BACHARACH
The Measurable Difference

MGS-350

Gas Detector

Installation and Operation Manual
Instruction 6509-9000
Revision 1 – February 2013

Product Leadership • Training • Service • Reliability

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Section 1. Overview

1.1. General Information

The MGS-350 is a state-of-the-art fixed gas detector which can detect a wide range of different gases. The gas sensors can be used on a stand-alone basis or integrated into Controls or Building Management Systems (BMS).

Supported gas types include the following.

Category	Gases
Refrigerant gases	All refrigerant gases including: Ammonia, Carbon Dioxide, Halocarbons - HFCs, HCFCs, CFCs
Combustible gases	Methane, LPG, Propane, Butane, and Hydrogen
Toxic gases	Hydrogen Sulfide in sewage treatment, Carbon Monoxide in parking garages, etc.
Volatile Organic Compounds	Acetone, Benzene, Carbon Tetrachloride, Chloroform, Ethanol, Toluene, Trichloroethylene, etc.

CAUTION: Suitably qualified operators of the unit should be aware of the regulations and standards applicable to their industry/country for the operation of this unit. This manual is only intended as a guide and Bacharach bears no responsibility for the installation or operation of this unit.

CAUTION: Failure to install and operate the unit in accordance with these instructions and with industry guidelines may cause serious injury or death.

1.2. Specifications

Housings	Dimensions	Weight
Standard	145 x 185 x 80 mm 5.7 x 7.3 x 3.1 in	850 g 1.9 lb
IP66 w/ Digital Display	175 x 165 x 82 mm 6.9 x 6.5 x 3.2 in	719 g 1.6 lb
IP66	175 x 165 x 82 mm 6.9 x 6.5 x 3.2 in	660 g 1.5 lb
IP66 w/ Splash Guard	175 x 225 x 82 mm 6.9 x 8.9 x 3.2 in	756 g 1.7 lb
Splash Guard w/ M42 Thread	75mm x 50 mm 3.0 x 2.0 in	72 g 0.2 lb
IP66 w/ Remote Sensor Head	175 x 155 x 82 mm 6.9 x 6.1 x 3.2 in	917 g 2.0 lb
Exd	130 x 175 x 90 mm 5.1 x 6.9 x 3.5 in	4003 g 8.8 lb
Exd + Digital Display	140 x 180 x 130 mm 5.5 x 7.1 x 5.1 in	2322 g 5.1 lb
IP66 w/ Exd Remote Sensor Head	175 x 155 x 82 mm 6.9 x 6.1 x 3.2 in	1240 g 2.7 lb
IP66 w/ PRV Remote Sensor Head	175 x 155 x 82 mm 6.9 x 6.1 x 3.2 in	900 g 2.0 lb
IP66 Airflow/Duct Mount	175 x 125 x 82 mm 6.9 x 4.9 x 3.2 in	643 g 1.4 lb
Remote Face Plate	86 x 86 mm 3.4 x 3.4 in	86 g 0.2 lb

Category	Specification
Power Supply	12-24 VAC 50/60 Hz, 12-30 VDC, 5 W maximum
Power Monitoring	Green LED
Visual Alarm	Orange LED for low level; Red LED for high level
Analog Outputs	0-5 V, 0-10 V, 4-20 mA
Digital Interface	RS-485 (Modbus)
Digital Outputs	2 relays rated 1 A/125 VAC (resistive load)
Standard Compliance	CE mark UL/CSA/IEC/EN 61010-1 FCC CFR 47 Part 15, Subpart B

Sensor Information	Electro-Chemical (EC)	Semi-conductor (SC)	Catalytic (CAT)	Infrared (IR)
Sensor Life (Typical)	3 years	5-8 years	5 years	5 years

EC Sensors	Formula	Typical Detection Range(s)
Ammonia	NH_3	0-100 ppm, 0-1,000 ppm, 0-5,000 ppm
Carbon Monoxide	CO	0-100 ppm, 0-500 ppm, 0-1,000 ppm
Chlorine	Cl_2	0-20 ppm
Chlorine Dioxide	ClO_2	0-1 ppm
Ethylene Oxide	C_2H_4O	0-20 ppm
Ethylene	C_2H_4	0-20 ppm, 0-1,000 ppm
Fluorine	F_2	0-1 ppm
Hydrazine	N_2H_4	0-1 ppm
Silane - Hydride	SiH_4	0-5 ppm
Hydrogen	H_2	0-1,000 ppm, 0-10,000 ppm, 0-100% LEL
Hydrogen Chloride	HCl	0-50 ppm
Hydrogen Cyanide	HCN	0-50 ppm
Hydrogen Sulfide	H_2S	0-30 ppm, 0-200 ppm
Nitric Oxide	NO	0-10 ppm, 0-500 ppm
Nitrogen Dioxide	NO_2	0-50 ppm

EC Sensors	Formula	Typical Detection Range(s)
Oxygen	O_2	0-30%
Ozone	O_3	0-2 ppm
Phosgene	$COCl_2$	0-1 ppm
Phosphine	PH_3	0-5 ppm
Sulfur Dioxide	SO_2	0-100 ppm

IR Sensors	Formula	Typical Detection Range(s)	
Carbon Dioxide	CO_2	Standard range:	0-10,000, 0-1% volume
		Special request:	0-5,000ppm, 0-2%, 0-5%, 0-10%
Combustible Gases	Selected	0-100% LEL, 0-100% volume	

CAT Sensors	Formula	Typical Detection Range(s)
All Combustible Gasses	Selected	0-100% LEL

SC Sensors	Example Gases	Typical Detection Range(s)
HFCs	R134a, R404A, R407C, R410A, R507	10-10,000 ppm
HCFCs	R22	10-10,000 ppm
CFCs	R11, R12	10-10,000 ppm
Combustibles	Methane (Natural gas), Propane, Butane, LPG, Isobutane, Ethylene	0-10,000 ppm
Ammonia	NH_3	0-10,000 ppm
Hydrogen	H_2	0-10,000 ppm
VOCs	Acetone, Chloroform, Ethanol, Methanol, Methyl and Methylene Chloride, Ethyl and Ethylene Chloride	0-10,000 ppm

NOTE: The actual factory calibration gas and detection range is marked on each instrument.

Sensor Types	Temperature Ranges	
	Standard Enclosure	IP 66
SC	-4º to 122º F (-20º to 50º C)	-40º to 122º F (-40º to 50º C)
EC	-4º to 104º F (-20º to 40º C)	-40º to 104º F (-40º to 40º C)
CAT	-4º to 122º F (-20º to 50º C)	-40º to 122º F (-40º to 50º C)
IR	-4º to 122º F (-20º to 50º C)	-40º to 122º F (-40º to 50º C)

For temperature requirements lower than -40°, please contact the factory.

