MODEL 4100 SERIES
GAS SENSOR MODULES
GAS GROUPS A, B, C, D

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APPLICABILITY & EFFECTIVITY

This manual provides instructions for the following Sierra Monitor products and are effective as of the dates and serial numbers shown:

Model	Description	Date	Serial Number
4100-33	Gas Sensor Module, Group A	11/1/95	93-33-100
4100-34	Gas Sensor Module, Group B	11/1/95	93-34-100
4100-35	Gas Sensor Module, Group C	11/1/95	93-35-100
4100-36	Gas Sensor Module, Group D	11/1/95	93-36-100

Instruction Manual Part Number. T13013
Rev. D3

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1.0 Product Description

1.1 Introduction

The Model 4100-3X series Gas Monitor utilizes semiconductor sensor technology to detect part per million (PPM) concentrations of various combustible or toxic gases. These monitors operate on 24 VDC input and source a non-linear 4-20 mA current loop output. However, curves can be provided to enable the operation of these sensors with various controllers.

The four gas sensor modules in this series covered by this manual are:

4100-33
4100-34
4100-35
4100-36

***NOTE**: Models 4100-30, 4100-31 and Model 4100-32 are not covered by this manual.*

All Model 4100-3X series monitors have similar instructions. This manual provides the instructions for each of the monitors and identifies those functions or procedures which differ between the models. Model numbers using the suffix 3X (as in 4100-33), 34, 35 etc. define the group of gases which can be monitored. Appendix A provides instructions for configuring the sensors for each specific application.

These gas sensor modules can monitor a wide variety of gases. Appendix A provides a partial list of gases that can be reliably monitored. If you gas is not on this list, check with your Sierra Monitor representative to determine if the 4100 Series gas sensor module is available for your specific need

Also, these gas sensor modules can be calibrated with the gas of interest or with methane, carbon monoxide or hydrogen. Thus, the user does not have to obtain a special calibration gas.

1.2 How it Works

Semiconductor sensors have a resistance in air that is affected by oxygen adsorbed on the surface of the sensor. Oxygen atoms capture electrons on the semiconductor surface, thereby increasing its resistance.

The sensors can be impregnated with dopants such that the sensor's resistance changes when specific gases displace the adsorbed oxygen.

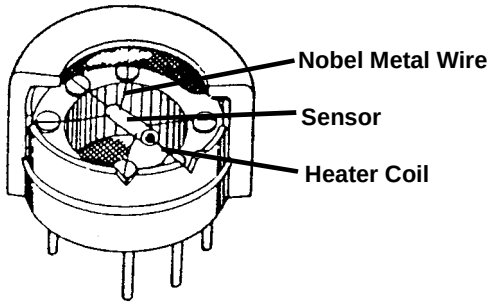

Figure 1
Semiconductor Sensor

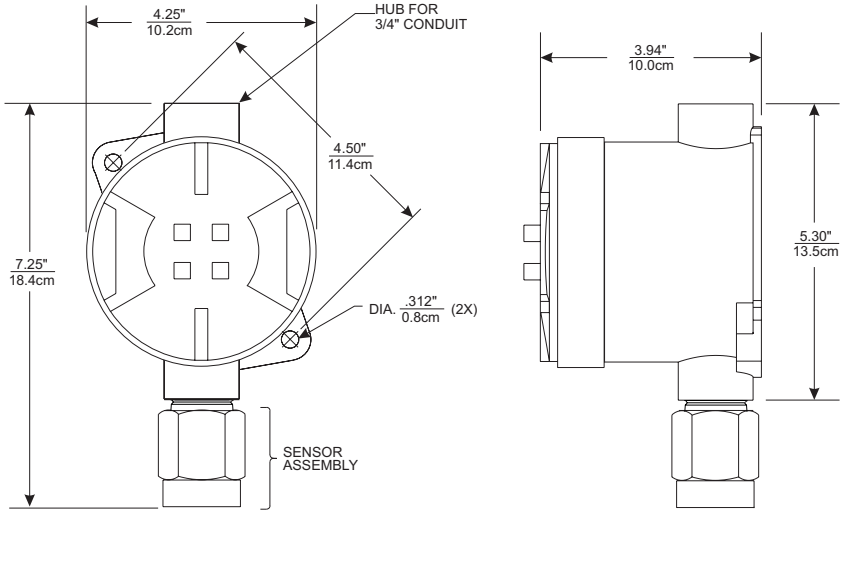

Figure 2
Outline and Dimensions

2.0 Installation and Start-up

2.1 Location

Select a location for the monitor based on the following criteria.

