detcon inc.

# Detcon MicroSafe™

## FP-624C Combustible Gas Sensor (0-100% LEL)


**Operator's Installation & Instruction Manual**

May 18, 2010 • Document #2246 • Revision 7.1

# CAUTION:

*Before operating the Model FP-624C sensor, read this manual thoroughly and verify that the configuration of default factory settings are appropriate and correct for your application. The settings include: Target gas and calibration gas (section 3.7), relay contact outputs (section 3.5.5d), alarm settings (section 3.5.5e and 3.10), and RS-485 ID (section 3.5.5f and 3.12).*

# Table of Contents

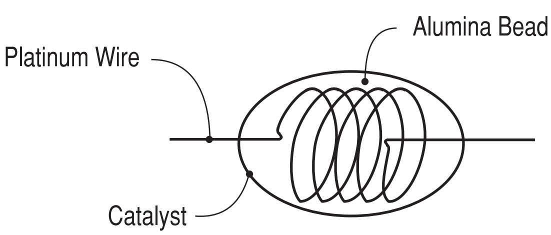
## 3.0 Description


Detcon MicroSafe™ Model FP-624C, combustible gas sensors are non-intrusive "Smart" sensors designed to detect and monitor combustible gas in air over the range of 0-100% lower explosive limit (LEL). 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 and provides relays for two alarms plus fault as standard. The sensor comes with two different outputs: analog 4-20 mA, and serial RS-485. 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.

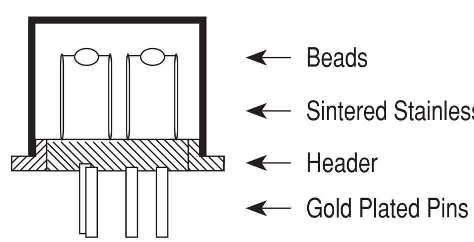
The sensor technology is of the catalytic pellistor type. Catalytic pellistors show a good response to a long list of combustible gases. The technique is referred to as non-selective and may be used for the detection and monitoring of target combustible gases. Model FP-624C sensors are specifically designed to be resistive to poisons such as sulfides, chlorides and silicone. The sensors are characteristically stable and capable of providing reliable performance for periods exceeding 5 years in most industrial environments.

### 3.0.1 Catalytic Detector

The catalytic detector is supplied as a matched pair of elements mounted in a plug-in replaceable housing. One element is an active catalytic detector and the other is a non-active compensating element. Each element consists of a fine platinum wire embedded in a bead of alumina. A catalytic mixture is applied to the detecting element while the compensating element is treated so that catalytic oxidation of gas does not occur. The beads are mounted in a plug-in module that is enclosed by a sintered porous stainless steel flame arrestor. The plug-in sensor module uses gold plated pins and mounts inside the stainless steel sensor head via mating gold plated sockets.

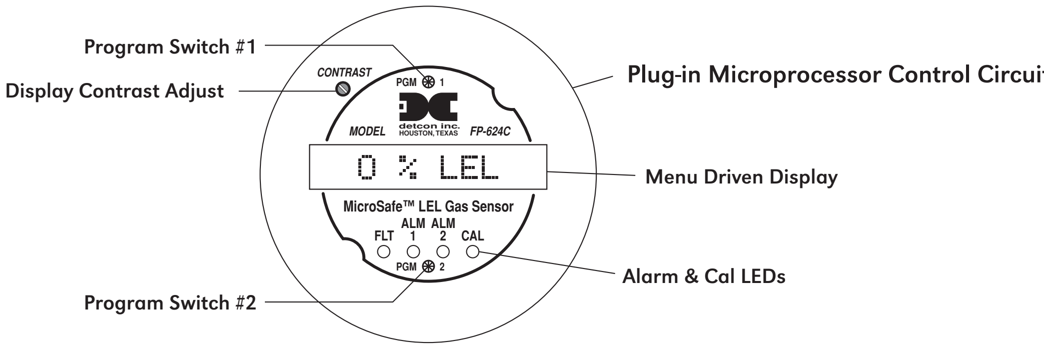



Construction of
Detector Bead



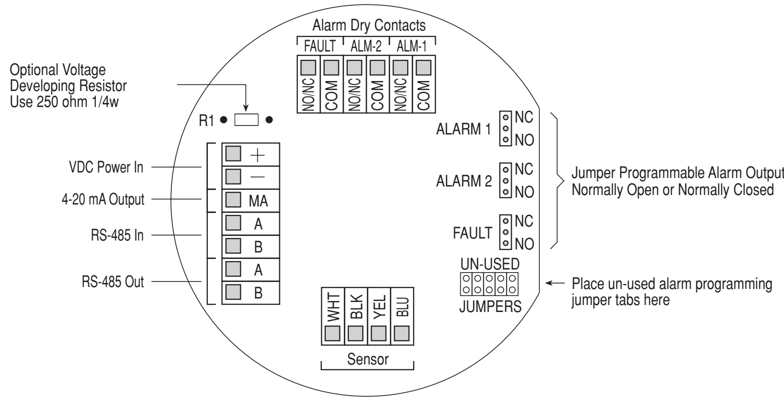

### 3.0.2 Microprocessor Control Circuit

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, sensor temperature control, 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.



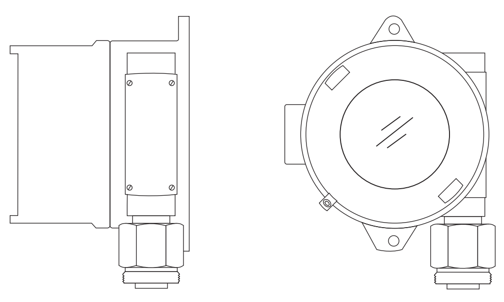

### 3.0.3 Base Connector Board

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

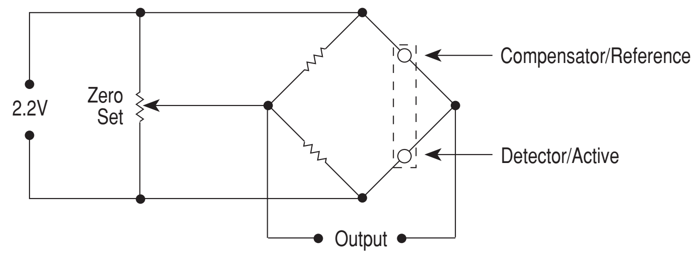
The sensors are packaged in a cast metal explosion proof enclosure. The enclosure is fitted with a threaded cover that has a glass lens window. Magnetic program switches located behind the transmitter module face plate are activated through the lens window via a hand-held magnetic programming tool allowing 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; Groups B, C, D; Div. 1.



## 3.1 Principle of Operation

Method of detection is by a controlled rate of diffusion/adsorption. Air and gas diffuse through a sintered stainless steel filter and contact both the active and reference detector beads. The surface of the active detector promotes oxidation of the combustible gas molecule while the reference detector has been treated not to support this oxidation. The reference detectors serve as a means to maintain zero stability over a wide operating temperature range.

