GENERAL MONITORS

MODEL S106A

Three Relay
Smart Sensor for
Combustible Gas Applications

INSTRUCTION MANUAL 05/99

Part No. MANS106A
Revision D/05-99

Warranty

General Monitors warrants the *Model S106A* to be free from defects in workmanship or material under normal use and service within two (2) years from the date of shipment. General Monitors will repair or replace without charge any 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 prepaid to General Monitors' plant or the representative from which 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 do 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 use or performance of the product.

Warning

The Model S106A Combustible Gas Enhanced Smart Sensor Assembly 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.

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EC Declaration of Conformity in accordance with EC Directives.

We, at General Monitors, Inc., 26776 Simpatica Circle, Lake Forest, California 92630, U.S.A., hereby declare that the equipment described below, both in its basic design and construction, and in the version or versions marketed by us, conforms to the relevant safety and health related requirements of the appropriate EC Directives, only as follows:

a) Conforms with the protection requirements of Council Directive 89/336/EEC, +Amd 92/31/EEC, +Amd 93/68/EEC relating to Electro-magnetic Compatibility, by the application of;

A Technical Construction File No. GMI96008-1 and Competent Body Report No. 4473/1H5.

and

b) Conforms with protection requirements of IEC 1010-1:1990 + Amd 1:1992 relating to the safety by the application of;

A Technical Construction File No. GMI96008-1 and Competent Body Report Nos. 96-0215 and 96-0383, issued by;

ERA Technology Ltd., Cleeve Road, Leatherhead, Surrey, KT22 7SA, England. Tel: +44-1372-367000

This declaration shall cease to be valid if modifications are made to the equipment without our approval.

PRODUCT: HC and H2S Smart Sensors
MODEL /S: S106A, S216A, S104, S214

It is ensured through internal measures and our ISO 9001:1994 certification, that series production units conform at all times to the requirements of these current EC Directives and relevant standards.

Responsible Person: Robert J. Wek Date: 14 OCT 96

Robert J. Wek
Chief Operating Officer

The signatory acts on behalf of company management, and with full power of attorney.

1.0 Introduction

1.1 General Description

The Model S106A is an enhanced Smart Sensor assembly that can be used for detecting combustible gases 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. Relay contacts and an analog signal (4-20mA) provide remote and/or discrete indications of the sensor's operation.

The Model S106A enhanced Smart Sensor assembly is rated explosion proof for use in Class I, Division 1, Group B, C, and D hazardous areas.

1.2 Features and Benefits

Microprocessor Based Electronics: monitors nine individual fault conditions, processing input signals from the sensor and providing outputs in the form of display codes, relay contact activation, and an analog signal.

One Person Calibration: initiate the calibration sequence with a magnet, apply the gas, and wait for the display to indicate that the unit has completed the calibration. No tools or adjustments are required.

2 Digit Display: indicates gas concentrations, fault codes, calibration cues, and is used for selecting relay options.

4 to 20 mA Output: transmits fault, over range, calibration, and gas concentrations to a remote display, computer or other device.

Relay Contacts (SPDT): provides discrete relay contacts for Alarm, Warn and Fault indications to activate hazard prevention or safety control devices (such as fans, vacuum pumps, ventilation equipment, etc.).

1.3 Applications

This is a partial listing of applications:

- Drilling and Production Platforms
- Fuel Loading Facilities
- Compressor Stations
- Oil Well Logging
- LNG/LPG Processing and Storage
- Waste Water Treatment
- Gas Turbines
- Solvent Vapors
- Hydrogen Storage

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2.0 Sensor Assembly

2.1 Sensor Signal Processing

Combustible material is found in many gases and vapors. General Monitors uses a low temperature catalytic bead to detect the presence of combustible gases and vapors. The catalytic bead converts the combustible materials to heat. A change in heat is then converted to a change in resistance, which can be measured.

By taking a matched pair of catalytic beads and coating one so that it does not respond to the presence of combustible gases, we can compare the change in resistance between the two beads. The bead that is coated is called the reference bead and the other is called the active bead (figure 1). Environmental factors can also influence the temperature of the catalytic beads. Because the beads are a matched pair, they will respond to changes in ambient temperature, humidity, and pressure equally.

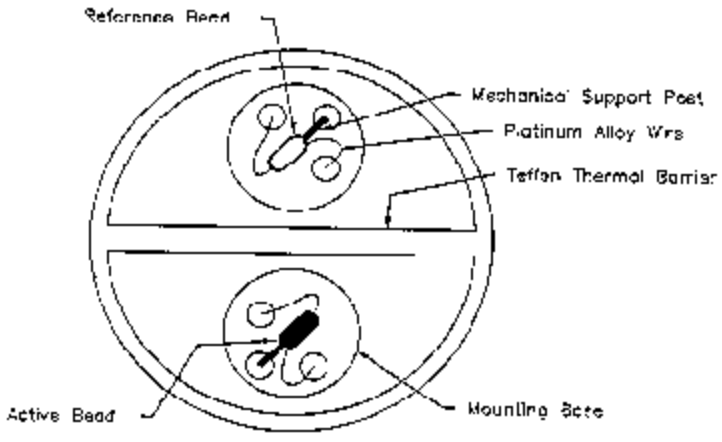

figure 1

By connecting one end of each catalytic bead together, a series circuit is formed. This circuit is supplied with a constant voltage. The voltage drop across each of the beads will be identical in the absence of combustible gases. As combustible material is converted to heat, the resistance of the active bead increases causing the voltage drop across each bead to be different. This difference is proportional to the amount of combustible gas that is present.

The voltage from the sensor is amplified and fed to an Analog to Digital (A/D) converter and then made available to the microprocessor (figure 2).

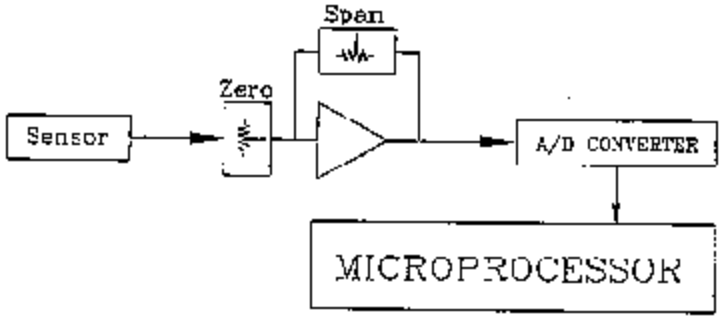

figure 2

The baseline and the gain for the amplifier are determined by digital potentiometers. They are adjusted by the microprocessor during calibration.

Sensor Assembly

2.2 Power Supply

The Model S106A operates from a +24 VDC (nominal) input. This unregulated source is fed to a converter board that produces voltages (see figure 3). These signals are the source for operating all of the circuitry on the control and the display boards, and supplying the sensor with power. Terminal connections inside of the housing have been provided for accepting the input power.

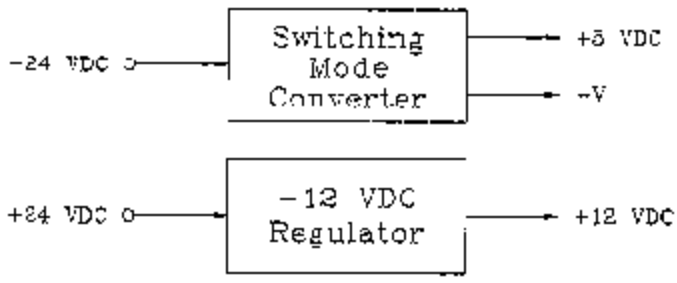

figure 3

2.3 Control Electronics

The control electronics are centered around an eight bit microprocessor (figure 4). The sensor signal, the CAL switch, the non-volatile memory (NOVRAM), and certain fault conditions are monitored as inputs. By processing these inputs, the following outputs are generated: 4-20mA output signal, relay contact states, digital display indications, and calibration values (NOVRAM).

As the microprocessor (MPU) receives and processes the inputs, it determines what value is output to the display, the 4-20mA current generator, and the state of the relay contacts.

When the CAL Switch is activated, the MPU allows the user to choose between the Calibration, the Calibration Check, or the Alarm Set Point and Relay Option Selection modes. While the unit is in the Calibration Check mode, the MPU will fix the 4-20mA output signal to 1.5mA. The 0mA option applies to the calibration mode, the alarm set point and relay option selection modes.

Calibration Mode: When the unit is placed in this mode, the MPU accepts a ZERO value and waits for the signal from the sensor to increase and then stabilize. It accepts this final value as a SPAN value. These values are stored in NOVRAM and are used in adjusting with the digital potentiometers associated with the Input Amplifier.

Calibration Check Mode: In this mode, the MPU will output the gas concentration to the display while inhibiting the Warn & Alarm outputs. When the gas concentration drops below 10% LEL, the unit will return to normal operation. The purpose of this mode is to check the response of the unit to a known level of gas and determine if calibration is necessary.

Warn & Alarm Set Points and Relay Options Selection Mode: The Alarm Set Point can be set in increments of 5% LEL, from 5 to 60 on the display for each set point (Warn & Alarm). The two Relay Options that are available are Energized/De-Energized and Latching/Non-Latching for the Warn & Alarm relays.

