



GENERAL MONITORS

Model S4000T

Intelligent Sensor for
Hydrogen Sulfide Gas Detection



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Instruction Manual **0307**

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Part No.
Revision

MANS4000T
H/03-07

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Quick Start Guide

Mounting and Wiring

Tools Required

1. "5mm" Allen head wrench to remove enclosure lid (included with gas detector).
2. Flat-head screwdriver maximum 3/16 in (5 mm) width for terminal block connections (included with gas detector).
3. Adjustable wrench for conduit or cable gland connections (not included).

The overall and mounting dimensions for the Model S4000T (Figure 1) should be used when making installation determinations.

Information on Class I location seals can be found in the NEC, Article 501-5.



WARNING: Acetic acid will cause damage to metal components, metal hardware, ceramic IC's, etc. If damage results from the use of a sealant that outgases acetic acid (RTV silicone), the warranty will be void.

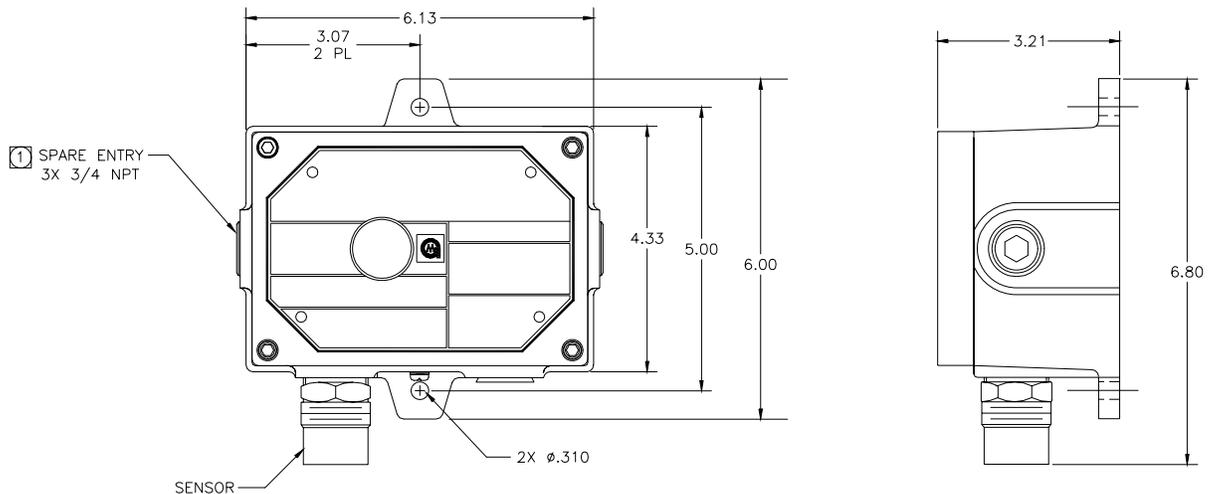


Figure 1: S4000T Outline and Mounting Dimensions

Terminal Connections

The terminal blocks (TB) are located inside the housing and can be accessed by removing the cover. A label on the inside of the housing cover provides details of all the terminal connections.

It is recommended that a three-wire (red, black, white) shielded cable be used for making power and output signal connections on the Model S4000C. The Spring Type terminal block accepts 14 AWG to 20 AWG and the Screw Type terminal block accepts 12 AWG to 18 AWG stranded or solid wire. Each wire should be stripped before wiring the Model S4000C Intelligent Sensor. To connect wiring to the Spring Type terminal block, insert a screwdriver into the

orange tab and press down (Figure 2), opening the terminal. Insert the wire into the terminal and release the orange tab, clamping the wire in the terminal. Check the hold of the wire by GENTLY tugging it to ensure it is locked in.

To connect wiring to the Screw Type terminal block, (Figure 3) use a screwdriver to loosen the top screw counter clock wise. Insert the wire into the terminal and tighten the top screw clock wise. Check the hold of the wire by GENTLY tugging it to ensure it is locked in.

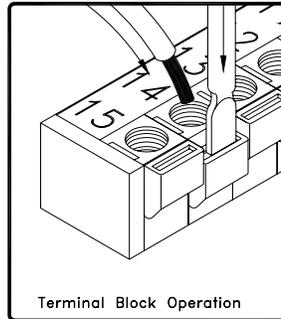


Figure 2: Spring Type Terminal Block Operation

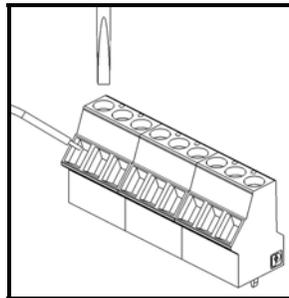


Figure 3: Screw Type Terminal Block Operation

NOTE: Power must remain disconnected until all other wiring connections have been made.

The maximum distance between the Model S4000T and the power supply is 2000 feet or 610 meters (each cable run should be as short as possible). See Section 9.2.3 for cable length specifications. Connect +24VDC to TB2, position 9. Connect the ground or common wire to TB2, position 8. For making power and ground connections to display devices see Figures 2 and 3.

The instrument is now ready to operate. Please consult the manual for more information on the instrument's many features.

NOTE: If you have any problems in the set-up or testing of the detector, please refer to the "Trouble Shooting Section", or call the factory direct.

Worldwide service is available by calling:

Lake Forest, California
(24 hr. service) Toll Free: +1-800-446-4872
Phone: +1-949-581-4464
Fax: +1-949-581-1151

Houston, Texas Phone: +1-281-855-6000
Fax: +1-281-855-3290

Ireland Phone: +353-91-751175
Fax: +353-91-751317

Singapore Phone: +65-6748-3488
Fax: +65-6748-1911

United Arab Emirates Phone: +971-4-8815751
Fax: +971-4-8817927

United Kingdom Phone: +44-1625-619583
Fax: +44-1625-619098

1.0 Introduction

1.1 Protection for Life

General Monitors' mission is to benefit society by providing solutions through industry leading safety products, services, and systems that save lives and protect capital resources from the dangers of hazardous flames, gases, and vapors.

This manual provides instruction for installing and operating General Monitors' Model S4000T for Hydrogen Sulfide Gas Detection. While the S4000T is easy to install and operate, this manual should be read in full and the information contained herein understood before attempting to place the system in service.

The safety products you have purchased should be handled carefully and installed, calibrated, and maintained in accordance with the respective product instruction manual. Remember these products are for your safety.



1.2 Special Warnings

The Model S4000T Intelligent Sensor contains components, which can be damaged by static electricity. Special care must be taken when wiring the system to ensure that only the connection points are touched.

Hydrogen Sulfide (H₂S) is an extremely toxic gas, and exposure may result in a loss of consciousness or death.

1.3 System Integrity Verification

To ensure operation at optimum performance, General Monitors recommends that certain maintenance items be performed.

Commissioning Safety Systems

Before power-up, verify wiring, terminal connections and stability of mounting for all integral safety equipment including, but not limited to:

- Power supplies
- Control modules
- Field detection devices
- Signaling / output devices
- Accessories connected to field and signaling devices

After the initial application of power (and any factory specified warm-up period) to the safety system, verify that all signal outputs, to and from devices and modules, are within the manufacturers' specifications. Initial calibration / calibration checking / testing should be performed per the manufacturer's recommendations and instructions.

Proper system operation should be verified by performing a full, functional test of all component devices of the safety system, ensuring that the proper levels of alarming occur.

Fault/Malfunction circuit operation should be verified.

Periodic Testing/Calibration of Field Devices

Periodic testing/calibrating should be performed per the manufacturer's recommendations and instructions. Testing/Calibrating procedures should include, but not be limited to:

- Verify zero reading
- Apply a known concentration of gas, and verify accuracy
- Verify integrity of all optical surfaces and devices
- For flame detectors, use the appropriate test lamp

When testing produces results outside of the manufacturer's specifications, re-calibration or repair/replacement of the suspect device(s) should be performed as necessary. Calibration intervals should be independently established through a documented procedure, including a calibration log, maintained by plant personnel or third party testing services.

Periodic System Verification

The following system verifications should be performed at least annually:

Verify wiring, terminal connections and stability of mounting for all integral safety equipment including, but not limited to:

- Power supplies
- Control modules
- Field detection devices
- Signaling / output devices
- Accessories connected to field and signaling devices

Calibration intervals should be independently established through a documented procedure, including a calibration log maintained by plant personnel or third party testing services.

2.0 Product Description

2.1 General Description

The Model S4000T is an intelligent sensor for the detection of Hydrogen Sulfide (H₂S) gas. The microprocessor-based electronics process information at the sensor site, within an explosion-proof housing.

A digital display provides indications and display codes that can be viewed through a window in the cover. A red LED above the digital display signifies an ALARM condition, while a red LED below the digital display signifies a WARN condition. Analog signal (4-20mA) optional Dual Redundant MODBUS communications and relays, provide remote and/or discrete indications of the sensor's operation.

The Model S4000T Intelligent Sensor is rated explosion-proof for use in the following hazardous areas:

- CSA/FM: Class I, Division 1, Groups B, C, D and Class I, Zone 1, Ex d IIB+H₂, T6
- ATEX: EEx d IIB T6 (T_{amb}=-40°C to +40°C)



Figure 4: Model S4000T Intelligent Sensor

3.0 Installation

3.1 Receipt of Equipment

All equipment shipped by General Monitors is pre-packed in shock absorbing containers, which provide protection against physical damage (original containers should be kept for future shipping or storage needs).

Shipping container contents should be carefully removed and checked against the packing list. If any damage has occurred or there is any discrepancy in the order, please notify General Monitors as soon as possible.

All correspondence with General Monitors must specify the equipment part number and serial number.

The factory tests each unit; however, a complete system checkout is suggested upon initial installation to ensure system integrity.



WARNING: Installation and maintenance must be carried out by suitably skilled and competent personnel only.



WARNING: The Model S4000T Intelligent Sensor contains components, which can be damaged by static electricity. Special care must be taken when wiring the system to ensure that only the connection points are touched.

3.2 Tools Required

1. "5mm" Allen head wrench to remove enclosure lid (included with gas detector).
2. Flat-head screwdriver maximum 3/16 in (5 mm) width for terminal block connections (included with gas detector).
3. Adjustable wrench for conduit or cable gland connections (not included).

3.3 Choosing Product Locations

There are no standard rules for sensor placement, since the optimum sensor location is different for each application. The customer must evaluate conditions at the facility to make this determination. Generally, the Model S4000T Intelligent Sensor should be easily accessible for calibration checks.

