

**MODEL 4101 SERIES
ELECTROCHEMICAL
GAS SENSOR MODULE
4-20 mA**

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Model 4101 Series
Electrochemical Gas Sensor Module
4-20 mA

APPLICABILITY & EFFECTIVITY

This manual provides instructions for the following Sierra Monitor products:

<u>Model</u>	<u>Description</u>	<u>Range</u>
4101-04	Carbon Monoxide	0-500 ppm
4101-05	Hydrogen Sulfide	0-100 ppm
4101-06	Chlorine	0-10 ppm
4101-07	Hydrogen	0-1000 ppm
4101-10	Sulfur Dioxide	0-100 ppm
4101-12	Nitrogen Dioxide	0-20 ppm
4101-13	Carbon Monoxide (High Range)	0-1000 ppm
4101-16	Carbon Monoxide (H ₂ Immune)	0-2,000 ppm
4101-19	Nitric Oxide	0-20 ppm
4101-21	Hydrogen Chloride	0-20 ppm
4101-22	Hydrogen Cyanide	0-20 ppm
4101-27	Ethylene Oxide	0-20 ppm

The instructions are effective for the above models as follows:

<u>Model</u>	<u>Date</u>	<u>Serial Number</u>
4101-04	6/1/91	91-DD-6176
4101-05	8/23/91	91-EE-101
4101-06	12/1/91	91-FF-107
4101-07	10/1/91	91-GG-101
4101-10	4/1/92	92-PP-0391
4101-12	3/1/93	93-LL-412
4101-13	10/1/95	95-NN-150
4101-16	1/1/90	90-JJ-101
4101-19	2/1/95	95-II-211
4101-21	9/1/92	92-HH-2210
4101-22	11/1/92	92-KK-1410
4101-27	11/1/95	95-VV-101

Instruction Manual Part Number: T13001
Rev B2

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1.0 PRODUCT DESCRIPTION

1.1 Introduction

Model 4101 series gas sensor module is a 4-20 mA transmitter designed for use with industry standard control instruments.

This manual provides instructions for 4101 series gas monitors which utilize common packaging and transmitter electronics with different sensors for detection of various gases. The full model number of the gas monitor includes a suffix, 4101-XX, where "XX" is a number which identifies a gas type. (See "Applicability & Effectivity" list on first page)

1.2 Application

Model 4101 series gas monitors are intended for use in ambient monitoring applications. They are designed for fixed installation and for continuous operation.

Optional fittings and adapters can be supplied by Sierra Monitor to provide continuous sample delivery to the sensor module.

1.3 Configuration

The gas monitor is comprised of a NEMA-7 enclosure which contains the transmitter electronics and a gas sensor which is installed in one of the two 3/4" conduit hubs.

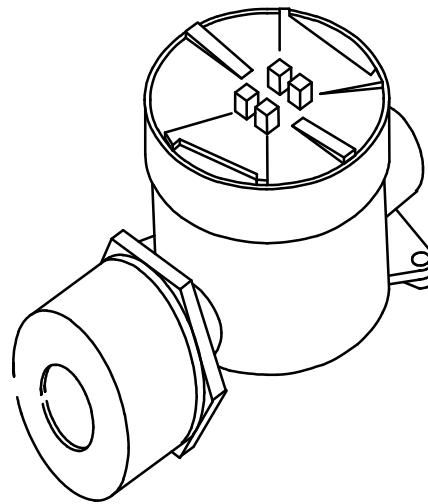
1. Electronics

When installed, the transmitter electronics will be connected to a power supply and control device via three wire cable.

The electronics provide a 4-20 mA current loop which is proportional to the full scale sensitivity of the sensor. Integral features include:

- **Power On delay to avoid nuisance alarms.**
- **Calibration delay feature.**
- **Volt meter readout proportional to gas concentration.**
- **Visual indicators for fault and calibration delay.**
- **Electrical fault indication (0 mA) to controller.**

The transmitter electronics assembly includes a printed circuit assembly and a cover plate which contains volt meter test points, indicator LED's and access to adjusting potentiometers.



FORM MNT-A-H.CDR REV B

Figure 1.1
Outline View - Gas Sensor Module

2. Sensor

The gas sensor is an electrochemical type using a capillary diffusion barrier. The electrochemical cell is enclosed in a threaded housing and is plugged into a signal conditioning card located in the threaded housing. This configuration allows for easy field replacement of the sensor cell.

For each gas type (different model number suffix the conditioning card and the sensor are unique.