Sensor Assembly

Control Electronics (*continued*)

NOTE: **Once the Warn & Alarm Set Points and Relay Options have been selected, the unit will revert to the calibration sequence, and must be calibrated.**

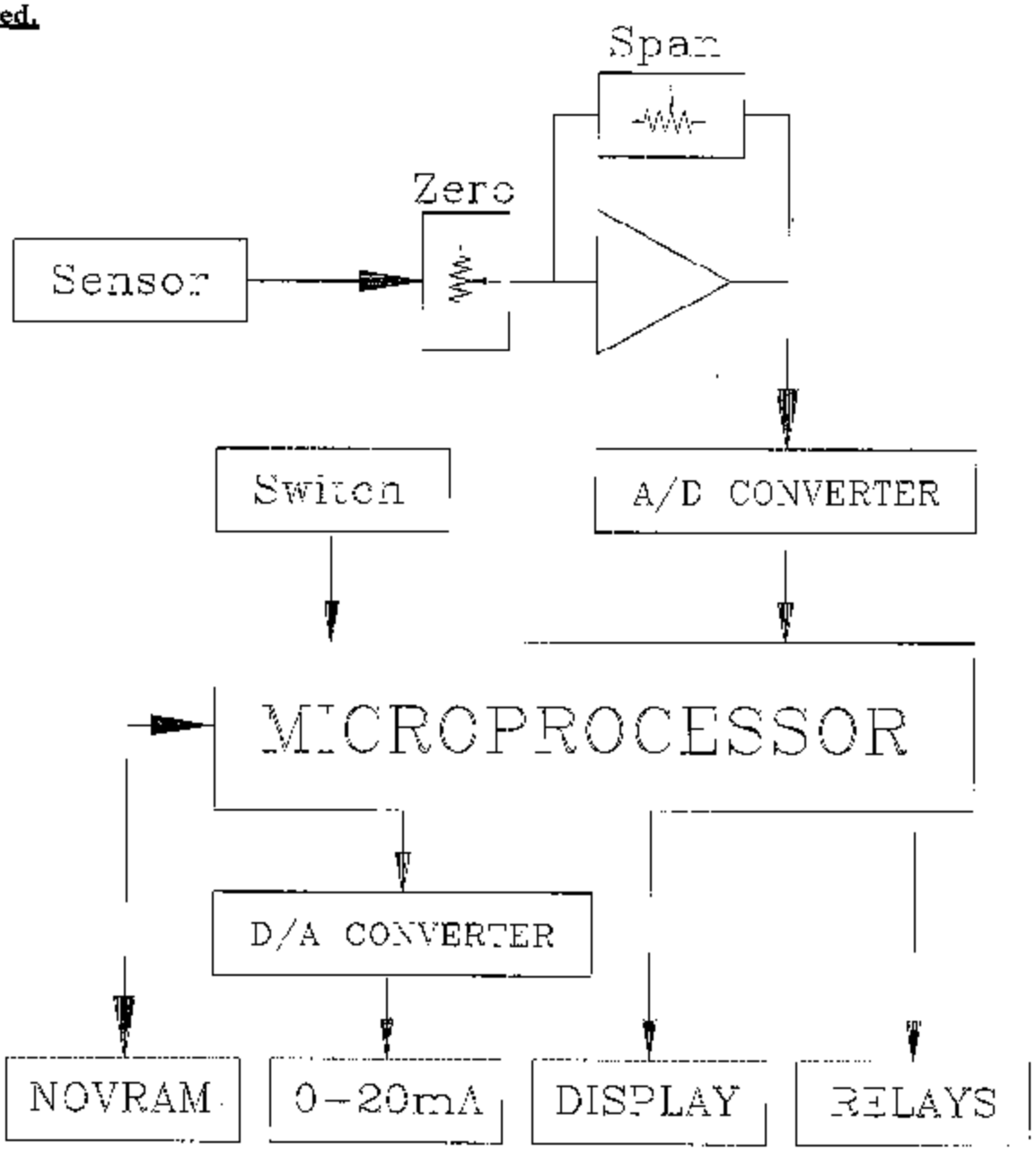

figure 4

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3.0 Installation

3.1 Receipt of Equipment

All equipment shipped by General Monitors is prepackaged in shock absorbing containers which provide considerable protection against physical damage. The contents should be carefully removed and checked against the packing slip. If any damage has occurred or if there is any discrepancy in the order, notify General Monitors as soon as possible. All subsequent correspondence with General Monitors must specify the equipment part and serial numbers.

Each Model S106A is completely checked by the factory. However, a complete check-out is necessary upon initial installation and start up to ensure system integrity.

3.2 Sensor Location Considerations

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 S106A Enhanced Smart Sensor should be easily accessible for calibration checks.

- The sensor assembly should be mounted pointing down to prevent water build-up on the sensor head.
- The sensor assembly should not be placed where it may be coated by contaminating substances.
- Although the Model S106A is RFI resistant, it should not be mounted in close proximity to radio transmitters or similar equipment.
- Locate the Model S106A where prevailing air currents contain the maximum concentration of gas.
- Locate the Model S106A near possible sources of gas leaks.
- Observe the Model S106A's temperature specification and locate the unit away from concentrated sources of heat.
- Sensor Assemblies should be mounted in an area that is as free from wind, dust, water, shock, and vibration as possible. See Appendix, section 5.1.4 for the environmental specifications of the unit.

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:

- Prolonged presence of Hydrogen Sulfide (H_2S) gas
- Silicones (often contained in greases and aerosols)
- Halides . . . compounds containing Fluorine, Chlorine, Bromine and Iodine
- Heavy metals, e.g. Tetraethyl Lead

The presence of poisons and contaminants in an area does not necessarily preclude the use of a Model S106A Enhanced Smart 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.

Installation

Sensor Location Considerations *(continued)*

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

CAUTION: **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.**

Remoting 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 100 feet, using 14 AWG wire. Sensors that are remotely mounted must be placed in a sensor housing (GMI P/N 10252) and the cable run must be contained in a conduit running from the sensor housing to the electronics. See Appendix, section 5.4 for FMRC approval requirements.

3.3 Installation Instructions

The overall and mounting dimensions for the Model S106A (figures 5 & 27) should be used when making installation determinations. A complete list of the mechanical specifications can be found in the Appendix (section 5.1.3).

To prevent possible corrosion due to moisture or condensation, it is recommended that the conduit connected to the Model S106A housing, be sealed or contain a drain loop (figure 6).

Each conduit run from a hazardous location to a non-hazardous location should be sealed so that gases, vapors, and/or flames can not 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 S106A housing to maintain its explosion proof integrity, however, conduit runs containing wires attached to the Model S106A's relay contacts must be sealed (see section 5.4).

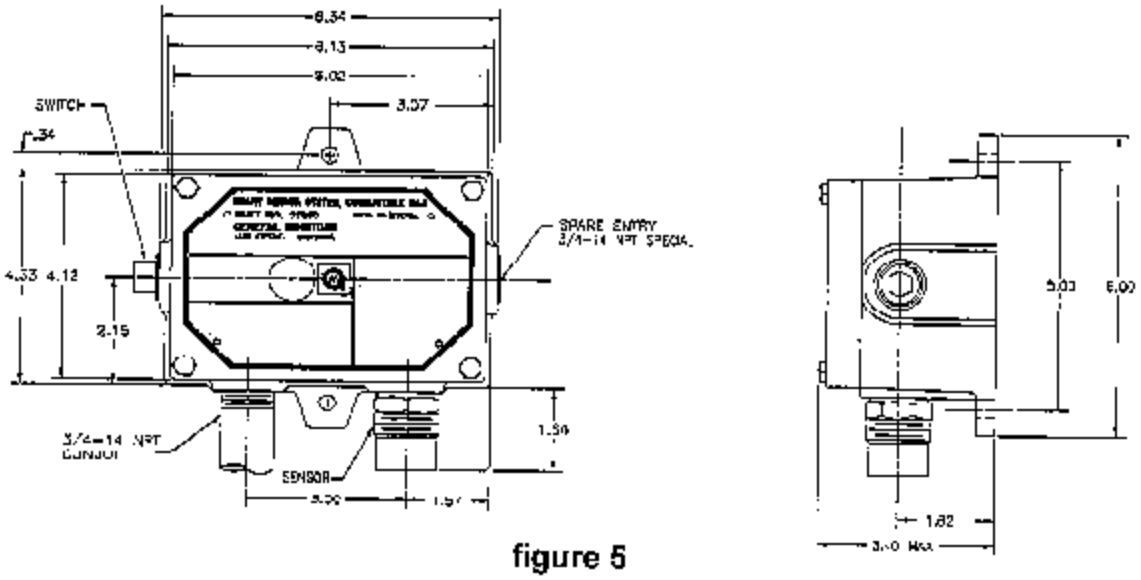

figure 5

Installation

Installation Instructions (*continued*)

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

NOTE: 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 S106A 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.