When combustible gas molecules oxidize on the surface of the active detector, heat is generated, effectively changing the electrical conductance of the active detector. Electronically, the detectors form part of a balanced bridge circuit. As the active detector changes in electrical conductance, the bridge circuit unbalances. This change in output is conditioned by amplifier circuits that are an integral part of the assembly. The sensor response and clearing characteristics are quite rapid resulting in a method of continuous and accurate monitoring of ambient air conditions.

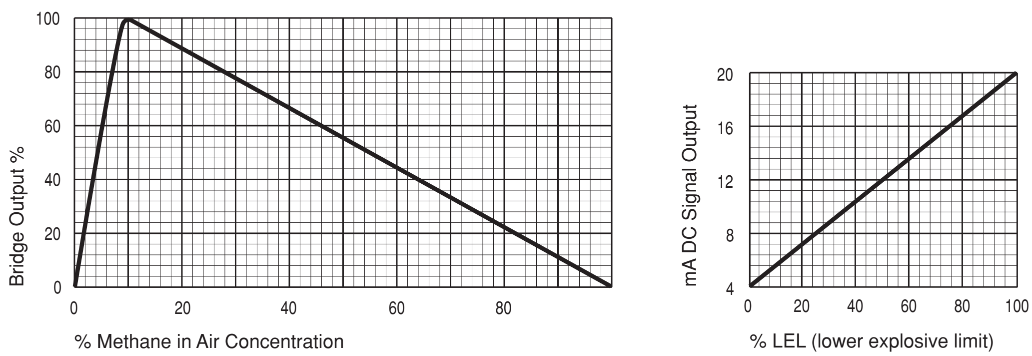



### 3.1.2 Characteristics

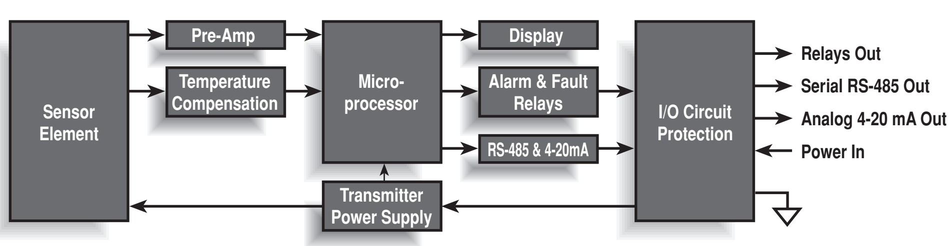
The detector elements maintain good sensitivity to combustible gases in air in the lower explosive limit range, as shown in the response curve illustration below. However, for gas concentrations above the LEL range, the bridge output decreases. Ambiguous readings above LEL range conditions dictate that alarm circuitry be of the latching type wherein alarms are held in the "on" position until reset by operations personnel.

The performance of the detector elements may be temporarily impaired by operation in the presence of substances described as inhibitors. These are usually volatile substances containing halogens and the detectors may recover after short periods of operation in clean air. When the inhibiting substance produces a permanent effect on the catalyst with a catastrophic reduction in sensitivity, the detector is said to be poisoned. Examples of poisons are; silicone oils and greases, anti-knock petrol additives and phosphate esters. Activated carbon filters will provide adequate protection from poisoning in the majority of cases.

**Response Curve**




**Functional Block Diagram**




## 3.2 Application

Model FP-624C MicroSafe™ sensors are designed to detect and monitor combustible gas in ambient air in the range of 0-100% LEL. Minimum sensitivity and scale resolution is 1%. 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. The sensors are generally located 2 - 4 feet above grade.

### 3.2.2 Response to Different Gases

An attractive feature of the catalytic detector elements is their almost universal response to lower explosive limits of hydrocarbons. Most detectable gases produce a similar output, however the signal amplitudes differ. The table in section 3.7 lists theoretical factors (K factors) for different gases which are a measure of their signal amplitude as compared to methane which has a K factor of 1.00. Since these factors are theoretical, they will only give a guide to the response expected in other gases. The Model FP-624C sensor can be configured to detect any of the listed gases. The gas selected for detection is referred to as the target gas. The sensor can also be configured to allow the user to calibrate with a listed gas other than the target gas. This selection is referred to as the calibration gas. Unless otherwise specified, Model FP-624C sensors are configured to detect methane and are calibrated with methane to a scale of 0-100% LEL. Refer to section 3.7 for details.

## 3.3 Specifications

**Method of Detection**
Catalytic detector diffusion/adsorption

**Measurment Range**
0-100% (lower explosive limit) LEL

**Accuracy/Repeatability**
± 3% LEL in 0-50% LEL Range; ± 5% LEL in 51-100% LEL Range

**Response/Clearing Time**
T50 <10 seconds; T90 <30 seconds

**Zero Drift**
< 5% per year

**Operating Temperature Range**
-40° to +175° F; -40° to +75°C

**Operating Humidity Range**
0-99% non-condensing

**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

**Power Consumption**
Normal operation = 84 mA (2 watts); Full alarm = 128 mA (3.1 watts)

**Electrical Classification**
Explosion Proof; Class I; Div. 1; Groups B, C, D

**Safety Approvals**
CSA/NRTL (US OSHA Certified)

**Sensor Warranty**
2 year conditional

## 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) Zero
    b) Span

03. Program Menu
    a) Program Status
    b) Alarm 1 Level

c) Alarm 2 Level
d) Target gas selection (gas K factor)
e) Calibration gas selection (cal K factor)
f) Calibration Level
g) Set Bridge Volts

### 3.4.1 Normal Operation

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

### 3.4.2 Calibration Mode

Calibration mode allows for sensor zero and span adjustments. **"1-ZERO 2-SPAN"**

*3.4.2.1 Zero Adjustment*

Zero is set in ambient air with no combustible gas present or with zero gas applied to the sensor. **"AUTO ZERO"**

*3.4.2.2 Span Adjustment*

Unless otherwise specified, span adjustment is performed at 50% LEL methane in air. **"AUTO SPAN"**

### 3.4.3 Program Mode

The program mode provides a program status menu, allows for the adjustment of alarm set point levels, the selection of the target gas K factor, the selection of the calibration gas K factor and the selection of the calibration gas level setting.