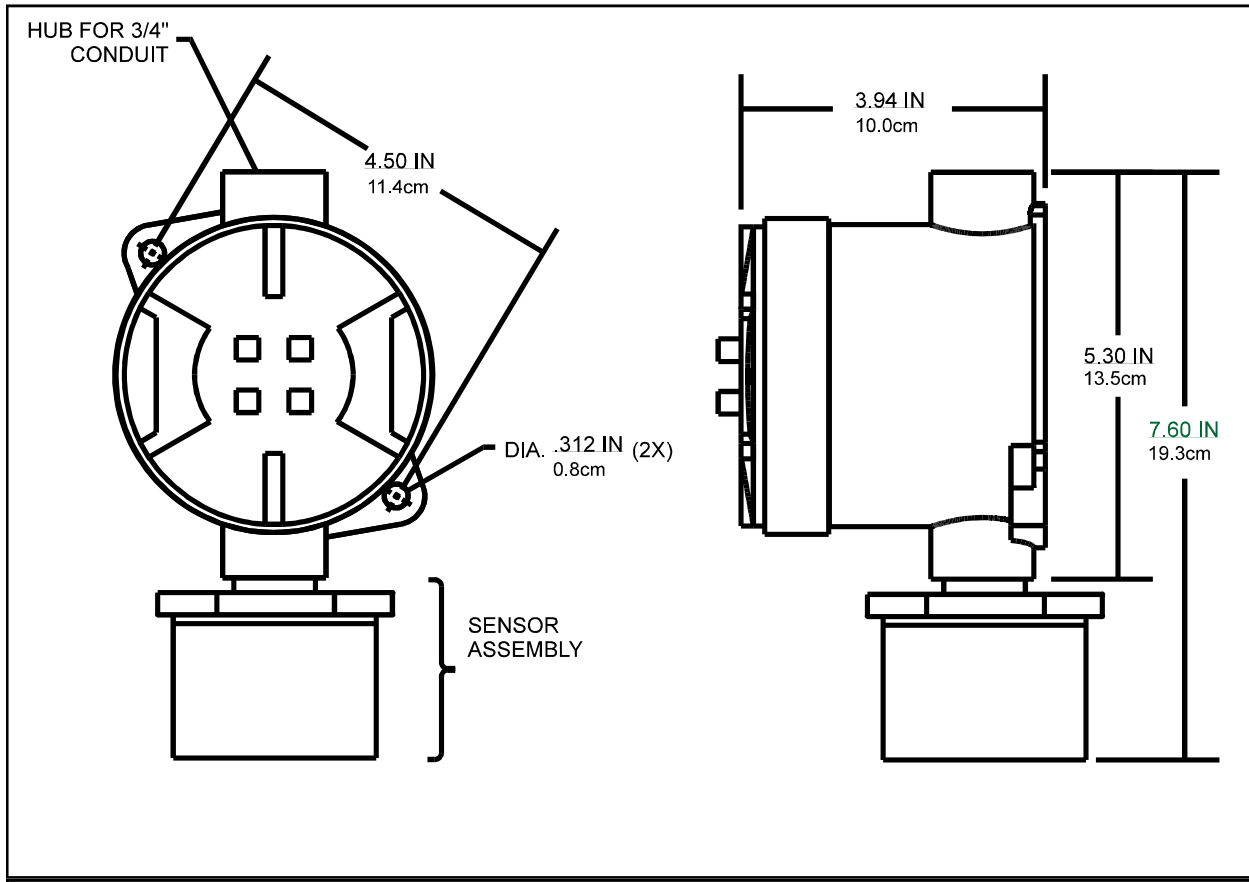


Figure 1.2
Outline and Dimensions

2.0 QUICK START

2.1 Overview

The gas sensor module has been supplied factory calibrated and ready for immediate installation and operation. An installer familiar with installation and operation of gas detection products can use this section to begin immediate use of the monitor.

2.2 Wiring

Provide three conductor wiring from the power supply/control device to the sensor module location. See section 6.3 for wiring specifications.

2.3 Module Installation

Remove spring on electromechanical sensor prior to installation. See Figure 2.2.

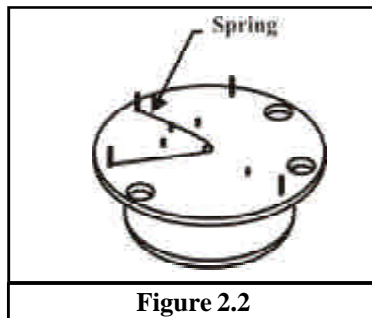


Figure 2.2

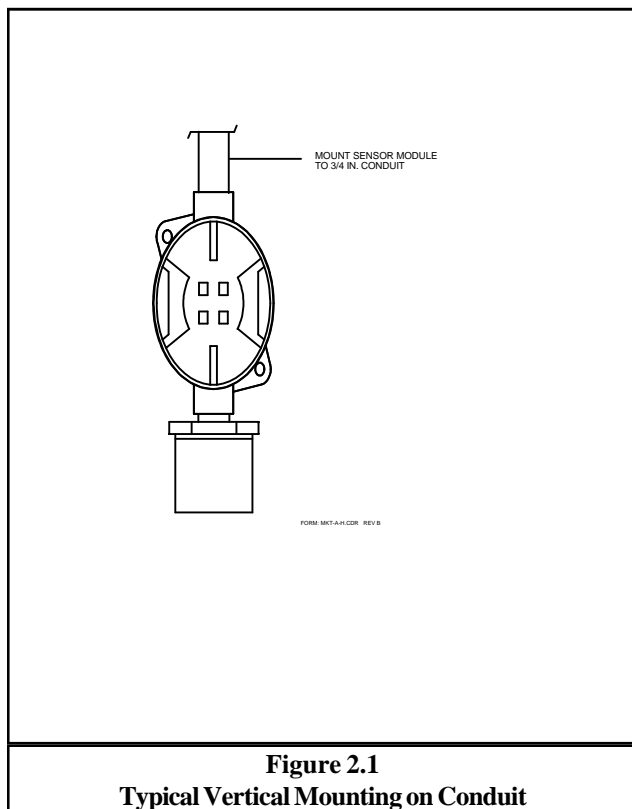


Figure 2.1
Typical Vertical Mounting on Conduit

The module can either be installed on the end of a 3/4" conduit, or attached to a vertical surface using the mounting flange on the enclosure. Two important warnings:

- **The installation must meet any hazardous environment codes for electrical equipment.**
- **The sensor module enclosure mounting must be far enough from any vertical surface to allow removal and replacement of the sensor assembly which is threaded into the second 3/4" conduit hub.**

2.4 Wiring Connection

Terminal positions on the transmitter printed circuit assembly are labeled "P" (power), "S" (signal), "G" (ground) (Figure 9.1). Make the corresponding connections to the control device/power supply.

The sensor harness should remain plugged into the transmitter printed circuit assembly at "J1".

2.5 Transmitter Installation

To install the transmitter printed circuit assembly into the housing, carefully turn the face plate so that the printing is in the correct horizontal position and slide the assembly over the two stand-offs in the enclosure.

Hand tighten the two captive panel thumb screws into the stand-offs. Replace the enclosure cover prior to providing power to the transmitter

- **If the sensor transmitter is installed in a classified hazardous area, replace the threaded cover prior to providing power.**

2.6 Start-up & Operation

To begin operation of the sensor module provide 14-28 VDC from a regulated power supply. Each time the sensor module is powered up it will perform a warm-up for approximately five minutes. During this time the calibration delay LED will be "on" and the loop output will be held at 4 mA.

After the warm-up period has expired the delay LED will turn off and the loop will be released to output in the range of 4-20 mA proportional to the gas concentration.

2.7 Zero Stabilization

All electrochemical sensors require at least 30 minutes on power prior to calibration. This allows the electrode potentials to equilibrate, resulting in a stable zero signal level.

NOTE: For HCl, HCN, NO and ETO sensors, 24 hours or more is required.

3.0 OPERATION

3.1 Introduction

Under normal conditions the sensor module does not require operator or technician intervention. The following are conditions under which the module requires attention:

- **Routine periodic calibration.**
- **Calibration after a high gas alarm.**
- **Sensor replacement on a planned schedule or when a sensor failure occurs.**
- **Periodic cleaning as necessary.**
- **Unanticipated maintenance.**

3.2 Operating Characteristics

1. Signal Value

During normal operation the current loop of the sensor module and the controller will be between 4 mA indicating no presence of gas, and 20 mA indicating that the full concentration of gas is present. The signal value is proportional to the concentration of gas present.