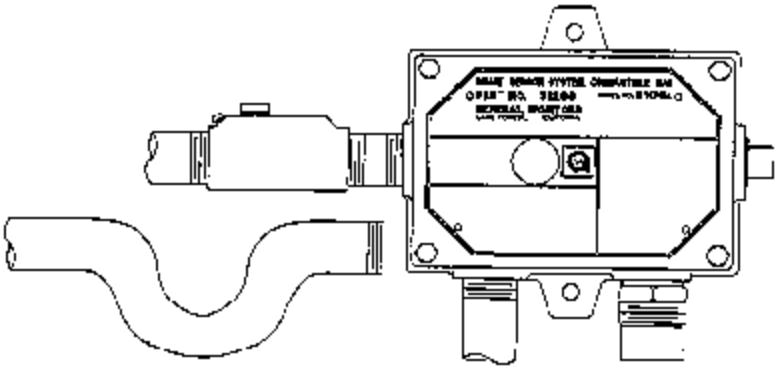

figure 6

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

General Monitors recommends that the complete system, including all alarm circuitry, be tested at least annually. Some typical items to check during maintenance examinations are:

- The sensor mounting, to see it is secure.
- The sensor screen, to see it is clear of water, oil, dust or paint.
- The cable connections for tightness and possible damage.
- All sensor placements, to see that they are up to date with the layout of the plant (e.g. modifications to the plant).
- The complete system, to see it has a back up supply for the full prescribed time.

3.4 Terminal Connections

The terminal blocks (TB) are located inside of the housing and can by accessed by removing the cover (figure 7, CE Marked units see figure 28). TB3 contains the three sensor connections, White (W), Black (B), and Red (R).

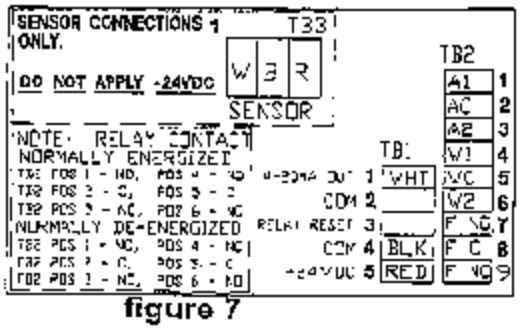

figure 7

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Model S106A

Installation

Terminal Connections (*continued*)

TB1 contains the connections for Power, Relay Reset, and Output Signal (CE Marked units, see figure 28).

TB1 position	Function
1	0-20mA Output
2	Reset Common
3	Relay Reset
4	Common (Ground)
5	+24VDC Power

TB2 contains the connections for the Relay Contacts. 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:

Alarm Relay - Normally Energized

TB2 position	Relay Contact
1	Normally Open
2	Common
3	Normally Closed

Alarm Relay - Normally De-Energized

TB2 position	Relay Contact
1	Normally Closed
2	Common
3	Normally Open

Warn Relay - Normally Energized

TB2 position	Relay Contact
4	Normally Open
5	Common
6	Normally Closed

Warn Relay - Normally De-Energized

TB2 position	Relay Contact
4	Normally Closed
5	Common
6	Normally Open

The Fault Relay contacts are always Normally Energized.

TB2 position	Relay Contact
7	Normally Open
8	Common
9	Normally Closed

Inductive loads (bells, buzzers, relays, etc.) on dry relay contacts must be clamped down (figures 8 and 9). Unclamped inductive loads can generate voltage spikes in excess of 1000 volts. Spikes of this magnitude may cause false alarms and contact damage.

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

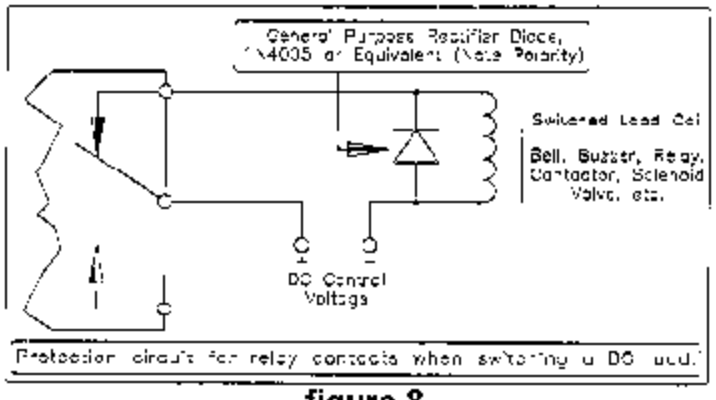

figure 8

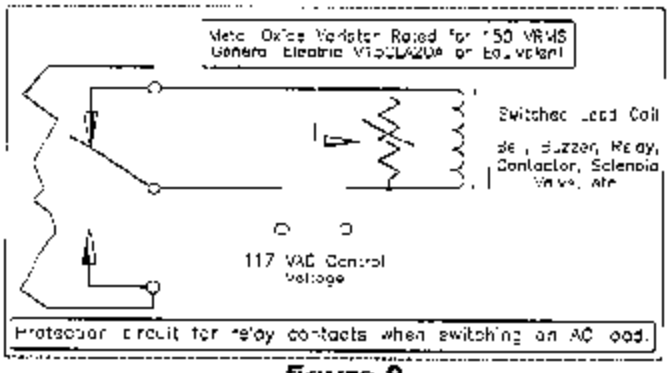

figure 9

Installation

Terminal Connections (*continued*)

It is recommended that a three wire (red, black, white) shielded cable be used for making power and output signal connections on the Model S106A. The terminal block accepts 16 AWG to 22 AWG stranded or solid wire. Each wire should be stripped before wiring the Model S106A Combustible Gas Enhanced Smart Sensor. To connect wiring to the terminal block, insert a screw driver into the orange tab and press down (figure 10), 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.

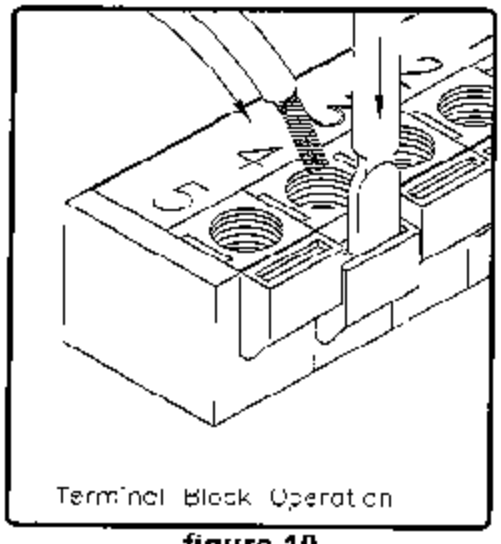

figure 10

NOTE: up to 14 AWG wire can be used if it is carefully stripped (figure 11).

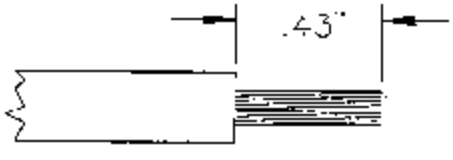

figure 11

A 4 to 20mA output signal is provided by the Model S106A Combustible Gas Enhanced Smart Sensor and can be sent up to 9000 feet (2740 meters) to a General Monitors readout/relay display module, industrial analog to digital converter, computer based monitor, PLC, DCS, etc. The 4 to 20mA signal provides for control room or other locations remote to the Model S106A to display indications of operation and alarm conditions. To connect the 4 to 20mA output signal with another unit, connect the white wire into TB1, position 1, labeled 4-20 mA OUT (CE Marked units TB 4, position 1). For making output signal connections to display devices, refer to the specific manual for that device (figure 12).

FROM	TO				
MODEL S106A	MODEL DC100	MODEL DC110	MODEL DC120	MODEL DC130	MODEL TA102A
TB1 PN 1 4-20 mA OUT	REAR PIN 3 ANALOG IN	REAR CH 7-8 4-20mA	REAR TB1 PN 8 or 9	REAR PIN 2 or 5 ANALOG IN	REAR PIN 26d,z

4 to 20mA Output Connections

figure 12

If a device other than a General Monitors readout/relay display module is being used, the commons, COM, of both systems must be connected together See Appendix, section 5.4. The Model S106A Combustible Gas Enhanced Smart Sensor operates on a nominal power of +24 VDC.

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Installation

Terminal Connections (*continued*)

Primary DC power must be provided by the customer unless one of the following General Monitors Modules is being used with the Model S106A:

- DC100 Readout/Relay Display Module
- DC110 Readout/Relay Display Module with Power Supply & Relay Module
- DC130 Readout/Relay Display Module
- TA102A Trip Amplifier Module with a PS002

The following General Monitors Modules provide power connections for the Model S106A, but need a customer supplied DC source:

- DC110 Readout/Relay Display Module without a Power Supply & Relay Module
- DC120 Dual Channel Display Module
- TA102A Trip Amplifier Module without a PS002

Since the Model S106A is designed to operate continuously, a power switch is not included, in order to prevent accidental system shut-down.

NOTE: <u>Power must remain disconnected until all other wiring connections have been made.</u>

The maximum distance between the Model S106A and the power supply is 4500 feet or 1372 meters (each cable run should be as short as possible). See the Appendix (section 5.1.2) for cable length specifications. To connect +24VDC to the Model S106A, connect the red wire to TB1, position 5, labeled +24VDC (CE Marked units TB 4, position 3). Connect the black wire to TB1, position 4, labeled COM (CE Marked units TB 4, position 2). For making power connections to display devices see figure 13 (CE Marked units see figure 28).

3.5 Applying Power

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, or after a fault condition, the unit will enter a fifty second Start-Up mode. During this period the display will indicate an SU.

