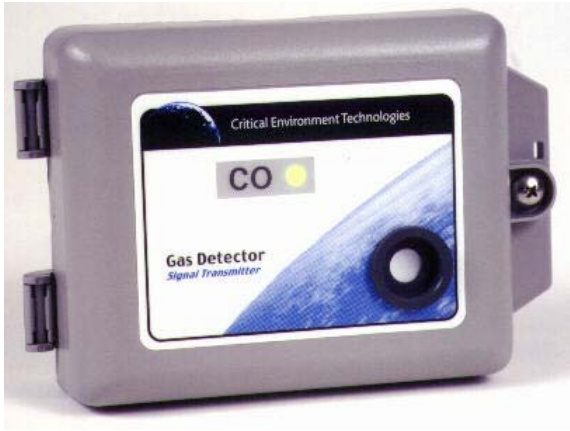
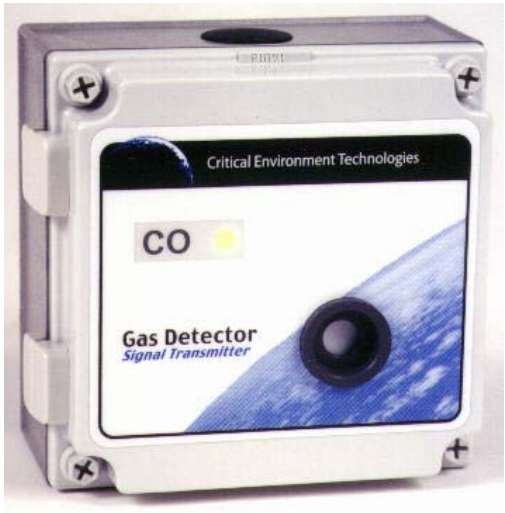
Critical Environment Technologies

AST SERIES ANALOG TRANSMITTERS with ELECTROCHEMICAL SENSORS



General Purpose PVC

Water / Dust Tight, Corrosion Resistant Polycarbonate



INSTALLATION & INSTRUCTION MANUAL

FOR REV-E TRANSMITTERS WITH LCD DIGITAL DISPLAY OCT 16, 2002

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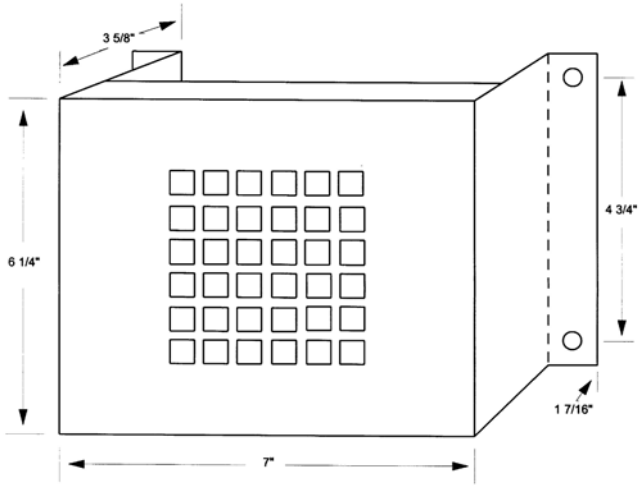
8.0 ACCESSORIES , CONT'D.....



METAL PROTECTIVE GUARD DRAWING

9.0 WARRANTY

All AST electrochemical series analog transmitters are warranted against defects in materials and workmanship for a period of two years from the date of shipment from Critical Environment Technologies Canada Inc., excluding the electrochemical sensor elements, which are warranted for one year. The one exception to this is the HVAC electrochemical CO sensor element which is also warranted for two years from the date of shipment. Throughout the warranty period, we will repair or replace any component that proves to be defective, in our opinion, as a result of "normal use".

Critical Environment Technologies Canada Inc. is not liable for damage caused by transmitters that have not been regularly maintained and calibrated as per our written instructions, or auxiliary interfaced equipment, or consequential damage. All returned goods must be shipped to Critical Environment Technologies Canada Inc. by prepaid freight. If, in our opinion, the repaired or replaced component proves to be defective, we will reimburse the customer for shipping costs based on the most economical freight carrier rates at the time.

Due to on-going product research and development, Critical Environment Technologies Canada Inc. reserves the right to change specifications without notice. The information contained herein is based on data considered accurate. However, no warranty is expressed or implied regarding the accuracy of this data.