- The transmitter should be mounted pointing down to prevent water build-up on the sensor head.
- The transmitter should not be placed where contaminating substances may coat it.
- Although the Model S4000T is RFI resistant, it should not be mounted in close proximity to radio transmitters or similar equipment.
- Locate the Model S4000T where prevailing air currents contain the maximum concentration of gas.

- Locate the Model S4000T near possible sources of gas leaks.
- Observe the Model S4000T's temperature specification and locate the unit away from concentrated sources of heat.
- Transmitters should be mounted in an area that is as free from wind, dust, water, shock, and vibration as possible. See Section 9.3.4 for the environmental specifications of the unit. If dust and rain cannot be avoided, we recommend the use of our splash guard (GM P/N 10395-1).

Sensors may be adversely affected by prolonged exposure to certain materials. Loss of sensitivity or corrosion may be gradual if such materials are present in low concentrations, or it may be rapid at high concentrations. The more important materials adversely affecting sensors are:

- Silicones (often contained in greases and aerosols)
- Halides: compounds containing Fluorine, Chlorine, Bromine and Iodine
- Heavy metals, e.g. Tetraethyl Lead
- Caustic and Acidic liquids and vapors
- Glycol

The presence of contaminants in an area does not necessarily preclude the use of a Model S4000T Intelligent Sensor. The feasibility of using a sensor in such areas must be determined by an analysis of the specific factors in each application, and General Monitors should be consulted before attempting any such installation.

Sensors used in these areas usually require more frequent calibration checks than normal, and typically have a shorter life. In many such applications the standard two-year warranty would not apply.

IMPORTANT: Each H₂S Sensor is shipped with a red plastic cap fitted over the sensor head. Inside the cap is a desiccant. DO NOT remove this cap until you are ready to power the system. SAVE the cap and RE-CAP the sensor anytime the system power is off for more than one hour.



WARNING: General Monitors discourages the painting of sensor assemblies. If the sensor head is painted over, the gas will not be able to diffuse into the sensor. If the assembly cover is painted over, the digital display cannot be read.

3.3.1 Remote Mounting of the Sensor from the Electronics

If it is necessary to remotely mount the sensor from the electronics and the housing, the maximum distance can be no greater than 3700 feet (1125) meters, using 14 AWG wire. Sensors that are remotely mounted, must be placed in an explosion-proof rated sensor housing (GM P/N 10252-1), and the cable run must be contained in a conduit running from the sensor housing to the electronics. See Section 9.6, for FMRC approval requirements.

3.4 Mounting and Wiring



WARNING: The conduit entries should be sealed per the NEC 500-3d, or Canadian Electrical Code Handbook (Part 1, Section 18-154). Additional benefit of conduit seals is the prevention of water entering the housing through the conduit entry.



WARNING: Unused cable entry holes must be sealed with an approved explosion-proof plug. Red caps supplied by General Monitors are for dust protection only and must not be left on the unit when installed.

The overall and mounting dimensions for the Model S4000T (Figure 5) should be used when making installation determinations. A complete list of the mechanical specifications can be found in Section 9.3.2.

To prevent possible corrosion due to moisture or condensation, it is recommended that the conduit connected to the Model S4000T housing be sealed, or contain a drain loop.

Each conduit run from a hazardous location to a non-hazardous location should be sealed so that gases, vapors, and/or flames cannot pass beyond the seal. The purpose of seals in a Class I hazardous location, is to prevent the passage of gases, vapors, or flames from one electrical installation to another, through the conduit system. It is not necessary to seal the Model S4000T housing to maintain its explosion-proof integrity; however, conduit runs containing wires attached to the Model S4000T's relay contacts must be sealed (Section 3.5).

Information on Class I location seals can be found in the NEC, Article 501-5.

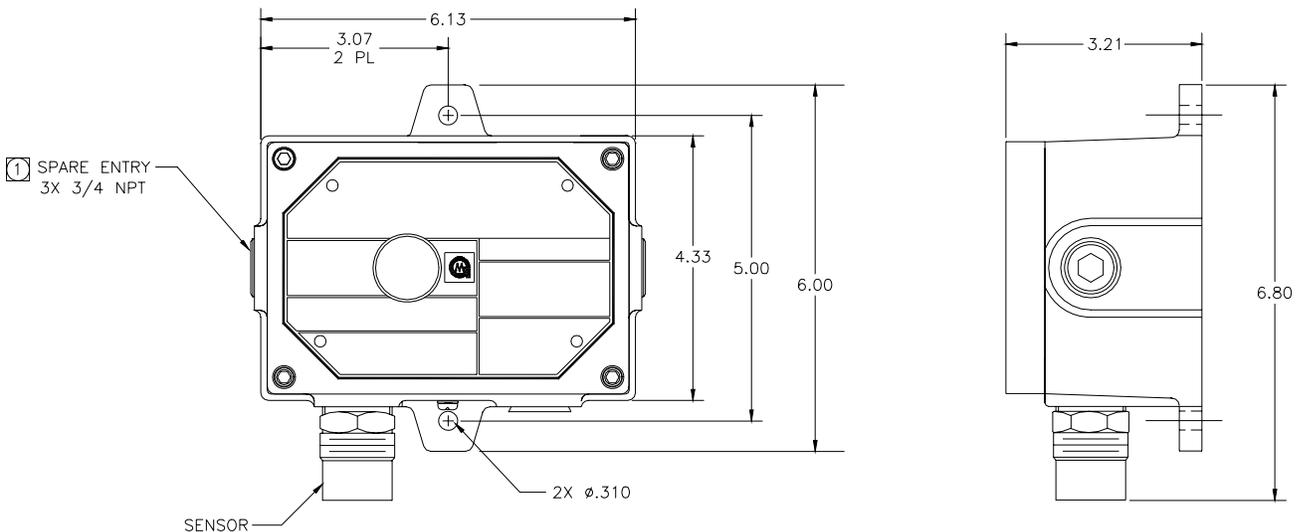


Figure 5: S4000T Outline and Mounting Dimensions



WARNING: Acetic acid will cause damage to metal components, metal hardware, ceramic IC's, etc. If damage results from the use of a sealant that outgases acetic acid (RTV silicone), the warranty will be void.

Once correctly installed, the Model S4000T requires little or no maintenance, other than periodic calibration checks to ensure system integrity. General Monitors recommends that a schedule be established and followed.

NOTE: The system's full two-year warranty will be voided if customer personnel or third parties damage the system during repair attempts.

Sensor heads exposed to the elements may require the accessory mounting threads to be lubricated. Grease must not be used. As an alternate, PTFE (Teflon) tape may be used on sensor accessory threads.

NOTE: Do not use any material or substance on threads that contact the sensor housing.

The removal of particulate matter from sensor accessories may be done through the use of an appropriate halogen-free solvent. Water and/or ethanol are examples of suitable solvents. The accessories should be thoroughly dried, with compressed air if necessary, before refitting to the sensor body.

3.5 Terminal Connections

The terminal blocks (TB) are located inside of the housing and can be accessed by removing the cover. A label on the inside of the housing cover provides details of all the terminal connections.

3.5.1 Terminal Block TB1 – Sensor Connections

TB1 contains the four sensor connections, white (W), black (B), red (R) and green (G). Remove the display board by loosening the two captive screws on the board and lifting it straight up. Connect the color-coded wires from the sensor to the matching colored terminals on TB1. The label on the inside of the cover can serve as a guide. Replace the display board, by pressing it into place, and tightening the two captive screws.



WARNING: Do not connect +24VDC to TB1. Damage to the electronics or sensor may result.

3.5.2 Terminal Block TB2 – Power and Signal Connections

TB2 contains the connections for Power, Relay Reset, Remote Calibration, MODBUS and 0-20mA Output Signal. The terminal connections are as follows:

TB2 position	Function
1	0-20mA Output
2	CH1 MODBUS -
3	CH1 MODBUS +
4	CH2 MODBUS -
5	CH2 MODBUS +
6	Remote Calibration
7	Relay Reset
8	Ground
9	+24VDC Power

Table 1: TB2 Power and Signal Connections

It is recommended that a three-wire (red, black, white) shielded cable be used for making power and output signal connections on the Model S4000C. The Spring Type terminal block accepts 14 AWG to 20 AWG and the Screw Type terminal block accepts 12 AWG to 18 AWG stranded or solid wire. Each wire should be stripped before wiring the Model S4000C Intelligent Sensor. To connect wiring to the Spring Type terminal block, insert a screwdriver into the orange tab and press down (Figure 6), opening the terminal. Insert the wire into the terminal and release the orange tab, clamping the wire in the terminal. Check the hold of the wire by GENTLY tugging it to ensure it is locked in.

To connect wiring to the Screw Type terminal block, (Figure 7) use a screwdriver to loosen the top screw counter clock wise. Insert the wire into the terminal and tighten the top screw clock wise. Check the hold of the wire by GENTLY tugging it to ensure it is locked in.

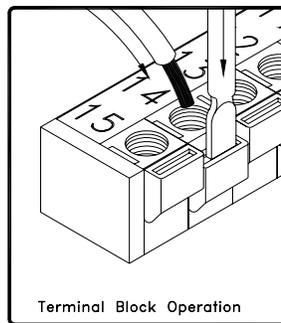


Figure 6: Spring Type Terminal Block Operation

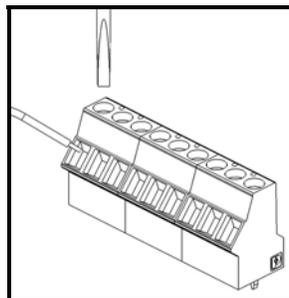


Figure 7: Screw Type Terminal Block Operation

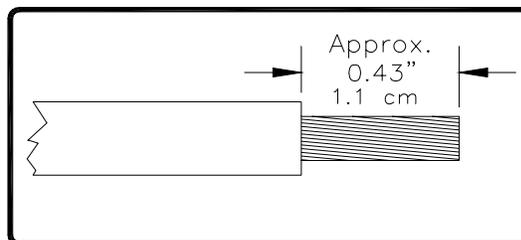


Figure 8: Wire Strip Length

NOTE: Up to 12 AWG wire can be used if it is carefully stripped (on a Screw Type terminal only-Figure 8).

3.5.3 DC Power and Ground Connections

The customer must provide Primary DC power, unless one of the following General Monitors' Modules is being used with the Model S4000T:

- DT230 Dual-Channel Readout/Relay Display Module
- TA202A Trip Amplifier Module with a PS002 Power Supply & Relay Module

The following General Monitors' Modules provide power connections for the Model S4000T, but need a customer supplied DC source:

- DT210 Eight-Channel Readout/Relay Display Module
- TA202A Trip Amplifier Module without a PS002

Since the Model S4000T is designed to operate continuously, a power switch is not included, in order to prevent accidental system shutdown.