1. The monitor enclosure accepts a 3/4" NPT male conduit or fitting. (See figure 1 - Outline Drawing)
2. Determine the potential source and destination of the gas of interest and spot monitors where they are most likely to be exposed to the gas.
3. Take into account the specific gravity of the gas to be detected. Heavy gases should be monitored close to the floor, light gases should be monitored near the ceiling. (See Application Data Sheet ADS-001 for further information)
4. Provide for calibration access which requires removal of the enclosure lid and application of span gas to the sensor.
5. Sensor MUST be pointed down to avoid contamination from dust collection.

2.2 Module Installation

The monitor enclosure is a dual 3/4 inch hub explosion proof electrical housing. The sensor is factory installed in one hub, the other is for wiring access. Two mounting holes spaced 4.5" on center are located on the upper right and lower left sides of the enclosure at a 45° angle to vertical.

The monitor is to be installed on the end of rigid vertical 3/4" conduit or using the mounting flanges to secure it, to a vertical surfaces. Access is required for application of a threaded calibration gas delivery fitting into the face of the sensor. It is recommended that both the conduit and the explosion proof housing be connected to an EARTH ground.

Table 1 shows the wire gauge requirements for the maximum cable distance between the Controller and the gas monitor. The recommended wire to be used should meet UL1007 or UL1O1S specifications when installed in a continuous metal conduit. When cable is not installed continuously in metal conduit then the recommended shielded cable to be used is the Belden number identified in the table.

Wire Gauge (AWG)	Maximum Cable Length (feet)	Belden Number
20	2,000	8772
18	3,000	8770
16	4,000	8618
14	5,000	83753
12	9,000	83803

Table 1: Wire Gauge and Length

Follow the steps below to install the monitor:.

1. Remove the transmitter electronics (Figure 2) from the main housing by unscrewing the two thumb screws located on the top plate of the transmitter. Lift the transmitter out of the housing and unplug the sensor cable harness from the back of the transmitter (JI, a 4 position brown connector).
2. Connect the three wires from the controller to the terminal block marked "P" "S" "G" on the transmitter electronics (Figure 2). See Table 2 for connector labeling and four recommended wire colors.
3. Connect an earth ground wire to the ground screw provided in the main housing.
4. Reconnect the sensor cable harness to the transmitter electronics (Connector JI) and replace the transmitter assembly into the enclosure insuring that a sufficient service loop stores into the enclosure.
5. Complete any required terminations of the cables to the controller.

Controller Label	Monitor Label	Wire Color
+EXC	P	White
+CH#	S	Black
GND	G	Green

Table 2: Connector Labeling & Wire Colors

2.3 Start-up Procedure

After all the wiring has been installed apply power to the sensor module(s) by providing power to the controller.

Note that typical controller operation provides a five minute warm-up period, after power up, before signals from the monitor are processed for alarm decision purposes.

When power is applied, the Sensor OK (Sens Check) green LED will glow. If the LED is not *ON*, see the troubleshooting instructions in this manual.

3.0 Calibration

3.1 Frequency of Calibration

Sierra Monitor recommends that Model 4100 series gas monitors be calibrated every ninety days. Monitors should be on power for at least 24 hours continuously before calibration adjustments are made.

3.2 Procedure

The following procedure adjusts the monitor output to a precise 4-20 mA output.

1. Equipment required:
   a. Digital Volt Meter (DVM) 3 1/2 digits
   b. Calibration (Span) gas of a concentration equal to the full scale value of the monitor. (See Appendix A)
2. Procedure:
   a. Remove the enclosure lid by turning counterclockwise.
   b. Connect DVM to Ground (GND) and Signal Out on the top plate of the transmitter (figure 2).
   c. Confirm that the sensor is presently exposed to clean air (or apply a source of clean air), and, if necessary adjust the 4 mA Adjust so that the meter reading is 0.20 VDC +/- 0.025 VDC
   d. Apply Span gas at a flow rate of 50 cc/ min for three minutes.
   e. With Span gas still flowing to the sensor, adjust the Span Adjust so that the signal-out voltage is at the voltage selected from appendix A.
   f. Remove span gas and verify that the meter reading returns to 0.20 VDC within 5 minutes.