TABLE OF CONTENTS

SECTION	DESCRIPTION	PAGE
1.0	General Description	4
1.1	Transmitter Specifications	4 - 5
1.2	Sensor Specifications	5 - 7
2.0	General Purpose PVC Enclosure	8
2.1	Analog Output Circuit Board for 4-20 mA Signal	8
2.2	Water/Dust Tight Polycarbonate Enclosure	9
2.3	Analog Output Circuit Board for 0-10 VDC Signal	9
3.0	Installation Instructions	10 - 11
4.0	Wiring Hook-Up Instructions	11
4.1	Wiring Hook-Up Drawing	11
5.0	Details of Operation	12
6.0	Maintenance Instructions	13
6.1	Calibration Procedure	13 - 14
6.2	Local Digital Display Option	14
6.3	Calibration Set-Up Drawing	15
6.4	Potentiometer & test point locations	15
6.5	Relay Set Point Adjustment	16
6.6	Sensor Replacement Instructions	16
7.0	Parts Listing	16 - 17
8.0	Accessories	17 - 18
9.0	Warranty	18

Note-1: *Due to ongoing development and testing, the manufacturer reserves the right to change specifications and instructions without prior notice. Information contained in this manual is considered accurate based on testing data available at the time of publication. No warranty is expressed or implied regarding the accuracy of this data. The manufacturer does not accept liability for damages resulting from the use of this product. This product is only to be used for purposes stated herein.*

Note-2: *Read and understand this operation manual prior to using this gas detector. This equipment should be inspected and maintained by a qualified and trained technician. Regular calibration maintenance (6 month frequency) is required to maintain best accuracy and reliability of the sensor / transmitter and to provide indication of an expired electrochemical sensor element.*

1.0 GENERAL DESCRIPTION

The AST electrochemical series are remote mount analog transmitting gas detectors with integral, electrochemical toxic gas or Oxygen sensors and either general purpose pvc or water / dust tight, corrosion resistant polycarbonate enclosures with hinged, secured doors and Lexan labels. This series of transmitters has been designed for commercial and light industrial applications such as underground vehicle parking, pools, arenas, maintenance shops, water and sewage treatment plants, etc. **For use only in environments that are not classified as hazardous (explosive).**

The AST electrochemical series transmitters provide continuous monitoring with continuous analog signal output, representing the quantitative presence of gases / vapours. The industry standard 4-20 mA or 0-10 VDC signal is linear and can be "fed" directly into a building management system, PLC, or any generic controller that will accept an analog signal. The controlling device can then utilize the continuous analog signal to provide a measured control output for exhaust fans, alarms, etc.

1.1 TRANSMITTER SPECIFICATIONS

Size:
General Purpose: 4.50"H x 6.13"W x 2.56" TH (114 mm x 156 mm x 65 mm).
Water/Dust Tight: 4.92"H x 4.92"W x 2.56" TH (125 mm x 125 mm x 65 mm).

Weight:
9 ounces (148 grams) both enclosures

Construction:

General Purpose: Very rugged, heavy wall pvc with hinged, secured door and Lexan door label with viewing window for optional local LED digital display.

Water/Dust Tight: Very rugged, Polycarbonate with 3/32" thick walls and hinged, secured door. Lexan door label with viewing window for optional local LED digital display.

Power Requirements:

16 to 24 VAC or 20 to 30 VDC (unregulated or regulated)
Approximate current draw: 30 to 50 mA (maximum)

Output Signal:
Linear, analog 4 - 20 mA or 0—10 VDC

Operating Temperature:
See individual sensor specifications on following pages

7.0 PARTS LISTING, CONT'D…..

DESCRIPTION	PART NUMBER
Electrochemical sensor elements:	
Carbon Monoxide - HVAC	SEC-7000-MCO
Carbon Monoxide - Industrial	SEC-7000-CO
Chlorine	SEC-7000-CL2
Ammonia	SEC-7000-NH3
Nitrogen Dioxide	SEC-7000-NO2
Nitric Oxide	SEC-7000-NO
Hydrogen Sulphide	SEC-7000-H2S
Sulphur Dioxide	SEC-7000-SO2
Ethylene Oxide	SEC-7000-ETO

8.0 ACCESSORIES

Calibration Gases:

Zero Emissions Air (17 liter disposable cylinder) (also available in 105 liter cylinders)	CG1-ZERO

NOTE: For all calibration span gases, contact Critical Environment Technologies Canada Inc. for desired type of gas, size of cylinder and appropriate cylinder regulator. Reactive gases such as Chlorine, Ammonia and others have a considerably shorter life span in cylinders than non-reactive gases. The type of gas usually determines the type and sizes of cylinders available.

For ease of operation in the field, all gases can be flowed at 0.5 LPM. If regulators with other flow rates are used, a slight difference in response may be noticed. Store all cylinders of calibration gas with regulators removed and at temperatures above freezing.

