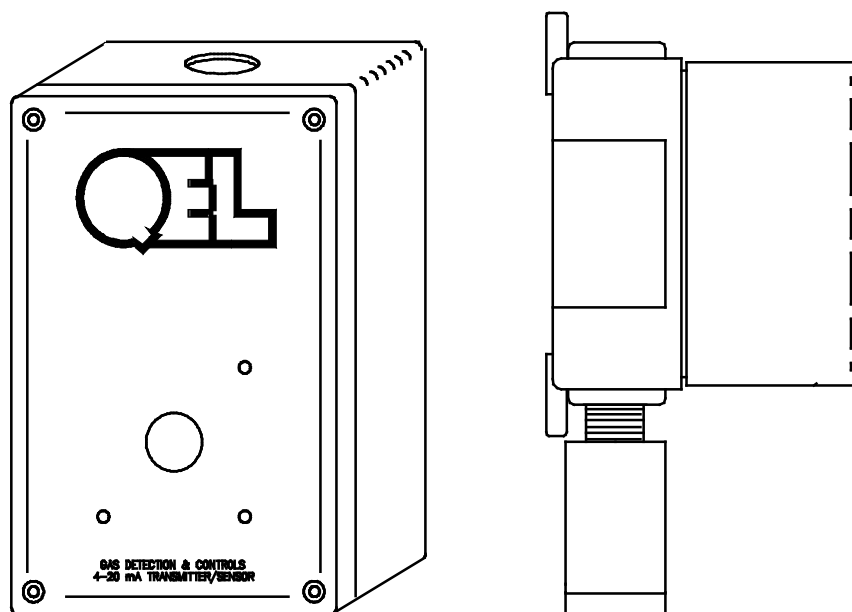


**MODEL QTS-1300
OXYGEN (O₂) ANALOG TRANSMITTER/SENSOR**



**INSTALLATION
OPERATION AND MAINTENANCE
MANUAL**

QUATROSENSE ENVIRONMENTAL LTD.
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GENERAL SPECIFICATIONS

DIMENSIONS:

Commercial: 4.2" W x 6" H x 2.6" D (107 mm x 152 mm x 66 mm)
Explosion Proof: 5.7" W x 8.2" H x 4.2" D (145 mm x 210 mm x 110 mm)

POWER SUPPLY: 24 VDC (12-36 VDC)

SIGNAL: 4 - 20 mA Linear (maximum over scale: 25 mA)
Zero = 4.00 mA +/- 0.1 mA

WIRING: 2- Wire 14 - 24 AWG

SENSOR TYPE: Electrochemical

HUMIDITY:
Continuous: 0 - 99 % RH Non- Condensing

Model Number	Gas Type	Standard Measurement Range	Recommended Alarm Settings		Operating Temperature	Recommended Mnt Height*
			Warning	Alarm		
QTS-13001x-	O ₂	0-25% v/v	17% v/v	19% v/v	-20° C to + 50° C	Mid

* Mid = 4 to 60 ft (1.2 to 1.8 m) above floor

WARRANTY STATEMENT

The information contained in this manual is based upon data considered accurate; however, no warranty is expressed or implied regarding the accuracy of this data. All QEL equipment is warranted against defects in material and workmanship for a period of two years from date of shipment with the following exceptions:

Electrochemical Sensors (Toxic)	Six Months
Catalytic Sensors (Combustible)	One Year

During the warranty period we will repair or replace, at our discretion, any components or complete units that prove, in our opinion, to be defective. We are not liable for consequential or incidental damage to auxiliary interfaced equipment.

A returned material authorization number should be obtained from the factory prior to returning any goods. All return shipments must be shipped freight prepaid and a copy of the Maintenance Records should accompany the unit concerned.

Warranty should be considered F.O.B. the factory. Labour and travel time are chargeable for any field site visits required for warranty work.

LIMITED LIABILITY

All QEL systems shall be installed by a qualified technician/electrician and maintained in strict accordance with data provided for individual systems in the form of installation/maintenance manuals. QEL assumes no responsibility for improper installation, maintenance, etc., and stresses the importance of reading all manuals. QEL shall not be responsible for any liability arising from auxiliary interfaced equipment nor any damage resulting from the installation or operation of this equipment.