NOTE: Power must remain disconnected until all other wiring connections have been made.

The maximum distance between the Model S4000T and the power supply is 2000 feet or 610 meters (each cable run should be as short as possible). See Section 9.3.3 for cable length specifications. Connect +24VDC to TB2, position 9. Connect the ground or common wire to TB2, position 8. For making power and ground connections to display devices see Table 2 and Table 3.

FROM		TO	
Model S4000T	Model DT210	Model DT230	Model TA202A
TB2-8 "COM"	Rear COMMON	Rear Pin 3 or 6 "COM"	Rear Pin 30d or 30z

Table 2: Ground or Common Connections

FROM		TO	
Model S4000T	Model DT210	Model DT230	Model TA202A
TB2-9 "+24 VDC"	Rear CH 1 - 8 24V	Rear Pin 4 or 7 "DC OUT"	Rear Pin 28d or 28z

Table 3: Power Connections

3.5.4 Analog Signal Connections

The Model S4000T Intelligent Transmitter provides a 4 to 20mA output signal. This signal can be sent up to 9000 feet (2740 meters) to:

- A General Monitors readout/relay display module, or
- An industrial analog to digital converter, or
- A computer-based monitor,
- A PLC, or
- A DCS.

The 4 to 20mA signal provides for control room or other locations remote to the Model S4000T to display indications of operation and alarm conditions. To connect the 4 to 20mA output signal with another unit, connect the wire into TB2, position 1, labeled 4-20mA OUT. For making output signal connections to display devices, refer to the specific manual for that device (Table 4).

FROM		TO	
Model S4000T	Model DT210	Model DT230	Model TA202A
TB2-1 4-20mA Output	Rear CH 1 – 8 4-20mA	Rear Pin 2 or 5 Analog In	Rear Pin 26d or 26z

Table 4: Analog Signal Connections

If a device other than a General Monitors readout/relay display module is being used, the DC ground, COM, of both systems must be connected together.

3.5.5 Terminal Block TB3 – Relay Connections

TB3 contains the connections for the Relay Contacts (optional). The function for the Warn and Alarm Relay connections vary, according to the normal state of the relay. Use the following as a guide for determining the Normally Open (**NO**) and the Normally Closed (**NC**) contact:

TB3 position	Relay Contact (De-Energized)	Relay Contact (Energized)
1	Normally Closed	Normally Open
2	Common	Common
3	Normally Open	Normally Closed

Table 5: Alarm Relay Connections

TB3 position	Relay Contact (De-Energized)	Relay Contact (Energized)
4	Normally Closed	Normally Open
5	Common	Common
6	Normally Open	Normally Closed

Table 6: Warn Relay Connections

TB3 position	Relay Contact (Energized)
7	Normally Open
8	Common
9	Normally Closed

Table 7: Fault Relay Connections

***NOTE:** Fault relay is normally energized. Relay will change state after power up.



WARNING: Contact with PCB components should be avoided to prevent damage by static electricity. All wire connections are made to the Terminal Blocks.



WARNING: Relay contacts must be protected against transient and over voltage conditions (Figure 9).

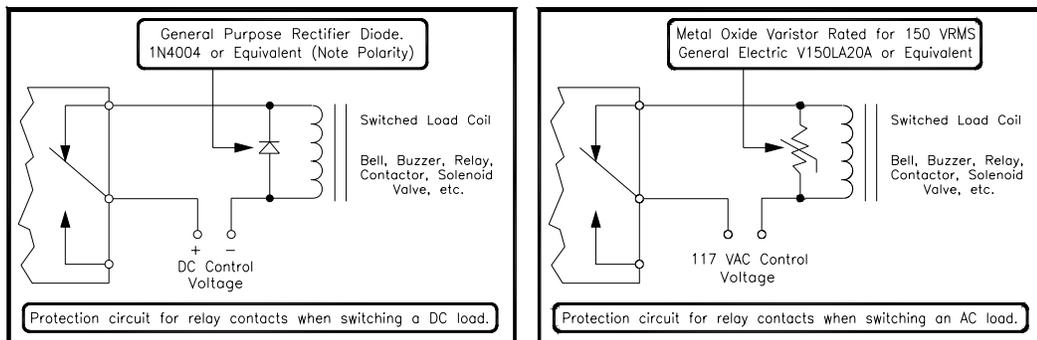


Figure 9: Relay Protection for DC and AC Loads

North American Approved Applications - The ALARM relay contact ratings are 8A @ 250 VAC and 8A @ 30 VDC resistive max.

European Union (EU) Approved Applications - The ALARM relay contact ratings are 8A, 30 V RMS/42.4 V peak or 8A @ 30 VDC resistive max.

3.5.6 European Union (EU) Approved Applications

Interconnecting cables must have an overall screen, or screen and armor. Cables BS5308 Part 2, Type 2, or equivalent are suitable.

NOTE: The terms 'screen' and 'shield' are equivalent for the purpose of this manual. The cable armor must be terminated in a suitable cable gland at the detector, to ensure a positive electrical connection.

3.5.7 Cable termination in the non-hazardous area

- The cable **armor** must be connected to **safety earth** in the safe area.
- The cable **screen** (drain wire) must be connected to an **instrument earth** in the safe area.

- The power supply **OV return** must be connected to an **instrument earth** in the safe area.
- The interconnecting cables should be segregated from power and other noisy cables. Avoid proximity to cables associated with radio transmitters, welders, switch mode power supplies, inverters, battery chargers, ignition systems, generators, switch gear, arc lights and other high frequency or high power switching process equipment. In general, maintain separation of at least 1 meter between instrument and other cables. Greater separations are required where long parallel cable runs are unavoidable. Avoid running instrument cable trenches close to lightning conductor earthing pits.
- Complete all cable insulation testing before connecting the cable at either end.



WARNING: Under **NO** circumstances should equipment be connected or disconnected when under power. This is contrary to hazardous area regulations and may lead to serious damage to the equipment. Equipment damaged in this manner is not covered under warranty.

3.6 Maintaining the X/P Integrity

The Model S4000T is rated explosion-proof for the following hazardous locations:

- CSA/FM: Class I, Division 1, Groups B, C, D and Class I, Zone 1, Ex d IIB+H₂, T6 and
- ATEX: EEx d IIB T6 (Tamb=-40°C to +40°C)

Some of the factors that influence the explosion-proof integrity of the Model S4000T housing are:

- Strength of the enclosure material
- Thickness of the enclosure walls
- Flame path between the housing and cover
- Flame path of threaded joints

The acceptable limits for explosion-proof housings that are used in Class I hazardous locations are defined in CSA Standard C22.2 No.30-M1986, FM 3615 and EN50014.

Anytime the cover of the Model S4000T housing is removed or the cover bolts are loosened, the flame path between the lid and the housing is affected. If power is to be left on while removing the cover or loosening the cover bolts on the Model S4000T, it will be necessary to declassify the area.

When replacing the cover, the gap between the lid and the housing should be less than .0015 inch (.038 mm). Make sure that the flame path is clear of dirt and debris before replacing the cover. This can be verified by tightening the cover bolts to a torque setting of 50 inch-pounds or by using a feeler gauge to ensure the gap between the cover and the housing is less than .0015 inch (.038 mm).

There are four entry holes, one each on the left and right sides, and two on the bottom of the Model S4000T housing. These holes are dedicated for the sensor, the reset switch and conduit. Each hole is tapped for 3/4" NPT threads. If a particular entry hole is not used, it must be

plugged during operation in the field. The factory installs plugs in the unused entry holes, except one. A red plastic cap is placed into the remaining hole and must be removed before conduit can be attached to the housing.

The Model S4000T will have the following items placed in the three remaining entry holes, at the factory:

- A sensor, if present (otherwise a red plastic cap)
- A reset switch, if present (otherwise an aluminum housing plug – optional)
- An aluminum housing plug

The sensor, reset switch and aluminum-housing plug have seven threads. Each of these components is screwed into the housing using five to seven turns. If it becomes necessary to replace the sensor, reset switch and/or the aluminum-housing plug, the user must use five to seven turns to ensure the explosion-proof integrity of the housing is maintained.

4.0 Operation

4.1 Start-Up Checklist

Prior to starting the system, verify the following:

1. Inhibit any external devices, such as Trip Amplifiers, PLC's, or DCS systems.
2. Verify that the optional settings are set for the desired configuration.
3. Verify that the unit is properly mounted. Ensure the conduit/cable gland entries are pointed downward.
4. Verify that the signal wiring is correct.
5. Verify that the power supply is connected properly. The Model S4000T is powered by +24VDC (20 to 36 VDC voltage range). The detector will output a low voltage fault (F6) at 18.5 VDC or below.
6. Make sure the lid is securely installed or the area has been de-classified.

4.2 Start-Up

Before applying power to the system for the first time, all wiring connections should be checked for correctness and the housing cover replaced. Upon first power-up, the sensor may take up to fifteen minutes to stabilize.

At the initial application of power, the unit will test all of the LED segments by displaying "88.8". The software revision letter will then be displayed for a few seconds. The unit will then enter Operational Mode and the current gas concentration at the sensor will be displayed. For details of Calibrating and Gas Checking the unit, see Sections 4.5 and 4.6.

4.3 Relay Reset

If the Warn and Alarm relays are configured as latching, they must be manually reset, after an alarm occurs. This can be accomplished by three different methods:

1. The relays can be reset via the MODBUS Interface (Section 8.8.15).
2. The relays can be reset via the magnetic switch using a magnet. Place the magnet over the GM Logo on the cover of the unit. After three seconds the display will show "rSt". Remove the magnet at this time and the relays will be reset (Figure 10).

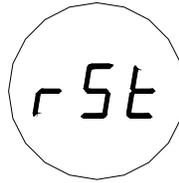


Figure 10: Relay Reset

3. The relays can be reset via the Remote Reset input terminals on TB2. Connect a normally open switch between terminal TB2-7 and TB2-8. Closing the switch momentarily will reset the relays. General Monitors explosion-proof switch, P/N 30051-1 can be used for this purpose. See Section 9.5 for ordering instructions.

NOTE: Red LED's above and below the digital display indicate that the Alarm and Warn relays are active. Latching relays can only be reset if the gas concentration has fallen below the respective relay set point.

4.4 User Selectable Options

The Model S4000T Intelligent Sensor includes many selectable options to provide the user with the most flexible H₂S gas detector possible. These options include Selectable Sensor Range, Warn and Alarm Relay Set Points and Configuration, and MODBUS Communications Settings. These allow the unit to operate with a wide variety of PLC and DCS Systems. The following sections explain the available options and how they can be customized.