Calibration kits, gases and metal protective guards

6.4 RELAY SET POINT ADJUSTMENT

If the optional on-board, dry contact relay has been selected, the set point can be adjusted in the field and as a "rule of thumb" any set point up to about 50% of transmitter scale can be set without the use of span gas.

Attach meter leads to the signal test points "TP-1" and "TP-2". Next, using the formula on page 13, calculate the expected signal for the desired set point, substituting the desired set point gas concentration for "CALIBRATION GAS PPM" in the formula.

Next, adjust the null potentiometer to achieve the desired signal, as calculated above, then adjust the relay set potentiometer until the relay coil LED illuminates and the relay "clicks" indicating it has energized.

Next, move the meter leads to the null test points "TP-6" and "TP-7" and adjust the null potentiometer to achieve a reading of "0.000" VDC. Ensure the sensor is in a clean environment, free of background gas before adjusting the null.

If you are unable to attain the desired set point signal by adjusting the null potentiometer, flow a little bit of span gas to help elevate the signal. After flowing gas, allow the sensor at least 15 minutes to recover before adjusting the null to "0.000" VDC.

6.5 SENSOR REPLACEMENT INSTRUCTIONS

If the electrochemical sensor element of the transmitter must be replaced, please follow these instructions. Very carefully remove the four screws and washers securing the circuit board to the enclosure door. Carefully lift out the transmitter circuit board, handling only the edges of the board. Grasp the electrochemical sensor by it's edges and gently tug on it to unplug it. **Remove shorting bar / spring from new sensor.** Plug in new replacement sensor, being careful to maintain pin configuration and ensure the o'ring is still in place. Re-attach the transmitter circuit board and replace the four securing screws and washers securely (do not over tighten nuts).

NOTE: Whenever replacing any sensor element, a complete calibration procedure is required (see section 6.1 on pages 13 & 14).

7.0 PARTS LISTING

DESCRIPTION	PART NUMBER
PVC transmitter enclosure (general purpose)	AST-8700-EN1
Polycarbonate transmitter enclosure (water tight)	AST-8700-EN4
Transmitter circuit board	AST-7000-TCB
Sensor shroud (dark gray)	AST-8700-USS
Transmitter door securing nuts (polycarbonate)	Consult Factory
Calibration adapter plug (accessory)	AST-7000-CAP
Transmitter protective guard (accessory)	SCS-8000-RSG

1.1 TRANSMITTER SPECIFICATIONS, CONT'D.....

Humidity:
10 to 95% (non-condensing)

Current Loop Resistance:
Maximum 1000 Ohms

Options:
a) Local display, LCD (non-backlit), 3 1/2 digits (3/8" digits)
b) Local dry contact relay 2 amps @ 28 VDC S.P.D.T.
c) Water tight enclosure
d) Metal enclosure (16 gauge, powder painted)

1.2 SENSOR SPECIFICATIONS

Carbon Monoxide: *(Commercial HVAC) Model: AST-MCO*
* Range: 0 - 200 ppm (HVAC CO) (other ranges available)
* Response Time: <30 seconds to 90% of signal response
* Operating Temp. Range: -20 deg. C. to +50 deg. C.
* Long Term Drift: <2% signal loss/ year typically
* Repeatability: 2% of signal
* Life Span: 5 years "plus" in air (under normal conditions)

Carbon Monoxide: *(Industrial) Model: AST-ECO*
* Range: 0 - 250 ppm (other ranges available)
* Response Time: <30 seconds to 90% of signal response
* Operating Temp. Range: -20 deg. C. to +50 deg. C.
* Long Term Drift: <2% signal / month
* Repeatability: 2% of signal
* Life Span: 2 to 3 years in air (under normal conditions)

Nitrogen Dioxide: *Model: AST-END*
* Range: 0 - 5.0 ppm (other ranges available)
* Response Time: <35 seconds to 90% of signal response
* Operating Temp. Range: -20 deg. C. to +40 deg. C.
* Long Term Drift: <2% signal / month
* Repeatability: 2% of signal
* Life Span: 2 to 3 years in air (under normal conditions)

Chlorine: *Model: AST-ECL-W*
* Range: 0 - 5.0 ppm (other ranges available)
* Response Time: <30 seconds to 90% of signal response
* Operating Temp. Range: -20 deg. C. to +40 deg. C.
* Long Term Drift: <10% signal loss / month
* Repeatability: 2% of signal
* Life Span: 2 years in air (under normal conditions)

