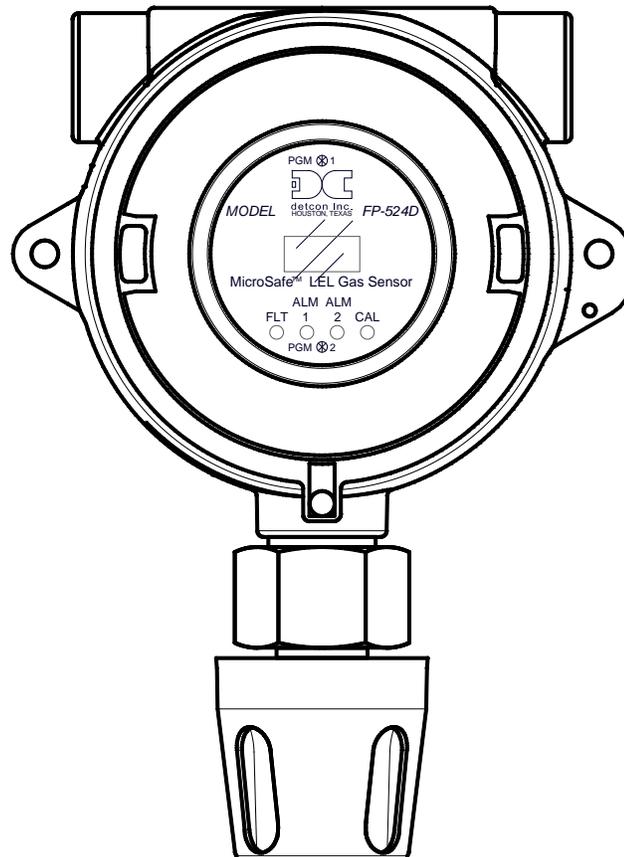


# INSTRUCTION MANUAL

## Detcon Model FP-524D-HRT



### FP-524D-HRT Combustible Gas Sensor (0 – 100% LEL) with HRT Bridge



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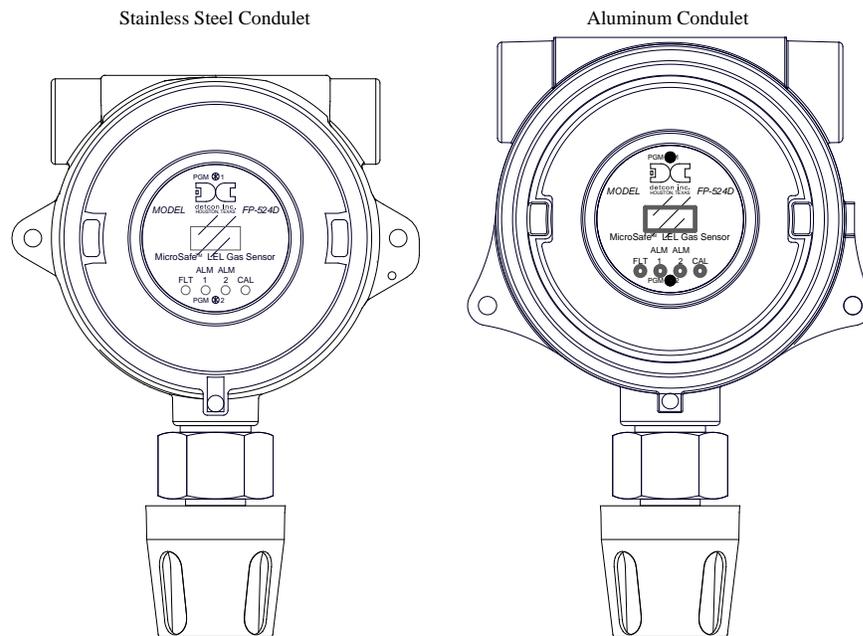
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# 1. Introduction

## 1.1 Description

Detcon Model FP-524D-HRT LEL Combustible sensors are non-intrusive “Smart” sensors designed to detect and monitor combustible gases in air. Range of detection is 0-100% LEL (Lower Explosive Limit). The sensor features an LED display of current reading, fault, and calibration status. The Sensor is equipped with a HRT Bridge Interface, analog 4-20mA output. The HRT Bridge interface provides bi-directional digital communication with HART®-enabled devices. A primary feature of the sensor is its method of automatic calibration, which guides the user through each step via fully scripted instructions displayed on the LED display.

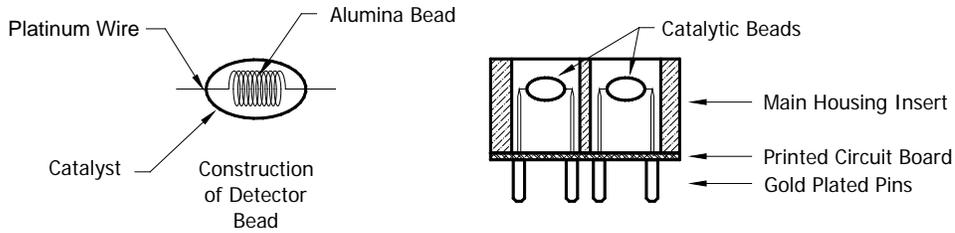
The microprocessor-supervised electronics are packaged as a plug-in replaceable Transmitter Module that is housed in an explosion proof junction box. The Transmitter Module includes a four character alpha/numeric LED used to display sensor readings, and the sensor’s menu driven features when the hand-held programming magnet is used.



**Figure 1 Sensor Assembly Front View**

### Catalytic Bead (Pellistor) Sensor Technology

The sensor technology is a poison-resistant catalytic bead type. Catalytic bead sensors show a strong response to a long list of combustible gases. The sensor is supplied as a matched-pair of detector elements mounted in a plug-in replaceable module. One bead is a catalytically active detector and the other is a non-active reference detector. Each detector consists of a fine platinum wire coil embedded in aluminum oxide. A catalytic mixture is applied to the active detector while the reference detector is treated so that oxidation of the gas does not occur. This technique is referred to as non-selective and may be used to monitor most any combustible gas. Detcon catalytic bead sensors are specifically designed to be resistant to poisons such as sulfides, chlorides, and silicones. The sensors are characteristically stable and capable of providing reliable performance for periods exceeding 5 years in most industrial environments.

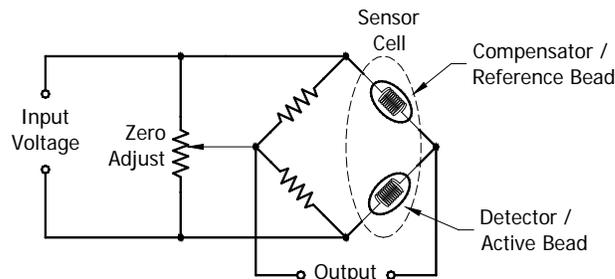


**Figure 2 Sensor Cell Construction**

### Principle of Operation

Method of detection is by diffusion/adsorption. Air and combustible gases pass through a sintered stainless steel filter and contact the heated surface of both the active and reference detectors. The surface of the active detector promotes oxidation of the combustible gas molecules while the reference detector has been treated not to support this oxidation. The reference detector serves as a means to maintain zero stability over a wide range of temperature and humidity.

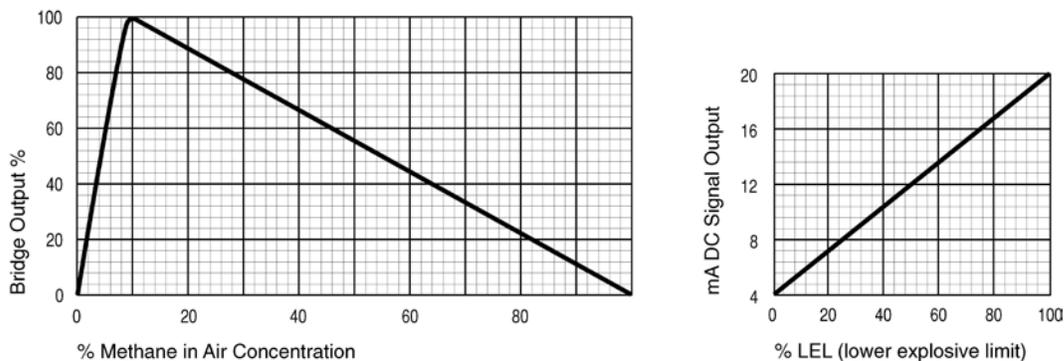
When combustible gas molecules oxidize on the surface of the active detector, heat is generated, and the resistance of the detector changes. Electronically, the detectors form part of a balanced bridge circuit. As the active detector changes in resistance, the bridge circuit unbalances. This change in output is conditioned by the amplifier circuitry, which is an integral part of the sensor design. The response and clearing characteristics of the sensor are rapid and provide for the continuous and accurate monitoring of ambient air conditions.



**Figure 3 Wheatstone Bridge**

### Performance Characteristics

The detector elements maintain good sensitivity to combustible gas concentrations in the Lower Explosive Limit (LEL) range, as shown in the response curves in Figure 4. However, for gas concentrations significantly above the LEL range (100% LEL = 5% by volume Methane), the bridge output begins to decrease. Ambiguous readings above the LEL range dictate that alarm control logic be of the latching type, wherein alarms are held in the “ON” position until reset by operations personnel.



**Figure 4 Response Curves**

## 1.2 Modular Mechanical Design

The Model FP-524D-HRT Sensor Assembly is completely modular and is made up of four parts:

- 1) FP-524D with HRT Bridge Plug-in Transmitter
- 2) Field Replaceable Combustible Gas Sensor
- 3) Connector PCB
- 4) Splash Guard.

### FP-524D-HRT Plug-in Transmitter

The Plug-in Transmitter Module is a microprocessor-based package that plugs into the connector board located in the explosion proof junction box. Circuit functions include extensive I/O circuit protection, sensor pre-amplifier, sensor temperature control, on-board power supplies, microprocessor, LED display, magnetic programming switches, and a linear 4-20mA DC output with HART. Magnetic program switches located on either side of the LED Display are activated via a hand-held magnetic programming tool, thus allowing non-intrusive operator interface with the Transmitter Module. Calibration can be accomplished without declassifying the area. Electrical classifications are Class I, Division 1, Groups B C D.

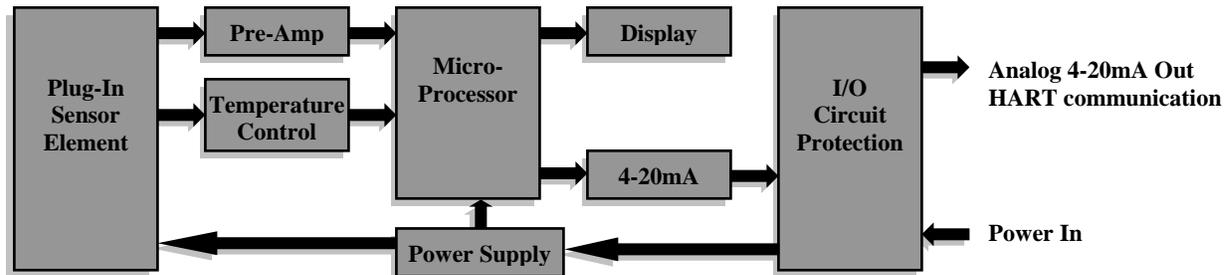


Figure 5 Circuit Functional Block Diagram

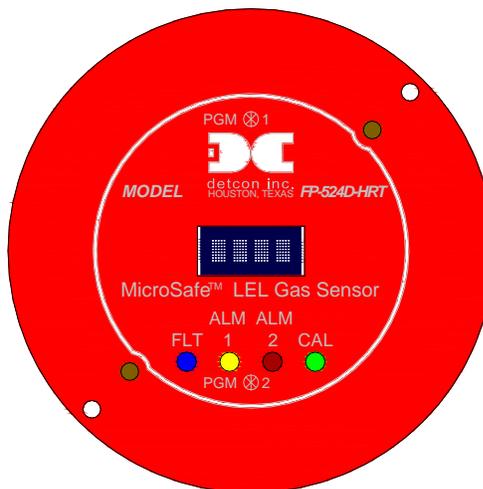
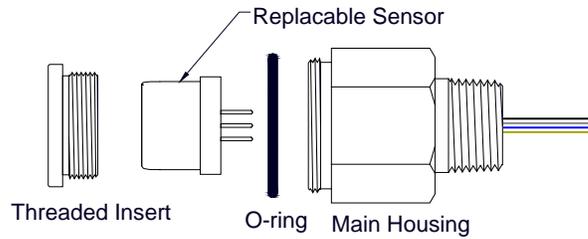


Figure 6 FP-524D-HRT Transmitter Module

### Field Replaceable Sensor

The Detcon combustible gas sensor is a field proven, replaceable type sensor. It can be accessed and replaced in the field by unthreading the lower half of the sensor housing. The cell can then be unplugged and replaced. The Detcon combustible gas sensor has an infinite shelf life and is supported by a 2 year warranty.

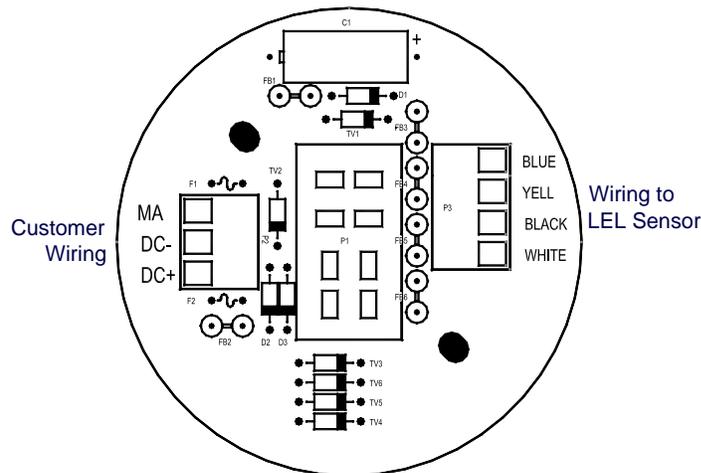


**Figure 7 LEL Sensor Housing with replaceable Sensor**

NOTE: The Field Replaceable Combustible Gas Sensor housing is constructed from 316 Stainless Steel in order to maximize corrosion resistance in harsh environments.

