



Detcon MicroSafe™

FP-524HT Combustible Gas Sensor (0-100% LEL)

Specialized Version For High Temperature Operation of Sensor Head



Operator's Installation & Instruction Manual

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CAUTION:

Before operating the Model FP-524HT sensor, read this manual thoroughly and verify that the configuration of default factory settings are appropriate and correct for your application.

Table of Contents

- 3.0 Description
- 3.1 Principle of Operation
- 3.2 Application
- 3.3 Specifications
- 3.4 Operating Software
- 3.5 Installation
- 3.6 Start-up
- 3.7 Target Gas and Calibration Gas Selection
- 3.8 Calibration
- 3.9 Status of Programming, Calibration Level, Bridge Voltage, and Sensor Life
- 3.10 Program Features
- 3.11 Display Contrast Adjust
- 3.12 Trouble Shooting Guide
- 3.13 Spare Parts List
- 3.14 Warranty
- 3.15 Service Policy
- 3.16 Software Flow Chart

3.0 DESCRIPTION

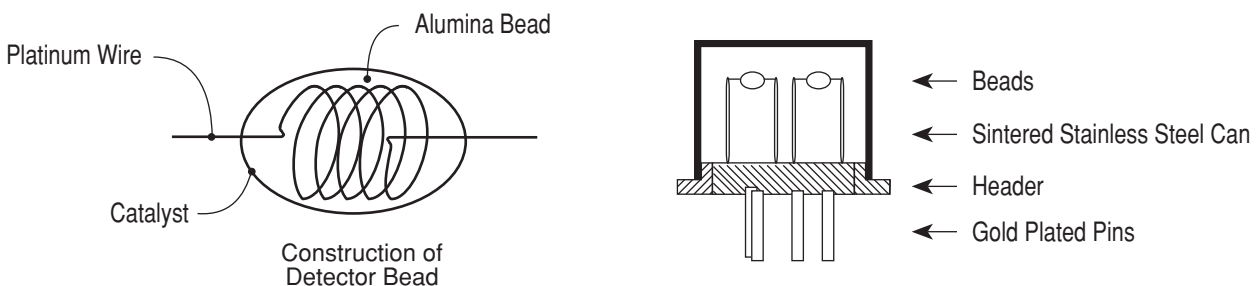
Detcon MicroSafe™ Model FP-524HT, combustible gas sensors are non-intrusive “Smart” sensors designed to detect and monitor combustible gas in air over the range of 0-100% lower explosive limit (LEL), and this model uses a sensor head that is specially rated to operate up to 150°C. One of the primary 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 output is a standard 4-20 mA signal. 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 conduit that includes a glass lens. A 16 character alpha/numeric indicator is used to display sensor readings as well as 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. Refer to section 3.7.1 for a partial list of detectable gases. The technique is referred to as non-selective and may be used for the detection and monitoring of target combustible gases. Model FP-524HT 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.