1.2 SENSOR SPECIFICATIONS, CONT'D.....

Ammonia: *Model: AST-EAE*
* Range: 0 - 1000 ppm (other ranges available)
* Response Time: <60 seconds to 90% of signal response
* Operating Temp. Range: -20 deg. C. to +40 deg. C.
* Long Term Drift: <5% signal loss / 6 months
* Repeatability: better than 10% of signal
* Life Span: 2 years 'plus in air (under normal conditions)

Hydrogen Sulphide: *AST-EHS-W*
* Range: 0 - 50 ppm (other ranges available)
* Response Time: <35 seconds to 90% of signal response
* Operating Temp. Range: -40 deg. C. to +50 deg. C.
* Long Term Drift: <5% signal loss / year
* Repeatability: 1% of signal
* Life Span: 2 to 3 years in air (under normal conditions)

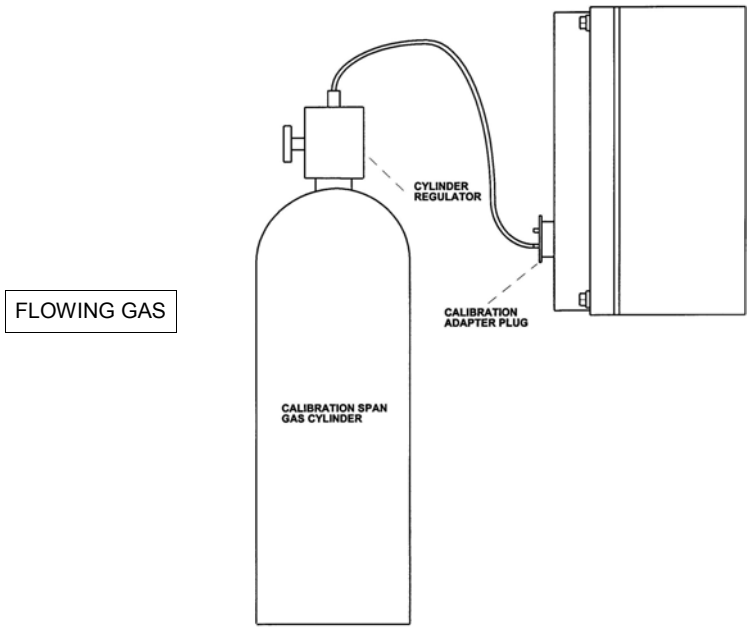
Sulphur Dioxide: *Model: AST-ESO-W*
* Range: 0 - 10 ppm (other ranges available)
* Response Time: <30 seconds to 90% of signal response
* Operating Temp. Range: -20 deg. C. to +50 deg. C.
* Long Term Drift: <2% signal loss/ month
* Repeatability: 2% of signal
* Life Span: 2 to 3 years in air (under normal conditions)

Nitric Oxide: *Model: AST-ENO*
* Range: 0 - 100 ppm (other ranges available)
* Response Time: <10 seconds to 90% of signal response
* Operating Temp. Range: -20 deg. C. to +50 deg. C.
* Long Term Drift: <2% signal / month
* Repeatability: 2% of signal
* Life Span: 3 years in air (under normal conditions)

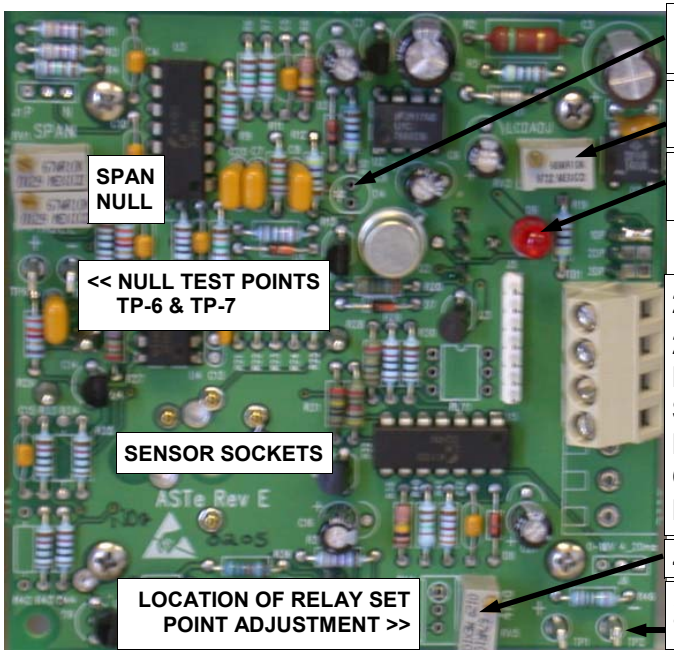
Hydrogen: *Model: AST-EH2*
* Range: 0 - 1000 ppm (other ranges available)
* Response Time: <30 seconds to 90% of signal response
* Operating Temp. Range: -20 deg. C. to +50 deg. C.
* Long Term Drift: <2% signal loss / month
* Repeatability: 2% of signal
* Life Span: 2 years in air (under normal conditions)