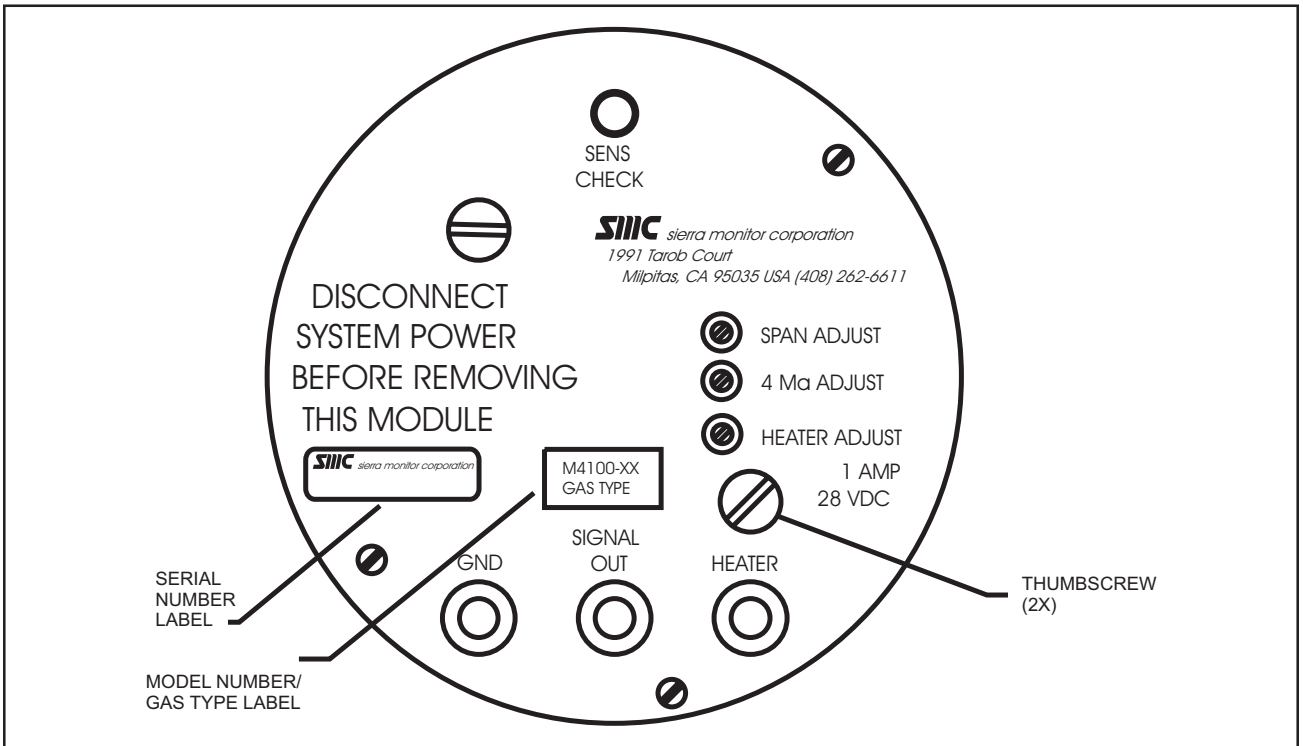

Figure 2: Top Plate Detail

4.0 Service

4.1 Sensor Replacement

The sensor should be replaced when either of the following conditions occur:

1. It is no longer possible to obtain adjust the transmitter output to either the 4 mA (.2 VDC) or the 20 mA (1.0 VDC) levels.
2. When the signal out becomes noisy causing erroneous or fluctuating display values at the controller.
3. When other troubleshooting determines that the sensor is not OK

To replace the failed sensor, remove the transmitter from the main housing and unplug the sensor connector harness from the electronics.

Unscrew the old sensor from the main housing and install the new sensor in the reverse order.

After sensor replacement, a coarse calibration adjustment may be performed. Precision calibration is required after twenty four hours of stabilization.

4.2. Troubleshooting

Sensor Check: The transmitter electronics constantly test for continuity through the sensor heater and sensor film. While the two sensor tests pass, the green "SensCheck" LED will glow. If the LED is off, check the following:

1. Confirm that there is power to the transmitter.
2. Confirm that the sensor is correctly plugged into the electronics board and that there is no corrosion or other contamination on the connector contacts.
3. Inspect the sensor wiring harness for breaks, loose wires or other damage.
4. If correction of the above items fails to correct the problem the sensor should be replaced.

