the set point value and whether the alarm condition is a high or low alarm. If the alarm is a Flow Alarm the set point is not displayed because this alarm does not have set point values. Audible annunciation can be activated for each of the alarms. If annunciation is activated, a continuous tone will occur when the overlay is displayed. Pressing ESC while the overlay is displayed will silence the tone and cause the overlay to disappear. Once an alarm has been acknowledged (by pressing ESC) its number will be continuously displayed in the Data Display Window on the Annunciator Line. The numbers are assigned as shown in Table 8.

The alarm number will clear only after the alarm condition is over.

For simultaneous alarms, each will alternately overwrite the display. Successive presses of ESC (as the overwrite is displayed) are necessary to clear the overwrite and annunciation. This will not clear the alarm. Only a restoration of the condition that existed prior to the alarm will clear the alarm.

There are also a number of special messages that can appear on the Annunciator Line of the display:

UNCALIBRATED - Warns that the Analyzer is not calibrated, or that NOVRAM data has been corrupted.

If there is an acknowledged alarm indicated in the Annunciator Line, special messages will appear in the upper left corner of the oxygen display box.

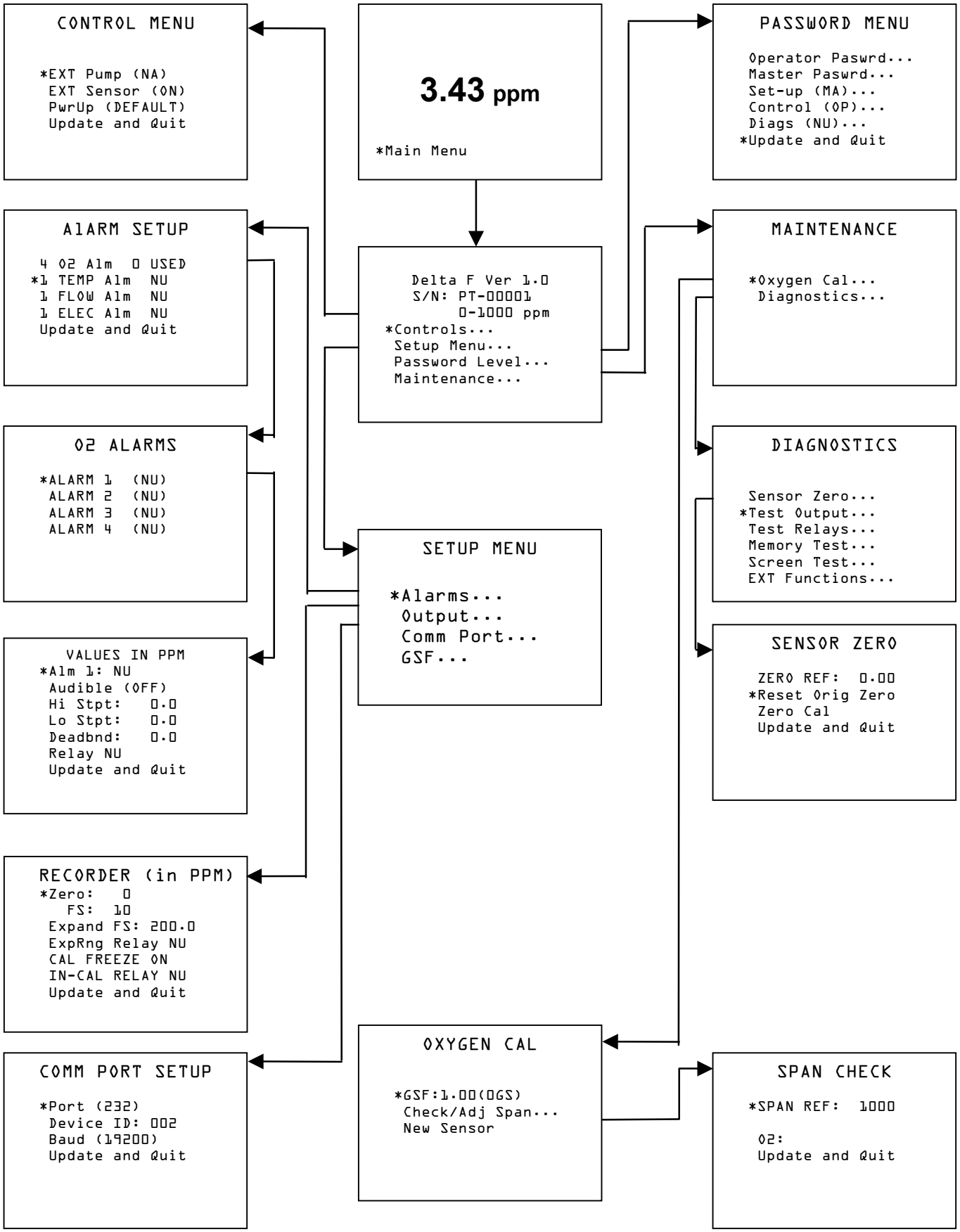
EXT SENSOR! Indicates that the polarization voltage on the oxygen sensor has been turned off remotely.

EXT PUMP Indicates that the pump has been turned on remotely.

Other possible messages, that may appear on various screens, include “Wait!”, and “Memory Error!” “Wait!” indicates that the instrument is performing an operation that is time consuming (> 10 seconds), such as an internal electrical zero calibration. “Memory Error!” indicates that the instrument has failed the boot-up memory test. Perform a Memory Test using the Diagnostics Menu and if it fails contact the Delta F Customer Support Services Department at 781-935-5808.

Alarm Number	Function
1	Oxygen 1
2	Oxygen 2
3	Oxygen 3
4	Oxygen 4
F	Flow

Table 8: Alarm Identification


CONTROL MENU
*EXT Pump (NA)
EXT Sensor (ON)
PwrUp (DEFAULT)
Update and Quit
3.43 ppm
*Main Menu
PASSWORD MENU
Operator Paswrd...
Master Paswrd...
Set-up (MA)...
Control (OP)...
Diags (NU)...
*Update and Quit
ALARM SETUP
4 O2 Alm 0 USED
*1 TEMP Alm NU
1 FLOW Alm NU
1 ELEC Alm NU
Update and Quit
Delta F Ver 1.0
S/N: PT-00001
0-1000 ppm
*Controls...
Setup Menu...
Password Level...
Maintenance...
MAINTENANCE
*Oxygen Cal...
Diagnostics...
O2 ALARMS
*ALARM 1 (NU)
ALARM 2 (NU)
ALARM 3 (NU)
ALARM 4 (NU)
SETUP MENU
*Alarms...
Output...
Comm Port...
GSF...
DIAGNOSTICS
Sensor Zero...
*Test Output...
Test Relays...
Memory Test...
Screen Test...
EXT Functions...
VALUES IN PPM
*Alm 1: NU
Audible (OFF)
Hi Stpt: 0.0
Lo Stpt: 0.0
Deadbnd: 0.0
Relay NU
Update and Quit
SENSOR ZERO
ZERO REF: 0.00
*Reset Orig Zero
Zero Cal
Update and Quit
RECORDER (in PPM)
*Zero: 0
FS: 10
Expand FS: 200.0
ExpRng Relay NU
CAL FREEZE ON
IN-CAL RELAY NU
Update and Quit
OXYGEN CAL
*GSF:1.00(OGS)
Check/Adj Span...
New Sensor
COMM PORT SETUP
*Port (232)
Device ID: 002
Baud (19200)
Update and Quit
SPAN CHECK
*SPAN REF: 1000
O2:
Update and Quit

8.2 Main Menu

The Main Menu, Figure 19, is accessed by pressing ↵ from the Data Display Window. Alarm Overlay information will continue to display over the Main Menu.

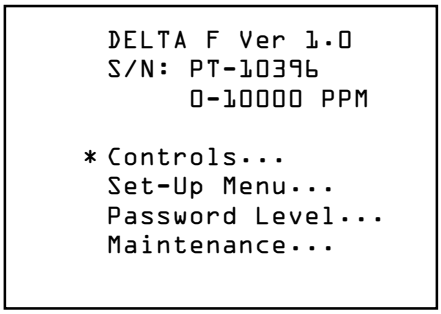


Figure 19: Main Menu

The first three lines of the Main Menu display the firmware version, followed by the instrument serial number and the range of the Analyzer.

Four screens can be accessed from the main screen:

Controls - Used to turn on the pump, or sensor voltage, choose sensor off relay, and select power up default conditions for the above functions. See page 45.

Set-Up Menu - Used to set alarm parameters, the recorder output level and functions, configure communication port, to enter the gas scale factor, to perform or check the span calibration, or to install a replacement sensor. See page 47.