COMMON

FROM	TO			
MODEL S106A	MODEL DC100	MODEL DC110	MODEL DC130	MODEL TA102A
TB1 PIN 4 "COM"	REAR TERMINAL BLOCK PIN 5 "PARALLEL COM"	REAR COMMON (BX)	REAR PIN 3 OR 8 "COM"	REAR PIN 3 OR 8

+24 VDC

FROM	TO			
MODEL S106A	MODEL DC100	MODEL DC110	MODEL DC130	MODEL TA102A
TB1 PIN 5 "+24VDC"	REAR TERMINAL BLOCK PIN 4 "DC OUT"	REAR CH.-B 24V	REAR PIN 4 OR 7 "DC OUT"	REAR PIN 2 OR 3

Power Connections

figure 13

Installation

3.6 Maintaining the X/P Integrity

The Model S106A is rated explosion proof for Class I, Division 1, Group B, C & D hazardous locations. Some of the factors that influence the explosion proof integrity of the Model S106A 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.

Anytime the cover of the smart sensor housing is removed or the cover bolts are loosened, the flame path between the lid and the housing is effected. If power is to be left on while removing the cover or loosening the cover bolts on the Model S106A, it will be necessary to de-classify 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 on the left and right sides and two on the bottom of the Model S106A 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 S106A 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)
- 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.

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4.0 Operation

4.1 Relay Options

The Model S106A has user selectable relay options. The three types of relay options that are available for the Warn and Alarm Relays are Energized or De-Energized, Latching or Non-Latching and the Set Point. Each of these relays has one Normally Open and one Normally Closed contact.

The Energized/De-Energized option specifies if the relay is to have power applied normally (energized) or if the relay is normally at mechanical rest (de-energized). The Latching/Non-Latching option specifies whether the Warn/Alarm relay contacts need to be manually reset or if they reset automatically. If the non-latching option is selected, the user should read section 5.4 in the Appendix. The set point option specifies the level of gas concentration at which the Warn/Alarm relay will activate. When the gas concentration exceeds a particular set point (Warn or Alarm, that relay will activate).

The Fault relay has no options that are user selectable options. The standard configuration for the Fault relay is Energized and Non-Latching. When a Fault condition is present the Fault circuit is activated and the Fault code appears in the display window. The Fault codes and their remedies are presented in section 4.4 of this Instruction Manual.

Procedure for setting the Warn & Alarm relay options:

- Place the magnet over the General Monitors' (GMI) Logo on the cover and observe the Digital Display (figure 14).

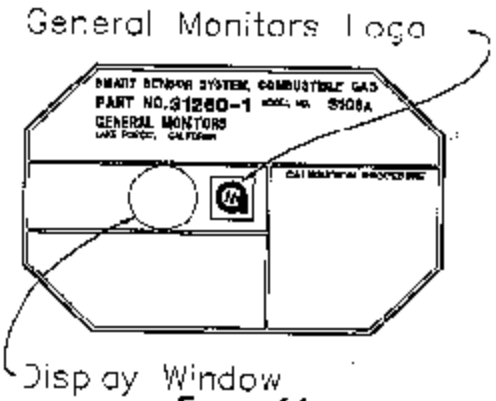


figure 14

- The display will indicate a steady pair of bars "- -" (figure 15). This lets the user know that the magnet has been properly placed over the GMI Logo.

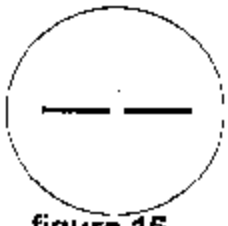


figure 15


figure 16

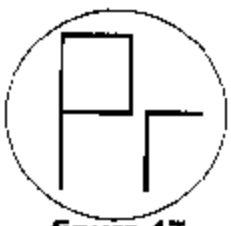


figure 17

- Keep the magnet placed over the Logo. Next, a flashing pair of bars "- -" will appear on the display, then the letters "**AC**" (figure 16) followed by "**Pr**" (figure 17). Then the letters "**AL**" will appear.
- When the letters "**AL**" (figure 18) appear on the display, remove the magnet. This is the Warn / Alarm Relay Options Mode. The Warn relay options will be selected first, then the Alarm options. The Warn & Alarm relay option sequences are identical.


figure 18

GENERAL MONITORS
Model S106A

Operation

Relay Options (*continued*)

- The display will alternate between "**En**" and "**dE**" (figure 19), until the magnet is re-applied. Apply and remove the magnet when the desired option appears on the display. "**En**" stands for Energized and "**dE**" stands for De-Energized. When this selection has been made, the next option will appear.

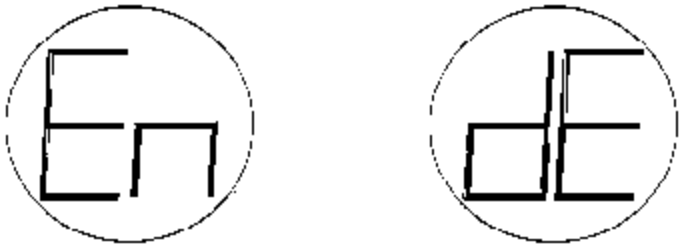


figure 19

- The display will alternate between "**LA**" and "**nL**" (figure 20), until the magnet is re-applied. Apply and remove the magnet when the desired option appears on the display. "**LA**" stands for Latching and "**nL**" stands for Non-Latching. When this selection has been made, the next option will appear.

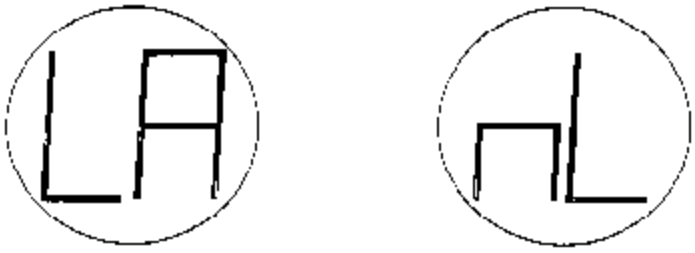


figure 20

- The display will sequence through the Warn Set Point Levels beginning with "**5**" and increasing in increments of 5 up to "**60**" and then back to "**5**" (figure 21), where the the display will increase again in increments of 5. Apply and remove the magnet when the desired Warn Set Point appears on the display.

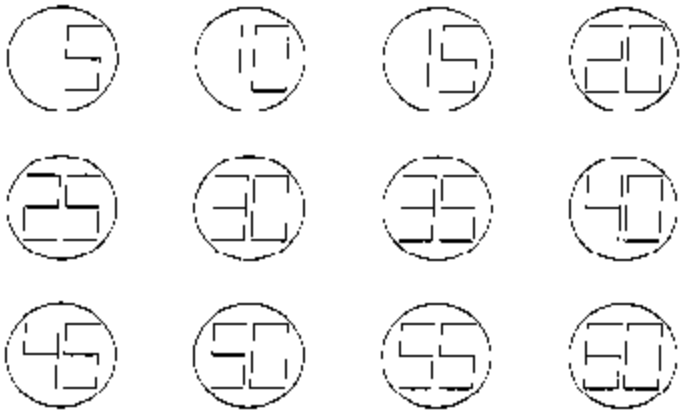


figure 21

- When this selection has been made, the Alarm sequence will begin and the same options will need to be set for the Alarm relay.
- The Energized/De-Energized option for the Alarm relay will be displayed as in figure 19.
- The Latching/Non-Latching option for the Alarm relay will be displayed as in figure 20.
- Finally, the Alarm Set Point option will be displayed as in figure 21 (cannot be lower than the Warn set point).

NOTE: **After the Warn and Alarm relay options are selected the Model S106A will revert to the calibration mode and must be calibrated.**

Operation

4.2 Program Review Mode

The Program Review (Pr) Mode allows the operator to view the relay options that have been selected for the Warn & Alarm relays. To enter the Program Review Mode place the magnet over the GMI logo on the cover and wait until "**Pr**" appears in the display window. Then remove the magnet.

The display will indicate the Warn options and then the Alarm options in the sequence listed below:

- Warn Relay Options

  Energized (En) or De-Energized (dE)
  Latching (LA) or Non-Latching (nL)
  Warn Set Point (#)

- Alarm Relay Options

  Energized (En) or De-Energized (dE)
  Latching (LA) or Non-Latching (nL)
  Alarm Set Point (#)

Each selection will be displayed for approximately 5 seconds before sequencing to the next option. When the last option has been displayed the unit will return to normal operation.

NOTE : <u>The Program Review Mode does not allow the operator to make changes to the relay options.</u>

4.3 Calibration

Activating the Calibration Switch will automatically disable the alarm circuits by sending a 1.5mA (0mA optional) output signal. This will prevent activation of the relay contacts when using a General Monitors Readout/Relay Display Module with the Model S106A.

General Monitors recommends that the Model S106A Combustible Gas Enhanced Smart Sensor be calibrated one hour after start-up, and that 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.

NOTE: <u>A calibration check consists of applying a known concentration of gas to the sensor and observing the reading on the Model S106A, the Readout/Relay Module, or other computer data collecting systems.</u>

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

Calibration Procedure:

- If it is suspected that combustible gas is present, it will be necessary to purge the sensor environment with ***Zero Air***. If ***Zero Air*** is not available, cover the sensor for about thirty seconds before applying the calibration gas. ***Zero Air*** is air that is hydrocarbon free.