2. Loop Signal Delay Feature

When power is first applied to the module the output signal is clamped to 4 mA by internal circuitry on the board. This allows the sensor to stabilize after power has been applied to the module. The delay is visually indicated by an LED (Labeled CAL DELAY) on the transmitter cover plate (Figure 3.1). The delay will last approximately 5 minutes after which time the electronics removes the 4 mA hold.

During calibration it may be necessary to avoid changing the loop current output from its normal 4 mA condition. This can be accomplished by connecting a magnetic calibration head, or by jumping the calibration test jack "CALSW" on the module plate to the "GND" test jack. Either of these actions will cause the output to be clamped at 4 mA.

The calibration delay LED (CAL DELAY) will remain on and the output will remain clamped to 4 mA while the calibration head or the jumper is in place.

The Calibration Delay will remain on for 4 to 6 minutes after the calibration head or the jumper have been removed.

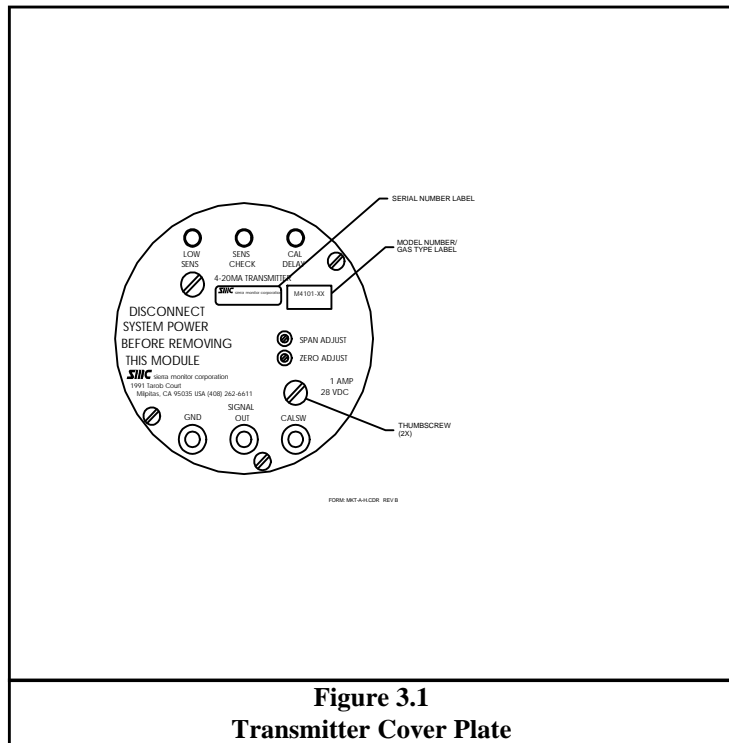


Figure 3.1
Transmitter Cover Plate

3. Low Sensitivity

The module has been designed to automatically perform a Low Sensitivity Check when the power is first applied to the module, when the magnetic calibration head has been removed, or when the jumper has been removed from the "CALSW" and "GND" test jacks. Either one of these actions will cause the "SENS CHECK" LED and "CAL DELAY" LED to turn on. This check verifies that the output of the sensor has not deteriorated to a level that may cause its output to dramatically decrease over a short period of time. If the output of the sensor is below the factory set Low Level Threshold then the "LOW SENS" LED will turn ON and the module output current will drop to 0 mA. The "LOW SENS" LED indicates that the sensor should be replaced.

4. CALIBRATION

4.1 Frequency of Calibration

The manufacturer recommends that the gas sensor module be calibrated every ninety days.

4.2 Calibration Process

The output signal of the gas sensor module is calibrated using a span mixture containing a known concentration of the gas of interest. The concentration of the span gas must be within the full scale of the sensor module and should be either 50% of the full scale, or approximately equal to the lowest alarm level.

Calibration requires application of the span gas to the sensor and adjustment of the "SPAN" potentiometer to make the module signal output equivalent to the concentration of sample gas.

4.3 Calibration Methods

There are two methods for determining the required span adjustment when calibration gas is applied.

Method 1: If it is acceptable to cause the controller alarm relay to turn on during calibration then the controller can be used to indicate the concentration (value of the output signal). This is the simplest alternative. The only tools required are a small flat screwdriver to adjust the span potentiometer on the gas sensor module and a standard calibration adapter (SMC Model 5358-01).

Note: This is the only procedure which may be used for Model 4101-16.

Method 2: If activation of the alarm is not acceptable then the 4-20 mA loop current must be "clamped" to 4 mA and a Digital Volt Meter (DVM) must be connected to the "SIGNAL OUT" and "GND" test jacks to indicate the concentration.

Note: This procedure may not be used for Model 4101-16.

To clamp the 4 to 20 mA output to 4 mA screw a magnetic calibration adapter (Model 5358-00) into the sensor housing, or, jumper (use Pomona P-40 jumper) the "CALSW" test jack to the "GND" test jack on the module plate (Figure 3.1). The "CAL DELAY" LED will turn on and the current loop will be clamped to 4 mA.

Because the controller display will not be used connect a DVM to "SIGNAL OUT" and "GND" test jacks to indicate the concentration measured as VDC. Where the voltage out (V_{out}) is calculated as follows:

$$V_{out} = 2(C/R)$$

Where:

C = concentration of span gas

R = the range of detection

For Example: If the span gas is 10 ppm and the range of the gas sensor module output is 20 ppm, then the voltage out (V_{out}) would equal $2(10/20) = 2 \times 0.5 = 1.0$ VDC. The SPAN pot would then be adjusted for +1.0 VDC at "SIGNAL OUT" test jack when the span gas is applied.

4.4 Equipment Required

The following tools and equipment will be required for calibration:

Method 1

- Jewelers Screwdriver
- Calibration Gas
- Calibration Adapter (Model 5358-01)

Method 2

- Jewelers Screwdriver
- Calibration Gas
- Digital Volt Meter (DVM) 3½ digit.
- Magnetic Calibration Adapter (Model 5358-00) or Patch Cord (Pomona P-40)

4.5 Calibration Procedure

To begin calibration remove the cover from the Module, select the calibration method to be used and proceed according to the alternate methods below:

Method 1:

1. Apply Calibration gas at the flow rate recommended for the specific sensor. (Table 4.1 on page 6)
2. Allow 3-5 minutes before making any adjustments.
3. If necessary adjust the SPAN pot so that the correct concentration is displayed at the controller.
4. Remove the calibration gas, wait 5 minutes and verify that the concentration displayed on the controller goes to 0 ppm. If not adjust the "ZERO" pot to obtain the correct reading.

