SERIES 3510
TRACE OXYGEN TRANSMITTER

Product shown with optional pump and filter

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WARRANTY

Alpha Omega Instruments Corp. warrants the products delivered to be free from defects in material and workmanship at the time of delivery to the FOB point specified in the purchase order, its liability under this warranty being limited to repairing or replacing, at Alpha Omega Instruments' option, items (excluding the oxygen sensor) which are returned to it **prepaid** within two (2) years from the date of shipment and found to Seller's satisfaction to be defective.

Alpha Omega Instrument's one (1) year sensor warranty offers protection for one full year from the date of shipment of the Series 3510 Trace Oxygen Transmitter. Any sensor from a Series 3510 Trace Oxygen Transmitter that fails under normal use must be returned to Seller prepaid and, if such sensor is determined by Seller to be defective, Seller shall provide Buyer a replacement sensor. Buyer must provide the serial number of the transmitter from which the sensor has been removed. If a sensor is found to be defective and a new one issued, the warranty of the replacement sensor (s) is for a period of one year from the date of shipment. At times, it may be necessary to ship a replacement sensor in advance of receiving one returned for warranty claim. In such cases, if the returned sensor is not covered under warranty, the user will be charged the full price of a replacement sensor. **In no event shall Alpha Omega Instruments Corp. be liable for consequential damages. NO PRODUCT IS WARRANTED AS BEING FIT FOR A PARTICULAR PURPOSE AND THERE IS NO WARRANTY OF MERCHANTABILITY.**

This warranty applies only if:

(i) the items are used solely under the operating conditions and manner recommended in this 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 Alpha Omega Instruments Corp. and, the directions received for properly identifying items returned under warranty are followed;

(iv) the return notice authorizes Alpha Omega Instruments Corp. to examine and disassemble returned products to the extent the Company 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 Alpha Omega Instruments Corp. does not assume any other obligation or liability in connection with the sale or use of said products.

Disclaimer of Warranty

Alpha Omega Instruments Corp. makes no representation or warranties, either expressed or implied, by or with respect to anything in this manual, including, but not limited to, implied warranties of merchantability or fitness for a particular purpose. In no event will Alpha Omega Instruments Corp. be liable for any damages, whether direct or indirect, special, consequential, or incidental arising from the use of this manual. Some states in the USA do not allow the exclusion of incidental or consequential damages. Alpha Omega Instruments Corp. also reserves the right to make any changes to improve the performance of its products at any time and without notice.

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SECTION 1.0
SPECIFICATIONS

PERFORMANCE

Measurement Ranges (parts per million)
0-10, 0-50, 0-100, 0-500, 0-1,000, 0-5,000, 0-10,000, and 0-20,000.

Accuracy [1]	± 1% of full scale.
Linearity	± 1% of full scale.
Response Time	90% of full scale in less than 10 seconds (typical). The response time for ranges of 0-50 PPM or less depend to a great extent on the design of the sample delivery system including the materials used.
Sensor Type	Electrochemical Sensor (Optional CO2 Resistant Sensor Available).
Temperature Compensation	Standard.
Operating Temp. Range	40° to 105°F (5° to 40°C). <40° F (<5º C) use heated sensor enclosure >104ºF (>40º C) cooling of sample gas/sensor required
Warranty	Two years electronics one year sensor.

ELECTRICAL

Electrical Input	Input power 115/230 VAC, 50-60 Hz, or 24 VDC. The voltage (115/230 VAC or 24 VDC) must be stated at time of order.
Analog Output	4-20 mADC (optional 0-10 VDC in place of the 4-20 Madc) with a maximum loop resistance of 600 ohms.

SAMPLE GAS CHARACTERISTICS

Sample Flow Rate	1.0 to 2.0 standard cubic feet per hour (SCFH). 0.5 to 1.0 liters/ minute (LPM).
Sample Gas Pressure Limits.	0.1 to 1.5 psig (0.007 to 0.1 kg/cm^2).
Entrained Solids	<3 mg/ft^3 no in-line filter required >3 mg/ft^3 in-line filter required

Hydrocarbon Mist	<0.7 mg/ft^3 no in-line filter required >0.7 mg/ft^3 in-line filter required

CONSTRUCTION

Enclosure	Polycarbonate, rated NEMA 4X (IP66) without optional equipment Optional NEMA 7 Explosion Proof
Gas Connections:	1/4" compression fittings with manual isolation valves.
Dimensions	5.5 in (139.9 mm) length. 8.8 in (223.5 mm) width. 3.4 in (86.4 mm) deep. Note: All dimensions are without optional equipment

[1] Stated at constant temperature and pressure

SECTION 2.0
SYSTEM DESCRIPTION

General Description

The Series 3510 Trace Oxygen Transmitter is an AC powered trace oxygen transmitter designed to provide accurate and dependable trace oxygen measurements in a variety of gases. The transmitter enclosure is made from durable polycarbonate, and is rated for NEMA 4 (IP 66) service.

The instrument is powered from 115 or 230 VAC, 50-60 Hz, or 24 VDC, and provides a 4-20 mADC output or an optional 0-10 VDC output that can be sent to a datalogger, recorder, PLC, DCS, etc. Options include a pressure regulator, flow meter, an in-line filter for sample gases that contain particulate matter, coalescing filter, explosion proof (NEMA 7) housing, sample pump, and solenoid valves.

Ambient Temperature Electrochemical Sensor

The Series 3510 Trace Oxygen Transmitter features an advanced trace oxygen sensor. The sensor is a lead-oxygen battery comprised of a lead anode, a gold plated cathode, and an electrolyte consisting of potassium hydroxide. All types of electrochemical transducers have three primary components; a cathode, anode, and electrolyte. In the Alpha Omega Instruments advanced oxygen sensor, the cathode is the sensing electrode or the site where chemical reduction of the oxygen takes place.

The chemical reactions are as follows:

Cathode Reaction $4e- + O_2 + 2H_2O \longrightarrow 4OH^-$ (1)

In the above reaction, four electrons combine with one oxygen molecule to produce four hydroxyl ions. This cathodic half-reaction occurs simultaneously with the following anodic half-reaction:

Anode Reaction $Pb + 2OH^- \longrightarrow PbO + H_2O + 2e^-$ (2)

The anode (lead) is oxidized (in a basic media) to lead oxide and in the process, two electrons are transferred for each atom of lead that is oxidized. The sum of the half-reactions (1) and (2) results in the overall reaction (3):

Overall Reaction $O_2 + 2Pb \longrightarrow 2PbO$ (3)

From this reaction it can be seen that the sensor is very specific for oxygen providing there are no gaseous components in the sample stream capable of oxidizing lead. The only likely compounds that meet this requirement are the halogens (iodine, bromine, chlorine, and fluorine).

In reaction (1), four electrons are transferred for each oxygen molecule undergoing reaction. In order to be reacted, an oxygen molecule must diffuse through both the sensing membrane and the thin film of electrolyte maintained between the sensing membrane and the upper surface of the cathode. The rate at which oxygen molecules reach the surface of the cathode determines the electrical output. This rate is directly proportional to the concentration of oxygen in the gaseous mixture surrounding the sensor cell.

SECTION 3.0
INSTALLATION PROCEDURES

Unpacking the Instrument

Upon opening the shipping container, carefully unpack the transmitter to check if the outer surfaces have been damaged. If so, report the findings immediately to Alpha Omega Instruments who will provide further instructions. If there is no apparent damage, check the contents to ensure all items were shipped. In some cases, items may be backordered.

ALL DAMAGE AND SHORTAGE CLAIMS MUST BE MADE KNOWN TO ALPHA OMEGA INSTRUMENTS WITHIN 10 DAYS AFTER RECEIPT OF SHIPMENT.

There are four screws securing the cover of the Series 3510 Trace Oxygen Transmitter. Removing these screws allows access to the inside of the enclosure. The cover should be removed and the interior of the enclosure checked to ensure that no components have been loosened or dislodged. **If there are loose or dislodged components, notify the factory for further instructions.** If all is found to be satisfactory, the installation procedure can begin.

Electrical Installation

The Series 3510 Trace Oxygen Transmitter is powered from an external AC power source. There is no power cord supplied as wiring AC power is to be done by the user. Please refer to Figure 3.0 (transmitters with the standard 4-20 mADC output) or Figure 4.0 (transmitters with the optional 0-10 VDC output).

NOTE: AC POWER SHOULD BE CONNECTED TO THE THREE TERMINALS BETWEEN THE TWO CORD GRIPS ***AND NOT TO ANY TERMINALS FOUND ON THE PRINTED CIRCUIT BOARD.***

Wiring to the Analog Output

Figures 3.0 and 4.0 provide wiring information for the analog output. As indicated above, if the Series 3510 was supplied with the standard 4-20 mADC output, please use Figure 3.0 to identify the proper wiring sequence. If the optional 0-10 VDC output was ordered, please refer to Figure 4.0. In, either configuration the analog output is available on terminals J4 & J5 (please note polarity of terminals).

SECTION 4.0
OPERATING PROCEDURES

Gas System Pressure Limits
For sample gases and/or calibration gases that are under pressure, it is imperative that the sample gas pressure to the sensor be kept to under **1.5 pound per square inch**. If it is expected to be in excess of 1.5 psig (0.1 kg/cm^2) a pressure regulator should be used.