Operation

Calibration (*continued*)

- Place the magnet over the GMI Logo on the cover (figure 14) of the unit and hold it there until "**AC**" (figure 16) appears on the display (about ten seconds). Allow about five seconds for the unit to acquire the zero reading before applying the calibration gas. If the GMI Portable Purge Calibrator (P/N 1400150) is **not** used when calibrating the Model S106A with Methane (CH_4), the SPAN gas flow rate needs to be 440cc/min to 460cc/min. See Appendix, section 5.4.

- Apply a 50% LEL gas concentration to the sensor. The display will change from "**AC**" (Automatic Calibration) to "**CP**" (Calibration in Progress) indicating that the sensor is responding to the calibration gas (figure 22).

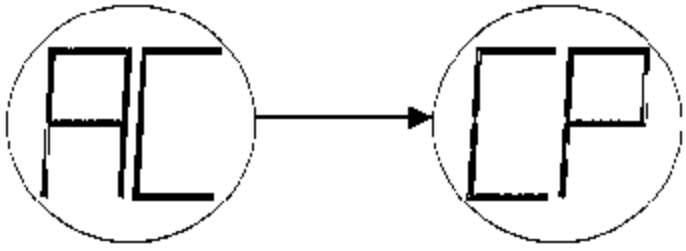


figure 22

- After one or two minutes the display will change from "**CP**" to "**CC**" (figure 23) indicating that the calibration is complete.

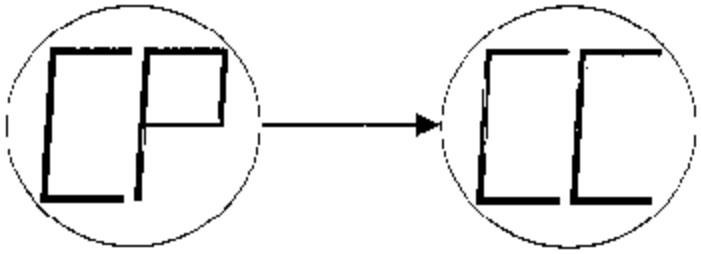


figure 23

- Remove the gas and wait for the unit to return to normal operation. The display will indicate a few percent LEL and then drop to "**0**" (figure 24).

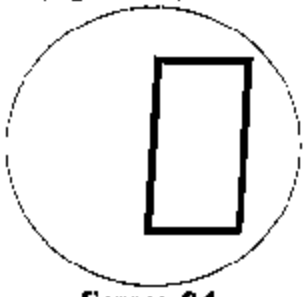


figure 24

- The unit is now calibrated and the new ZERO and SPAN values have been stored in the non-volatile memory (EEPROM)

The Model S106A can be returned to normal operation, if the magnet is re-applied ninety seconds after initiating the calibration sequence (with the old calibration values valid).

If the Model S106A is placed in the Calibration Mode and no gas is applied for six minutes, the unit will revert to a Fault condition. Re-applying the magnet over the GMI Logo will return the unit to the Calibration mode (with the old calibration values valid).

Calibration Check Mode:

If it is desired to check the sensor for its response without sending a gas concentration signal to a remote display device, this can be accomplished by placing the Model S106A into the "Calibration Check" mode. Placing the S106A in this maode inhibits the Warn & Alarm relays.

Operation

Calibration (*continued*)

Procedure for checking the calibration:

- Place the magnet over the GMI Logo on the cover of the Model S106A. Remove the magnet when a **flashing** pair of bars, "- -", appears on the display (about three seconds).

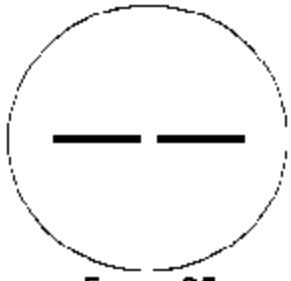


figure 25

- Apply the test gas to the sensor and the value of the gas concentration will be indicated by the flashing display in one to two minutes.

- 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% LEL.

The test gas concentration must be at least 10% LEL before the unit will complete the Calibration Check sequence. If the Model S106A is placed in the Calibration Check mode and no gas is applied for six minutes, the unit will revert to a Fault condition. Re-applying the magnet over the GMI Logo will return the unit to normal operation.

Calibration Equipment:

The **Portable Purge Calibrator** is a compact, accurate and safe system containing no explosive gas concentration. The lecture bottle is filled with a standard 50% LEL mixture of gas/air. Using a known gas/air mixture reduces the likelihood of error in field calibration. The included hose and cup adapter allow for quick calibrations.

Pre-mixed calibration gases at approximately 50% LEL are available, in lecture bottles, at 1200 psia, 8.3 MPa maximum pressure.

- Butadiene C_4H_6
- Butane C_4H_{10}
- Ethane C_2H_6
- Hydrogen H_2
- Methane CH_4
- Propane C_3H_8

Please specify the gas upon ordering. Spare bottles containing these gases may be ordered. Methane and Hydrogen lecture bottles may be returned to General Monitors for refilling.

The **Portable Calibration Chamber** is a 3 liter (3000 cc) sample chamber with a spring driven mixing fan. A porthole allows the chamber to be placed on the sensor for calibration. A syringe is included for accurate measurement of volatile test liquids. Sensors should be calibrated to a specific vapor for greatest accuracy. A hydrocarbon sensor calibrated for 50% LEL Acetone, for example, will detect all hydrocarbons and most combustible solvent vapors, however, it will accurately read ONLY the % LEL of Acetone.

The indicated measures of volatile liquids found on the next page produces 50% LEL vapor mixtures at 75° Fahrenheit (25° Celsius) temperature and standard pressure when used with the Portable Calibration Chamber (see Appendix, section 5.4).

Operation

Calibration (*continued*)

Volatile liquids are not supplied by General Monitors. Below is a list of volatile liquids and the volume required (in microliters) to produce 50% LEL in the 3 liter chamber.

Acetaldehyde	136
Acetic Acid	140
Acetone	112
Acetonitrile	96
Acrylonitrile	120
Amyl Acetate	100
Amylamine	156
Benzene	65
Butyl Acetate	137
Butyl Acrylate	132
Butyl Alcohol	78
sec-Butyl Alcohol	96
tert-Butyl Alcohol	136
Butyl Cellosolve	88
Butyraldehyde	102
Cyclohexane	86
Decane	95
Diethyl Ketone	103
Diisobutyl Ketone	82
Dimethylformamide	104
p-Dioxane	104
Dodecane	83
Ethanol (Ethyl Alcohol)	118
Ethyl Acetate	110
Ethyl Amine	140
Ethyl Benzene	60
Ethyl Ether	120
Ethylene Oxide	89
Gasoline 100 Octane	107
Heptane, Normal	91
Hexane, Normal	86
Isopentane	99
Isoprene	89
Isopropyl Alcohol	93
Isopropyl Ether	120
JP-4 Jet Fuel	183
Methanol	148
Methyl Ethyl Ketone (MEK)	76
Methyl Methacrylate	111
Naptha (Petroleum Ether)	96
Octane	99
Pentane, Normal	106
Propanal	114
Propyl Acetate	106
Propylamine	103
Propylbenzene	68
Propylene Oxide	98
Styrene	63
Tetradecane	79
Tetrahydrofuran	99
Tetrahydrofurfuryl Alcohol	89
Toluene	78
1,1,1-Trichlorethane	456
Trichloroethylene	438
Triethylamine	102
Vinyl Acetate	152
Vinyl Ethyl Ether	99
o-Xylene	67
p-Xylene	83
Xylenes	83

REFERENCE NFPA-1994

4.4 Digital Display Codes

The following codes will appear on the display when then unit is placed in a mode other than the normal operating mode.

SU	Start-Up Mode
- - (steady)	Magnetic Switch Activated
- - (flashing)	Test Gas Mode
AC	Automatic Calibration
CP	Calibration in Progress
CC	Calibration is Complete
AL	Alarm Options Mode
Pr	Program Review
En	Energized Relay Option
dE	De-Energized Relay Option
LA	Latching Relay Option
nL	Non-Latching Relay Option
5,10,...,60	Alarm Set Point Option
F1	Failed to Zero during calibration
F2	Failed to complete the calibration
F3	Failed to Span during calibration
F4	Sensor Reference Bead Error
F5	Sensor Active Bead Error
F6	Low Supply Voltage
F7	EEPROM Verification Failure
F8	Negative Zero Drift
F9	Calibration check period exceeded

SU This is displayed for about fifty seconds during start-up and after a Fault condition has been corrected.

- - Appears on the display when the magnet has been properly positioned over the GMI Logo and when the Test Gas Mode can be or has been entered.

Operation

Digital Display Codes (*continued*)

AC **CP** **CC**	These codes appear on the display during the calibration process. For more information about these codes, refer to Section 4.3.
AL, Pr **En/dE** **LA/nL** **5,10,...,60**	These codes are used for selecting and viewing the Warn & Alarm Relay options. For more information about these codes, refer to section 4.1.
F1,F2,F3 **F4,F5, F6** **F7,F8,F9**	These codes will appear on the display if a Fault condition occurs. For more information about these codes, refer to Section 4.5.

When the unit is in the normal operating mode, the display will indicate the presence of combustible gas in percent of the Lower Explosive Level (% LEL). The range of detection is from 0 to 99% LEL.

99 (flashing) Over-Range, a gas concentration exceeding 99% LEL is present.

4.5 Fault Codes & Their Remedies

The Model S106A 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 S106A 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.