QEL's total liability is contained as above with no other liability expressed or implied as the purchaser is entirely responsible for installation and maintenance of systems.

This warranty is in lieu of all other warranties, expressed or implied, and no representative or person is authorized to represent or assume for QEL any liability in connection with the sales of our products other than that set forth herein.

NOTE: Due to on-going product development, QEL reserves the right to change specifications without notice and will assume no responsibility for any costs as a result of modifications.

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1. INTRODUCTION

Thank you for purchasing this quality product from Quatrosense Environmental Ltd. (QEL). We want you to enjoy many years of effective use and protection from your QTS-13001 Electrochemical Oxygen Sensor/Transmitter. This manual is intended to provide you with all of the details you need to properly install, operate, and maintain your equipment.

To properly prepare to install, configure, and start-up your QTS-13001 Electrochemical Oxygen Sensor/Transmitter we recommend that you read these sections of the manual before beginning the work. The sections at the beginning of the manual covering description, specifications, and theory of operation will provide general background and reference information. Please refer to the sections at the end of the manual on test, calibration, and troubleshooting before performing these tasks.

Throughout this manual your attention will be drawn to certain information in the following manner:

NOTE: This will highlight tasks or information important to the proper operation of the sensor/transmitter.

CAUTION This will detail steps that will cause malfunction of the unit if performed improperly.

WARNING This will indicate critical actions that could cause harm to personnel or damage to the sensor/transmitter or associated equipment if performed improperly

If you have any questions, or you find any errors or omissions in your manual, please contact our customer service team at **(613) 838-4005** by phone or fax us at **(613) 838-4018**.

2. BASIC DESCRIPTION

The QTS-13001 Electrochemical Oxygen Sensor/Transmitter is a significant upgrade from our previous Oxygen sensor/transmitter. It features improved performance with the ability to operate over a wide range of input DC voltages and provide a 4 to 20 mA DC output over a two-wire connection.

The sensor portion of this unit is a City Technology compact electrochemical sensor element. This element is completely sealed and has a typical life of two years in normal operation, with recalibration recommended every three months. See 'Theory of Operation' for details on how this sensor functions.

The transmitter portion of this unit uses solid state components on two circuit card assemblies to measure the DC microamp signal from the sensor element and convert it to a 4 to 20 mA DC output.

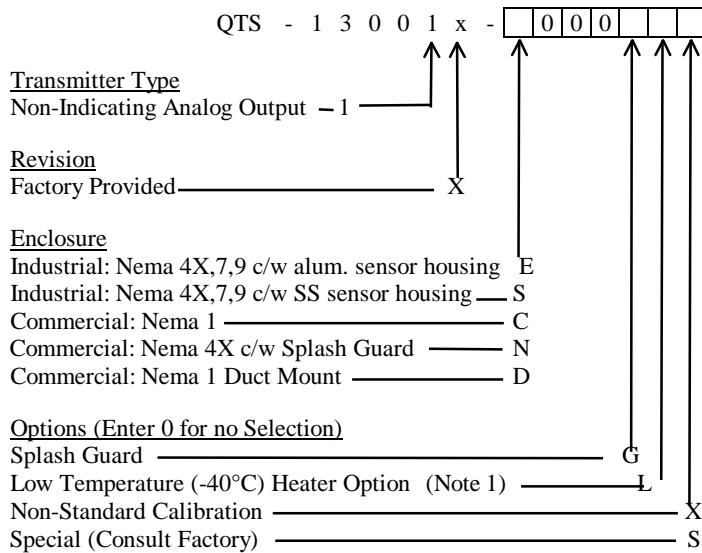
The transmitter electronics are powered with two-wire 24 VDC and transmit the 4 to 20 mA DC output over the same two wires. They have been designed to provide protection from interference caused by Radio Frequency (RFI) and Electro-Magnetic (EMI) sources. The designs have been tested for proper operation under radiated interference of 4 watts at a distance of 1 meter. See 'Installation' for details on correct wiring and grounding to ensure proper operation.