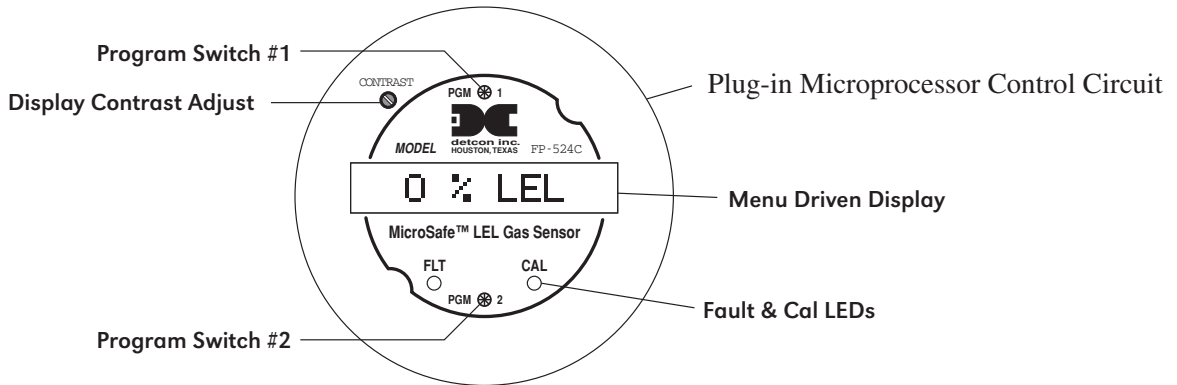
3.0.1 Catalytic Detector

The FP524HT’s catalytic detector is supplied as a matched pair of elements mounted in a special 150°C rated thread-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 porous bead. 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 features gold plated pins and mounts inside a stainless steel sensor housing via a mating gold plated socket.



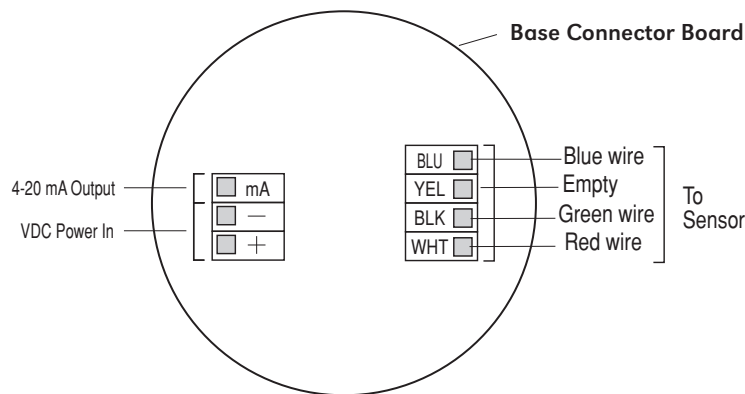
3.0.2 Microprocessor Control Circuit

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, magnetic programming switches, and a linear 4-20 mA DC output.



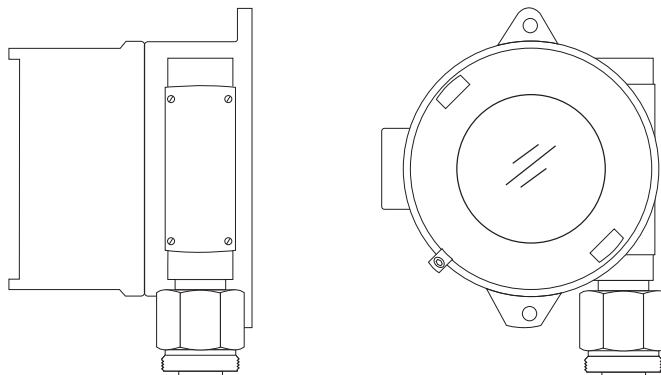
3.0.3 Base Connector Board

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, and lugless terminals for field wiring.



3.0.4 Explosion Proof Enclosure

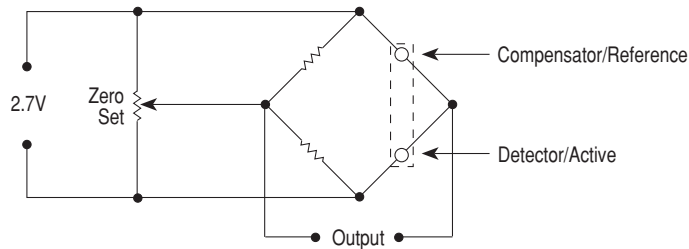
The sensors are packaged in a cast metal explosion proof enclosure. The enclosure is fitted with a threaded cover that has a glass lens window. Magnetic program switches located behind the transmitter module face plate are activated through the lens window via a hand-held magnetic programming tool allowing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