*3.4.3.1 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: **"LEL 0-100 V6.4"**
* The alarm set point level of alarm 1. The menu item appears as: **"ALM1 SET @ ##%"**
* 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 @ ##%"**
* 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.
* Identification of the target gas K factor. The menu item appears as: **"GAS FACTOR #.##"**
* Identification of the calibration gas K factor. The menu item appears as: **"CAL FACTOR #.##"**
* The calibration gas level setting. The menu item appears as: **"CalLevel @ xx%"**
* 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%. For combustible gas sensors, the level is factory set at 20%. The menu item appears as: **"SET ALM1 @ 20%"**

*3.4.3.3 Alarm 2 Level Adjustment*

The alarm 2 level is also adjustable over the range 10 to 90%. For combustible gas sensors, the level is factory set at 40%. The menu item appears as: **"SET ALM2 @ 40%"**

*3.4.3.4 Target Gas Selection*

The target gas K factor is adjustable over the range 0.79 to 5.65. For combustible gas sensors configured for the detection of methane, the level is factory set at 1.00. The menu item appears as: **"GAS FACTOR 1.00"**

*3.4.3.5 Calibration Gas Selection*

The calibration gas K factor is adjustable over the range 0.79 to 5.65. For combustible gas sensors that are calibrated using methane, the level is factory set at 1.00. The menu item appears as: **"CAL FACTOR 1.00"**

*3.4.3.6 Calibration Level Adjustment*

The Calibration level is adjustable from 10% to 90% LEL. The menu item appears as: **"CalLevel @ ##%"**

*3.4.3.7 Set Bridge Volts*

For applications where the sensor is remotely mounted away from the sensor transmitter, the detector bridge voltage is adjustable to compensate for differing wire resistances. The menu item appears as: **"SET BRIDGE VOLTS"**

## 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 FP-624C combustible gas 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) Accessibility for routine maintenance

***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 2-4 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.

***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.

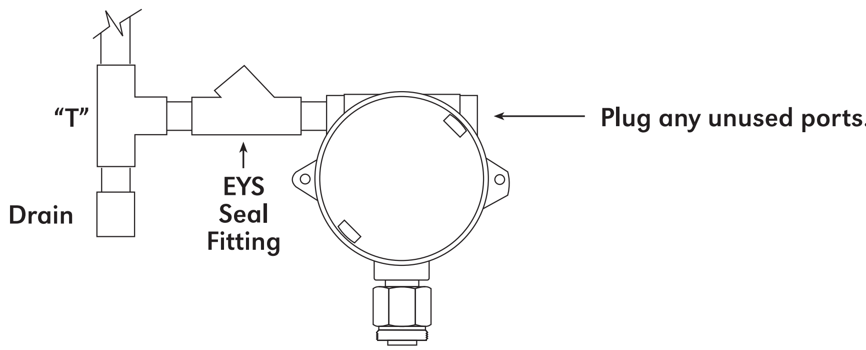



Figure #1

### 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 are required at the bottom of vertical conduit runs. The sensor assemblies are designed to meet NEC and CSA requirements for Class I; Div. 1; Groups B, C, D, 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. See dimensional drawing (Fig. 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 @ 120VAC; 5 amp @ 30VDC) are provided for Fault, Alarm 1, and Alarm 2.

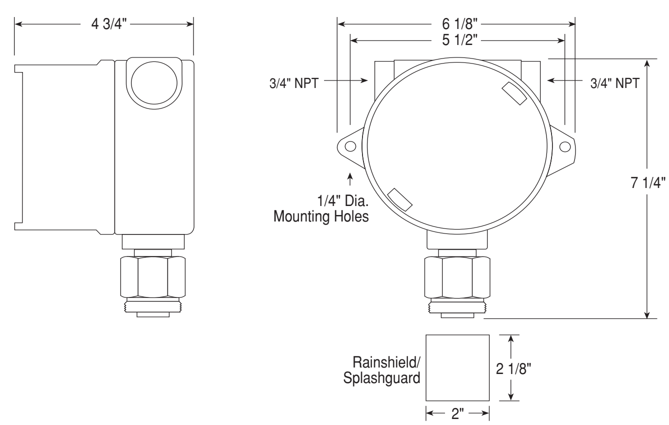



Figure #2

*Note 1* : The second electrical port should be used for wiring to relay contacts or to connect RS-485 and/or 24 volt power source to the next sensor in the serial loop (never mix VAC and VDC in the same conduit run).

*Note 2:* 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).

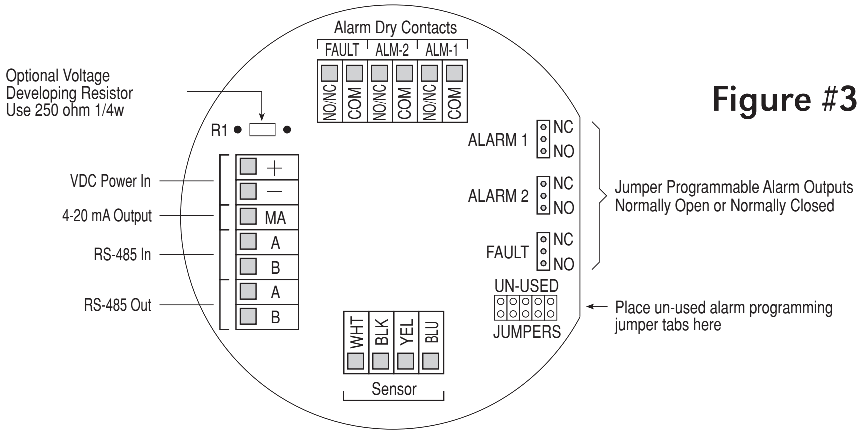



Figure #3

***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).

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.

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, combustible 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).

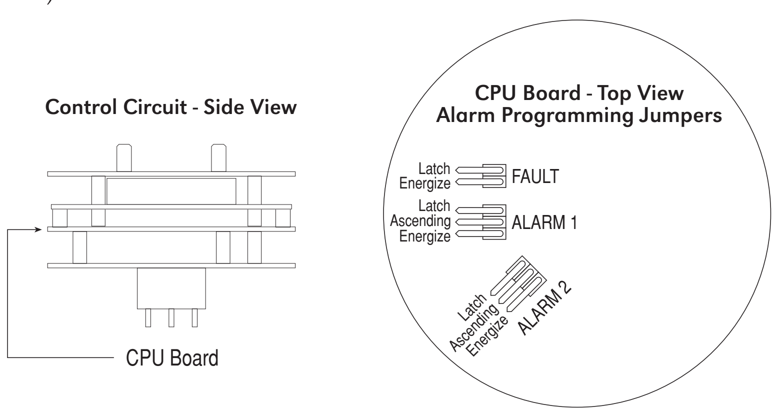
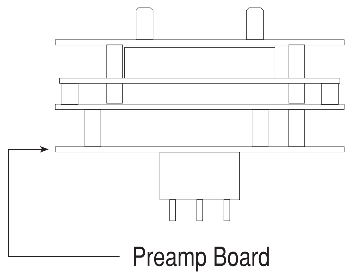
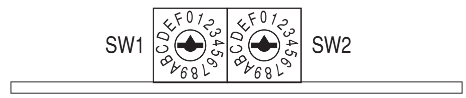



Figure #4

**Control Circuit - Side View**




**Preamp Board - Side View**
**RS-485 ID Set Dip Switches**




## Figure #5

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 hexidecimal 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 hexidecimal table listed below. If RS-485 communications are not used, leave the dip switches in the default position which is zero/zero (0)-(0).