Range Identification
The Series 3510 Trace Oxygen Transmitter is available in eight (8) different ranges. To identify the specific range of the transmitter in question, please refer to the original purchase order document or invoice from Alpha Omega Instruments. In it, you will find a model number starting with the number 3510. The letter immediately following "3510" is the range identifier. The various ranges, with their associated identifier, are as follows:

Range	Identifier	Range	Identifier
0-10 ppm	A	0-1,000 ppm	E
0-50 ppm	B	0-5,000 ppm	F
0-100 ppm	C	0-10,000 ppm	G
0-500 ppm	D	0-20,000 ppm	H

Over Range
It is quite important that the sensor not be exposed to high levels of oxygen for prolonged periods of time. Should this happen, response time will be adversely effected. To help eliminate this problem, the Series 3510 Trace Oxygen Transmitter is equipped with valves that are used to isolate the sensor during times when the instrument it is in storage, in transit, or off line. When not in use, it is highly recommended that the sensor housing be purged with an inert gas to ensure an "on scale" oxygen reading is obtained. Once accomplished, the sensor should be isolated by closing both valves. It is recommended that the inlet valve be closed first, followed immediately by the outlet valve (optional AC or DC powered solenoid valves are available from the factory). Alpha Omega Instruments sensor housing has been helium leak tested and shown to provide exceptional protection from ingression of oxygen from sources outside the housing.

Sample Connections
The sample flow connections to the Series 3510 Trace Oxygen Transmitter are 1/4 inch stainless steel compression fittings.

Electrical Output
The standard Series 3510 provides 4-20 mADC output over the range of instrument. A signal of 4 mADC is equivalent to 0 ppm oxygen with 20 mADC equivalent to the full scale value.

An optional 0-10 VDC output is available in place of the 4-20 mADC output. Please refer to the purchase order if there is any uncertainty as to the analog output associated with the Series 3510 Trace Oxygen Transmitter in question.

SECTION 5.0
CALIBRATION PROCEDURES

Routine Span Gas Calibration Checks
The Series 3510 Trace Oxygen Transmitter has been calibrated at the factory prior to shipment. However, with the potential hazards associated with shipping instrumentation, it is advisable that the transmitter be given a system calibration check prior to startup. Alpha Omega Instruments trace oxygen sensors feature high accuracy and excellent long term stability characteristics. As a result, routine maintenance is kept to a minimum. As is the case with all gas analyzers and transmitters, it is advisable to periodically check the overall system calibration. The frequency of these checks is often determined by in-house calibration protocols. If none exists, Alpha Omega Instruments Corp. recommends a calibration check be made once every 2-3 months.

Calibration Gas
The oxygen sensor used in the Series 3510 Trace Oxygen Transmitter has a linear output. As a result, it can be calibrated using a single calibration gas as long as the test is performed accurately. The calibration gas should contain a defined concentration of oxygen with a balance of nitrogen (N_2). The actual concentration of oxygen should be chosen based on the range of the transmitter. Alpha Omega Instrument's recommendation is to obtain a calibration gas that has a concentration of oxygen somewhere between 40-60% of full scale. For instance, if a transmitter has a measuring range of 0-10 ppm, a calibration gas containing 4-6 ppm oxygen/balance nitrogen should be used.

Procedure for Checking Calibration
1) Select a cylinder of calibration gas as described above.

2) When selecting a pressure regulator to use with the cylinder gas, it is advisable to use a two-stage regulator with the second stage capable of delivering a gas sample at a pressure of 1.0 psig. Also, be sure to choose a regulator with a **metal diaphragm, preferably stainless steel.**

3) In addition to the selection of the pressure regulator, care must be taken to choose the correct sample tubing materials. For trace oxygen measurements, stainless steel or copper tubing is the material of choice.

4) Begin flowing the calibration gas to the transmitter by connecting the gas to the inlet valve. The flow of calibration gas should be set to 0.5 liter per minute. If the optional flow meter was not purchased with the Series 3510, it is advisable to secure one for use during calibration. Begin monitoring the 4-20 mADC (or optional 0-10 VDC) output waiting until a stable reading has been established.

5) Once the oxygen reading has stabilized, check the system for gas leaks. This is best done when step 4 has been completed. An easy method of determining the leak integrity of the system is to vary the flow rate of the calibration gas. If increasing the flow rate from 0.5 liter per minute to 1 liter per minute causes a drop in the reading, there is a good chance that somewhere between the gas source and inlet to the sensor there is a leak. Check all gas fittings, connections, etc. If the integrity of the sample delivery system appears to be good, move on to step 6.

6) The milliamp current output controlled by the transmitter should reflect the oxygen concentration of the calibration gas. As an example, if a 0-10 ppm range transmitter is being calibrated with a 5 ppm calibration gas, an output of 12 mADC should be obtained (5 VDC with the optional 0-10 VDC output). The general form of the equation for determining the oxygen concentration reading "PPM" from the 4-20 mADC reading in milliamps "$mADC$" is:

$$PPM = (mADC - 4) \quad FSV/16$$

where "FSV" is the Full Scale Value for the oxygen range selected. In the example given above, $PPM = (12 - 4)$ x $10/16 = 5$ ppm.

7) If the oxygen value obtained from the analog output differs from that which is expected from the calibration gas, a span adjustment should be made. (BE SURE TO ALLOW THE READING TO COME INTO EQUILIBRIUM BEFORE MAKING ANY ADJUSTMENTS. OXYGEN ADSORBED ON INPUT LINES, VALVES, REGULATORS AND FILTERS MAY TAKE SOME TIME TO COMPLETELY DESORB) To accomplish this, refer to Figures 1.0 or 2.0 and locate the gain adjustment (R26). Adjust this potentiometer so the oxygen value reflected in the analog output is equal to the oxygen value represented by the calibration gas.

Once step 7 has been completed, resume normal operation.

Zero Adjustment
During factory calibration, the zero adjustment is made to compensate for parts per billion concentrations of oxygen that enter the sensor housing and plumbing system through leakage. In addition, there is a small error produced by oxygen dissolved in the electrolyte of the sensor. The amounts vary from system to system, but it is not uncommon to have an oxygen readings in the range of 0.1 ppm. Alpha Omega Instruments does not recommend the user make any zero adjustments unless a new sensor has been installed. To make a zero gas adjustment, the steps outlined in the aforementioned section should be followed with some important distinctions.

The sample gas used for zeroing the transmitter should be catalytically scrubbed in order to remove residual oxygen. After treatment, the zero gas should contain **< 50 ppb** of oxygen. Do not attempt to make any adjustments to the zero setting unless the quality of the zero gas sample can be assured to be as described above.

Once the transmitter is placed on zero gas, enough time should be given for the reading to stabilize. This length of time will be predicated on factors such as length of tubing, tubing material, flow rate, etc. Once the zero reading has stabilized, if the oxygen value obtained from the 4-20 mADC output is not equivalent to zero (4 mADC) an offset adjustment should be made. To do this, locate the zero adjustment R18 (Figures 1.0 or 2.0). Adjust this potentiometer so the oxygen value reflected in the 4-20 mADC output is at 4 mADC. Once accomplished, the transmitter can now be placed back in service.

SECTION 6.0
REPLACEMENT OF THE OXYGEN SENSOR

Procedure for Replacing the Oxygen Sensor
The Alpha Omega Instruments oxygen sensor is designed to operate for prolonged periods of time without replacement. However, in time the sensor's performance will dictate that a replacement be made. One indicator is a decrease in time intervals for routine calibrations. When this happens, a replacement sensor should be ordered directly from the factory.

To install a new sensor follow the directions below:

1. Remove power from the instrument.

IT IS ADVISABLE TO KEEP A LOW PPM GAS FLOWING THROUGH THE SENSOR HOUSING WHILE THE SENSOR IS BEING REPLACED. IT IS IMPORTANT THAT WHEN A NEW SENSOR IS INSTALLED, THE TIME BETWEEN WHEN IT WAS UNPACKED AND FIRST EXPOSED TO CALIBRATION GAS SHOULD BE KEPT TO AN ABSOLUTE MINIMUM. THE AMOUNT OF TIME TAKEN TO ACHIEVE THE GAS CALIBRATION LEVEL IS A FUNCTION OF HOW LONG THE SENSOR WAS EXPOSED TO AIR DURING REPLACEMENT. WHEN A NEW SENSOR IS INSTALLED, IT MAY TAKE APPROXIMATELY ONE HOUR TO REACH EQUILIBRIUM ON A CALIBRATION GAS.

2. Locate the sensor housing (metal enclosure mounted below the polycarbonate enclosure).
If the enclosure to which the sensor housing is attached is permanently mounted and the gas lines are rigidly installed, it will be necessary to disconnect both gas inlet and outlet lines.

3. With one hand supporting the sensor housing, loosen (do not remove) the four servo clamp screws that hold the metal ring to the enclosure. The sensor housing will drop from the enclosure.

4. Disconnect the modular connector at the top of the sensor housing.

5. Remove the socket head screws that hold the two halves of the sensor housing together. Once these screws have been removed, the two halves should easily separate.

WHEN SEPARATING THE TOP HALF OF THE SENSOR HOUSING FROM THE BOTTOM HALF, NEVER TWIST THE TWO AS THIS WILL CAUSE DAMAGE TO THE SPRING LOADED PINS THAT ARE USED TO MAKE ELECTRICAL CONNECTION TO THE SENSOR. ALSO, BE CAREFUL NOT TO BEND THESE PINS WHEN THE SENSOR HALVES ARE APART.

6. Remove the old sensor from the bottom half of the sensor housing.

THE SENSOR CONTAINS A SMALL AMOUNT OF CAUSTIC ELECTROLYTE, WHEN DISCARDING SPENT SENSORS, CARE SHOULD BE GIVEN NOT TO PUNCTURE THE SENSOR OR TO TAKE IT APART. DISPOSE OF THE SPENT SENSOR ACCORDING TO LOCAL, COUNTY, OR STATE GUIDELINES.