**Base Connector PCB**

The base connector board is mounted in the Junction Box. The connector board includes lug-less terminal connections for incoming power and MA output / HART Interface, and connections for the Combustible Gas Replaceable Sensor.



**Figure 8 Base Connector Board**

## 2. Installation

### 2.1 Operational Guidelines for Safe Use

1. Install sensor only in areas with classifications matching with those described on the approval label. Follow all warnings listed on the label.
2. Ensure that the sensor is properly mounted in a vertical orientation with sensor facing down. Avoid use of Teflon Tape, or any type of non-conductive pipe thread coating on the NPT threaded connection.
3. Use ¾" NPT plugs properly rated for hazardous locations to block any unused connections
4. Removal of the Junction box cover or threaded sensor housing (612-820000-000) violates the Ex d protection method and hence power must be removed from the sensor prior its safe removal.
5. Ensure that the housing bottom and plug-in sensor are installed during operation. The housing bottom should be threaded tightly to the sensor housing. Removal of the housing bottom violates the Ex d protection method and hence power must be removed from the sensor prior to its safe removal.
6. Proper precautions should be taken during installation and maintenance to avoid the build-up of static charge on the plastic splashguard of the sensor.
7. Do not operate the sensor outside of the stated operating temperature limits.
8. Do not operate the sensor outside the stated operating limits for voltage supply.

### 2.2 Sensor Placement

Selection of sensor location is critical to the overall safe performance of the product. Six 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
- (6) Additional Placement Considerations

#### 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.

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**NOTE:** Methane and Hydrogen are lighter than air. Most other combustible gases are heavier than air. Compare the molecular weight, density, or specific gravity of the target gas(es) with that of air to determine appropriate placement.

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## Leak Sources

The 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 approach to selecting sensor location is combining leak source and perimeter protection in the best possible configuration.

## Maintenance Access

Consideration should be given to providing easy access for maintenance personnel. Consideration should also be given to the consequences of close proximity to contaminants that may foul the sensor prematurely.

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**NOTE:** In all installations the gas sensor should point straight down (refer to Figure 10). Improper sensor orientation may result in false readings and permanent sensor damage.

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## Additional Placement Considerations

The sensor should not be positioned where it may be sprayed or coated with surface contaminating substances. Painting sensor assemblies is prohibited.

Although the sensor is designed to be RFI resistant, it should not be mounted in close proximity to high-powered radio transmitters or similar RFI generating equipment.

When possible mount in an area void of high wind, accumulating dust, rain, or splashing from hose spray, direct steam releases, and continuous vibration. If the sensor cannot be mounted away from these conditions then make sure the Detcon Harsh Location Dust Guard accessory is used.

Do not mount in locations where temperatures will exceed the operating temperature limits of the sensor. Where direct sunlight leads to exceeding the high temperature-operating limit, use a sunshade to help reduce temperature.

## 2.3 Sensor Contaminants and Interference

Detcon combustible gas sensors may be adversely affected by exposure to certain airborne substances. Loss of sensitivity or corrosion may be gradual if such materials are present in sufficient concentrations.

The performance of the detector elements may be temporarily impaired during operation in the presence of substances described as inhibitors. Inhibitors are usually volatile substances containing halogen compounds. Inhibitors include halide compounds such as Cl<sub>2</sub>, ClO<sub>2</sub>, F<sub>2</sub>, HF, HCl, Br<sub>2</sub>, vinyl chloride, and methyl chloride. Inhibition is typically a temporary effect and the detectors generally recover after short periods of operation back in clean air.

Some background gases may act as poisoning agents and have a more damaging effect on the sensor. Although the sensor is designed to be poison resistant, it does have physical limits. Poisoning gases deactivate

the active detector's catalytic ability and cause a permanent reduction in the span sensitivity. Examples of typical poisons are: silicone oils and greases, siloxanes (HMDS), H<sub>2</sub>S, anti-knock petrol additives, and phosphate esters. Activated carbon filters can be used to provide additional protection from poisoning in most cases.

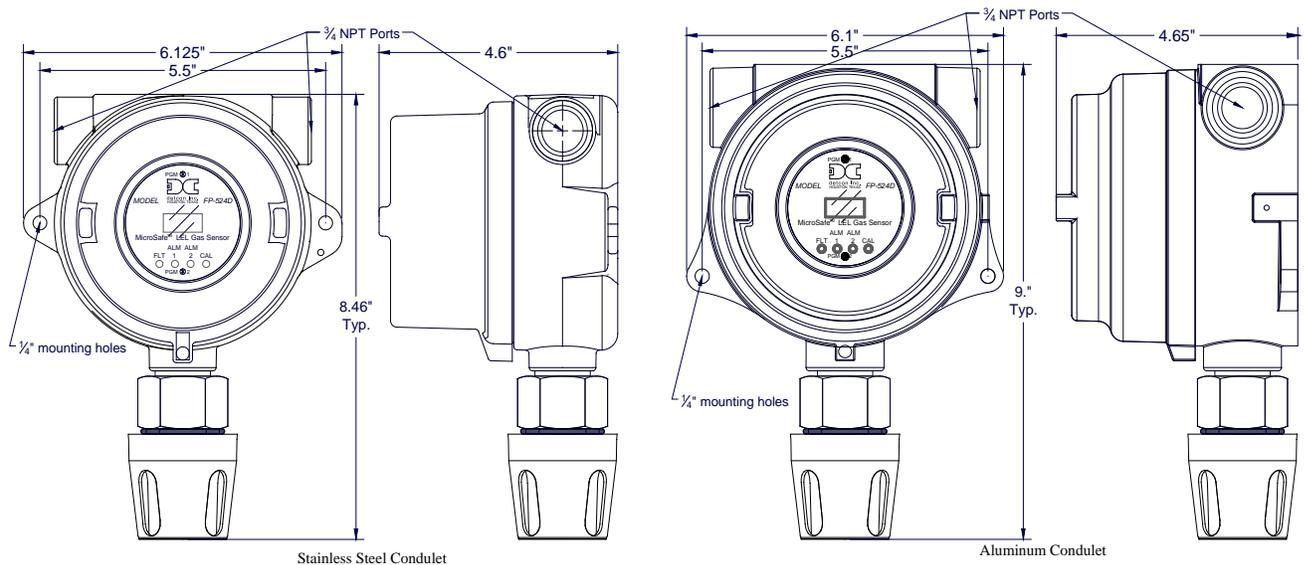
The presence of such inhibitors and poisons in an area does not preclude the use of this sensor technology, although it is likely that the sensor lifetime will be shorter as a result. Use of this sensor in these environments may require more frequent calibration checks to ensure safe system performance.

## 2.4 Mounting Installation

The FP-524D-HRT should be vertically oriented so that the sensor points straight downward. The explosion-proof enclosure or junction box would then typically be mounted on a wall or pole (See Figure 9). Detcon provides a selection of standard junction boxes in both Aluminum and Stainless Steel.

**NOTE:** Do not use Teflon Tape or any other type of Pipe Thread material on the 3/4" threads unless the unit is mounted in a severe or harsh environment. Metal-on-metal contact must be maintained to provide a solid electrical ground path. If Teflon Tape is used the Sensor *must* be externally grounded using a ground strap.

When mounting on a pole, secure the Junction Box to a suitable mounting plate and attach the mounting plate to the pole using U-Bolts. (Pole-Mounting brackets for Detcon Junction Box's are available separately.)



**Figure 9 Typical Outline and Mounting Dimensions**

## 2.5 Electrical Installation

The Sensor Assembly should be installed in accordance with local electrical codes. The sensor assemblies are CSA/NRTL approved (US and Canada) for Class I, Division 1, Groups B, C, & D area classifications.

Proper electrical installation of the gas sensor is critical for conformance to Electrical Codes and to avoid damage due to water leakage. Refer to Figure 10 and Figure 11 for proper electrical installation.

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**NOTE:** If a conduit run exits the secondary port, repeat the installation technique shown in Figure 10.

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In Figure 10, the drain allows H<sub>2</sub>O condensation inside the conduit run to safely drain away from the sensor assembly. The electrical seal fitting is required to meet the National Electrical Code per NEC Article 500-3d (or Canadian Electrical Code Handbook Part 1 Section 18-154). Requirements for locations of electrical seals are covered under NEC Article 501-5. Electrical seals also act as a secondary seal to prevent water from entering the wiring terminal enclosure. However, they are not designed to provide an absolute watertight seal, especially when used in the vertical orientation.

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**NOTE:** For products utilizing the aluminum junction box option, the conduit seal shall be placed at the entry to the junction box (see figure 10 as an example). For products utilizing the stainless steel junction box option, the conduit seal shall be placed within 18" of the enclosure. Crouse Hinds type EYS2, EYD2 or equivalent are suitable for this purpose.

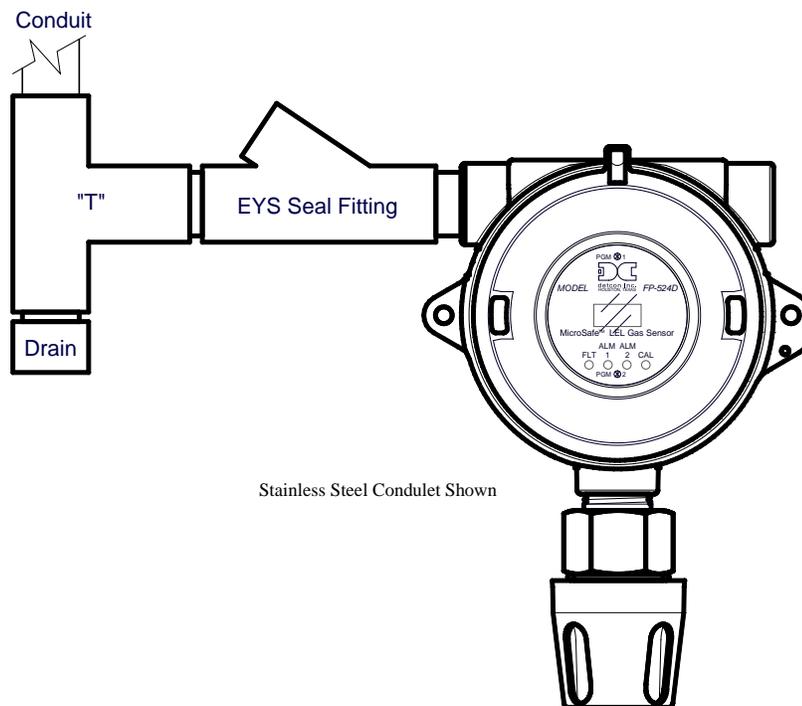
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**NOTE:** The Detcon Warranty does not cover water damage resulting from water leaking into the enclosure.

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**Figure 10 Typical Installation**

**NOTE:** Any unused ports should be blocked with suitable 3/4" male NPT plugs. Detcon supplies one 3/4" NPT male plug with each J-box enclosure. If connections are other than 3/4" NPT, use an appropriate male plug of like construction material.

## 2.6 Field Wiring

Detcon Model FP-524D-HRT combustible gas sensor assemblies require three conductor connections between power supplies and host electronic controller's 4-20mA / HART interface. A 250 ohm load resistor is needed on the 4-20 mA line when it is not being used. Wiring designations are DC+, DC-, and MA (sensor signal). The maximum wire length between sensor and 24VDC source is shown in the Table below. The maximum wire size for termination in the Junction Box is 14 AWG.

**Table 1 Wire Gauge vs. Distance**

AWG	Wire Dia.	Meters	Feet	Over-Current Protection
22	0.723mm	700	2080	3A
20	0.812mm	1120	3350	5A
18	1.024mm	1750	5250	7A
16	1.291mm	2800	8400	10A
14	1.628mm	4480	13,440	20A

**NOTE 1:** Wiring table is based on stranded tinned copper wire and is designed to serve as a reference only.

**NOTE 2:** Shielded cable is required for installations where cable trays or conduit runs include high voltage lines or other possible sources of induced interference. Separate conduit runs are highly recommended in these cases.

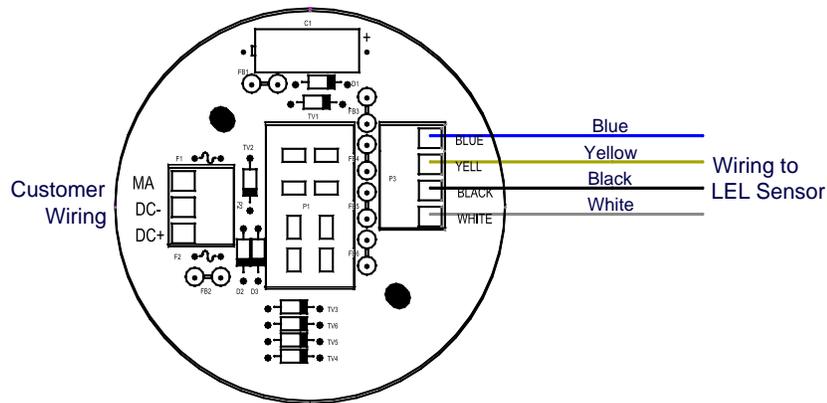
**NOTE 3:** The supply of power should be from an isolated source with over-current protection as stipulated in table.

**NOTE 4:** A 250 ohm load resistor is needed on the 4-20 mA line when it is not being used.

### Terminal Connections



**CAUTION:** Do not apply system power to the sensor until all wiring is properly terminated. Refer to Section 2.7 Initial Start Up.



**Figure 11 Sensor Connector PCB**

- Remove the junction box cover and unplug the Transmitter Module. Identify the terminal blocks for customer wire connections.
- Observing correct polarity, terminate the 3-conductor 4-20mA field wiring (DC+, DC-, and MA) to the sensor assembly wiring in accordance with the detail shown in Figure 11.
- Trim all exposed wire leads if they are not permanently landed in the terminal block.
- Plug the Transmitter Module into the connector PCB and replace the junction box cover.

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**NOTE:** A 6-32 or 8-32 threaded exterior ground point is provided on most junction boxes for an external ground. If the Sensor Assembly is not mechanically grounded, an external ground strap *must* be used to ensure that the sensor is electrically grounded.