### Hexidecimal 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.

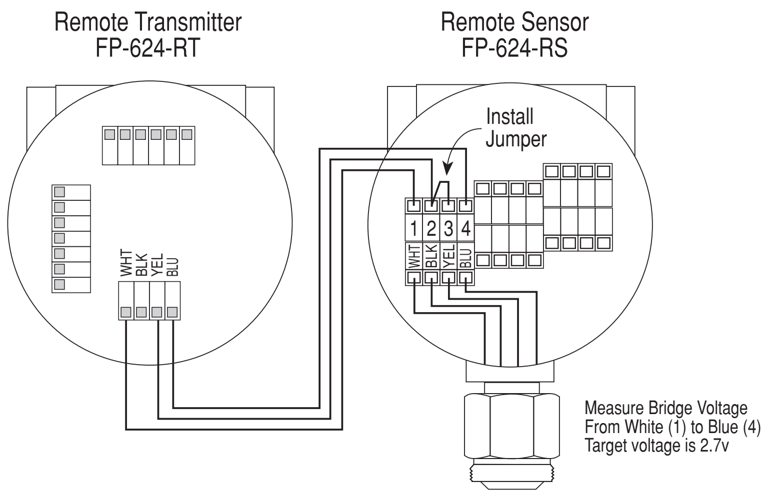
### 3.5.6 Remote Mounting Applications

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 FP-624C sensor in a remote-mount configuration in which the sensor (Model FP-624C-RS) and the transmitter (Model FP-624C-RT) are provided in their own condulet housing and are interfaced together with a three conductor cable. There is a limit 0.5 ohm maximum resistance drop per wire over the seperation distance.

| AWG | Maximum Seperation (feet) |
|---|---|
| 20 | 50 |
| 18 | 75 |
| 16 | 125 |
| 14 | 175 |

Reference figure 5A for wiring diagram. Also note the jumper that is required on the remote sensor connector board. Failure to install this jumper will cause a sensor fault condition.

Figure #5A




**Remote Mounting Configuration - Bridge Voltage Adjustment**

When a sensor is remotely mounted away from the transmitter, consideration must be given to the lengths of cable used and how it affects the sensor bridge voltage. Differing lengths of cables will have varying amounts of resistance which will will shift the sensor bridge voltage. Because of this, the bridge voltage will need to be adjusted after initial power up. This adjustment is only required after initial installation and will not be necessary thereafter, even in the event of replacement of the plug-in sensor. See section 3.6.1 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) FP-624C "Fault" LED is off.
b) A temporary upscale reading may occur as the sensor heats up. This upscale reading will clear to "0" % within 1-2 minutes of turn-on, assuming there is no gas in the area of the sensor.

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 3.11.
Note 3: If the sensor has been installed using the remote mounting configuration as described in section 3.5.5, the sensor bridge voltage must be adjusted after initial power up. If this is the case, first adjust the bridge voltage as described in section 3.6.2, then proceed with the initial operation tests below (section 3.6.1).

### 3.6.1 Remote Mount Bridge Voltage Setup

If the sensor has been installed using the remote mounting configuration as described in section 3.5.6, the sensor bridge voltage must be adjusted after initial power up. If this is not the case skip this section and proceed to Initial Operational Tests. Otherwise follow the steps below to set the sensor bridge voltage.

***Material Requirements***

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

### 3.6.2 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 alarm level programming without removing the enclosure cover, thereby eliminating the need for area de-classification or the use of hot permits.

A magnetic programming tool (see figure 6) is used to operate the switches. Switch action is defined as momentary contact, 3 second hold, and 30 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 30 second hold, the programming magnet is held in place over a switch location for 30 or more seconds. Three and thirty 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 7.

Magnetic Programming Tool

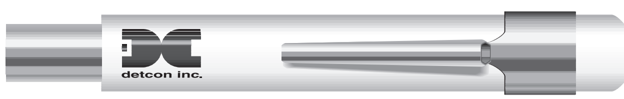



Figure #6

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.

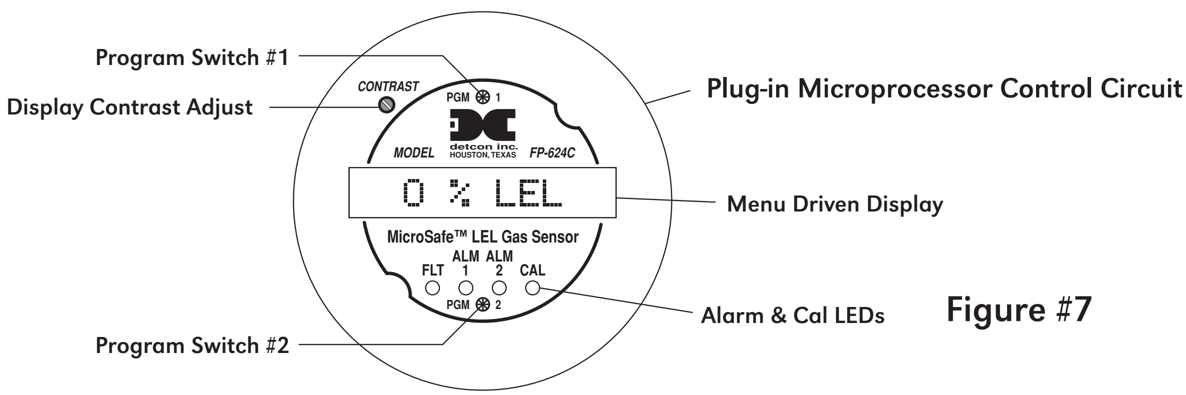



Figure #7

*3.6.1 Continued - Set Sensor Bridge Voltage Procedure*

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 “Blue” terminal as shown in figure 5A. Target voltage is 2.7 ±0.2 volts.
d) At the transmitter, enter the programming menu by holding the programming magnet stationary over “PGM 2” for 30 seconds until the display reads **“VIEW PROG STATUS”**, then withdraw the magnet.
e) Next, scroll to the **“SET BRIDGE VOLTS”** listing and then hold the programming magnet over “PGM 1” for 3 seconds. The menu item appears as **“BRIDGE VOLTS U/D”.**
f) Use the programming magnet to make an adjustment to “PGM 1” to increase or “PGM 2” to decrease the bridge voltage.
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 operations 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.

Bridge voltage set is complete. This procedure need only be done once after initial power up.

**3.6.3 Initial Operational Tests**

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

***Material Requirements***

* Detcon PN 6132 Threaded Calibration Adapter
* Span Gas 50% LEL methane in air at a controlled flow rate of 200 ml/min.

  NOTE: If the sensor has been configured for calibration with a gas other than methane you will need to use that gas. See section 3.7 for further information on calibration gas.

a) Attach the calibration adapter to the threaded sensor housing. Apply the test gas at a controlled flow rate of 200 ml/m. Observe that the LCD display increases to a level of 20% or higher.
b) Remove the test gas and observe that the LCD display decreases to **“0 % LEL”.**
c) If alarms are activated during the test, and have been programmed for latching operation, reset them according to the instructions in section 3.10.2.

Initial operational tests are complete. Detcon combustible 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 within 24 hours of installation. Refer to calibration instructions in later text.

## 3.7 Target Gas and Calibration Gas Selection

Because of the catalytic detector elements almost universal response to lower explosive limits of combustible gas, the FP-624C sensor can be configured to specifically detect any of the combustible gases listed in table 1. This specific gas is referred to as the “target gas”. In addition, the sensor can be configured so that it can be calibrated with any of the listed gases, regardless of which target gas is selected. This gas is referred to as the “calibration gas”. These two features allow a significant degree of flexibility in the detection and calibration process.