When a Calibration Fault (F1, F2, F3) has occurred and has been corrected, the unit will automatically revert to the calibration process and the unit must be re-calibrated. If a Fault other than a Calibration Fault occurs, after it is corrected the unit will return to the Start-Up Mode (SU).

Fault Codes and their Remedies:

F1 = Failed to Zero during Calibration

Faulty Sensor - If both Catalytic Beads are not closely matched. This may happen as a sensor approaches the end of its useful life or if the Beads have become corroded. **ACTION** - Replace the sensor.

Gas Present - If the magnet was applied with a high level of gas present, the Model S106A will not be able to obtain a valid ZERO. **ACTION** - Ensure the sensor is in clean air.

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 six minutes. **ACTION** - Make sure there is calibration gas present, re-apply magnet and attempt to calibrate.

F3 = Failed to Span during Calibration

Low Gas - If the gas concentration applied to the unit does not give sufficient response for a valid SPAN parameter. **ACTION** - Use the correct gas concentration, i.e. 50% LEL.

Bad Sensor - If the sensor response has gone below an acceptable level. **ACTION** - Replace the sensor.

Operation

Fault Codes & Their Remedies (*continued*)

NOTE: **If the unit fails to calibrate** and an F1 or an F3 code is displayed, the calibration gas must be removed, and the sensor must see clean air for at least five minutes before a second calibration is initiated.

F4 = Sensor Reference Bead Error

This fault may occur as a result of one of the following:

- excessive negative drift
- an open sensor reference bead
- the sensor BLACK wire is disconnected

ACTION - Attempt to recalibrate the unit. If this is unsuccessful make sure that the BLACK sensor wire is connected to the terminal block. If these actions do not cure the fault condition, then replace the sensor.

F5 = Sensor Active Bead Error

This fault occurs if the sensor active bead becomes open circuited or, if the sensor WHITE or the sensor RED lead becomes disconnected. **ACTION** - Check the WHITE and RED wires then replace the sensor.

F6 = Low Supply Voltage

This fault occurs if the supply voltage drops below +17.5VDC approximately. **ACTION** - Ensure that the supply voltage is at least +20VDC at the Model S106A.

Correcting Fault conditions F4 through F9 will initiate the Start-Up Mode.

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 S106A 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.

F7 = EEPROM Verification Failure

This fault occurs during calibration when an attempt to verify the calibration parameters just written to the non-volatile memory fails. **ACTION** - Place the magnet over the GMI Logo and the unit will attempt another EEPROM write and verify.

F8 = Negative Zero Drift

If the zero baseline of the sensor drifts 10% of full scale below zero for more than 20 seconds this fault will occur. **ACTION** - A routine re-calibration will be required.

F9 = Calibration Check Period Exceeded

If the Model S106A is left in the Test Gas Mode for more than six minutes without a Test Gas being applied, this fault will occur. **ACTION** - Place the magnet over the General Monitors Logo 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.

5.0 Appendix

5.1 Specifications

5.1.1 System Specifications

Sensor Type:
Diffusion, low temp. catalytic bead

Standard industrial types: Combustible Gas; Solvent Special; Standard and High Temperature Versions (See section 5.3)

Typical Life: 3 years in normal service

Accuracy:
±3% LEL up to 50% LEL, ±5% LEL above 50% LEL and less than 100% LEL

Zero Drift:
Less than 5% per year

Response Time:
With 100% LEL Methane Applied, T50 < 10 sec. & T90 < 30 sec.

Readout/Relay Modules (See section 5.4):

DC100	Single Channel Display
DC110	Eight Channel Display
DC120	X/P, Dual Channel Display
DC130	Dual Channel Display
TA102A	Single Channel, 02 Series

Fault Conditions Monitored:
Low DC Supply, Sensor Bead Open, Calib. Out of Range, EEPROM Failure

Warranty:
Two Years

Approvals:
CSA certifed to C22.2 No.152

Cenelec certified (with SST flame arrestor sensors only)

FMRC Approved.

CE Mark approval against EMC Directive and Product Safety

5.1.2 Electrical Specifications

Input Power:
24 VDC @ 250 mA nom., 1A during SU
20 to 30 VDC range

Output Current: *(0-22mA @ 300 Ohms max. load)*

Fault:	0.0mA	
Calibration:	1.5mA	(0mA optional)
Test Gas:	1.5mA	(always)
Relay Options:	1.5mA	(always)
0-100%LEL:	4 to 20mA	
Over-range:	20 to 22mA	

Electrical Classification:
Class I, Division 1, Groups B, C & D
NEMA 4x rated

Alarm, Warn & Fault Relay Contact Rating:
SPDT - 5A 250VAC, 5A 30VDC, resistive max.

Recommend Three Wire Shielded Cable:

Maximum distance between the Model S106A and the power source.

AWG	Feet	Meters
22	750	228
20	1100	335
18	1600	488
16	2250	685
14	4500	1372

Appendix

Specifications (*continued*)

Electrical Specifications (*continued.*)

For interfacing with 250 ohm input impedance devices, the following maximum cable lengths apply, with respect to the Analog Signal, with the total loop resistance less than 300 ohms.

AWG	Feet	Meters
22	1600	488
20	2400	730
18	3800	1160
16	5200	1585
14	9000	2740

NOTE. Good design practices dictate cable lengths conservatively shorter than the maximum given values.

5.1.3 Mechanical Specifications

Weight (approx)	5.5 LB	2.5 kg
Length	6.34 in.	161 mm
Height (w/bolts)	3.40 in.	86 mm
Width at the base	4.10 in.	104 mm
Between mounting hole centers	4.99 in.	127 mm
Between outside edges of mounting flanges	6.00 in.	152 mm

5.1.4 Environmental Specifications

Operating Temperature Range:
Sensor (See section 5.4)
-65°F to 200°F
-55°C to 93°C

High Temperature Sensor (See section 5.4)
-65°F to 400°F
-55°C to 200°C

Electronics (pc board assemblies)
-40°F to 140°F
-40°C to 60°C

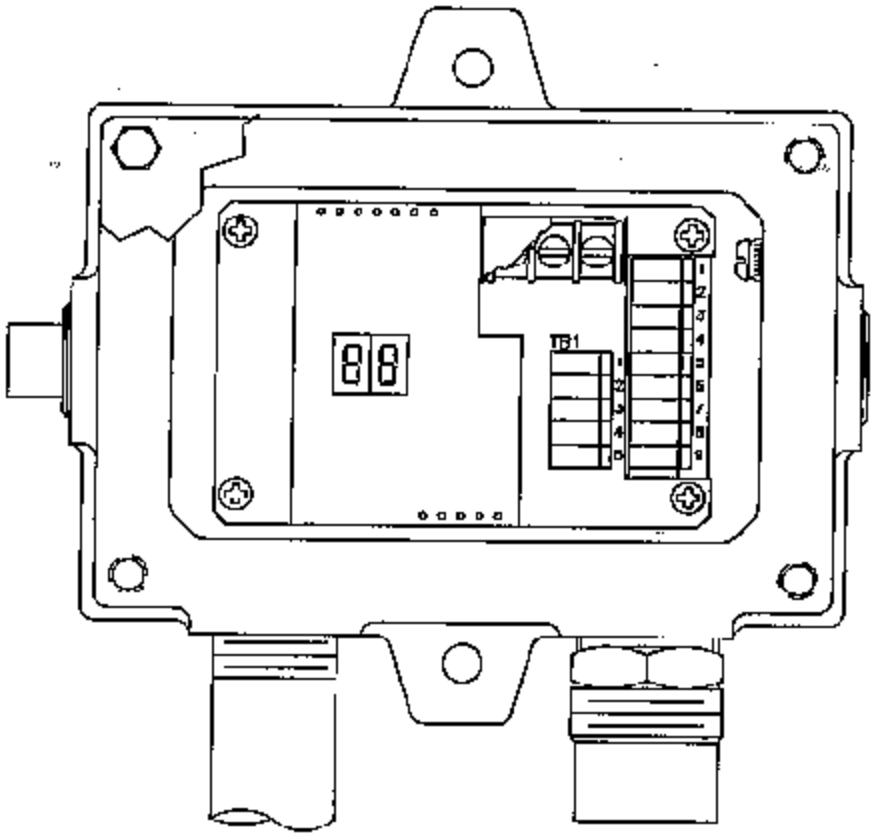
Storage Temperature Range:
(Smart Sensor Assembly)
-58°F to 158°F
-50°C to 70°C

Humidity Range:
10 to 95% Relative Humidity
(non-condensing)