Ethylene Oxide: *Model: AST-EET-W*
* Range: 0 - 20 ppm (other ranges available)
* Response Time: <90 seconds to 90% of signal response
* Operating Temp. Range: -20 deg. C. to +50 deg. C.
* Long Term Drift: <2% signal loss / month
* Repeatability: 1% of signal
* Life Span: 2 years in air (under normal conditions)

6.3 CALIBRATION SET-UP DRAWING



POTENTIOMETER & TEST POINT LOCATIONS



6.1 CALIBRATION PROCEDURE, CONT'D.....

Step-Two: With zero emissions air still flowing, move meter leads to test points "TP-1+" and "TP-2-". These are the signal output test leads. Adjust the 4 mA potentiometer to achieve "0.400" VDC.

Step-Three: Using one of the formulas from the preceding page, calculate what signal is to be expected from the concentration of calibration gas being utilized. Attach cylinder of calibration (span) gas and turn regulator fully on. Flow calibration gas for approximately two to three minutes.

Note-1: For Oxygen sensors, utilize a cylinder of Oxygen or zero air with a known Oxygen content or simply allow the sensor to stabilize in ambient outdoor air. If utilizing outdoor air as a span source, avoid exhaling in the direction of the sensor as the CO2 in exhaled breath will displace Oxygen.

Observe meter reading. Note: 4-20 mA signal at test points "TP1" and "TP2" is across a 100 ohm resistor which coverts it to a voltage signal (4 - 20 mA = 0.400 to 2.00 VDC). The expected mA reading calculated from the formula on the previous page should be divided by ten, to arrive at the correct, expected voltage signal. Eg: an expected reading of "7.2 mA" will be displayed as "0.72 VDC". If the reading displayed after approximately three minutes of gas flow is not what you calculated, adjust the "SPAN" pot. to achieved the desired reading.

Allow sensor approximately 5 to 10 minutes to recover, then recheck the null output at test points "TP-6+" and "TP-7-". Readjust to "0.000" VDC if necessary. Do not make this adjustment until the sensor has stabilized for at least 10 minutes. The null and span potentiometers do not interact with each other, so an additional span adjustment should not be required.

Shut off gas flow and **remove regulator from cylinder for storage**. Calibration procedure is finished.

IMPORTANT NOTES:

1. If the sensor / transmitter being calibrated is fitted with a local digital display, make all adjustments utilizing the display, after viewing multi-meter. If sensor / transmitters are connected to a control panel with a digital display, correct all transmitter signals to the system controller digital display.

See calibration connection drawing on following page.

6.2 LOCAL DIGITAL DISPLAY OPTION

1. Upon power up, the LCD digital display will automatically zero as the transmitter stabilizes in clean air. Span adjustment must be performed while flowing calibration span gas. When sensor has stabilized, adjust the LCD display span potentiometer until the display reads the concentration of the gas you are flowing.

1.2 SENSOR SPECIFICATIONS, CONT'D.....

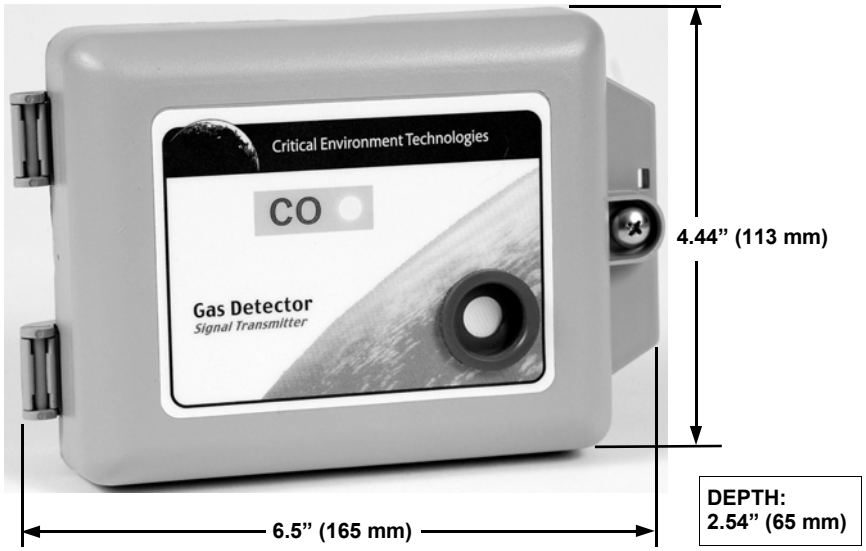
Ozone: *Model: AST-EO3-W*

* Range: 0-1.00 ppm
* Response time: t50 = <30 seconds, t90 = <60 seconds
* Operating Temp. Range: -10 deg. C to +40 deg. C
* Long Term Drift: <5% (per six months)
* Repeatability: 2% of signal
* Life Span: 18 months in clean air