Password - Used to set passwords and indicate which menus are "password" protected 54

Maintenance – Used to access three screens related to oxygen calibration and diagnostics.

The diagram on page 54 shows the "Menu Tree" for the operator interface. Sufficient detail is provided to orient the user during instrument set-up; however, not all the program details are illustrated in this diagram.

Each level in the Main Menu allows the user to access options for setting and testing instrument parameters. Ellipsis (**...**) after an entry indicates that additional screens follow.

8.2.1 Programming Protocol

The following protocols are used to program the Analyzer:
To access a level, use the ▲ or ▼ key to move the asterisk (*) to the desired level and press ↵ .
To edit a numerical value, use the ↵ key to highlight (reverse video) the digit to be changed. Successive use of the ↵ key will highlight the digits on a left to right basis. Use of the ESC key will move the highlighting back to the left and eventually cancel any adjustment. The rightmost digit will be the active digit for editing. Use ▲ or ▼ to adjust the desired value. After the desired numerical value has been entered, press the ↵ key until the number no longer appears in reverse video.

The ESC key is used to return to the previous screen without changing any parameters that may have been altered. If any parameters have been edited without updating memory, the display will present the message "**ABANDON CHANGES?, ↵ FOR YES**". All parameter changes will be **lost** if the ↵ key is pressed.

Select the UPDATE & QUIT choice using ↵ to save the changes and automatically return to the previous menu.

8.3 Controls Menu

The Controls menu is used to turn on or off a number of optional features of the Oxygen Analyzer. When the Controls menu is selected, and the appropriate password is entered (if required), the display will show Figure 20.

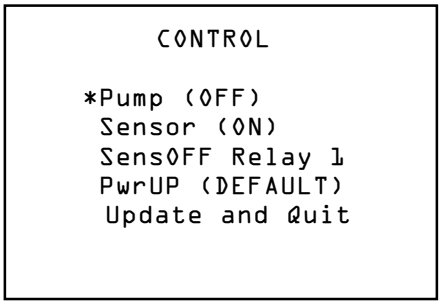


Figure 20: Controls Menu

8.3.1 Pump

(Optional) - After accessing the Pump entry, the pump is toggled ON or OFF by pressing ↵. If the Analyzer does not have a pump, **NA** will be displayed.
See the section on ESC, page 47, for additional information about leaving the menu after changing the Pump setting.
See the section on Remote Controls, page 34, for additional information on remote control of the pump.

NOTE

Analyzers with pumps are fitted with a valve on the rotameter (downstream of the sensor) and a valve on the sensor inlet (upstream of the sensor). When using a pump to draw a gas sample at less than 0.2 psig, the downstream rotameter valve is used as the flow control valve. The sensor inlet (upstream) valve is shipped from the factory in the fully opened (counter-clockwise) position. Its position should not be changed unless the Analyzer is operated on positive pressure, e.g., when measuring a sample greater than 0.2 psig (but less than the maximum limit of 10 psig) that is vented to atmosphere. Likewise, when operating with a positive pressure the rotameter (downstream) valve should be fully opened and the upstream flow control valve used for flow control.
FAILURE TO FOLLOW THESE INSTRUCTIONS MAY CAUSE THE SENSOR TO EXPERIENCE OVER OR UNDER PRESSURE WHICH MAY CAUSE PERMANENT DAMAGE.

8.3.2 Sensor Polarization

After accessing the Sensor entry, the sensor power is toggled ON or OFF by pressing ↵. The sensor ON command applies a polarizing voltage to the sensor. See the section on ESC, page 47, for additional information about leaving the menu after changing the Sensor setting.
The Analyzer has been programmed to protect the sensor from extended operation in an over-range condition (> 30 minutes). If such a condition exists, the software will turn off the polarizing voltage to the sensor. A message will be displayed indicating that the sensor has been turned off, and an intermittent beep will occur as in Figure 21. The beep can be silenced and message canceled by pressing ESC. When ESC is pressed a reverse video SENSOR OFF! legend will overlay the oxygen display.
The user should investigate the reason for the excessively high O_2 level, remedy the situation, and then restore power to the sensor via the Controls menu. The oxygen value is approximately zero when the sensor is off. Also, the analog outputs will go to zero, so any low Oxygen alarms set above zero will trigger on.

See the section on Remote Controls, page 34, for additional information on remote control of the sensor polarization voltage.

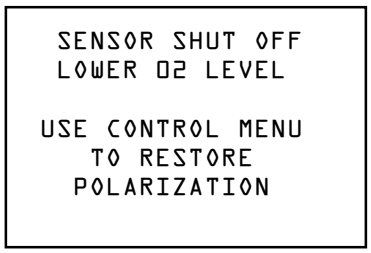


Figure 21: Sensor Shut-off Warning

8.3.3 SensOFF Relay

When the sensor is manually turned off from the front panel, or automatically turned off because the instrument has been over-range for more than 30 minutes, a relay may be assigned to signal that the sensor is off. This feature is important when the Analyzer is used in an unattended area, so that a remote operator can be notified that the instrument is no longer measuring oxygen. If the instrument is not equipped with any relays this selection will show **NA**. It is possible to assign more than one alarm or status condition to any relay. Since the status condition of the sensor, being switched off, signifies an "Analyzer Off-line" condition, it is important to make sure that the relay assigned to SensOFF service is only assigned to alarm conditions signifying similar levels of alert, such as a Low Flow Alarm.

Note: Alarm or Analyzer status conditions that signal an "Analyzer off-line" fault condition (such as sensor off) can be assigned to a single relay contact used as a trouble indicator. If the Analyzer signal is only monitored remotely, it is suggested to route the 4-20 mADC signal through the "Analyzer Trouble" relay such that an alarm condition will cause the relay to break the current loop. This method allows a computerized system to be configured to detect an analyzer fault condition whenever the 4-20 mADC signal is below 4 mA.

8.3.4 P(o)w(e)r UP

When the Analyzer is powered down, and then turned back on, the pump controls default to OFF, and the Sensor defaults to ON. This activity is the DEFAULT operational mode of the pump and sensor. Instead, it is possible to store the states of the pump and sensor every time they change and allow the LAST state to be reestablished when the Analyzer is powered up. The selection "PwrUP" toggles between "DEFAULT" and "LAST".

8.3.5 ESC

If only the Pump, or Sensor selection has been changed, and the PwrUP selection is set to DEFAULT, the Controls menu may be exited with ESC. The new changes will be in effect. If SensOFF Relay or PwrUP has been changed, and the changes are to be stored, or the PwrUP selection is set to LAST, the menu should be exited by selecting Update and Quit. If the changes are to be discarded press ESC. The Analyzer will present the message "**ABANDON CHANGES?, ↵ FOR YES**." Press enter and the display will return to the Data Display Screen.

8.4 Set-Up Menu

Note: When the Set-up entry is selected from the Main Menu, a DISABLING ALARMS message appears which notifies the user that the alarms have been temporarily disabled. The alarm overlay messages will not show in the display. **Relays will remain in the alarm state that immediately preceded the Disabling Alarms message.**
The Set-Up Menu is used to establish a variety of Analyzer parameters. When the selection is made from the Main Menu, Figure 19, and the appropriate password is entered (if required), Figure 22 is shown.

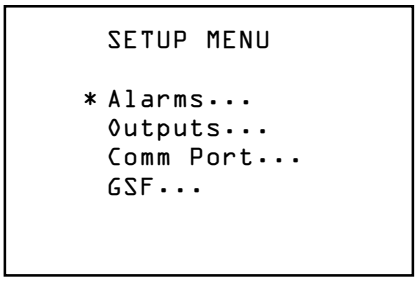


Figure 22: Setup Menu

Each entry in Figure 22 leads to a sub-menu. To select the desired sub-menu, use the ▲ and ▼ keys to place the asterisk next to it, then press ↵**.** A new display will be shown as indicated below.

8.4.1 Alarms

The Alarms screen is used to set or determine the status of alarms. When the Alarms entry is selected from Figure 22, the display will present Figure 23.

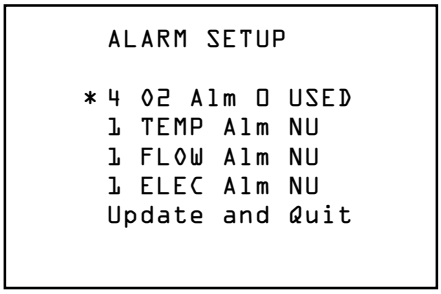


Figure 23: Alarm Setup Menu

To select an alarm to edit, use the ▲ and ▼ keys to move the asterisk. Press ↵ when the alarm is indicated. If (NA) is displayed next to any entry, that alarm option is Not Available.