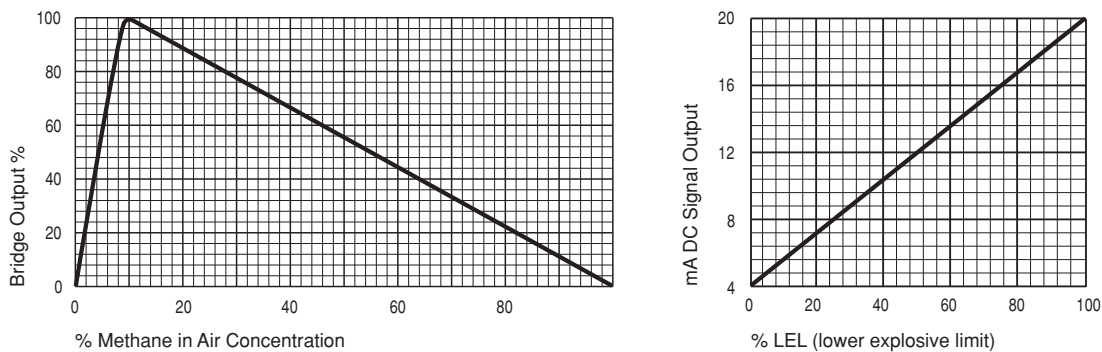
When combustible gas molecules oxidize on the surface of the active detector, heat is generated, effectively changing the electrical conductance of the active detector. Electronically, the detectors form part of a balanced bridge circuit. As the active detector changes in electrical conductance, the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



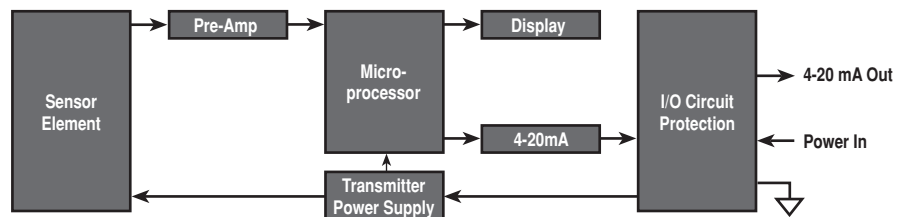
3.1.2 Characteristics

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. 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-524HT 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 for transmitter electronics is -40° to +175° F; -40° to +75°C . Operating temperature range for Sensor Head of this HT version is 40° to +302° F; -40° to +150°C. It is expected that anyone purchasing this unit will be remote mounting the HT Sensor Head from transmitter and placing sensor in a very high temperature location. 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 4-6 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 virtually any combustible gas. 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 from other gases. The Model FP-524HT 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-524HT 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

Measurement 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 (Transmitter electronics)

-40° to +302° F; -40° to +150°C (Special HT Sensor Head)

Operating Humidity Range

0-99% non-condensing

Output

Linear 4-20 mA DC

Input Voltage

11.5-28 VDC

Power Consumption

1.9 watts @ 24V

Electrical Classification

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

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 (reference figure 6). 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) Target gas selection (gas K factor)
 - c) Calibration gas selection (cal K factor)
 - d) Calibration Level
 - e) 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 selection of the target gas K factor, the selection of the calibration gas K factor, the selection of the calibration gas level setting, and the selection of the bridge voltage 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 V#.#”**
- * 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%”**
- * Sensor bridge voltage. The menu item appears as: **“BRIDGE @ #.## VDC”**
- * The estimated remaining sensor life. The menu item appears as: **“SENSOR LIFE 100%”**

3.4.3.2 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”**

3.4.3.3 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”**

3.4.3.4 Calibration Level Adjustment

The Calibration level is adjustable from 10% to 90% LEL. The menu item appears as: **“CalLevel @ ##%”**
Factory default setting is 50%.

3.4.3.5 Set Bridge Volts

The bridge voltage is adjustable from 1.80 to 3.10 VDC. The menu item appears as: **“BRIDGE @ #.## VDC”**

The factory default setting is 2.70 VDC.

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-524HT 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.

