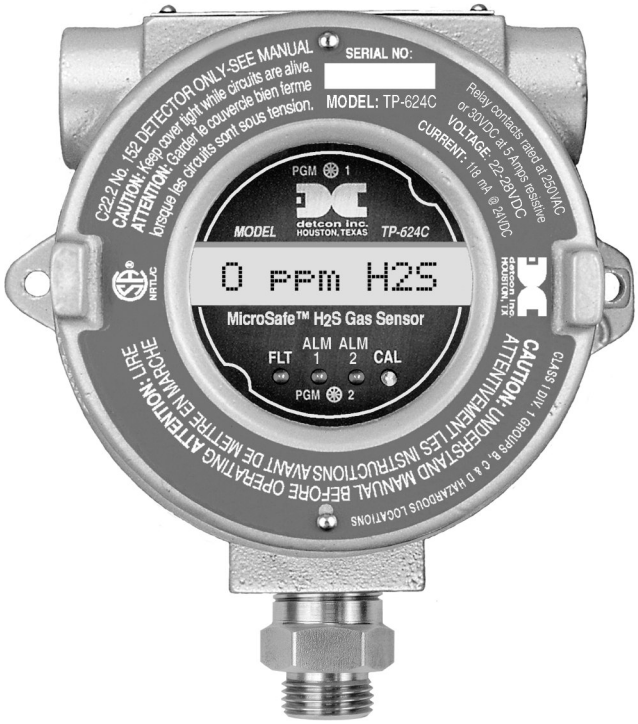
detcon inc.

Detcon MicroSafe™

TP-624C Hydrogen Sulfide Sensor

This manual covers the following ranges: 0-20 PPM, 0-50 PPM, and 0-100 PPM



Operator's Installation & Instruction Manual

February 01, 2010 • Document #2017 • Version 8.2

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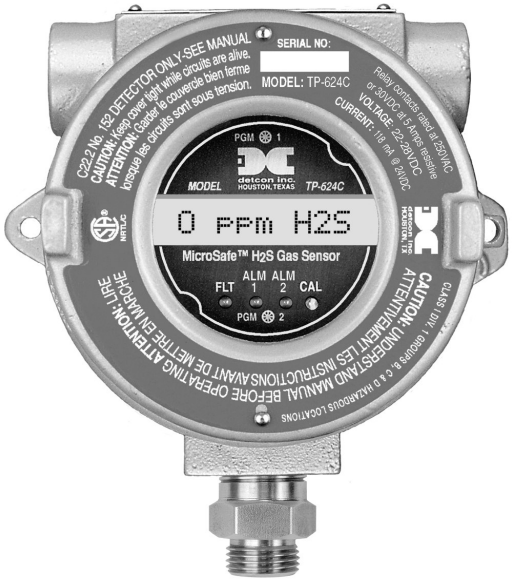
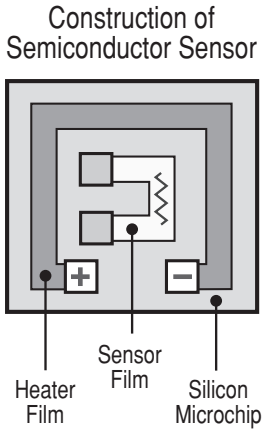
3.0 DESCRIPTION

Detcon MicroSafe™ Model TP-624C, hydrogen sulfide sensors are non-intrusive "Smart" sensors designed to detect and monitor H2S in air. Ranges of detection are user-settable between 0-20 ppm, 0-50 ppm, and 0-100 ppm. One of the primary features of the sensor is its method of automatic calibration which guides the user through each step via instructions displayed on the backlit LCD. The sensor features field adjustable, fully programmable alarms, relays for two gas level alarms, and one for any fault condition. The sensor is equipped with both an analog 4-20 mA, and serial RS-485 output. These outputs allow for greater flexibility in system integration and installation. The microprocessor supervised electronics are packaged as a plug-in module that mates to a standard connector board. Both are housed in an explosion proof condulet that includes a glass lens window which allows for the display of sensor readings as well as access to the sensor's menu driven features via a hand-held programming magnet.



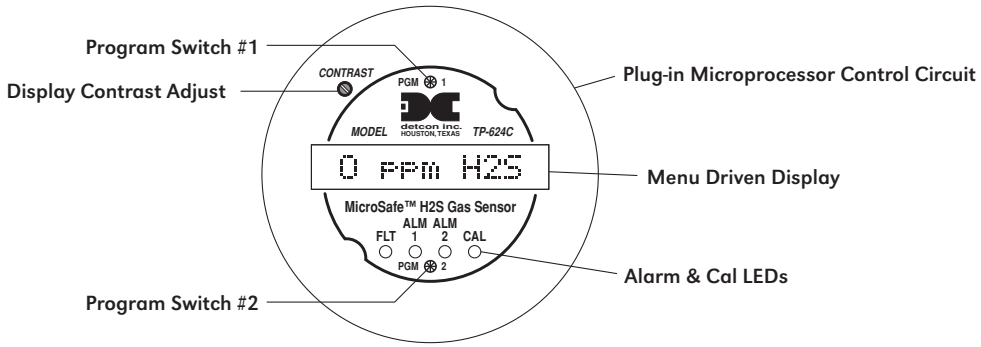
3.0.1 Sensor Technology

The sensor technology is a patented solid state metal oxide semiconductor. The sensor consists of two thin films; a temperature sensitive heater film, and an hydrogen sulfide sensitive sensor film. Both films are deposited on a silicon microchip by vacuum deposition. The heater film elevates the operating temperature of the sensor film to a level where a good sensitivity and response to hydrogen sulfide is achieved. The sensor film is a proprietary metal oxide that shows a dynamic response to hydrogen sulfide gas. Range of sensitivity is from part per billion to % by volume. The rugged sensor is capable of maintaining its operating characteristics for periods of up to 7-10 years in most industrial environments and as such, is supported by a 10-year conditional warranty.



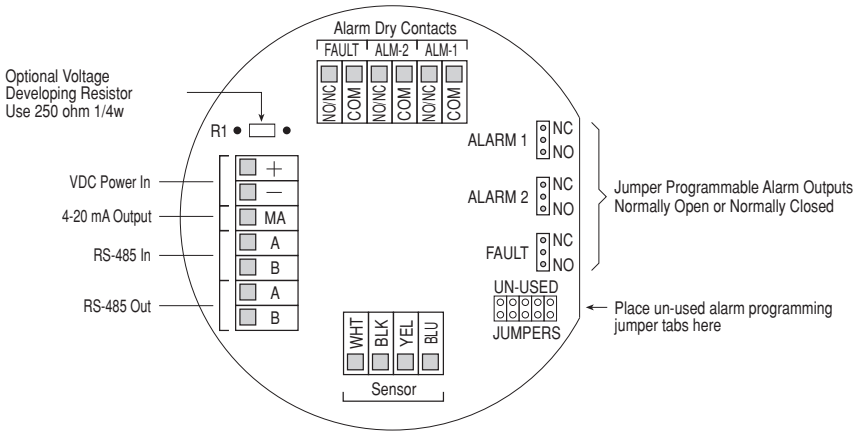
3.0.2 Microprocessor Control Circuit

The control circuit is microprocessor based and is packaged as a plug-in field replaceable module, facilitating easy replacement and minimum down time. Circuit functions include a basic sensor pre-amplifier, on-board power supplies, microprocessor, back lit alpha numeric display, alarm status LED indicators, magnetic programming switches, an RS-485 communication port, and a linear 4-20 mA DC output.



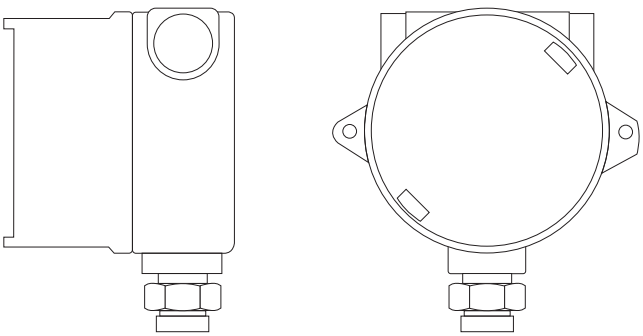
3.0.3 Base Connector Board

The base connector board is mounted in the explosion proof enclosure and includes: the mating connector for the control circuit, reverse input and secondary transient suppression, input filter, alarm relays, lugless terminals for all field wiring, and a terminal strip for storing unused programming jumper tabs. The alarm relays are contact rated 5 amps @ 125 VAC, 5 amps @ 30 VDC and coil rated at 24 VDC. Gold plated program jumpers are used to select either the normally open or normally closed relay contacts.



3.0.4 Explosion Proof Enclosure

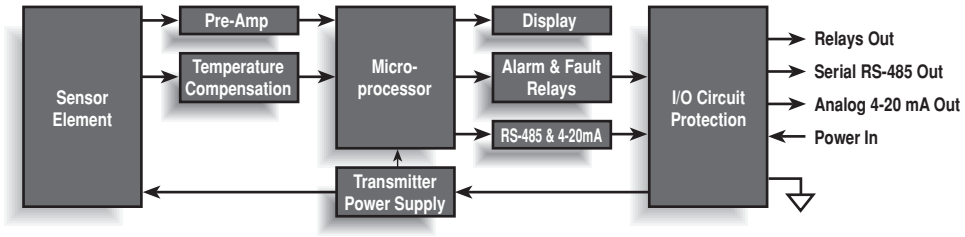
The sensors are packaged in a cast metal explosion proof enclosure. The enclosure is fitted with a threaded cover that has a glass lens window. Magnetic program switches located behind the transmitter module face plate are activated through the lens window via a hand-held magnetic programming tool allowing non-intrusive operator interface with the sensor. All calibration and alarm level adjustments can be accomplished without removing the cover or declassifying the area. Electrical classification is Class I; Division 1; Groups B, C, D (explosion proof).



3.1 Principle of Operation

Method of detection is by diffusion/adsorption. Air and gas diffuse through a sintered stainless steel filter and contact the heated surface of the metal oxide sensor film. As hydrogen sulfide gas molecules react with oxygen ions on the film, there is a decrease in electrical resistance proportional to the gas concentration. The heater film elevates the temperature of the sensor film creating convection and promoting a quick response to changing gas concentrations. Electronically, the heater film is used to maintain a constant temperature of the sensor film enhancing stability and repeatability. The sensor response is reversible and results in continuous monitoring of ambient air conditions.