Appendix

5.2 Engineering Documentation

5.2.1 Termination & Outline Drawings



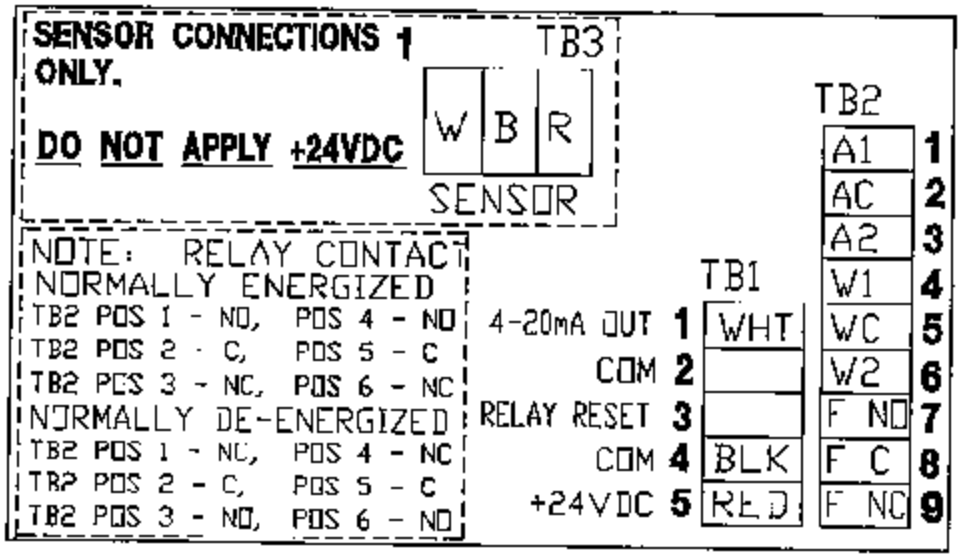
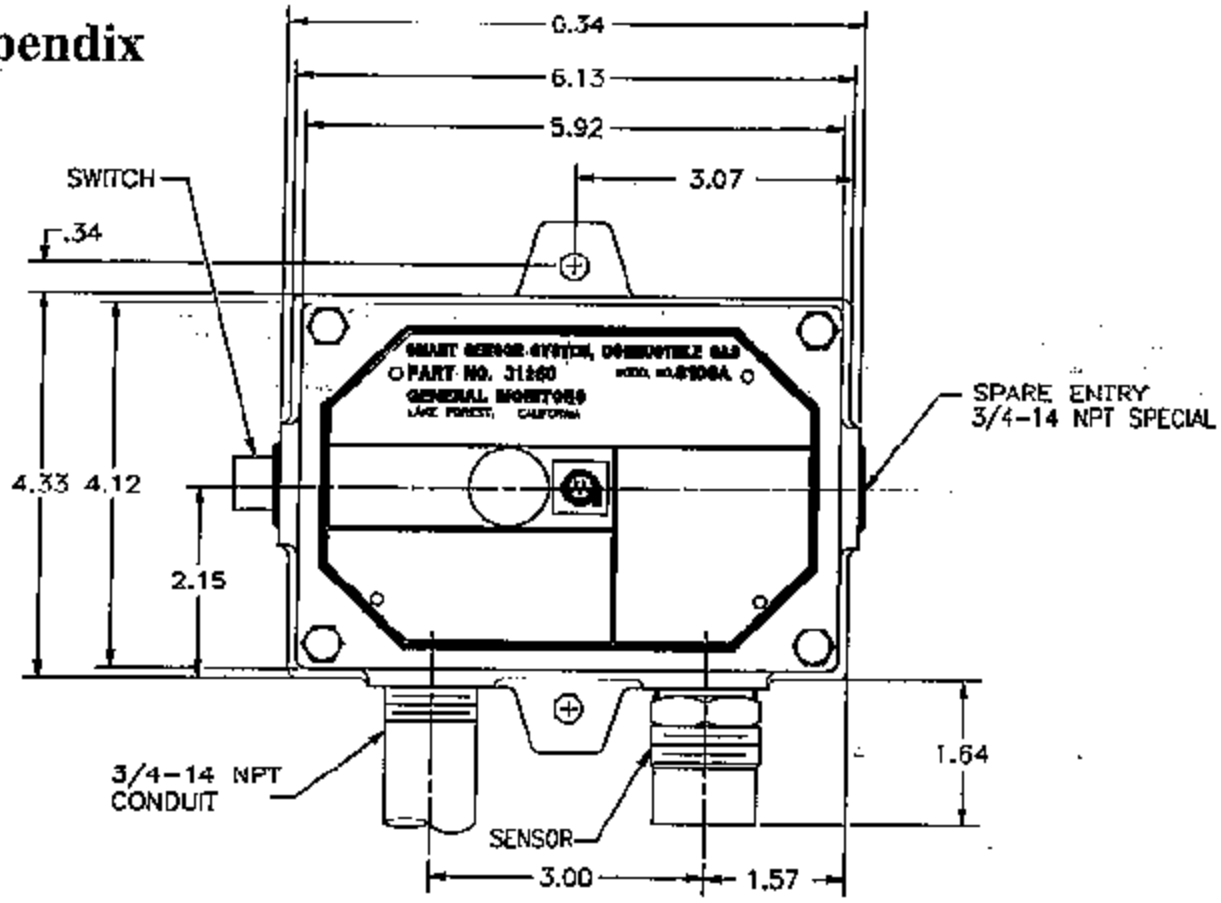