8.4.1.1 O_2 Alarms

If an O_2 alarm has been selected from the Alarm Setup Screen Figure 23, the display will show Figure 24.

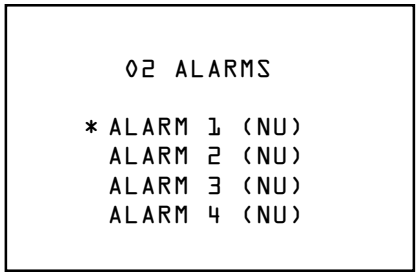


Figure 24: Oxygen Alarm Menu

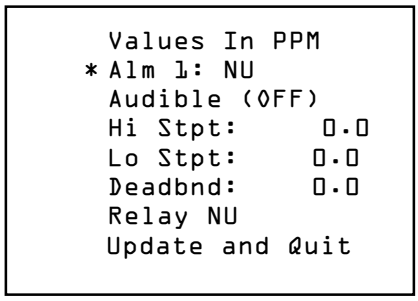


Figure 25: Oxygen Alarm Setup Screen (Alarm not used)

After selecting an Alarm with the ▲ and ▼ keys , use ↵ to toggle the alarm On (USED) or Off (NU). When an unused alarm (NU) is accessed, the display will appear as shown in Figure 25. (Oxygen ALARM 1 is used in the example shown in Figure 26.) To indicate that the alarm is to be used, move the asterisk to Alm 1and press ↵. For the oxygen alarms, the **NU** will change

to **O2**.

Audible is used to toggle On or Off the audible alarm feature. The **Hi Stpt** (high set point) and **Lo Stpt** (low set point) refer to the limits above and below which the alarm will be triggered.

Each oxygen alarm (and the temperature alarm) can be set for a high trip point and a low trip point. This feature gives the user the ability to operate the process between limits of high and low O_2 concentration (or temperature range) using only one alarm.

Deadband refers to how far the current value must be above (for lo alarms) or below (for hi alarms) the set point before an alarm is reset. For example, for a High Alarm (Hi Stpt) set to 50 ppm, a Low Alarm (Lo Stpt) set to 30 ppm, and the deadband (Deadbnd) set at 5 ppm, the alarm will trigger at 50 ppm. The alarm will continue to report until the oxygen concentration falls below 45 ppm (Set point minus Deadband). At 45 ppm, the alarm will reset.
With the Low Alarm, the alarm would trigger at 30 ppm and continue to report until the O_2 concentration increased to 35 ppm (Set point plus Deadband). At 35 ppm the alarm would reset.

Relay indicates the relay to which the alarm is assigned. The options are NU (not used), 1, 2, 3 or 4. Each relay can be assigned up to seven alarms. If more than one alarm is assigned to a relay, any assigned alarm will trip the relay, and the relay will remain tripped until ALL alarms assigned to it are cleared. The alarm can be assigned to only one relay.
If an active alarm is accessed, the display will indicate the present values. An example of an active alarm (O2 Alm 1) is shown in Figure 26.

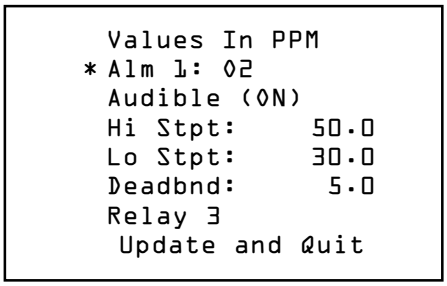


Figure 26: Oxygen Alarm Setup Screen (Alarm used)

8.4.1.2 Temperature Alarm

The **TEMP** alarm is used to indicate an out of range temperature condition for the sensor. From the Alarm Setup Menu, Figure 23, selecting TEMP Alm (ON) will bring a display similar to Figure 25. The alarm can be assigned to any one relay.
The temperature alarm is programmed in the same way as an O_2 alarm. The temperature alarm cannot be set to a value greater than 45 Deg. C. It is recommended that the High Set point be set at 40 Deg. C.

8.4.1.3 Low Flow Alarm

The **FLOW** alarm is used to indicate a low flow condition. The optional low flow switch will trip if the gas flow rate drops below the value listed in Table 9.

Background Gas	Trip Point (scfh)
Air	0.25
Ammonia	0.33
Argon	0.22
Butane	0.18
Carbon Monoxide	0.26
Ethane	0.25
Ethylene	0.26
Helium	0.69
Hexane	0.15
Hydrogen	0.96
Methane	0.34
Nitrogen	0.26
Propylene	0.21

Table 9: Flow Switch Trip Points

From the Alarm Setup Menu, Figure 23, selecting FLOW Alm (ON) will bring a display similar to Figure 25. The alarm can be assigned to any one relay.
The flow alarm is programmed in the same way as an O_2 alarm. However, the values for Hi Stpt, Lo Stpt and Deadbnd will indicate **NA**. These values cannot be accessed.

8.4.1.4 Electrolyte Condition Alarm

The **ELEC** alarm is used to indicate electrolyte condition. From the Alarm Setup Menu, Figure 23, selecting the ELEC Alm (ON) will bring a display similar to Figure 25. The alarm can be assigned to any one relay.
The electrolyte condition alarm is programmed in the same way as an O_2 alarm. However, the values for Hi Stpt, Lo Stpt and Deadbnd will indicate **NA**. These values cannot be accessed.

8.4.2 Analog Outputs

The **Outputs** entry in the Setup Menu, Figure 22**,** is used to scale the full range of the analog output (voltage and current) over a partial or full range of oxygen concentration.

NOTE: Alarm or Analyzer status conditions that signal an "Analyzer off-line" fault condition (such as sensor off) can be assigned to a single relay contact used as a trouble indicator. If the Analyzer signal is only monitored remotely, it is suggested to route the 4-20 mADC signal through the "Analyzer Trouble" relay such that an alarm condition will cause the relay to break the current loop. This method allows a computerized system to be configured to detect an analyzer fault condition whenever the 4-20 mADC signal is below 4 mA.
After accessing the Outputs on the Setup Menu, Figure 22, the display will be as shown in Figure 27.

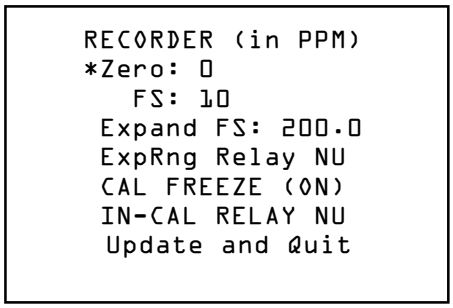


Figure 27: Recorder Output Setup Menu

From the Recorder Outputs menu, the recorder zero and full scale (FS) can be set. On Trace Analyzers, the values are in ppm; on Percent Analyzers, the values are in %. The selected Zero and FS values will be displayed underneath the oxygen reading in the Data Display Screen. The Zero value corresponds to the lowest possible voltage and current output (0 VDC, 4 mA), while the FS (Full Scale) value corresponds to the maximum voltage and current output (1/2/5/10 VDC [see Section 4.6] and 20 mA).
The Zero to Full Scale window (FS setting - Zero setting) can be as narrow as 10% of the Analyzer's full scale range. This limit is based on the fact that oxygen information is in a digital format. Like a digital photograph it is only possible to magnify the information so much before there isn't enough resolution and the result is too grainy to use. Analyzers are shipped with a factory setting that corresponds to the full scale range of the Analyzer. For example, a 0-100 ppm Analyzer on first power-up would show OUT: 0-100 underneath the oxygen reading in the Data Display Screen.
Some examples of valid scaling for a 0-100 ppm Analyzer with standard resolution are:

Output (Zero to FS)	Percentage of Full Scale Used
0-10 ppm	10 %
20-40 ppm	20 %
10-50 ppm	40 %
0-100 ppm	100 % (Factory Set)
50-85 ppm	35 %

If an invalid Zero to FS window is entered the following error message will be briefly displayed.