Method 2:

1. Install the magnetic calibration adapter or jumper and connect the DVM. (When both the jumper and DVM are used the common leads will need to be connected at the meter.)
2. Apply Calibration gas at the flow rate recommended for the specific sensor (Table 4.1).

NOTE: SO₂ may be used instead of HCN to calibrate: 10ppm SO₂ = 16ppm HCN. HCN is extremely hazardous.

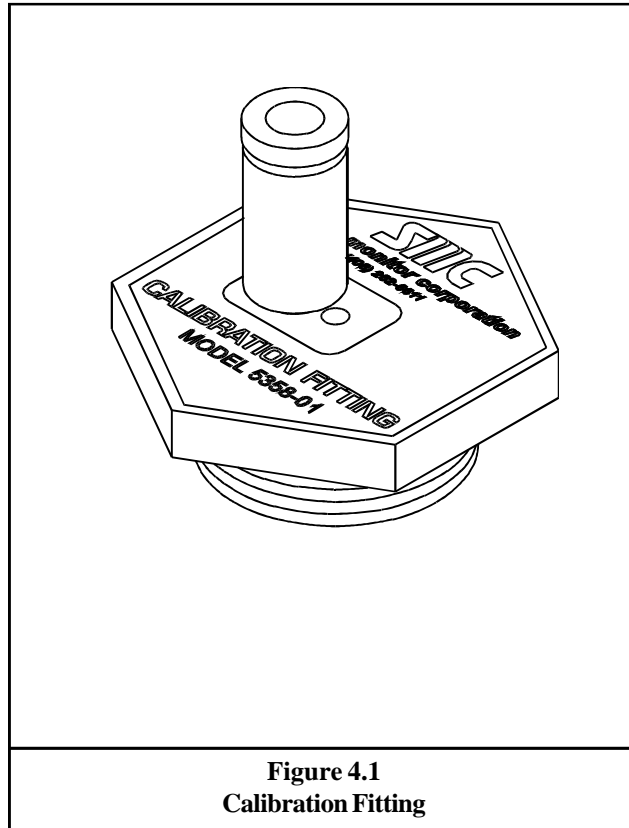
NOTE: H₂S may be used instead of HCl to calibrate: 10 ppm H₂S = 10 ppm HCl.

3. Allow 3-5 minutes before making any adjustments.
4. If necessary adjust the SPAN pot so that the correct concentration is displayed on the DVM.
5. Remove the calibration gas, wait 5 minutes and verify that the DVM attached to the "SIGNAL" output displays 0.0 volts (+/- 0.1 volt). If not, adjust the "ZERO" pot to obtain the correct reading.
6. Remove the magnetic calibration head from the sensor housing or remove the CALSW/GND jumper. The "SENS CHECK" LED will come on for approximately five minutes. If the "LOW SENS" LED comes on then the sensor output is too low and the sensor should be replaced.

Model	Gas	Min. Flow Rate (cc/min)
4101-04	CO	150
4101-05	H ₂ S	300
4101-06	Cl ₂	300
4101-07	H ₂	300
4101-10	SO ₂	300
4101-12	NO ₂	300
4101-13	CO	300
4101-16	CO	300
4101-19	NO	300
4101-21	HCl	1000
4101-22	HCN*	300
4101-27	C ₂ H ₄ O	500

It is always preferred that the primary gas of interest be used for calibration. However, for new sensors, alternative gases may be used for calibration of HCN and HCl sensor modules (see 4.5 Method 2).

**Table 4.1
Calibration Span Gas Flow Rates**



**Figure 4.1
Calibration Fitting**

5.0 SERVICE

5.1 Sensor Module Configuration

The gas sensor module is comprised of the following sub assemblies (Figure 5.1):

4101-XX	Gas Sensor Module
-SPL21767	Enclosure
-SPM27049	Transmitter Assy.
-SPM27048-XX	Sensor Assy.
-SPM33000-XX	Sensor

[Where "XX" is the suffix to the gas sensor module model number (Table 4.1)]

There are no field serviceable components below the sub assembly level.

Warning: Prior to removal of the transmitter assembly remove system power at the controller or other power source.

5.2 Enclosure Replacement

The enclosure should be replaced if the lid threads or conduit threads have been damaged, or if the enclosure has corroded sufficiently that it no longer meets the required NEMA classification.

To replace the enclosure follow the transmitter and sensor assembly removal instructions, remove the damaged enclosure from it's conduit or wall mounting, install a new enclosure and continue the transmitter and sensor assembly replacement instructions.

5.3 Transmitter Replacement

The transmitter assembly should be replaced when it is determined that it is unreliable, noisy or cannot be adjusted for calibration. This may occur due to age, corrosion or failed components.

To replace the transmitter assembly:

1. Remove the cover of the main enclosure.
2. Unscrew the two thumb screws in the top of the cover plate, lift the assembly and rotate 90° to relieve the wiring service loop.
3. Unplug the sensor connector from the transmitter.
4. Remove the three wires from the P,S,G terminals.
5. Reverse the preceding steps to install the new transmitter.
6. Restore power and allow a minimum of 30 minutes for stabilization before re-calibration.

5.4 Sensor Assembly Replacement

The sensor assembly should be replaced when it is determined that, with a known good sensor, the sensor signal reaching the transmitter assembly is unreliable. The sensor housing contains an encapsulated electronics assembly that may fail due to age, moisture or excessive environmental stress.