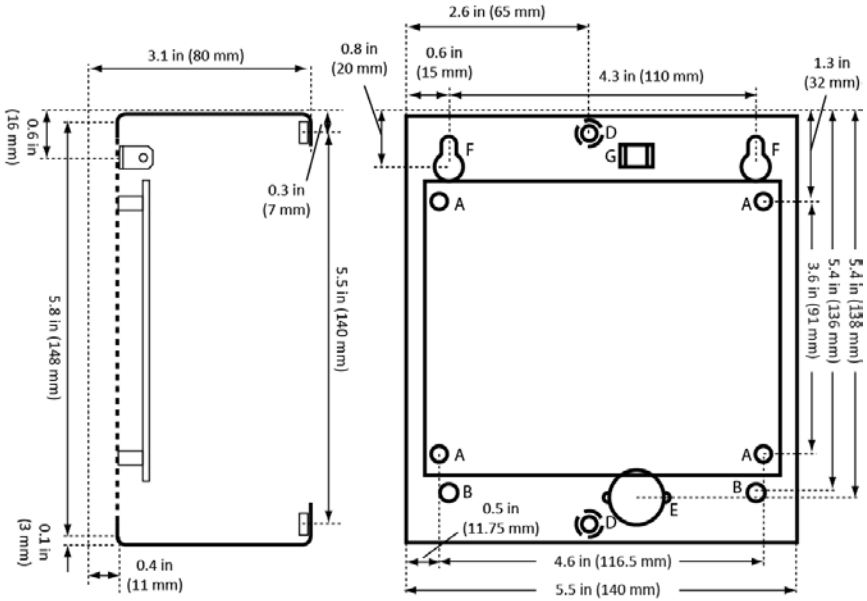

Figure 1. MGS-350 Standard Housing

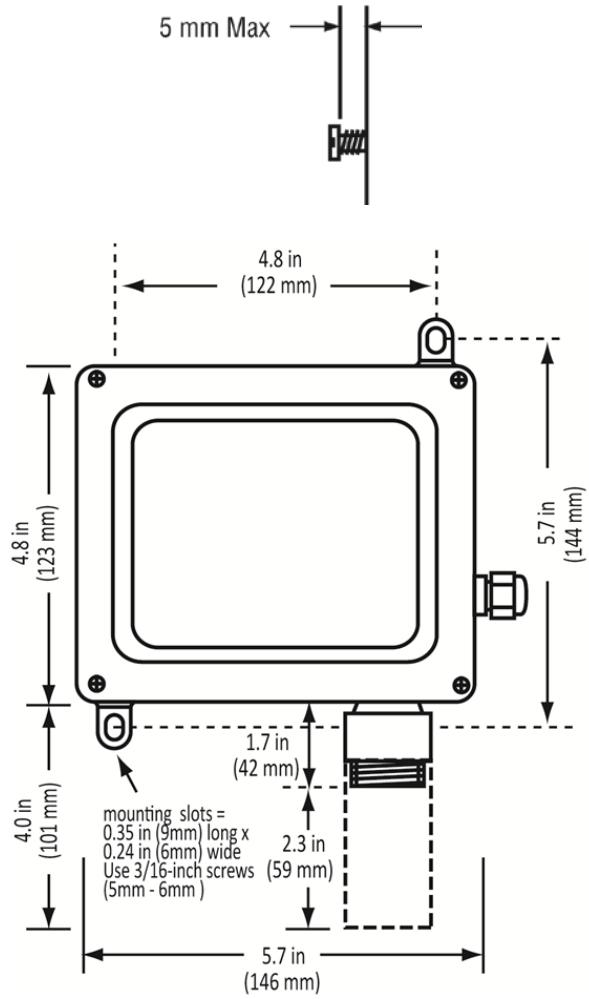

Figure 2. MGS-350 IP66 Housing (with Splash Guard)

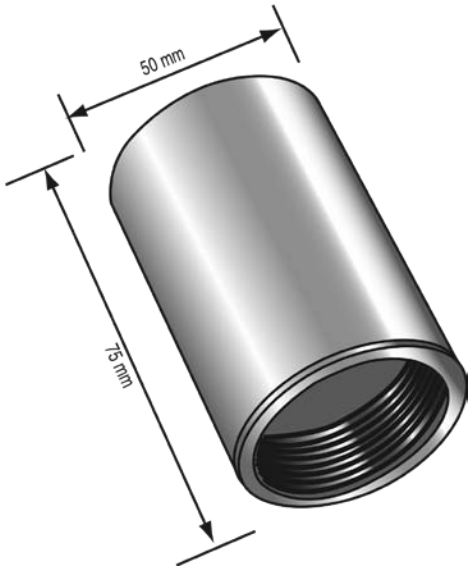

Figure 3. IP66 Splashguard (M42 x 1.5 Thread)