<u>AWG</u>	<u>Meters</u>	<u>Feet</u>
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:

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

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 prox-

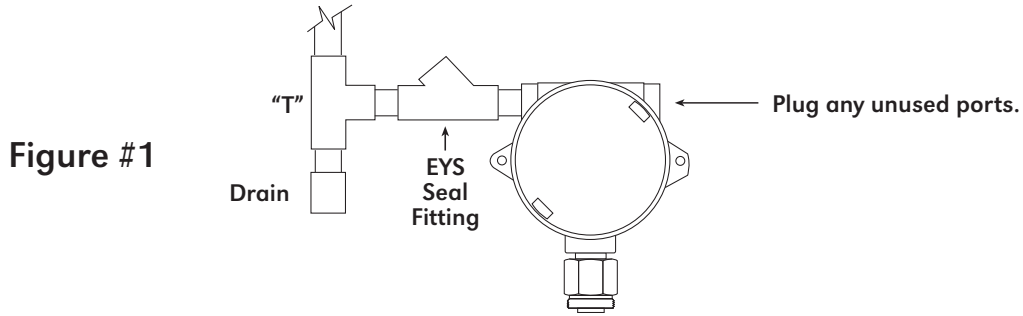


Figure #1

imity 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 premature sensor damage.

3.5.4 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.

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.

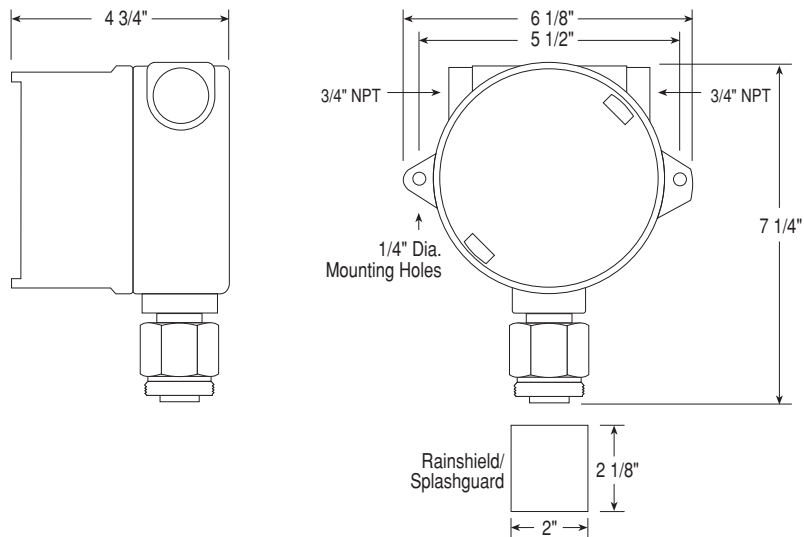


Figure #2

3.5.4 Installation Procedure

- Remove the junction box cover and un-plug the control circuit by grasping the two thumb screws and pulling outward.
- Securely mount the sensor junction box in accordance with recommended practice. See dimensional drawing (Fig. 2).
- Observing correct polarity, terminate 3 conductor field wiring to the sensor base connector board in accordance with the detail shown in Figure 3.
- Use a 3/4 NPT plug to block the unused port.
- Replace the plug-in transmitter circuit and replace the junction box cover.

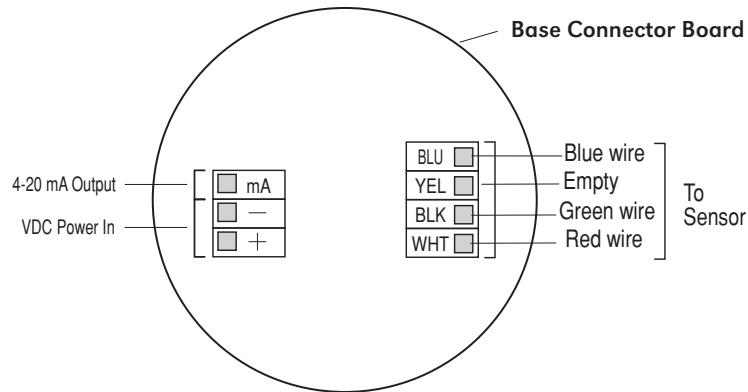
3.5.5 Remote Mounting Applications

Some sensor mounting applications require that the gas sensor head, such as the HT Sensor head to 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.