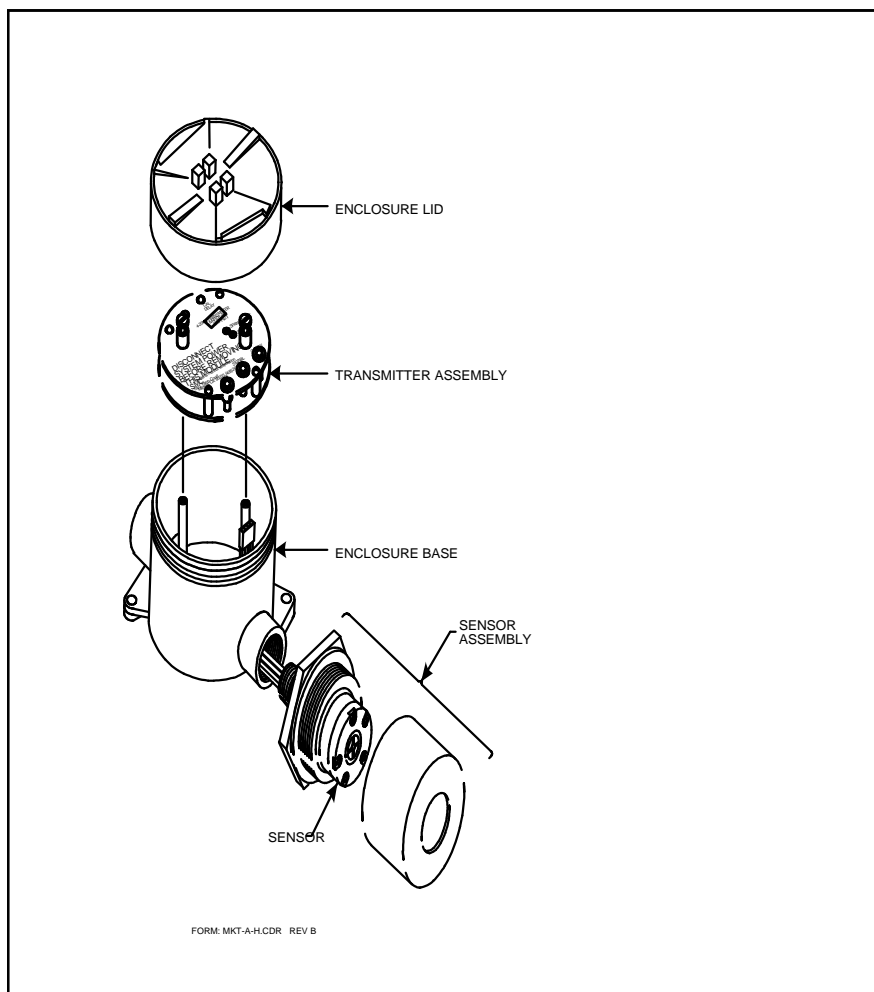


Figure 5.1
Gas Sensor Module - Exploded View

To replace the sensor assembly:

1. Remove the gas sensor module enclosure lid.
2. Unscrew the two thumb screws in the top of the cover plate, lift the transmitter assembly and rotate 90° to relieve the wiring service loop.
3. Unplug the sensor connector from the transmitter.
4. Unscrew the old sensor assembly from the enclosure conduit hub. Remove the sensor assembly with its harness.
5. Reverse the preceding steps to install the sensor assembly.
6. Allow the new sensor to stabilize for a minimum of 30 minutes and then calibrate using the procedure in Section 4. (See Section 2.7)
8. Install the sensor assembly into the enclosure hub and tighten firmly.
9. Reconnect the sensor harness to the transmitter, carefully install the transmitter into the housing and restore system power.
10. Recalibrate the transmitter following the instructions in Section 6. If, during calibration, it is not possible to correctly adjust the span voltage it will be necessary to make an adjustment to the sensor output. The procedure for this adjustment is described in the Appendix to this manual.

5.5 Sensor Replacement

The gas sensor which is located inside the sensor assembly housing can be replaced without replacement of the housing. The gas sensor needs replacement when:

- It is no longer possible to obtain correct Zero and Span values at the test points or at the controller.
- The "LOW SENS" LED turns on after calibration.
- The sensor output signal is noisy, causing erroneous gas level readings.

To replace the sensor:

1. Confirm that system power has been removed.
2. Remove the transmitter electronics board from the main housing and unplug the sensor harness from the transmitter electronics (Figure 5.2).
3. Unscrew the sensor housing from the bottom of the enclosure.
4. Hold the sensor assembly so that the harness faces down and the sensor faces up. Unscrew and remove the round section of the housing from the hex section. [Be careful not to lose the spacer washer which will be sitting on top of the exposed sensor.]
5. Carefully pull the old sensor straight up from the socket.
6. Orient the new sensor so that the sensor pin labeled "C" faces the socket labelled "C" which is on the far side of the board from the vertical reed switch. The reed switch will slide into the hole on the side of the new sensor. Press the new sensor into the socket.
7. Carefully replace the cover on the sensor assembly, including the spacer washer.

6.0 INSTALLATION

6.1 Sensor Locations

The gas sensor module is a diffusion type sensor which should be located close to either the expected source or destination of the gas hazard. Table 6.1 indicates the specific gravities (SG) of each of the gases to be monitored. For heavier (SG>1) gases install the sensor within 24 inches of the ground. For lighter gases use higher elevations.

After optimum locations are determined based on the above recommendations, consideration should be given to placing the sensors in locations which are accessible for calibration service. Slight adjustments to the location of the sensor may have little impact on effectivity but major effect on accessibility.

6.2 Sensor Mounting

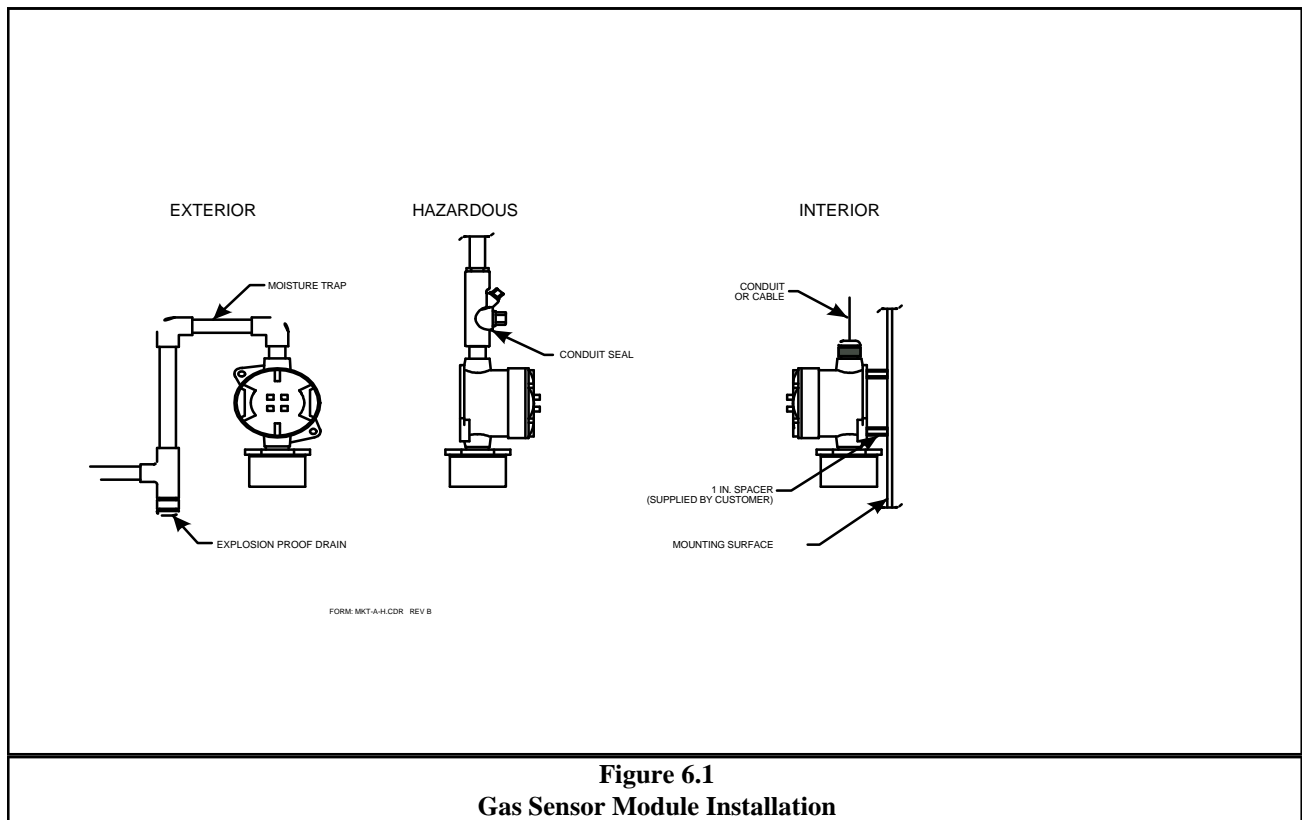
Where possible sensor modules should be installed with the sensor facing vertically down. The lid of the sensor module should face out for easy access.