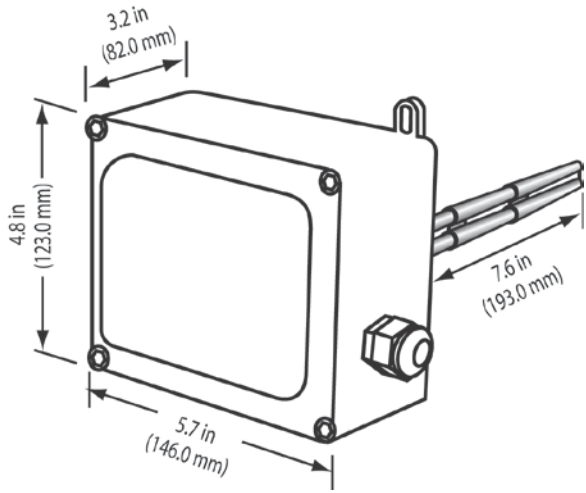

Figure 4. IP66 Duct Mount Housing

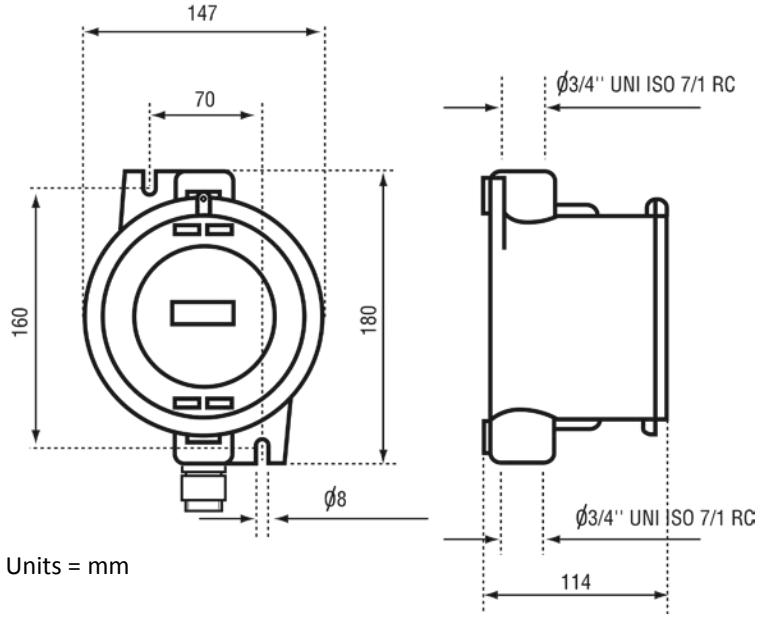

Figure 5. Exd Housing

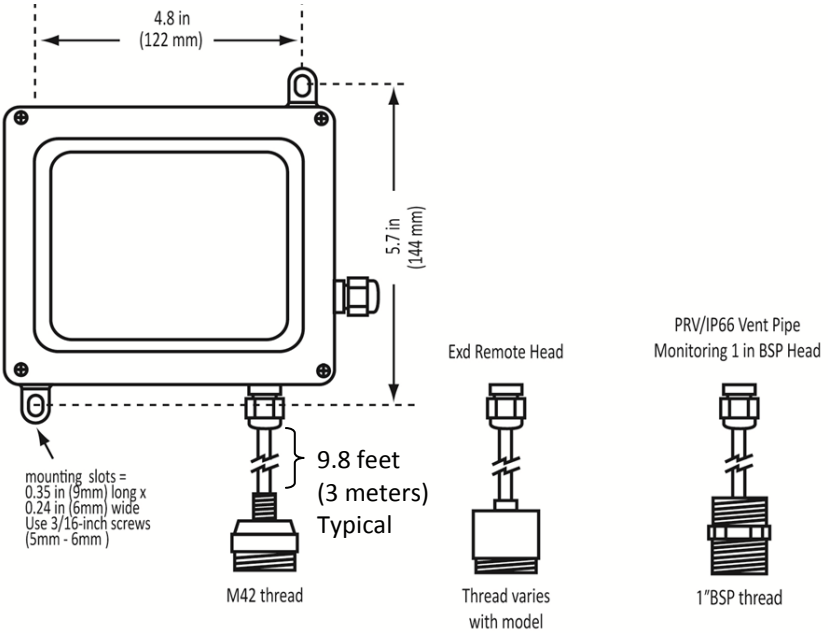

Figure 6. IP66 Housing with Remote Sensor Head

NOTE: For the Exd Remote Head and 16.4 ft (5 m) cable, the thread varies based on the model.

Section 2. Installation and Wiring

WARNING: Explosion hazard! Do not mount the MGS-350 in an area that may contain flammable liquids, vapors, or aerosols. Operation of any electrical equipment in such an environment constitutes a safety hazard.

CAUTION: The MGS-350 contains sensitive electronic components that can be easily damaged. Do not touch nor disturb any of these components.

NOTE: The mounting location of the monitor should allow it to be easily accessible for visual monitoring and servicing.

NOTE: The monitor must be connected by a marked, suitably located and easily reached switch or circuit-breaker as means of disconnection.

NOTE: Connect monitor power and signaling terminals using wiring that complies with local electrical codes or regulations for the intended application.

CAUTION: An earth ground connection must be made when using the vented metal enclosure or Exd enclosure. The safety of this equipment is dependent on the integrity of the power supply and the grounding of the MGS-350 enclosure.

IMPORTANT: For main PCB connections, Bacharach suggests using one of the following:

- Belden 8761, 22 AWG single-pair shielded cable
- Belden 8450, 22 AWG individually shielded pairs
- an alarm type cable of 7/0.2 mm, 22 AWG.

NOTE: All external connections are made to the motherboard through a cable fitting. A cable tie should be fitted within approximately 0.75" (20 mm) of the cable gland inside the enclosure. The connectors are plug-and-socket type, and will accept wire of 16-22 AWG. Cable runs should be kept to a minimum.

NOTE: This instrument can be equipped with a semiconductor sensor for the detection of refrigerant, combustible and VOC gases. Semiconductor sensors are not gas specific and respond to a variety of other gases including propane exhaust, cleaners, and solvents. Changes in temperature and humidity may also affect the sensor's performance.

2.1. General Placement Guidelines

NOTE: The MGS-350 should be installed plumb and level and securely fastened to a rigid mounting surface.

Sensors must be located within the appropriate wire lengths from the central control unit (if used). In all cases the sensor supplied is designed for maximum sensitivity to a particular gas. However, in certain circumstances false alarms may be caused by the occasional presence of sufficiently high concentrations of other gaseous impurities. Examples of situations where such abnormalities may arise include the following:

- Plant room maintenance activity involving solvent or paint fumes or refrigerant leaks.
- Accidental gas migration in fruit ripening/storage facilities (bananas - ethylene, apples - carbon dioxide).
- Heavy localized exhaust fumes (carbon monoxide, dioxide, propane) from engine-driven forklifts in confined spaces or close to sensors.

Bacharach recommends setting the alarm delay to minimize false alarms.

2.2. Machinery Rooms

There is no absolute rule in determining the number of sensors and their locations. However, a number of simple guidelines will help to make a decision. Sensors monitor a point as opposed to an area. If the gas leak does not reach the sensor then no alarm will be triggered. Therefore, it is extremely important to carefully select the sensor location. Also consider ease of access for maintenance.

The size and nature of the site will help to decide which method is the most appropriate to use. Locations requiring the most protection in a

machinery or plant room would be around compressors, pressurized storage vessels, refrigerant cylinders or storage rooms or pipelines. The most common leak sources are valves, gauges, flanges, joints (brazed or mechanical), filling or draining connections, etc.

- When **mechanical or natural ventilation** is present, mount a sensor in the airflow.
- In machinery rooms where there is **no discernible or strong airflow** then options are:

  Point Detection, where sensors are located as near as possible to the most likely sources of leakage, such as the compressor, expansion valves, mechanical joints or cable duct trenches.
  Perimeter Detection, where sensors completely surround the area or equipment.

- For **heavier-than-air gases** such as halocarbon and hydrocarbon refrigerants such as R404A, propane, and butane sensors should be located near ground level.
- For **lighter-than-air gas** (e.g., ammonia), the sensor needs to be located above the equipment to be monitored on a bracket or high on a wall within 12 in (300 mm) of (or on) the ceiling – provided there is no possibility of a thermal layer trapped under the ceiling preventing gas from reaching the sensor.

NOTE: At very low temperatures (e.g., refrigerated cold store), ammonia gas becomes heavier than air.

- With similar density or miscible gases (e.g., CO or $CO_{2)}$, sensors should be mounted about head high (about 5 ft [1.5 m]).
- Sensors should be positioned just far enough back from any high-pressure parts to allow gas clouds to form and be detected. Otherwise, a gas leak might pass by in a high-speed jet and not be detected by the sensor.
- Make sure that pits, stairwells and trenches are monitored since they may fill with stagnant pockets of gas.
- If a pressure relief vent (PRV) pipe is fitted to the system, it may be a requirement to mount a sensor to monitor this vent pipe. It could be positioned about 6 feet (2 m) above the PRV to allow gas clouds to form.
- For racks or chillers pre-fitted with refrigerant sensors, these should be mounted so as to monitor the compressors. If extract ducts are fitted the airflow in the duct may be monitored.

2.3. Refrigerated Spaces

In refrigerated spaces, sensors should be located in the return airflow to the evaporators on a sidewall (below head-high is preferred), or on the ceiling, not directly in front of an evaporator. In large rooms with multiple evaporators, sensors should be mounted on the central line between 2 adjacent evaporators, as turbulence will result in airflows mixing.

2.4. Chillers

In the case of small water- or air-cooled enclosed chiller units mount the sensor so as to monitor airflow to the extract fans. With larger models also place a sensor inside the enclosure under or adjacent to the compressors.

In the case of outdoor units:

- For enclosed air-cooled chillers or the outdoor unit for variable refrigerant volume and variable refrigerant flow (VRV/VRF) systems, mount the sensor so as to monitor airflow to the extract fan. With large units also place a sensor inside the enclosure under or adjacent to the compressors.

In the case of non-enclosed outdoor units:

- If there is an enclosed machinery section locate a sensor there.
- In the case of units with enclosed compressors, mount sensors in the enclosures.
- Where you have protective or acoustic panels mount the sensor low down under the compressors where it is protected by the panels.
- With air-cooled chillers or air-cooled condensers with non-enclosed condenser sections it is difficult to effectively monitor leaks in the coil sections. With some designs it will be possible using an airflow sensor to monitor airflow to the start–up fans in the front or rear sections.
- If there is a possibility of refrigerant leaks into a duct or air-handling unit install a sensor to monitor the airflow.