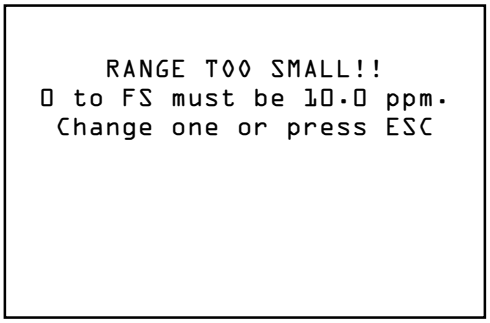


Figure 28: Recorder Output Setup Error

8.4.2.1 Scaling Analog Output Range On High-Resolution Analyzers

On High-Resolution Analyzers the instrument has two internal operating ranges: 0-10% of full scale (Scale A) and 0-100% of full scale (Scale B). When the oxygen reading decreases below 10% of full scale the analyzer automatically increases it's internal gain by a factor of ten by switching to Scale A. This gain increase permits the front panel oxygen display to provide an additional digit of displayed resolution. Refer to the section on Specifications page 7, for a list of displayed resolutions. The increased gain also permits the analog output scaling to be set for from 10% to 100% of Scale A, in addition to 10% to 100% of Scale B. See Table 10 for details. Using the High-Resolution model is preferred if the oxygen reading will usually be below 10% of the analyzer full scale reading and small changes in concentration (0.1% of full scale) must be detectable. The selected Zero and FS values will be displayed underneath the oxygen reading in the Data Display Screen. Following are examples of valid recorder output settings on a 0 – 100 ppm analyzer.

Output (Zero to FS)	Percentage of scale used on a 0 – 100 ppm analyzer
0-1 ppm	10 % of Scale A
2-4 ppm	20 % of Scale A
1-5 ppm	40 % of Scale A
0-10 ppm	100 % of Scale A
0-20 ppm	20 % of Scale B
20-40 ppm	20 % of Scale B
10-50 ppm	40 % of Scale B
0-100 ppm	100 % (Factory Set)
50-85 ppm	35 % of Scale B

Table 10: Examples of Valid Output Scaling

8.4.2.2 Expanded Range Scale Operation And Setup

The expanded range scale option allows the analog output scaling to be automatically expanded to a larger value when the primary scaling range is exceeded. For example, in the display shown in Figure 6-10, the analog outputs (0-10 VDC and 4-20 mA) are scaled over the 0-10.00 ppm area. However, the Analyzer is a 0-500 ppm unit and if the oxygen value exceeds 10.00 ppm the analog output will peg. With the expanded range option it is possible to set a larger ppm range that will automatically rescale the analog output when the primary scale is exceeded. In the example, the analog output is scaled over 0-200 ppm as soon as 10.00 ppm is exceeded. If the oxygen level falls, the Analyzer will switch back to the original 0-10.00 ppm scaling as soon as the value is below 95% of the primary scale (9.5 ppm). This scaling change only affects the analog outputs.

When operating on the expanded range the analog output scaling information on the front panel will change to:

XPOUT: 0.0 - 2000

When the asterisk is on the Expand FS line, each time the ↵ key is pressed a different full scale

value will appear. In this way it is possible to scroll through a list of selections. The expanded range full scale value must be larger than the normal FS value, or the Analyzer will not accept the setting. Expanded range may be turned off at any time by setting Expand FS to NU. The zero point setup on the primary range is also used when operating on the Expanded Range.

8.4.2.3 ExpRng Relay

An alarm relay may be assigned to indicate when the expanded range is in effect. The relay will be in the "Normal" state when the analog output is on the primary range scale, and will switch to the "Alarm" state when the expanded range scale is in effect. If there are no relays installed this option will show **NA**. Since it is possible to assign more than one alarm or status condition to any alarm relay, it is important to ensure that there are no other items assigned to this chosen relay unless it is really desired.

8.4.2.4 CAL FREEZE

When a zero or span calibration is started CAL FREEZE holds the analog output at the last valid oxygen value prior to the calibration. The oxygen value remains held until the calibration is completed. This feature prevents a PLC or data acquisition system from "Seeing" a calibration. If the PLC is used to detect alarms, a calibration could involve sampling gas sources with concentrations above process alarm set points. CAL FREEZE may be turned off so that the analog output operates normally (follows the oxygen value) during calibration.

8.4.2.5 IN-CAL RELAY

This is a setup feature that allows an optional alarm relay to be assigned to indicate when the instrument is in the zero or span calibration mode. This feature may be used to signal a PLC, DCS or other external device when the instrument is in calibration (not sending "Process" O2 data). Any relay may be assigned to IN-CAL RELAY service. If the Analyzer is not equipped with relays, this selection will be NA. Since it is possible to assign more than one alarm or status condition to any alarm relay, it is important to ensure that there are no other items assigned to this chosen relay unless it is really desired.

8.4.3 Comm Port

The Comm Port Menu, selected from the Setup Menu Figure 22, is used to edit information about the external communications port. This port operates with an 8 bit, no parity, one stop bit setting. No hardware or software handshaking is used. See the Section on Connecting to External Devices on page 31 for more information.
After accessing the Comm Port Menu, the display in Figure 29 will be shown.

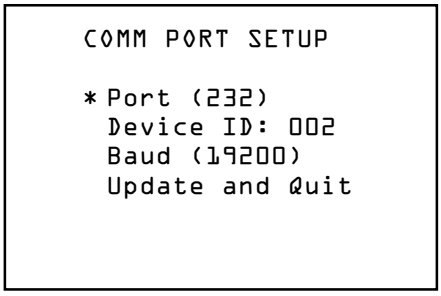


Figure 29: Comm Port Setup Menu

8.4.3.1 Port

Used to indicate if the data should be sent to the RS-232C port (232), the RS-485 (485) port or no communication port (OFF). Optional hardware must be factory installed to support either port option. It is not possible for the analyzer to be equipped with both the RS-232C and RS-485 option.

8.4.3.2 Device ID:xxx

Device ID is used to indicate the identity of the Analyzer. When using multiple Analyzers on an RS-485 loop the device ID is used as a unique address which allows Analyzers to be individually contacted by the communication software. The device number can be edited. The valid ID address range is 1 to 255. Even when equipped for RS-232 (one host communicating with one analyzer) it is necessary to set a valid ID address for the analyzer. The communication protocol uses the ID address as part of the data packet sent to the analyzer.

8.4.3.3 Baud

This setting is used to choose the data transmission rate. The options are 19200, 9600, 4800, 2400 or 1200. The Analyzer is capable of receiving 19200 Baud transmissions without requiring hardware or software handshaking. It is suggested that the highest data rate be used that reliably works in the application. In this way the system will be as responsive as possible.

8.4.3.4 Update And Quit

Update and Quit is used to accept the values set on this screen.

8.4.4 GSF

The Gas Scale Factor function is not available on this analyzer and is fixed at 1.000.

8.5 The Password Menu

The Platinum Series Process Oxygen Analyzer may include optional password protection which can be used to limit access to the Control Menu, the Set-Up Menu, and the Diagnostics Menu.

Note: When the Password entry is selected from the Main Menu, a DISABLING ALARMS message appears which notifies the user that the alarms have been temporarily disabled. The alarm overlay messages will not show in the display. **Relays will remain in the alarm state that immediately preceded the Disabling Alarms message.**

The password operates on two levels, a Master Password to establish overall control of the system, and an Operator Password to allow partial access to the system. If the selected level requires a password, the display will present a password prompt. The password menu is displayed in Figure 30.

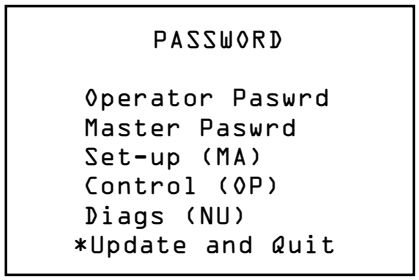


Figure 30: Password Menu

The two-letter codes adjacent to the **Set-Up**, **Control** and **Diags** entries in the display are used to indicate the level of password that is required to access the Set-Up, Controls or Diagnostics menus. There are three possible settings for each entry:

MA (Master) - Indicates that the master password must be used to access the menu.

OP (Operator) - Indicates that the operator password or master password can be used to access the menu.

NU (Not Used) - Indicates that no password is required to access the menu.

Note: When an Analyzer is shipped from the factory no password is installed.

To enter an Operator Password or Master Password, select the desired level. The display for an operator password is shown in Figure 31. The display for a master password is identical except the bottom line is blank instead of OP:

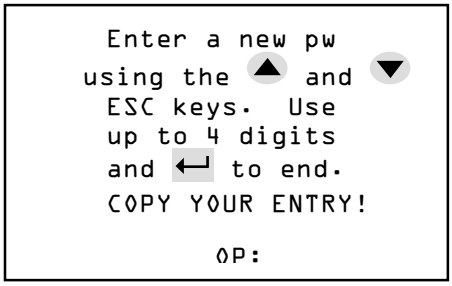


Figure 31: Password Entry Screen

A password consists of a series of one to four keystrokes using the ESC, ▲ and ▼ keys. Password entry is completed by pressing ↵. Any combination of these keystrokes is acceptable. A typical password is ▲, ESC, ▼, ▼. After the fourth key is pressed in the Operator's Password, the display will automatically return to the Password Menu, Figure 30. After the fourth key is pressed in the Master's Password, press ↵ to return to Figure 30.