Sensors may be mounted directly onto the end of a vertical conduit, or bracketed to a vertical surface using the two mounting flanges. Insure that the body of the enclosure

Model	Gas	Specific Gravity
N/A	Air	1.00
4101-04	CO	1.00
4101-05	H ₂ S	1.20
4101-06	Cl ₂	2.48
4101-07	H ₂	0.10
4101-10	SO ₂	2.25
4101-12	NO ₂	1.59
4101-13	CO	1.00
4101-16	CO	1.00
4101-19	NO	1.04
4101-21	HCl	1.28
4101-22	HCN	0.68
4101-27	C ₂ H ₄ O	1.52

**Table 6.1
Specific Gravities**

sure is at least 1" from the wall so that the sensor assembly can be rotated for removal and replacement. See Figure 6.1 for installation configurations.



6.3 Wiring

The gas sensor module will be installed in conjunction with a single or multi-channel loop controller or a distributed control system. In each case, three wires will be required to run between the control device and the gas sensor module. See Table 6.2 for recommended minimum wire gauge. Use shielded cable in any location which may be expected to be electrically noisy or where cable is expected to be in close contact with AC wiring.

The wiring should be run in either a cable tray or conduit as required by applicable code and area classification. Control wiring should not be installed in a cable tray or conduit with higher voltage and AC circuits.

Wiring connections at the gas sensor module are as follows:

Wire #	Function	Terminal
1	Power	“P”
2	Signal	“S”
3	Ground	“G”

Connect an earth ground to the ground screw provided in the base of the gas sensor module enclosure.

Wire Gauge	Maximum Length
20 AWG	2,000 Ft.
18 AWG	3,000 Ft.
16 AWG	4,000 Ft.
14 AWG	6,500 Ft.
12 AWG	9,000 Ft.