Weatherproof sensors should be used for unprotected outdoor applications.

2.5. Air Conditioning (Direct Systems VRF/VRV)

For compliance with EN378, at least one detector shall be installed in each occupied space being considered and the location of detectors shall be chosen in relation to the refrigerant and they shall be located where the refrigerant from the leak will collect. In this case refrigerants are heavier than air and detectors should have their sensors mounted low, e.g., at less than bed height in the case of a hotel or other similar Category Class A spaces. Ceilings or other voids if not sealed are part of the occupied space.

CAUTION: Monitoring ceiling voids in a hotel room would not strictly comply with EN378.

Do Mount In-Room Sensors…	Don't Mount Sensors…
…at less than the normal heights of the occupants. E.g., in a hotel room this is less than bed height (between 8 and 20 inches [200 and 500 mm] off the floor).	…under mirrors.
…away from drafts and heat sources like radiators, etc.	…at vanity units.
… to avoid sources of steam.	…in or near bathrooms.

2.6. Remote Sensor Head Installation

If you do not wish to surface mount the MGS-350, a brushed stainless steel faceplate is available. The remote sensor is mounted in an electrical box 1.7 in (44 mm) deep to which the vented faceplate is fitted.

CAUTION: To avoid component mix-up, do not remove sensor boards from multiple units at the same time. Alternatively, label them, or match the serial number on the main PCB and the remote sensor PCB when reinstalling.

1. Remove the connector from the sensor PCB to feed the cable through the housing.
2. Immediately refit the connector to the sensor board in the back of the box. The MGS-350 and remote sensor must be kept together as they are calibrated together and are a matched pair.

To clean, the faceplate should be lightly dusted.

IMPORTANT: Do not spray chemicals on the MGS-350.

2.7. Components Overview and Configuration

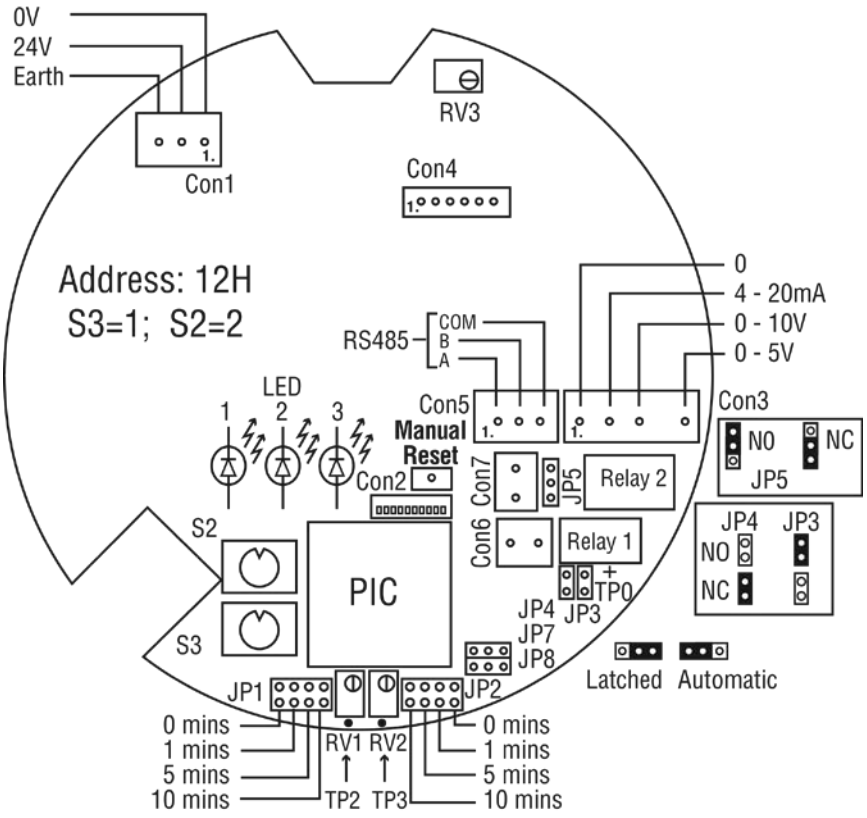

Figure 7. MGS-350 Connections and Key Components

Item	Description
LEDs	LED 1 Green Power Status LED 2 Red Software Check (2-second flash) Relay 2 High-level alarm LED 3 Yellow Software Check (2-second flash) Relay 1 Low-level alarm
CON1	Input supply voltage and consumption (see below). Supply voltages to be either: • 12 to 24 VAC or • 12 to 30 VDC. **CAUTION:** An earth ground connection must be made when using the vented metal enclosure or Exd enclosure. The safety of this equipment is dependent on the integrity of the power supply and the grounding of the MGS-350 enclosure.
CON2	Optional display connector
CON3	Analog Output Pin 1: 0 V Pin 2: 4-20 mA Load resistance < 400 Ω Pin 3: 0-10 V Load resistance > 10 KΩ Pin 4: 0-5 V Load resistance > 10 KΩ
CON4	Daughter board plug-in connection (installed in factory)
CON5	RS-485 Interface for connection to controller. Pin 1: RS-485 “A” Pin 2: RS-485 “B” Pin 3: Common (shield) For the communications cable, use a minimum 2 conductor with a common drain wire (screen). Set address through address switches S2 and S3.
CON6	Relay 1 contacts (Low-level alarm, indicated by yellow LED3)

<table>
<tr><th>Item</th><th>Description</th></tr>
<tr><td>CON7</td><td>Relay 2 contacts (High-level alarm. Indicated by red LED2)</td></tr>
<tr><td>S2 and S3</td><td>Hexadecimal Address Switches – Used to set a unique address for the sensor when multiple sensors are connected to a controller.
Address range: 1 to 99 decimal (0x01 to 0x63)

S2 = Least Significant Hex Character (0-F)
S3 = Most Significant Hex Character (0-F)
<table>
<tr><th>ADDR</th><th>S3</th><th>S2</th><th>ADDR</th><th>S3</th><th>S2</th><th>ADDR</th><th>S3</th><th>S2</th></tr>
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</table>
</td></tr>
<tr><td>JP1</td><td>Relay 1 delayed response time (Default: 0 minutes)</td></tr>
</table>

Item	Description
JP2	Relay 2 delayed response time (Default: 0 minutes)
JP3/JP4	Jumpers to set normally open/closed for relay 1
JP5	Jumper to set normally open/closed for relay 2
JP7	Jumper to set latching for relay 2 (Default Automatic).
JP8	Jumper to set latching for relay 1 (Default Automatic).
RV1 **TP0** **TP2**	Alarm Threshold level set by RV1 and can be set by putting a meter between TP0 (negative) and TP2 (positive) and adjusting RV1 (scale is 0 to 5V e.g. 2.5V is 50% of calibrated range) to the setpoint at which the relay activates. Check rating plate on the side of the MGS-350 for alarm relay settings.
RV2 **TP0** **TP3**	Alarm Threshold level set by RV2 and can be set by putting a meter between TP0 (negative) and TP3 (positive) and adjusting RV2 (scale is 0 to 5V e.g. 2.5V is 50% of calibrated range) to the setpoint at which the relay activates. Check rating plate on the side of the MGS-350 for alarm relay settings.

NOTE: After adjusting relay settings or modifying jumpers, the unit must be powered off and on again to store the new settings.