Heater Adjustment: The standard heater voltage value is 5.0 VDC. For special configurations, the factory may issue instructions to use an alternate heater voltage.

1. Test the heater voltage by connecting a DVM to the Ground (GND) and Heater test points.
2. Adjust the heater voltage by adjusting the Heater Adjust potentiometer.

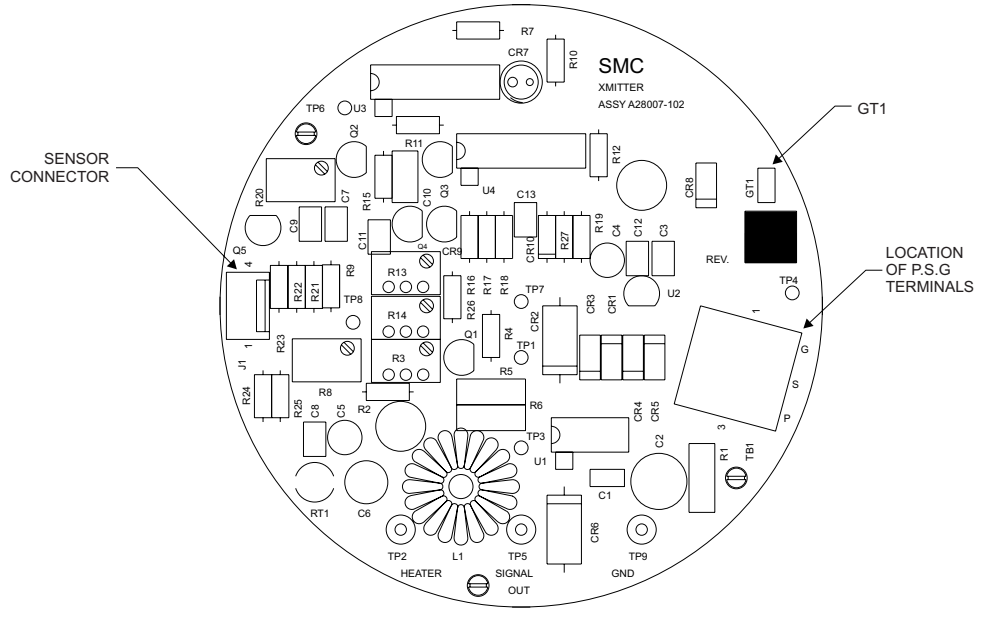

Figure 3: Component and Test Point Locator

5.0 Specifications

Sensor

Type:	Solid State Metal Oxide Semiconductor
Range:	See Appendix A, or special factory instructions.
Response:	80% of concentration in less than 30 seconds.
Typical Life	2-4 years in Normal Service.

Detectable Gases And Vapors

Typical List: See Appendix A

Calibration

Adjustments:	Zero Adjust Span Adjust
Sensor LED	OFF indicates that either the heater or film is an open circuit.

Environmental

Operating:	Temperature 14°F to 104°F (-I0°C to +40°C)
	Humidity 5% to 95% non condensing
Storage	Temperature -67°F to 185°F (-55°C to +85°C)

Electrical Data

Wiring:	3 wire non isolated
Input Voltage:	14 - 30 VDC
Current:	70mA @ 4mA loop current;
	90mA @ 20mA loop current at 24VDC.
Power:	2.1 Watts
Output Range:	4-20mA DC Non-linear
Loop Res.:	800 ohms at 28VDC

Mechanical

Physical:	Nominal Dimensions 6.75" x 4' x 3.5" (HxWxD)
	(17.1 cm x 10.2 cm x 8.9 cm)
Material:	Cast Aluminum epoxy painted
Weight:	2 pounds (0.9 Kg)
Classification:	Class I Division I Groups C, D
Mounting:	Connects to a vertical 3/4" electrical conduit

6.0 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

APPENDIX A

Sensors used in the model 4100 series provide an electrical output, proportional to the gas concentration, which is always non-linear over an extended range. By selection of a specific section of the response curve the model 4100 series gas monitors source a 4-20 mA output which is either linear or non linear. The monitors are characterized for detection of various gases, either by direct testing at Sierra Monitor, or by extrapolation of data supplied by the sensor manufacturer.

In the Table A-1 gases which have been characterized are listed in alphabetical order and are shown with the recommended model number and the full scale range of detection. For each entry a "method" is identified. Each method is described at the end of the appendix. The method description refers to constant values which are listed in the 'voltage' and 'equivalent" columns.