7. Remove the existing O ring and examine the grooves in the upper and lower halves of the sensor housing to be sure they are clean. Replace the O ring with the new one supplied with the sensor. Apply a light coating of silicon grease to the O ring prior to reinstalling the O ring.

8. Remove the new sensor from its package. Before installing it in the lower half of the sensor housing, REMOVE THE CAP and then install the sensor with the two gold rings facing out.

9. Take the two halves of the sensor housing and align them so the socket head screws can be reinstalled. Hand tighten the socket head screws being careful to do so evenly. If any resistance is experienced when starting any of the socket head screws, do not force the screws into the threads. Instead, if resistance is felt, simply rotate the screw CCW while pushing down on it until you feel the threads snap to a new starting location and again try to install the screw in the CW direction. If there is still a resistance to installing the screw, repeat the above procedure until the screw can be started without any difficulty.

10. Reconnect the cable and install the sensor back on the case with the servo clamp.

11. Reconnect the gas lines and begin processing gas through the sensor housing. Apply power and calibrate according to previous instructions.

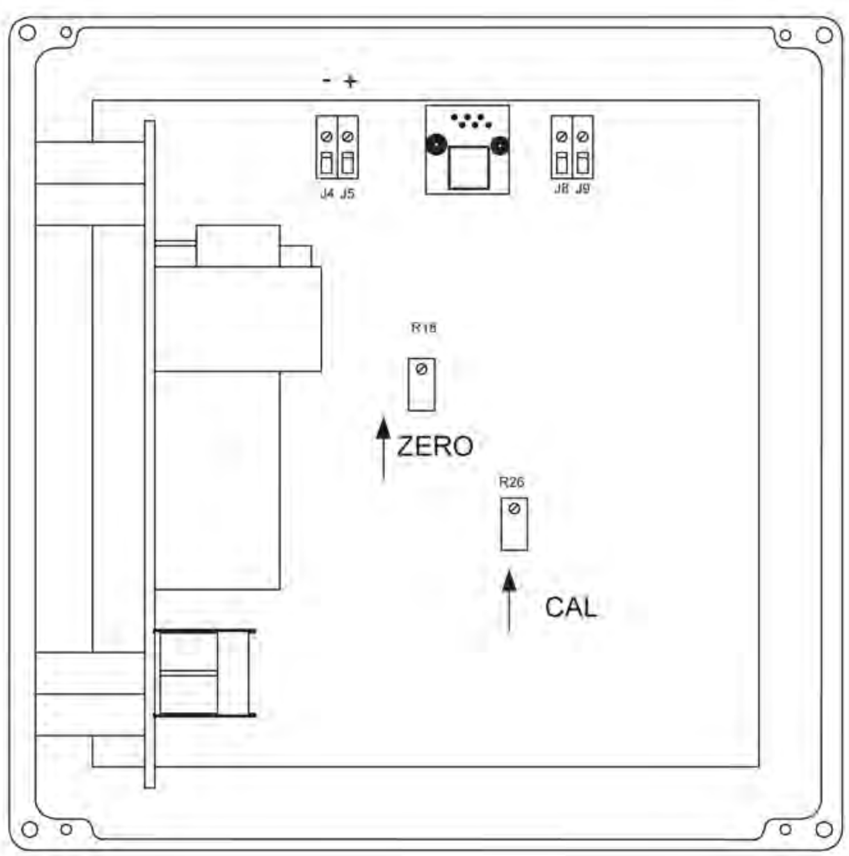


Figure 1.0
SERIES 3510 TRACE OXYGEN TRANSMITTER (AC POWERED) WITH 4-20 mADC ANALOG OUTPUT (TRANSMITTER BOARD)