**Table 6.2
Recommended Wire / Cable Gauge**

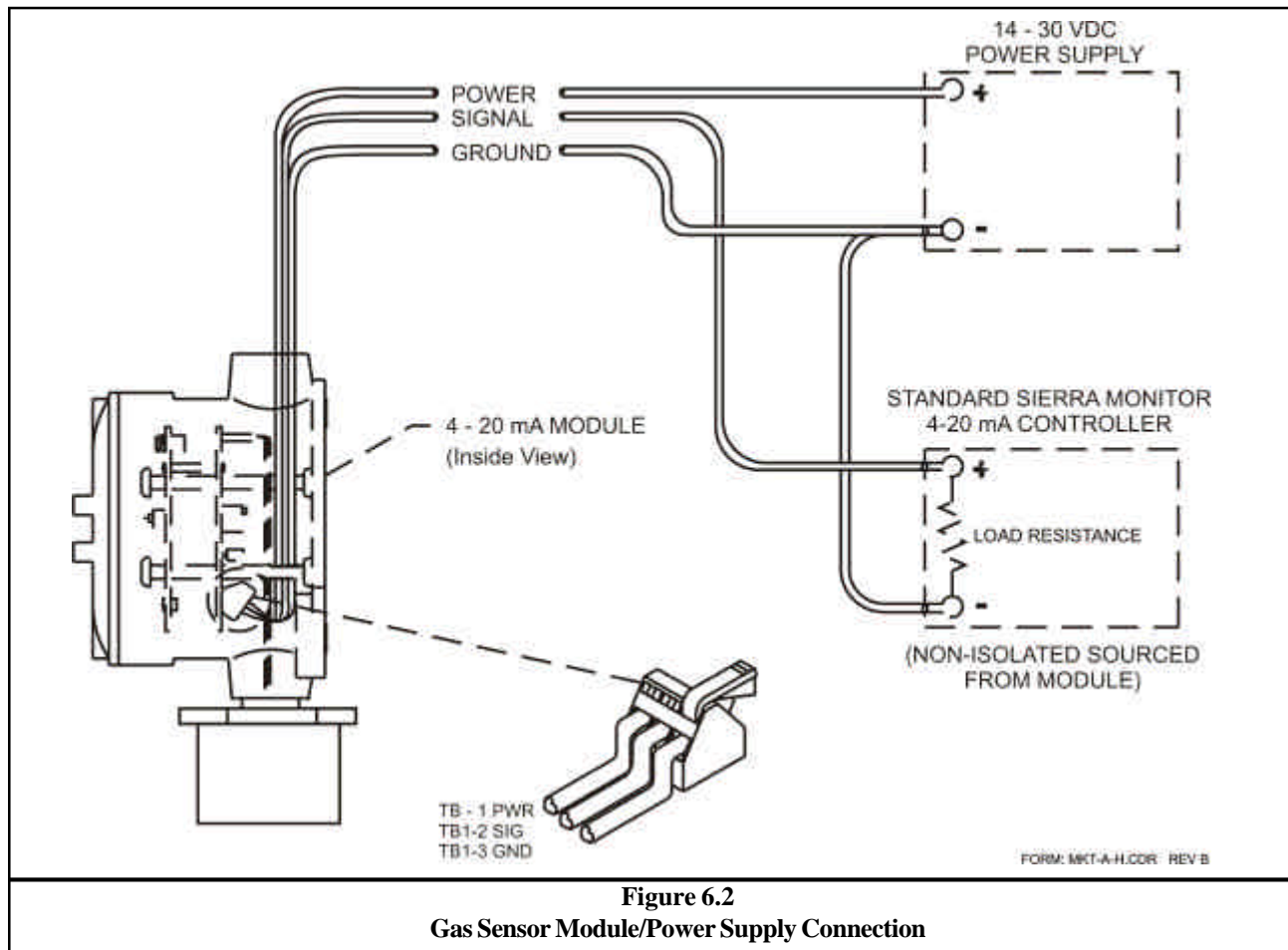
6.4 Explosion Proof Installation

Where area classification requires explosion proof (NEMA-7) installation a sealing fitting will be required immediately above the gas sensor module enclosure.

6.5 Power Supply

The power supplied by the controlling device or an external power supply must meet the following specifications:

- Voltage: 14-28 VDC
- Current: 80 mA



**Figure 6.2
Gas Sensor Module/Power Supply Connection**

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7.0 Specifications

Model	4101-04	4101-05	4101-06	4101-07	4101-10	4101-12
Gas	CO	H ₂ S	Cl ₂	H ₂	SO ₂	NO ₂
Sensor Type	E.C.	E.C	E.C.	E.C.	E.C.	E.C.
Units	ppm	ppm	ppm	ppm	ppm	ppm
Range	0-500	0-100	0-10	0-1000	0-100	0-20
Resolution	1	0.1	0.1	2	0.5	0.2
Response Time to 90% of signal	<25 sec.	<30 sec.	<60 sec.	<30 sec.	<20 sec.	<35 sec.
Sensor Life ¹	2 yrs	2 yrs	2 yrs	2 yrs	2 yrs	2 yrs
<u>Operating Range</u>						
Temperature	4 to 122°F -20 to 50°C	-40 to 122°F -40 to 50°C	-4 to 122°F -20 to 50°C	-4 to 122°F -20 to 50°C	-4 to 122°F -20 to 50°C	-4 to 122°F -20 to 50°C
Relative Humidity	15-90%	15-90%	15-90%	10-90%	15-90%	15-90%
Pressure	10%	10%	10%	10%	10%	10%
<u>Electrical Data</u>						
Loop Type	3 wire					
Loop Resistance @28 Volts	800 Ohm					
Input Voltage DC	14-30					
Input Current	40 mA					
Input Power Max.	1.4 W					
Output-Normal	4-20 mA					
Output-Trouble	0 mA					
<u>Construction</u>						
Dimensions:	H: 8.0", D: 6.0", W: 6.0" (20.3 x 15.2 x 15.2 cm)					
Weight (Module)	2.7 lb.					
Mounting	3/4" NPT					
Housing	Explosion proof (NEMA 7) (Div. I, Class 1, Groups C,D) Optional NEMA 4X Enclosure (Div. I, Class 1, Groups B, C, D)					
Notes: 1. Sensor life is for use at standard temperature and pressure with occasional exposure to the gas of interest						

7.0 Specifications (Cont.)

Model	4101-13	4101-16	4101-19	4101-21	4101-22	4101-27
Gas	CO	CO ⁴	NO	HCl	HCN	C ₂ H ₄ O
Sensor Type	E.C.	E.C.	E.C.	E.C.	E.C.	E.C.
Units	ppm	ppm	ppm	ppm	ppm	ppm
Range	0-1000	0-2000	0-20	0-20	0-20	0-20
Resolution	0.5	0.1	0.5	0.1	0.1	0.1
Response Time to 90% of signal	<35 sec.	<35 sec.	<15 sec.	<100 sec.	<70 sec.	<90 sec.
Sensor Life ¹	2 yrs	2 yrs	3 yr	2 yr	2 yrs	2 yrs
<u>Operating Range</u>						
Temperature	-4 to 122°F -20 to 50°C	-4 to 122°F -20 to 50°C	-4 to 122°F -20 to 50°C	-4 to 122°F -20 to 50°C	-4 to 122°F -20 to 50°C	-4 to 122°F -20 to 50°C
Relative Humidity	15-90%	15-90%	15-90%	15-90%	15-90%	15-90%
Pressure	10%	10%	10%	10%	10%	10%
<u>Electrical Data</u>						
Loop Type	3 wire					
Loop Resistance @28 Volts	800 Ohm					
Input Voltage DC	14-30					
Input Current	40 mA					
Input Power Max.	1.4 W					
Output-Normal	4-20 mA					
Output-Trouble	0 mA					
<u>Construction Dimensions:</u>	H: 8.0", D: 6.0", W: 6.0" (20.3 x 15.2 x 15.2 cm)					
Weight (Module)	2.7 lb.					
Mounting	3/4" NPT					
Housing	Explosion proof (NEMA 7) (Div. I, Class 1, Groups C,D) Optional NEMA 4X Enclosure (Div. I, Class 1, Groups B, C, D)					
Notes:	<p>1. Sensor life is for use at standard temperature and pressure with occasional exposure to the gas of interest</p> <p>2. Model 4101-16 Hydrogen Tolerant up to 1000 PPM Hydrogen</p>					

8.0 LIMITED WARRANTY

SIERRA MONITOR CORPORATION warrants its products to be free from defects in workmanship or material under normal use and service for two years after date of shipment. SMC will repair or replace without charge any equipment found to be defective during the warranty period. Final determination of the nature and responsibility for defective or damaged equipment will be made by SMC personnel.

All warranties hereunder are contingent upon proper use in the application for which the product was intended and do not cover products which have been modified or repaired without SMC approval or which have been subjected to accident, improper maintenance, installation or application, or on which original identification marks have been removed or altered. This Limited Warranty also will not apply to interconnecting cables or wires, consumables (ie. calibration gases, batteries, sensors), nor to any damage resulting from battery leakage.

In all cases SMC's responsibility and liability under this warranty shall be limited to the cost of the equipment. The purchaser must obtain shipping instructions for the prepaid return of any item under this warranty provision and compliance with such instruction shall be a condition of this warranty.