When selecting a module for a specific gas, it is imperative to remember that the range must remain the same as the full scale indicated in the Table A-1.

Gas	Monitor	Full Scale	Method	Sig Out Voltage	Display Equivalent	Notes
acetic acid	4100-35	5,000 PPM	1	0.70	700 PPM	
acetic acid	4100-34	500 PPM	2	0.94	120 PPM	
acetone	4100-35	5,000 PPM	1	0.63	350 PPM	
acetone	4100-34	500 PPM	2	0.63	20 PPM	
acetonitrile	4100-35	5,000 PPM	1	0.75	1,000 PPM	
acetonitrile	4100-34	500 PPM	2	0.68	30 PPM	
acetylene	4100-35	5,000 PPM	1	0.96	4,000 PPM	
acetylene	4100-34	500 PPM	2	0.90	200 PPM	
acrylonitrile	4100-35	5,000 PPM	1	0.75	1,000 PPM	
acrylonitrile	4100-34	500 PPM	2	0.73	50 PPM	
ammonia (<0°C)	4100-34	500 PPM	2	1.00	500 PPM	
ammonia (>0°C)	4100-36	500 PPM	3	1.00	500 PPM	
benzene	4100-34	500 PPM	2	0.68	30 PPM	
1-butanol	4100-34	500 PPM	2	0.08	30 PPM	
2-butanol	4100-34	500 PPM	2	0.68	30 PPM	
i-butane	4100-35	5,000 PPM	1	0.72	800 PPM	
i-butane	4100-34	500 PPM	2	0.82	100 PPM	
n-butane	4100-34	500 PPM	2	0.78	70 PPM	
n-butane	4100-35	5,000 PPM	1	0.72	800 PPM	
1-butanol	4100-35	5,000 PPM	1	0.70	700 PPM	
2-butanol	4100-35	5,000 PPM	1	0.75	1,000 PPM	
i-butanol	4100-35	5,000 PPM	1	0.75	I,000 PPM	
i-butanol	4100-34	500 PPM	2	0.73	50 PPM	
t-butanol	4100-35	5,000 PPM	1	0.84	2,000 PPM	
t-butanol	4100-34	500 PPM	2	0.73	50 PPM	
butene	4100-35	5,000 PPM	1	0.94	2,000 PPM	
butene	4100-34	500 PPM	2	0.71	40 PPM	
carbon monoxide	4100-34	500 PPM	2	1.00	500 PPM	
chloroform	4100-34	500 PPM	2	0.90	200 PPM	
cyclohexane	4100-35	5,000 PPM	1	0.77	1,200 PPM	
cyclohexane	4100-34	500 PPM	2	0.79	90 PPM	