Accessible from the top of the transmitter are test jacks that will accept standard DVM test leads. The transmitter 4 to 20 mA DC signal can be monitored from these test points without interrupting the output. Two trim potentiometers provide adjustment of zero and span for accurate calibration of the transmitter to specific gas concentrations. No linearization adjustments are required as the electrochemical cell is inherently linear.

The sensor/transmitter is offered in a variety of enclosures. These range from general purpose Nema 1 enclosures through to explosion-proof enclosures listed by CSA, UL, and FM for Class 1, Division 1, Groups B,C,D service. The same transmitter board assembly is used for all enclosure types. The plug-in sensor element connects directly to the transmitter circuit card assembly in the ABS plastic Nema 1 and Nema 4 enclosures. An aluminum or stainless steel sealed sensor assembly is provided for the plug-in sensor element on the explosion-proof enclosures. The sensor connects to the circuit card assembly via a connector at the end of leads extending from the sensor assembly.

3. SPECIFICATIONS AND ORDERING INFORMATION

3.1 Model Number Ordering Code



Note 1: Available only in type N or C enclosures

3.2 Sensor/Transmitter Specifications

- Input Power:** 12 to 36 VDC
- Fuse:** 0.5 Amp socketed pico fuse
- Output Signal:** 4 to 20 mA DC into 750 ohms at 24 VDC, Two-wire configuration
- RFI/EMI Protection:** 4.0 Watt at 1 meter radiated
- Enclosure Rating:** E - NEMA Type 4X Weatherproof, Type 7 and 9 Explosion Proof; IP66-68, Class 1, Div. 1, Groups A,B,C,D, CSA, FM, UL listed; Aluminum Sensor Housing (also Group A rated)
 S - Same as E above except with 316 Stainless Steel Sensor Housing
 C, D - NEMA Type 1 General Purpose
 N - NEMA Type 4X Weatherproof
- Encl. Materials:** E,S - Cast Aluminum, Epoxy Painted
 C,N,D - ABS Plastic
- Sensor Technology:** Electrochemical
- Response Time:** Typically less than 60 seconds for 90% response to a step change.
- Sensor Life:** Typically 2 years.
- Temperature - Sensor:** -20° to +50° C (-4° to +122° F).
- Temp. - Transmitter:** -40° to +50° C (-40° to +122° F).
- Humidity - Sensor:** 0 to 99% RH continuous operating, non-condensing.
- Humidity - Transmitter:** 0 to 99% RH, non-condensing, operating and storage.
- Pressure:** Atmospheric ± 10%.
- Accuracy:** ± 2.5% of Reading.
- Repeatability:** ± 1.0%
- Approvals:** CSA - C22.2 -30, C22.2-142,

4. THEORY OF OPERATION

4.1 Electrochemical Sensor Elements

The sensor portion of the QTS-13001 is a compact City Technology electrochemical sensor. These sensors are metal air battery types that are completely sealed so as to be maintenance free and stable for long periods.

The cell consists of a diffusion barrier, O-ring seal, electrolyte reservoir, an anode and a cathode (see Fig. 1). The gas enters the cell through a diffusion barrier. The chemical process of the measurement is one of oxidation of the lead anode. Oxygen is reduced at the cathode to hydroxyl ions, which then oxidize the lead anode to lead oxide. This signal is linear to the volume concentration of the sensed gas rather than the partial pressure. These sensors will not respond to normal variations in atmospheric pressure.

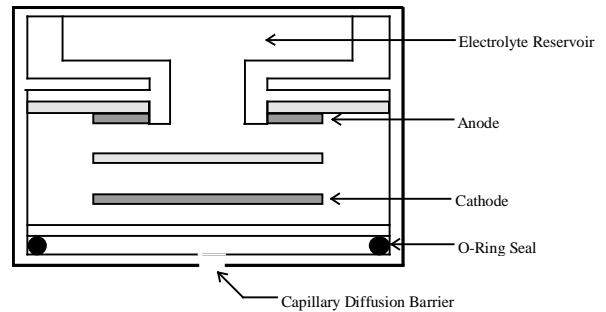


Figure 1 - Oxygen Cell Construction
(Schematic Drawing)

This oxidation of the anode limits the life of the sensor.