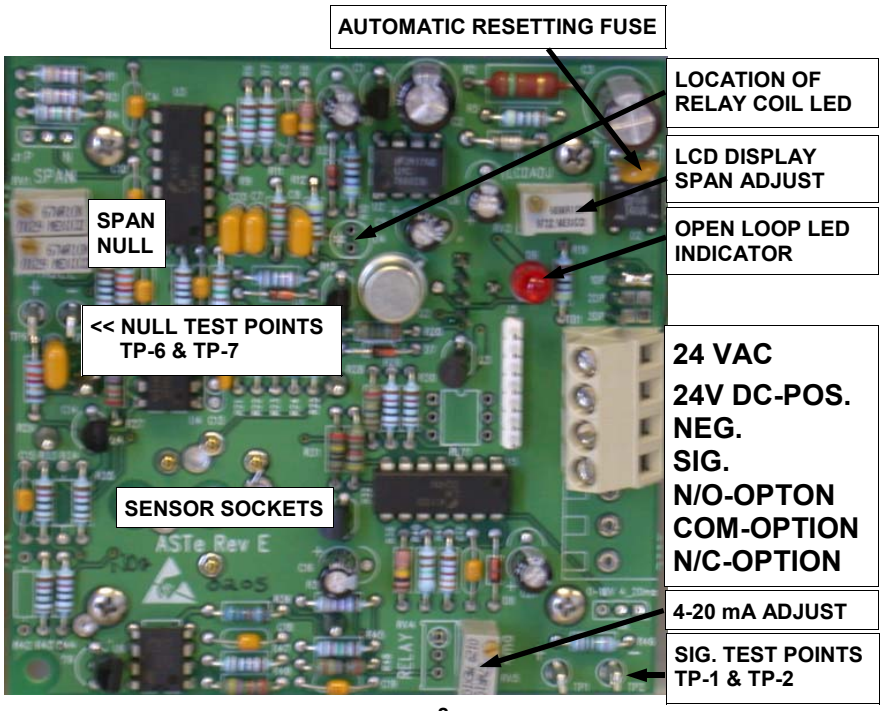
Oxygen: *Model: AST-OO2*

* Range: 0 - 25.0% Volume
* Response Time: <15 seconds to 90% of signal response
* Operating Temp. Range: -20 deg. C. to +50 deg. C.
* Long Term Drift: <1% signal loss / month
* Repeatability: 0.2% Vol. or better
* Life Span: 2 years in air (under normal conditions)

2.0 GENERAL PURPOSE PVC ENCLOSURE



2.1 ANALOG OUTPUT CIRCUIT BOARD FOR 4-20 mA SIGNAL



6.0 MAINTENANCE INSTRUCTIONS

All transmitters should be inspected on-site after installation to ensure that they have been installed and connected properly. All transmitters have been factory calibrated twice, prior to shipping, but on-site gas tests serve to confirm accuracy of zero (null) and span settings, in the event that they may have been tampered with. Regular maintenance is minimal and consists of two to four times per year on-site gas calibration (application dependent). A digital multi-meter will confirm the transmitter output signal response and will help to indicate when a sensor element is ready to be replaced.

6.1 CALIBRATION PROCEDURE

Important: Ensure that the transmitter has been powered up for at least 2 -4 hours prior to calibration to ensure that the sensor has completely stabilized.

Equipment Required:
a) Precision digital multi-meter capable of displaying a VDC scale of "0.000".
b) Small blade screwdriver (to adjust potentiometer)
c) Calibration kit with the proper cylinders of calibration gas

Note: Transmitter must be connected to system signal loop to see voltage readings at test points.

Calibration Equations:

$$\frac{\text{CALIBRATION GAS PPM}}{\text{SENSOR SPAN RANGE PPM}} \times 16 + 4 = \text{mA SIGNAL EXPECTED}$$

$$\frac{\text{CALIBRATION GAS PPM}}{\text{SENSOR SPAN RANGE PPM}} \times 10 = \text{VDC SIGNAL EXPECTED}$$

Procedure:

Step-One: Connect leads from digital multi-meter (observe polarity) to test points "TP6+" and "TP7-". Set meter to VDC scale ".000". Attach cylinder of "zero emissions air" to regulator (flow rate 0.2 to 0.5 LPM). Moisten o"ring of adapter plug and gently push into sensor shroud on enclosure door. Turn regulator fully on. Flow zero air for approximately two minutes to allow sensor to stabilize. Observe meter reading. Signal displayed should read approximately ".000". If it does not, then carefully adjust "NULL" pot. to obtain this reading. Reference photo on page 13.