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## 2.7 Initial Start Up

Upon completion of all mechanical mounting and termination of all field wiring, apply system power in the range of 12-28VDC (24VDC typical) and observe the following normal conditions:

- FP-524D-HRT display reads “0”, and no fault messages are flashing.
- A temporary upscale reading may occur as the sensor heats up. This upscale reading will decrease to “0” % within 1-2 minutes of power-up, assuming there is no gas in the area of the sensor.

---

**NOTE:** The 4-20mA signal is held constant at 4mA for the first two minutes after power up.

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### Initial Operational Tests

After a warm up period of 1 hour, the sensor should be checked to verify sensitivity to combustible gas.

### Material Requirements

- Detcon PN 600-610000-000 Splash Guard with integral Cal Port -OR-
- Detcon PN 943-000006-038 Threaded Calibration Adapter
- Detcon PN 942-520124-050 Span Gas; 50% LEL methane/balance Air at fixed flow rate of 200-500cc/min.

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**NOTE:** Do not use calibration gases in Nitrogen background gas mixtures. This will cause

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significant reading inaccuracies.

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- a) Attach the calibration adapter to the threaded sensor housing. Apply the test gas at a controlled flow rate of 200 - 500cc/min (200cc/min is the recommended flow). Allow 1-2 minutes for the reading to stabilize. Observe that during the 1-2 minutes the display increases to a level near that of the applied calibration gas value.
- b) Remove test gas and observe that the display decreases to "0".

Initial operational tests are complete. Detcon combustible gas sensors are factory calibrated prior to shipment, and should not require significant adjustment on start up. However, it is recommended that a complete calibration test and adjustment be performed 16 to 24 hours after power-up. Refer to span calibration instructions in Section 3.4.

## 3. Operation

### 3.1 Programming Magnet Operating Instructions

The Operator Interface of the FP-524D-HRT Series gas sensors is accomplished via two internal magnetic switches located above and below the LED display (Figure 13). The two switches, labeled “PGM1” and “PGM2”, allow for complete calibration and configuration, thereby eliminating the need for area de-classification or the use of hot permits.



Figure 12 Magnetic Programming Tool

The magnetic programming tool (Figure 12) is used to operate the magnetic switches. Switch action is defined as momentary contact, 3-second hold, and 10-second hold. (Hold times are defined as the time from the point when the arrow prompt “▼” appears.) For momentary contact use, the programming magnet is briefly held over a switch location. For 3-second hold, the programming magnet is held in place over the switch location for three seconds. For 10-second hold, the programming magnet is held in place over the switch location for 10 seconds. The 3 and 10 second holds are generally used to enter calibration/program menus and save new data. The momentary contact is generally used to move between menu items and to modify set-point values. Arrows (“▼” and “▲”) are used on the LED display to indicate when the magnetic switches are activated. The location of “PGM1” and “PGM2” are shown in Figure 13.

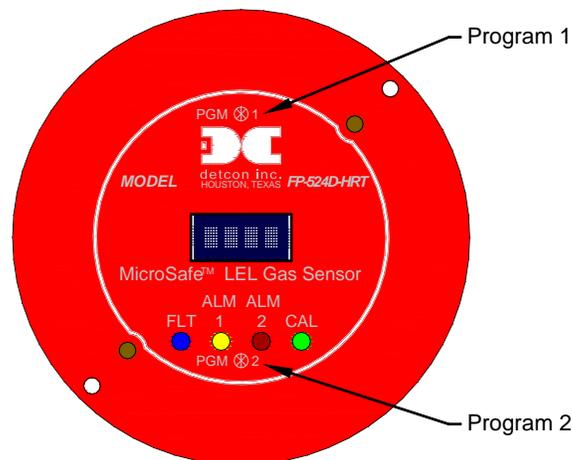


Figure 13 Magnetic Programming Switches

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**NOTE:** While in the Program Mode, if there is no magnetic switch interaction after 4 consecutive menu scrolls, the sensor will automatically revert to normal operating condition. While changing values inside menu items, **if there is no magnet activity after 3-4 seconds the sensor will revert to the menu scroll.**  
*(Exception to this is with “Signal Output Check” mode.)*

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## 3.2 Operator Interface

The operating interface is menu-driven via the two magnetic program switches located under the target marks of the sensor housing. The two switches are referred to as “PGM1” and “PGM2”. The menu list consists of three major items that include sub-menus as indicated below. (Refer to the complete Software Flow Chart.)

### Normal Operation

- Current Reading and Fault Status

### Calibration Mode

- AutoZero
- AutoSpan

### Program Mode

- View Sensor Status
  - Sensor Model Type
  - Current Software Version
  - Range of Detection
  - AutoSpan Level
  - Days Since Last AutoSpan
  - Remaining Sensor Life
  - Sensor Bridge Current
  - Sensor Bridge Voltage
  - Gas Factor
  - Cal Factor
  - mA Output
  - Input Voltage Supply
  - Sensor Temperature
  - Alarm 1 Level
  - Alarm 1 Ascending
  - Alarm 1 Latching
  - Alarm 2 Level
  - Alarm 2 Ascending
  - Alarm 2 Latching
  - Fault Latching

- Set AutoSpan Level
- Set Gas Factor
- Set Cal Factor
- Set Bridge Voltage
- Signal Output Check
- Restore Default Settings
- Alarm 1 Settings
- Alarm 2 Settings
- Fault Settings

### Software Flowchart

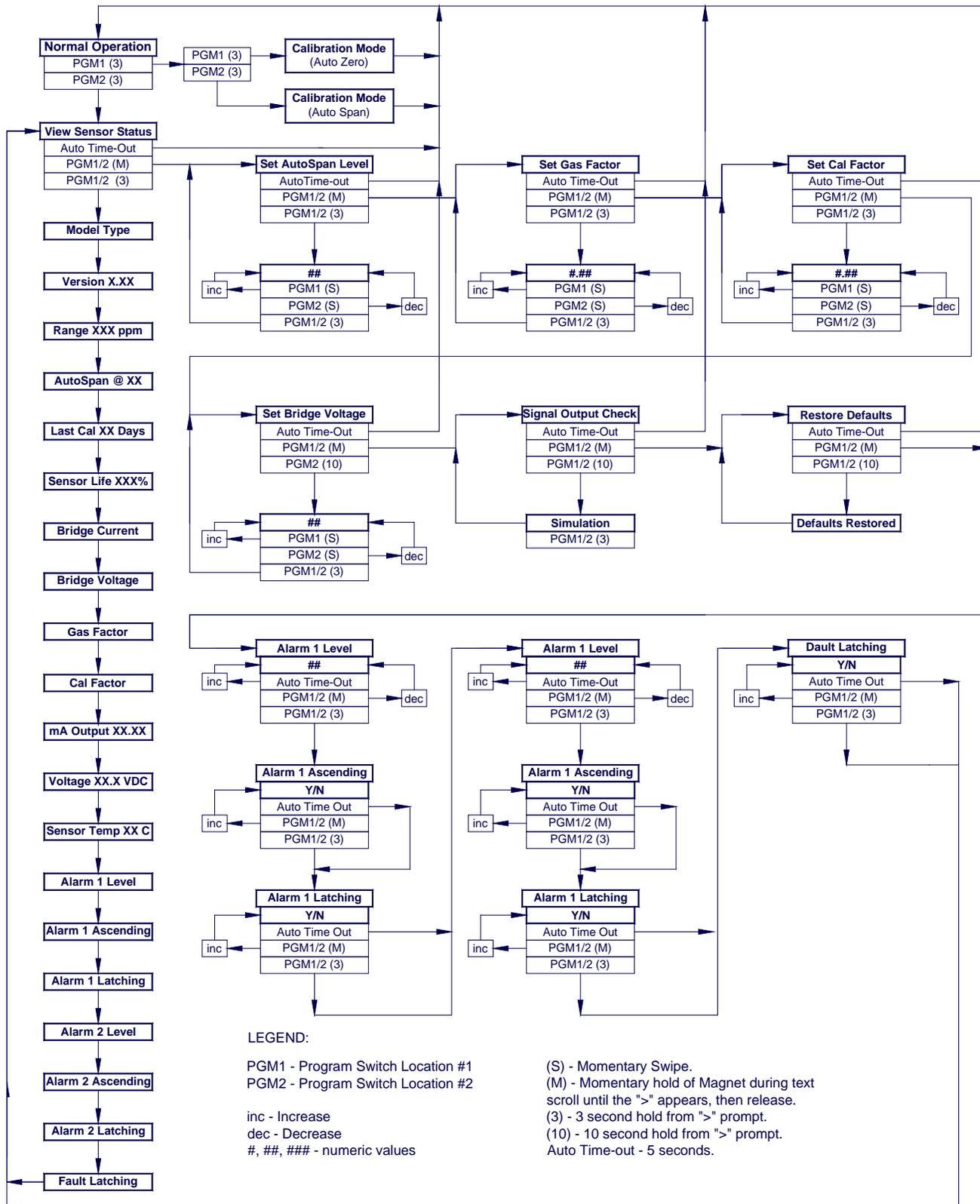


Figure 14 FP-524D-HRT Software Flowchart

### 3.3 Normal Operation

In normal operation, the display continuously shows the current sensor reading, which will normally appear as “0”. Once every minute, the LED display will flash the sensor’s units of measure and the gas type (i.e. “% LEL”). If the sensor is actively experiencing any diagnostic faults, a “Fault Detected” message will scroll across the display on the display once every minute instead of the units of measure and the gas type. At any time, while the sensor is in “Fault Detected” mode, PGM1 or PGM2 can be swiped to prompt the sensor to display a list of the active faults.

In normal operation, the 4-20mA current output linearly corresponds with the full-scale range.

### 3.4 Calibration Mode (AutoZero and AutoSpan)

Calibration Mode allows for sensor span calibration. Span calibration should be performed on a routine basis (quarterly minimum) to ensure reliable performance. If a sensor has been exposed to any de-sensitizing gases or to very high over-range combustible gas levels, then a re-calibration should be considered. Unless otherwise specified, span adjustment is recommended at 50% LEL. This function is called “AUTO SPAN.”

#### 3.4.1 AutoZero

The AutoZero function is used to zero the sensor. Local ambient air can be used to zero calibrate the sensor as long as it can be confirmed that it contains no combustible gases. If this cannot be confirmed then a zero air cylinder should be used.

Material Requirements:

- Detcon PN 327-000000-000 MicroSafe™ Programming Magnet
- Detcon PN 613-120000-000 Splash Guard with integral Cal Port. -OR-
- Detcon PN 943-000006-132 Threaded Calibration Adapter
- Detcon PN 942-001123-000 Zero Air cal gas or use ambient air if no combustible gas is present.

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**NOTE:** The zero gas source should have a normal background concentration of 20.9% O<sub>2</sub>. Pure Nitrogen gas standards should not be used or errors may result.

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- a) If the ambient air is known to contain no combustible gas content, then it can be used to zero calibrate. If a zero gas cal cylinder is going to be used then attach the calibration adapter and set flow rate of 200-500cc/min and let sensor purge for 1-2 minutes before executing the AutoZero.
- b) From Normal Operation, enter Calibration Mode by holding the programming magnet over PGM1 for 3-4 seconds. Note, the “▲” prompt will show that the magnetic switch is activated during the 3 second hold period. The display will then scroll “PGM1=Zero ...PGM2=Span”. Hold the programming magnet over PGM1 for 3-4 seconds once the “▲” prompt appears to execute AutoZero (or allow to timeout in 10 seconds if AutoZero is not desired).

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**NOTE:** Upon entering Calibration Mode, the 4-20mA signal drops to 2mA and is held at this level until the program returns to normal operation.

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- c) The transmitter will display the following sequence of text messages as it proceeds through the AutoZero sequence:

**Zero Cal . . . Setting Zero . . . Zero Saved (each will scroll twice)**

- d) Remove the zero gas and calibration adapter, if applicable.

## 3.4.2 AutoSpan

### Material Requirements:

- Detcon PN 327-000000-000 MicroSafe™ Programming Magnet
- Detcon PN 613-120000-000 Splash Guard with integral Cal Port -OR-
  - Detcon PN 943-000006-132 Threaded Calibration Adapter
- Detcon PN 942-520124-050 50% LEL Methane in balance air (recommended) or other suitable span gas containing a certified level of % LEL concentration of combustible gas in air balance. A flow fixed rate of 200-500cc/min is recommended.

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**NOTE 1:** Before performing AutoSpan Calibration, verify that the AutoSpan level matches the span calibration gas concentration as described in Section 3.5.2 Set AutoSpan Level.

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**NOTE 2:** The span gas source must have a normal background concentration of 20.9% O<sub>2</sub>. Pure Nitrogen background mixtures are not acceptable! Significant span calibration inaccuracies will result.

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**NOTE 3:** If the target gas is other than methane, use the appropriate Gas Factor as described in Section 3.5.3 Set Gas Factor

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**CAUTION:** Verification that the calibration gas level setting matches the calibration span gas concentration is required before executing “AutoSpan” calibration. These two numbers must be equal.

AutoSpan consists of entering Calibration Mode and following the menu-displayed instructions. The display will ask for the application of span gas in a specific concentration. This concentration must be equal to the calibration gas level setting. The factory default setting and recommendation for span gas concentration is 50% LEL. If a span gas containing the recommended concentration is not available, other concentrations may be used as long as they fall between 5% and 95% LEL. However, any alternate span gas concentration value must be programmed via the “Set AutoSpan Level” menu before proceeding with AutoSpan calibration. Follow the instructions “a” through “e” below for AutoSpan calibration.

- a) Verify that the AutoSpan Level is equal to the calibration span gas concentration. (Refer to View Sensor Status in Section 3.5.1.) If the AutoSpan Level is not equal to the calibration span gas concentration, adjust the AutoSpan Level as instructed in Section 3.5.2 Set AutoSpan Level.
- b) From Normal Operation, enter Calibration Mode by holding the programming magnet over PGM1 for 3-4 seconds. Note, the “▲” prompt will show that the magnetic switch is activated during the 3-4 second hold period. The display will then scroll “PGM1=Zero...PGM2=Span”. Hold the programming magnet over PGM2 for 3-4 seconds once the “▼” prompt appears, until the display starts to scroll “Span Cal” to execute AutoSpan (or allow to timeout in 5 seconds if AutoSpan is not desired). The display will then scroll “Apply XX % LEL” (where XX is the AutoSpan Level).