There is a limit 0.5 ohm maximum resistance drop per wire over the separation distance.

<u>AWG</u>	<u>Maximum Separation (feet)</u>
20	50
18	75
16	125
14	175

Figure #3

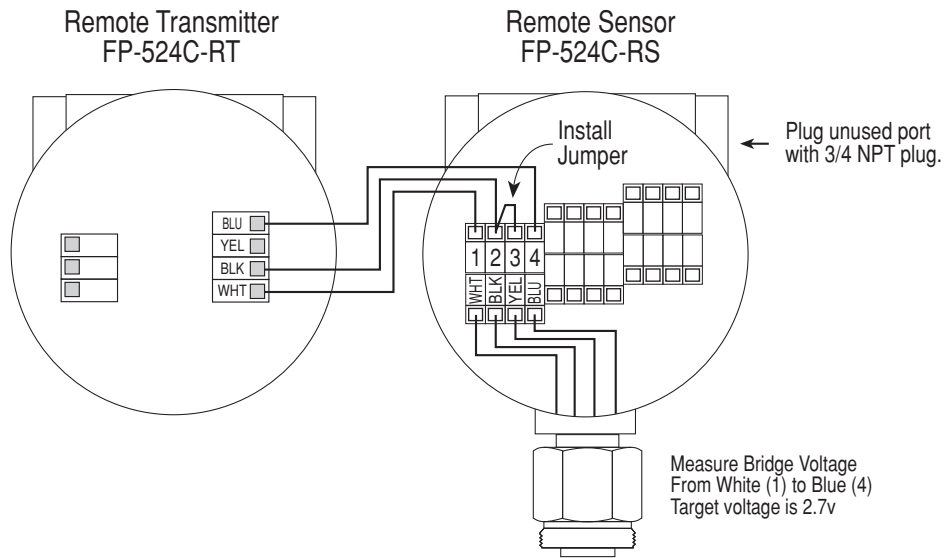


Reference figure 4 for wiring diagram. Also note the jumper that is required on the remote sensor connector board. Failure to install this jumper will cause a sensor fault condition.

Remote Mounting Configuration - Bridge Voltage Adjustment

When a sensor is remote mounted, 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 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 3.6.2 for instructions.

Figure #4



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-524HT “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: If the display contrast needs adjustment, refer to section 3.11.

Note 2: 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 Initial Operational Tests

After a warm up period of approximately 15 minutes, the sensor should be checked to verify sensitivity to combustible gas.

Material Requirements

- * Detcon PN 612-0100000-700 Splashguard with Cal Port
- * Detcon PN 600-003427-000 FP-High Temp Splashguard 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**”.

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.

3.6.2 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. Follow the steps below to set the sensor bridge 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 4).
- 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 4. Target voltage is 2.7 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 @ #.## VDC**”.
- f) Use the programming magnet to make an adjustment to “PGM 1” to increase or “PGM 2” to decrease the bridge voltage. Set the voltage to 2.7 VDC.
- 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.

Bridge 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

Magnetic Programming Tool



Figure #5

cover, thereby eliminating the need for area de-classification or the use of hot permits.

A magnetic programming tool (see figure 5) 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 con-