Alternative for Step-1: If zero air is not available, install both zeroing plug caps for calibration adapter and allow sensor to stabilize for approximately three to five minutes before adjusting the "NULL" pot. Be sure to remove both zeroing plug caps before flowing gas.

Note-1: For Oxygen sensors, substitute 100% Nitrogen for zero air. Oxygen sensors must be null adjusted with Nitrogen gas.

Note-2: If transmitter is fitted with local digital display, it will automatically zero along with the transmitter circuit.

5.0 DETAILS OF OPERATION

When power has been applied to the transmitter, the electrochemical sensor output signal to circuit will rise, possibly indicating gas alarm conditions on the building management system or whatever controller the output signal is connected to. This condition may last from several minutes to several hours or longer while the sensor stabilizes in the new environment.

Once the sensor stabilizes, the transmitter output signal will automatically settle down to normal operating state (non-gas alarm condition = 4.00 mA or 0 vdc), if no background gas is present. The signal will represent the concentration of gas present in the environment, if any. A green LED, visible through the door label window, will illuminate continuously, to indicate that power has been properly connected. The transmitter circuit is protected by an "automatic resetting" thermal fuse . In the event that the green LED does not illuminate, check to ensure that the wiring is properly connected and measure the supply voltage input to ensure there is indeed power applied to the transmitter circuit. **If an improper connection has caused the fuse to blow, it will reset itself. To achieve this, disconnect the supply voltage wires for approximately 3 minutes (allowing the fuse time to cool down and reset), then reconnect supply voltage wires correctly.**

A red LED located on the middle bottom area of the circuit board, acts as a signal loop "open loop" indicator. If it is illuminated, the 4-20 mA signal loop has not been connected properly. If a proper connection has been made, the red LED will not illuminate.

Note: The open loop indicator works only with current output transmitter, not voltage output transmitters.

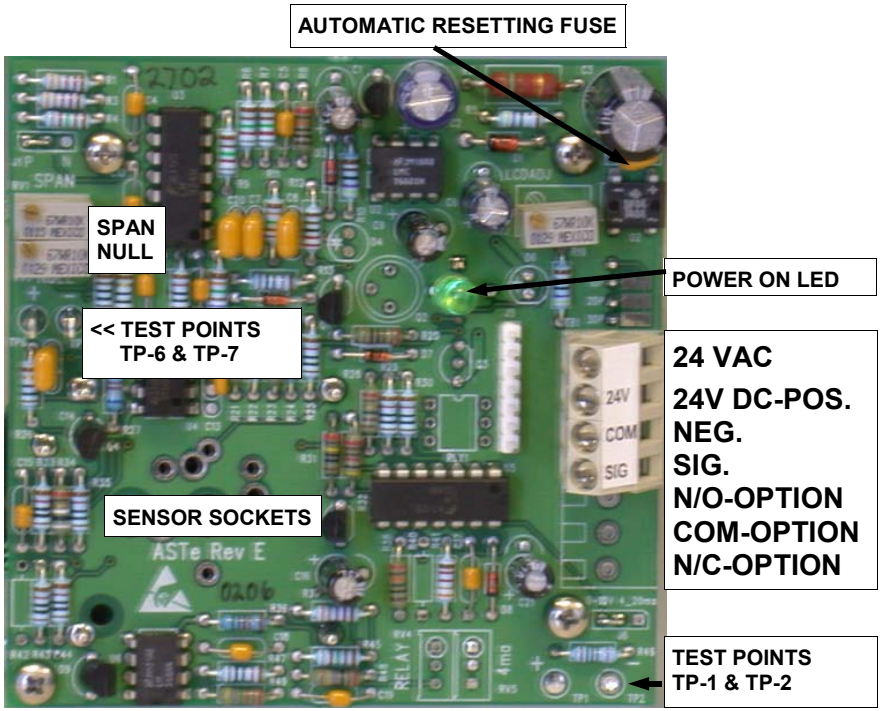
A powered up transmitter in normal operating state (non gas environment) will have a linear analog signal output of approximately "4.00 mA" or "0" VDC, which = "0" ppm gas. Once gas has been detected, the transmitter signal will rise through the sensor detection range of 4-20 mA or 0-10 VDC. *Eg. electrochemical CO sensor (standard range: 0 - 200 ppm):* a concentration of 25 ppm = 6.0 mA or 1.25 VDC. All signal output readings for electrochemical sensors are accurate to the specifications listed on preceding pages.