A flow diagram is included to help the user in understanding the process of reviewing and changing the available options (Figure 11).

NOTE: If the unit was ordered without relays or MODBUS communications, changing the relay or MODBUS settings will have no effect on the operation of the unit.

4.4.1 Model S4000T User Menu Structure

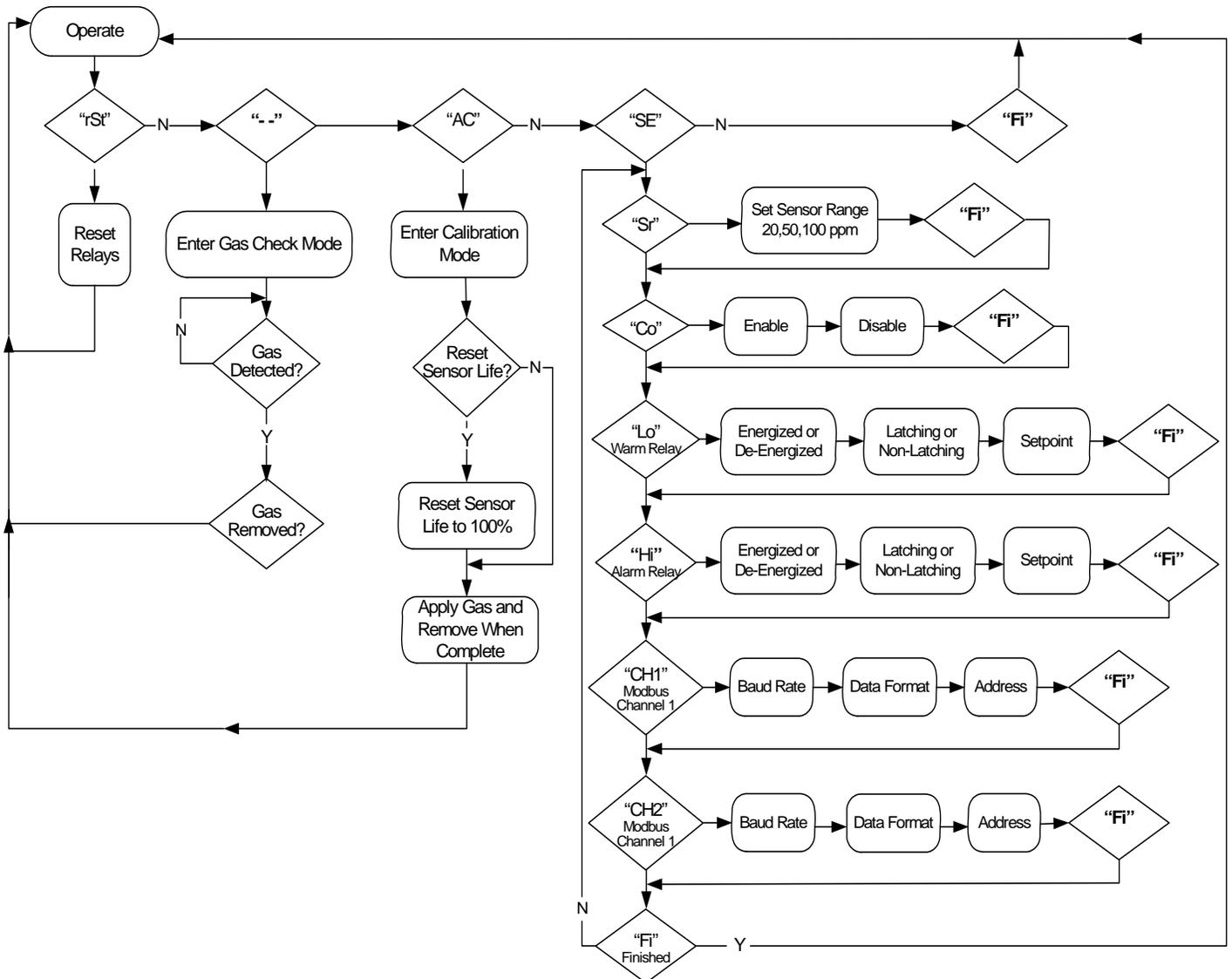


Figure 11: User Menu Structure

NOTE: "Co" represents Calibration Output. When "Co" is enabled and calibration is successful, the analog output goes from 1.5 mA to 3.2 mA for 5 seconds, settling at the desired value of 4mA.

4.4.2 Sensor Range

The Sensor Range is selectable between 0-20ppm, 0-50ppm, or 0-100ppm depending on the installed sensor. To adjust the Sensor Range of the Model S4000T, apply the magnet to the GM Logo on the cover of the unit until "SE" is displayed, then remove the magnet. This puts the unit into Setup Mode. After a few seconds "Sr" will be displayed. Apply and remove the magnet to adjust the Sensor Range. The current Sensor Range will be displayed. To change the sensor

range, apply and remove the magnet repeatedly, until the desired range is displayed. Once the desired range is displayed, wait 3 seconds and “Fi” will be displayed. Apply and remove the magnet, to return to the next level of the Setup menu. When “Fi” is displayed again, apply and remove the magnet to return to normal operation.

NOTE: When the Sensor Range is changed, the Warning and Alarm set points are automatically scaled to the new range. The unit must now be calibrated to the new range (Section 4.6.1).

4.4.3 Warning Relay Settings

To adjust the Warning Relay Settings of the Model S4000T, apply the magnet to the GM Logo on the cover of the unit until “SE” is displayed, then remove the magnet. This puts the unit into Setup Mode. After a few seconds “Lo” will be displayed. Apply and remove the magnet to change the Warning or “Low” alarm settings.

First, the Energized/De-Energized state of the relay is displayed by either “En” or “dE” being displayed respectively. Apply and remove the magnet until the desired state is displayed.

After a few seconds the Latching/Non-Latching state of the relay is displayed by either “La” or “nL”. Apply and remove the magnet until the desired state is displayed.

After a few seconds, the current Warning relay set point is displayed. Apply and remove the magnet until the desired set point is displayed. Once the desired set point value is displayed, wait 3 seconds and “Fi” will be displayed. Apply and remove the magnet to return to the next level of the Setup menu. When “Fi” is displayed again, apply and remove the magnet to return to normal operation.

The default Warning relay settings are: non-latching, de-energized, 30% FS set point. The maximum allowable set point is 50ppm.

NOTE: The Warn Relay set point cannot be set higher than the Alarm Relay set point.

4.4.4 Alarm Relay Settings

To adjust the Alarm Relay Settings of the Model S4000T, apply the magnet to the GM Logo on the cover of the unit until “SE” is displayed, then remove the magnet. This puts the unit into Setup Mode. After a few seconds “Hi” will be displayed. Apply and remove the magnet, to change the Alarm or “High” alarm settings.

First, the Energized/De-Energized state of the relay is displayed by either “En” or “dE” being displayed respectively. Apply and remove the magnet, until the desired state is displayed.

After a few seconds the Latching/Non-Latching state of the relay is displayed by either “La” or “nL”. Apply and remove the magnet, until the desired state is displayed.

After a few seconds the current Alarm relay set point is displayed. Apply and remove the magnet until the desired set point is displayed. Once the desired set point value is displayed, wait 3 seconds and “Fi” will be displayed. Apply and remove the magnet to return to the next level of the Setup menu. When “Fi” is displayed again, apply and remove the magnet, to return to normal operation.

The default Alarm relay settings are: latching, de-energized, 60% FS set point.

NOTE: The Alarm Relay set point cannot be set lower than the Warning Relay set point.

4.4.5 MODBUS Channel 1 Settings

To adjust the MODBUS Channel 1 settings of the Model S4000T, apply the magnet to the GM Logo on the cover of the unit until “SE” is displayed, then remove the magnet. This puts the unit into Setup Mode. After a few seconds “CH1” will be displayed. Apply and remove the magnet, to change the MODBUS Channel 1 settings.

First, the current Baud Rate MODBUS Channel 1 is displayed. If another baud rate is to be selected, apply and remove the magnet until the desired baud rate is displayed. The choices are: 19.2k baud “19.2”, 9600 baud “96”, 4800 baud “48”, or 2400 baud “24”.

After a few seconds, the current Data Format for MODBUS Channel 1 is displayed. If another data format is to be selected, apply and remove the magnet until the desired data format is displayed. The choices are: 8-N-1 “8n1”, 8-N-2 “8n2”, 8-E-1 “8E1”, or 8-O-1 “8O1”.

After a few seconds, the current address for MODBUS Channel 1 is displayed. Apply and remove the magnet until the desired address is displayed. Once the desired address is displayed, wait 3 seconds and “Fi” will be displayed. Apply and remove the magnet, to return to the next level of the Setup menu. When “Fi” is displayed again, apply and remove the magnet, to return to normal operation.

Default settings for Channel 1 are: address 1, 19.2k baud, 8-N-1.

NOTE: The address can be adjusted from 1 - 247. Channel 1 and Channel 2 addresses may be the same.

4.4.6 MODBUS Channel 2 Settings

To adjust the MODBUS Channel 2 Settings of the Model S4000T, apply the magnet to the GM Logo on the cover of the unit until “SE” is displayed, then remove the magnet. This puts the unit into Setup Mode. After a few seconds “CH2” will be displayed. Apply and remove the magnet to change the MODBUS Channel 2 settings.

First, the current Baud Rate MODBUS Channel 2 is displayed. If another baud rate is to be selected, apply and remove the magnet until the desired baud rate is displayed. The choices are: 19.2k baud “19.2”, 9600 baud “96”, 4800 baud “48”, or 2400 baud “24”.

After a few seconds, the current Data Format for MODBUS Channel 2 is displayed. If another data format is to be selected, apply and remove the magnet until the desired data format is displayed. The choices are: 8-N-1 “8n1”, 8-N-2 “8n2”, 8-E-1 “8E1”, or 8-O-1 “8O1”.

After a few seconds, the current address for MODBUS Channel 2 is displayed. Apply and remove the magnet until the desired address is displayed. Once the desired address is displayed, wait 3 seconds and “Fi” will be displayed. Apply and remove the magnet to return to the next level of the Setup menu. When “Fi” is displayed again, apply and remove the magnet to return to normal operation.

Default settings for Channel 2 are: address 2, 19.2 kbaud, 8-N-1.

NOTE: The address can be adjusted from 1 - 247. Channel 1 and Channel 2 addresses may be the same.

4.5 Gas Check Mode

The sensor's response can be checked without activating external alarms by placing the Model S4000T in Gas Check Mode. In this mode, the alarm relays are inhibited and the analog output is fixed at 1.5mA.