Typical life for these sensors is two years in normal operation. This will vary somewhat from sensor to sensor, with some working lifetimes exceeding three years. This oxidization of the anode also changes the characteristics of the sensor, requiring regular re-calibration. It is recommended that these sensors be re-calibrated every three months or as necessary.

4.2 Two Wire Transmitters

The standard transmitter output signal is 4 - 20 mA DC. If the current draw required for operation of the transmitter is less than 4 mA DC, then only two wires are needed for power and signal (See figure 2). The connection to ground is supplied by the monitoring equipment, which measures the voltage developed by the current across a precision resistor. A functioning transmitter will always draw its operating current, so there will always be some output signal in a functioning circuit.

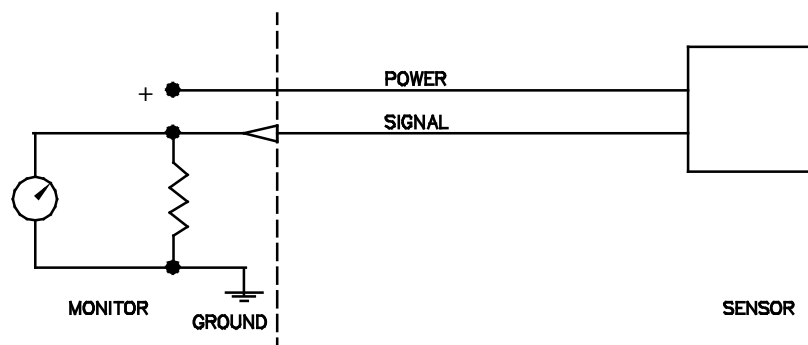


Figure 2 -Two Wire Transmitters

4.3 Explosion Proof Enclosures for Hazardous Locations

Special considerations are necessary in hazardous locations areas where flammable or explosive dusts and/or gases may be present. Such areas are generally classified as either Class 1 (gases) or Class 2 (dusts) and Division 1 (danger is normally present) or Division 2 (danger is present under failure conditions). An additional Group letter code specifies the gases or dusts presenting the hazard. Electrical equipment installed in these areas must be protected from generating a spark of sufficient ignition temperature that an explosion may occur. This is achieved by installing the electrical equipment in certified explosion-proof enclosures. When properly installed, these heavy metal enclosures are sealed from the hazardous condition and guaranteed to contain any spark or flame that might occur in the electronics. Access to the contents requires measures to ensure that the area is in a non-hazardous condition.

For hazardous areas, the QTS-13001 is available in an explosion proof housing CSA, FM, and UL rated to Class 1 Division 1 Groups B,C,D. The sensor assembly attached to this enclosure is also rated for Group A (Acetylene).

5. INSTALLATION

WARNING **STATIC ELECTRICITY - Installation, wiring, configuration, or other activity may require handling or disassembly of the transmitter circuit card assemblies (CCA). Handling of a CCA without proper precautions can expose the electronic components to the possible damage from static electricity discharge.**

Try to ensure you are grounded when handling a CCA. If continuous grounding is not practical, touch some metal item, which is known to be grounded. Avoid walking around after this as you can regenerate a static charge. Note that the smallest static discharge, which is noticeable by humans, is 3,000 Volts. A noticeable, significant discharge may be as high as 30,000 Volts.

WARNING **WORKING LIVE - While wiring the unit when powered is possible and allowed for in the design, this practice is discouraged. Accidental contact of leads with electronic components can cause damage.**

5.1 Mounting

The QTS-13001 Sensor/Transmitter should be mounted where the oxygen concentration is of concern. Air circulation should also be taken into account.

Where possible, the sensor/transmitter should be mounted where it is accessible for the purposes of routine re-calibration and periodic sensor replacement. Sufficient room should be left to allow the enclosure cover to be removed. On units with industrial explosion-proof enclosures sufficient room should be left to allow the connection of the calibration adapter to the sensor assembly. For sensor element replacement there will need to be enough room to reach into the sensor assembly.