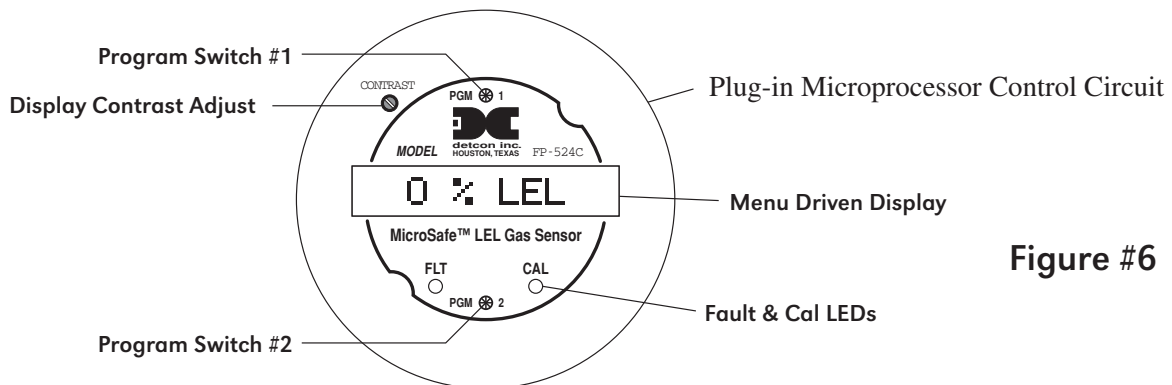


Figure #6

tact is used to make adjustments. The location of “PGM 1” and “PGM 2” are shown in 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.

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-524HT 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-524HT 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 from other gases.

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 Oxsulphide	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 Oxsulphide	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

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

- 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 Gas Factor (target gas), Set Cal Factor (calibration gas), Set Cal Level, and Set Bridge Voltage.
- 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 #2 and the “K factor” for the calibration gas is displayed in item #3. 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 target gas K factor. The menu item appears as: “**GAS FACTOR #.##**”
 - 3 - The calibration gas K factor. The menu item appears as: “**CAL FACTOR #.##**”
 - 4 - The calibration gas level setting. The menu item appears as: “**CalLevel @ xx%**”
 - 5 - Sensor bridge voltage. The menu item appears as: “**BRIDGE @ #.## VDC**”
 - 6 - 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-524HT 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 612-0100000-700 Splashguard with Cal Port
- * Detcon PN 600-003427-000 FP-High Temp Splashguard 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 combustible gas present or be prepared to apply a zero gas standard.

- 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: When a “cal fault” occurs, the sensor microprocessor retains its previous calibration references but the 4-20 mA signal drops to 0 mA until the Fault is corrected.

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 4. 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, Set Cal Level, and Set Bridge Voltage.
- 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 indicate 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 causing the display to alternate between the sensor’s current status reading and the calibration fault screen which appears as: “**CAL FAULT**”. During “Cal Fault” the Fault LED will light and the 4-20 mA signal is taken to 0 mA until the Fault is corrected by re-calibration. 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, TARGET GAS, CALIBRATION GAS, CALIBRATION LEVEL, SENSOR LIFE, AND BRIDGE VOLTAGE

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 target and calibration gas settings, calibration gas level setting, bridge voltage, 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 3.8.2), and bridge voltage setting (see section 3.6.2).

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 Gas Factor, Set Cal Factor, Set Cal Level, and Set Bridge Voltage.
- 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 target gas K factor. The menu item appears as: “**GAS FACTOR #.##**”
 - 3 - The calibration gas K factor. The menu item appears as: “**CAL FACTOR #.##**”
 - 4 - The calibration gas level setting. The menu item appears as: “**CalLevel @ xx%**”
 - 5 - Sensor bridge voltage. The menu item appears as: “**BRIDGE @ #.## VDC**”
 - 6 - 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 PROGRAM FEATURES

Model FP-524HT 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 zero base line should drift to below a -10% LEL, 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. Normal heater voltage is 2.7 VDC. If the voltage has drifted from the programmed heater voltage value by more than $\pm 1V$, 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**”. The Fault LED will light and the 4-20 mA signal is

dropped to 0 mA until the Fault is corrected.

Fail-Safe/Fault Supervision

Model FP-524HT MicroSafe™ sensors are programmed for fail-safe operation. Any of the following fault condition will 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”, “Cal 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.

3.11 DISPLAY CONTRAST ADJUST

Model FP-524HT 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 6 for location.