2.8. Connecting to an MGS Controller

Multiple MGS-350s may connect to a 2- or 6-channel MGS Controller. For details on wiring and installation, refer to the MGS Controller Manual (P/N 6709-9000).

NOTE: The MGS-350 has an addressing capability and a RS-485 interface for connection to higher-level controller systems.

2.9. Connecting to a Repeater

If you wish to use more than 31 MGS-350 sensors in the system or if your cable is longer than 1000 m, then you must install a repeater. An example repeater is the IR12 by Innotech. The detailed specifications of this particular repeater are available from the following link:

www.innotech.com.au/products/pdf/dsrptr.pdf

Section 3. Operation and Stabilization

On powering up, the MGS-350 will sense for the presence of gas after an initial warm-up delay and a 2-second software check. The green LED will light and the red and yellow LEDs will flash during the software check.

In an alarm condition:

- green LED stays on
- low level alarm: yellow LED will be on and relay 1 will operate
- high level alarm: yellow and red LEDs will be on and relay 1 and 2 will operate
- V or I output changes proportionally with gas concentration.

Typical times to stabilize for various sensor types are shown below. The units are powered up and the output voltage monitored on the 0-10V output. The approximate time for the signal to drop to 0V is shown.

Sensor Type	Stabilized (≈0 V)
Electrochemical (EC)	20-30 seconds
Catalytic (CAT)	7-15 minutes
Semiconductor (SC)	1-3 minutes
Infrared (IR)	2 minutes

The electro-chemical sensor on power up outputs a signal voltage normally below the set alarm level. IR typically shows 0V. Semiconductors and Catalytic output are normally over the + max scale i.e., > 10V. All move towards zero as they stabilize.

If sensors have been in long-term storage or the detectors have been turned off for a long period, stabilization is much slower. However within 1-2 hours sensors should have dropped below the alarm level and be operational. You can monitor progress exactly by monitoring the 0-10V output, when the output settles around zero (400 ppm in the case of CO_2 sensors) the sensor is stabilized. In exceptional circumstances the process can take up to 24 hours or more.

Section 4. Functional Tests and Calibration

4.1. Introduction

To comply with the requirements of EN378 and the European F-GAS regulation, sensors must be tested annually. However, local regulations may specify the nature and frequency of this test.

CAUTION: Check local regulations on calibration or testing requirements.

NOTE: The MGS-350 is calibrated at the factory. After installation, a zero adjustment may be required due to differences in environmental conditions.

IMPORTANT: If the MGS-350 is exposed to a large leak it should be tested to ensure correct functionality by electrically resetting the zero setting and carrying out a bump test. See procedures below.

IMPORTANT: Bacharach recommends annual checks and gas calibration. Bacharach also recommends sensor replacement every 3 years or as required. Calibration frequency may be extended based on application, but should never exceed 2 years.

IMPORTANT: In applications where life safety is critical, calibration should be done quarterly (every 3 months) or on a more frequent basis. Bacharach is not responsible for setting safety practices and policies. Safe work procedures including calibration policies are best determined by company policy, industry standards, and local codes.

IMPORTANT: Failure to test or calibrate the unit in accordance with applicable instructions and with industry guidelines may result in serious injury or death. The manufacturer is not liable for any loss, injury, or damage arising from improper testing, incorrect calibration, or inappropriate use of the unit.

IMPORTANT: Before testing the sensors on-site, the MGS must have been powered up and allowed to stabilize.

IMPORTANT: The testing and/or calibration of the unit must be carried out by a suitably qualified technician, and must be done:

- in accordance with this manual
- in compliance with locally applicable guidelines and regulations.

Suitably qualified operators of the unit should be aware of the regulations and standards set down by the industry/country for the testing or calibration of this unit. This manual is only intended as a guide and, insofar as permitted by law, the manufacturer accepts no responsibility for the calibration, testing, or operation of this unit.

The frequency and nature of testing or calibration may be determined by local regulation or standards.

EN378 and the F-GAS Regulation require an annual check in accordance with the manufacturer's recommendation.

NOTE: For improved accuracy and response, the instrument should be zeroed and calibrated in the environment in which it is being installed.

There are two concepts that need to be differentiated:

- bump test
- calibration.

Bump Test	Exposing the sensor to a gas and observing its response to the gas. The objective is to establish if the sensor is reacting to the gas and all the sensor outputs are working correctly. There are two types of bump test. **Quantified:** A known concentration of gas is used. **Non-Quantified:** A gas of unknown concentration is used.

Calibration	Exposing the sensor to a calibration gas, setting the "zero" or standby voltage to the span/range, and checking/adjusting all the outputs, to ensure that they are activated at the specified gas concentration.

CAUTION: Before you carry out the test or calibration:

- Advise occupants, plant operators, and supervisors.
- Check if the MGS-350 is connected to external systems such as sprinkler systems, plant shut down, external sirens and beacons, ventilation, etc. and disconnect as instructed by the customer.
- Deactivate alarm delays if selected (see JP1 and JP2).
- For bump test or calibration the MGS should be powered up overnight. The instrument should be fully stabilized per Section 3.

4.2. Bump Testing

After installation, the units should be bump tested. Expose the sensors to test gas (NH_3, CO_2, etc.). The gas should put the system into alarm and light LEDs 2 and 3. If a delay is set, it will prevent the relay from switching until the delay period passes.

With a bump test you can see the functions of the sensor - LEDs 2 and 3 will light, the relay will function, and the output selected (0-10V, for example) will show the gas level.

NOTE: Ideally bump tests are conducted on site in a clean air atmosphere.

NOTE: Prior to carrying out a bump test, check and adjust the zero setting.

NOTE: Do not pressurize the sensor.

NOTE: For semiconductor and catalytic sensors, you MUST use calibration gas in a balance of air (*not* N_2).

IMPORTANT: After a semiconductor or electrochemical sensor is exposed to a substantial gas leak, the sensor should be checked and replaced if necessary.

NOTE: Procedures for bump test and calibration vary depending on the sensor technology used and the gas in question. The MGS-350 is available in four sensor versions: Semiconductor (SC), Electrochemical (EC), Catalytic (CAT), and Infrared (IR).

Step	Bump Testing Using Calibration Gas Cylinders
1	Remove the enclosure lid of the gas detector (not in an exhaust area).
2	Connect voltmeter to monitor sensor response, monitor 0-10V on CON3 across pins 1 and 3.
3	Expose the sensor to gas from the cylinder. You can place the entire MGS-350 into a plastic bag or use a plastic hose/hood to direct gas to the sensor head. A response of above 80% is acceptable.

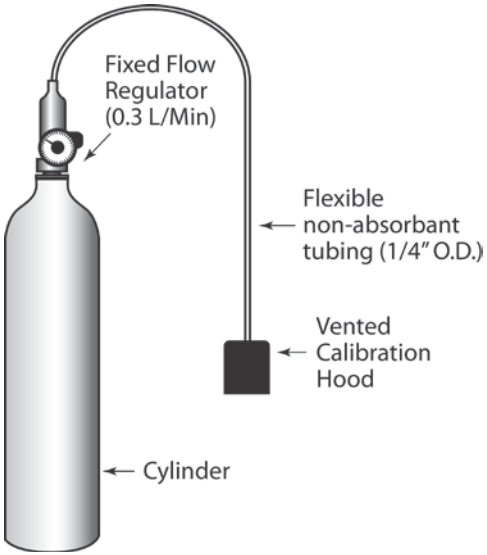

Figure 8. Gas Cylinder and Test Hardware

Gas ampoules are convenient and inexpensive alternatives to using gas cylinders for bump testing.