CAUTION

The sensor assemblies on the industrial explosion-proof enclosures are designed for integral mounting only. Remote mounting of the sensor assembly from the transmitter may be possible, but may require special wiring considerations. If you must remote mount the sensor from the transmitter please consult the factory for recommendations.

NOTE:

Avoid mounting the electronics near high voltage switchgear and other sources of radio frequency and/or electromagnetic interference. While RFI/EMI protection is built-in to the electronics, excessive levels of interference may cause instability in the output signal.

There are two mounting holes in the back of the ABS plastic enclosures for surface mounting. These holes will line up with standard electrical junction boxes. There are two tabbed mounting holes on the exterior of the industrial explosion-proof enclosure for surface mounting. See the appropriate installation drawing for dimensional details.

WARNING

When mounted where the unit will be subjected to rain or other water environments, all conduit connections must be properly sealed with duct seal or equivalent material. Failure to do this could result in water inside the enclosure which will cause a terminal failure of the electronics.

5.2 Wiring

The QTS-13001 Sensor/Transmitter is a low power consumption transmitter requiring only two wires for power and signal. Terminal block connections are provided for wiring. See the appropriate installation drawing for wiring terminal connection details. The transmitter electronics will work over a power range of 12 to 36 VDC. The resistance of the load that the 4 to 20 mA DC output can be driven into is relative to the power available at the transmitter. When calculating power supply requirements all loads on the transmitter need to be totalled, including wiring and any accessory devices.

Figure 4 shown below gives the maximum total loop resistance that can be used with the transmitter against the power supply voltage. The shaded area of the graph represents the allowable resistance.

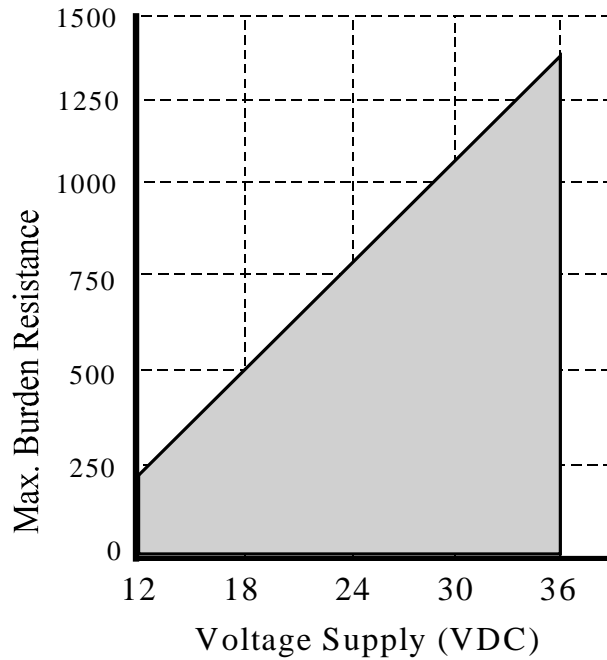


Figure 4 - Maximum Loop Resistance

2-Wire Connection: 24 VDC and Signal (4-20 mA)

Wire Gauge: 14 - 24 AWG

Maximum Burden Resistance:

750 Ohms = Monitor + Wiring (see Figure 4).

CAUTION

GROUNDING - The industrial explosion-proof metal enclosure must be connected to a safety ground, either locally or back at the monitor, in order to provide immunity to Electromagnetic Interference.