Unless otherwise specified at time of order, Model FP-624C combustible gas sensors are configured to detect methane gas in the range 0-100% LEL and are calibrated with 50% LEL methane in air. In this configuration, methane is chosen as both the target gas and the calibration gas.

**CAUTION:** Verification of specific target gas and calibration gas settings is required before commissioning.

To verify target gas and calibration gas settings, or to reconfigure the target gas or calibration gas, follow the instructions below.

**3.7.1 The “K” Factor**

Most detectable gases, as listed in table 1, produce a similar output, however the signal amplitudes will differ. This difference in amplitude is reflected by a numeric figure known as a “K factor”. The K factors are referenced to methane which has a K factor of 1.00. It should be noted that these factors are theoretical and should only be used as a guide to the response expected in other gases.

**3.7.2 Verification of Target Gas and Calibration Gas Configuration**

Verification of target gas and calibration gas configuration is obtained via interaction with the menu driven display which requires the use of a programming magnet.

***Material Requirements:***

Detcon PN 3270 MicroSafe™ Programming Magnet

**TABLE 1a** (alphabetical listing)

| Gas | K | Gas | K | Gas | K |
|---|---|---|---|---|---|
| Acetaldehyde | 1.66 | Decane | 3.05 | Dimethyl Ether | 1.60 |
| Acetic Acid | 1.84 | Diethylamine | 2.05 | Methylethylether | 2.27 |
| Acetic Anhydride | 2.17 | Dimethylamine | 1.73 | Methylethylketone | 2.42 |
| Acetone | 1.93 | 2,3-Dimethylpentane | 2.51 | Methyl Formate | 1.49 |
| Acetylene | 1.76 | 2,2-Dimethylpropane | 2.52 | Methylmercaptan | 1.64 |
| Alkyl Alcohol | 1.96 | Dimethylsulphide | 2.30 | Methylpropionate | 1.95 |
| Ammonia | 0.79 | 1,4-Dioxane | 2.24 | Methyl n-propylketone | 2.46 |
| n-Amyl Alcohol | 3.06 | Ethane | 1.47 | Naptha | 3.03 |
| Aniline | 2.54 | Ethyl Acetate | 1.95 | Naphthalene | 2.94 |
| Benzene | 2.45 | Ethyl Alcohol | 1.37 | Nitromethane | 1.72 |
| Biphenyl | 4.00 | Ethylamine | 1.90 | n-Nonane | 3.18 |
| 1,3-Butadiene | 1.79 | Ethyl Benzene | 2.80 | n-Octane | 2.67 |
| Butane | 1.71 | Ethylcyclopentane | 2.52 | n-Pentane | 2.18 |
| iso-Butane | 1.93 | Ethylene | 1.41 | iso-Pentane | 2.15 |
| Butene-1 | 2.20 | Ethyleneoxide | 1.93 | Propane | 1.81 |
| cis-Butene-2 | 2.06 | Diethyl Ether | 2.16 | n-Propyl Alcohol | 2.12 |
| trans-Butene-2 | 1.97 | Ethyl Formate | 2.26 | n-Propylamine | 2.07 |
| n-Butyl Alcohol | 2.91 | Ethylmercaptan | 1.78 | Propylene | 1.95 |
| iso-Butyl Alcohol | 1.89 | n-Heptane | 2.59 | Propyleneoxide | 2.18 |
| tert-Buty-alcohol | 1.34 | n-Hexane | 2.71 | iso-Propylether | 2.29 |
| n-Butyl Benzene | 3.18 | Hydrazine | 2.22 | Propyne | 2.40 |
| iso-Butyl Benzene | 3.12 | Hydrogencyanide | 2.09 | Toluene | 2.47 |
| n-Butyric Acid | 2.63 | Hydrogen | 1.30 | Triethylamine | 2.51 |
| Carbon Disulphide | 5.65 | Hydrogen Sulphide | 2.45 | Trimethylamine | 2.06 |
| Carbon Monoxide | 1.32 | **Methane** | **1.00** | Vinyl Chloride | 2.32 |
| Carbon Oxysulphide | 1.07 | Methyl Acetate | 2.01 | Vinylethylether | 2.38 |
| Cyanogen | 1.12 | Methyl Alcohol | 1.16 | o-Xylene | 2.79 |
| Cyclohexane | 2.43 | Methylamine | 1.29 | m-Xylene | 2.55 |
| Cyclopropane | 1.60 | Methylcyclohexane | 2.26 | p-Xylene | 2.55 |

**TABLE 1b** (numerical listing)

| Gas | K | Gas | K | Gas | K |
|---|---|---|---|---|---|
| Ammonia | 0.79 | Ethyleneoxide | 1.93 | Methylethylketone | 2.42 |
| **Methane** | 1.00 | Ethyl Acetate | 1.95 | Cyclohexane | 2.43 |
| Carbon Oxysulphide | 1.07 | Methylpropionate | 1.95 | Benzene | 2.45 |
| Cyanogen | 1.12 | Propylene | 1.95 | Hydrogen Sulphide | 2.45 |
| Methyl Alcohol | 1.16 | Alkyl Alcohol | 1.96 | Methyl n-propylketone | 2.46 |
| Methylamine | 1.29 | trans-Butene-2 | 1.97 | Toluene | 2.47 |
| Hydrogen | 1.30 | Methyl Acetate | 2.01 | 2,3-Dimethylpentane | 2.51 |
| Carbon Monoxide | 1.32 | Diethylamine | 2.05 | Triethylamine | 2.51 |
| tert-Buty-alcohol | 1.34 | cis-Butene-2 | 2.06 | 2,2-Dimethylpropane | 2.52 |
| Ethyl Alcohol | 1.37 | Trimethylamine | 2.06 | Ethylcyclopentane | 2.52 |
| Ethylene | 1.41 | n-Propylamine | 2.07 | Aniline | 2.54 |
| Ethane | 1.47 | Hydrogencyanide | 2.09 | m-Xylene | 2.55 |
| Methyl Formate | 1.49 | n-Propyl Alcohol | 2.12 | p-Xylene | 2.55 |
| Cyclopropane | 1.60 | iso-Pentane | 2.15 | n-Heptane | 2.59 |
| Dimethyl Ether | 1.60 | Diethyl Ether | 2.16 | n-Butyric Acid | 2.63 |
| Methylmercaptan | 1.64 | Acetic Anhydride | 2.17 | n-Octane | 2.67 |
| Acetaldehyde | 1.66 | n-Pentane | 2.18 | n-Hexane | 2.71 |
| Butane | 1.71 | Propyleneoxide | 2.18 | o-Xylene | 2.79 |
| Nitromethane | 1.72 | Butene-1 | 2.20 | Ethyl Benzene | 2.80 |
| Dimethylamine | 1.73 | Hydrazine | 2.22 | n-Butyl Alcohol | 2.91 |
| Acetylene | 1.76 | 1,4-Dioxane | 2.24 | Naphthalene | 2.94 |
| Ethylmercaptan | 1.78 | Ethyl Formate | 2.26 | Naptha | 3.03 |
| 1,3-Butadiene | 1.79 | Methylcyclohexane | 2.26 | Decane | 3.05 |
| Propane | 1.81 | Methylethylether | 2.27 | n-Amyl Alcohol | 3.06 |
| Acetic Acid | 1.84 | iso-Propylether | 2.29 | iso-Butyl Benzene | 3.12 |
| iso-Butyl Alcohol | 1.89 | Dimethylsulphide | 2.30 | n-Butyl Benzene | 3.18 |
| Ethylamine | 1.90 | Vinyl Chloride | 2.32 | n-Nonane | 3.18 |
| Acetone | 1.93 | Vinylethylether | 2.38 | Biphenyl | 4.00 |
| iso-Butane | 1.93 | Propyne | 2.40 | Carbon Disulphide | 5.65 |