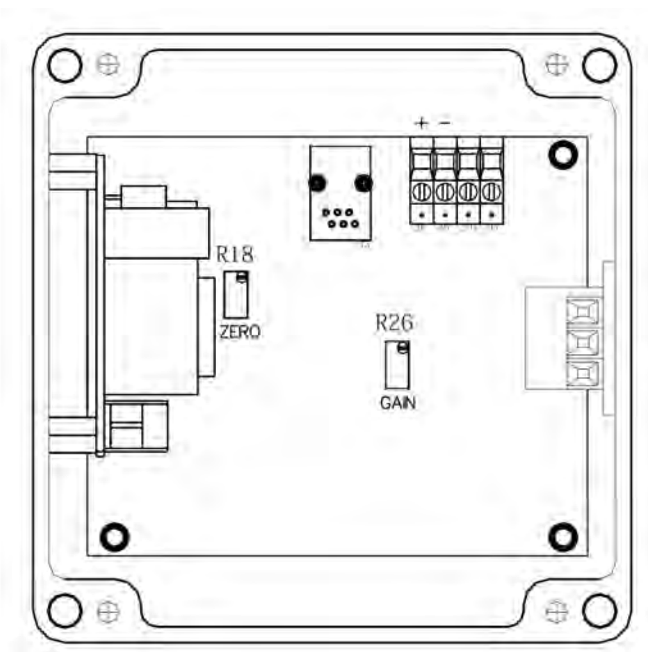


Figure 2.0
Transmitter Board with 0-10 VDC Output

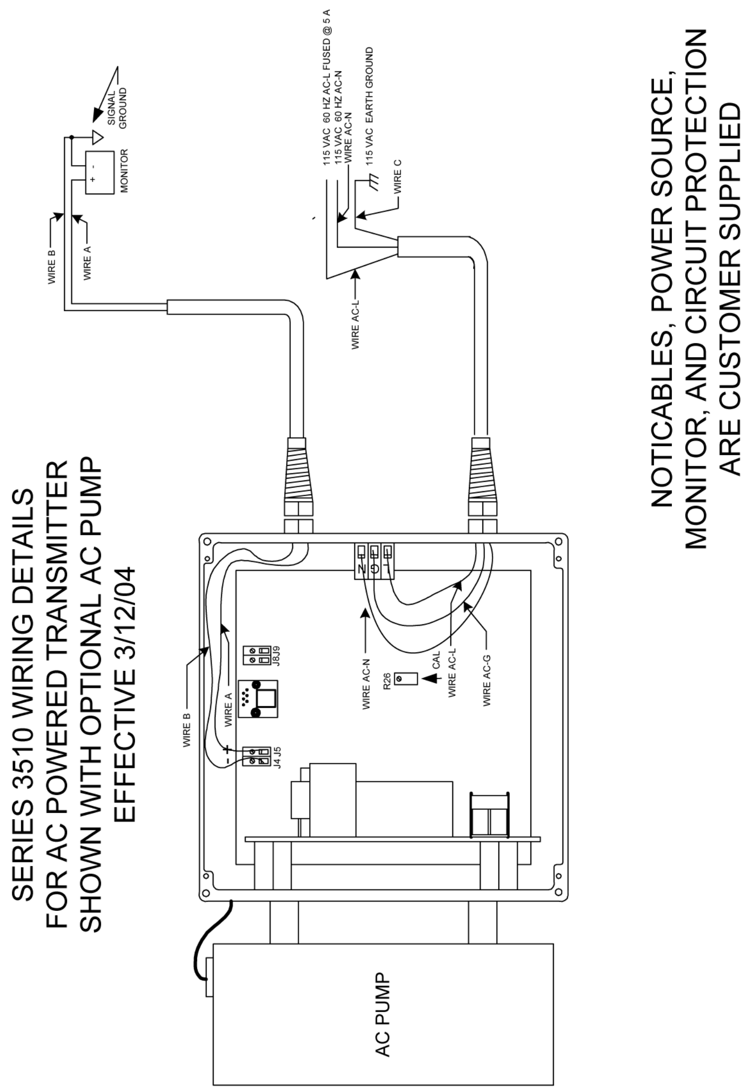


Figure 3.0
Wiring Details for the 4-20 mADC

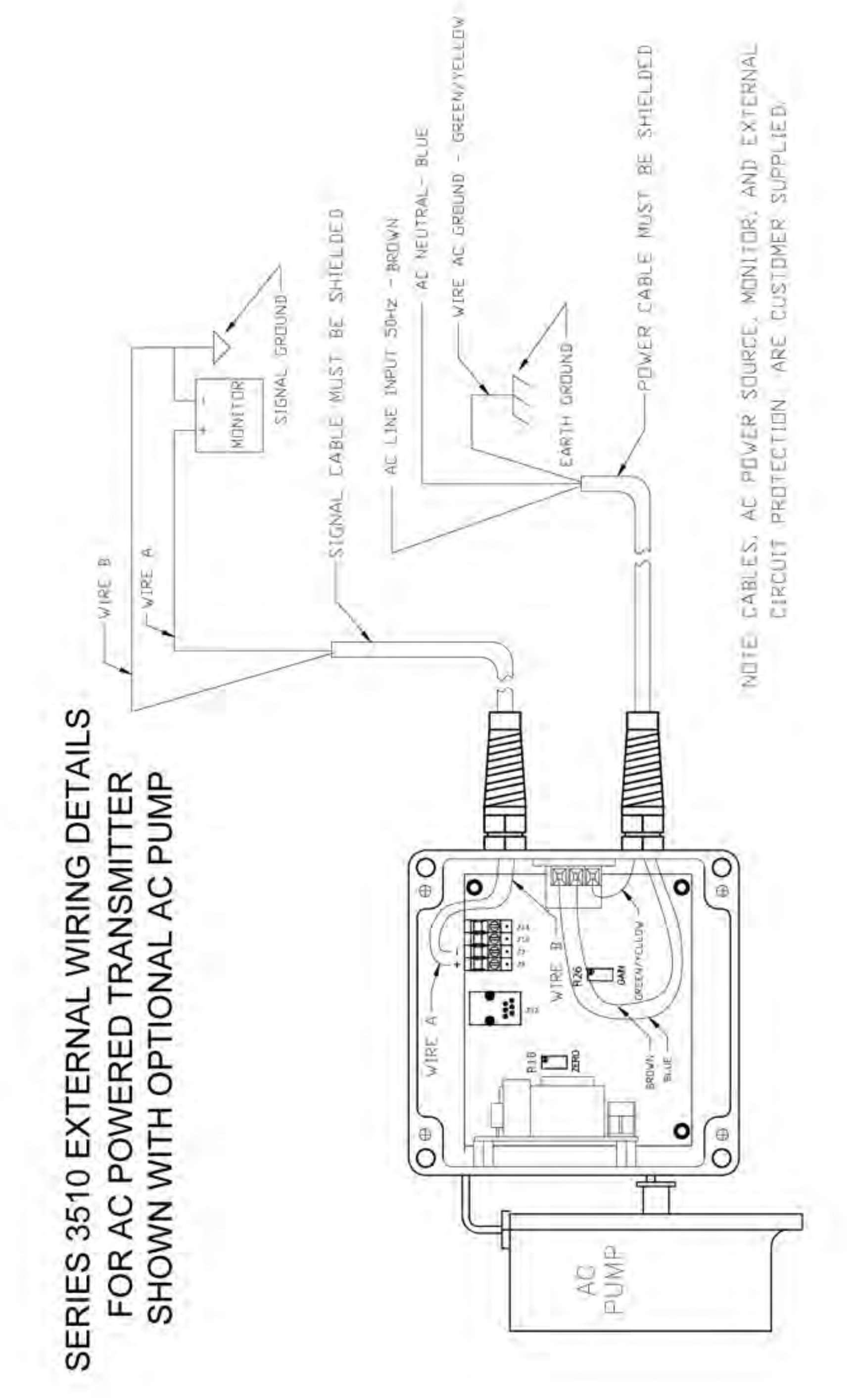


Figure 4.0
Wiring Details for the 0-10 VDC Output

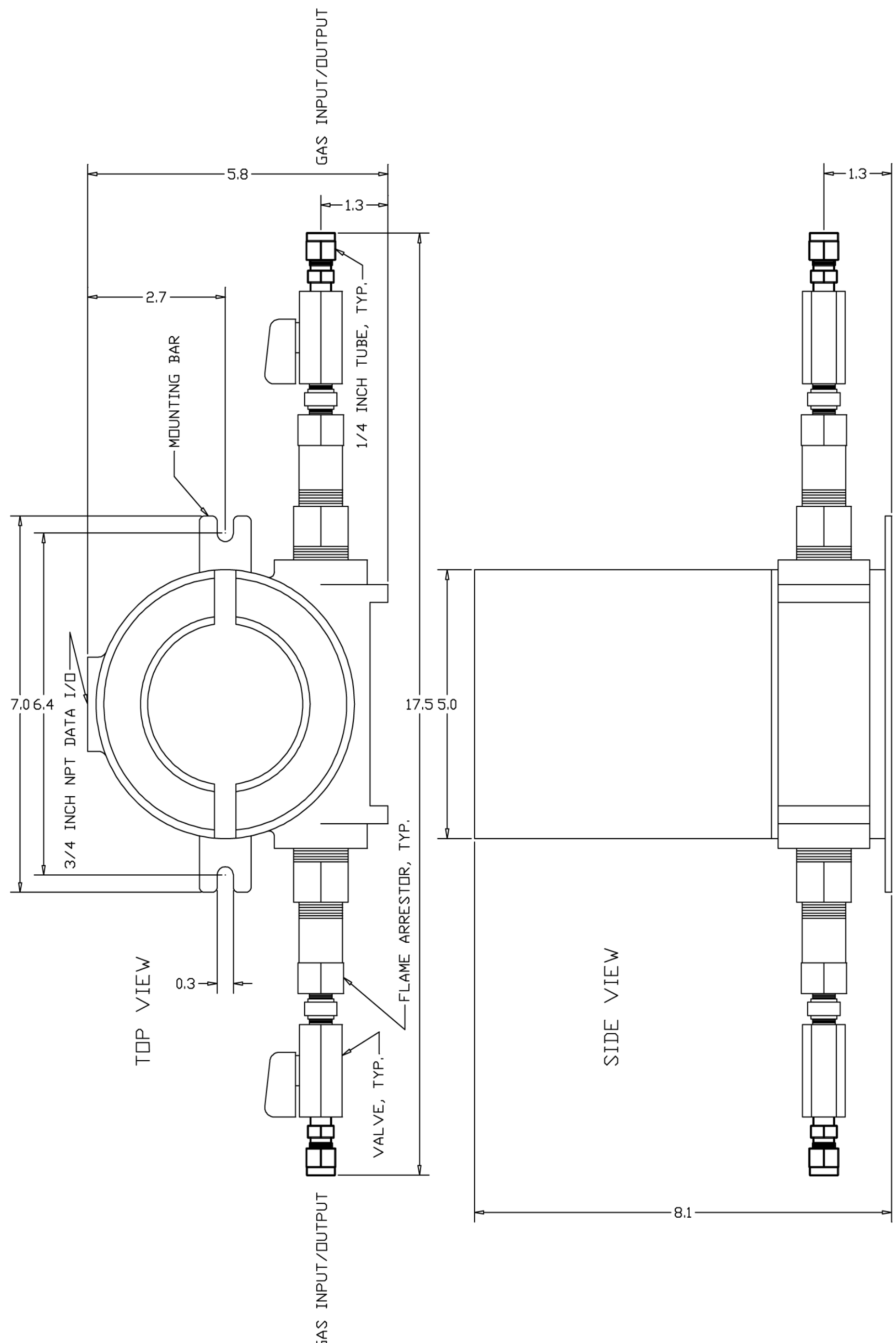


Figure 5.0
Series 3510 with NEMA 7 Enclosure

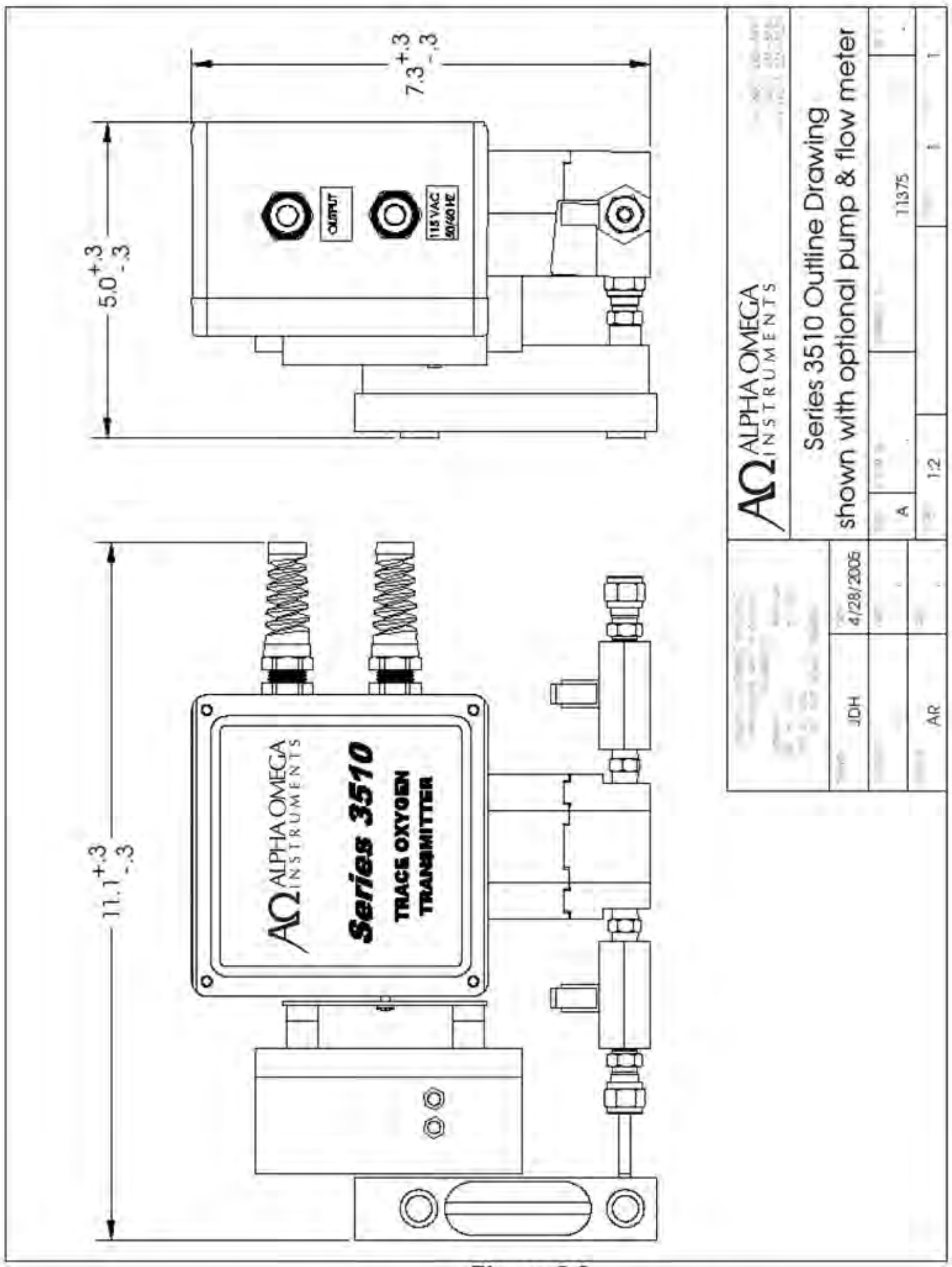


Figure 6.0
Series 3510 Outline Dimension Drawing

10.1 Product Identification

Product Name	Oxygen Sensor Model Prefix 3SEN
Synonyms	Electrochemical Sensor, Galvanic Fuel Cell
Manufacturer	Alpha Omega Instruments Corp. 30 Martin Street, Cumberland, RI 02864
Emergency Phone Number	401.333.8580
Preparation / Revision Date	January 1, 1995
Notes	❑ *Oxygen sensors are sealed, contain protective coverings and in normal conditions do not present a health hazard.* ❑ Information applies to electrolyte unless otherwise noted.