NOTE

The master password should be recorded in a secure location. Once the master password has been accepted, the Analyzer will not display it again. If the master password is misplaced, contact the Delta F Customer Support Services Department, at 781-935-5808, for assistance.

The master password and operator password can be changed as desired after the present master password has been entered. The new password(s) are activated by pressing ↵ when the asterisk is at **Update and Quit**.
To password protect a menu item (Set-Up, Control, Diags) use the ▲ or ▼ key to place the asterisk next to the item and press ↵. Subsequent pressing ↵ will cycle through **NU**, **OP**, and **MA**. When the passwords and the settings for all three menus have been set, select **Update and Quit**.

8.6 Maintenance

Note: When the Maintenance entry is selected from the Main Menu, a DISABLING ALARMS message appears which notifies the user that the alarms have been temporarily disabled. The alarm overlay messages will not show in the display. **Relays will remain in the alarm state that immediately preceded the Disabling Alarms message.**
The Maintenance Menu is used to access the Oxygen Calibration and Diagnostics Screens. When selected from the Main Menu, Figure 19, the display shows Figure 32.

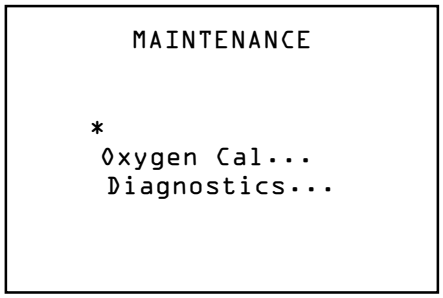


Figure 32: Maintenance Menu

Note: When the Maintenance entry is selected from the Main Menu, a DISABLING ALARMS message appears which notifies the user that the alarms have been temporarily disabled. The alarm overlay messages will not show in the display. **Relays will remain in the alarm state that immediately preceded the Disabling Alarms message.**
The Maintenance Menu is used to access the Oxygen Calibration and Diagnostics Screens. When selected from the Main Menu, Figure 19, the display shows Figure 32.

8.6.1 Oxygen Calibration

Analyzer calibration checks and adjustments are made from the Oxygen Cal Menu which is entered from the Setup menu, Figure 22. After accessing the Oxygen Cal Menu, the display will present Figure 33.

If the system has been previously recalibrated by the user, when the Oxygen Cal selection is made, an additional line will be added to the menu that states **Reset Orig Span**. The section on Maintenance and Calibration on page 69 provides more information about spanning the analyzer.

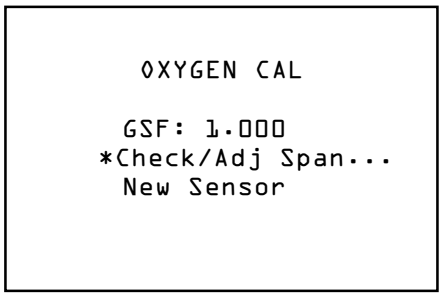


Figure 33: Oxygen Calibration Menu

8.6.1.1 Background Gas Correction

The Gas Scale Factor function is not available in this analyzer and is fixed at a value of 1.000.

8.6.1.2 Check/Adj Span

Note: A calibration should be performed only after the Analyzer has been operating at least eight hours. The door should be closed when calibrating the Analyzer to keep the sensor temperature stable.

It is not possible to perform a Span Adjustment if the TEMP OVER RANGE condition is occurring.

The **Check/Adj Span** entry in the Oxygen Cal Menu, Figure 33, is used to adjust the O_2 calibration. Selecting Check/Adj Span will display the screen shown in Figure 34.

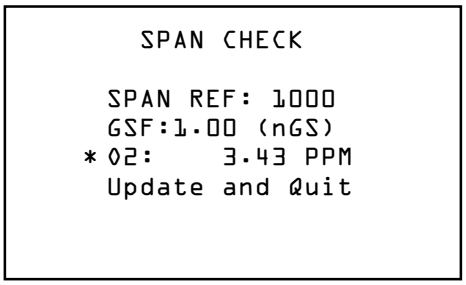


Figure 34: Span Check Menu

The GSF factor of the calibration gas can be entered directly or calculated by the instrument as described on page 57. The legend (nGS) indicates the number of gases used to calculate the GSF. If n has a value of zero, it indicates that the factor was directly entered, or the default value of GSF=1.00 was used.

The Span Reference value **SPAN REF** is a numerical indicator for calibration changes made in the field. All instruments are shipped from the factory with a SPAN REF value of 1000. The number will decrease if the sensor's output decreases and vice versa. For example: For a 100 ppm Analyzer if a 70 ppm span gas is being used, the Analyzer reads 65 ppm, and an Oxygen Cal is performed, the Span Reference will change to 928 ([65 ppm / 70 ppm] X 1000) following the calibration process.
The following information should be recorded at each calibration:

Date
Span Gas Value
Old Span Ref Value
New Span Ref Value
Time spent sampling Span Gas

Note: If the sensor has lost or gained significant sensitivity, verify the quality of the gas used as the calibration standard.
Review the section, Sampling Considerations During Calibration, on page 27 for information regarding calibration standards, regulators, purging, and sample conditions. When introducing a

calibration gas into the sample system, it is important to maintain the same pressure and flow conditions that occur during process monitoring.

NOTE

Over-pressurizing the Analyzer can result in permanent damage to the sensor and optional pump. If the sample supply gas pressure exceeds 10.0 psig, install a pressure regulator in the inlet calibration gas line to regulate the pressure to 5.0 psig or less. The upstream flow control valve is used to set the flow at 2.0 (scfh).

If the normal process sample is being supplied to the Analyzer under moderate vacuum conditions (4" Hg vacuum or higher), such as when taxing the capability of the on-board pump, the Analyzer should be calibrated with the pump operating even if the calibration gas has sufficient pressure to preclude the use of the pump. The operating pump will create a pressure condition at the sensor that simulates the operating condition.

Analyzers with a pump are fitted with two flow control valves, one on the downstream rotameter and one on the sensor inlet (upstream of the sensor). Before turning on the pump, open the rotameter valve fully by turning it counter-clockwise. Close the upstream flow control valve completely (clockwise). Set the calibration gas regulator to less than 10.0 psig, then attach the calibration gas line to the Analyzer inlet. Use the upstream flow control valve to set the flow rate to 2.0 scfh. Turn on the pump and readjust the flow rate prior to calibrating.

NOTE

Do not adjust the valve at the rotameter, leave it in the fully open position during calibration.

For an accurate calibration, the sensor output must be stable. The time to achieve stability depends on the range of the Analyzer and the difference between the sample gas value and the span gas concentration. Typically, lower ppm range instruments require more time to achieve a stable output than higher ppm or percent instruments. The use of a chart recorder is suggested to monitor stabilization.

NOTE

Time required for the O_2 reading to stabilize when on span gas can vary from 15 to 60 minutes.

After a stable reading is obtained, enter the O_2 concentration of the calibration gas. Then press ↵ to complete the calibration.

A “Wait...” message will appear, followed by the display shown in Figure 35.

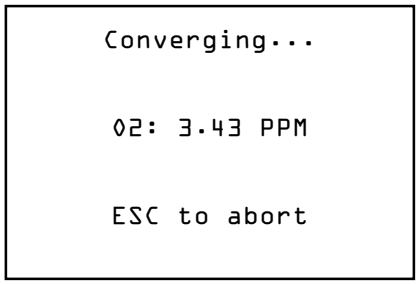


Figure 35: Calibration Convergence Screen

It may take several minutes before convergence occurs. During convergence, the Analyzer is verifying stability of the reading before accepting the data. After convergence two short beeps will be heard. The Analyzer's electronics can be updated to the new calibration information by selecting **Update and Quit**.

If convergence does not occur within 5 minutes, check the following:

a. Make sure the gas connections are leak free.
b. Make sure the sensor has been allowed sufficient time to have attained a stable reading on the calibration gas.
c. Check the electrical connections to the sensor.

If all items check out, allow the Analyzer to operate an additional 30 minutes on calibration gas. Repeat the calibration. If the results are the same, acceptance of the calibration may forced by the user by hitting the ↵ key while in the "Convergence" screen. See Figure 35.

To leave the Calibration before completing convergence, press ESC. The previous calibration will remain in effect.

If the system has been recalibrated by the user, when the Oxygen Cal selection is made from the SETUP MENU the display will appear as shown in Figure 36. The option to "Reset Orig Span" now appears to facilitate the removal of any user calibration if need be.