a) First, enter the programming menu by holding the programming magnet stationary over "PGM 2" for 30 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, and Set Alarm 2 Level, Set Gas Factor (target gas), Set Cal Factor (calibration gas).

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. Note that the "K factor" for the target gas is displayed in item #12 and the "K factor" for the calibration gas is displayed in item #13. Compare the K factors to the listing in Table 1 to determine the target/calibration gas configuration.

1 - The gas type, range of detection and software version number. The menu item appears as: **"LEL 0-100 V6.0"**
2 - The alarm set point level of alarm 1. The menu item appears as: **"ALM1 SET @ 20%"**
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 @ 40%"**
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 - The target gas K factor. The menu item appears as: **"GAS FACTOR #.##"**
13 - The calibration gas K factor. The menu item appears as: **"CAL FACTOR #.##"**
14 - The calibration gas level setting. The menu item appears as: **"CalLevel @ xx%"**
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%"**

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.

### 3.7.2 Changing the Target Gas

To change the target gas setting, select the applicable K factor from Table 1 and follow the instructions below.

a) First, enter the programming menu by holding the programming magnet stationary over "PGM 2" for 30 seconds until the display reads **"VIEW PROG STATUS"**, then withdraw the magnet.

b) Next, scroll to the **"SET GAS FACTOR"** listing and then hold the programming magnet over "PGM 1" for 3 seconds. The menu item appears as **"GAS FACTOR #.##".** 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 K factor. Save value by holding the programming magnet over "PGM1" for 3 seconds.

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.

### 3.7.3 Changing the Calibration Gas

Optimum calibration of the FP-624C sensor requires that the calibration gas be the same as the target gas. However, if the applicable calibration gas is not available, any other gas listed in Table 1 can be used to calibrate the sensor. Note that the K factors are theoretical and calibration with a gas other than the target gas may be subject to error. A calibration gas of 50% LEL in air is required. To change the calibration gas setting, select the applicable K factor from Table 1 and follow the instructions below.

a) First, enter the programming menu by holding the programming magnet stationary over "PGM 2" for 30 seconds until the display reads **"VIEW PROG STATUS"**, then withdraw the magnet.

b) Next, scroll to the **"SET CAL FACTOR"** listing and then hold the programming magnet over "PGM 1" for 3 seconds. The menu item appears as **"CAL FACTOR #.##".** 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 K factor. Save value by holding the programming magnet over "PGM1" for 3 seconds.

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.

## 3.8 Calibration

***Material Requirements***

* Detcon PN 3270 MicroSafe™ Programming Magnet
* Detcon PN 6132 Threaded Calibration Adapter
* Span Gas containing the applicable calibration gas in air (see section 3.7). Span gas concentration is recommended at 50% of range (which is the factory default) at a controlled flow rate of 200 ml/min. Other concentrations can be used as long as they fall within 10% to 90% of range. See section 3.8.2 for details.

### 3.8.1 Calibration Procedure - Zero

NOTE: Before performing a zero calibration, be sure there is no background target gas present.

a) Enter the calibration menu by holding the programming magnet stationary over "PGM 1" (see figure 7) for 3 seconds until the display reads **"1-ZERO 2-SPAN"**, then withdraw the magnet. Note that the "CAL" LED is on.

b) Next, enter the zero menu by holding the magnet stationary over "PGM 1" for 3 seconds until the display reads: **"ZERO 0%"**, then withdraw the magnet. The sensor has now entered the auto zero mode. When it is complete the display will read **"ZERO COMPLETE"** for 5 seconds and then return to the normal operations menu, "**0 % LEL**".

NOTE 1: If the circuitry is unable to adjust the zero to the proper setting the sensor will enter a 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 3.8.3).

NOTE 2: In every instance where a sensor is re-zeroed, the zero error is directly proportional to resulting span error. For example, if a sensor zero error is 2 %, upon completion of auto zero, the resulting span error is 2 %. When this error exceeds 5% of full scale sensitivity, the sensor should be calibrated with span gas.

NOTE 3: When a "cal fault" occurs, the sensor microprocessor retains its previous calibration references. Zero calibration is complete.

### 3.8.2 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 50% LEL. In this instance, a span gas containing a concentration equal to 50% LEL is required. If a span gas containing 50% LEL is not available, other concentrations may be used as long as they fall within 10% to 90% of 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 3.9 and make note of the setting found in listing number 14. The item appears as **"CalLevel @ xx%".**
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 30 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 Gas Factor, Set Cal Factor, and Set Cal Level.
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 @ ##%"**, 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. Save value 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) From the calibration menu **"1-ZERO 2-SPAN"** (section 3.8.1-a) proceed into the span adjust function by holding the programming magnet stationary over "PGM 2" for 3 seconds until the display reads **"APPLY xx% LEL"** then withdraw the programming magnet. The x's here indication the gas concentration requested.
g) Apply the calibration gas at a flow rate of 200 milliliters per minute. As the sensor signal changes, the display will change to **"SPAN XX%"**. The "XX" part of the reading indicates the actual gas reading which will increase until the sensor stabilizes. When the sensor signal is stable it will auto span to the request concentration and the display will change to **"SPAN COMPLETE"** for two seconds and then **"REMOVE GAS"**. Remove the gas. When the signal level has fallen below 10% of full scale, the display will return to the normal operation menu, "**0 % LEL**".

NOTE 1: If the circuitry is unable to adjust the span 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 3.8.3).

NOTE 2: If, after entering the span function, more than one minute elapses before calibration gas is applied, the sensor will enter 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 3.8.3).

Span calibration is complete.

### 3.8.3 *Additional Notes*

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

2. If during calibration the sensor circuitry is unable to attain the proper adjustment for zero or span, the sensor will enter into the calibration fault mode which will activate fault alarm functions (see section 3.11) and cause the display to alternate between the sensor's current status reading and the calibration fault screen which appears as: **"CAL FAULT".** If this occurs you may attempt to recalibrate by entering the calibration menu as described in section 3.8.1-a. If the sensor fails again, defer to technical trouble shooting.