10.2 Specific Generic Ingredients

Carcinogens at levels > 0.1%	None
Others at levels > 1.0%	Potassium Hydroxide, Lead
CAS Number	Potassium Hydroxide = KOH 1310-58-3, Lead = Pb 7439-92-1
Chemical (Synonym) and Family	Potassium Hydroxide (KOH) – Base, Lead (Pb) – Metal

10.3 General Requirements

Use	Potassium Hydroxide - electrolyte, Lead - anode
Handling	Rubber or latex gloves, safety glasses
Storage	Indefinitely

10.4 Physical Properties

Boiling Point Range	100 to 115° C
Melting Point Range	KOH -10 to 0° C, Lead 327° C
Freezing Point	-40 to 0° C
Molecular Weight	KOH = 56, Lead = 207
Specific Gravity	1.09 @ 20° C
Vapor Pressure	Not applicable
Vapor Density	Not applicable
pH	> 14

Solubility in H_2O	Complete
% Volatiles by Volume	None
Evaporation Rate	Similar to water
Appearance and Odor	Colorless, odorless aqueous solution

10.5 Fire and Explosion Data

Flash and Fire Points	Not applicable
Flammable Limits	Not flammable
Extinguishing Method	Not applicable
Special Fire Fighting Procedures	Not applicable
Unusual Fire and Explosion Hazards	Not applicable

10.6 Reactivity Data

Stability	Stable
Conditions Contributing to Instability	None
Incompatibility	Avoid contact with strong acids
Hazardous Decomposition Products	None
Conditions to Avoid	None

10.7 Spill or Leak

Steps if material is released

- ❏ Sensor is packaged in a sealed plastic bag, check the sensor inside for electrolyte leakage.
- ❏ If the sensor leaks inside the plastic bag or inside an analyzer sensor housing do not remove it without rubber or latex gloves and safety glasses and a source of water.

Flush or wipe all surfaces repeatedly with water or wet paper towel (fresh each time).

Waste Disposal Method: In accordance with federal, state and local regulations

10.8 Health Hazard Information

Primary Route(s) of Entry	Ingestion, eye and skin contact
Exposure Limits	Potassium Hydroxide - ACGIH TLV 2 mg/cubic meter; Lead - OSHA PEL .05 mg/cubic meter
Ingestion	Electrolyte could be harmful or fatal if swallowed. Oral LD50 (RAT) = 2433 mg/kg
Eye	Electrolyte is corrosive and eye contact could result in permanent loss of vision.
Skin	Electrolyte is corrosive and skin contact could result in a chemical burn.

Inhalation	Liquid inhalation is unlikely.
Symptoms	❏ Eye contact - burning sensation. Skin contact - soapy slick feeling.
Medical Conditions Aggravated	None
Carcinogenic Reference Data	❏ NTP Annual Report on Carcinogens - not listed ❏ LARC Monographs - not listed ❏ OSHA - not listed
Other	Lead is listed by some states as a chemical known to cause birth defects or other reproductive harm.

Addendum

for

Series 3510 with In-Line Filter, Isolation Solenoid Valves, Flow meter, and Low Flow Indication Switch.

If your analyzer has been equipped with the above option, please read below.

This instrument has been designed in a NEMA 4 (IP 66) enclosure rated for general purpose use. Also provided with the instrument is an in-line sample filter (coalescing type), flow meter, Isolation solenoid valves, and a low flow indication switch.

The instrument is powered by a customer provided 24 Volt DC power supply with connections made to an internal terminal block.

The sourced 4-20ma Output is available on terminal blocks J4 and J5 on the circuit board.
J4 is the return (-) side, J5 is the Positive (+) side.

The instrument is equipped with isolation solenoids and a low flow indication switch that are not factory wired. The customer must provide the 24V DC power to operate the solenoid valves. The customer has access to the low flow indication switch contacts for connection to their own interface to determine the status of the switch.

Below is a description of the internal terminal block and the wiring description for the isolation solenoid valves and low flow indication switch.

System Wiring

Board Power
This instrument is powered by a customer supplied 24V DC Supply. Inside the instrument is a terminal block for providing power to the board. The terminal block has 3 terminals. The "+" terminal is for 24V DC Positive, the "G" Terminal is for a Chassis Ground connection, and the "-" terminal is for 24V DC Return.

Series 3510	
Terminal	Description
"+"	24V DC Positive for Board
"G"	Chassis Ground
"-"	24V DC Return for Board

Solenoid Valves
The instrument is equipped with 2 Isolation Solenoid Valves. These valves require **24V DC** to operate. The Red wire of each solenoid is the positive side. The Black wire of each solenoid is the return side. **WARNING: To avoid a pressure differential across the sensor which could cause damage to the sensor, both Solenoid Isolation Valves should be activated and deactivated simultaneously.**

Low Flow Indication Switch
The instrument is equipped with a low flow indication switch. The switch contacts are available to the customer to wire to their interface to determine the status of the switch. The flow switch is installed at the factory in a state where an open connection indicates low flow, and a closed connection indicates sufficient flow (the contact leads exit the top of the switch).

Switch Specifications:
- SPST Hermetically Sealed Reed Switch
- Max Switching Voltage DC (V) 200, AC (VA) 150
- Contact Rating DC (W) 50, AC(VA) 70
- Max Switching Current DC (A) 1.0, AC (A) 0.7

Addendum

for

Series 3510 with In-Line Filter, Isolation Solenoid Valves, Flow meter, and Vacuum Pump.

If your analyzer has been equipped with the above option, please read below.

This instrument has been designed in a NEMA 1 enclosure rated for general purpose use. Also provided with the instrument is an in-line sample filter (coalescing type), flow meter, isolation solenoid valves, and a vacuum pump.

The instrument is powered by a customer provided 24 Volt DC power supply with connections made to an internal terminal block.

The sourced 4-20ma Output is available on terminal blocks J4 and J5 on the circuit board.
J4 is the return (-) side, J5 is the Positive (+) side.

The instrument is equipped with isolation solenoid valves and a vacuum pump that are factory wired. The solenoid valves and vacuum pump are controlled by the switch on the right side of the instrument labeled “Flow”. This switch will activate both the solenoid valves and the vacuum pump. Located inside the instrument is a terminal block with a wire jumper to allow for remote control of the solenoid valves and vacuum pump. Simply replace the red jumper in the terminals labeled “CS” (customer switch) with a remotely operated switch contact. Please note that the switch labeled “Flow” on the right side of the instrument is wired in series with this terminal connection, the switch labeled “Flow” must be on for this remote switch contact to work.

Below is a description of the internal terminal block and the wiring description.

System Wiring

The terminal block provided in the instrument has 5 terminals. The "+" terminal is for 24V DC Positive, the "G" Terminal is for a Chassis Ground connection, and the "-" terminal is for 24V DC Return. The terminals labeled "CS" are for connection of a remote switch contact for use in controlling the solenoid valves and vacuum pump.

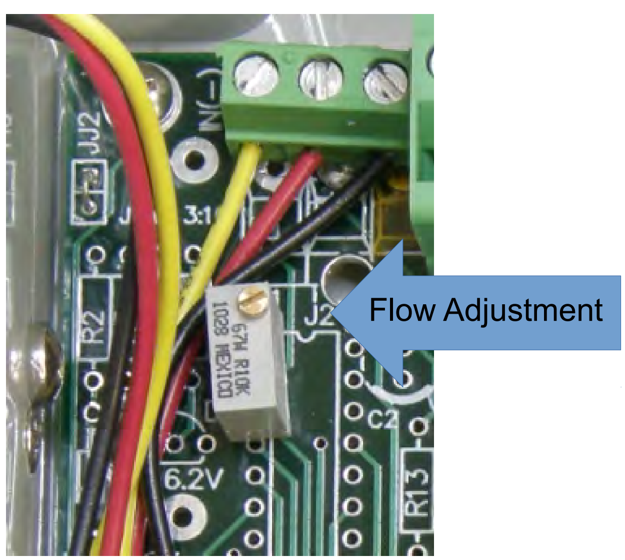
Series 3510	
Terminal	Description
"+"	24V DC Positive
"G"	Chassis Ground
"-"	24V DC Return
"C"	CS is Customer Switch Remote Switch Contacts for operation of solenoid valves and vacuum pump
"S"	

Sample Flow Rate Adjustment

The sample flow rate of the vacuum pump is set at the factory. Normal flow adjustments should be made using the attached flow meter with integral flow control needle valve. If the flow rate has become insufficient due to aging of the device, the flow rate may be adjusted by using a small flat blade screw driver to turn the flow adjustment potentiometer located inside of the instrument as shown below.