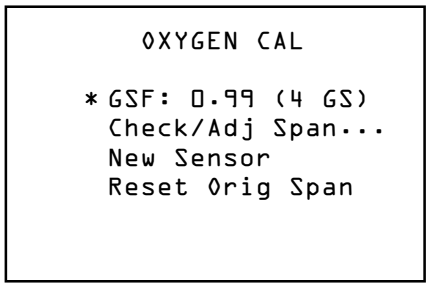


Figure 36: Completed Oxygen Calibration Menu

8.6.1.3 Reset Orig(inal) Span

The **Reset Orig Span** entry is used to restore the calibration that was made at the factory when the unit was manufactured, or the New Sensor calibration if the sensor has been field replaced.

If the **Reset Orig Span** entry is selected, the display will ask **Erase Cal?... ↵ FOR YES**. Press ↵ to use the factory set calibration. The bottom line of Figure 36 will disappear, and the factory span calibration will be restored.

8.6.1.4 New Sensor

The **New Sensor** entry is used after a new sensor is field installed. New sensors are supplied with calibration information. The procedure for installing a new sensor is described in instructions supplied with it.

NOTE

Do not edit this entry without specific instructions from the Delta F Customer Support Services Department. Editing the entry will alter the stored factory calibration parameters and may cause dramatically erroneous operation. If the entry has been accidentally accessed, press ESC.

8.6.2 Diagnostics

Note: When the Diagnostics entry is selected from the Main Menu, a DISABLING ALARMS message appears which notifies the user that the alarms have been temporarily disabled. The alarm overlay messages will not show in the display. **Relays will remain in the alarm state that immediately preceded the Disabling Alarms message.**

The Diagnostics menu is used to test different functions of the Analyzer. When this menu is selected and the password is entered (if required), Figure 37 is displayed.

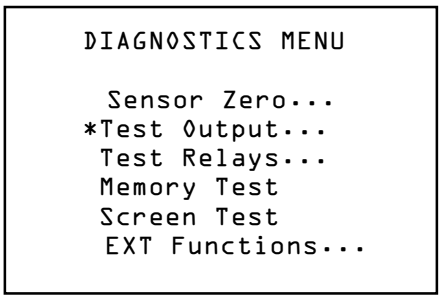


Figure 37: Diagnostics Menu

8.6.2.1 Sensor Zero

The Sensor Zero entry is used to calibrate the zero baseline level of the sensor. The sensor zero baseline is calibrated at the factory and should not require any adjustments or checking under normal operating conditions. See Section 8.1.1 for details on normal operating conditions. If operating outside normal operating conditions contact Delta F for an application specific recommendation on checking the zero of the instrument in the field. Contact the Delta F Customer Support Services Department at 781-935-5808.

Should Delta F recommend checking the zero baseline calibration of the Analyzer, the following procedure can be followed: purge the sensor with gas that is free of O_2 until the output is stable. A suitable way to obtain an oxygen-free gas is to pass a pure grade of nitrogen gas through an oxygen purifier such as SAES MicroTorr™, Millipore Waferpure™ or Semigas Nanochem® resin purifiers. It is necessary to have a zero gas sample source that is assured to be at least one order of magnitude purer than the lowest resolution of the Analyzer.

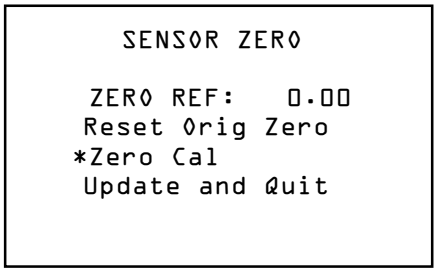


Figure 38: Sensor Zero Menu

Note: The difficulty in delivering a high quality zero gas to the Analyzer in the field can introduce significant error when attempting to zero calibrate the Analyzer. It is recommended that recalibration be done at the factory with its certified low ppb system. If checking zero calibration in the field, ensure that the gas system used to zero calibrate the Analyzer is leak-free by performing the low flow test described on page 70.

Reaching a stable zero for the lowest range Analyzer may require 24 hours or longer, even assuming that the Analyzer has been running continuously for several weeks on a process application where readings are near the detection limits of the Analyzer. It is recommended that a recorder be used to chart the zero point, especially for low trace units. When the Sensor Zero entry is selected, the display will present Figure 38.

8.6.2.1.1 ZERO REF

The **ZERO REF** value is a numerical indicator for calibration changes made in the field. All instruments are shipped from the factory with a ZERO REF value of 0.00. The number will become negative, following a user zero calibration, if the sensor zero is below the factory calibration and vice versa. This value should be recorded both before and after a Zero Calibration.

8.6.2.1.2 Reset Orig(inal) Zero

The **Reset Orig Zero** entry is used to restore the zero calibration that was made at the factory when the unit was manufactured, or the New Sensor zero calibration if the sensor has been field replaced.

If the Reset Orig Zero entry is selected, the display will ask **Erase?... ↵ FOR YES**. Press ↵ to use the factory set calibration. The Reset Orig Zero line of Figure 38 will disappear. It is necessary to select Update and Quit to make the reset permanent.

8.6.2.1.3 Zero Cal(ibration)

Selecting Zero Cal will result in the display shown in Figure 39.

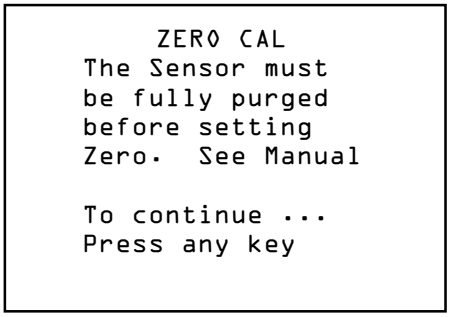


Figure 39: Zero Cal Warning Screen

Note: The zero baseline stabilization criteria is only verifying stability over a short time scale (1-5 minutes). The output on zero gas should be recorded (by manual or strip chart technique) and stability should be monitored over a much larger time scale (18 to 24 hours for 0-1000 ppm and lower range High Resolution Analyzers). Only when it is clear that the Oxygen reading has

reached a constant minimum value should a zero calibration be attempted.

When any key is pressed, the display will show Figure 40 without the OFFSET line. This screen will be overwritten with a "WAIT..." message for about ten seconds and then the OFFSET: line will appear. Two beeps will sound when the “WAIT...” message clears. When the offset is stable, the instrument will sound two short beeps and display a "STABLE" message on the blank line below ZERO CAL. The user has the option to accept the new offset value by pressing the ↵ key, or not accepting the new offset value by pressing the ESC key. With either choice, the display will return to the SENSOR ZERO Menu as seen in Figure 38.

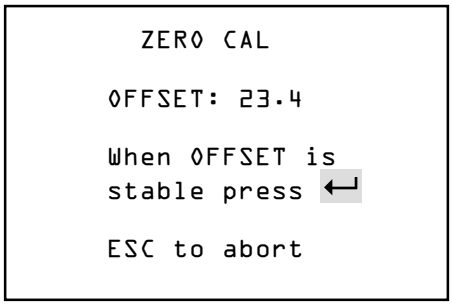


Figure 40: Zero Cal Screen

Pressing the ESC key at any time aborts the process and returns the user to the SENSOR ZERO menu.

If ↵ is pressed before the “STABLE” message is displayed the screen will change as shown in Figure 41.

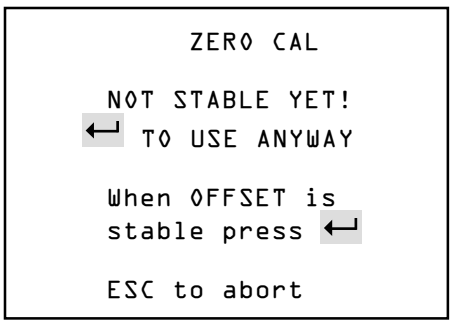


Figure 41: Zero Cal Not Stable

To accept the unstable OFFSET value press ↵. This is not recommended! The offset value at this point may not be satisfactorily close to the eventual zero baseline level because the zero baseline level is still equilibrating. To resume stabilization press ESC.

During Zero Cal the other messages that may appear below ZERO CAL are:

INVALID DATA - Indicates that the instrument's analog- to-digital converter is reading a value which is over or under its full scale range. Check sensor's electrical connections and the delivery of oxygen free sample gas (see PRESCALER HIGH below).

8.6.2.2 Test Output

The Test Output entry is used to calibrate the recorder. When the Test Output option is selected, the display will show Figure 42.