### 3.8.4 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.

## 3.9 Status of Programming, Alarms, Target Gas, Calibration Gas, Calibration Level, RS-485 ID, 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, target and calibration gas settings, calibration gas level setting, RS-485 ID number, and estimated remaining sensor life. The programming menu also allows the changing of target gas and calibration gas settings (see section 3.7), the calibration gas level setting (see section 3.82), and alarm levels (see section 3.10).

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 30 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 Gas Factor, Set Cal Factor, and Set Cal Level.

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: **"LEL 0-100 V6.0"**
2 - The alarm set point level of alarm 1. The menu item appears as: **"ALM1 SET @ 20%"**
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 @ 40%"**
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 - The target gas K factor. The menu item appears as: **"GAS FACTOR #.##"**
13 - The calibration gas K factor. The menu item appears as: **"CAL FACTOR #.##"**
14 - The calibration gas level setting. The menu item appears as: **"CalLevel @ xx%"**
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%"**

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.

## 3.10 Programming Alarms

### 3.10.1 Alarm Levels

Both alarm 1 and alarm 2 levels are factory set prior to shipment. Alarm 1 is set at 20%; alarm 2 at 40%. Both alarms can be set in 1% increments from 10 to 90%. 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 30 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 Gas Factor, Set Cal Factor, 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 @ 20%"**, 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 @ 40%"**, 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.

#### 3.10.2 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.

#### 3.10.3 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 3.5.5-e for details.

### 3.11 Program Features

Model FP-624C MicroSafe™ 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 100% LEL, it will cause the display to flash **"100 % LEL"** on and off.

***Under Range Fault***

If the sensor should drift below a zero baseline of approximately 10% of scale, the display will indicate a fault: **"SIGNAL FAULT"**.

***Open Sensor Bridge Fault***

If either the active or reference side of the catalytic sensor bead should fail and become electrically open, the display will indicate a fault: **"SENSOR FAULT".**

***Sensor Heater Voltage Functions/Fault***

The heater voltage is continuously monitored. The normal heater voltage is 2.7 VDC. If the voltage has drifted from the programmed heater voltage value by more than ±.1V, the display will indicate a fault: **"HEATER FAULT".**

***Calibration Fault***

If during calibration the sensor circuitry is unable to attain the proper adjustment for zero or span, the sensor will enter into the calibration fault mode and cause the display to alternate between the sensor's current status reading and the calibration fault screen which appears as: **"CAL FAULT".**

***Fail-Safe/Fault Supervision***
Model FP-624C MicroSafe™ sensors are programmed for fail-safe operation. Any of the following fault condition will activate the fault relay, illuminate the fault LED, and cause the display to read its corresponding fault condition: **"SENSOR FAULT"**, **"SIGNAL FAULT"**, **"HEATER FAULT"**, or **"CAL FAULT"**. A "Sensor Fault", "Signal Fault", and "Heater Fault", will also cause the mA output to drop to zero (0) mA.

***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.

## 3.12 RS-485 Protocol

Detcon 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 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.

## 3.13 Display Contrast Adjust

Model FP-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.

## 3.14 Trouble Shooting Guide

**Sensor Fault**
1. Open Sensor – broken wire or contact in sensor.
2. Remove replaceable sensor element and check adjacent pin pairs with ohm-meter. Normal reading is 1-4 ohms and failed reading is an open circuit.
3. Replace sensor if verified as Open Sensor.

**Heater Fault**
1. Open sensor or drifted heater voltage setting.
2. Check heater voltage setting and re-adjust to target reading. Unplug/replug transmitter to see if Fault clears.
3. Remove replaceable sensor element and check adjacent pin pairs with ohm-meter. Normal reading is 1-4 ohms and failed reading is an open circuit.
4. Replace sensor if verified as Open Sensor.

**Signal Fault**
1. Zero has drifted too far negative.
2. Re-zero sensor in clean air.

**Poor Sensor Performance (Slow Response, Drifting Sensor)**
1. Check that correct Heater Voltage is applied to your Sensor.

**NOTE:** Detcon has two version sensors: C-Style and the J-Style. Each uses a different heater voltage setting.

The C-Style sensor measures 0.9"across the exposed stainless steel sinter face and has a serial number format C??-###. The C-Style sensor requires 2.7 VDC.

The J-Style sensor measures 0.4"across exposed the stainless steel sinter face and has a serial number format J??-###. The J-Style sensor requires 2.2 VDC.

2. If heater voltage is incorrect, adjust accordingly for the correct sensor type.

**Excessive Span Drift or Slow Response**

1. Check Heater Voltage Setting (should be 2.7V C-Style and 2.2V J-Style) and check heater voltage at the sensor if remote mounted.
2. Verify correct cal gas flow rate and proper use of the cal gas adapter.
3. Check validity of cal gas via the expiration date and use pull tube if necessary.
4. Check for obstructions through stainless steel sinter element (including being wet)
5. Replace plug-in sensor if Sensor Life is < 50%.
6. Check area for presence of sensor poisoning gases such as silicon grease vapors, HMDS, high H2S, chlorine or chlorinated compounds if sensor failures persist.

**Drifting Zero**

1. It may be the correct reading if there are real gas leaks or the sensor was zero calibrated when actual gas was around and subsequently cleared.
2. Check Heater voltage is set correctly for sensor type (check voltage at the sensor if remote mounted).
3. Replace plug-in sensor if Sensor Life is < 50%.
4. If sensor drift is gradual and continuously positive then contact Detcon for sensor replacement.

**Unstable Output/ Sudden Spiking/Nuisance Alarms**

1. Check condulet for accumulated water.
2. Check transmitter and Terminal PCB for abnormal corrosion.
3. Determine if problem correlates with condensation cycles.
4. Add/change Detcon condensation prevention packet PN 960-202200-000 (replace annually).
5. Check for unstable power supply.
6. Check for inadequate grounding.
7. If correlates with radio communications then use Detcon RFI filter accessory.
8. Contact Detcon for assistance in optimizing shielding, grounding, and RFI protection.

**Span Calibration Fault – (Sensitivity, Stability, Clearing)**

To remove any calibration fault repeat calibration process successfully or unplug/replug transmitter.

Sensitivity - Check Heater Voltage Setting (should be 2.7V C-Style and 2.2V J-Style), Check for obstructions through stainless steel sinter element (including being wet), check validity and flow rate of cal gas.

Stability - Check Heater Voltage Setting (should be 2.7V C-Style and 2.2V J–Style), check validity and flow rate of cal gas, Check for obstructions through stainless steel sinter element (including being wet).

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

**Memory or Error Reports**

1. Reinitialize Sensor - Unplug transmitter and 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 display has blue background when hot, 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.