CAUTION: Before adjusting the flow, make sure that the flow control needle valve on the flow meter is fully open (counter clockwise) and check that there is no restriction which may be limiting the flow rate before adjustments are made. This includes making sure that the provided filter has not become clogged.

WARNING: Improperly setting the flow rate may cause erroneous low readings or potentially damage the sensor.



Addendum

for

Series 3510 Explosion Proof with In-Line Filter, Sample Pump, Isolation Solenoid, and Flow meter.

If your analyzer has been equipped with the above option, please read below.

This instrument has been designed in a NEMA 7 explosion proof enclosure rated for use in areas requiring Class I, Div 1, Groups B,C,D. Also provided with the instrument is an in-line sample filter (coalescing type), pump, and flow meter. A solenoid valve has also been included to provide isolation when the instrument is powered off.

The instrument is powered by a customer provided 24 Volt DC power supply.

The sourced 4-20ma Output is available on terminal blocks J4 and J5 on the circuit board.
J4 is the return (-) side, J5 is the Positive (+) side.

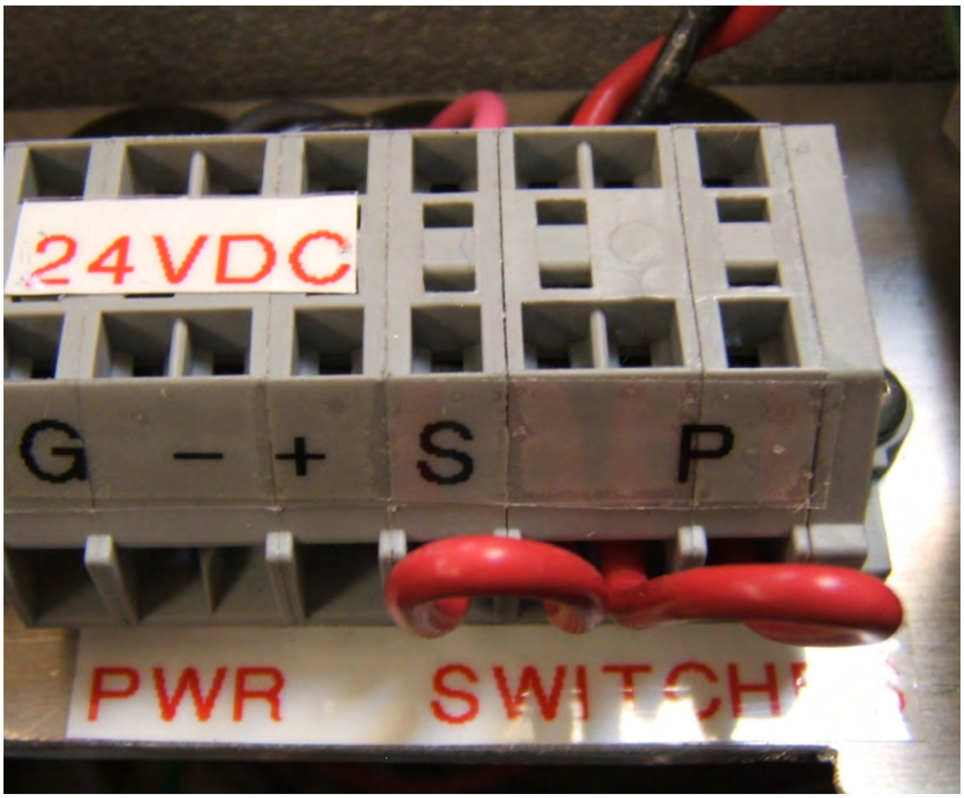
The instrument is shipped with the isolation solenoid and the sample pump wired to be active when the instrument is powered. Provided on the terminal block is the ability to replace the wire jumper with a customer switch to allow external control of the isolation solenoid and sample pump. Please note that when the instrument is not in use the isolation solenoid should be powered off (closed) to prevent the sensor from being exposed to high levels (relatively) of oxygen present in the atmosphere.

CAUTION: Great care should be taken to avoid any sample line restrictions when the sample pump and isolation solenoid are active, this includes the ball valves located on the sample gas inlet and sample gas outlet. Before applying power to the instrument the ball valves must be opened and the sample line must be free of restrictions or, if wired to a customer switch, the sample pump and isolation solenoid must be off before opening the ball valves. The instrument must also be powered off or, if wired to a customer switch, the sample pump and isolation solenoid must be powered off before closing the ball valves on the sample gas inlet and sample gas outlet or creating any sample line restrictions.

Below is a description of the terminal block and sample flow adjustment.

System Wiring

Shown below is the terminal block to which the customer will connect the 24V DC power and the optional customer switches (if desired). Please refer to the table below for the description of each terminal.

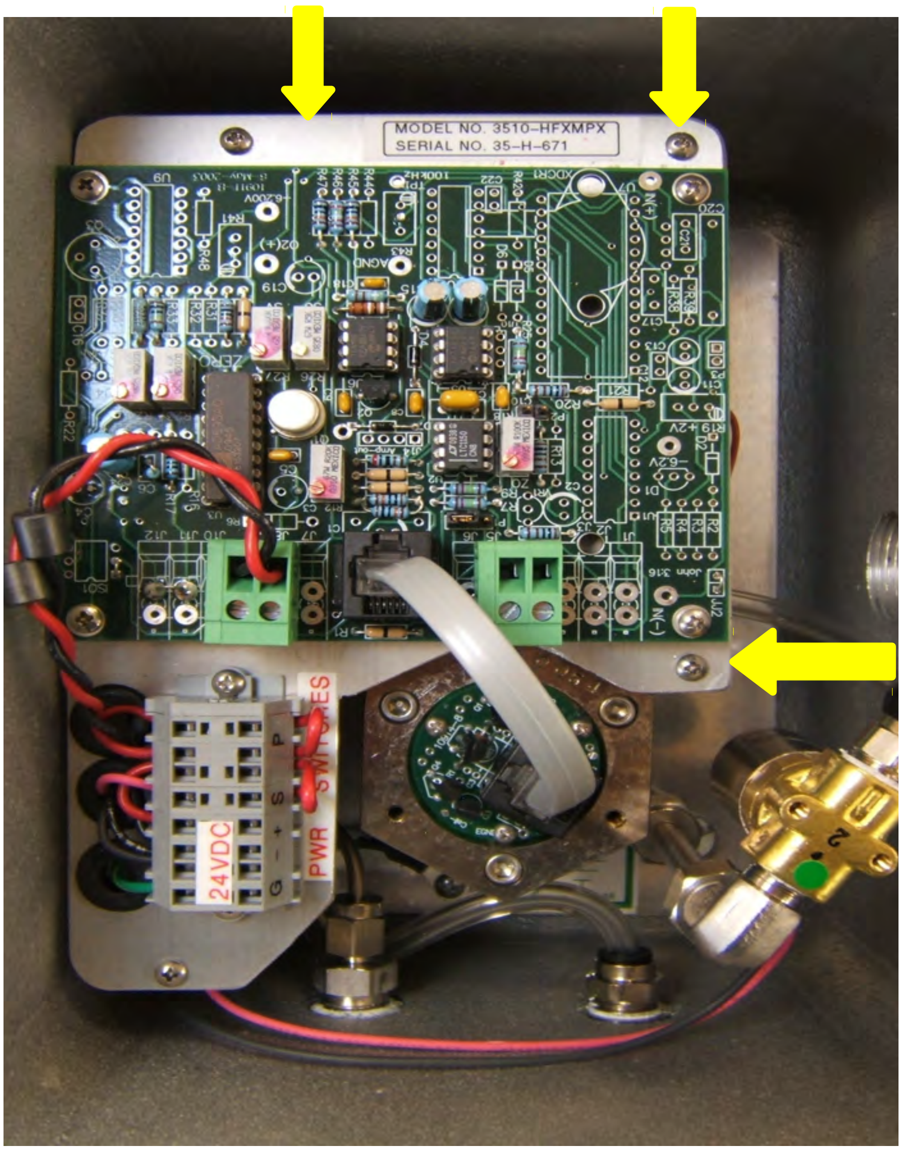


Series 3510	
Terminal	Description
"G"	Chassis Ground
"-" (Double Entry)	24V DC Return
"+"	24V DC Power
"S"	Solenoid Customer Switch
"" (Double Entry)	Customer Switch (24V)
"P"	Pump Customer Switch