4.5.1 Procedure for Checking the Calibration:

Place the magnet over the GM Logo on the cover of the Model S4000T. Remove the magnet when a flashing pair of bars, "--" (Figure 12), appear on the display (about ten seconds). Apply the test gas to the sensor, and the value of the gas concentration will be indicated by the flashing display and should stabilize in one to two minutes.

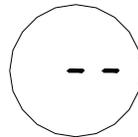


Figure 12: Gas Check

When the reading has stabilized and the test is complete, remove the gas and the unit will return to normal operation, when the concentration drops below 5% full-scale. If, after the reading has stabilized the sensor is to be calibrated, simply apply the magnet to the GM Logo on the housing cover, and the unit will enter Calibration Mode.

Gas Check Mode can be aborted if gas has not been applied to the sensor. Simply reapply the magnet to the GM Logo on the cover and the unit will return to normal operation.

NOTE: The test gas concentration must be at least 10% full-scale before the unit will complete the Gas Check sequence. If the Model S4000T is placed in the Gas Check mode and no gas is applied for twelve minutes, the unit will revert to a Fault condition. Re-applying the magnet over the GM Logo will return the unit to normal operation.

4.6 Calibration

General Monitors recommends that the Model S4000T Intelligent Sensor be calibrated one hour after start-up, and again 24 hours after initial start-up, and that the calibration be checked at least every ninety (90) days, to ensure system integrity. General Monitors is not implying that the customer should expect problems with sensor life or stability, but "frequent" calibration checks merely ensure the integrity of the life protecting equipment.

The above statement is not intended to discourage the customer from checking calibration more frequently. Frequent calibration checks are recommended for environments that have

problems, such as mud collecting on the sensor head, sensors accidentally being painted over, etc.

General Monitors recommends that a calibration schedule be established and followed. A logbook should also be kept showing calibration dates and dates of sensor replacement.

4.6.1 Calibration Procedure

If Hydrogen Sulfide (H₂S) gas is suspected to be present, it will be necessary to purge the sensor environment with clean air.

Entering Calibration Mode automatically disables the alarm circuits by sending a 1.5mA output signal and disabling the Warn and Alarm relays, if present. This will also prevent activation of the remote relay contacts when using a General Monitors Readout/Relay Display Module with the Model S4000T.

To enter Calibration Mode, place the magnet over the GM Logo on the cover of the unit (Figure 4) and hold it there until “AC” (Figure 13) appears on the display (about ten seconds). The display will flash the Remaining Sensor Life (Section 4.6.3) for a few seconds. Ensure that the sensor is seeing clean air during this time.

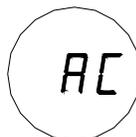


Figure 13: Automatic Calibration Mode

Apply the calibration gas concentration to the sensor (50% FS of the desired range of H₂S). The display will change from “AC” (Automatic Calibration) to “CP” (Calibration in Progress) indicating that the sensor is responding to the calibration gas (Figure 14).



Figure 14: Calibration in Progress Mode

After three to five minutes, the display will change from “CP” to “CC” (Figure 15), indicating that the calibration is complete.

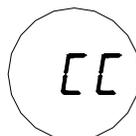


Figure 15: Calibration Complete Mode

Remove the gas and wait for the unit to return to normal operation. The display will indicate a few percent full-scale and then drop to “0”.

The unit is now calibrated and the new SPAN value has been stored in the non-volatile memory (EEPROM).

4.6.2 Aborting Calibration

If calibration is to be aborted, and gas has not been applied, wait ninety seconds and reapply the magnet. The unit will return to normal operation with the previous calibration values unchanged.

NOTE: Once gas has been applied, it is not possible to abort a calibration.

If the Model S4000T is placed in the Calibration Mode, and no gas is applied for twelve minutes, the unit will revert to a Fault (F2) condition. Re-applying the magnet over the GM Logo will return the unit to operational mode with the previous calibration values unchanged.

4.6.3 Remaining Sensor Life

The Model S4000T Intelligent Sensor provides an estimate of remaining sensor life, in percent remaining, to provide the user with an early warning of the need for sensor replacement. The remaining sensor life is updated each time the unit is calibrated. The current remaining sensor life estimate is displayed during the zeroing portion of a calibration sequence. It can also be read via the MODBUS interface (Section 8.0).

NOTE: The remaining sensor life provides an estimate of the amount of life remaining for the sensor. This estimate can be affected by many factors, including environmental conditions, poisons, etc. It should be used only as an estimate for preventive maintenance and logistic purposes.

4.6.4 Initializing the Remaining Sensor Life

The remaining sensor life estimate must be initialized each time a new Hydrogen Sulfide Sensor is installed. The initialization should be done during the first calibration of a newly installed sensor. After the sensor has been on power for a minimum of one hour, enter calibration mode as described in Section 4.6. While the display is flashing the remaining sensor life estimate during zeroing, apply the magnet to the GM Logo on the cover. The flashing number will change to “100”, indicating the sensor has 100% of remaining sensor life. Complete the calibration per Section 4.6.1.

4.7 Calibration Equipment

4.7.1 Breaker Bottles and Ampoules

General Monitors offers ampoules with breaker bottles as a method of reliably introducing calibration gas to the Model S4000T. The ampoule is placed inside the breaker bottle into the breaker slot, and the breaker bottle is placed over the sensor. The ampoule should contain 50% FS of H₂S of the sensor range. Follow the calibration procedure in Section 4.6. When the display indicates “AC”, break the ampoule by turning the thumbscrew on the side of the breaker bottle clockwise. The display will change to “CP” indicating that the sensor is seeing the gas. When the display reads “CC”, the calibration is complete. Remove the breaker bottle and allow the sensor to see clean air. It will return to normal operation once the gas at the sensor is below 5% of full-scale. See Section 9.5 for available equipment.

4.7.2 H₂S Portable Purge Calibrator

An alternate method for introducing calibration or test gas to the Model S4000T is available. The H₂S Portable Purge Calibrator is a compact, practical, accurate and safe system for field calibration of H₂S Sensors. The bottle is filled with a hydrogen sulfide (H₂S) in air mixture and is available in 7 concentrations. The temperature limitation for operation and storage is 0°F to +130°F (-18°C to +54°C).

NOTE: Do not store the cylinder with the regulator fully engaged in the cylinder valve.

Use the calibration procedure listed below for H₂S Portable Purge calibrations:

Make sure the Portable Purge Calibrator contains a gas concentration equivalent to 50% of full-scale for the unit that is going to be calibrated.

1. Ensure that the sensor is seeing clean air. If it is suspected that hydrogen sulfide gas is present, it will be necessary to purge the sensor environment with clean air.
2. Place the gas cup over the sensor and initiate the calibration sequence, by placing the magnet over the GM Logo on the cover of the unit.
3. When the letters “**AC**” appear in the display window remove the magnet and apply the calibration gas (50% of full-scale) by opening the valve on the cylinder.
4. When the sensor begins to see the gas, the display will change from “**AC**” to “**CP**” to indicate “Calibration in Progress”.
5. When the calibration sequence is complete, the display will change from “**CP**” to “**CC**” to indicate “Calibration Complete”.
6. Remove the gas by closing the valve on the cylinder, and remove the cup allowing the sensor to see clean air. The display will change from “**CC**” to indicate a few parts per million (ppm) and then drop to “**0**”.

The unit is now calibrated and the new values have been stored in the EEPROM (non-volatile memory). See Section 9.5 for available equipment.

5.0 Maintenance

5.1 General Maintenance



WARNING: Disconnect or inhibit external devices such as Trip Amplifiers, PLC's, or DCS systems before performing any maintenance.

European Union (EU) Approved Applications: The following grease compound is recommended for use: PBC Polybutylcuprysil, (or equivalent), which has BASEEFA Health & Safety Executive component approval No. 1051U for use as a jointing compound on flameproof electrical enclosures. This is available from General Monitors. The neoprene rubber gasket should also be lubricated with Type P80 lubricant available from General Monitors (P/N 610-010).

5.2 Storage

The Model S4000T H₂S Gas Detector should be stored in a clean, dry area and within the temperature and humidity ranges quoted in the Appendix under Environmental Specifications.

Insert red dust caps into any vacant cable entry holes.

6.0 Troubleshooting



CAUTION: Component level repair must be undertaken either by General Monitors' personnel, or by competent authorized service engineers. SMT PCB repair shall only be performed at a General Monitors' facility. Failure to comply with this requirement will invalidate the warranty.

Be sure to inhibit or disconnect external alarm wiring before making any check, which might send the unit into alarm, if an alarm condition will cause a problem.

6.1 Fault Codes & Their Remedies

The Model S4000T has self-diagnostics incorporated into the microprocessor's program. If a fault is detected, the output signal will drop to 0mA, the Fault relay will de-energize and a fault code will be displayed. The output signal will inform a remote display module that the Model S4000T is in the Fault Mode. The display will indicate a fault code that can be viewed at the sensor site.

There are nine fault conditions that are monitored by the microprocessor as follows:

6.1.1 F2 - Failed to Complete the Calibration

This fault will occur if the unit is placed in the calibration mode and no gas has been applied within twelve minutes, or if gas has been left on for more than 12 minutes.

ACTION – Remove gas, if present. Apply magnet to GM Logo on the cover to clear fault. Recalibrate, if necessary.

6.1.2 F3 - EPROM Checksum Error

This fault indicates that the contents of the Model S4000T's program memory have changed. This usually occurs when powering the unit up after a lightning strike or large voltage transient on the power or signal lines to the unit.

ACTION - The unit must be returned to the factory or authorized service center for repair.

6.1.3 F4 - Sensor Heater Open Error

This fault indicates that one of the sensor circuit leads is open-circuited.

ACTION - Check the integrity of all sensor connections, and ensure that the cable from the Model S4000T to the remote sensor is not damaged. If this does not correct the problem, replace the sensor and recalibrate.

6.1.4 F5 - Sensor Heater Shorted Error

This fault indicates that one of the sensor circuit leads is short-circuited.

ACTION - Check the integrity of all sensor connections, and ensure that the cable from the Model S4000T to the remote sensor is not damaged. If this does not correct the problem, replace the sensor and recalibrate.

6.1.5 F6 - Low Supply Voltage

This fault occurs if the supply voltage at the S4000T drops below +18.5VDC.

ACTION - Ensure that the supply voltage is at least +20VDC at the Model S4000T.

NOTE: With long supply leads, a considerable voltage drop may occur, due to the electrical resistance of the leads. The maximum cable resistance, which the Model S4000T can tolerate, is dependent on the supply voltage. A maximum of 20 ohms per conductor (40 ohms loop), at +24VDC minimum, or a maximum of 10 ohms per conductor (20 ohms loop), at +20VDC minimum.