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**NOTE:** Upon entering Calibration Mode, the 4-20mA signal drops to 2mA and is held at this level until the program returns to normal operation.

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- c) Apply the span calibration test gas at a flow rate of 200-500cc/min (200cc/min is the recommended flow rate). As the sensor signal begins to increase, the display will switch to reporting a flashing “XX” reading as the display shows the sensor’s “as found” response to the span gas presented. If it fails to meet the

minimum in-range signal change criteria within 2½ minutes, the display will report “Range Fault” twice and the sensor will return to normal operation, aborting the AutoSpan sequence. The sensor continues to report a “Range Fault” and will not clear the fault until a successful AutoSpan is completed.

Assuming acceptable sensor signal change, after 1 minute the reading will auto-adjust to the programmed AutoSpan level. During the next 30 seconds, the AutoSpan sequence checks the sensor for acceptable reading stability. If the sensor fails the stability check, the reading is re-adjusted back to the AutoSpan level and the cycle repeats until the stability check is passed. Up to three additional 30-second stability check periods are allowed before the unit reports a “Stability Fault” twice and the sensor will return to normal operation, aborting the AutoSpan sequence. The sensor will continue to report a “Stability Fault” and will not clear the fault until a successful AutoSpan is completed.

If the sensor passes the stability check, the sensor display reports a series of messages:

“AutoSpan Complete”

“Sensor Life XXX%”

“Remove Span Gas”

- d) Remove the span gas and calibration adapter. The sensor will report a live reading as it clears toward “0”. When the reading clears below 5 % LEL, the sensor will display “Span Complete” and will revert to normal operation. If the sensor fails to clear to less than 5% LEL within 5 minutes, a “Clearing Fault” will be reported twice and the sensor will return to normal operation, aborting the AutoSpan sequence. The sensor will continue to report a “Clearing Fault” and will not clear the fault until a successful AutoSpan is completed.

---

**NOTE 1:** If the sensor fails the minimum signal change criteria, a “Range Fault” will be declared and a “Fault Detected” message will be displayed alternately with the sensor’s current reading. The 4-20mA output will be taken to 0mA.

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**NOTE 2:** If the sensor fails the stability criteria, a “Stability Fault” will be declared and a “Fault Detected” message will be displayed alternately with the sensor’s current reading. The 4-20mA output will be taken to 0mA.

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**NOTE 3:** If the sensor fails the clearing time criteria, a “Clearing Fault” will be declared and a “Fault Detected” message will be displayed alternately with the sensor’s current reading. The 4-20mA output will be taken to 0mA.

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### 3.5 Program Mode

Program Mode provides a View Sensor Status menu to check operational and configuration parameters. Program Mode also provides for adjustment of the AutoSpan Level, Bridge Voltage, Gas Factor, and Cal Factor. Additionally, it includes the Restore Factory Defaults and Signal Output Check diagnostic functions.

The Program Mode menu items appear in the order presented below:

- View Sensor Status
- Set AutoSpan Level
- Set Gas Factor
- Set Cal Factor
- Set Bridge Voltage
- Signal Output Check
- Restore Default Settings

Alarm 1 Settings  
Alarm 2 Settings  
Fault Settings

## **Navigating Program Mode**

From Normal Operation, enter Program Mode by holding the magnet over PGM2 for 4 seconds (until the displays starts to scroll “View Sensor Status”). Note, the “▼” prompt will show that the magnetic switch is activated during the 4 second hold period. The sensor will enter Program Mode and the display will display the first menu item “View Sensor Status”. To advance to the next menu item, hold the magnet over PGM1 or PGM2 while the current menu item’s text is scrolling. At the conclusion of the text scroll, the arrow prompt (“▼” for PGM2 or “▲” for PGM1) will appear, immediately remove the magnet. The display will advance to the next menu item. Repeat this process until the desired menu item is displayed. Note, PGM1 moves the menu items from right to left and PGM2 moves the menu items from left to right.

To enter a menu item, hold the magnet over PGM1 or PGM2 while the menu item is scrolling. At the conclusion of the text scroll the “▼” prompt (“▼” for PGM2 or “▲” for PGM1) will appear, continue to hold the magnet over PGM1 or PGM2 for an additional 3-4 seconds to enter the selected menu item. If there is no magnet activity while the menu item text is scrolling (typically 4 repeated text scrolls), the sensor will automatically revert to Normal Operation.

### **3.5.1 View Sensor Status**

**View Sensor Status** displays all current configuration and operational parameters including: sensor type, software version number, detection range, AutoSpan level, days since last AutoSpan, estimated remaining sensor life, bridge current, bridge voltage, gas factor, cal factor, mA output, input voltage, and sensor ambient temperature.

From the **View Sensor Status** text scroll, hold the magnet over PGM1 or PGM2 until the “▼” prompt appears and continue to hold the magnet in place for an additional 3-4 seconds (until the display starts to scroll “Status Is”). The display will scroll the complete list of sensor status parameters sequentially:

#### **Sensor Model Type**

The menu item appears as: “FP-524D”

#### **Current Software Version**

The menu item appears as: “V X.XXXZ5”

#### **Range of Detection**

The menu item appears as: “Range XXX”

#### **AutoSpan Level**

The menu item appears as: “Auto Span Level XX”

#### **Days Since Last AutoSpan**

The menu items appears as: “Last Cal XX days”

#### **Remaining Sensor Life**

The menu item appears as: “Sensor Life XXX%”

**Sensor Bridge Current**

The menu item appears as: “Bridge XXXmA”

**Sensor Bridge Voltage**

The menu item appears as: “Bridge X.XXVDC”

**Gas Factor**

The menu item appears as: “Gas Factor X.XX”

**Cal Factor**

The menu item appears as: “Cal Factor X.XX”

**mA Output**

The menu item appears as: “mA Output XX.XX mA”

**Input Voltage Supply**

The menu item appears as: “Voltage XX.X VDC”

**Operating Temperature**

The menu item appears as: “Temp XX C”

**Alarm 1 Level**

The menu item appears as: “Alarm 1 Level XX”

**Alarm 1 Ascending**

The menu item appears as: “Alarm 1 Ascending or Descending”

**Alarm 1 Latching**

The menu item appears as: “Alarm 1 Latching or Non-Latching”

**Alarm 2 Level**

The menu item appears as: “Alarm 2 Level XX”

**Alarm 2 Ascending**

The menu item appears as: “Alarm 2 Ascending or Descending”

**Alarm 2 Latching**

The menu item appears as: “Alarm 2 Latching or Non-Latching”

**Fault Latching**

The menu item appears as: “Fault Latching or Non-Latching”

When the status list sequence is complete, the display will revert to the “View Sensor Status” text scroll. The user can either: 1) review list again by executing another 3-4 second hold, 2) move to another menu item by executing a momentary hold over PGM1 or PGM2, or 3) return to Normal Operation via automatic timeout of about 15 seconds (the display will scroll “View Sensor Status” 4 times and then return to Normal Operation).

### 3.5.2 Set AutoSpan Level

**Set AutoSpan Level** is used to set the span gas concentration level that is being used to calibrate the sensor. This level is adjustable from 5% to 95% of selected full-scale range. The current setting can be viewed in View Program Status.

The menu item appears as: “**Set AutoSpan Level**”.

From the **Set AutoSpan Level** text scroll, hold the magnet over PGM1 or PGM2 until the “▼” prompt appears and continue to hold the magnet in place for an additional 3-4 seconds (until the display starts to scroll “Set Level”). The display will switch to “XX”(where XX is the current gas level). Swipe the magnet momentarily over PGM1 to increase or PGM2 to decrease the AutoSpan Level until the correct level is displayed. When the correct level is achieved, hold the magnet over PGM1 or PGM2 for 3-4 seconds to accept the new value. The display will scroll “Level Saved”, and revert to “Set AutoSpan Level” text scroll.

Move to another menu item by executing a momentary hold, or return to Normal Operation via automatic timeout of about 15 seconds (the display will scroll “Set AutoSpan Level” 4 times and then return to Normal Operation).

### 3.5.3 Set Gas Factor

Because of the catalytic bead sensor’s almost universal response to combustible gases, the FP-524D-HRT sensor can be configured to specifically detect any of the combustible gases listed in Table 2. This gas is referred to as the “target gas”. In addition, the sensor can also 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 “cal gas”. These two features, **Set Gas Factor** and **Set Cal Factor**, allow a significant degree of flexibility in the detection and span calibration process.

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**NOTE:** The default value for gas factor is 1.0. This would be used when methane is the target gas. Values other than 1.0 would be used when the target gas is not methane.

---

**Set Gas Factor** is used to make the appropriate signal sensitivity adjustment when the target gas is a gas other than methane. This is necessary because the catalytic bead sensor has different signal strengths for each combustible gas and all reading calculations are made based on a reference to methane. The gas factor value is adjustable from 0.2 to 5.0. It represents the translation between the target gas and methane gas, where methane has a normalized gas factor = 1.0. For example, the gas factor for butane is 1.71, because the signal strength of butane is 1.71 times lower than methane. The current setting can be viewed in View Program Status – Gas Factor.

The following table shows the gas factors of most combustible gases that can be measured. Find the target gas and enter the corresponding value as the gas factor. For example, if butane were the target gas, the correct gas factor would be 1.71. If there is a mixture of target gases, use a weighted approach to determine the correct gas factor. For example, if the target gas was 50% butane and 50% methane, the correct gas factor would be calculated and entered as  $0.5(1.71) + 0.5(1.0) = 1.35$ .

**Table 2 Gas/Cal Factors**

Gas	Factor	Gas	Factor	Gas	Factor
Acetaldehyde	1.66	Decane	3.05	Dimethyl Ether	1.60
Acetic Acid	1.84	Diethylamine	2.05	Methylethyl Ether	2.27
Acetic Anhydride	2.17	Dimethylamine	1.73	Methylethyl Ketone	2.42
Acetone	1.93	2,3-Dimethylpentane	2.51	Methyl Formate	1.49
Acetylene	1.76	2,2-Dimethylpropane	2.52	Methyl Mercaptan	1.64
Alkyl Alcohol	1.96	Dimethyl sulfide	2.30	Methyl propionate	1.95
Ammonia	0.79	1,4-Dioxane	2.24	Methyl n-propyl Ketone	2.46
n-Amyl Alcohol	3.06	Ethane	1.47	Naphtha	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	Ethylene Oxide	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	Ethyl Mercaptan	1.78	Propylene	1.95
iso-Butyl Alcohol	1.89	n-Heptane	2.59	Propylene Oxide	2.18
tert-Butyl-Alcohol	1.34	n-Hexane	2.71	iso-Propyl Ether	2.29
n-Butyl Benzene	3.18	Hydrazine	2.22	Propyne	2.40
iso-Butyl Benzene	3.12	Hydrogen Cyanide	2.09	Toluene	2.47
n-Butyric Acid	2.63	Hydrogen	1.30	Triethylamine	2.51
Carbon Disulphide	5.65	Hydrogen Sulphide	2.54	Trimethylamine	2.06
Carbon Monoxide	1.32	Methane	1.00	Vinyl Chloride	2.32
Carbon Oxysulphide	1.07	Methyl Acetate	2.01	Vinyl Ethyl Ether	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

The menu item appears as: “**Set Gas Factor**”.

From the **Set Gas Factor** text scroll, hold the magnet over PGM1 or PGM2 until the “▼” prompt appears and continue to hold the magnet in place for an additional 3-4 seconds (until the display starts to scroll “Set Factor”). The display will then switch to “X.XX”(where X.XX is the current gas factor). Swipe the magnet momentarily over PGM1 to increase or PGM2 to decrease the gas factor level until the correct value is displayed. Hold the magnet over PGM1 or PGM2 for 3 seconds to accept the new value. The display will scroll “Factor Saved”, and revert to “Set Gas Factor” text scroll.

Move to another menu item by executing a momentary hold, or, return to Normal Operation via automatic timeout of about 15 seconds (the display will scroll “Set Gas Factor” 4 times and then return to Normal Operation).

### 3.5.4 Set Cal Factor

Because of the catalytic bead sensor’s almost universal response to combustible gases, the FP-524D-HRT sensor can be span calibrated with any of the combustible gases listed in Table 2 above. This specific gas is referred to as the “cal gas”.

---

**NOTE:** The default value for cal factor is 1.0. This would be used when methane is the cal gas. Values other than 1.0 would be used when the span cal gas is not methane.

---

**Set Cal Factor** is used to make the appropriate signal sensitivity adjustment when the cal gas is a gas other than methane. This is necessary because the catalytic bead sensor has different signal strengths for each combustible gas and all reading calculations are made based on a reference to methane. The cal factor value is adjustable from 0.2 to 5.0. It represents the translation between the cal gas and methane gas, where methane has a normalized cal factor = 1.0. For example, the cal factor for butane is 1.71 because the signal strength of butane is 1.71 times lower than methane. The current setting can be viewed in View Program Status.

Table 2 shows the cal factors of most combustible gases that will be used as span calibration sources. Find the gas of interest and enter that value the cal factor. For example, if propane were used as the cal gas, the correct cal factor would be 1.81.

The menu item appears as: “**Set Cal Factor**”.

From the **Set Gas Factor** text scroll, hold the magnet over PGM1 or PGM2 until the “▼” prompt appears and continue to hold the magnet in place for an additional 3-4 seconds (until the display starts to scroll “Set Factor”). The display will then switch to “X.XX”(where X.XX is the current cal factor). Swipe the magnet momentarily over PGM2 to increase or PGM1 to decrease the gas factor level until the correct value is displayed. Hold the magnet over PGM1 or PGM2 for 3-4 seconds to accept the new value. The display will scroll “Factor Saved”, and revert to “Set Cal Factor” text scroll.

Move to another menu item by executing a momentary hold, or, return to Normal Operation via automatic timeout of about 15 seconds (the display will scroll “Set Cal Factor” 4 times and then return to Normal Operation).

### 3.5.5 Set Bridge Voltage

Each Detcon plug-in combustible gas sensor requires a one-time setting for optimal bridge voltage. This is set automatically during the “Set Bridge Voltage” sequence. The “Set Bridge Voltage” sequence determines the required bridge voltage such that every plug-in sensor operates at exactly 200mA current. This technique provides for tremendous uniformity in sensor-to-sensor operational performance, and it is notably better than sensors that are operated on a common fixed bridge voltage platform. The range of bridge voltages required for Detcon sensors is generally between 2.5 – 2.9VDC.