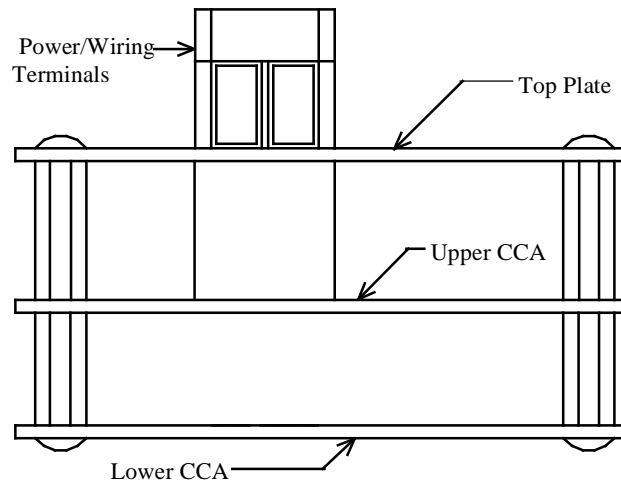


Figure 5 - Electronics Assembly

6. NEW SENSOR INSTALLATION

New sensor cells should be left installed at least 24 hours before calibration.

6.1 Industrial

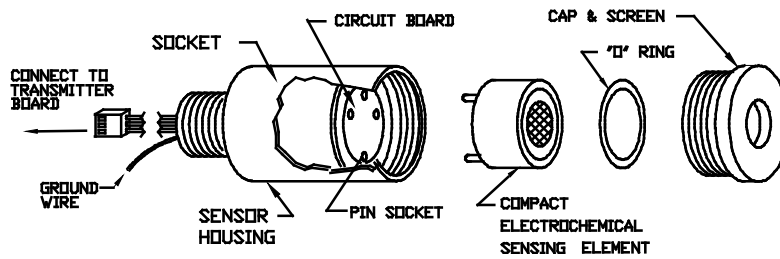


Figure 6 - Cell Installation: Explosion Proof

6.2 Commercial

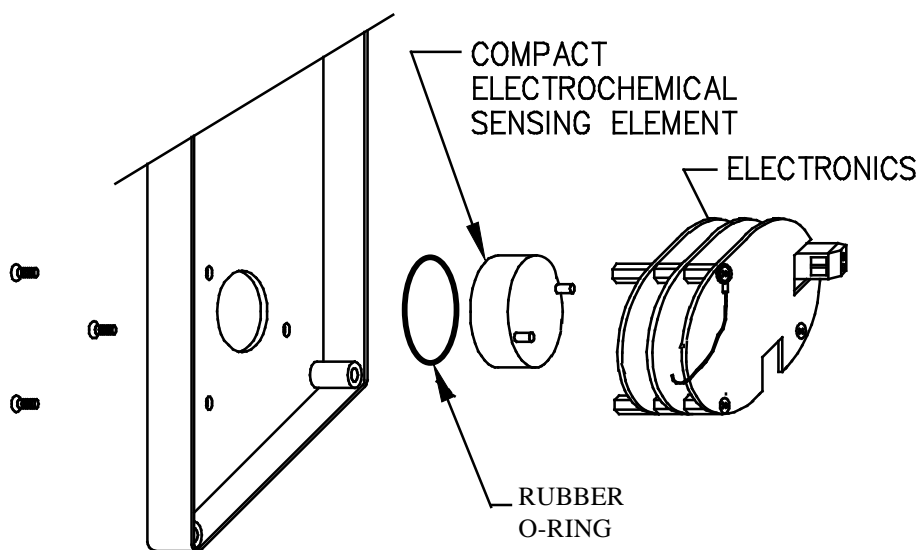


Figure 7 - Cell Installation: Commercial

7. CALIBRATION AND TEST

Recommended calibration or verification is every 90 days; however, the user should bear in mind the actual installation environment and the possibilities for failure due to water or corrosive atmospheres and the seriousness of a failure to alarm or lack of precision in that location and adjust his calibration periods accordingly.

7.1 Equipment

Digital Multimeter accurate to 0.01 mA

Small adjustment **screwdriver**

Span Gas - Oxygen with a balance of Nitrogen. The concentration of Oxygen should be as close to the span concentration (the concentration corresponding to 20 mA) as possible.

Zero Gas - 100% Nitrogen. (An alternative for zeroing the transmitter is to disconnect the sensor)

Flow Regulator - should regulate the gas flow in the range 200 - 1000 ml/min.

Calibration Adapter

7.2 Procedure

7.2.1 Current Measurement

Configure the Multimeter for DC Milliamp measurement.