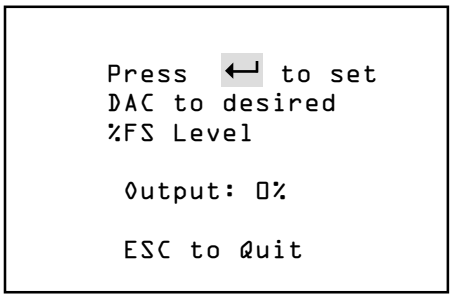


Figure 42: Test Output Screen

Use the ↵ key to set the desired output level in 10% percent steps of full scale from 0% to 100%. After setting the **% FS Level**, press ↵. The analog output response should match the %FS Level value that was entered. For example, if 80% is entered for the %FS value on a 0-10 VDC recorder, the output will be 8.000 VDC. See the sticker inside the front door that indicates to what full-scale voltage the Analog Output has been configured.

8.6.2.3 Test Relays

The **Test Relays** selection in the Diagnostics Menu, Figure 37, is used to assure that the relay outputs are functioning. When the Test Relays option is selected, the display will show Figure 43.

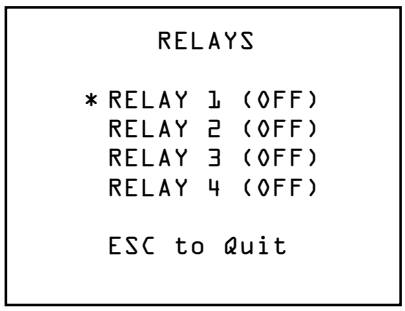


Figure 43: Test Relay Screen

Select the relay to be tested, then press ↵. The relay will toggle between on and off each time ↵ is pressed. An audible click will occur. The condition of the relays before the test will be restored when the test is concluded.

8.6.2.4 Memory Test

The Memory Test selection is used to test the internal memory of the Analyzer. When the Memory test option is selected from the Diagnostics Menu, Figure 37, the display will show Figure 44. Testing automatically begins.

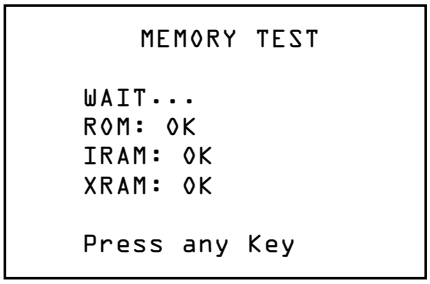


Figure 44: Memory Test Screen

During the ROM test the program EPROM contents is used to calculate a checksum, which is compared to a checksum that was stored in the EPROM at the factory. Any changes in the program code can be detected. Next, the microprocessor internal memory (IRAM) is tested, followed by the system "external" random access memory (XRAM). As each portion of the memory is successfully tested an OK will appear at the end of the line. If any memory test fails, repeat the test. If a failure is repeated contact the Delta F Customer Support Services Department at 781-935-5808.

8.6.2.5 Screen Test

When the screen test option is selected, the display will test each pixel. A series of horizontal lines will appear on the display, followed by a series of vertical lines. After the test has been completed, the display will return to the Diagnostics Menu, Figure 37. Pressing ESC will abort the screen test. If an error message appears, or a pixel is inactive, contact the Delta F Customer Support Services Department at 781-935-5808.

8.6.2.6 EXT Functions

The EXT Function screen indicates to the user which, if any, functions have been factory programmed for remote control through the J2 connector. Chosen at the time of order, the following analyzer functions can be remotely controlled: Sensor polarizing voltage, Pump on/off See page 34 for additional information on wiring. NU will appear if no functions have been enabled. It is important to note that the front panel has no control of these functions while the analyzer is under remote control.

If the sensor polarization voltage has been turned off remotely, the display will indicate EXT SENSOR! at the bottom.

If the pump has been turned on remotely, the display will indicate EXT PUMP at the bottom.

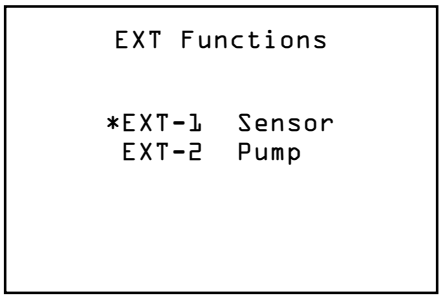


Figure 45: EXT Functions

9 Troubleshooting and Calibration

9.1 Return Material Authorization Number

If an analyzer has to be returned to the factory, the shipper will have to obtain a Return Material Authorization number from Delta F by calling the Service Line at (781) 935-5808 or sending a written request via the Service Fax Line at (781) 932-0053 or e-mail to service@delta-f.com. See the Shipping Section on page 73 for more details.

9.2 Maintenance

The analyzer maintenance recommendations made in this manual apply to all Analyzers being operated under Normal Operating Conditions and in clean gas applications.

A clean gas application is one in which certain process conditions are met. Sample condensation must be avoided. For a hydrocarbon background gas, the sample must be kept at a temperature of at least 40°F over the sample dewpoint. A wet sample (high water dewpoint) must be kept at a temperature of at least 10° F over the dewpoint. The particulate density must be below the limit of 0.03 mg/L (weight of particulate matter / volume of sample at atmospheric pressure).

Some examples of clean gas applications include monitoring of high purity gas pipelines, compressed cylinder gases, cryogenic air separation plants, polyolefin feedstocks, glove boxes, and semiconductor process tools.

9.2.1 Calibration

All Delta F Platinum Series Process Oxygen Analyzers are calibrated with NIST (National Institute For Standards And Technology) traceable certified gas standards at the factory prior to shipment. No initial calibration is required upon receipt from the factory.

For Analyzers used in clean gas applications (as described above) and operated under Normal Operating Condition**s**, Delta F recommends verifying the span calibration every 12 months of continuous use. This can be accomplished by using the Analyzer to read a gas sample with a known concentration, such as a certified cylinder gas mixture of O_2 in N_2 background, available from any specialty gas supplier. For process applications containing more significant quantities of acid gases or particulate, or where liquids may be encountered, contact Delta F for a recommendation on calibration verification for your specific case.

For Analyzers used in clean gas applications, and operated under ***Normal Operating Conditions*** there is no need for zero calibration checks in the field.

NOTE

If the analyzer is used in a portable mode, the optional isolation valves should be used during transport to preserve the stability of the zero calibration.

9.2.2 Storage Conditions

If the analyzer is to be stored for extended periods of time, be sure that the temperature of storage location does not exceed 70° C (160° F). Storage in direct sunlight can cause temperatures to exceed the recommended limits even though ambient temperatures may be below the maximum temperature.

9.2.3 Sensor Maintenance

The oxygen sensor requires no maintenance.

9.3 Replaceable Spare Parts List

When ordering spare parts, be sure to include the analyzer serial and model numbers.

Description	P/N
Connector – (10 pin)	50980743
Connector – (4 pin)	50980755
Display assembly with PCB	15330110
Filter Element – Coarse	64005011
Filter Element – Fine	64005012
Flow Meter	11220841
Flow Meter w/Valve	11220842
Fuse 1A 24V Operation	45002421
Fuse 2.5A 100-240VAC Operation	45002521
Manual - Instruction	99000039
Pump – 24 VDC	63000310
Sensor	Call Delta F

Table 11: Replaceable Spare Parts

9.4 Troubleshooting

The following *Troubleshooting Guide* helps the user resolve many of the common operational situations that occur with the analyzer. Investigate possible remedies in the listed order.

9.4.1 Sample System Leak Test (Low Flow Sensitivity)

By far the most common reason for high Oxygen readings is a leak in the sample delivery system. Leaks are divided into two types: real leaks and virtual leaks. A real leak is due to a lack of integrity in the sample delivery system. A virtual leak is caused by Oxygen that is trapped in the upstream plumbing and components, such as regulators and filters. This Oxygen

is slowly being purged out of the system. Virtual leaks are most common in new installations. Determining the nature of the leak is not a difficult task. It is important to be consistent in the approach and technique. The steps listed below will be helpful toward resolving any leak related problems.

1) Determine if the high reading is due to a leak or is a real indication of Oxygen level. This can be easily done by performing a "Flow Sensitivity Test". If the Analyzer is equipped with a pump, it is recommended that it not be used during the Flow Sensitivity Test. This test requires a positive pressure sample delivery system. If it is not possible to provide positive sample pressure to the Analyzer, skip to Step 2. Perform the Flow Sensitivity Test as follows:

a) Establish a flow rate that is within the normal operating tolerances of the Analyzer. Generally a flow rate of around 1 LPM or 2 SCFH is ideal.

b) Give the Analyzer a couple of minutes to stabilize, and then carefully note the flow rate and the Oxygen level displayed.

c) Reduce the flow rate by 75%. In a system with good integrity, there should be little change in the front panel display. If a leak exists, however, the reading will rise noticeably. Allow it time to stabilize, and carefully note the flow rate and the Oxygen level displayed.

d) Re-establish a normal flow rate and allow the Analyzer to purge for ½ hour. Note again the flow rate and Oxygen level displayed.

e) Repeat step c. If the Oxygen level stabilizes at a level that is close to the prior value from step c, then the leak is real. If the reading shows a lower Oxygen level than the prior value from step c, the leak is probably a virtual leak and continued purging should rectify the problem.