---

**NOTE:** The “Set Bridge Voltage” function is executed during factory calibration of every FP-524D-HRT sensor. In the field, this menu item is only needed when a replacement plug-in sensor is being installed, or when mating a new FP-524D-HRT transmitter with an existing plug-in sensor.

---

The menu item appears as: “**Set Bridge Voltage**”.

From the **Set Bridge Voltage** text scroll, hold the magnet over PGM1 or PGM2 until the “▼” prompt appears and continue to hold the magnet in place for an additional 7-8 seconds (until the display starts to scroll “Setting Bridge”). The transmitter will then display “WAIT”. During the 1-minute sequence, the transmitter will display the three-digit number that corresponds to the bridge current as it is being adjusted. At conclusion, display will scroll “Set Bridge Voltage”. The new bridge voltage can be viewed in the “View Sensor Status” menu.

Move to another menu item by executing a momentary hold, or, return to Normal Operation via automatic timeout of about 15 seconds (the display will scroll “Set Bridge Voltage” 4 times and then return to Normal Operation).

### 3.5.6 Signal Output Check

**Signal Output Check** provides a simulated 4-20mA output. This simulation allows the user to conveniently perform a functional system check of their entire safety system. This signal output simulation also aids the user in performing troubleshooting of signal wiring problems.

The menu item appears as: “**Signal Output Check**”.

From the “Signal Output Check” text scroll, hold the magnet over PGM1 or PGM2 until the “▼” prompt appears and then hold continuously for an additional 10 seconds. Once initiated, the display will scroll “Simulation Active” until the function is stopped. During simulation mode, the 4-20mA value will be increased from 4.0mA to 20.0mA (in 1% of range increments at about a 1 second update rate) and then decreased from 20.0mA to 4.0mA.

---

**NOTE:** Signal Output Check stays active indefinitely until the user stops the function. There is no automatic timeout for this feature.

---

To end simulation mode, hold magnet over PGM1 or PGM2 for 3 seconds. The display will either move to the prior menu item or move to the next menu item respectively.

Move to another menu item by executing a momentary hold, or, return to Normal Operation via automatic timeout of about 15 seconds.

### 3.5.7 Restore Factory Defaults

**Restore Factory Defaults** is used to clear current user configuration and calibration data from memory and revert to factory default values. This may be required if the settings have been configured improperly and a known reference point needs to be re-established to correct the problem.

This menu item appears as: “**Restore Defaults**”.

---

**NOTE:** “Restoring Factory Defaults” should only be used when absolutely necessary. All previously existing configuration inputs will have to be re-entered if this function is executed. A full 10-second magnet hold on PGM 1 is required to execute this function.

---

From the “Restore Defaults” text scroll, hold the programming magnet over PGM1 until the “▲” prompt appears and continue to hold 10 seconds. The display will scroll “Restoring Defaults”, and then will revert to the “Restore Defaults” text scroll.

Move to another menu item by executing a momentary hold, or, return to Normal Operation via automatic timeout of about 15 seconds (the display will scroll “Restore Defaults” 4 times and then return to Normal Operation).

Following the execution of “**Restore Defaults**”, the FP-524D-HRT will revert to its factory default settings. The default settings are:

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**NOTE:** The following *must* be performed in order before the sensor can be placed back into operation.

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- AutoSpan Level = 50 %LEL. AutoSpan level must be set appropriately by the operator (Section 3.5.2).
- Gas Factor = 1.0. The Gas Factor must be set appropriately by the operator (Section 3.5.3).
- Cal Factor = 1.0. The Cal Factor must be set appropriately by the operator (Section 3.5.4).

- AutoZero: AutoZero Settings are lost and user must perform new AutoZero (Section 3.4.1).
- AutoSpan: AutoSpan Settings are lost and user must perform new AutoSpan (Section 3.4.2).

### 3.5.8 Alarm 1 and 2 Settings

The FP-524D has the ability to set alarm levels that are displayed on the front of the sensor via the LED's ALM 1 and ALM 2. These alarm LEDs can be set as latching or non-latching. In non-latching mode, the LED is deactivated as soon as the sensor alarm condition is cleared. In latching mode, the LED remains active even after the alarm condition has cleared. Once activated, the LED can only be deactivated by swiping a magnetic programming tool above the PGM1 or PGM2 mark on the FP-524D face plate.

The alarm LEDs can be configured for ascending or descending mode. In ascending mode the LED will be activated when the concentration is *above* the alarm threshold. This is the most common mode of operation for the FP-524D. The alarm LEDs can also be activated in descending mode. In this mode, the alarm LEDs will activate when the concentration is *below* the alarm threshold.

The menu item appears as: “**Alarm X Settings**”

From the “**Alarm X Settings**” text scroll, hold the programming magnet over PGM1 or PGM2 until the “▼” prompt appears and continue to hold the magnet in place for an additional 3-4 seconds (until the display starts to scroll “Set Level”). The display will then switch to “XXX“(where XXX is the current alarm level in ppm). Swipe the magnet momentarily over PGM2 to decrease or PGM1 to increase the alarm level until the desired level is displayed. Hold the magnet over PGM1 or PGM2 for 3 seconds to accept the new value (until the display starts to scroll “Level Saved”).

The display will scroll “Set Ascending”, and then switch to “Yes” or “No”. “Yes” indicates the LED is in ascending mode and “No” indicates the LED is in descending mode. Swipe the magnet momentarily over PGM2 or PGM1 until the correct value is displayed. Hold the magnet over PGM1 or PGM2 for 3 seconds to accept the new value.

The display will scroll “Set Latching”, and then switch to “Yes” or “No”. “No” indicates the LED is non-latching and “Yes” indicates the LED is latching. Swipe the magnet momentarily over PGM2 or PGM1 until the correct value is displayed. Hold the magnet over PGM1 or PGM2 for 3 seconds to accept the new value.

Hold the magnet over PGM1 or PGM2 for 3 seconds to accept the new value (until the display starts to scroll “Saved”). Move to another menu item by executing a momentary hold, or, return to Normal Operation via automatic timeout of about 15 seconds (the display will scroll “Alarm X Settings” 4 times and then return to Normal Operation).

### 3.5.9 Fault Settings

The FP-524D Fault LED can be configured to change state when the sensor experiences a fault condition. This LED can be configured as either latching or non-latching. In non-latching mode, the LED is deactivated as soon as the fault condition is cleared. In latching mode, the LED remains active even after the fault condition has cleared. Once activated, the LED can only be deactivated by swiping a magnetic programming tool above the PGM1 or PGM2 mark on the FP-524D face plate.

The menu item appears as: “**Fault Settings**”

From the “**Fault Settings**” text scroll, hold the programming magnet over PGM1 or PGM2 until the “▼” prompt appears and continue to hold the magnet in place for an additional 3-4 seconds. The display will scroll “Set Latching”, and then switch to “Yes” or “No”. “No” indicates the relay is non-latching and “Yes” indicates the relay is latching. Swipe the magnet momentarily over PGM2 or PGM1 until the correct value is displayed. Hold the magnet over PGM1 or PGM2 for 3 seconds to accept the new value.

Hold the magnet over PGM1 or PGM2 for 3 seconds to accept the new value (until the display starts to scroll “Saved”). Move to another menu item by executing a momentary hold, or, return to Normal Operation via automatic timeout of about 15 seconds (the display will scroll “Fault Settings” 4 times and then return to Normal Operation).

## 3.6 Program Features

Detcon FP-524D-HRT combustible gas sensors incorporate a comprehensive set of diagnostic features to achieve Fail-Safe Operation. These Operational features and Failsafe Diagnostic features are detailed below.

### 3.6.1 Operational Features

#### Over-Range

When gas greater than the full-scale range is detected, the sensor display will continuously flash the full-scale reading of 100. This designates an over-range condition. The 4-20mA signal will report a 22mA output during this time.

#### In-Calibration Status

When the sensor is engaged in AutoZero or AutoSpan calibration, the 4-20mA output signal is taken to 2.0mA. This alerts the user that the sensor is not in an active measurement mode. This feature also allows the user to log the AutoZero and AutoSpan events via their master control system.

#### Sensor Life

Sensor Life is calculated after each AutoSpan calibration and is reported as an indicator of remaining service life. It is reported in the “View Sensor Status” menu. Sensor Life is reported on a scale of 0-100%. When Sensor Life falls below 25%, the sensor cell should be replaced within a reasonable maintenance schedule.

#### Last AutoSpan Date

This reports the number of days that have elapsed since the last successful AutoSpan. This is reported in the View Sensor Status menu. After 180 days, an AutoSpan Fault will be declared.

### 3.6.2 Fault Diagnostic/Failsafe Features

#### Fail-Safe/Fault Supervision

Model FP-524D-HRT MicroSafe™ sensors are designed for Fail-Safe operation. If any of the diagnostic faults listed below are active, the sensor display will scroll the message “Fault Detected” every 60 seconds during normal operation. At any time during “Fault Detected” mode, holding the programming magnet over PGM1 or PGM2 for 1 second will display the active fault(s). All active faults are reported sequentially.

Most fault conditions result in failed operation of the sensor. In these cases the 4-20mA signal is dropped to the universal fault level of 0mA. These include the AutoZero and AutoSpan Calibration faults, Sensor Faults, Processor Fault, Memory Fault, Loop Fault, and Input Voltage Fault. (The 0mA fault level is not employed for a Temperature Fault, or during Calibration.)

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**NOTE:** For FP-524D sensors that have the HRT Bridge Interface installed, an active fault will cause the mA output to drop to 1mA to signify a sensor fault.

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**NOTE:** Refer to the Troubleshooting Guide, Section 6, for guidance on fault conditions.

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### **Zero Fault**

If the sensor drifts below  $-10\%$  LEL, the “Zero Fault” will be declared. A “Zero Fault” will cause a “Fault Detected” message to scroll once a minute on the transmitter display and drop the 4-20mA output to 0mA. The sensor should be considered “Out-of-Service” until a successful AutoZero calibration is performed.

### **Range Fault – AutoSpan**

If the sensor fails the minimum signal change criteria during AutoSpan sequence (Section 3.4), the “Range Fault” will be declared. A “Range Fault” will cause a “Fault Detected” message to scroll once a minute on the sensor display and drop the 4-20mA output to 0mA. The sensor should be considered “Out-of-Service” until a successful AutoSpan calibration is performed.

### **Stability Fault - AutoSpan**

If the sensor fails the signal stability criteria during AutoSpan sequence (Section 3.4), the “Stability Fault” will be declared. A “Stability Fault” will cause a “Fault Detected” message to scroll once a minute on the sensor display and drop the mA output to 0mA. The sensor should be considered as “Out-of-Service” until a successful AutoSpan calibration is performed.

### **Clearing Fault - AutoSpan**

If the sensor fails the signal stability criteria during AutoSpan sequence (Section 3.4), the “Clearing Fault” will be declared. A “Clearing Fault” will cause a “Fault Detected” message to scroll once a minute on the sensor display and drop the mA output to 0mA. The sensor should be considered as “Out-of-Service” until a successful AutoSpan calibration is performed.

### **Sensor Current Fault**

If the current through the sensor bridge (See Figure 3) drifts outside the range of  $200\text{mA} \pm 50\text{mA}$ , a “Sensor Current Fault” will be declared. A “Sensor Current Fault” will cause a “Fault Detected” message to scroll once a minute on the transmitter display. If a Sensor Current Fault occurs, the 4-20mA signal will be set at 0mA until the fault condition is resolved.

### **Sensor Voltage Fault**

If the voltage across the sensor bridge (See Figure 3) is greater than 3.5VDC or less than 1.8VDC, a “Sensor Voltage Fault” will be declared. A “Sensor Voltage Fault” will cause a “Fault Detected” message to scroll once a minute on the transmitter display. If a Sensor Voltage Fault occurs, the 4-20mA signal will be set at 0mA until the fault condition is resolved.

### **Processor Fault**

If the detector has any unrecoverable run-time errors, a “Processor Fault” is declared. A “Processor Fault” will cause a “Fault Detected” message to scroll once a minute on the sensor display. If a Processor Fault occurs, the 4-20mA signal will be set at 0mA until the fault condition is resolved.

### **Memory Fault**

If the detector has a failure in saving new data to memory, a “Memory Fault” is declared. A “Memory Fault” will cause the “Fault Detected” message to scroll once a minute on the sensor display. If a Memory Fault occurs, the 4-20mA signal will be set at 0mA until the fault condition is resolved.

### **4-20mA Loop Fault**

If the sensor detects a condition where the 4-20mA output loop is not functional (high loop resistance or failed circuit function) a “4-20mA Fault” is declared. A “4-20mA Fault” will cause the “Fault Detected” message to scroll once a minute on the ITM display. If a Loop Fault occurs, the 4-20mA signal will be set at 0mA until the fault condition is resolved. If the 4-20mA current loop is still out of tolerance, contact Detcon at [Service@detcon.com](mailto:Service@detcon.com), or contact Detcon customer service.

### **Input Voltage Fault**

If the detector is currently receiving an input voltage that is outside of the 11.5-28VDC range, an “Input Voltage Fault” is declared. An “Input Voltage Fault” will cause the “Fault Detected” message to scroll once a minute on the sensor display. If an Input Voltage Fault occurs, the 4-20mA signal will be set at 0mA until the fault condition is resolved.

### **Temperature Fault**

If the detector is reporting currently an ambient temperature that is outside of the  $-40^{\circ}\text{C}$  to  $+75^{\circ}\text{C}$  range, a “Temperature Fault” is declared. A “Temperature Fault” will cause the “Fault Detected” message to scroll once a minute on the sensor display. If a Temperature Fault occurs, the 4-20mA signal remains operational.

### **AutoSpan Fault**

If 180 days has elapsed since the last successful AutoSpan, an AutoSpan Fault will be generated. An “AutoSpan Fault” will cause the “Fault Detected” message to scroll once a minute on the sensor display. If an AutoSpan Reminder Fault occurs, the 4-20mA signal remains operational.