Two small jacks on the output CCA, accessible through holes in the cover plate, accept leads from most handheld Multimeters. When the Multimeter is configured for milliAmp current measurement, then the 4 - 20 mA signal will pass through the meter as soon as it is connected.

7.2.2 Adjustment

Potentiometer adjustment for zero and span are accessible through a slot on the cover plate.

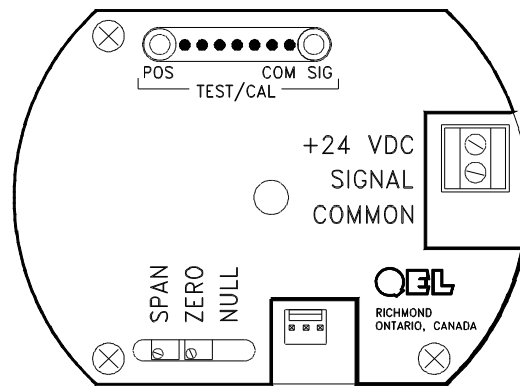


Figure 8 - Calibration Adjustments

7.2.3 Calibration

First apply Zero Gas (or disconnect sensor) and adjust the Zero Potentiometer until the signal is 4.00 mA DC, ± 0.05 mA

Next apply the Span gas and adjust the Span potentiometer until the meter reads the appropriate current $\pm 1.5\%$.

7.2.4 Calculation of Intermediate Readings

For calibration and readings between Zero (4.00 mA) and Span (20.00) mA, the following calculations are used.

$$\text{Signal} = 4.00 + \frac{16 \times \text{Concentration}}{\text{Span}}$$

$$\text{Concentration} = \frac{(\text{Signal} - 4.00 \text{ mA}) \times \text{Span}}{16 \text{ mA}}$$

8. FIELD TROUBLE SHOOTING

8.1 Sensor Life

The response to gas of electrochemical sensors will reduce with time. The rate of reduction is dependent upon such factors as ambient temperature, humidity, and exposure to gas. In order to compensate for this, the gain of the transmitter can be increased when the unit is calibrated in the field by adjusting the gain (span) potentiometer. A lifetime of two years is expected under normal operating conditions for the oxygen sensor.

8.2 Transmitter Electronics

WARNING **STATIC ELECTRICITY** - Installation, wiring, configuration, or other activity may require handling or disassembly of the transmitter circuit card assemblies (CCA). Handling of a CCA without proper precautions can expose the electronic components to the possible damage from static electricity discharge.

Try to ensure you are grounded when handling a CCA. If continuous grounding is not practical, touch some metal item, which is known to be grounded. Avoid walking around after this as you can regenerate a static charge. Note that the smallest static discharge, which is noticeable by humans, is 3,000 Volts. A noticeable, significant discharge may be as high as 30,000 Volts

The two CCAs are the lowest level of field replaceable assembly. These assemblies must be replaced with the power removed from the transmitter. See Figure 9 for an exploded view of the transmitter CCAs and associated hardware, and for details on the disassembly and reassembly procedures.

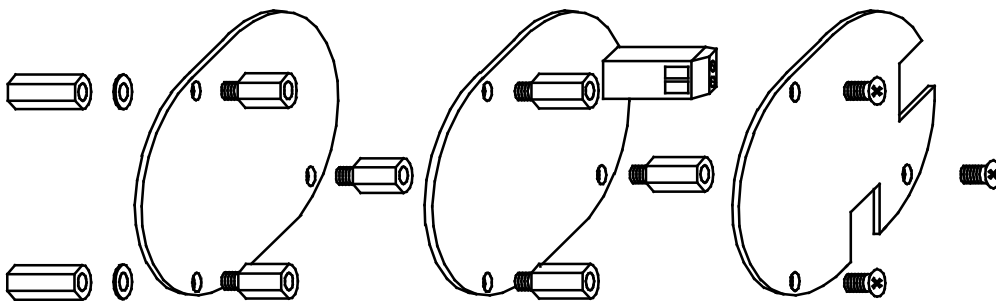


Figure 9 - Circuit Card Assembly

8.3 Installation and Applications Problems

Most problems encountered with this equipment is either installation or application related. Some common problems, their symptoms, results, and corrective action are listed below.