Functional Block Diagram



3.2 Application

Model TP-624C MicroSafe™ sensors are designed to detect and monitor hydrogen sulfide gas in ambient air in the range of 0-100 parts per million. The sensor can also be programmed to operate in the range 0-20 ppm or 0-50 ppm. Minimum sensitivity and scale resolution is 1 ppm. Operating temperature range is –40° F. to +175° F. While the sensor is capable of operating outside these temperatures, performance specifications are verified within the limit.

3.2.1 Sensor Placement/Mounting

Sensor location should be reviewed by facility engineering and safety personnel. Area leak sources and perimeter mounting are typically used to determine number and location of sensors. Hydrogen sulfide gas is slightly heavier than air (approximately 1.18); therefore, the sensors are generally located 2 - 4 feet above grade.

3.2.2 Interference Data

Gas	PPM
Methane	25,000 = 0
Ethane	5,000 = 0
Hexane	5,000 = 0
Propane	5,000 = 0
Butane	5,000 = 0
Carbon Monoxide	800 = 0
Carbon Dioxide	5,000 = 0
Carbon Disulfide	14 = 0
Methanol	200 = 0
Isopropanol	200 = 0
Ammonia	500 = 0
Diesel Fuel	= 0
Demethyl Sulfide	4.4 = 0
Ethylene	200 = 0
Freon 12	1000 = 0
Hydrogen	1000 = 8
Methyl Mercaptan	5 = 8
Sulfur Dioxide	300 = 0
Toluene	32 = 0
Ethanol	200 = 0

3.3 SPECIFICATIONS

Method of Detection
Solid state metal oxide diffusion/adsorption
Electrical Classification
CSA-NRTL approved Class I; Groups B, C, D; Div. 1.
Response Time
T50 < 45 seconds, T80 < 90 seconds
Clearing Time
T80 < 90 seconds
Repeatability
± 5% FS
Range
0-20 ppm, 0-50 ppm, or 0-100 ppm
Operating Temperature
-40° to +175° F
Accuracy
± 5% FS
Sensor Warranty
10 year conditional
Power Consumption
Normal operation = 83 mA (<2 watt); Full alarm = 118 mA (<3 watts)
Output
3 relays (alarm 1, alarm 2, and fault) contact rated 5 amps @ 125 VAC, 5 amps @ 30 VDC;
Linear 4-20 mA DC
RS-485 Modbus™
Input Voltage
22-28 VDC

3.4 OPERATING SOFTWARE

Operating software is menu listed with operator interface via the two magnetic program switches located under the face plate. The two switches are referred to as "PGM 1" and "PGM 2". The menu list consists of 3 items which include sub-menus as indicated below. (Note: see the last page of this manual for a complete software flow chart.)

01. Normal Operation
    a) Current Status

02. Calibration Mode
    a) Span

03. Program Menu
    a) View Program Status
    b) Set Alarm 1 Level
    c) Set Alarm 2 Level
    d) Set Calibration Level
    e) Set Heater Level
    f) Set Range
    g) Linearize Sensor

3.4.1 Normal Operation

In normal operation, the display reflects the current status of the sensor and gas concentration and appears as: **"0 PPM H2S"**. The mA current output corresponds to the monitoring level and range of 0-100 ppm = 4-20 mA.

3.4.2 Calibration Mode

Calibration mode allows for sensor span adjustments. Unless otherwise specified, span adjustment is performed at 10 ppm H2S in air for the range 0-20 ppm, and 25 ppm H2S in air for the ranges 0-50 ppm and 0-100 ppm.
"AUTO SPAN"

3.4.3 Program Mode

The program mode provides a program status menu (View Program Status) to check operational parameters. It also allows for the adjustment of alarm set point levels, the calibration gas level setting, the heater voltage level, range, and linearity correction.

3.4.3.1 View Program Status

The program status scrolls through a menu that displays:
* The gas type, range of detection and software version number. The menu item appears as: **"H2S 0-100 V6.1"**
* The alarm set point level of alarm 1. The menu item appears as: **"ALM1 SET @ ##PPM"**
* The alarm firing direction of alarm 1. The menu item appears as: **"ALM1 ASCENDING"** or descending.
* The alarm relay latch mode of alarm 1. The menu item appears as: **"ALM1 NONLATCHING"** or latching.
* The alarm relay energize state of alarm 1. The menu item appears as: **"ALM1 DE-ENERGIZED"** or energized.
* The alarm set point level of alarm 2. The menu item appears as: **"ALM2 SET @ ##PPM"**
* The alarm firing direction of alarm 2. The menu item appears as: **"ALM2 ASCENDING"** or descending.
* The alarm relay latch mode of alarm 2. The menu item appears as: **"ALM2 LATCHING"** or nonlatching.
* The alarm relay energize state of alarm 2. The menu item appears as: **"ALM2 DE-ENERGIZED"** or energized.
* The alarm relay latch mode of the fault alarm. The menu item appears as: **"FLT NONLATCHING"** or latching.
* The alarm relay energize state of the fault alarm. The menu item appears as: **"FLT ENERGIZED"** or deenergized.
* The calibration gas level setting. The menu item appears as: **"CalLevel @ xxPPM"**
* The sensor heater voltage setting. The menu item appears as: **"HEATER @ #.##VDC"**
* The range of detection setting. The menu item appears as: **"RANGE @ 0-###PPM"**
* Identification of the RS-485 ID number setting. The menu item appears as: **"485 ID SET @ ##"**
* The estimated remaining sensor life. The menu item appears as: **"SENSOR LIFE 100%"**

3.4.3.2 Alarm 1 Level Adjustment

The alarm 1 level is adjustable over the range 10 to 90% FS. For hydrogen sulfide gas sensors, the level is factory set at 10 ppm. The menu item appears as: **"SET ALM1 @ 10PPM"**

3.4.3.3 Alarm 2 Level Adjustment

The alarm 2 level is also adjustable over the range 10 to 90% FS. For hydrogen sulfide gas sensors, the level is factory set at 20 ppm. The menu item appears as: **"SET ALM2 @ 20PPM"**

3.4.3.4 Calibration Level Adjustment

The Calibration level is adjustable from 10% to 50% of full scale range. The menu item appears as: **"CalLevel @ ##PPM"**

3.4.3.5 Set Heater Level Adjustment

The Heater Level is adjustable from 4.40 to 5.40 vdc (normally 5.25). The menu item appears as: **"Heater @ #.## vdc"**

3.4.3.6 Set Range

The full-scale range is adjustable between 0-20 ppm, 0-50 ppm and 0-100 ppm The item appears as: **"Range @ 0-### ppm"**

3.4.3.7 Sensor Linearization

The sensor linearization feature is a two point calibration reference used to characterize each sensor for linearity. Two calibration points are required: The menu item appears as: **"Apply XX PPM Gas" & "Apply ## PPM Gas"** depending on the full-scale range selected.

3.5 INSTALLATION

Optimum performance of ambient air/gas sensor devices is directly relative to proper location and installation practice.

3.5.1 Field Wiring Table (4-20 mA output)

Detcon Model TP-624C solid state H2S sensor assemblies require three conductor connection between power supplies and host electronic controllers. Wiring designators are **+** (DC), **–** (DC) , and **mA** (sensor signal). Maximum single conductor resistance between sensor and controller is 10 ohms. Maximum wire size for termination in the sensor assembly terminal board is 14 gauge.

AWG	Meters	Feet
20	240	800
18	360	1200
16	600	2000
14	900	3000

Note 1: This wiring table is based on stranded tinned copper wire and is designed to serve as a reference only.

Note 2: Shielded cable may be required in installations where cable trays or conduit runs include high voltage lines or other sources of induced interference.

Note 3: The supply of power must be from an isolating source with over-current protection as follows:

AWG	Over-current Protection	AWG	Over-current Protection
22	3A	16	10A
20	5A	14	20A
18	7A	12	25A

The RS-485 (if applicable) requires 24 gauge, two conductor, shielded, twisted pair cable between sensor and host PC. Use Belden part number 9841. Two sets of terminals are located on the connector board to facilitate serial loop wiring from sensor to sensor. Wiring designators are **A** & **B** (IN) and **A** & **B** (OUT).

3.5.2 Sensor Location

Selection of sensor location is critical to the overall safe performance of the product. Five factors play an important role in selection of sensor locations:

(1) Density of the gas to be detected
(2) Most probable leak sources within the industrial process
(3) Ventilation or prevailing wind conditions
(4) Personnel exposure
(5) Maintenance access

Density - Placement of sensors relative to the density of the target gas is such that sensors for the detection of heavier than air gases should be located within 4 feet of grade as these heavy gases will tend to settle in low lying areas. For gases lighter than air, sensor placement should be 4-8 feet above grade in open areas or in pitched areas of enclosed spaces.

Leak Sources - Most probable leak sources within an industrial process include flanges, valves, and tubing connections of the sealed type where seals may either fail or wear. Other leak sources are best determined by facility engineers with experience in similar processes.

Ventilation - Normal ventilation or prevailing wind conditions can dictate efficient location of gas sensors in a manner where the migration of gas clouds is quickly detected.

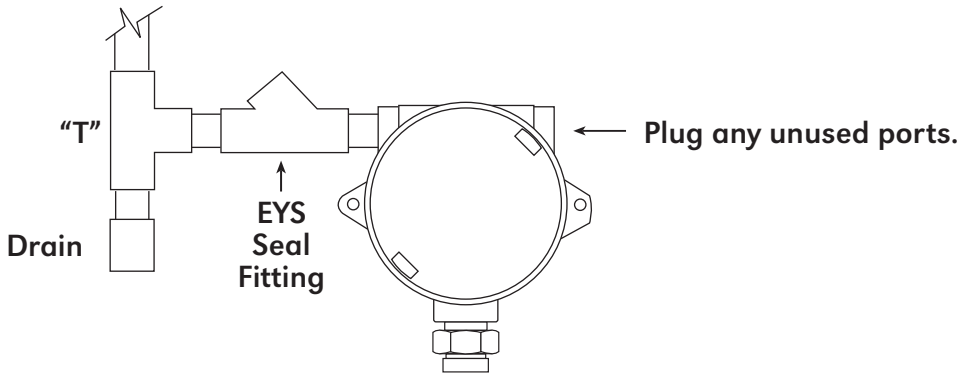
Personnel Exposure - The undetected migration of gas clouds should not be allowed to approach concentrated personnel areas such as control rooms, maintenance or warehouse buildings. A more general and applicable thought toward selecting sensor location is combining leak source and perimeter protection in the best possible configuration.