Sample Flow Adjust

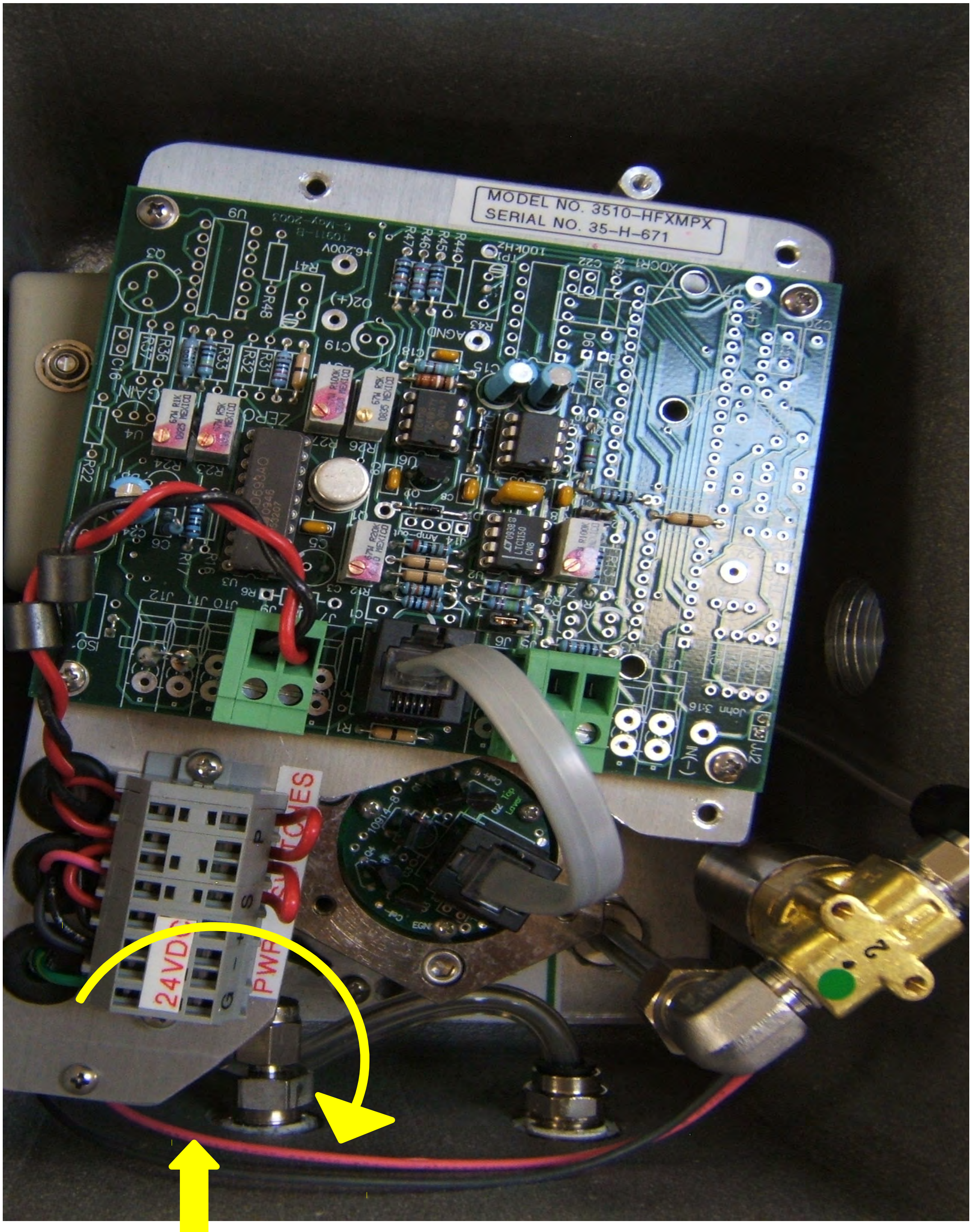
The sample flow rate is set at the factory. If the sample flow has become insufficient please check that the filter element is clean. Also check that there is no restriction upstream which may be limiting the flow rate.

If no restrictions have been found and the flow rate is still insufficient, the flow rate may be adjusted using a potentiometer on the sample pump. To access the flow rate adjustment potentiometer, remove the 3 screws show in the photo below. Loosen the 4th screw and rotate the mounting plate. Adjust the potentiometer for the desired flow rate. Rotate the mounting plate back into position, replace and tighten all screws.



Remove these screws.

Loosen this screw and rotate the plate.



Adjust the flow adjustment potentiometer to the desired flow rate using a small flat blade screw driver.

Addendum

for

Series 3510 Oxygen Transmitter with Integrated Heater

If your analyzer has been equipped with the above option, please read below.

This instrument (S/N 3510-D-655) has been designed in an explosion proof enclosure rated for use in areas requiring Class I, Div 1, Groups B,C,D. Also provided is a heating element for operations in sub-freezing temperatures.

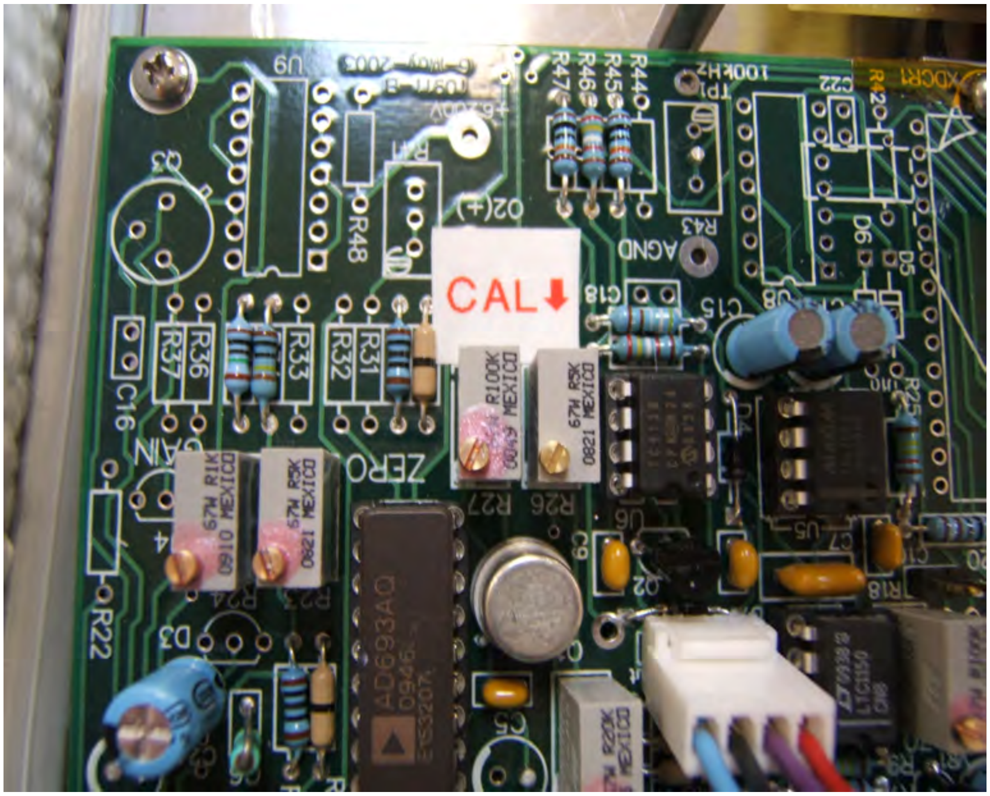
The instrument is powered by a customer provided 24 Volt DC power supply. The power supply should be capable of delivering a **minimum of 4 Amperes of current at 24 Volts** for proper instrument function.

CAUTION: Care should be taken when opening the instrument during operation. There is a risk of burn injury associated with certain surfaces within the instrument enclosure. All servicing of the instrument should be performed with the power OFF. Also, allow the instrument to sit for at least 15 Minutes after power has been turned off before servicing.

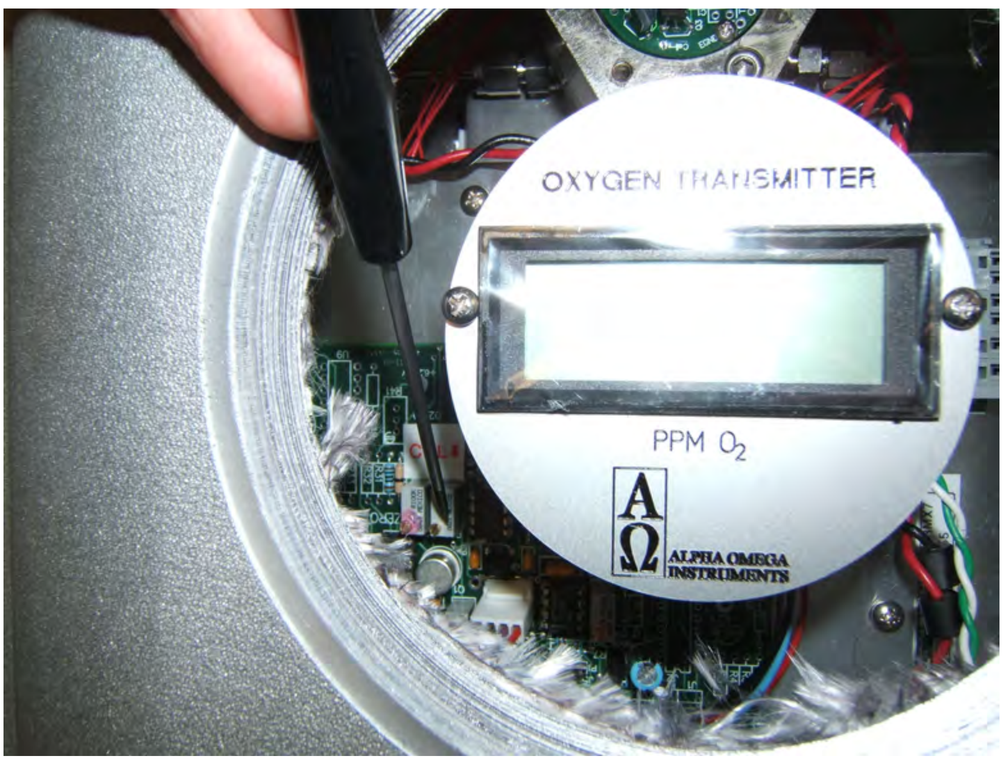
The Calibration, Wiring, and Plumbing information for this instrument is described on the following pages.

Calibration Information

The Calibration Potentiometer is marked with a CAL Sticker.