figure 26

Appendix



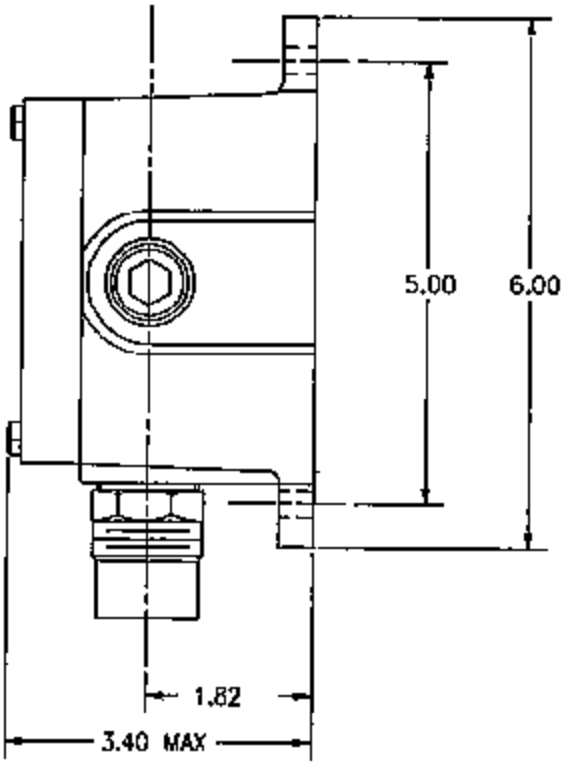


figure 27

Appendix

5.2.2 Termination Drawing **CE Marked Units**

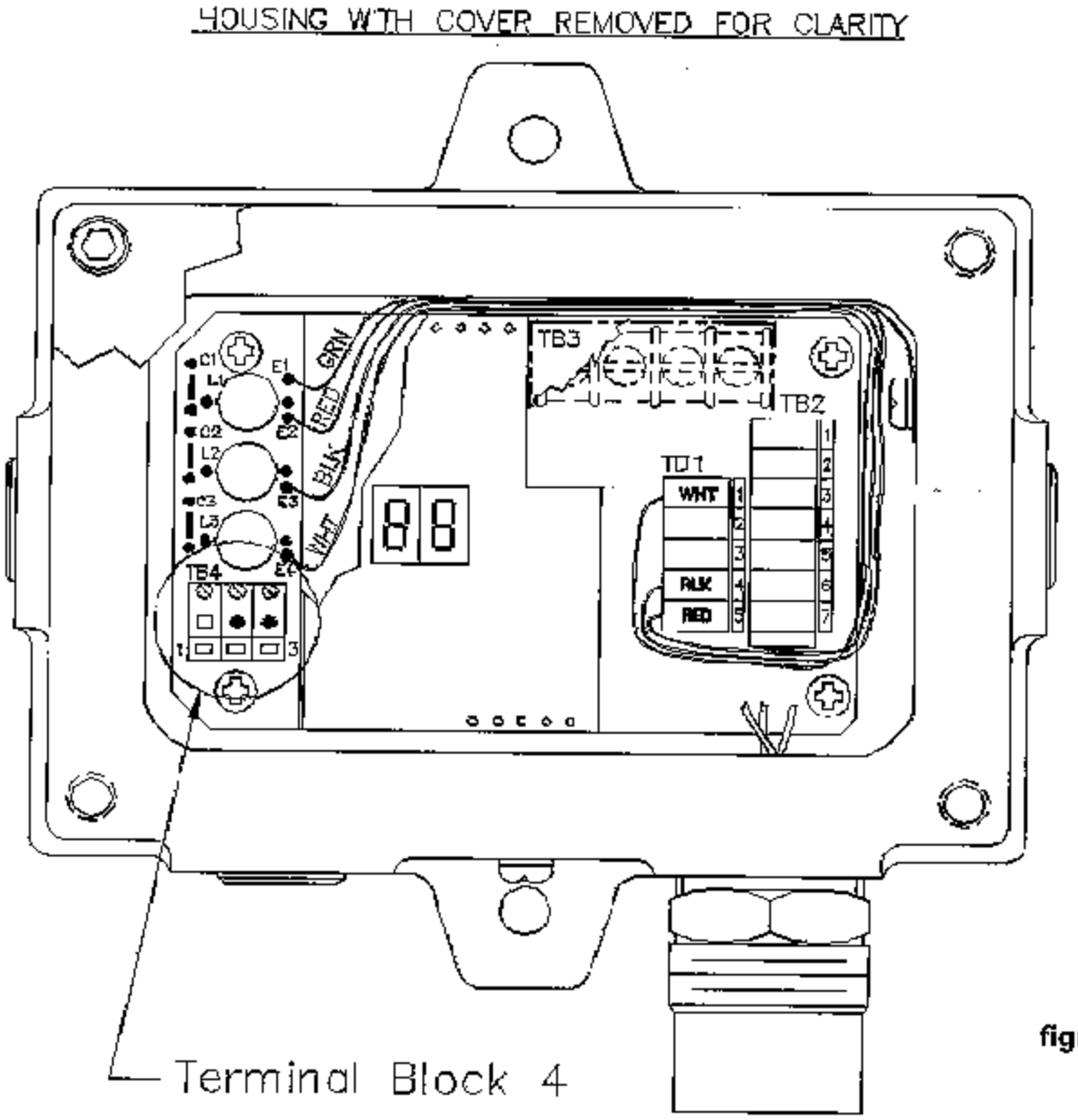


figure 28

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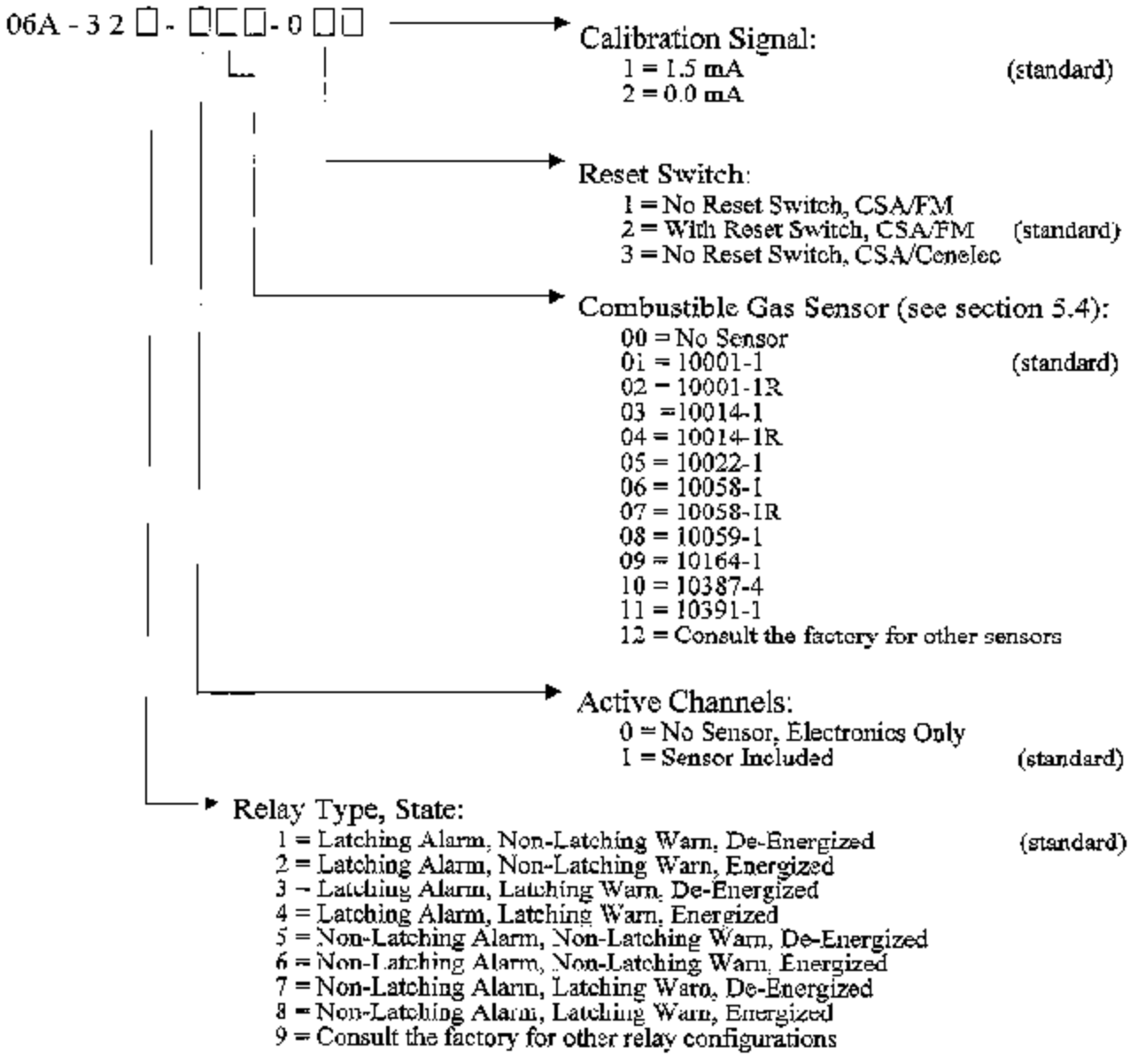
Appendix

5.3 Ordering Information

5.3.1 Configuration Codes



The Standard Configuration for the Model S106A is: **S106A-321-101-021**

Appendix

5.3.2 Spare Parts & Accessories

To order spare parts and/or accessories, please contact your 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

Sensors:

10001-1	General Purpose, Alum.,
10001-1R	General Purpose, Alum., Poison Resistant
10014-1	General Purpose, Alum., High Temperature
10014-1R	General Purpose, Alum., Hi-Temp, Poison
Resistant	
10022-1	General Purpose, Alum., Industrial PTB
10058-1	General Purpose, SST
10058-1R	General Purpose, SST, Poison Resistant
10059-1	General Purpose, SST, Industrial PTB
10164-1 Alum.	Hydrogen Specific,
10387-4	General Purpose, Alum., Super Poison Resistant
10391-1	General Purpose, SST, Hi-Temperature
10102-1	Dummy Sensor

Sensor Housing:

10252	Universal Housing

Sensor Accessories:

10460-2	Test Gas Applicator
10041	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
50060-1	H_2S Guard Filter
50061-1	Purafil Insert Assembly
10110-1	Dust Guard Assembly
1800822 SST	Dust Guard, Sintered

Calibration Equipment:

10221-1	Model RC-3, Remote Calibrator Assembly
10378-1	RC-3 Interconnection Assembly
10345-1	RC-3 Position Indicator
10375-1	RC-3 Battery Assembly
10233-1	RC-3 Wind Shield
1400200	3 Liter CAL Chamber with syringe
1400204	Fan Motor for the 3 liter Chamber
1400207	Fan Blade for the 3 liter Chamber

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Appendix

Calibration Equipment (*continued*):

928-700 Chamber	Dish for the 3 liter
928-715	250 microliter syringe
1400150-M Calibrator,	Portable Purge Methane @ 50% LEL
1400150-H Calibrator,	Portable Purge Hydrogen @ 50% LEL
1400150-BD Calibrator,	Portable Purge Butadiene @ 50% LEL
1400150-B Calibrator,	Portable Purge Butane @ 50% LEL
1400150-E Calibrator,	Portable Purge Ethane @ 50% LEL
1400150-PR Calibrator,	Portable Purge Propane @ 50% LEL
1400155-M	Replacement Cylinder, Methane @ 50% LEL
1400155-H	Replacement Cylinder, Hydrogen @ 50% LEL
1400155-BD	Replacement Cylinder, Butadiene @ 50% LEL
1400155-B	Replacement Cylinder, Butane @ 50% LEL
1400155-E	Replacement Cylinder, Ethane @ 50% LEL
1400155-PR	Replacement Cylinder, Propane @ 50% LEL

Cylinder refills are available for Methane and Hydrogen only. Replacement cylinders must be ordered for the other gases.

922-009 Gauge	Pressure Regulator
1400152-1	Small Calibration Cup
1400154	Large Calibration Cup

Smart Sensor (S106A) Replacement Parts:

31265-1 Electronics	Control Board
31270-1 Electronics	Converter Board
30080-1 Electronics	Display Board
10884-8	Cover Assembly
30051-1	Explosion-Proof SPST Switch
30060-1	Calibration Magnet
925-5007	Cover Assy O-Ring

Recommended Spare Parts for One (1) Year:

1 Extra Calibration Magnet (30060-1)

Appendix

5.4 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 process 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 be FMRC approved.

The following sensors have been FMRC approved for use with the Model S106A:

- 10001-1 Aluminum Body General Purpose Combustible Gas Sensor
- 10058-1 Stainless Steel Body General Purpose Combustible Gas Sensor

The following apparatus have been FMRC approved (although they have not been verified as part of a Model S106A sytem):

- Model DC100 Single Channel Readout Relay Display Module
- Model DC110 Eight Channel Readout Relay Display Module
- Model DC120 Explosion Proof Dual Channel Readout Relay Display Module
- Model DC130 Dual Channel Readout Relay Display Module

Factory Mutual Reseach Corporation has tested the Model S106A according to the criteria listed under the FMRC Approval Standards for Combustible Gas Detector, Class Numbers 6310 & 6320.

FMRC has tested the Model S106A using the specifications listed in section 5.1 (of this instruction manual), permitting an operating temperature of -40°F to +140°F (-40°C to +60°C), a general purpose sensor (10001-1 or 10058-1) attached to the housing (i.e. not remoted), calibration performed with a General Monitors' Portable Purge Calibrator using 50% LEL gas (Methane, Hydrogen, Butadiene, Butane, Ethane or Propane) and the procedure listed in section 4.3 of this (instruction manual). The conduit containing wires connected to the relay contacts must be sealed. If the non-latching relay option has been selected, from the relay options, the user must provide alternate means of latching the relay output.