Maintenance Access

Consideration should be given to easy access by maintenance personnel as well as the consequences of close proximity to contaminants that may foul the sensor prematurely.

Note: In all installations, the sensor element in SS housing points down relative to grade (Fig. 1). Improper sensor orientation may result in false reading and permanent sensor damage.

Figure #1



3.5.3 Local Electrical Codes

Sensor and transmitter assemblies should be installed in accordance with all local electrical codes. Use appropriate conduit seals. Drains & breathers are recommended. The sensor assemblies are CSA-NRTL approved for Class I; Groups B, C, D; Div. 1 environments.

3.5.4 Accessibility

Consideration should be given to easy access by maintenance personnel as well as the consequences of close proximity to contaminants that may foul the sensor prematurely.

Note: An appropriate conduit seal must be located within 18" of the sensor assembly. Crouse Hinds type EYS2, EYD2 or equivalent are suitable for this purpose.

3.5.5 Installation Procedure

a) Remove the junction box cover and un-plug the control circuit by grasping the two thumb screws and pulling outward.

b) Securely mount the sensor junction box in accordance with recommended practice and proper orientation (see fig. 1 & 2).

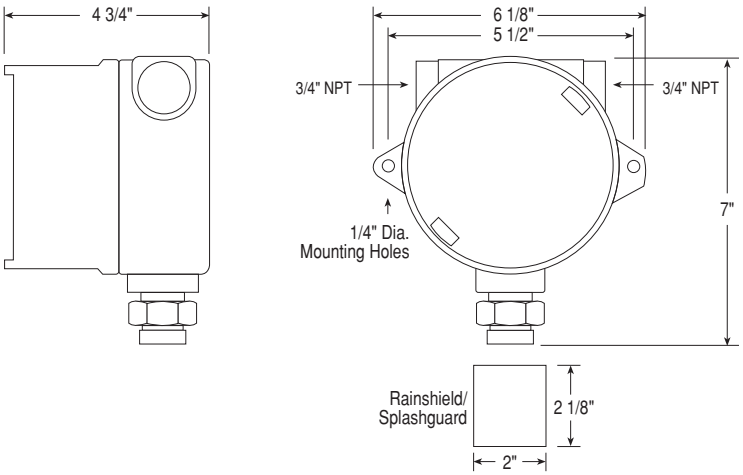


Figure #2

c) Observing correct polarity, terminate 3 conductor field wiring, RS-485 wiring, and applicable alarm wiring to the sensor base connector board in accordance with the detail shown in Figure 3. Normally open and normally closed Form C dry contacts (rated 5 amp @ 125VAC; 5 amp @ 30VDC) are provided for Fault, Alarm 1, and Alarm 2.

Note: Per U.L. approval, these relays may only be used in connecting to devices that are powered by the **same** voltages.

d) Position gold plated jumper tabs located on the connector board in accordance with desired Form C dry contact outputs: NO = Normally Open; NC = Normally closed (see figure 3).

Note: If a voltage signal output is desired in place of the 4-20mA output, a 1/4 watt resistor must be installed in position R1 of the terminal board. A 250Ω resistor will provide a 1-5V output (– to mA). A 100Ω resistor will provide a .4-2V output, etc. This linear signal corresponds to 0-100% of scale (see figure 3).

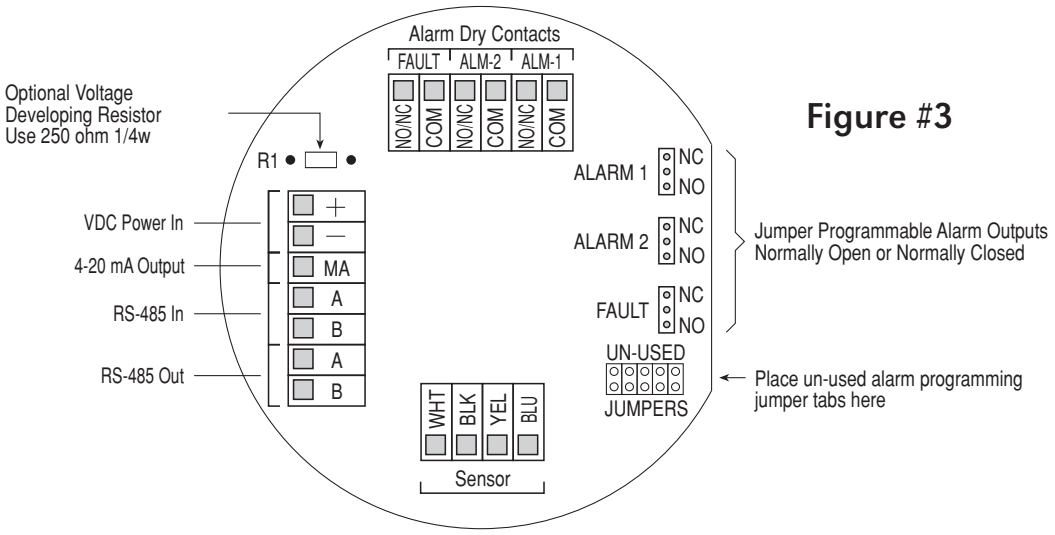
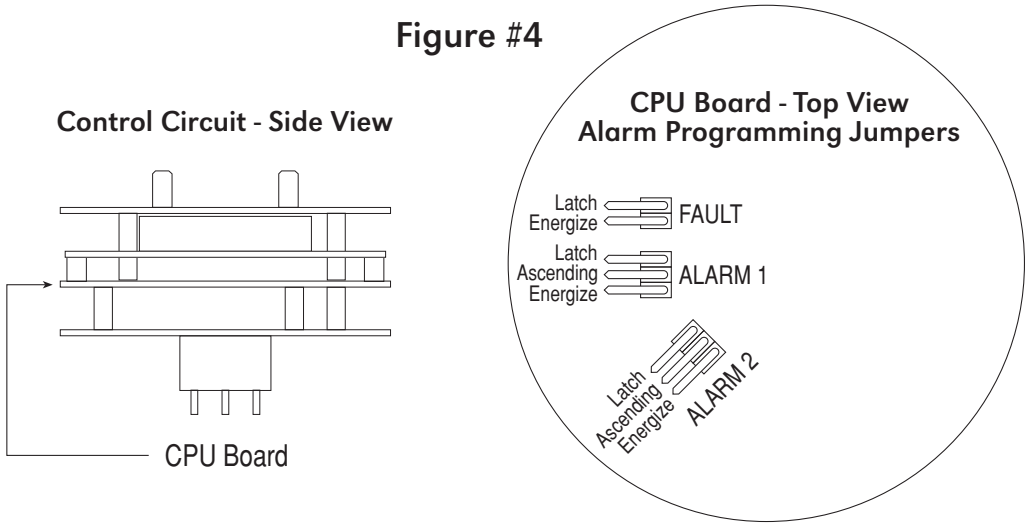


Figure #3

e) Program the alarms via the gold plated jumper tab positions located on the CPU board (see figure 4). Alarm 1 and Alarm 2 have three jumper programmable functions: latching/non-latching relays, normally energized/normally de-energized relays, and ascending/descending alarm set points. The fault alarm has two jumper programmable functions: latching/non-latching relay, and normally energized/normally de-energized relay. The default settings of the alarms (jumpers removed) are normally de-energized relays, non-latching relays, and alarm points that activate during descending gas conditions.

Figure #4



If a jumper tab is installed in the latch position, that alarm relay will be in the latching mode. The latching mode will latch the alarm after alarm conditions have cleared until the alarm reset function is activated. The non-latching mode (jumper removed) will allow alarms to de-activate automatically once alarm conditions have cleared.

If a jumper tab is installed in the energize position, that alarm relay will be in the energized mode. The energized mode will energize or activate the alarm relay when there is no alarm condition and de-energize or de-activate the alarm relay when there is an alarm condition. The de-energized mode (jumper removed) will energize or activate the alarm relay during an alarm condition and de-energize or de-activate the alarm relay when there is no alarm condition.

If a jumper tab is installed in the ascending position, that alarm relay will be in the ascending mode. The ascending mode will cause an alarm to fire when the gas concentration detected is greater than or equal to the alarm set point. The descending mode (jumper removed) will cause an alarm to fire when the gas concentration detected is lesser than or equal to the alarm set point. Except in special applications, H2S gas monitoring will require alarms to fire in **"ASCENDING"** gas conditions.

Any unused jumper tabs should be stored on the connector board on the terminal strip labeled "Unused Jumpers" (see figure 3).

f) If applicable, set the RS-485 ID number via the two rotary dip switches located on the preamp board (see figure 5). There are 256 different ID numbers available which are based on the hexadecimal numbering system. If RS-485 communications are used, each sensor must have its own unique ID number. Use a jewelers screwdriver to set the rotary dip switches according to the hexadecimal table listed below. If RS-485 communications are not used, leave the dip switches in the default position which is zero/zero (0)-(0).