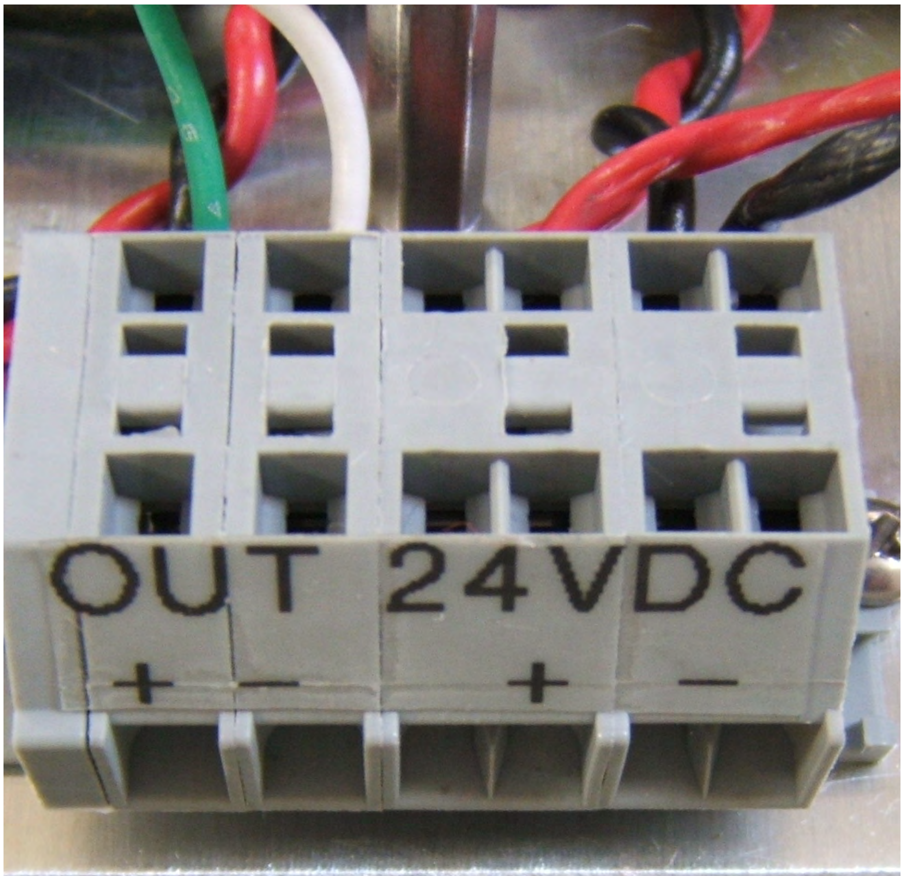


For ease of access the Calibration Potentiometer may be accessed by removing the window by rotating it counter clockwise.



System Wiring

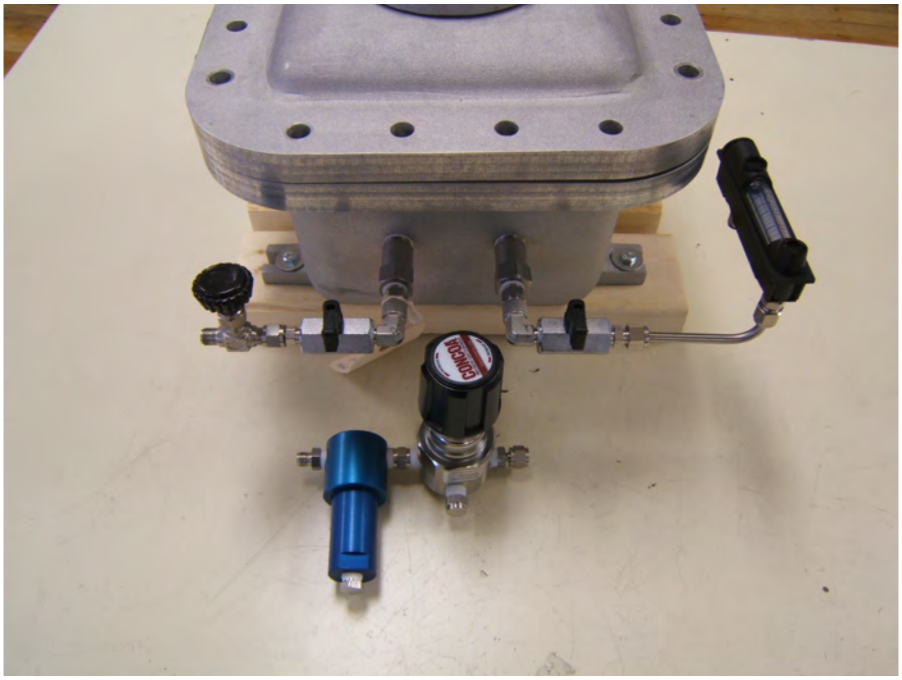
Shown below is the terminal block to which the power (24V DC) and the output is wired. Please refer to the table below for the description of each terminal.



Series 3510	
Terminal	Description
"OUT +"	4/20 mA Positive
"OUT -"	4/20 mA Return
"24 VDC +" (Double Entry)	24V DC Power Positive
"24 VDC -" (Double Entry)	24V DC Return

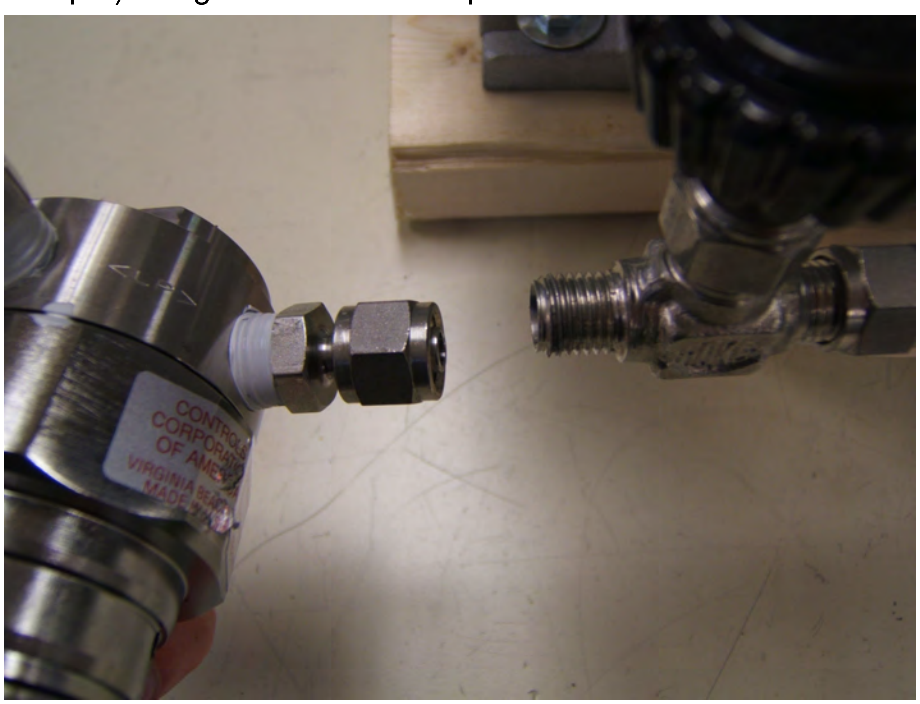
Plumbing

The Filter and Pressure Regulator are shipped separate from the instrument.

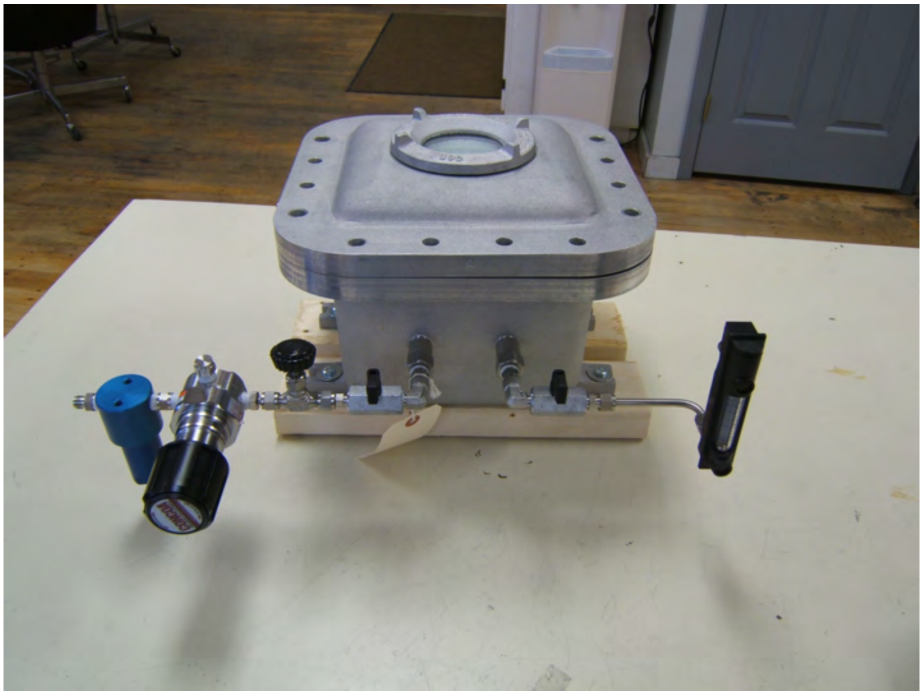


Please have qualified personnel install the Filter and Pressure Regulator to best fit the mounting of the instrument. (shown on next page)

Installation of the Filter and Pressure Regulator require a single compression fitting (Included on the Pressure Regulator output) be tightened onto the input of the Needle Valve.



For **Horizontal Mounting** of the instrument please install the Filter and Pressure Regulator and adjust the flow meter as shown below:



For **Vertical Mounting (Wall)** of the instrument please install the Filter and Pressure Regulator and adjust the flow meter as shown below