6.1.6 F7 - EEPROM Verification Failure

This fault occurs when an attempt to verify the setup/calibration parameters just written to the EEPROM memory fails.

ACTION - The unit must be returned to the factory or authorized service center for repair.

6.1.7 F8 - Failure to Complete Setup

This fault occurs if the unit is left in setup mode for more than 6 minutes.

ACTION - Exit setup mode. Enter setup mode again if it is necessary, to change any user selectable options.

6.1.8 F9 - Gas Check Period Exceeded

If the Model S4000T is left in the gas check mode for more than twelve minutes with Test Gas applied, this fault will occur.

ACTION - Place the magnet over the GM Logo on the cover to return the unit to normal operation.

NOTE: Anytime a sensor is replaced, the unit should be disconnected from all alarms, as the unit may go upscale upon power-up.

6.1.9 F10 – Switch Error

This fault occurs if either the remote test, remote calibrate, or magnetic switch are closed for more than two minutes.

ACTION – Check the wiring on the Remote Reset and Remote Calibrate switches. Once the short circuit is cleared, the unit will return to normal operation. If the magnetic switch is shorted, the unit must be returned to the factory or to an authorized service center for service.

7.0 Customer Support

7.1 General Monitors' Offices

Area	Phone/Fax/Email
UNITED STATES	
Corporate Office: 26776 Simpatica Circle Lake Forest, CA 92630	Toll Free: +1-800-446-4872 Phone: +1-949-581-4464 Fax: +1-949-581-1151 Email: info@generalmonitors.com
9776 Whithorn Drive Houston, TX 77095	Phone: +1-281-855-6000 Fax: +1-281-855-3290 Email: gmhou@generalmonitors.com
UNITED KINGDOM	
Heather Close Lyme Green Business Park Macclesfield, Cheshire, United Kingdom, SK11 0LR	Phone: +44-1625-619-583 Fax: +44-1625-619-098 Email: info@generalmonitors.co.uk
IRELAND	
Ballybrit Business Park Galway, Republic of Ireland	Phone: +353-91-751175 Fax: +353-91-751317 Email: info@gmil.ie
SINGAPORE	
No. 2 Kallang Pudding Rd. #09-16 Mactech Building Singapore 349307	Phone: +65-6-748-3488 Fax: +65-6-748-1911 Email: genmon@gmpacifica.com.sg
MIDDLE EAST	
LOB12, #G20 P.O. Box 61209 Jebel Ali, Dubai United Arab Emirates	Phone: +971-4-8815751 Fax: +971-4-8817927 Email: gmme@emirates.net.ae

Table 8: GM Locations

8.0 MODBUS Interface

8.1 Baud Rate

The Baud Rate is selectable via the MODBUS Communications Interface. The selectable baud rates are 19200, 9600, 4800, or 2400 bits per second.

8.2 Data Format

The Data Format is selectable via the MODBUS Communications Interface. The selectable data formats are as follows:

Data Bits	Parity	Stop Bit	Format
8	None	1	8-N-1
8	Even	1	8-E-1
8	Odd	1	8-O-1
8	None	2	8-N-2

Table 9: Data Format

8.3 MODBUS Read Status Protocol (Query/Response)

8.3.1 MODBUS Read Query Message

Byte	MODBUS	Range	Referenced to S4000T
1 st	Slave Address	1-247* (Decimal)	S4000T ID (Address)
2 nd	Function Code	03	Read Holding Registers
3 rd	Starting Address Hi**	00	Not Used by S4000T
4 th	Starting Address Lo**	00-FF (Hex)	S4000T Commands
5 th	No. Of Registers Hi	00	Not Used by S4000T
6 th	No. Of Registers Lo	01	No. Of 16 Bit Registers
7 th	CRC Lo	00-FF (Hex)	CRC Lo Byte
8 th	CRC Hi	00-FF (Hex)	CRC Hi Byte

***NOTE:** Address 0 is reserved for broadcast mode and will not be supported at this time.

**** NOTE:** Start Address can be a maximum of 9999 Address Locations (0000-270E).

8.3.2 MODBUS Read Response Message

Byte	MODBUS	Range	Referenced to S4000T
1 st	Slave Address	1-247* (Decimal)	S4000T ID (Address)
2 nd	Function Code	03	Read Holding Registers
3 rd	Byte Count	02	No. Of Data Bytes
4 th	Data Hi	00-FF (Hex)	S4000T Hi Byte Status Data
5 th	Data Lo	00-FF (Hex)	S4000T Lo Byte Status Data
6 th	CRC Lo	00-FF (Hex)	CRC Lo Byte
7 th	CRC Hi	00-FF (Hex)	CRC Hi Byte

8.4 MODBUS Write Command Protocol (Query/Response)

8.4.1 MODBUS Write Query Message

Byte	MODBUS	Range	Referenced to S4000T
1 st	Slave Address	1-247* (Decimal)	S4000T ID (Address)
2 nd	Function Code	06	Preset Single Register
3 rd	Register Address Hi	00	Not Used by S4000T
4 th	Register Address Lo	00-FF (Hex)	S4000T Commands
5 th	Preset Data Hi	00-FF (Hex)	S4000T Hi Byte Command Data
6 th	Preset Data Lo	00-FF (Hex)	S4000T Lo Byte Command Data
7 th	CRC Lo	00-FF (Hex)	CRC Lo Byte
8 th	CRC Hi	00-FF (Hex)	CRC Hi Byte

***NOTE:** Address 0 is reserved for broadcast mode and will not be supported at this time.

****NOTE:** Start Address can be a maximum of 9999 Address Locations (0000-270E).

8.4.2 MODBUS Write Response Message

Byte	MODBUS	Range	Referenced to S4000T
1 st	Slave Address	1-247* (Decimal)	S4000T ID (Address)
2 nd	Function Code	06	Preset Single Register
3 rd	Register Address Hi	00	Not Used by S4000T
4 th	Register Address Lo	00-FF (Hex)	S4000T Commands
5 th	Preset Data Hi	00-FF (Hex)	S4000T Hi Byte Command Data
6 th	Preset Data Lo	00-FF (Hex)	S4000T Lo Byte Command Data
7 th	CRC Lo	00-FF (Hex)	CRC Lo Byte
8 th	CRC Hi	00-FF (Hex)	CRC Hi Byte

8.5 Function Codes Supported

Function Code 03 (Read Holding Registers) will be used to read status from the slave unit.

Function Code 06 (Preset Single Register) will be used to write a command to the slave unit.

8.6 Exception Responses and Exception Codes

8.6.1 Exception Response

In a normal communications query and response, the master device sends a query to the S4000T and the S4000T receives the query without a communications error and handles the query normally within the master device's allowable timeout. The S4000T then returns a normal response to the master. An abnormal communications produces one of four possible events:

1. If the S4000T does not receive the query due to a communications error, then no response is returned from the S4000T and the master device will eventually process a timeout condition for the query.
2. If the S4000T receives the query, but detects a communication error (CRC, etc.), then no response is returned from the S4000T and the master device will eventually process a timeout condition for the query.
3. If the S4000T receives the query without a communications error, but cannot process

the response to the master within the master's timeout setting, then no response is returned from the S4000T. The master device will eventually process a timeout condition for the query. **In order to prevent this condition from occurring, the maximum response time for the S4000T is 200 milliseconds. Therefore, the master's timeout setting should be set to 200 milliseconds or greater.**

4. If the S4000T receives the query without a communications error, but cannot process it due to reading or writing to a non-existent S4000T command register, then the S4000T will return an exception response message informing the master of the error.

The exception response message (ref. No. 4 above) has two fields that differentiate it from a normal response:

Byte	MODBUS	Range	Referenced to S4000T
1 st	Slave Address	1-247* (Decimal)	S4000T ID (Address)
2 nd	Function Code	83 or 86 (Hex)	MSB is set with Function Code
3 rd	Exception Code	01 - 06 (Hex)	Appropriate Exception Code (See Below)
4 th	CRC Lo	00-FF (Hex)	CRC Lo Byte
5 th	CRC Hi	00-FF (Hex)	CRC Hi Byte

8.6.2 Exception Code

Exception Code Field: In a normal response, the S4000T returns data and status in the data field, which was requested in the query from the master. In an exception response, the S4000T returns an exception code in the data field, which describes the S4000T condition that caused the exception. Below is a list of exception codes that are supported by the S4000T:

Code	Name	Description
01	Illegal Function	The function code received in the query is not an allowable action for the S4000T.
02	Illegal Data Address	The data address received in the query is not an allowable address for the S4000T.
03	Illegal Data Value	A value contained in the query data field is not an allowable value for the S4000T.
04	Slave Device Failure	An unrecoverable error occurred while the S4000T was attempting to perform the requested action.
05	Acknowledge	The S4000T has accepted the request and is processing it, but a long duration of time will be required to do so. This response is returned to prevent a timeout error from occurring in the master.
06	Device Busy	The S4000T is engaged in processing a long-duration program command. The master should retransmit the message later when the slave is free.