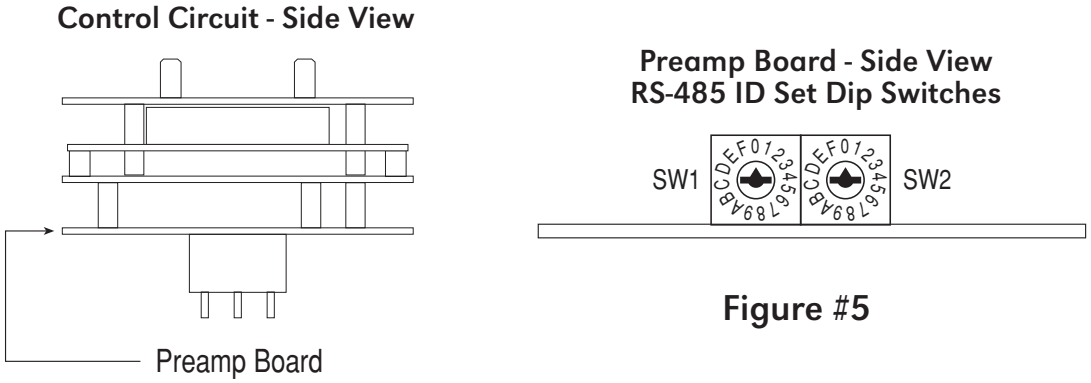


Figure #5

Hexadecimal Table

ID#	SW1	SW2	ID#	SW1	SW2	ID#	SW1	SW2	ID#	SW1	SW2	ID#	SW1	SW2	ID#	SW1	SW2
none	0	0	43	2	B	86	5	6	129	8	1	172	A	C	215	D	7
1	0	1	44	2	C	87	5	7	130	8	2	173	A	D	216	D	8
2	0	2	45	2	D	88	5	8	131	8	3	174	A	E	217	D	9
3	0	3	46	2	E	89	5	9	132	8	4	175	A	F	218	D	A
4	0	4	47	2	F	90	5	A	133	8	5	176	B	0	219	D	B
5	0	5	48	3	0	91	5	B	134	8	6	177	B	1	220	D	C
6	0	6	49	3	1	92	5	C	135	8	7	178	B	2	221	D	D
7	0	7	50	3	2	93	5	D	136	8	8	179	B	3	222	D	E
8	0	8	51	3	3	94	5	E	137	8	9	180	B	4	223	E	F
9	0	9	52	3	4	95	5	F	138	8	A	181	B	5	224	E	0
10	0	A	53	3	5	96	6	0	139	8	B	182	B	6	225	E	1
11	0	B	54	3	6	97	6	1	140	8	C	183	B	7	226	E	2
12	0	C	55	3	7	98	6	2	141	8	D	184	B	8	227	E	3
13	0	D	56	3	8	99	6	3	142	8	E	185	B	9	228	E	4
14	0	E	57	3	9	100	6	4	143	8	F	186	B	A	229	E	5
15	0	F	58	3	A	101	6	5	144	9	0	187	B	B	230	E	6
16	1	0	59	3	B	102	6	6	145	9	1	188	B	C	231	E	7
17	1	1	60	3	C	103	6	7	146	9	2	189	B	D	232	E	8
18	1	2	61	3	D	104	6	8	147	9	3	190	B	E	233	E	9
19	1	3	62	3	E	105	6	9	148	9	4	191	B	F	234	E	A
20	1	4	63	3	F	106	6	A	149	9	5	192	C	0	235	E	B
21	1	5	64	4	0	107	6	B	150	9	6	193	C	1	236	E	C
22	1	6	65	4	1	108	6	C	151	9	7	194	C	2	237	E	D
23	1	7	66	4	2	109	6	D	152	9	8	195	C	3	238	E	E
24	1	8	67	4	3	110	6	E	153	9	9	196	C	4	239	F	F
25	1	9	68	4	4	111	6	F	154	9	A	197	C	5	240	F	0
26	1	A	69	4	5	112	7	0	155	9	B	198	C	6	241	F	1
27	1	B	70	4	6	113	7	1	156	9	C	199	C	7	242	F	2
28	1	C	71	4	7	114	7	2	157	9	D	200	C	8	243	F	3
29	1	D	72	4	8	115	7	3	158	9	E	201	C	9	244	F	4
30	1	E	73	4	9	116	7	4	159	9	F	202	C	A	245	F	5
31	1	F	74	4	A	117	7	5	160	A	0	203	C	B	246	F	6
32	2	0	75	4	B	118	7	6	161	A	1	204	C	C	247	F	7
33	2	1	76	4	C	119	7	7	162	A	2	205	C	D	248	F	8
34	2	2	77	4	D	120	7	8	163	A	3	206	C	E	249	F	9
35	2	3	78	4	E	121	7	9	164	A	4	207	C	F	250	F	A
36	2	4	79	4	F	122	7	A	165	A	5	208	D	0	251	F	B
37	2	5	80	5	0	123	7	B	166	A	6	209	D	1	252	F	C
38	2	6	81	5	1	124	7	C	167	A	7	210	D	2	253	F	D
39	2	7	82	5	2	125	7	D	168	A	8	211	D	3	254	F	E
40	2	8	83	5	3	126	7	E	169	A	9	212	D	4	255	F	F
41	2	9	84	5	4	127	7	F	170	A	A	213	D	5			
42	2	A	85	5	5	128	8	0	171	A	B	214	D	6			

g) Replace the plug-in control circuit and replace the junction box cover.

3.5.6 Remote Mounting Applications

Some sensor mounting applications require that the gas sensor head be remotely mounted away from the sensor transmitter. This is usually true in instances where the gas sensor head must be mounted in a location that is difficult to access. Such a location creates problems for maintenance and calibration activities. Detcon provides the TP-624C sensor in a remote-mount configuration in which the sensor (Model TP-624C-RS) and the transmitter (Model TP-624C-RT) are provided in their own condulet housing and are interfaced together with a four conductor cable. Reference figure 5A below for wiring diagram.

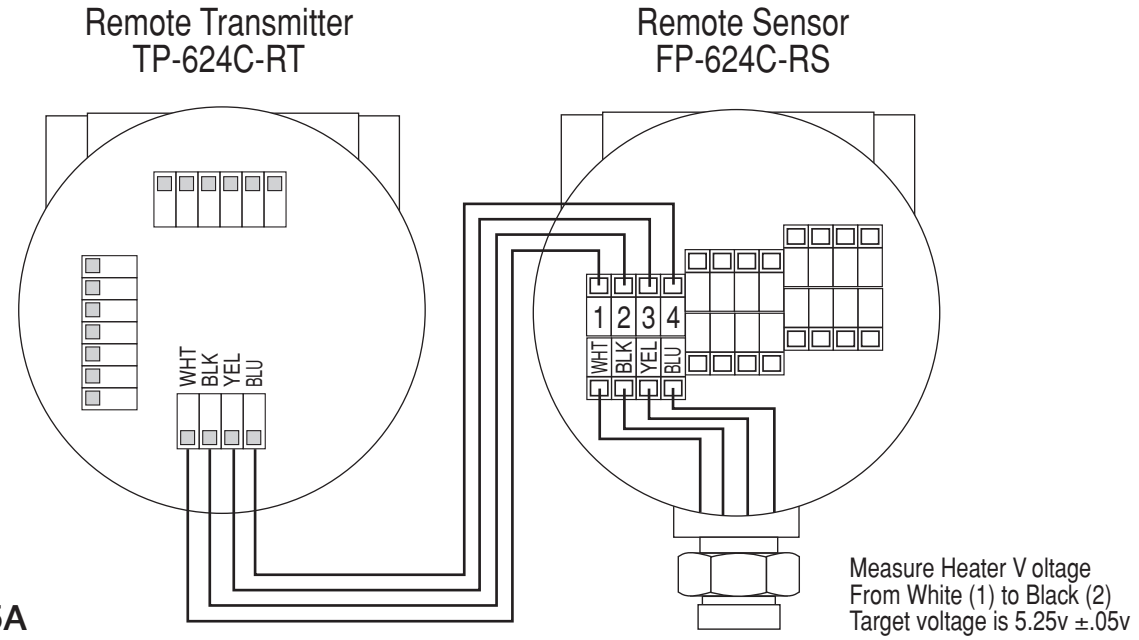


Figure #5A

Remote Mounting Configuration - Heater Voltage Adjustment

When a sensor is remote mounted, consideration must be given to the length and gauge of cable used and how it affects the sensor heater voltage. Fourteen to sixteen gauge wire is recommended. Differing lengths of cables will have varying amounts of resistance which will shift the sensor heater voltage. Because of this, the heater voltage will need to be adjusted after initial power up. Replacement of the sensor will also require readjusting the heater voltage. See section 3.6.2 for instructions.

3.6 START UP

Upon completion of all mechanical mounting and termination of all field wiring, apply system power and observe the following normal conditions:

a) TP-624C "Fault" LED is off.
b) A temporary upscale reading may occur as the sensor heats up. This upscale reading will clear to "0" ppm within 1-2 minutes of turn-on, assuming there is no gas in the area of the sensor.

Important Note:

A desiccant cap is attached to the sensor housing during storage and shipping. This prevents H20 from contacting the sensor film while it is off power, and thus helps to retain the stability of the factory span calibration. Remove the desiccant cap 5~10 minutes after applying power to the sensor, then install the weatherproof splashguard accessory supplied with your sensor.

Store the desiccant caps in a sealed container (i.e., zip-lock bag) for future use. It is advised (but not mandatory) to use the desiccant caps during long periods without power.

Note 1: All alarms will be disabled for 1 minute after power up. In the event of power failure, the alarm disable period will begin again once power has been restored.
Note 2: If the display contrast needs adjustment, refer to section 3.12.
Note 3: If the sensor has been installed using the remote mounting configuration as described in section 3.5.6, the sensor heater voltage must be adjusted after initial power up. If this is the case, first adjust the heater voltage as described in section 3.6.2, then proceed with the initial operation tests below (section 3.6.1).
Note 4: The 4~20mA signal will be held at 4mA for the first two minutes after power up.

3.6.1 Initial Operational Tests

After a warm up period has been allowed for, the sensor should be checked to verify sensitivity to H2S gas.

Material Requirements

* Detcon PN 6038 Threaded Calibration Adapter
* Span Gas 25 ppm H2S in air at a controlled flow rate between 200 and 500 ml/min (or 10 ppm for 0-20 ppm range - see section 3.6.4 for more information on ranges). NOTE: Do not use H2S and nitrogen gas mixtures.
* Detcon PN 985-241100-321 In-Line Humidifying Tube

a) Attach the Perma-Pure tubing inline with the tubing between the Cal Gas Cylinder and the sensor. The humidifying tube will introduce the ambient relative humidity into the Cal Gas as it passes through the tube.
b) Attach the calibration adapter to the threaded sensor housing. Apply a the test gas at a controlled flow rate of 200 to 500 ml/m (200cc/min is the recommended flow). Observe that the LCD display increases to a level of 10-25 ppm or higher (or 5-10 ppm for 0-20 ppm range).
c) Remove the test gas and observe that the LCD display decreases to **"0 PPM H2S".**
d) If alarms are activated during the test, and have been programmed for latching operation, reset them according to the instructions in section 3.9.2.

Initial operational tests are complete. Detcon H2S gas sensors are pre-calibrated prior to shipment and will, in most cases, not require significant adjustment on start up. However, it is recommended that a complete calibration test and adjustment be performed 16 to 24 hours after power-up. Refer to calibration instructions in later text.

3.6.2 Remote Mount Heater Voltage Setup

If the sensor has been installed using the remote mounting configuration as described in section 3.5.6, the sensor heater voltage must be adjusted after initial power up. Replacement of the sensor will also require readjusting the heater voltage. Follow the steps below to set the sensor heater voltage.

Material Requirements

* Detcon PN 3270 MicroSafe™ Programming Magnet
* Digital volt/ohm meter.