Step	Bump Testing Using Gas Ampoules
1	Make sure that both the ampoules and the calibration beaker are clean and dry.
2	Unscrew the beaker hold screw and place the ampoule so that it sits in the base of the beaker (see Figure 9).
3	Tighten the wing-nut screw onto the ampoule without breaking it.
4	Remove the enclosure lid of the gas detector (not in an exhaust area).
5	Connect a voltmeter to monitor sensor response. Monitor 0-10v on CON3 across pins 1 and 3.
6	Place the beaker over the sensor head using the multi sensor adaptor to fit the sensor, or, if an Exd, IP66 or Remote sensor head version, screw the beaker on the remote sensor head M42 thread or M35 thread adaptor. It should be as tight fitting as possible to allow maximum gas exposure.

Step	Bump Testing Using Gas Ampoules
7	Tighten the wing-nut screw onto the ampoule until it shatters allowing the gas to diffuse in the beaker. It should be left in place for approximately 5 minutes.
8	The voltage output will increase. This confirms that the sensor is responding. A response equivalent to at least 50% (typically) of the test gas will confirm that the system is in order.
9	Remove the beaker from the sensor. Carefully remove any ampoule remains from the gas detector and beaker.

Figure 9. Gas Ampoules for Bump Testing

4.3. Calibration: Exchange Method

Bacharach recommends replacement of the sensor PCB with a pre-calibrated certified unit every 3 years for semiconductor (SC), infrared (IR) and catalytic (CAT), and 2 years for Electrochemical (EC) types.

Tools required:

- A pre-calibrated PCB sensor board
- A voltmeter (crocodile clips recommended)

Step	Calibration: Exchange Method (Estimate: 10 minutes/sensor)
1	Power off the unit.
2	Fit the new pre-calibrated sensor and PCB in place of the old sensor and PCB. Set time delays if appropriate, and power on the unit.
3	Carry out a bump test to confirm that the sensor is responding.
4	Keep records of the test date, sensor serial number, and any observations.

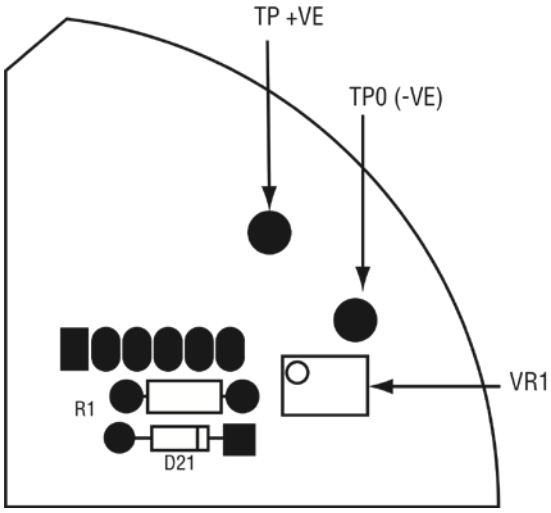

Figure 10. Example Pre-calibrated Sensor Board

There are a number of advantages to sensor exchange. It is simpler and quicker than gas calibration. Also, you avoid sensor end-of-life concerns.

4.4. Calibration: Gas Method

This is the adjustment of the gas detector's accuracy using calibration gas. Bacharach offers a calibration kit that consists of a Calibration gas cylinder and a flow regulation valve with flexible non-absorbent tubing and vented calibration hood.

In many cases this option may be expensive because of the cost of visiting a site and the cost of the calibration gas and possibly excess delivery charges as it is classified as a hazardous substance.

The MGS-350 consists of a motherboard PCB and a sensor board PCB. There are four sensor board versions: SC, EC, CAT and IR, but the motherboard is the same for all models.

Calculating Calibration Voltage

Calibration is done on a 0-10V scale, however the alarm relay setting pots work on a 0-5V scale.

Sensor outputs are linear. As long as you have a gas cylinder of known concentration you can calibrate to any desired range.

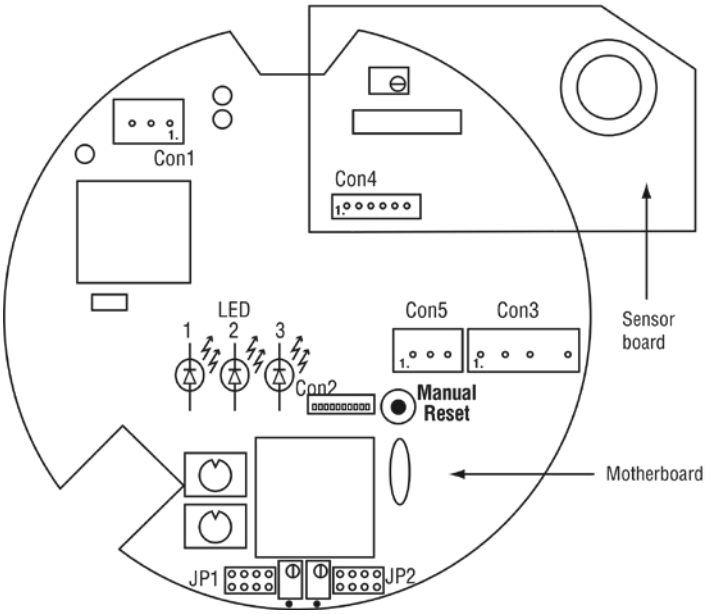

Figure 11. Example Sensor Board and Motherboard

Example: For a sensor range of 0-10,000 ppm and a cylinder of the target gas at 800 ppm:

$$\textbf{Voltage} = \textbf{Target Gas Concentration} \times \frac{\textbf{5 V}}{\textbf{Sensor Range}}$$

$$\textbf{Voltage} = \textbf{800 ppm} \times \frac{\textbf{5 V}}{\textbf{10000 ppm}} = \textbf{0.4 V}$$

So the output voltage signal should be adjusted to 0.4V.

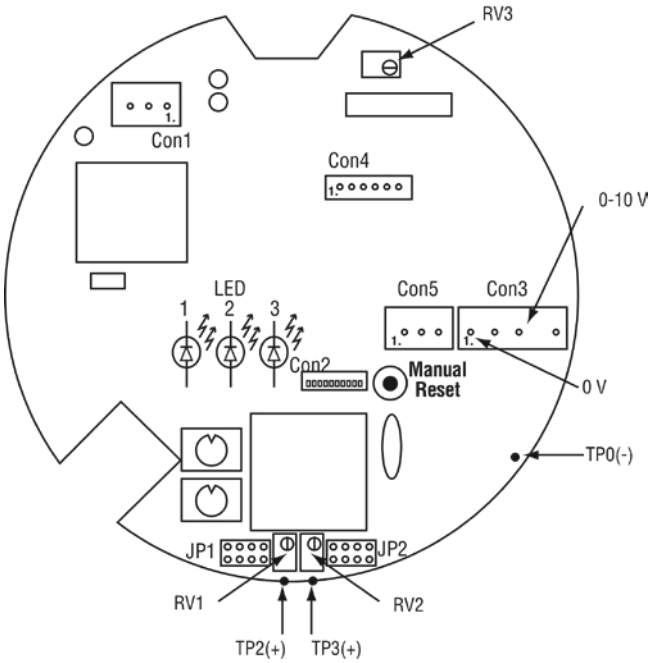

Figure 12. Adjusting Alarm Relays on the Mother Board

IMPORTANT: RV3 is used to adjust the relationship between the 0-10 V scale and the 4-20mA scales. THIS IS FACTORY SET AND SHOULD NOT BE ADJUSTED.