## 4. HRT Bridge

The HRT Bridge interface is an integral part of the Transmitter Module for the FP-524D-HRT. The sensor utilizes the a 4-20mA output with the added HART interface information.

### 4.1 Description

The HRT Bridge PCA is a bi-directional digital communication interface that provides data communication between the Model FP524D-HRT sensor and HART<sup>®</sup>-enabled devices. The HART<sup>®</sup> (Highway Addressable Remote Transducer) Communication Protocol is a standard for sending and receiving digital information across analog wires between smart devices and a control host or monitoring system. A host can be any software application from a technician's hand-held device or laptop to a plant's process control, asset management, safety or other system using any control platform.

The HART Communication Protocol makes use of the Bell 202 Frequency Shift Keying (FSK) Standard to superimpose digital communication signals on the 4-20mA signal utilized by the FP-524D-HRT sensor. This enables two-way communication and makes it possible for additional information to be transferred to and from the sensor. This communication includes the ability for the Host to:

- Configure or re-configure the sensor
- Perform sensor diagnostics
- Troubleshoot the sensor
- Read additional information from the sensor
- Determine the sensor's health and status

### 4.2 Connecting the HRT Bridge

The HRT Bridge connection to the Host utilizes the same 3-wire connection of power, power return, and mA output as the typical FP-524D (Refer to Figure 8 Base Connector Board). Connect the 24VDC to the base connector board terminal labeled 'DC+'. Connect the 24V Return to the terminal labeled 'DC-', and connect the 4-20mA to the terminal labeled 'mA'. The 4-20mA signal from the HRT Bridge must be connected to a load resistor to operate properly. If this signal is not terminated properly, the HRT Bridge, and the HART Interface will fail to work properly.

### 4.3 Operation

When power is applied to the FP-524D with HRT Bridge, the HRT Bridge will go through a boot up sequence that will last for approximately 30 seconds. During this time, the 4-20mA line will be held at 1mA. After the boot up sequence the HRT Bridge will enter normal operation, and communication with the Host will begin. A red LED (D7) Labeled "HART" on the HRT Bridge PCA will illuminate when the PCA is communicating with the HART Host. (The HRT Bridge is part of the FP-524D-HRT Transmitter assembly.)

The 4-20mA signal from the HRT Bridge must be connected to a load resistor for HART communication to operate properly. If this signal is not terminated properly, the HRT Bridge, and the HART Interface will fail to work. Normal termination for the 4-20mA signal is accomplished by connection to a Host device, which will have the correct load to terminate the signal properly.

If the HRT Bridge senses a fault in the sensor, it will take the 4-20mA signal down to 1mA. This 1mA signal will signify to the Host that a sensor fault has occurred, and the Host should, in turn, flag an error with the associated sensor.

The HRT Bridge communicates with the FP-524D-HRT sensor through Modbus™. The HRT Bridge reads the appropriate Modbus™ register and creates the 4-20mA signal from the register reading. This allows the HRT Bridge complete control of the HART Communications. A red LED Labeled “MODBUS” will blink when communication with the sensor occurs.

The HART interface has the ability to take the sensor into calibration. If the sensor is taken into calibration via the HART interface, the HART Communication Protocol will inform the Host that the sensor is in calibration mode, and will not set a fault. The 4-20mA signal will be set at 2mA. Starting a calibration using the sensor interface and magnetic tool will also cause the 4-20mA to be set to 2mA.

## 4.4 Operator Interface

The HRT Bridge provides the ability to interface with the sensor via the HART Interface. The HART interface Host can be a PC, a Laptop, or several handheld devices such as the Emerson 475 Field Communicator. Although the displays on each device may be different and the menu names may change, the information provided should be the same. The HART Interface consists of three basic Menus, each with a subset of menus or screens:

### Device Variables Menu

- Primary Variables
- Identification

### Diagnostics Menu

- Device Status
- Sensor Status

### Device Status Menu

- Configuration Setup
- Calibration
- HART Setup

---

**NOTE: The screen shots shown below are taken from the HART Communication Foundation SDC625 Reference Host. The user's screen appearance may be different depending on the HART host used.**

---

### 4.4.1 Device Menu

#### 4.4.1.1 Primary Variables

The primary Variable Screen contains the basic information from the sensor and is broken into four basic sections. None of these variables are changeable, and are directly read from the sensor.

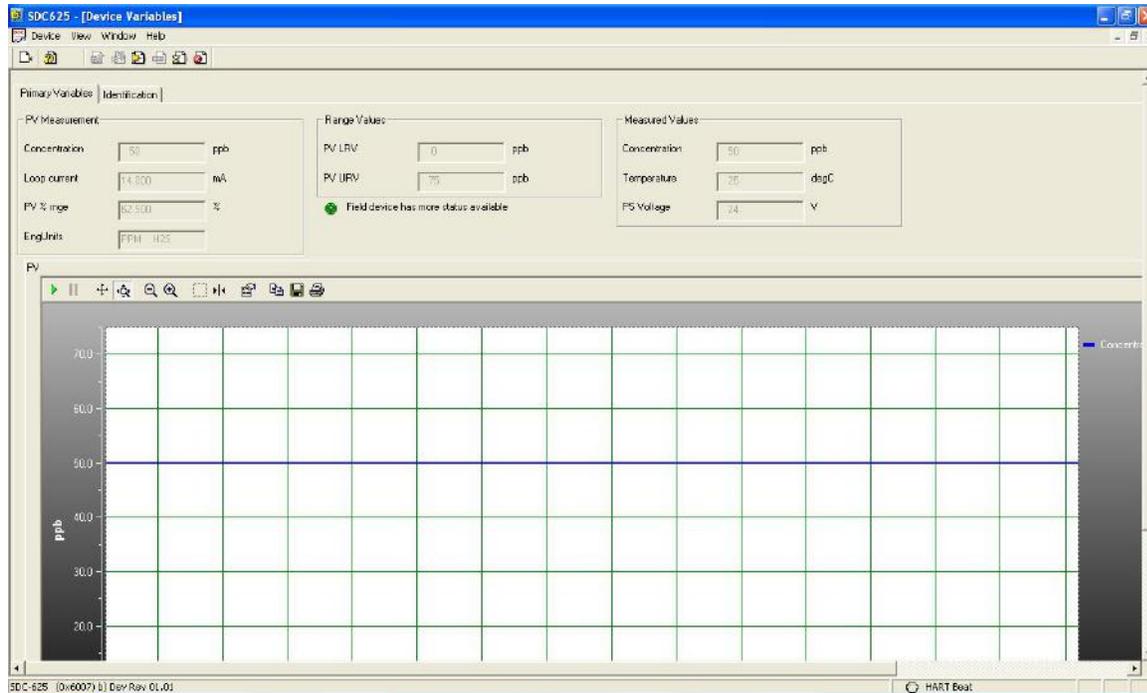


Figure 15 Primary Variables

### Primary Variables

- Concentration – the value of the gas concentration measured by the sensor. The units of measurement (ppm, ppb, or %) are shown to the right of the concentration value. This is the HART primary variable.
- Loop Current – the value of the output 4-20mA loop current
- PV % range – Primary variable percent of range
- EngUnits – the measurement units and gas type

### Range Variables

- PV LRV – Primary variable lower range value (normally 0 for most sensors)
- PV URV – Primary variable upper range value, or the range of the sensor (i.e. 100ppm, 10ppm, 5%, etc.)

### Device Status

- Indicates the device has more status information available. If this icon is green, no additional status information is available. If it is red, refer to Section 4.4.2 Diagnostics for more information.

### Measured Values

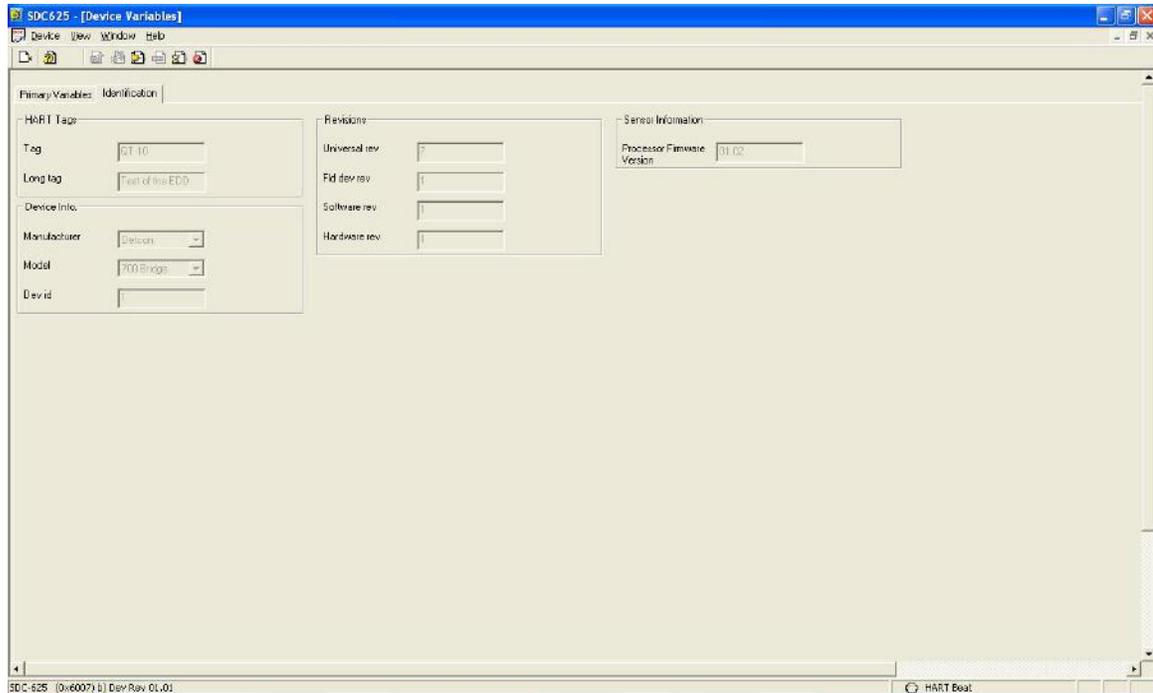
- Concentration – the value of the gas concentration measured by the sensor. The units of measurement (ppm, ppb, or %) are shown to the right of the concentration value
- Temperature – displayed in degrees Centigrade.
- PS Voltage – power supply voltage. Nominally 24VDC

### PV – Graphic display

A graphic display of the sensor concentration reading may also be displayed in this screen. The graph will be a graphic display of concentration verses time.

## • Identification

The Identification screen contains 4 sections that provide some basic HART information as well as some additional sensor information. None of these variables are able to be changed in this screen, although some of these variables may be changed elsewhere.



**Figure 16 Identification**

### HART Tags

- Tag – Text that is associated with the field device installation. This text can be used by the user in any way. A recommended use is a unique label that correlates to a field device label: a plant drawing, or on a control system. This variable is also used as a type of data link layer address handle.
- Long Tag – Functions exactly like the Tag except the size is larger (max 32 ISO Latin 1 characters).

### Device Info.

- Manufacturer – Device manufacturer – “Detcon”
- Model – Device model – “700 Bridge”
- Dev id – Field Device Identification – Uniquely identifies the field device when combined with the Manufacturer and Model.

### Revisions

- Universal rev – Revision of the HART Communication Protocol (currently revision 7)
- Fld dev rev – Revision of the Field Device Specific Device Description
- Software rev – Revision of the software embedded in the HRT Bridge PCA
- Hardware rev – Revision of the hardware in the HRT Bridge PCA.

### Sensor Information

- Processor Firmware Version – Version of the firmware currently loaded in the FP-524D-HRT sensor.

## 4.4.2 Diagnostics Menu

The Diagnostics Menu contains two screens; 1) Device Status and 2) Channel Status. Both screens consist of a list of possible device error or status conditions. Next to each status condition is a small icon that will be either green to display the normal status, or red to indicate an abnormal, changed, or a malfunction condition.

### 4.4.2.1 Device Status

Device Status contains one screen that shows the status of the sensor and the HRT Bridge PCA. The left side of the screen (Device Status) displays the status of the HRT Bridge PCA, with icons that will display either green to indicate normal condition, or red to indicate an error, a change, or a malfunction.

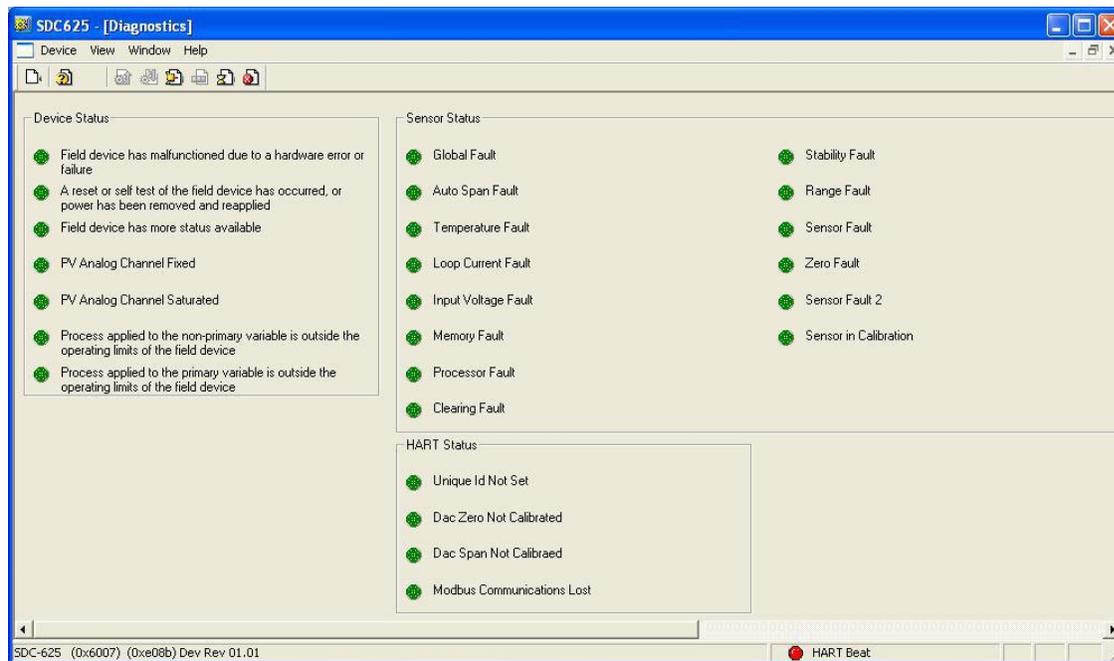


Figure 17 Device Status Screen

- Field device has malfunctioned due to a hardware error or failure
- A reset or self test of the field device has occurred, or power has been removed and reapplied
- Field device has more status available
- PV analog channel fixed
- PV analog channel saturated
- Process applied to the non-primary variable is outside the operating limits of the field device
- Process applied to the primary variable is outside the operating limits of the field device

### 4.4.2.2 Sensor Status

The Sensor Status section of the screen shows the status of the FP-524D-HRT sensor. Icons are used to display the status of the sensor and display either green to indicate normal condition or red to indicate an error, a change, or a malfunction.