3.12 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

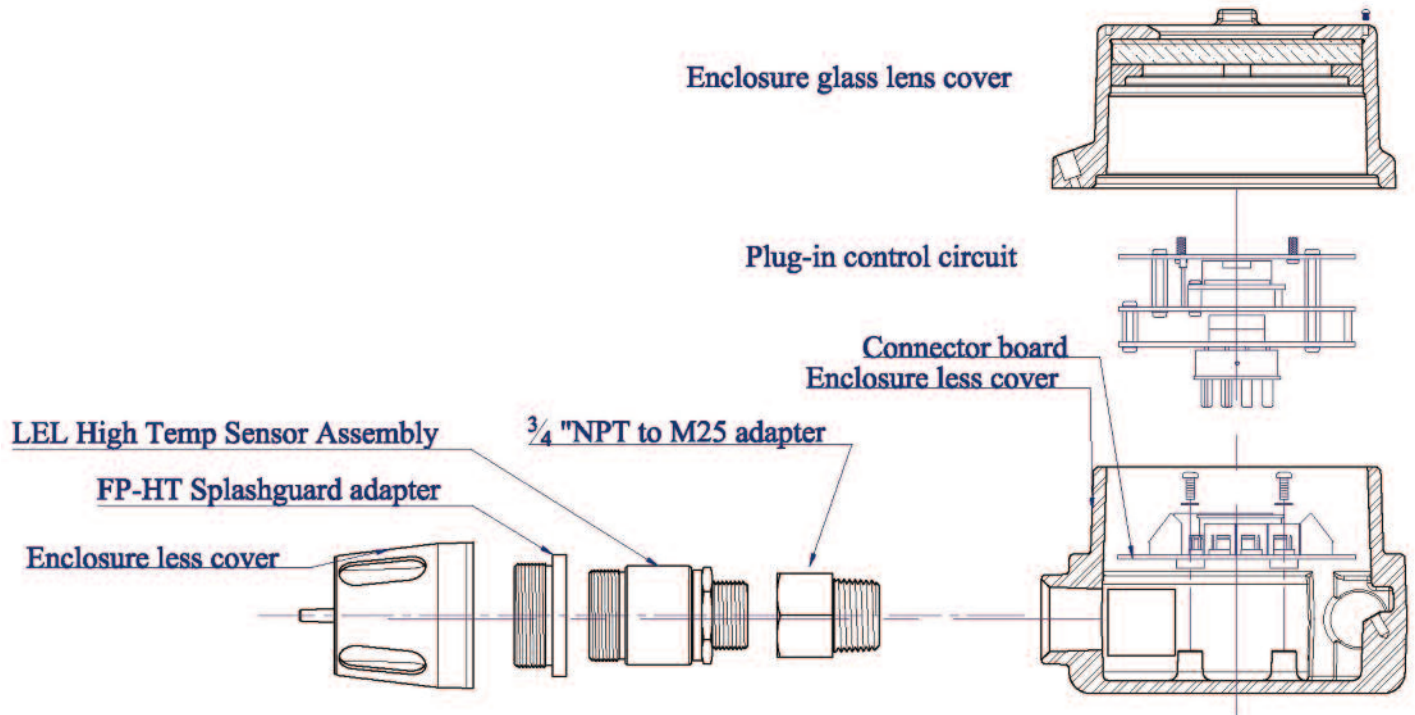
1. Verify condulet has no accumulated water or abnormal corrosion.
2. Verify required DC power is applied to correct terminals.
3. Swap with a known-good transmitter to determine if transmitter is faulty.

Bad 4-20 mA Output

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

3.13 SPARE PARTS LIST

613-120000-700	Splashguard with Cal Port
600-003427-000	FP-High Temp Splashguard Adapter
365-037020-16H	FP-HT Sensor Assembly
899-075M25-000	3/4 to M25 Adapter (used with P/N365-037020-16H to install in conduit)
925-525400-100	FP-524C Plug-in control circuit
500-005065-007	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).