Tools required:

- Gas cylinder with the appropriate gas and concentration
- A voltmeter (crocodile clips recommended)

Step	Calibration: Mother Board Alarm Relays (Estimate: 30 minutes/sensor)
1	Monitor the output between TP0 (negative) and TP2 (positive). Set the low alarm at the desired level using RV1. This is the set point at which the low relay activates.
2	Monitor the output between TP0 (negative) and TP3 (positive). Set the high alarm at the desired level using RV2. This is the set point at which the high relay activates.
3	After adjusting alarm settings or modifying jumpers, the unit must be powered off and on again to store the new settings.

4.5. Calibration: Gas Method for SC Sensors

There are two adjustments required: the zero and the span. They are performed on the sensor board, but are monitored on the motherboard at the 0-10 V output.

Step	Calibrating Semiconductor (SC) Sensors
1	RV2 is used to adjust the zero of the sensor. On the motherboard, monitor the output between TP0 (negative) and CON3 pin 3 (positive) and adjust RV2 until the volt meter reads 0 V or slightly positive (0.01 V is acceptable).
2	RV1 is used to calibrate the range (span) of the sensor. On the motherboard, monitor the output between TP0 (negative) and CON3 pin 3 (positive). Expose the sensor to calibration gas. Allow a minimum of 3 minutes to stabilize and adjust RV1 until the voltmeter reads the voltage calculated in section 4.4.

NOTE: For semiconductor sensors, you MUST use calibration gas in a balance of air (*not* N_2).

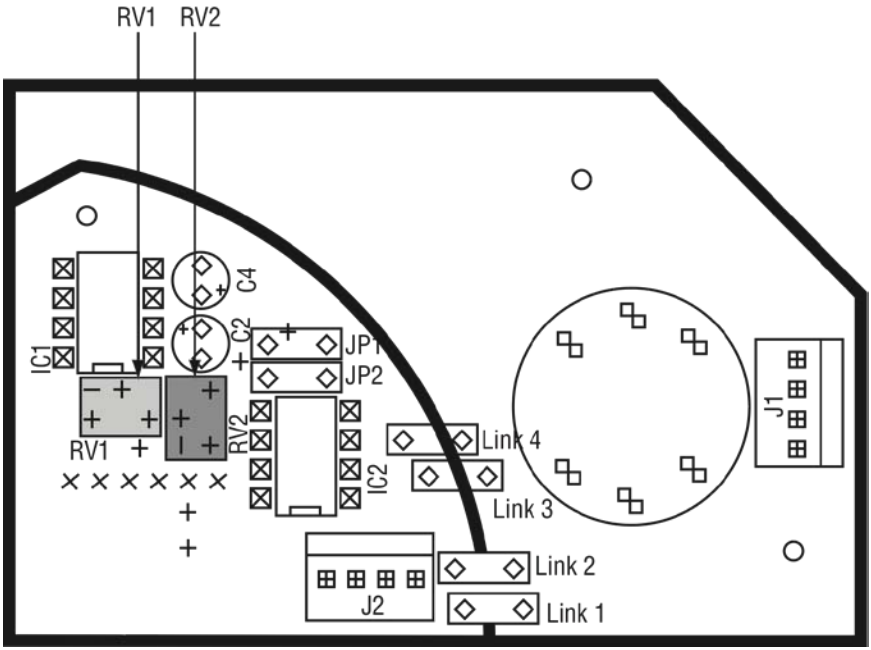

Figure 13. SC Sensor Board

4.6. Calibration: Gas Method for CAT Sensors

There are two adjustments required: the zero and the span. They are performed on the sensor board but are monitored on the motherboard at the 0-10V output.

IMPORTANT: R7 is used to set the supply voltage to the sensor and can be monitored between TP0 (negative) and Link 4 (positive). THIS IS FACTORY SET AND SHOULD NOT BE ADJUSTED.

Step	Calibrating Catalytic (CAT) Sensors
1	R3 is used to adjust the zero of the sensor. On the motherboard, monitor the output between TP0 (negative) and CON3 pin 3 (positive) and adjust R3 until the voltmeter reads approximately 0 V.
2	R1 is used to calibrate the range (span) of the sensor. On the motherboard, monitor the output between TP0 (negative) and CON3 pin 3 (positive). Expose the sensor to calibration gas. Allow a minimum of 3 minutes to stabilize, then adjust pot R1 until the voltmeter reads the voltage calculated in section 4.4.

NOTE: For catalytic sensors, you MUST use calibration gas in a balance of air (*not* N_2).

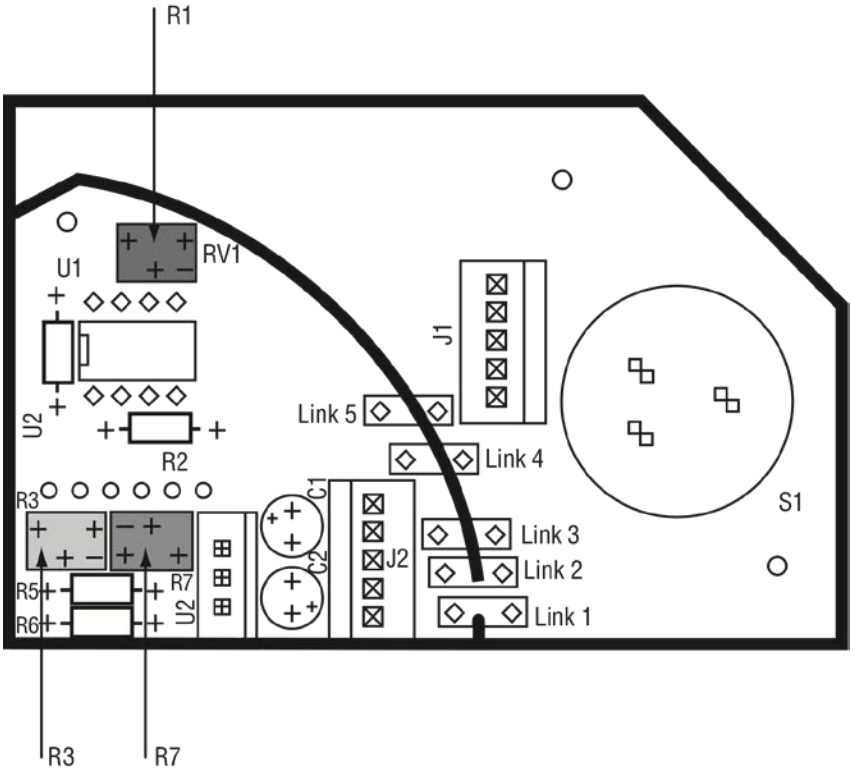

Figure 14. CAT Sensor Board

4.7. Calibration: Gas Method for EC Sensors

There are two adjustments required: the zero and the span. They are performed on the sensor board but are monitored on the motherboard at the 0-10V output.

IMPORTANT: VR204 (not always fitted) is used to set the bias voltage to the sensor and can be monitored between TP0 (negative) and U2 Pin 3 (positive). THIS IS FACTORY SET AND SHOULD NOT BE ADJUSTED.