- Global Fault – The FP-524D-HRT sensor has one or more faults.
- Auto span fault – 180 days or more has elapsed since the last successful AutoSpan
- Temperature fault – the detector is currently reporting an ambient temperature that is outside of the – 40C to +75C range

- Loop current fault – The sensor has detected a condition where the 4-20mA output loop is not functional
- Input voltage fault – The sensor is currently receiving an input voltage that is outside of the 12-28VDC range
- Memory fault – The detector has a failure in saving new data to memory
- Processor fault – The detector has an unrecoverable run-time error
- Clearing Fault – The sensor reading failed to clear after removal of span gas during an AutoSpan sequence
- Stability Fault – The sensor reading failed to attain a stable reading when span gas was applied during an AutoSpan sequence
- Range Fault – Sensor fails the minimum signal change criteria during an AutoSpan sequence
- Sensor fault – The sensor cell has failed
- Zero Fault – the sensor drifts below –10% of full range
- Sensor Fault 2 – Wheatstone bridge fault
- Sensor in Calibration – The sensor is currently being calibrated

#### **4.4.2.3 HART Status**

The HART status section of the screen shows the status of the HART interface on the HRT Bridge PCA. Icons next to each error description indicate if an error has occurred. A green icon indicates the error condition is not present and a red icon indicates an error has occurred.

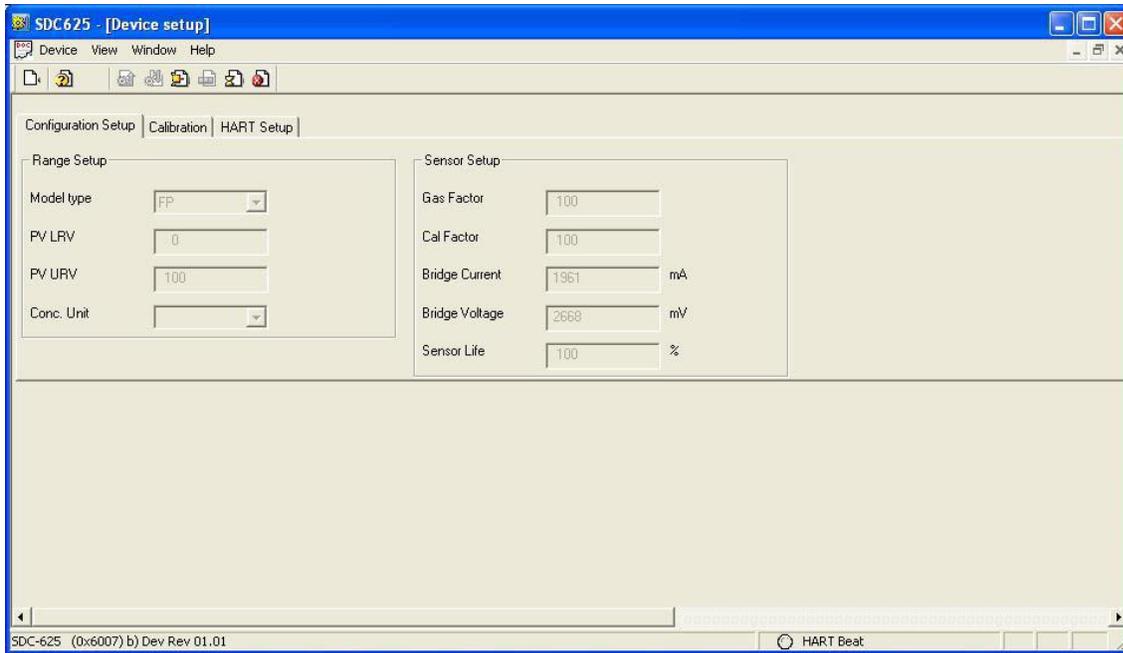
- Unique ID Not Set – The unique device ID for the HRT Bridge PCA has not been set. This ID is set at the Detcon factory prior to shipping. If this error occurs, please contact Detcon technical support.
- DAC Zero Not Calibrated – The 4mA output of the HRT Bridge PCA has not been calibrated. Please see Section 4.4.3.4 for calibration instructions
- DAC Span Not Calibrated – The 20mA output of the HRT Bridge PCA has not been calibrated. Please see Section 4.4.3.4 for calibration instructions
- Modbus Communications Lost – The FP-524D-HRT sensor has failed to respond to more than 3 Modbus poll requests. This error condition can be reset using the “Reset Comm Lost Status” button that appears when this error condition occurs.

#### **4.4.3 Device Setup Menu**

The Device Status Menu consists of three sub menus that allow parameters within the HRT Bridge PCA, and within the sensor to be changed or modified, and allows calibration of the sensor.

##### **4.4.3.1 Configuration Setup**

The Configuration Screen displays the configuration of the FP-524D-HRT sensor. There are no fields that can be changed on this screen, these fields are read directly from the FP-524D-HRT sensor.



**Figure 18 FP Configuration Setup**

The Range Setup will display the Model Type of the sensor, followed by the PV LRV (Primary Variable Lower Range Value) and the PV URV (Primary Variable Upper Range Value), and the Conc Units (Concentration Units), the display may also show the Sensor Range. The Sensor Setup portion of the screen will display sensor specific parameters:

- Gas Factor
- Cal Factor
- Bridge Current
- Bridge Voltage
- Sensor Life

---

**NOTE: The values above are read when the HRT Bridge boots up and are not updated in real-time.**

---

#### 4.4.3.2 Calibration

The Calibration screen displays the days since the last calibration, and the auto span level. This screen also allows the user to calibrate the sensor by performing an Auto Zero Calibration and an Auto Span Calibration. Calibration of the sensor using this feature also notifies the Host that the sensor is in calibration mode.

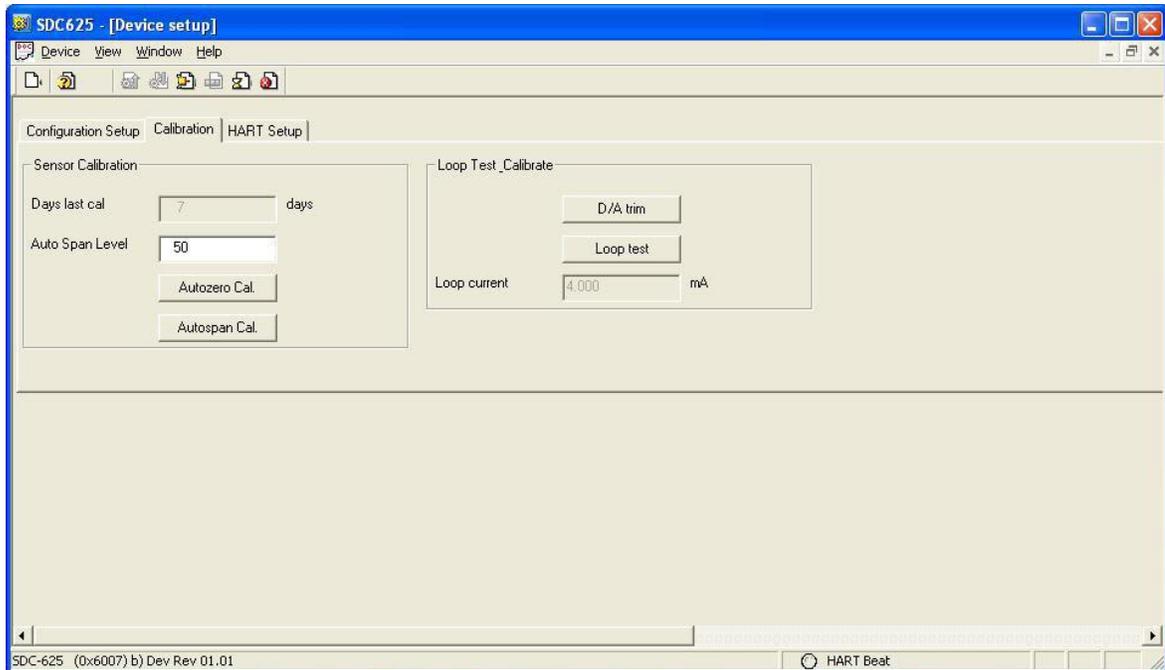


Figure 19 FP Calibration Screen

#### 4.4.3.3 Sensor Calibration using the HRT Bridge

Calibration of a sensor using the HRT Bridge follows the same principle as calibrating the sensor via the magnetic interface. Since most of the calibration information can be found in Section 3.4 Calibration Mode, it is important to have the sensor manual on hand when performing sensor calibration.

#### Auto Zero

Auto Zero function is used to zero the sensor. Local ambient air can be used to zero most sensors as long as there are no traces of target or interference gases. If this cannot be confirmed, then a zero air or N<sub>2</sub> should be used. N<sub>2</sub> *must* be used for zero calibration of O<sub>2</sub> deficiency sensors.

#### Material Requirements:

- Handheld Communicator or PC and interface for HRT Bridge.
- Detcon PN 613-120000-000 Splash Guard with integral Cal Port. -OR-  
-Detcon PN 943-000006-132 Threaded Calibration Adapter
- Detcon PN 942-001123-000 Zero Air cal gas or use ambient air if no combustible gas is present.

---

**NOTE:** The zero gas source should have a normal background concentration of 20.9% O<sub>2</sub>. Pure Nitrogen gas standards should not be used or errors may result.

---



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**NOTE:** Refer to Section 3.4.1 AutoZero. For FP sensors, zero air should be used. Zero Air should have a normal background of 20.89% O<sub>2</sub>. Pure Nitrogen (N<sub>2</sub>) should not be used or errors may result.

---

Auto Zero consists of entering “AutoZero Cal” and following the menu-displayed instructions.

1. If applicable install the Calibration Adapter or Splash Guard Adapter with integral Cal Port.
2. If applicable connect zero gas to the cal port.
3. Select “Autozero Cal” from the Sensor Calibration section of the screen.

4. Upon entering Auto Zero Calibration the procedure will prompt to begin Auto Zero Calibration. If zero gas is to be applied to the sensor, apply the gas.

---

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

---

5. The procedure will prompt to verify that no gas is present, and the sensor will perform Auto Zero.
6. The sensor will scroll “Zero Cal . . . Setting Zero . . . Zero Saved” twice.
7. After successfully setting Zero Cal the sensor and the HART Interface will return to Automatic Mode.
8. Remove the zero gas and calibration adapter if applicable.

## Auto Span

The Auto Span function is used to calibrate the sensor. Unless otherwise specified by the associated sensor manual, span calibration is recommended at 50% of range.

### Material Requirements:

- Handheld Communicator or PC and interface for HRT Bridge.
- Detcon PN 613-120000-000 Splash Guard with integral Cal Port -OR-  
-Detcon PN 943-000006-132 Threaded Calibration Adapter
- Detcon PN 942-520124-050 50% LEL Methane in balance air (recommended) or other suitable span gas containing a certified level of % LEL concentration of combustible gas in air balance. A flow fixed rate of 200-500cc/min is recommended.

---

**NOTE:** Refer to Section 3.4.2 AutoSpan for information regarding Span Gas, flow rates, cross interference, or other sensor specific criteria.

---

Auto Span consists of entering “AutoSpan Cal” and following the display. The procedure will ask for the application of span gas. The applied gas concentration must be equal to the AutoSpan gas level setting. The factory default setting and recommendation for span gas concentration is normally 50% of range. If a span gas containing the recommended concentration is not available, other concentrations may be used as long as they fall between 5% and 100% of range. However, any alternate span gas concentration value must be set in the “**Auto Span Level**” field before proceeding with “AutoSpan cal”.



**CAUTION:** Verification that the calibration gas level setting matches the calibration span gas concentration is required before executing “AutoSpan Cal”. These two numbers must be equal. Refer to the appropriate sensor manual for more information.

1. If applicable install the Calibration Adapter or Splash Guard Adapter with integral Cal Port.
2. Verify that the Auto Span Level is equal to the calibration span gas concentration. If the Auto Span Level is not equal to the Calibration span gas concentration, adjust the Auto Span Level.
3. Connect the Cal Gas to the sensor, but do not apply the gas.
4. Select “AutoSpan Cal” from the Sensor Calibration section of the screen.

---

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

---

5. Upon entering the procedure the procedure will prompt to begin Auto Span Calibration.

- The procedure will prompt to apply span gas. Apply span gas from the attached cal gas cylinder and respond to the prompt.

---

**NOTE:** The sensor reading will respond to the gas and will switch to displaying a flashing “XX”.

---

---

**NOTE:** Assuming acceptable sensor signal change, after 1 minute the reading will auto-adjust to the programmed Auto Span level. During the next 30 seconds, the Auto Span sequence checks the sensor for acceptable reading stability. If the sensor fails the stability check, the reading is re-adjusted back to the Auto Span level and the cycle repeats until the stability check is passed. Up to three additional 30-second stability check periods are allowed before the unit reports a “**Stability Fault**” twice and the sensor will return to normal operation, aborting the Auto Span sequence. The sensor will continue to report a “**Stability Fault**” and will not clear the fault until a successful Auto Span is completed.

---

- If the sensor passes the stability check, the sensor reports a series of messages:
  - “**AutoSpan Complete**”
  - “**Sensor Life XXX%**”
  - “**Remove Span Gas**”
- When the sensor passes calibration the procedure will prompt to remove the span gas. Unsuccessful completion of the span calibration will create a Global Fault, and “AutoSpan Cal” will be aborted with a change to the HART Sensor Status (refer to section 4.4.2.2 Sensor Status).
- After successfully setting span cal the sensor and the HART Interface will return to Automatic Mode.
- The Auto Span Calibration is complete
- Remove the cal gas and calibration adapter if applicable.