Table A-1

Gas	Monitor	Full Scale	Method	Voltage	Equivalent	Notes
cyclopentane	4100-35	5,000 PPM	1	0.70	700 PPM	
cyclopentane	4100-34	500 PPM	2	0.82	100 PPM	
diethylketone	4100-35	5,000 PPM	1	0.70	700 PPM	
diethylketone	4100-34	500 PPM	2	0.63	20 PPM	
dipropylether	4100-35	5,000 PPM	1	0.64	400 PPM	
dipropylether	4100-34	500 PPM	2	0.68	-30 PPM	
ethane	4100-35	5,000 PPM	1	0.62	300 PPM	
ethane	4100-34	500 PPM	2	0.98	400 PPM	
ethanol	4100-35	5,000 PPM	1	0.62	300 PPM	
ethanol	4100-34	500 PPM	2	0.68	30 PPM	
ethylene	4100-35	5,000 PPM	1	0.69	600 PPM	
ethylene	4100-34	500 PPM	2	0.76	60 PPM	
n-heptane	4100-34	500 PPM	2	0.78	7OPPM	
n-heptane	4100-35	5,000 PPM	1	0.80	1,500 PPM	
n-hexane	4100-34	500 PPM	2	0.76	60 PPM	
n-hexane	4100-35	5,000 PPM	1	0.76	1,100 PPM	
1-hexanol	4100-35	5,000 PPM	1	0.80	1,500 PPM	
1-hexanol	4100-34	500 PPM	2	068	30 PPM	
hexafluoropropylene	4100-34	2,000 PPM	1	1.00	2,000 PPM	Scaling Factor 4.28
hexafluoropropylene	4100-33	500 PPM	1	1.00	500 PPM	Scaling Factor 2.16
hydrogen	4100-34	500 PPM	2	0.73	50 PPM	
methane	4100-35	5,000 PPM	1	1.00	5,000 PPM	Use 5,000 ppm CH_4
methanol	4100-35	5,000 PPM	1	0-64	400 PPM	
methanol	4100-34	500 PPM	2	0.68	30 PPM	
methyl bromide	4100-35	5,000 PPM	1	0.55	150 PPM	
methyl bromide	4100-34	500 PPM	2	0.90	200 PPM	
methyl chloride	4100-35	5,000 PPM	1	0.55	150 PPM	
methyl chloride	4100-34	500 PPM	2	0.90	200 PPM	
methyl ethyl ketone	4100-35	5,000 PPM	1	0.67	500 PPM	
methyl ethyl ketone	4100-34	500 PPM	2	0.68	30 PPM	
methyl propyl ketone	4100-35	5,000 PPM	1	0.67	500 PPM	
methyl propyl ketone	4100-34	500 PPM	2	0.68	30 PPM	
methylene chloride	4100-35	500 PPM	2	0.82	100 PPM	
nitroethane	4100-35	5,000 PPM	1	0.75	1,000 PPM	
nitroethane	4100-34	500 PPM	2	0.60	15 PPM	
nitromethane	4100-35	5,000 PPM	1	0.84	2,000 PPM	
nitromethane	4100-34	500 PPM	2	0.79	80 PPM	
I-pentanol	4100-35	5,000 PPM	1	0.77	1,200 PPM	
I-pentanol	4100-34	500 PPM	2	0.63	20 PPM	
propanal	4100-35	5,000 PPM	1	0.67	500 PPM	
propane	4100-34	500 PPM	2	0.86	150 PPM	
i-propanol	4100-34	500 PPM	2	0.66	25 PPM	
i-propanol	4100-35	5,000 PPM	1	0.72	800 PPM	
n-propanol	4100-35	5,000 PPM	1	0.62	300 PPM	
n-propanol	4100-34	500 PPM	2	0.63	20 PPM	

Table A-1

Gas	Monitor	Full Scale	Method	Voltage	Equivalent	Notes
propylene	4100-35	5,000 PPM	1	0.94	2,000 PPM	
propylene	4100-34	500 PPM	2	0.71	40 PPM	
R11 (Freon 11)	4100-33	500 PPM	4	0.80	500 PPM	1000 PPM Methane
R12 (Freon 12)	4100-33	500 PPM	4	.96	500 PPM	3000 PPM Methane
R22 (Freon 22)	4100-33	500 PPM	4	1.00	500 PPM	1000 PPM Methane
R113 (Freon 113)	4100-34	500 PPM	2	0.79	80 PPM	
R123 (Freon 123)	4100-33	500 PPM	4	1.00	500 PPM	500 PPM Methane
R134a (Freon 134a)	4100-33	500 PPM	4	1.00	500 PPM	1000PPM Methane
R134a (Freon 134a)	4100-33	100 PPM	4	1.00	100 PPM	60 PPM Methane
toluene	4100-34	500 PPM	2	0.76	60 PPM	
xylene	4100-34	500 PPM	2	0.71	40 PPM	

Table A-1

Method 1

Description:

Method 1 is for non linear output with a full scale of 5,000 PPM.

Calibration:

Use 1,000 ppm Methane (CH_4) calibration gas. Apply the calibration gas and adjust the span potentiometer so that the signal out value matches the “voltage’ listed in Table A-1.

Method 2

Description

Method 2 is for non linear output with a full scale of 500 PPM.

Calibration:

Use 500 ppm Carbon Monoxide (CO) calibration gas. Apply the calibration gas and adjust the span potentiometer so that the signal out value matches the voltage’ listed in Table A-1.

Method 3

Description:

Method 3 is for non linear output with a full scale of 500 PPM.

Calibration:

Use 500 ppm of the gas of interest. Apply the calibration gas and adjust the span potentiometer so that the signal out value matches the ‘voltage’ listed in Table A-1 (1 volt).

Method 4

Description:

Method 4 is for linear output with a full scale of 500 PPM of the refrigerant gas.

Calibration:

As the response to gas occurs slowly, Methane gas at a concentration indicated in the notes section of Table A-1 can be used as an alternative span gas.

Apply the calibration gas and adjust the span potentiometer so that the signal out value matches the voltage listed in Table A-1.