Note: Refer to section 3.6.3 for programming magnet operating instructions.

a) Declassify the area around the sensor.
b) Remove the junction box cover from the remote sensor enclosure (see figure 5A).
c) Using the digital volt/ohm meter, measure the bridge voltage at the remote sensor connector board from the "White" terminal to the "Black" terminal as shown in figure 5A. Target voltage is 5.25 volts.
d) At the transmitter, enter the programming menu by holding the programming magnet stationary over "PGM 2" for 15 seconds until the display reads **"VIEW PROG STATUS"**, then withdraw the magnet.
e) Next, scroll to the **"SET HEATER VOLTS"** listing and then hold the programming magnet over "PGM 1" for 3 seconds. The menu item appears as **"HEATER @ #.## VDC".**
f) Use the programming magnet to make an adjustment to "PGM 1" to increase or "PGM 2" to decrease the voltage. Set this voltage so that the voltage measured at the remote sensor connector board is 5.25 VDC. This is the correct voltage for an ambient temperature of 25°C at the remote sensor connector board. If ambient temperature is not 25°C reference the table in section 3.6.5 for the proper voltage setting.
g) Exit to the programming menu by holding the programming magnet over "PGM1" for 3 seconds, or automatically return to the programming menu in 30 seconds.
h) Exit back to normal operation by holding the programming magnet over "PGM 2" for 3 seconds, or automatically return to normal operation in 30 seconds.

i) Replace the junction box cover on the remote sensor enclosure.
Heater voltage adjustment is complete.

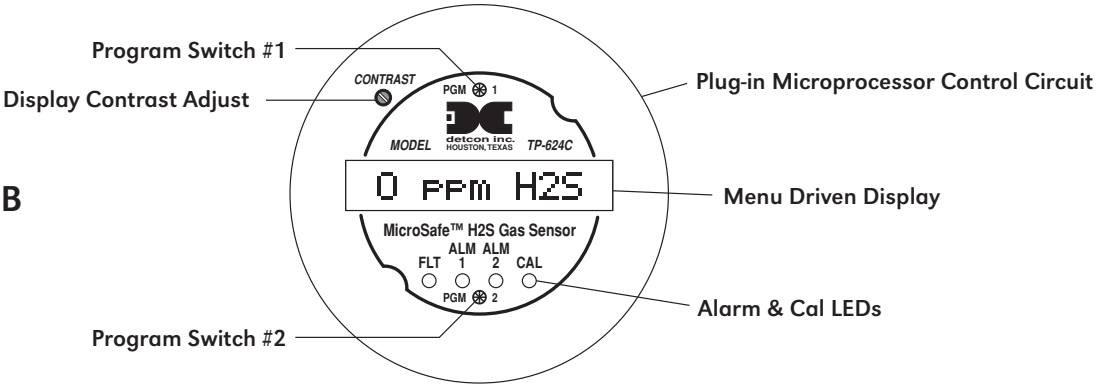
3.6.3 Programming Magnet Operating Instructions

Operator interface to MicroSafe™ gas detection products is via magnetic switches located behind the transmitter face plate. DO NOT remove the glass lens cover to calibrate or change programming parameters. Two switches labeled "PGM 1" and "PGM 2" allow for complete calibration and programming without removing the enclosure cover, thereby eliminating the need for area de-classification or the use of hot permits.

Figure #6

A magnetic programming tool (see figure 6) is used to operate the switches. Switch action is defined as momentary contact, 3 second hold, and 15 second hold. In momentary contact use, the programming magnet is waved over a switch location. In 3 second hold, the programming magnet is held in place over a switch location for 3 or more seconds. In 15 second hold, the programming magnet is held in place over a switch location for 15 or more seconds. Three and fifteen second hold is used to enter or exit calibration and program menus while momentary contact is used to make adjustments. The location of "PGM 1" and "PGM 2" are shown in figure 6B.
NOTE: If, after entering the calibration or program menus, there is no interaction with the menu items for more than 30 seconds, the sensor will return to its normal operating condition.

Figure #6B



3.6.4 Setting Range

Detcon Model TP-624C can be programmed to operate in one of three ranges of detection: 0-20 ppm, 0-50 ppm, or 0-100 ppm. To determine the current range setting follow the instructions given in section 3.8.

To change the range of detection follow the instructions below:

a) First, enter the programming menu by holding the programming magnet stationary over "PGM 2" for 15 seconds until the display reads **"VIEW PROG STATUS"**, then withdraw the magnet. At this point you can scroll through the programming menu by momentarily waving the programming magnet over "PGM 1" or "PGM 2". The menu options are: View Program Status, Set Alarm 1, Set Alarm 2, Set Cal Level, Set Heater Volts, Set Range, and Linearize Sensor.
b) Next, scroll to the **"SET RANGE"** listing and then hold the programming magnet over "PGM 1" for 3 seconds. The menu appears as **"Range @ 0-### ppm"** listing.
c) Use the programming magnet to make an adjustment to "PGM 1" to increase or "PGM 2" to decrease the reading to the desired range.
d) Exit to the programming menu by holding the programming magnet over "PGM1" for 3 seconds, or automatically return to the programming menu in 30 seconds.
e) Exit back to normal operation by holding the programming magnet over "PGM 2" for 3 seconds, or automatically return to normal operation in 30 seconds.

NOTE: When switching between ranges, remember to readjust your Cal Level setting if necessary (see section 3.7.2). Also remember to adjust your alarm setpoints if necessary (see section 3.9.1)

3.6.5 Setting Heater Voltage

The Detcon TP-624C H2S sensor is factory set for the correct heater voltage and should be ready to install without further adjustment being required. The correct heater voltage for the sensor is 5.25 VDC when set at 25°C room temperature. It is not normally necessary to adjust this heater voltage unless 1) the sensor is going to be used in the remote mount format or 2) the sensor is being swapped out with a new replacement sensor.

If the user needs to adjust the heater voltage due to the above-mentioned conditions, it is necessary to make the adjustment based on the current ambient temperature condition. Refer to the table below for guidance on proper heater voltage set-point:

Ambient Temp	Heater Voltage Set-point
25°C	5.25 VDC
35°C	5.18 VDC
45°C	5.10 VDC
55°C	5.00 VDC
15°C	5.32 VDC
5°C	5.39 VDC
-5°C	5.45 VDC
-15°C	5.50 VDC
-25°C	5.55 VDC
-40°C	5.60 VDC

3.7 CALIBRATION

NOTE: Before calibration, verify the range setting as described in section 3.6.4.

3.7.1 Material Requirements

* Detcon PN 3270 MicroSafe™ Programming Magnet
* Detcon PN 6038 Threaded Calibration Adapter
* Span gas containing the H2S gas in air. Nitrogen mixtures are not acceptable. H2S gas concentration is recommended at 25 ppm (which is the factory default for ranges 0-50 ppm and 0-100 ppm) or 10 ppm (which is the factory default for the range 0-20 ppm) at a controlled flow rate of 200 to 500 ml/min. Other concentrations can be used as long as they fall within allowable levels. See section 3.7.2 for details.
* Detcon PN 985-241100-321 In-Line Humidifying Tube.

NOTE: Span gas bottles contain 0% humidity and this ultra-low humidity condition will cause inaccurate readings when used to calibrate a sensor. To prevent this error, Detcon prescribes the use of a 24" flexible In-Line Humidifying Tube, which adds the relative humidify to the span gas. The humidifying tube is not necessary when using a gas generating calibration device that consists of pumped ambient air and an H2S generating source.

3.7.2 Calibration Procedure - Span

CAUTION: Verification of the correct calibration gas level setting and calibration span gas concentration is required before "span" calibration. These two numbers must be equal.

Calibration consists of entering the calibration function and following the menu-displayed instructions. The display will ask for the application of span gas in a specific concentration. This concentration is equal to the calibration gas level setting. The factory default setting for span gas concentration is 10 ppm for the range 0-20 ppm and 25 ppm for the ranges 0-50 ppm and 0-100 ppm. If a span gas containing the prescribed default concentration is not available, other concentrations may be used as long as they fall within 10% and 50% of full-scale range. However, any alternate span gas concentration value must be programmed via the calibration gas level menu before proceeding with span calibration. Follow the instructions below for span calibration.

a) Verify the current calibration gas level setting as indicated by the programming status menu. To do this, follow the instructions in section 3.8 and make note of the setting found in listing number 12. The item appears as **"CalLevel @ xxPPM".**

b) If the calibration gas level setting is equal to your calibration span gas concentration, proceed to item "f". If not, adjust the calibration gas level setting so that it is equal to your calibration span gas concentration, as instructed in items "c" through "e".

c) Enter the programming menu by holding the programming magnet stationary over "PGM 2" for 15 seconds until the display reads **"VIEW PROG STATUS"**, then withdraw the magnet. At this point you can scroll through the programming menu by momentarily waving the programming magnet over "PGM 1" or "PGM 2". The menu options are: View Program Status, Set Alarm 1 Level, Set Alarm 2 Level, Set Heater Level, Set Range, and Linearize Sensor.

d) From the programming menu scroll to the calibration level listing. The menu item appears as: **"SET CAL LEVEL".** Enter the menu by holding the programming magnet stationary over "PGM 1" for 3 seconds until the display reads **"CalLevel @ ##PPM"**, then withdraw the magnet. Use the programming magnet to make an adjustment to "PGM 1" to increase or "PGM 2" to decrease the display reading until the reading is equal to the desired calibration span gas concentration. Exit to the programming menu by holding the programming magnet over "PGM1" for 3 seconds.

e) Exit back to normal operation by holding the programming magnet over "PGM 2" for 3 seconds, or automatically return to normal operation in 30 seconds.

f) Enter the calibration span menu by holding the programming magnet stationary over "PGM 1" for 3 seconds The display will read **"1-SPAN 2-EXIT"** Hold PGM 1 for 3 seconds to proceed with a span or hold PGM 2 for 3 seconds to exit back to normal operation mode. After choosing span you may, within 1 minute, abort the span procedure by a 3 second hold on PGM 2.

g) Apply the calibration test gas with the humidifying tube installed at a flow rate of 200 to 500 milliliters per minute (200cc/min is the recommended flow). The display will read **"AUTO SPAN xxPPM"**. The "xx" part of the reading will change in single-digit increments as the sensor responds to the test gas. During the first 2 minutes of gas application, the sensor must satisfy a minimum resistance change which represents an "in range" sensor response (see NOTE 2 below). "Auto Span" cycle is programmed for 3 full minutes of exposure at which point an auto-adjustment is triggered. If, for example, automatic calibration is set for 25 ppm and the sensor response after 3 minutes is 17 ppm, the auto span function adjusts the reading to 25 ppm. After this adjustment, stability is verified for a period of 30 seconds. If less than 3 ppm of change occurs within the 30 second time, then auto span is completed and the display reads **"REMOVE GAS"**. Remove the gas sample and observe that the display clears to a reading of 0 ppm in less than 2 to 3 minutes.