Note: Some gases, vapours and other compounds may interfere with the sensors causing gas alarm conditions because of cross-sensitivity. This potential problem should be minimal (application dependent), because of the specificity of the sensors. It is highly recommended that sensor / transmitters installed in new construction areas be sealed with plastic bags immediately after installation to prevent contamination or damage from construction materials and liquids.

Direct exposure to strong solvent vapours may contribute to deterioration of the electrochemical sensor element.

2.2 WATER / DUST TIGHT ENCLOSURE PHOTO

2.3 ANALOG OUTPUT CIRCUIT BOARD FOR 0-10 VDC SIGNAL



3.0 INSTALLATION INSTRUCTIONS

General Purpose: Four 3/16" diameter mounting holes are located on the inside of the enclosure.

Water/Dust Tight Four 3/16" diameter mounting holes are located on the inside edge of the transmitter enclosure. They are accessed through the holes for the lid securing screws. (See section 2.0 drawing). One conduit entry port can be found on the top edge of the transmitter enclosure. ***If this enclosure is to be utilized in an atmosphere that truly requires a water tight enclosure, be sure to use the appropriate liquid tight conduit connector.***

Sensor Mounting Height and Locations

Carbon Monoxide: CO is slightly lighter than air and so the transmitter should be installed approximately 4' to 6' from the floor (Breathing Zone).

Nitrogen Dioxide: NO2 is heavier than air, but because many applications are for parking garages or compliance monitoring, the transmitter should be installed approximately 4' to 6' from the floor (Breathing Zone).

Chlorine: Cl2 is heavier than air and so the transmitter should be installed approximately 6" from the floor.

Ammonia: NH3 is lighter than air and so the transmitter should be installed on or near the ceiling.

Hydrogen Sulphide: H2S is heavier than air and so the transmitter should be installed approximately 6" from the floor.

Sulphur Dioxide: SO2 is heavier than air and so the transmitter should be installed approximately 6" from the floor.

Nitric Oxide: NO is heavier than air and so the transmitter should be installed approximately 6" from the floor.

Hydrogen: H2 is much lighter than air and so the transmitter should be installed on or near the ceiling.

Ethylene Oxide: is heavier than air and so the transmitter should be installed approximately 6" from the floor (application dependent).

Ozone: O3 is heavier than air, however the transmitter should be installed approximately 3' to 6' from the floor (breathing zone).

Oxygen: O2 is approximately the same weight as air and so the transmitter should be installed 4' to 6' from the floor (Breathing Zone).

3.0 INSTALLATION INSTRUCTIONS, CONT'D.....

Attach appropriate conduit and connector to transmitter enclosure and connect wiring conductors to terminal block as indicated in drawing.

Note-1: For some compliance / safety applications, a mounting height of 4' to 6' from the floor may be better suited to the "breathing air" working environment of employees, for any gas.

Note-2: Never install sensors in the direct path of moving air, such as exhaust fans, make-up air fans, ducts (without duct aspirator attachment), etc. Sensors should be installed in areas where air movement is poor and gases may have a tendency to build and present danger to people.

4.0 WIRING HOOK-UP INSTRUCTIONS

For **VAC** powered installations, utilize 18 - 22 gauge, 4-conductor shielded cable. Connect the two VAC power wires to the "AC" input terminals (top two terminal strip locations). Connect the remaining two wires, designated negative and positive, to the "SIG " "-" and "+" input terminals (bottom two terminal strip locations). Be sure to observe polarity labeling when connecting these wires.

For **VDC** powered installations, utilize 18 - 22 gauge, 3-conductor shielded cable. Connect the positive and negative wires to "DC" "+" and "-" input terminals (middle two terminal strip locations). Connect the third wire to the "SIG." "+" input terminal (bottom terminal strip location). Be sure to observe polarity labeling when connecting these wires.

Note-1: For either VAC or VDC powered installations, be sure to observe minimum and maximum voltage operation limitations, as indicated in section 1.1 "Transmitter Specifications", under "Power Requirements" and section 4.0 "Wiring Hook-up Instructions". Note: Maximum current loop resistance = 1000 ohms.

Note-2: For connecting the 0-10 VDC output signal versions, it is best to use four wires. Two for VAC power to the transmitter and two for your voltage output signal. Wire runs must be kept quite short to avoid line loss and interference which will result in inaccurate signals.

4.1 WIRING HOOK-UP DRAWING