3.14 WARRANTY

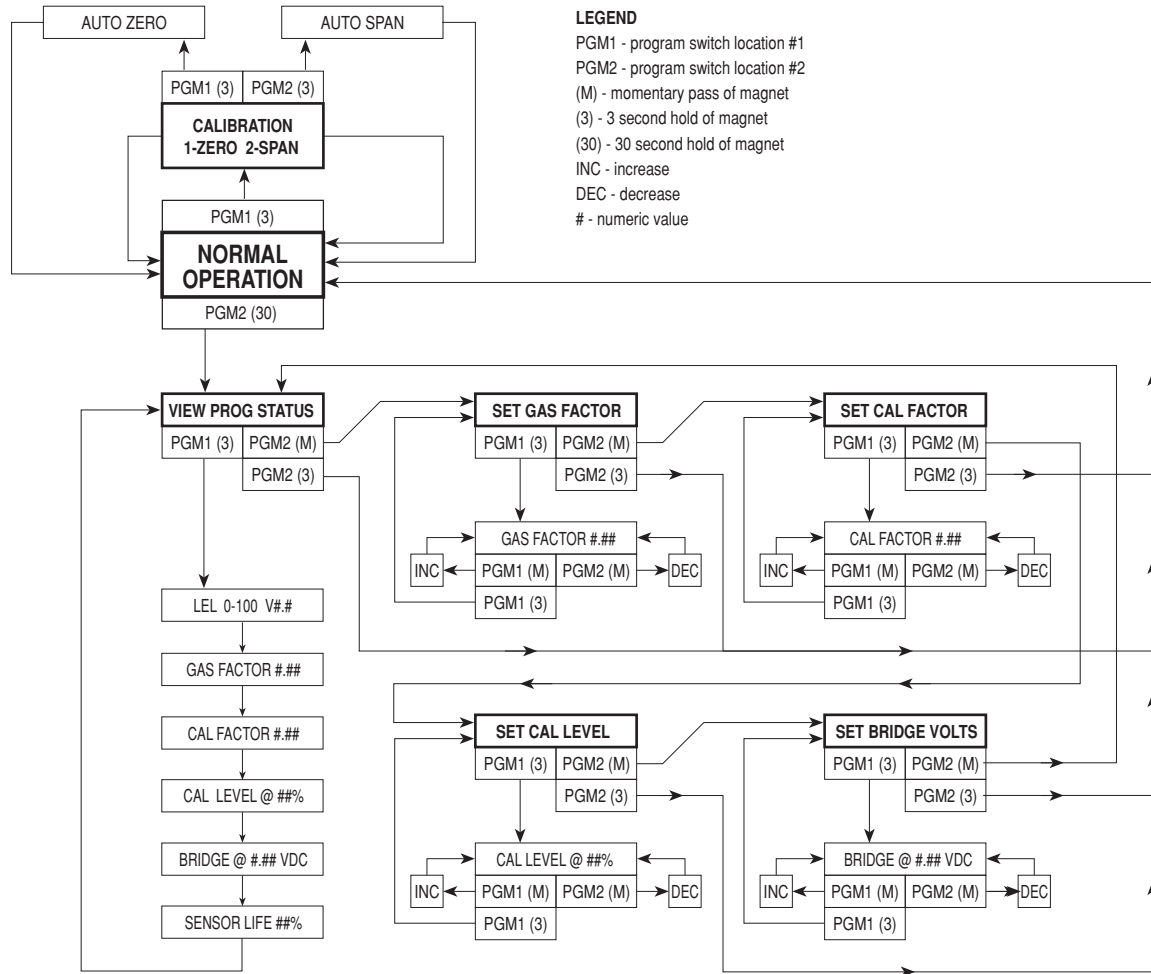
Detcon, Inc., as manufacturer, warrants each LEL High Temp Sensor Assembly (part no. 365-037020-16H), for a two year period under the conditions described as follows: The warranty period begins on the date of shipment to the original purchaser and ends two years thereafter. The sensor element is warranted 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.

3.15 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 \$55.00. 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.

3.16 SOFTWARE FLOW CHART



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