If instability is greater than or equal to 3 ppm, auto span makes another adjustment and an additional 30 second period is allowed for final stabilization.

NOTE 1: If the sensor does not clear to <10% of range in <5 minutes after completing a span calibration, the sensor will enter into a calibration fault mode which will cause the display to alternate between **"ZERO FAULT"** and the sensor's current reading.

NOTE 2: If the sensor fails the minimum signal change criteria, then a **"RANGE FAULT"** message will be displayed alternately with the sensor's current reading.

NOTE 3: When a "zero fault", or "range fault" occurs, the sensor microprocessor retains its previous calibration references.

3.7.3 *Additional Notes*

1. Upon entering the calibration menu, the 4-20 mA signal drops to 2 mA and is held at this level until the program returns to normal operation.

2. If during calibration the sensor circuitry is unable to attain the proper span adjustment, the sensor will enter into the calibration fault mode which will activate fault alarm functions (see section 3.10) and cause the display to alternate between the sensor's current status reading and the calibration fault screen which appears as either: **"ZERO FAULT, or RANGE FAULT".** If this occurs you may attempt to recalibrate by entering the calibration menu as described in section 3.7.2-f. If the sensor fails again, defer to technical trouble shooting.

3.7.4 Calibration Frequency

In most applications, monthly to quarterly calibration intervals will assure reliable detection. However, industrial environments differ. Upon initial installation and commissioning, close frequency tests should be performed, weekly to monthly. Test results should be recorded and reviewed to determine a suitable calibration interval.

3.7.5 Sensor Linearization

Sensor linearization is a function performed via a two point calibration process that optimizes the microprocessors ability to interpret a sensors response curve. **The "Linearize Sensor" feature is performed at the factory and is not a service requirement once a sensor is in the field.** However, for optimum full scale accuracy, it is recommended that a "Linearize Sensor" procedure be performed on an annual basis or upon replacement of the sensor (PN 3998-B). To perform a "Linearize Sensor" procedure, follow the instructions below.

Material Requirements

* Detcon PN 3270 MicroSafe™ Programming Magnet
* Detcon PN 6038 Threaded Calibration Adapter
* Span gas containing the 10 ppm H2S gas in air. Nitrogen mixtures are not acceptable.
* Span gas containing the 50 ppm H2S gas in air (for 0-100 ppm ppm & 0-50 ranges). Nitrogen mixtures are not acceptable.
* Span gas containing the 20 ppm H2S gas in air (for 0-20 ppm range). Nitrogen mixtures are not acceptable.
* Detcon PN 985-241100-321 Perma-Pure humidify tubing.

a) Enter the programming menu by holding the programming magnet stationary over "PGM 2" for 15 seconds until the display reads **"VIEW PROG STATUS"**, then withdraw the magnet. At this point you can scroll through the programming menu by momentarily waving the programming magnet over "PGM 1" or "PGM 2". The menu options are: View Program Status, Set Alarm 1 Level, Set Alarm 2 Level, Set Cal Level, Set Heater Level, Set Range, and Linearize Sensor.

b) From the programming menu scroll to the Linearize Sensor listing. The menu item appears as: **"LINEARIZE SENSOR".** Enter the menu by holding the programming magnet stationary over "PGM 1" for 3 seconds until the display reads **"Apply 10 PPM H2S"**, then withdraw the magnet.

c) Apply 10 ppm H2S at a controlled flow rate of 200-500 ml/m (200cc/min is the recommended flow). The display will report a value reading during the linearization check that reads **"LinCheck ## PPM".** The actual reading is unimportant. After waiting approximately 3 minutes for the 10 ppm sample to stabilize, the display will then ask for either a 20 ppm gas sample (if programmed for 0-20 ppm range) or a 50 ppm gas sample (if programmed for 0-50 ppm or 0-100 ppm range), **"Apply ## PPM H2S".**

d) Apply the H2S gas sample at a controlled flow rate of 200-500 ml/m (200cc/min is the recommended flow). The display will report a value reading during the linearization check that reads **"LinCheck ## PPM".** The actual reading is unimportant. After waiting approximately 3 minutes for the sample to stabilize, the display will change to **"Remove Gas ## PPM"** and when the unit clears to < 5 ppm a **"Linearization OK"** message will appear indicating a successful completion. Immediately following linearization, a normal span calibration is required and prompted by the sensor. Apply your regular span gas as described in section 3.7.2g. Upon completion of the span calibration, the unit will return to the **"LINEARIZE SENSOR"** menu.

f) Exit back to normal operation by holding the programming magnet over "PGM 2" for 3 seconds, or automatically return to normal operation in 30 seconds.

NOTE 1: If during this operation no gas is applied or the circuitry is unable to adjust the linearization to the proper setting the sensor will enter into the calibration fault mode which will cause the display to alternate between the sensor's current status reading and the calibration fault screen which appears as: **"CAL FAULT"** (see section 3.7.3).

3.8 Status of Programming, Alarms, Calibration Level, RS-485 ID, Heater Level, Range, and Sensor Life

The programming menu has a programming status listing that allows the operator to view the gas, range, and software version number of the program, as well as the current alarm settings, calibration gas level setting, RS-485 ID

number, heater level, range of detection, and estimated remaining sensor life. The programming menu also allows the changing of alarm levels (see section 3.9), the programming of the calibration gas level setting (see section 3.7.2), the sensor heater level (see section 3.6.2), the range of detection (see section 3.6.4), and the linearize sensor (see section 3.7.5).

The following procedure is used to view the programming status of the sensor:

a) First, enter the programming menu by holding the programming magnet stationary over "PGM 2" for 15 seconds until the display reads **"VIEW PROG STATUS"**, then withdraw the magnet. At this point you can scroll through the programming menu by momentarily waving the programming magnet over "PGM 1" or "PGM 2". The menu options are: View Program Status, Set Alarm 1 Level, Set Alarm 2 Level, Set Cal Level, Set Heater Level, Set Range, and Linearize Sensor.

b) Next, scroll to the **"VIEW PROG STATUS"** listing and then hold the programming magnet over "PGM 1" for 3 seconds. The menu will then automatically scroll, at five second intervals, through the following information before returning back to the **"VIEW PROG STATUS"** listing.

1 - The gas type, range of detection and software version number. The menu item appears as: **"H2S 0-100 V6.1"**
2 - The alarm set point level of alarm 1. The menu item appears as: **"ALM1 SET @ xxPPM"**
3 - The alarm firing direction of alarm 1. The menu item appears as: **"ALM1 ASCENDING"**
4 - The alarm relay latch mode of alarm 1. The menu item appears as: **"ALM1 NONLATCHING"**
5 - The alarm relay energize state of alarm 1. The menu item appears as: **"ALM1 DE-ENERGIZED"**
6 - The alarm set point level of alarm 2. The menu item appears as: **"ALM2 SET @ xxPPM"**
7 - The alarm firing direction of alarm 2. The menu item appears as: **"ALM2 ASCENDING"**
8 - The alarm relay latch mode of alarm 2. The menu item appears as: **"ALM2 LATCHING"**
9 - The alarm relay energize state of alarm 2. The menu item appears as: **"ALM2 DE-ENERGIZED"**
10 - The alarm relay latch mode of the fault alarm. The menu item appears as: **"FLT NONLATCHING"**
11 - The alarm relay energize state of the fault alarm. The menu item appears as: **"FLT ENERGIZED"**
12 - Calibration gas level setting. The menu item appears as: **"CalLevel @ xxPPM"**
13 - The sensor heater voltage setting. The menu item appears as: **"HEATER @ #.##VDC"**
14 - The range of detection setting. The menu item appears as: **"RANGE @ 0-###PPM"**
15 - Identification of the RS-485 ID number setting. The menu item appears as: **"485 ID SET @ 1"**
16 - The estimated remaining sensor life. The menu item appears as: **"SENSOR LIFE 100%"**
17 - The raw resistance from the sensor. The menu item appears as: **"RESISTANCE XXXXX"**

c) Exit back to normal operations by holding the programming magnet over "PGM 2" for 3 seconds, or automatically return to normal operation in 30 seconds.

3.9 Programming Alarms

3.9.1 Alarm Levels

Both alarm 1 and alarm 2 levels are factory set prior to shipment. For the ranges 0-50 ppm and 0-100 ppm, alarm 1 is set at 10ppm; alarm 2 at 15ppm. For the range 0-20 ppm, alarm 1 is set at 5ppm; alarm 2 at 10ppm. Both alarms can be set in 1 ppm increments; the range 0-100 ppm from 10 to 90 ppm, the range 0-50 ppm from 5 to 45 ppm, and the range 0-20 ppm from 2 to 18 ppm. The following procedure is used to change alarm set points:

a) First, enter the programming menu by holding the programming magnet stationary over "PGM 2" for 15 seconds until the display reads **"VIEW PROG STATUS"**, then withdraw the magnet. At this point you can scroll through the programming menu by momentarily waving the programming magnet over "PGM 1" or "PGM 2". The menu options are: View Program Status, Set Alarm 1 Level, Set Alarm 2 Level, and Set Cal Level.

b) ALARM 1 LEVEL From the programming menu scroll to the alarm 1 level listing. The menu item appears as: **"SET ALARM 1 LEVEL".** Enter the menu by holding the programming magnet stationary over "PGM 1" for 3 seconds until the display reads **"SET ALM1 @ ##PPM"**, then withdraw the magnet. Use the programming magnet to make an adjustment to "PGM 1" to increase or "PGM 2" to decrease the display reading until the reading is equal to the desired alarm set point. Exit to the programming menu by holding the programming magnet over "PGM1" for 3 seconds, or automatically return to the programming menu in 30 seconds.

c) ALARM 2 LEVEL From the programming menu scroll to the alarm 2 level listing. The menu item appears as: **"SET ALARM 2 LEVEL".** Enter the menu by holding the programming magnet stationary over "PGM 1" for 3 seconds until the display reads **"SET ALM2 @ ##PPM"**, then withdraw the magnet. Use the programming magnet to make an adjustment to "PGM 1" to increase or "PGM 2" to decrease the display reading until the reading is equal to the desired alarm set point. Exit to the programming menu by holding the programming magnet over "PGM1" for 3 seconds, or automatically return to the programming menu in 30 seconds.

d) Exit back to normal operations by holding the programming magnet over "PGM 2" for 3 seconds, or automatically return to normal operation in 30 seconds.