Except for the express warranty stated above, SMC disclaims all warranties with regard to the products sold hereunder including all implied warranties of merchantability and fitness and the express warranties stated herein are in lieu of all obligations or liabilities on the part of SMC for damages including, but not limited to, consequential damages arising out of/or in connection with the use or performance of the product.

9.0 INDEX

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10. APPENDICES

Appendix A: Cross Sensitivities

Model Number	Gas Type	Reading from 100 ppm of interfering gas									
		CO	H ₂ S	Cl ₂	H ₂	SO ₂	NO ₂	NO	HCl	HCN	C ₂ H ₄
4101-04	CO	100	5	0	<20	0	0	6	0	0	<50
4101-05	H ₂ S	<0.2	100	-20	<0.1	<15	-15	0	0	0	0
4101-06	Cl ₂	0	<-10	100	0	0	105	0	0	0	0
4101-07	H ₂	<1	<20	0	100	3	0	35	3	35	85
4101-10	SO ₂	<1	0	-40	0	100	-100	0	0	15	0
4101-12	NO ₂	0	-20	90	0	0	100	0	0	-3	0
4101-13	CO	100	350	0	<60	60	-60	25	0	0	<75
4101-16	CO	100	0	0	0	0	0	0	0	0	35
4101-19	NO	0	35	0	0	5	25	100	15	0	0
4101-21	HCl	0	75	-10	0	35	-2	0	100	-8	0
4101-22	HCN	<0.5		-50	0	160	-190	-5		100	<1
4101-27	C ₂ H ₄ O (Ethylene Oxide)			Ethanol	55						
				Toluene	20						
				Methyl-ethyl-ketone	10						
				Carbon Monoxide	40						

Appendix B: Sensor Output Adjustment

The following procedure is to be used when, during the normal calibration of a new sensor, the span voltage cannot be adjusted to a high enough level.

Note: This procedure is not applicable for Model 4101-16, -21, and -23.

1. Adjust the span potentiometer so that it is approximately mid range. (Twenty turns clockwise and ten turns counter-clockwise).
2. Remove system power and, following the procedure outlined in Section 5.5, remove both the transmitter and the sensor assembly from the enclosure. Remove the sensor assembly cover so that the sensor is visible.
3. Plug the sensor harness into the transmitter assembly and check that no components are touching the enclosure. Restore power and allow a minimum of 30 minutes for stabilization before adjustment.

4. Connect a DVM across TP8 and GT1 on the transmitter assembly (Figure 9.1).
5. Locate the gain potentiometer which is on the sensor electronics directly behind one of the holes through the side of the sensor. The potentiometer is accessible by inserting a jewelers screwdriver through the hole in the sensor.
6. Determine the correct value to be read at TP8 based on the following formula:

$$V_{TP8} = 2(C/R)$$

Where:

C = concentration of span gas

R = the range of detection

7. Apply span gas. Adjust the gain potentiometer until TP8 = the correct value as described above. To increase voltage at TP8, turn "GAIN" potentiometer counter clockwise.
8. Remove system power and re-install the sensor and transmitter in the enclosure. Restore power and calibrate using the procedure in Section 4.

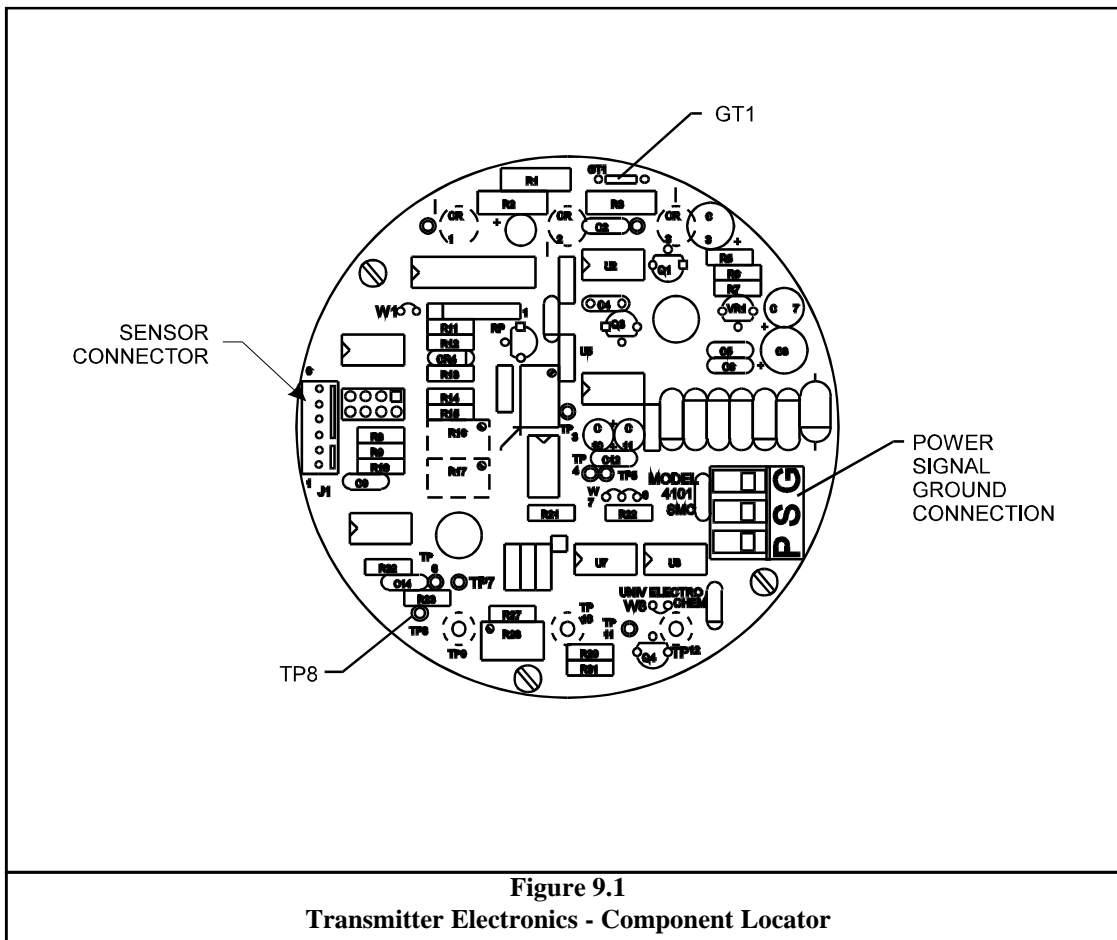


Figure 9.1
Transmitter Electronics - Component Locator