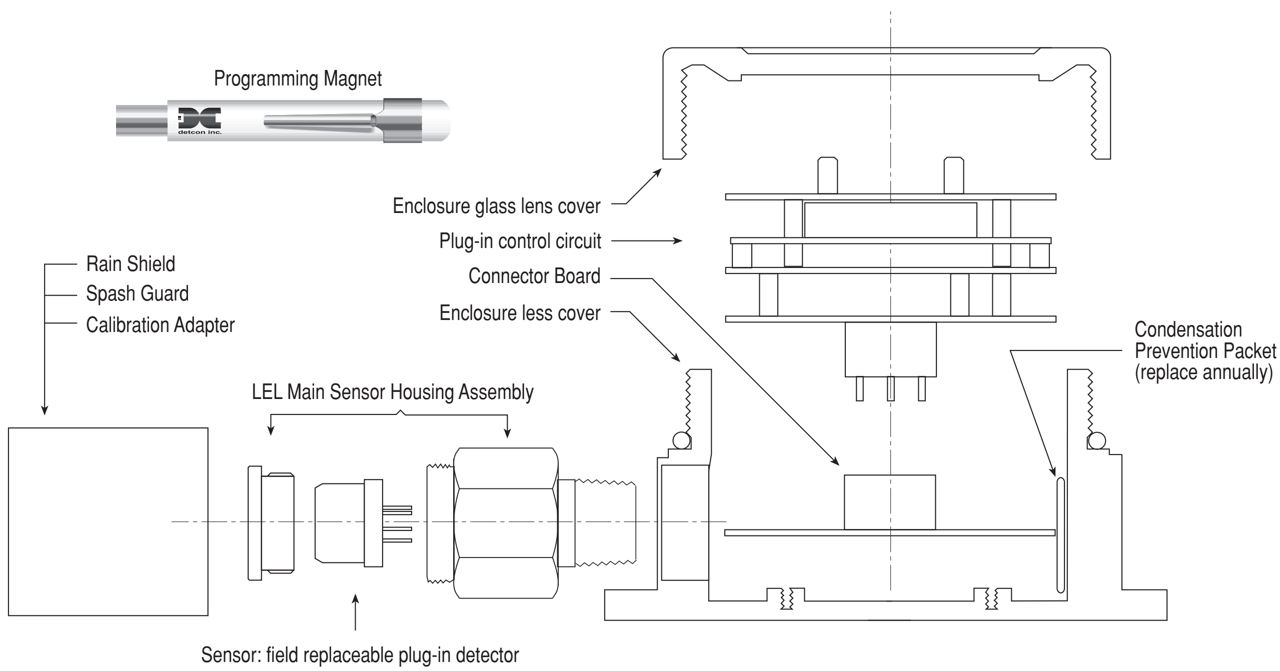
**Bad 4-20 mA Output or RS485 Output**

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

## 3.15 Spare Parts List

| | |
|---|---|
| 613-010000-000 | Sensor rain shield |
| 613-120000-000 | Sensor splash guard |
| 943-000006-132 | Threaded Calibration Adapter |
| 612-820000-000 | LEL sensor housing assembly (plug-in detector, PN370-201600-000, not included) |
| 370-201600-000 | Sensor: field replaceable plug in detector |
| 926-525500-100 | FP-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). |

### Figure #8



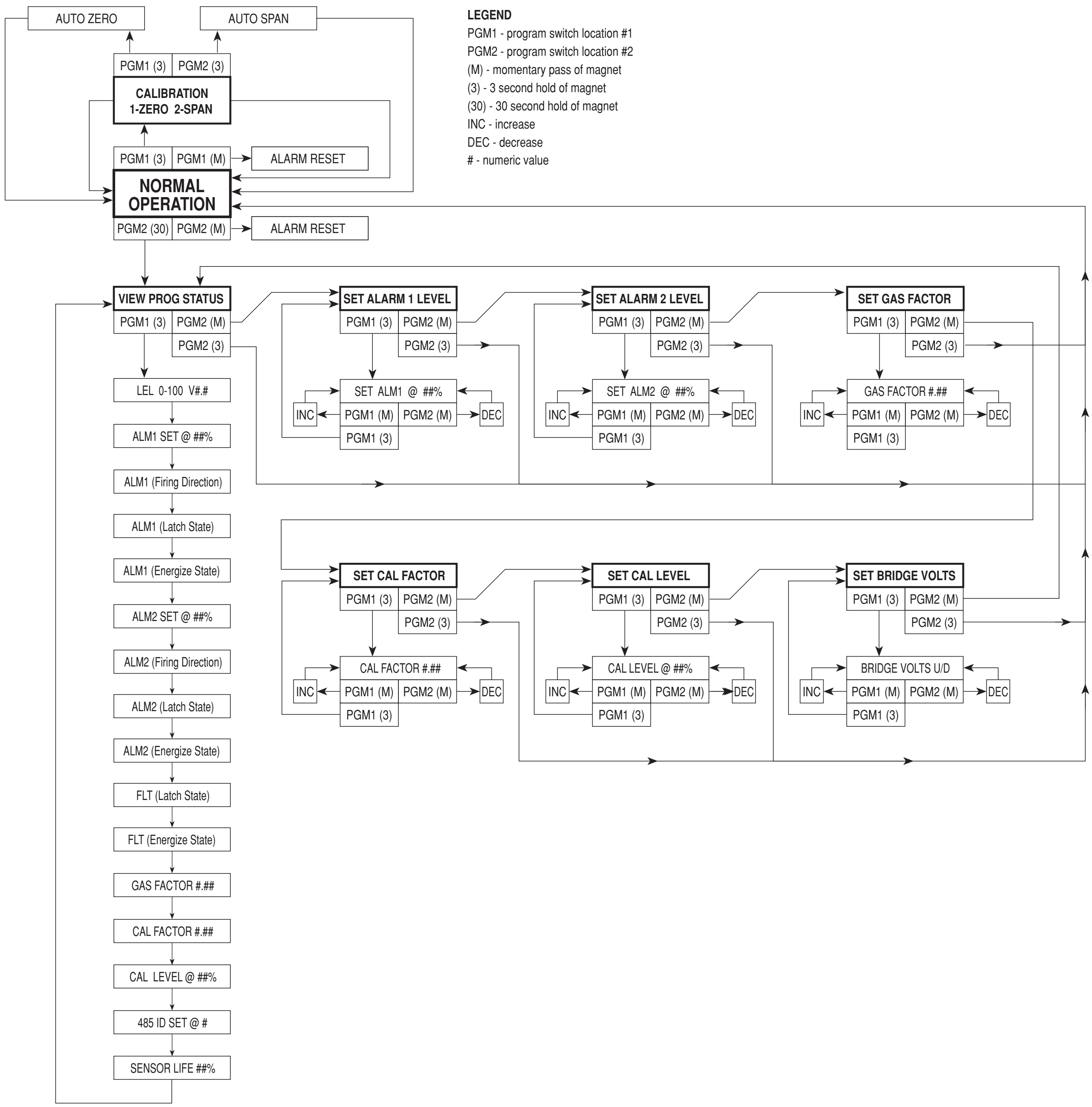

## 3.16 Warranty

Detcon, Inc., as manufacturer, warrants each LEL plug-in sensor element (part no. 370-201600-000), for a two 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.

## 3.17 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.

## 3.18 Software Flow Char




Shipping Address: 3200 A-1 Research Forest Dr., The Woodlands, Texas 7381
Mailing Address: P.O. Box 8067, The Woodlands, Texas 77387-8067
phone 888-367-4286, 281-367-4100 • fax 281-292-2860 • www.detcon.com • sales@detcon.com