3.9.2 Alarm Reset

An alarm condition will cause the applicable alarm to activate its corresponding relay and LED. If alarm 1, alarm 2, or fault alarms have been programmed for latching relays, an alarm reset function must be activated to reset the alarms after an alarm condition has cleared. To reset the alarms, simply wave the programming magnet over either "PGM 1" or "PGM 2", momentarily, while in normal operations mode and note that the corresponding alarm LED(s) turn off.

3.9.3 Other Alarm Functions

Alarms are factory programmed to be non-latching, de-energized; and to fire under ascending gas conditions. The fault alarm relay is programmed as normally energized which is useful for detecting a 24VDC power source failure. All alarm functions are programmable via jumper tabs. Changing alarm functions requires the sensor housing to be opened, thus declassification of the area is required. See section 3.5.4-e for details.

3.10 PROGRAM FEATURES

Detcon MicroSafe™ H2S gas sensors incorporate a comprehensive program to accommodate easy operator interface and fail-safe operation. Program features are detailed in this section. Each sensor is factory tested, programmed, and calibrated prior to shipment.

Over Range

When the sensor detects gas greater than its selected full scale range (20, 50, or 100 ppm), it will cause the display to flash **"20/50/100 PPM H2S"** on and off.

Zero Fault

If the sensor does not clear to <10% of range in <5 minutes after completing a span calibration, the sensor will enter into a calibration fault mode which will cause the display to alternate between **"ZERO FAULT"** and the sensors current reading.

Range Fault

If the sensor fails the minimum signal change criteria, then a **"RANGE FAULT"** message will be displayed.

Open Heater Fault

If the sensor heater should fail and become electrically open, the display will indicate a fault: **"HEATER FAULT".**

System Fault

If the detector has an irrecoverable calculation error, the display will indicate: **"SYSTEM FAULT".**

Sensor Heater Voltage Fault

Approximately one minute after start-up, the sensor will check the heater voltage. Normal heater voltage is 5.25 VDC. If the voltage drifts from this value by more than ±.3V, the display will indicate a fault: **"HEATER FAULT".**

Fail-Safe/Fault Supervision

Model TP-624C MicroSafe™ sensors are programmed for Fail-Safe operation. Any of the following fault conditions will activate the fault relay, illuminate the fault LED, and cause the display to read its corresponding fault condition: **"RANGE FAULT"**, **"ZERO FAULT"**, **"HEATER FAULT"**, or **"SYSTEM FAULT"**. A "Heater Fault",

"System Fault", "Zero Fault", and "Range Fault" will also cause the mA output to drop to zero (0) mA until the condition is corrected.

Sensor Life

The sensor life feature is a reference based on signal output from the sensor cell. When a sensor life of 25% or less remains, the sensor cell should be replaced within a reasonable maintenance schedule.

3.11 RS-485 PROTOCOL

Model TP-624C MicroSafe™ sensors feature Modbus™ compatible communications protocol and are addressable via rotary dip switches for multi-point communications. Other protocols are available. Contact the Detcon factory for specific protocol requirements. Communication is two wire, half duplex 485, 9600 baud, 8 data bits, 1 stop bit, no parity, with the sensor set up as a slave device. A master controller up to 4000 feet away can theoretically poll up to 256 different sensors. This number may not be realistic in harsh environments where noise and/or wiring conditions would make it impractical to place so many devices on the same pair of wires. If a multi-point system is being utilized, each sensor should be set for a different address. Typical address settings are: 01, 02, 03, 04, 05, 06, 07, 08, 09, 0A, 0B, 0C, 0D, 0E, 0F, 10, 11, etc.

In most instances, RS-485 ID numbers are factory set or set during installation before commissioning. If required, the RS-485 ID number can be set via rotary dip switches located on the preamp circuit board. However, any change to the RS-485 ID number would require the sensor housing to be opened, thus declassification of the area would be required. See section 3.5.4-f for details on changing the RS-485 ID number.

The following section explains the details of the Modbus™ protocol that the TP-624C MicroSafe™ sensor supports.

Code 03 - Read Holding Registers, is the only code supported by the transmitter. Each transmitter contains 6 holding registers which reflect its current status.

Register #	High Byte	Low Byte
40000	Gas type	Sensor Life

Gas type is one of the following:
01=CO, 02=H2S, 03=SO2, 04=H2, 05=HCN, 06=CL2, 07=NO2, 08=NO, 09=HCL, 10=NH3, 11=LEL, 12=O2

Sensor life is an estimated remaining use of the sensor head, between 0% and 100%
Example: 85=85% sensor life

Register #	High Byte	Low Byte
40001		Detectable Range

i.e. 100 for 0-100 ppm, 50 for 0-50% LEL, etc.

Register #	High Byte	Low Byte
40002		Current Gas Reading

The current gas reading as a whole number. If the reading is displayed as 23.5 on the display, this register would contain the number 235.

Register #	High Byte	Low Byte
40003		Alarm 1 Setpoint

This is the trip point for the first alarm.

Register #	High Byte	Low Byte
40004		Alarm 2 Setpoint

This is the trip point for the second alarm.

Register #	High Byte	Low Byte
40005	Status Bits	Status Bits

High Byte

Bit 7	Not used, always 0	
Bit 6	Not used, always 0	
Bit 5	Not used, always 0	
Bit 4	Not used, always 0	
Bit 3	1-Unit is in calibration	0-Normal operation
Bit 2	1-Alarm 2 is ascending	0-Alarm 2 is descending
Bit 1	1-Alarm 2 is normally energized	0-Alarm 2 is normally de-energized
Bit 0	1-Alarm 2 is latching	0-Alarm 2 is non-latching

Low Byte

Bit 7	1-Alarm 2 Relay is energized	0-Alarm 2 Relay is not energized
Bit 6	1-Alarm 1 is ascending	0-Alarm 1 is descending
Bit 5	1-Alarm 1 is normally energized	0-Alarm 1 is normally de-energized
Bit 4	1-Alarm 1 is latching	0-Alarm 1 is non-latching
Bit 3	1-Alarm 1 Relay is energized	0-Alarm 1 Relay is not energized
Bit 2	1-Fault is normally energized	0-Fault is normally de-energized
Bit 1	1-Fault is latching	0-Fault is non-latching
Bit 0	1-Fault Relay is energized	0-Fault Relay is not energized

The following is a typical Master Query for device # 8:

Field Name	HEX	DEC	RTU
Slave Address	08	8	0000 1000
Function	03	3	0000 0011
Start Address Hi	00	0	0000 0000
Start Address Lo	00	0	0000 0000
No. of Registers Hi	00	0	0000 0000
No. of Registers Lo	06	6	0000 0110
CRC	##		#### ####
CRC	##		#### ####

The following is a typical Slave Response from device # 8:

Field Name	HEX	DEC	RTU
Slave Address	08	8	0000 1000
Function	03	3	0000 0011
Byte Count	0C	12	0000 1100
Reg40000 Data Hi	02	2	0000 0010
Reg40000 Data Lo	64	100	0110 0100
Reg40001 Data Hi	00	0	0000 0000
Reg40001 Data Lo	64	100	0110 0100
Reg40002 Data Hi	00	0	0000 0000
Reg40002 Data Lo	07	7	0000 0111
Reg40003 Data Hi	00	0	0000 0000
Reg40003 Data Lo	0A	10	0000 1010

Reg40004 Data Hi	00	0	0000 0000
Reg40004 Data Lo	14	20	0001 0100
Reg40005 Data Hi	05	5	0000 0101
Reg40005 Data Lo	50	80	0101 0000
CRC	##		#### ####
CRC	##		#### ####

Additional Notes:
The calibration LED will light when the transmitter is sending a response to a Master Query.
Communications are 9600 baud, 8 data bits, 1 stop bit, No parity, half duplex 485.

3.12 Display Contrast Adjust

Model TP-624C MicroSafe™ sensors feature a 16 character backlit liquid crystal display. Like most LCDs, character contrast can be affected by viewing angle and temperature. Temperature compensation circuitry included in the MicroSafe™ design will compensate for this characteristic, however temperature extremes may still cause a shift in the contrast. Display contrast can be adjusted by the user if necessary. However, changing the contrast requires that the sensor housing be opened, thus declassification of the area is required.

To adjust the display contrast, remove the enclosure cover and use a jewelers screwdriver to turn the contrast adjust screw located beneath the metallic face plate. The adjustment location is marked "CONTRAST". See figure 7 for location.

3.13 Trouble Shooting Guide

SENSOR FAULTS

Open Heater

Verify resistance between black and white wires using ohm-meter with the sensor unplugged and at room temperature. Heater Film's normal reading range should be 65-95 ohms. Failure would be an open circuit.

Open Sensor

Verify resistance between blue and yellow wires using ohm-meter with the sensor unplugged and at room temperature. Sensor Film's normal reading range should be 5-100 k-ohms. For sensors with an "X" in the serial number, the normal reading range should be 75 k-ohms to 2 meg-ohms. Failure would be open circuit.

SPAN CALIBRATION FAULTS – (Range, Stability, Zero)

To remove the span calibration fault, you must repeat the calibration process successfully.

Range Fault

1. Check Heater Voltage Setting (should be 5.25 V).
2. Use humidifier with Distilled Water.
3. Check validity of cal gas using H2S pull tube or other means.
4. Check for obstructions through s/s sinter element (including being wet).
5. Check sensor lot # and report to Detcon .

Zero Fault

Must recover to <10% of range before calibration cycle is complete and returns to normal operation. Use bottled air if necessary.

Poor calibration Repeatability

1. Check for adequate Sensor Life.
2. Check Heater Voltage Setting (should be 5.25 V).
3. Use humidifier filled with Distilled Water.
4. Check validity of cal gas.
5. Check for obstructions through s/s sinter element (including being wet).

6. Check sensor lot # and report to Detcon.
7. Check area for presence of reducing gases such as Cl2 and ozone which may cause low readings.

Unstable output/ Sudden spiking

Unstable power supply, Inadequate grounding, Inadequate RFI protection.
1. Verify Power source.
2. Contact Detcon to optimize shielding and grounding.
3. Add RFI protection accessory.