2) Once it has been determined that there is a leak, the next logical step is to locate it. The easiest way to locate a leak is to close off the feed to the Analyzer from the sample delivery system, and to allow the system to pressurize. Apply Snoop® or another type of liquid leak detector to all of the fittings on the system. Any fitting that shows bubbles should be tightened or replaced.

3) If it is not practical to remove the Analyzer from the sample delivery system, leaks can be located by monitoring Analyzer output while applying Snoop® or another liquid leak detector to one fitting at a time. Snoop® will not show bubbles at the low pressure required for proper Analyzer operation. However, Snoop® will temporarily block any leak, at the fitting being checked, and the Analyzer output will drop. It is important to give sufficient time for the Analyzer to respond before going on to the next fitting.
The more distance between the fitting and the Analyzer, the more time should be given for the Analyzer to respond.

9.4.2 Basic Troubleshooting

Solutions are listed in the order that they should be attempted.

	PROBLEMS	SOLUTIONS
1)	Analyzer reads low	A B D H I J Z
2)	Analyzer reads high	A B C D I J Z
3)	Analyzer output is noisy	A I Z
4)	Analyzer reads high with pump on	C Z
5)	Analyzer reads 0.00 at all times	Q D Z
6)	Slow speed of response	G C D Z
8)	Display is blank, or shows an unusual appearance	K O Z
9)	Display reads any of the following:	
	- NOVRAM Failure	Z
	- Uncalibrated	Z
10)	Span reading is unacceptably high (>50% high)	R C J Z
11)	Span reading is unacceptably low (>50% low)	R J Z

SOLUTIONS KEY

A) Check instrument performance using a gas standard of known Oxygen content (Span Gas).
B) Check that the Analyzer zero setting matches the original factory setting. Consult the manual or the factory to verify these settings.
C) Check the sample delivery system for leaks.
D) With the sensor connected, verify that the correct voltages are being supplied.
Sensor Voltage (S+/-): Green (-) to White (+) = 0.7 – 1.3 VDC
Heater Voltage (H+/-): Black (-) to Red (+) = 2.2 – 4.0 VDC
Voltage levels between any other combination of wires should be less than 0.10 VDC. If there is any deviation from these values, contact the Delta F Customer Support Service Department at 781-935-5808.
G) Remove and check the filter element. Replace if needed.
H) Check for contaminated plumbing. This is most easily done by examining the rotameter (if so equipped) or Tygon tubing downstream from the sensor for evidence of oil, powder, or other material that may have made its way from the process to the Analyzer.
I) Remove any devices being driven by the Analyzer output, i.e., chart recorders, data acquisition systems, etc. Also, disconnect anything controlled by the Analyzer alarm relays. Attempt operation with these devices removed.
J) Ensure that the background gas is compatible with the Analyzers' current calibration.
K) Press the ↵ key once. If the display remains unchanged, power the Analyzer down momentarily, and then power it back up.
L) Ensure that the Analyzer has adequate sample flow.
M) Ensure that the sensor polarization voltage is turned on.

O) Confirm that the power supply is turned on, operating at the proper voltage and is connected properly to the analyzer.
Q) Check the sensor wiring. Trace the wires from the sensor back to the sensor connector. Make sure that the terminal pins are seated correctly in the connector plugs and are making good contact through the connector. Trace the wires further back to the backplane. Make sure the wires are soldered in and none have broken loose.
R) Check the accuracy and age of the calibration reference cylinder. Trace O_2 standards in steel cylinders decay over time due to oxidation of the cylinder walls. Standards below 100 ppm, in steel cylinders, should be re-analyzed or calibrated every three months. Ideally, standards below 100 ppm, and certainly standards below 10 ppm, should be prepared in aluminum cylinders.
Z) Contact the Delta F Customer Support Services Department. The phone number is 781-935-5808, fax number is 781-932-0053 and e-mail address is service@delta-f.com. For faster service, have the instrument serial number and model number in hand before calling.

9.4.3 Fuse Replacement

DANGER

The instrument power must be shut off before removing the fuse.
Failure to do so may expose the operator to hazardous voltages.

The operating voltage of the analyzer is marked on a label located on the rear of the cabinet. Always use the proper fuse for the operating voltage of the analyzer.

9.4.3.1 AC Power Fuse

If configured with an integral 100-240 VAC power supply, the 5X20 mm, 250 VAC, IEC Sheet III, Type T fuse is rated at 2.5A. There are two fuses that are located in the AC input connector located behind the cover on the rear of the cabinet.

Refer to the spare parts list on page 70 for Delta F replacement part numbers.

9.4.3.2 DC Power Fuse

If configured for 24 VDC operation, the 5X20 mm, 250 VAC, IEC Sheet III, Type T fuse is rated at 1A and is located in a holder on the front panel of the analyzer.

Refer to the spare parts list on page 70 for Delta F replacement part numbers.

9.4.3.3 4-20mA Output Fuse

The 4-20mA analog output is fused by a fast acting, automatically resetting, 100mA circuit breaker.

9.5 Shipping

If it becomes necessary to return the analyzer to the factory or ship it to another location, please follow the packaging and shipping procedure below in order to prevent damage to the analyzer

during shipment.

Note: If you are returning the analyzer to the factory, first call Delta F to obtain **a Return Material Authorization number** (see complete details below), then proceed as follows:

1. Turn off and disconnect the power source from the analyzer.
2. Disconnect all external electrical connections (alarms, data output, etc.).Mark each for re-attachment later.
3. Put the analyzer in its original container. Ensure that all internal components are adequately secured. It is recommended that bubble packing or similar protective material be added inside the container for added protection.

If you are returning the analyzer to the factory, call the Delta F Service Line at (781) 935-5808 to obtain a **Return Material Authorization number**. Clearly mark the Return Material Authorization number on the outside of the shipping container and on the packing list. The analyzer should be returned (freight prepaid) to:

RMA #_____
Delta F Corporation
4 Constitution Way
Woburn, MA 01801-1087

10 Safety

CAUTION

Do not setup or operate the Oxygen Analyzer without a complete understanding of the instructions in this manual. Do not connect this Analyzer to a power source until all signal and plumbing connections are made.

CAUTION

This analyzer must be operated in a manner consistent with its intended use and as specified in this manual.

DANGER

Potentially hazardous AC voltages are present within this instrument. Leave all servicing to qualified personnel. Disconnect the AC power source when installing or removing: external connections, the sensor, the electronics, or when charging or draining electrolyte.

EMI DISCLAIMER

This Analyzer generates and uses small amounts of radio frequency energy. There is no guarantee that interference to radio or television signals will not occur in a particular installation. If interference is experienced, turn-off the analyzer. If the interference disappears, try one or more of the following methods to correct the problem:
Reorient the receiving antenna.
Move the instrument with respect to the receiver.
Place the analyzer and receiver on different AC circuits.

11 Warranty

Delta F Corporation warrants each instrument manufactured by them to be free from defects in material and workmanship at the F.O.B. point specified in the order, its liability under this warranty being limited to repairing or replacing, at the Seller's option, items which are returned to it prepaid within two years from delivery to the carrier and found, to the Seller's satisfaction, to have been so defective.

In no event shall the Seller be liable for consequential damages. NO PRODUCT IS WARRANTED AS BEING FIT FOR A PARTICULAR PURPOSE AND THERE IS NO WARRANTY OF MERCHANTABILITY. Additionally, this warranty applies only if: (i) the items are used solely under the operating conditions and in the manner recommended in the Seller's instruction manual, specifications, or other literature; (ii) the items have not been misused or abused in any manner or repairs attempted thereon; (iii) written notice of the failure within the warranty period is forwarded to the Seller and the directions received for properly identifying items returned under warranty are followed; and (iv) with return, notice authorizes the Seller to examine and disassemble returned products to the extent the Seller deems necessary to ascertain the cause of failure. The warranties stated herein are exclusive. THERE ARE NO OTHER WARRANTIES, EITHER EXPRESSED OR IMPLIED, BEYOND THOSE SET FORTH HEREIN, and the Seller does not assume any other obligation or liability in connection with the sale or use of said products.

12 Index

G

H

I

L

M

N

O

P

R

S

T

U

W

Z