Step	Calibrating Electrochemical (EC) Sensors
1	VR201 is used to adjust the zero of sensor. On the motherboard, monitor the output between TP0 (negative) and CON3 pin 3 (positive) and adjust VR201 until the voltmeter reads 0 V or slightly positive (0.01 V is acceptable).
2	VR202 is used to calibrate the range (span) of the sensor. On the motherboard, monitor the output between TP0 (negative) and CON3 pin 3 (positive). Expose the sensor to calibration gas. Allow a minimum of 3 minutes to stabilize and then adjust VR202 until the voltmeter reads the voltage calculated in section 4.4.

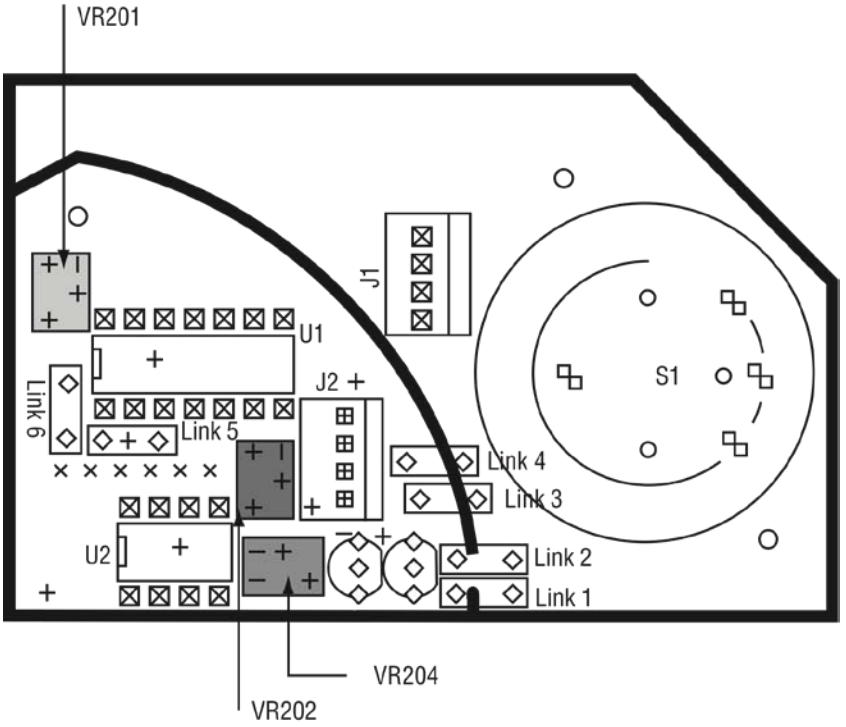

Figure 15. EC Sensor Board

4.8. Calibration: Gas Method for IR Sensors

There are two adjustments required: the zero and the span. They are performed on the sensor board but are monitored on the motherboard at the 0-10V output.

NOTE: R3 is not fitted.

Step	Calibrating Infrared (IR) Sensors
1	R7 is used to adjust the zero of the sensor. On the motherboard, monitor the output between TP0 (negative) and CON3 pin 3 (positive). Expose the sensor to nitrogen or zero air. Allow a minimum of 3 minutes to stabilize, and then adjust R7 until the voltmeter reads 0 V or slightly positive (0.01 V is acceptable).
2	R1 is used to calibrate the range (span) of the sensor. On the motherboard, monitor the output between TP0 (negative) and CON3 pin 3 (positive). Expose the sensor to calibration gas. Allow a minimum of 3 minutes to stabilize and then adjust R1 until the voltmeter reads the voltage calculated in section 4.4.

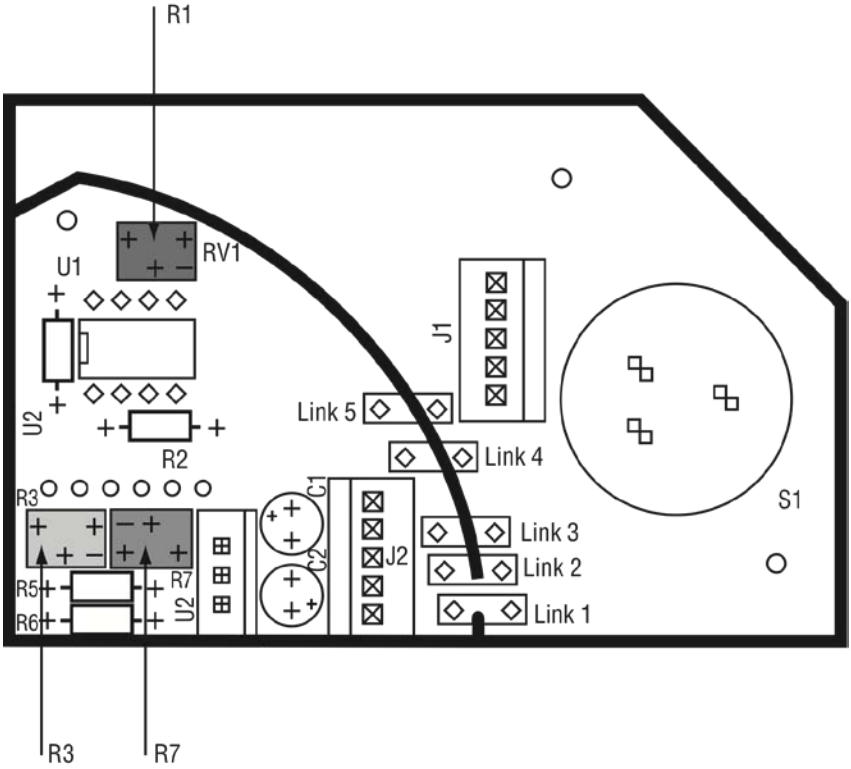

Figure 16. IR Sensor Board

Section 5. Troubleshooting

Symptom	Possible Cause(s)
Green LED off after power up	• Check power supply. Check wiring. • Check for proper voltage at CON1. • MGS-350 was possibly damaged. Check by installing another MGS-350 to confirm the fault.
Red light on, green led off (indicates a fault)	• Sensor may be disconnected from printed circuit board. Check to see sensor is properly inserted into board. • The sensor has been damaged or has reached the end of life and needs to be exchanged. Contact Bacharach for instructions and support.
Alarms in the absence of a leak; False alarms	• Try setting an alarm delay. • Perform a bump test to ensure proper operation. • Increase the response time delay to help eliminate false alarms. • Try adjusting the zero setting.

CE DECLARATION OF CONFORMITY

The manufacturer of the products covered by this declaration:	Bacharach, Inc. 621 Hunt Valley Circle New Kensington, PA 15068
Year conformity is declared:	2012
Product(s):	MGS
Model(s):	MGS-350

The undersigned hereby declares that the above referenced products are in conformity with the provisions of the following standard(s) and is in accordance with the following directive(s).

Directive(s):

2004/108/EC	EU EMC Directive
2006/95/EC	Low Voltage Directive (LVD)

Standard(s):

IEC 61010-1: 2010 EN 61010-1: 2010	Safety Standards	Electrical Equipment for Measurement, Control, and Laboratory Use; Part 1: General Requirements
EN 50270:2006 FCC CFR 47 Part 15, Subpart B	Electromagnetic Compatibility (EMC) Standards	Electrical Apparatus for the Detection and Measurement of Combustible Gases, Toxic Gases, or Oxygen

Signature:

Name: Doug Keeports
Title: VP of Product Development
Date: 7 August 2012

The technical documentation file required by this directive is maintained at the corporate headquarters of Bacharach, Inc.

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