Table 10: Exception Codes

8.7 S4000T Command Register Locations

Parameter	Function	Type	Scale	Access	Register Address	Master I/O Address
Analog	0-20mA Current Output	Value	16-Bit	R	0000	40001
Mode	Indicates and Controls Mode	Bit		R/W	0001	40002
Status/Error	Indicates Errors		Bit	R	0002	40003
Not Used	N/A					40004
Unit Type	Identifies the S4000T in Decimal	Value	16-Bit	R	0004	40005
Software Rev	Indicates the Software Revision	ASCII	2-Char	R	0005	40006
Status Block	Returns Analog, Mode, Status, Error, and Sensor Life	Multi	6-bytes	R	0006	40007
Not Used	N/A					40008-40013
Alarm Settings	Read or change settings for the high alarm	Bit	(0-15)	R/W	000D	40014
Warn Settings	Read or change settings for the low alarm	Bit	(0-15)	R/W	000E	40015
Com1 Addr.	Read or change settings for the Com1 Address	Value	8-Bit	R/W	000F	40016
Com1 Baud	Read or change settings for the Com1 Baud Rate	Bit	(0-7)	R/W	0010	40017
Com1 Data Format	Read or change settings for the Com1 Data Format	Bit	(0-7)	R/W	0011	40018
Com2 Addr.	Read or change settings for the Com2 Address	Value	8-Bit	R/W	0012	40019
Com2 Baud	Read or change settings for the Com2 Baud Rate	Bit	(0-7)	R/W	0013	40020
Com2 Data Format	Read or change settings for the Com2 Data Format	Bit	(0-7)	R/W	0014	40021
Not Used	N/A					40022
Reset Alarms	Reset any latched alarms	Bit	(0)	W	0016	40023
Sensor Life	Read the Remaining Sensor Life	Bit	(0)	R	0017	40024
Sensor Scale	Change the Scale for the H ₂ S sensors on the S4000T	Value	8-Bit	R/W	0018	40025
HazardWatch (Co)	Indicates Calibration Success	Value	8-Bit	R/W	0019	40026
Not Used	N/A					40027-40032
Total Receive Errors	Total # of Receive Errors	Value	8-Bit	R	0020	40033
Bus Activity Rate %	Bus Activity Rate in % of This Addressed Node vs. Other Addressed Nodes	Decimal		R	0021	40034
Function Code Errors	Total # of Function Code Errors	Value	8-Bit	R	0022	40035
Starting Addr. Errors	Total # of Starting Address Errors	Value	8-Bit	R	0023	40036

Table 11: Command Register Locations

Parameter	Function	Type	Scale	Access	Register Address	Master I/O Address
No. of Register Errors	Total # of Register Errors	Value	8-Bit	R	0024	40037
RXD CRC Hi Errors	Total # of RXD CRC Hi Errors	Value	8-Bit	R	0025	40038
RXD CRC Low Errors	Total # of RXD CRC Low Errors	Value	8-Bit	R	0026	40039
Not Used	N/A				0027 - 002C	40040-40045
Clear Comm Errors	Clear All Comm Errors	Bit	(0)	W	002D	40046

Table 12: Command Register Locations, Cont.

8.8 S4000T Command Register Details

8.8.1 Analog

A read returns a value, which is proportional to the 0-20mA output current. The current is based on a 16-bit value. The scaling is 0 - 65535 decimal which corresponds to 0 - 21.7mA.

8.8.2 Mode

A read returns the present mode of the S4000T. A write command changes the mode to the requested mode.

Exception: Returns an Exception Code 01 (illegal function) if an illegal write is requested.

A calibrate command returns an Exception Code 01 (Acknowledge 05). The operation will take a long time to complete.

Function	Bit Position	Access
Calibration Complete	7 MSB	Read
Spanning	6	Read
Zero Complete, Waiting for Gas	5	Read
Zeroing	4	Read
Calibration Mode	3	Read/Write
Calibration Check Mode	2	Read/Write
Run Mode	1	Read
Startup Mode	0 LSB	Read

8.8.3 Status/Error

A read returns the Alarm state and Errors that are occurring at the present time, which are indicated, by bit position.

Function	Bit Position	Access
Alarm	15 MSB	Read
Warn	14	Read
Fault	13	Read
Not Used	12	Read
Not Used	11	Read
Not Used	10	Read
Not Used	9	Read
Switch Error	8	Read
Setup Error	7	Read
Calibration Check Timeout	6	Read
EEPROM Error	5	Read
EPROM Error	4	Read
Sensor Error	3	Read
Fail to Calibrate	2	Read
Low Supply Voltage	1	Read

8.8.4 Unit Type

A read returns the Decimal Value 4000. This identifies the S4000C.

A read returns the Decimal Value 4001. This identifies the S4000T.

8.8.5 Software Revision

A read returns the software revision of the S4000T in 2 ASCII characters.

8.8.6 Status Block

A read returns a 6-byte message containing the analog (2 bytes), Mode (1 byte), Status/Error (2 bytes), and Sensor Life (1 byte) in that order. For the format of each byte, refer to the appropriate individual commands.

8.8.7 Alarm Settings

A read returns the present Alarm settings of the S4000T. A write command changes the settings to the requested values. The set points are programmable in 5% FS steps (1% FS steps for 20ppm range).

A 1 in the 9th bit position means the output is latching, a 0 means it is Non-Latching. A 1 in the 8th bit position means the output is normally energized a 0 means it is normally De-Energized. The Alarm set point cannot be set below the Warn set point. **Factory default is: 60% FS, latching, de-energized.**

Exception: Returns an Exception Code 01 (illegal function) if an illegal write is requested.

Byte	Function	Bit Position	Access
High	Not Used	15 MSB	Read
	Not Used	14	Read
	Not Used	13	Read
	Not Used	12	Read
	Not Used	11	Read
	Not Used	10	Read
	Latching/Non-Latching	9	R/W
	Energized/De-Energized	8	R/W
Low	Set point	(7-0)	R/W

8.8.8 Warn Settings

A read returns the present Warn settings of the S4000T. A write command changes the settings to the requested values. The set points are programmable in 5% FS steps (1% FS steps for 20ppm range).

A 1 in the 9th bit position means the output is latching, a 0 means it is Non-Latching. A 1 in the 8th bit position means the output is normally energized a 0 means it is normally De-Energized. The Warn set point cannot be set above the Alarm set point. **Factory default is: 30% FS, non-latching, de-energized. The maximum allowable set point is 50ppm.**

Exception: Returns an Exception Code 01 (illegal function) if an illegal write is requested.

Byte	Function	Bit Position	Access
High	Not Used	15 MSB	Read
	Not Used	14	Read
	Not Used	13	Read
	Not Used	12	Read
	Not Used	11	Read
	Not Used	10	Read
	Latching/Non-Latching	9	R/W
	Energized/De-Energized	8	R/W
Low	Set point	(7-0)	R/W

8.8.9 Com1 Address

A read command returns the current address for Com1. A write command changes the address to the requested value. Valid addresses are 1-247 decimal. **Factory default is 1.**

Exception: If the address is not in range an Illegal data value (03) is returned.

8.8.10 Com1 Baud Rate

A read command returns the current baud rate for Com1. A write command changes the baud rate to the requested values. Valid settings are shown in the table below. **Factory default is 19,200.**

Baud Rate	Value	Access
2400	24	Read/Write
4800	48	Read/Write
9600	96	Read/Write
19,200	192	Read/Write

Table 13: Com1 Baud Rate

Exception: If the baud rate is not in range, an illegal data value (03) is returned.

8.8.11 Com1 Data Format

A read command returns the current data format for Com1. Write command changes the data format to the requested values. Valid settings are shown in the table below. **Default format is 8-N-1.**

Data	Parity	Stop	Format	Data(Bits 9-8)	Access
8	None	1	8-N-1	0	Read/Write
8	Even	1	8-E-1	1	Read/Write
8	Odd	1	8-O-1	2	Read/Write
8	None	2	8-N-2	3	Read/Write

Table 14: Com1 Data Format

Exception: If the data format is not in range, an illegal data value (03) is returned.

8.8.12 Com2 Address

A read command returns the current address for Com2. A write command changes the address to the requested values. Valid addresses are 1-247 decimal. **Factory default is 2.**

Exception: If the address is not in range an Illegal data value (03) is returned.

8.8.13 Com2 Baud Rate

A read command returns the current baud rate for Com2. A write command changes the baud rate to the requested values. Valid settings are shown in the table below. **Factory default is 19,200.**

Baud Rate	Value	Access
2400	24	Read/Write
4800	48	Read/Write
9600	96	Read/Write
19,200	192	Read/Write

Table 15: Com2 Baud Rate

Exception: If the baud rate is not in range an illegal data value (03) is returned.

8.8.14 Com2 Data Format

A read command returns the current data format for Com2. Write command changes the data format to the requested values. Valid settings are shown in the table below. **Factory default is 8-N-1.**

Data	Parity	Stop	Format	Data(Bits 9-8)	Access
8	None	1	8-N-1	0	Read/Write
8	Even	1	8-E-1	1	Read/Write
8	Odd	1	8-O-1	2	Read/Write
8	None	2	8-N-2	3	Read/Write

Table 16: Com2 Data Format

Exception: If the data format is not in range an illegal data value (03) is returned.

8.8.15 Reset Alarms

A write to this register with a data value of 1 will reset any latched alarms provided the current gas level is below the alarm set point.

8.8.16 Sensor Life

A read returns the current estimate of remaining sensor life in percentage.

8.8.17 Sensor Scale

A read returns the current H₂S sensor scale selected: 0-20ppm, 0-50ppm, 0-100ppm. A write changes the scale to the desired scale. If the scale is changed, a calibration fault is generated, forcing the operator to calibrate the unit.

H2S Sensor Scale	Value (decimal)
0-20 ppm	20
0-50 ppm	50
0 –100 ppm	100

Table 17: Sensor Scale

8.8.18 HazardWatch (Co – Calibration Output)

A read to this register will return the status of the HazardWatch Option.

0x01 enables this option, 0x00 disables this option, similar to the write.

NOTE: Only Com1 can support read/write to this register.

8.8.19 Total Receive Errors

A read indicates the total MODBUS Comm Receive Errors that occurred in the slave device. The maximum count is 255 and then the counter will rollover to zero and begin counting again.

The total errors are an accumulation of the individual communication errors listed below:

8.8.20 Bus Activity Rate %

A read indicates the Bus Activity Rate in percent of this Slave's addressed node versus other addressed nodes. Range of this value is in hex (0-64) which translates to decimal (0-100%).

8.8.21 Function Code Errors

A read indicates the number of Function Code Errors that occurred in the slave device. The maximum count is 255 and then the counter will rollover to zero and begin counting again.

8.8.22 Starting Address Errors

The counter is incremented for each address that does not equal the device address.

A read indicates the number of Starting Address Errors that occurred in the slave device. The maximum count is 255 and then the counter will rollover to zero and begin counting again.

8.8.23 Number of Register Errors

A read indicates the Number of Register Errors that occurred in the slave device. The maximum count is 255 and then the counter will rollover to zero and begin counting again.

8.8.24 RXD CRC Hi Errors

A read indicates the number of RXD CRC Hi Byte Errors that occurred in the slave device. The maximum count is 255 and then the counter will rollover to zero and begin counting again.

8.8.25 RXD CRC Low Errors

A read indicates the number of RXD CRC Low Byte Errors that occurred in the slave device. The maximum count is 255 and then the counter will rollover to zero and begin counting again.

8.8.26 Clear Comm Errors

A Read or Write resets all the MODBUS Comm Error counters to zero.

9.0 Appendix

9.1 Warranty

General Monitors warrants the Model S4000T to be free from defects in workmanship or material under normal use and service within two years from the date of shipment.

General Monitors will repair or replace without charge any such equipment found to be defective during the warranty period. Full determination of the nature of, and responsibility for, defective or damaged equipment will be made by General Monitors' personnel.

Defective or damaged equipment must be shipped to the General Monitors' plant or representative from which the original shipment was made. In all cases this warranty is limited to the cost of the equipment supplied by General Monitors. The customer will assume all liability for the misuse of this equipment by its employees or other personnel.