Nuisance Alarms

1. Check condulet for accumulated water and abnormal corrosion.
If Nuisance alarms happening at night suspect condensation in condulet.
2. Add/Replace Detcon Condensation Prevention Packet P/N 960-202200-000

Memory or Error reports

1. Reinitialize Sensor - Unplug transmitter, replug transmitter then swipe magnet over PGM 1 in the first 3 seconds. This will clear the processor and recover from error state. Remember to put in all customer settings for range, alarm and cal gas level after re-initialization.

Non readable display

1. If blue background, install sunshade to reduce temperature.
2. If poor contrast, adjust contrast pot accordingly.

Nothing Displayed – Transmitter not Responding

1. Verify condulet has no accumulated water or abnormal corrosion.
2. Verify required DC power is applied to correct terminals.
3. Swap with a known-good transmitter to determine if transmitter is faulty.

Bad 4-20 mA output or RS485 Output

1. Check that wiring is connected to correct terminal outputs.
Swap with a known-good transmitter to determine if transmitter is faulty.

3.14 Spare Parts List

600-500000-000	Sensor rain shield
600-610000-000	Sensor splash guard
943-000006-038	Threaded Calibration Adapter
399-800000-000	H2S sensor in stainless steel housing
926-015500-100	TP-624C Plug-in control circuit
500-001794-004	Connector board
327-000000-000	Programming Magnet
897-850800-000	3 port enclosure less cover
897-850700-000	Enclosure glass lens cover
960-202200-000	Condensation prevention packet (replace annually).
985-241100-321	In-Line Humidifying Tube
943-020000-000	Span Gas Kit: Includes calibration adapter, In-Line Humidifying Tube, 200 ml/m span gas regulator, and carrying case. Does not include span gas.
942-010112-010	Span gas bottle containing 58 liters 10ppm H2S in air (operating range dependent).
942-010112-020	Span gas bottle containing 58 liters 20ppm H2S in air (operating range dependent).
942-010112-025	Span gas bottle containing 58 liters 25ppm H2S in air (operating range dependent).
942-010112-050	Span gas bottle containing 58 liters 50ppm H2S in air (operating range dependent).
943-090005-502	200 ml/m regulator for span gas bottle

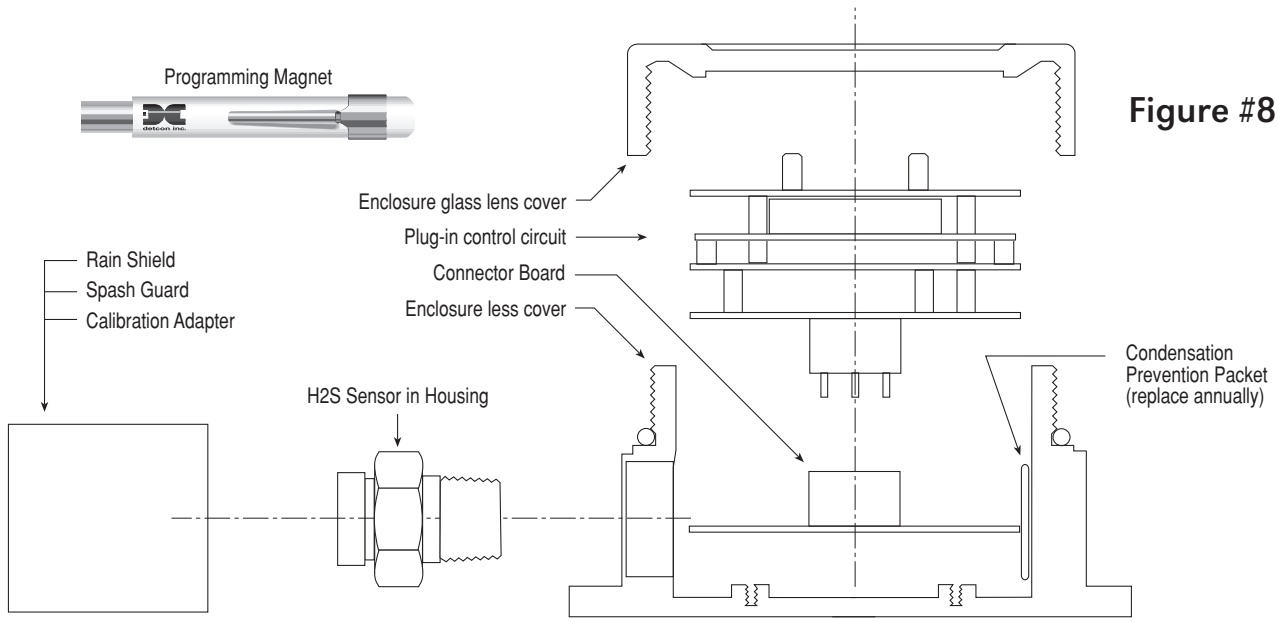


Figure #8

3.15 WARRANTY

Detcon, Inc., as manufacturer, warrants each hydrogen sulfide sensor element (PN 399-800000-000), for a ten year period under the conditions described as follows: The warranty period begins on the date of shipment to the original purchaser and ends two years thereafter. The sensor element is warranted to be free from defects in material and workmanship. Should any sensor fail to perform in accordance with published specifications within the warranty period, return the defective part to Detcon, Inc., 3200 A-1 Research Forest Dr., The Woodlands, Texas 77381, for necessary repairs or replacement.

First year	No Charge
2nd-5th years	$25.00 handling charge
6th year	$60.00 handling charge
7th year	$96.00 handling charge
8th year	$120.00 handling charge
9th year	$150.00 handling charge
10th year	$176.00 handling charge
Warranty voided	$200.00 charge
Non-warranty	$295.00 charge

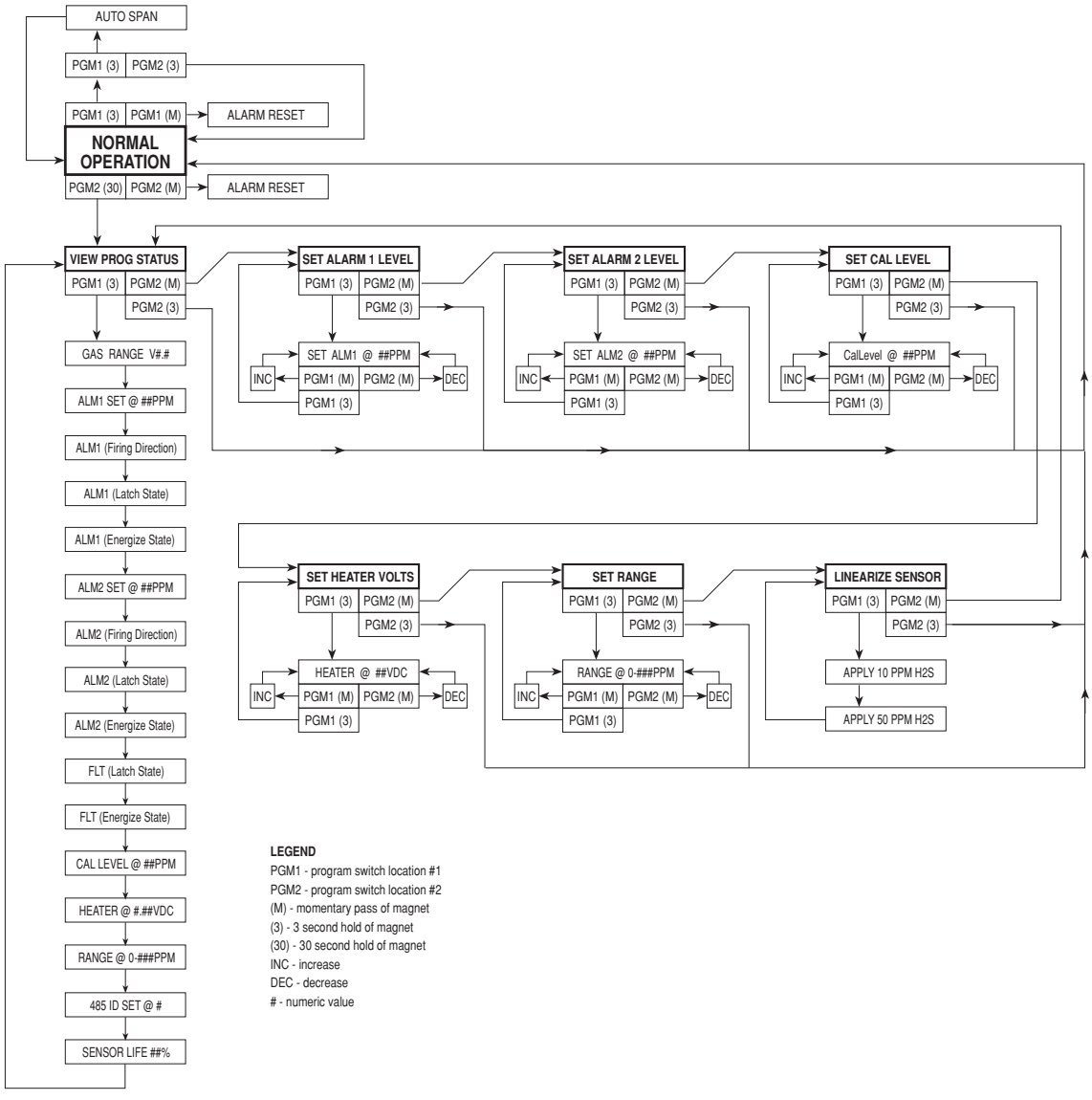
Terms & Conditions

* The original serial number must be legible on each sensor element base.
* Shipping point is FOB the Detcon factory.
* Net payment is due within 30 days of invoice.
* Detcon, Inc. reserves the right to refund the original purchase price in lieu of sensor replacement.

3.16 SERVICE POLICY

Detcon, Inc., as manufacturer, warrants under intended normal use each new MicroSafe™ plug-in control circuit to be free from defects in material and workmanship for a period of two years from the date of shipment to the original purchaser. Detcon, Inc., further provides for a five year fixed fee service policy wherein any failed transmitter shall be repaired or replaced as is deemed necessary by Detcon, Inc., for a fixed fee of $65.00. The fixed fee service policy shall affect any factory repair for the period following the two year warranty and shall end five years after expiration of the warranty. All warranties and service policies are FOB the Detcon facility located in The Woodlands, Texas.

3.17 Software Flow Chart



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