8.3.1 Supply and Signal Reversed

Symptom: Zero or excessively high output.

If the supply wire and the signal wire are reversed, then the Fuse may blow (0.5 Amp Pico-fuse, available at most controls suppliers or QEL Pt No 6700-0018-0). The only path for current to flow is through the signal line. Therefore the most likely occurrence will be that the Burden Resistance (monitor input resistance plus wiring resistance) will limit the current well below the fuse limit. Approximate readings are given below

24 VDC	250 ohms:	100 mA
	100 ohms:	240 mA

Corrective Action:

- 1) Measure DC Voltage at the terminals. Ensure sufficient supply voltage is present and the +24 Volt wire is connected to the proper terminal. Correct as necessary.
- 2) Using the test jacks, check to see if the output of the transmitter is correct.
- 3) If no output, or high output, turn off power to transmitter (by disconnecting wires, if necessary) and check the fuse. Replace as necessary.
- 4) If problem still persists there may be associated component damage. Replace upper CCA or contact factory.

8.3.2 Overvoltage Supply

Symptom: Constant High output.

The input is limited by a Zener diode and fuse. Overvoltage may blow the onboard Pico-fuse. The only path for current to flow is through the signal line. Therefore the most likely occurrence will be that the Burden Resistance (monitor input resistance plus wiring resistance plus intrinsic safety barrier if present) will limit the current well below the fuse limit (see 9.3.1 above). The device will turn on, but the readings will be high in the proportion of excess voltage over the Zener value of 39 VDC.

Corrective Action:

- 1) Measure DC Voltage at the terminals. Ensure supply voltage between 12 and 36 VDC is present. Correct as necessary.
- 2) Using the test jacks, check to see if the output of the transmitter is correct.
- 3) If no output, or high output, turn off power to transmitter (by disconnecting wires, if necessary) and check the fuse. Replace as necessary.
- 4) If problem still persists there may be associated component damage. Replace upper CCA or contact factory.

8.3.3 Excessive Burden Resistance or Undervoltage Supply

Symptom: Constant Low output or possibly no output.

If the Burden resistance (monitor input resistance plus wiring resistance plus intrinsic safety barrier if present) is greater than that specified for the particular supply voltage (see Figure 4 on page 6) then this will limit the maximum signal output capability to less than full range. If the burden resistance is sufficiently large, then the device may not turn on correctly.

Corrective Action:

- 1) Measure DC Voltage at the terminals. Ensure supply voltage between 12 and 36 VDC is present. Correct as necessary.
- 2) Disconnect power to the transmitter power/output current loop.
- 3) Disconnect wiring at the transmitter and measure resistance across the two wires.
- 4) If resistance is too high, either reduce the burden or increase the supply voltage.
- 5) Reconnect wiring and apply power to the transmitter.
- 6) Using the test jacks, check to see if the output of the transmitter is correct.
- 7) If problem still persists it may be caused by a cell that needs replacement. There may also be unrelated damage to the CCA. Consult factory.

8.3.4 RFI/EMI Effects

Symptom: Unstable, wandering output; spikes, drift, possibly false alarms.

The QTS-13001 Sensor/Transmitter has been designed to provide protection against Radio Frequency Interference (RFI) and Electro-Magnetic Interference (EMI). The unit has been tested against radiated signals of 4 watts at high frequencies and a distance of 1 meter. This protection can be overwhelmed by interference of higher strengths and/or closer proximity. The transmitter should not be mounted near high voltage, multi-phase switchgear or motors. It should not be mounted near constant sources of radio frequency.

The output signal from the sensor to the transmitter is DC microamps. It is imperative that the industrial explosion-proof sensor assemblies be properly grounded through the enclosure.

Corrective Action:

RFI/EMI problems are very difficult to troubleshoot. If you suspect a problem of this nature, inspect all the equipment mounted near the transmitter. Switch off each suspect item in turn to see if it is having an effect on the transmitter output. If you are able to identify a source of interference, relocate the transmitter at a distance from this source so that it is no longer affected.