All warranties are contingent upon proper use in the application for which the product was intended and does not cover products which have been modified or repaired without General Monitors' approval, or which have been subjected to neglect, accident, improper installation or application, or on which the original identification marks have been removed or altered.

Except for the express warranty stated above, General Monitors disclaims all warranties with regard to the products sold, 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 General Monitors for damages including, but not limited to, consequential damages arising out of, or in connection with, the performance of the product.

9.2 Principle of Operation

General Monitors uses a proprietary Metal Oxide Semiconductor (MOS) film on the sensor for detecting Hydrogen Sulfide (H_2S) gas. The MOS film is deposited onto a substrate between two electrodes. With no gas present, the measured resistance between these two electrodes is very high (in the mega-ohms). As H_2S adsorbs onto the film, the resistance between the two electrodes decreases (to kilo-ohms). This decrease in resistance is logarithmically proportional to the concentration of H_2S that is present.

The change in resistance is converted to a change in voltage, and amplified by the input circuit. This amplified signal is fed to an Analog to Digital (A/D) Converter, converted to a digital signal and sent to the microprocessor to be processed. The process of H_2S adsorbing onto the MOS film is most effective at an elevated temperature. On the outer edge of the substrate is a heater ring. The temperature of this heater ring is measured with a thermistor, and kept constant by a circuit located inside the body of the sensor.

As H_2S adsorbs onto the film, electrons move more freely from one electrode to the other. This is represented as a decrease in resistance. The process of H_2S adsorbing onto the MOS film is completely reversible. As the concentration of H_2S decreases (H_2S desorbs), the resistance between the electrodes will increase.

9.3 Specifications

9.3.1 System Specifications

Sensor Type:	Continuous diffusion, adsorption type Metal Oxide Semiconductor (MOS)
Sensor Life:	3 to 5 years typical
Repeatability:	±2 ppm or 10% of the applied gas, whichever is greater
Response Time:	T50<1 minute (screen) T50<2 minutes (sintered) with full scale gas applied
Measuring Ranges:	0-20 ppm, 0-50 ppm, 0-100 ppm
Modes:	Calibration, gas check, setup
Electrical Classification:	CSA/FM: Class I, Division 1, Groups B, C, D and Class I, Zone 1, Ex d IIB+H ₂ , T6. ATEX: EEx d IIB T6 (Tamb=-40°C to +40°C)
Warranty:	Two years

9.3.2 Mechanical Specifications

Length:	6.4 inches (161mm)
Height:	3.4 inches (86mm)
Width:	4.1 inches (104mm)
Weight:	5.5 lbs. (2.5 kg)
Mounting Holes:	5.0 inches (127mm) (center to center)

9.3.3 Electrical Specifications

Input Power:	24 VDC nominal, 20 to 36 VDC, 350mA max.
Power Consumption	Start-up 270mA, Normal Operation 120mA
Relay Ratings:	8A @ 250 VAC/8A @ 30 VDC resistive max. (3x) SPDT - Warning, Alarm & Fault
Analog Signal:	0-20mA (650 ohms max. load) Malfunction 0mA Gas Check 1.5mA Setup mode 1.5mA Calibration 1.5mA Zero reading 4mA±0.2mA 0-100% scale 4-20mA Over-range 20-22mA
Status Indicators:	Three-digit digital display with gas concentration, Warn and Alarm LED's, calibration prompts, fault codes, and setup options
RS-485 Output:	Dual Redundant MODBUS RTU, suitable for linking up to 128 units or up to 247 units with repeaters
Baud Rate:	2400, 4800, 9600, or 19200 BPS
Faults Monitored:	Open AO, calibration error, sensor heater error, low DC supply, EEPROM, EPROM, setup error, gas check time exceeded, switch error.
RFI/EMI Protection:	Complies with EN50081-2, EN50082-2

Cable Requirements: 3-wire shielded cable. Max. distance between S4000T and power source @ 24 VDC nominal

AWG	FEET	METERS
14	3430	1040
16	1550	410
18	1050	320
20	650	200

Table 18: 24VDC Cable Lengths

Max. distance for analog output (650 ohms max):

AWG	FEET	METERS
14	9000	2740
16	5200	1585
18	3800	1160
20	2400	730

Table 19: Analog Output Cable Lengths

Max. distance between the transmitter and sensor with one way resistance of 10 ohms (20-Ohm loop):

AWG	FEET	METERS
14	3700	1125
16	2400	730
18	1500	460
20	1000	300

Table 20: Sensor Cable Lengths

European Union (EU) Approved Applications: PSU noise and ripple voltage 1.0Vpp max. The customer supplied PSU must comply with IEC 1010-1, limiting current to 8A under Fault conditions, in order to comply with CE Marking requirements.

9.3.4 Environmental Specifications

Operating Temperature Range

CSA/FM:

Electronics -40°F to 167°F (-40°C to 75°C)
 Standard Sensor -40°F to 167°F (-40°C to 75°C)
 High Temp Sensor -40°F to 195°F (-40°C to 90°C)

ATEX:

Electronics (T6) -40°F to 104°F (-40°C to + 40°C)

Storage Temperature Range: -58°F to 185°F (-50°C to +85°C)

Operating Humidity Range: 5% to 100% RH, non-condensing

9.4 Approvals

CSA, FM, ATEX, CE Marking, GOST permission to use

Compiles with ISA-92.0.01, Part 1-1998 performance requirements

9.5 Spare Parts and Accessories

To order spare parts and/or accessories, please contact the nearest General Monitors' Representative or, General Monitors directly, and give the following information:

- Part Number of Spare Part or Accessory
- Description of Spare Part or Accessory
- Quantity of Spare Part or Accessory

9.5.1 Sensors

50445-1	0 to 100ppm, Aluminum Body, Wire Screen Arrestor
50445-5	0 to 50ppm, Aluminum Body, Wire Screen Arrestor
50445-9	0 to 20ppm, Aluminum Body, Wire Screen Arrestor
50448-1HT	0 to 100ppm, Stainless Steel Body, Wire Screen Arrestor, High Temp
50448-5HT	0 to 50ppm, Stainless Steel Body, Wire Screen Arrestor, High Temp
50448-9HT	0 to 20ppm, Stainless Steel Body, Wire Screen Arrestor, High Temp
51457-1L	0 to 100ppm, Stainless Steel Body, Sintered Steel Arrestor
51457-5L	0 to 50ppm, Stainless Steel, Sintered Steel Arrestor
51457-9L	0 to 20ppm, Stainless Steel, Sintered Steel Arrestor
50460-1	Sensor Simulator

9.5.2 Sensor Housing

10252-1	Universal Housing
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9.5.3 Sensor Accessories

10041-1	Duct Mounting Plate
10044-1	Dust Guard Kit - 1 Guard, 12 Replaceable Screens
10042-1	Replaceable Screens, Box of 12
10395-1	Splash Guard Assembly
10110-1	Dust Guard Assembly
1800822	Dust Guard, Sintered SST
10066	Sensor Flow Chamber

9.5.4 Calibration Equipment

50000	Breaker Bottle, Single
50004-3	Individual Ampoules, 10 ppm (12 minimum)
50004-21	Individual Ampoules, 25 ppm (12 minimum)
50004-13	Individual Ampoules, 50 ppm (12 minimum)
50008-9	12 Ampoules at 50ppm (0-100ppm scale)
50008-16	12 Ampoules at 25ppm (0-50ppm scale)
50008-10	12 Ampoules at 10ppm (0-20ppm scale)
50009-9	12 Ampoules at 50ppm, includes breaker bottle (0-100ppm scale)
50009-16	12 Ampoules at 25ppm, includes breaker bottle (0-50ppm scale)
50009-10	12 Ampoules at 10ppm, includes breaker bottle (0-20ppm scale)
1400250-1	10ppm H ₂ S Portable Purge Calibration Assembly
1400250-3	25ppm H ₂ S Portable Purge Calibration Assembly
1400250-5	50ppm H ₂ S Portable Purge Calibration Assembly
1400255-1	10ppm H ₂ S Replacement Cylinder
1400255-3	25ppm H ₂ S Replacement Cylinder
1400255-5	50ppm H ₂ S Replacement Cylinder

Case for Portable Purge Assembly

922-016 Replacement Regulator (0.2 L/min)

Replacement Hose

960-345 Hose Clamp, 5/16"

960-346 Hose Clamp, 1/4"

1400152-1 Calibration Cup

9.5.5 Intelligent Sensor (S4000T) Replacement Parts

31161-1 Control Board Electronics

31151-1 Output Board Electronics

31156-1 Display Board Electronics

31170-2 Enclosure Cover Assembly with Window

31195-2 Enclosure Base Assembly

30051-1 Explosion-Proof SPST Switch

30060-1 Calibration Magnet

Cover Assy., O-Ring

9.5.6 Recommended Spare Parts for One (1) Year

30060-1 Extra Calibration Magnet (Qty. 1)

9.6 FMRC Approval

Factory Mutual Research Corporation

1151 Boston-Providence Turnpike

Norwood, Massachusetts 02062

Approval of the transmitter does not include or imply approval of apparatus, to which the transmitter may be connected and which processes the electronic signal for the eventual end use. In order to maintain FMRC approved system, the control instrument, to which the subject instrument is connected, must also be FMRC approved.

The following sensors have been FMRC approved for use with the Model S4000T:

- 50445-1 Aluminum Body H2S Gas Specific MOS Sensor, 0 to 100 ppm
- 50445-5 Aluminum Body H2S Gas Specific MOS Sensor, 0 to 50 ppm
- 50445-9 Aluminum Body H2S Gas Specific MOS Sensor, 0 to 20 ppm
- 50448-1HT Stainless Steel Body H2S Gas Specific MOS Sensor, 0 to 100 ppm
- 50448-5HT Stainless Steel Body H2S Gas Specific MOS Sensor, 0 to 50 ppm
- 50448-9HT Stainless Steel Body H2S Gas Specific MOS Sensor, 0 to 20 ppm

The following apparatus have been FMRC approved (although they have not been verified as part of a Model S4000T system):

- Model DT210 Eight-Channel Readout/Relay Display Module with Power Supply and Relay Module
- Model DT230 Dual-Channel Readout/Relay Display Module



ADDENDUM
Product Disposal Considerations

This product may contain hazardous and/or toxic substances.

EU Member states shall dispose according to WEEE regulations. For further General Monitors' product WEEE disposal information please visit:

www.generalmonitors.com/customer_support/faq_general.html

All other countries or states: please dispose of in accordance with existing federal, state and local environmental control regulations.