---

**NOTE 1:** If the sensor fails the minimum signal change criteria, a “**Range Fault**” will be declared and a “**Fault Detected**” message will be displayed alternately on the sensor with the current reading. The HART Sensor Status will change to reflect a Range Fault.

---

---

**NOTE 2:** If the sensor fails the stability criteria, a “**Stability Fault**” will be declared and a “**Fault Detected**” message will be displayed alternately on the sensor with the current reading. The HART Sensor Status will change to reflect a Sensor Fault.

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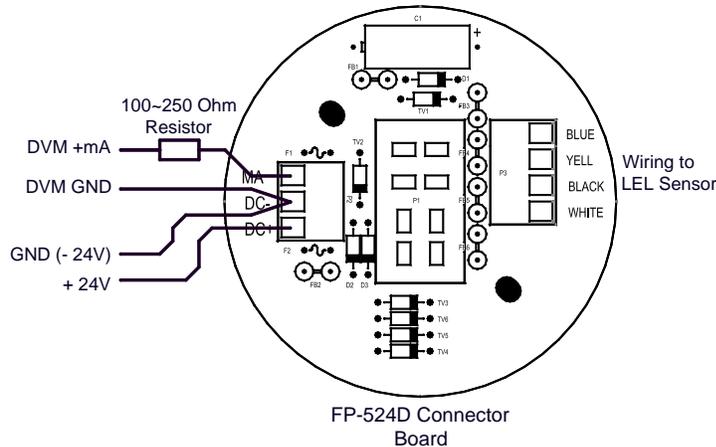
---

**NOTE 3:** If the sensor fails the clearing time criteria, a “**Clearing Fault**” will be declared and a “**Fault Detected**” message will be displayed alternately on the sensor with the current reading. The HART Sensor Status will change to reflect a Clearing Fault.

---

#### 4.4.3.4 Loop Test Calibrate

The Calibration Screen contains a Loop Test Calibration section. This section displays the loop current reading and allows the user to perform D/A trim and Loop Test. D/A trim is used to calibrate the 4mA and 20mA set points in the Digital/Analog converter. Loop test allows the user to set the mA output to any level within range; this can be a good troubleshooting tool for line degradation. A DVM capable of reading milliamps and a 100~250 Ohm resistor are required to perform D/A trim and/or Loop test.



**Figure 20 DVM Connection**

## D/A Trim

- 1) Select “D/A trim” from the Loop test Calibrate section of the screen.
- 2) The procedure will prompt to connect a meter: (Refer to Figure 20.)
  - a) Disconnect the wire from the connector board mA terminal.
  - b) Connect one end of a 100~250Ohm resistor to the mA terminal.
  - c) Connect the positive lead of a DVM set to measure milliamps to the other end of the resistor.
  - d) Connect the negative lead (-) of the DVM to the ‘DC-’ terminal of the connector board.
- 3) The procedure will set the output to 4ma, and prompt for the DVM Reading. Input the reading and select “OK”.
- 4) The HRT Bridge will readjust the output for 4mA, and inquire if the reading is 4mA on the DVM (select “YES” or “NO”).
- 5) If the reading on the DVM is 4mA, select “YES” and “OK” and the HRT Bridge will continue on to 20mA. If the reading is not 4mA, select “NO” and “OK” and the procedure will re-run the 4mA calibration (Step 3).
- 6) The procedure will set the output to 20mA, and prompt for the DVM Reading. Input the reading and select “OK”.
- 7) The HRT Bridge will readjust the output for 20mA, and inquire if the reading is 20mA on the DVM (select “YES” or “NO”).
- 8) If the reading on the DVM is 20mA, Select “YES” and “OK”. If the reading is not 20mA, select “NO” and “OK” and the procedure will re-run the 20mA calibration (Step 6).
- 9) When both the 4mA and the 20mA have been calibrated the procedure will return the HRT Bridge to automatic control.

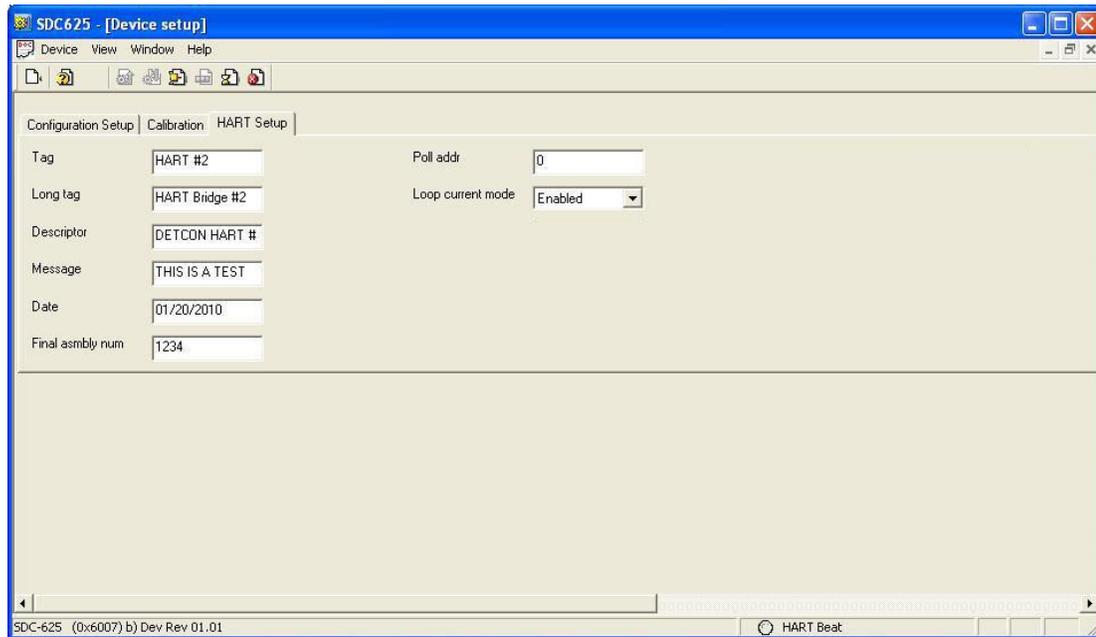
## Loop Test

- 1) Ensure that the DVM is connected as prescribed in Figure 20:
  - a) Disconnect the wire from the Connector Board mA terminal.
  - b) Connect one end of a 100~250Ohm resistor to the mA terminal on the connector board.
  - c) Connect the positive lead of a DVM, set to measure milliamps, to the other end of the resistor.
  - d) Connect the negative lead (-) of the DVM to the ‘DC-’ terminal of the connector board. (Figure 20)
- 2) Select “Loop test” from the Loop test Calibrate section of the screen.
- 3) The procedure will prompt for a setting (“4mA”, “20mA”, “Other”, and “End”).
- 4) Select one of the settings or “End” to exit.
- 5) If “Other” is selected, the procedure will prompt for a value. Only valid values will be accepted.
- 6) Select “OK”.
- 7) The HRT Bridge will set the output for the selected milliamp value.
- 8) Compare the reading on the DVM to the output displayed. Select “OK” when ready to continue

- 9) The procedure will return to Step 3. If “End” is selected, the HRT Bridge will exit Loop test and return to automatic control.

### 4.4.3.5 HART Setup

The HART Setup Screen allows parameters of the HRT Bridge to be changed or modified. Changes made on this screen will not be applied until power is cycled on the unit.



**Figure 21 HART Setup**

- Tag – Text that is associated with the field device installation. This text can be used by the user in any way. A recommended use is a unique label that correlates to a field device label: a plant drawing, or on a control system. This variable is also used as a type of data link layer address handle.
- Long Tag – Functions exactly like the Tag except the size is larger (max 32 ISO Latin 1 characters).
- Descriptor – Text that is associated with the field device. This text can be used by the user in any way. There is no specific recommended use.
- Message – Text that is associated with the field device. This text can be used by the user in any way. There is no specific recommended use.
- Date – Gregorian calendar date that is stored in the field device. This can be used by the user in any way. There is no specific recommended use. Note: This field is not updated by the HRT Bridge and does not indicate the current date.
- Final assembly num – Number that is used for identification purposes, and is associated with the overall field device.
- Poll addr – This number is the address of the HRT Bridge on a network and must be set to 0.

## 5. Service and Maintenance

### Calibration Frequency

In most applications, quarterly to biannual zero and span 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.

### Visual Inspection

The Sensor should be inspected annually. Inspect for signs of corrosion, pitting, and water damage. During visual inspection, the Splash Guard should be inspected to insure that it is not blocked. Examine the porous 316SS flame arrestor within the sensor's bottom housing for signs of physical blockage or severe corrosion. Also, inspect inside the Junction Box for signs of water accumulation or terminal block corrosion.

### Condensation Prevention Packet

A moisture condensation packet should be installed in every explosion proof junction box. The moisture condensation prevention packet will prevent the internal volume of the J-Box from condensing and accumulating moisture due to day-night humidity changes. This packet provides a critical function and should be replaced annually. Detcon's PN is 960-202200-000.

### Replacement of Combustible Gas Sensor

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**NOTE:** It is necessary to remove power while changing the combustible gas sensor in order to maintain area classification while the junction box cover is removed. Proper "Hot Permits" may apply.

---

- a) Remove the junction box cover and remove the Transmitter Module from the Connector PCB.
- b) Unthread the lower half of the sensor housing. The lower housing includes two recessed holes for a spanner wrench if needed.
- c) Gently pull on the combustible gas cell to unplug it from the upper housing.
- d) Orient the new plug-in sensor so that it matches with the female connector pins, and plug it into the upper housing.
- e) Thread the lower housing back into the upper housing and tighten using a spanner wrench.
- f) Perform "Set Bridge Voltage" (Section 3.5.5) to match the new combustible gas sensor with the Transmitter Module.
- g) Perform a successful AutoZero and AutoSpan to match the new combustible gas sensor with the Transmitter Module (Section 3.4).

### Replacement of Transmitter Module

- a) Remove the junction box cover and unplug the Transmitter Module from the Connector PCB.

---

**NOTE:** It is necessary to remove power to the junction box while changing the transmitter module in order to maintain area classification.

---

- b) Plug the new Transmitter Module into the connector PCB, and reinstall the junction box cover.
- c) Perform Set Bridge Voltage and Set AutoSpan Level and then perform a successful AutoZero and AutoSpan before placing sensor assembly into operation.

## Replacement of the Connector PCB

---

**NOTE:** It is necessary to remove power to the junction box while changing the connector PCB in order to maintain area classification.

---

- a) Remove the junction box cover and remove the transmitter module from the connector PCB.
- b) Remove the black, white, blue, and yellow wires coming from the combustible gas sensor from the connector PCB.
- c) Remove the output wiring from the connector PCB terminals labeled DC+, DC-, and MA.
- d) Remove the two 6-32 screws holding the Connector PCB to the base of the junction box, and remove the connector PCB.
- e) Install the new connector PCB using the two 6-32 screws removed in step d).
- f) Re-connect the output wiring to the terminals labeled DC+, DC-, and MA on the connector PCB,
- g) Reconnect the black, white, blue, and yellow wires from the combustible gas sensor to the connector PCB.
- h) Reinstall the transmitter module, and the junction box cover.

## 6. Troubleshooting Guide

Refer to the list of failsafe diagnostic features listed in Section 3.6.2 for additional reference in troubleshooting activities. Listed below are some typical trouble conditions and their probable cause and resolution path.



**Figure 22 Replaceable Combustible Gas Sensor**

### Sensor Current/Voltage Fault

Probable Cause: Plug-in sensor has failed

Remove plug-in sensor and verify resistance between PIN 5 and PIN 7 and PIN 2 and PIN 4 using an ohmmeter. At room temperature, the normal reading range should be 2.5-3.5 ohms for both catalytic beads.

Replace plug-in sensor if either measurement is open circuit or significantly out-of range.

### Zero Fault

Probable Causes: Plug-in sensor has drifted

Perform AutoZero calibration per Section 3.4.1

Replace the plug-in sensor.

### AutoSpan Calibration Faults – (Range, Stability, and Clearing)

To clear any AutoSpan Calibration fault, the AutoSpan process must be completed successfully (Section 3.4).

### Range Fault

Probable Causes: Failed sensor, cal gas not applied or not applied at appropriate time, or problems w/ cal gas and delivery

Check bridge voltage (should be 2.7 +/- 0.2VDC).

Check validity of span gas and flow rate (check MFG date on cal cylinder).

Make sure correct cal factor is set

Check for obstructions through stainless steel sinter element (including being wet).

Replace the plug-in sensor.

### Stability Fault

Probable Causes: Failed sensor, empty or close to empty cal gas cylinder, or problems w/ cal gas and delivery

Check bridge voltage (should be 2.7 +/- 0.2VDC).

Check validity of span gas and flow rate (check MFG date on cal cylinder).

Make sure correct cal factor is set

Check for obstructions through stainless steel sinter element (including being wet).

Replace the plug-in sensor.

### Clearing Fault

Probable Causes: Failed sensor, cal gas not removed at appropriate time, problems w/ cal gas and delivery, or Background combustible gases preventing clearing  
Confirm that no combustible gasses are present in background.  
Check bridge voltage (should be 2.7 +/- 0.2VDC).  
Check validity of span gas and flow rate (check MFG date on cal cylinder).  
Make sure correct cal factor and gas factor is set  
Check for obstructions through stainless steel sinter element (including being wet).  
Replace the plug-in sensor.

### **Poor Calibration Repeatability**

Probable Causes: Failed sensor, use of wrong cal gas, problems w/ cal gas and delivery, or poison or inhibitor gases  
Check for adequate sensor life.  
Check bridge voltage (should be 2.7 +/- 0.2VDC).  
Check validity of span gas and flow rate (check MFG date on cal cylinder).  
Check for obstructions through stainless steel sinter element (including being wet).  
Evaluate area for presence of poisoning or inhibiting gases as listed in Section 2.3.  
Increase calibration frequency.  
Note the sensor's serial # and report repetitive problems to Detcon's Repair Department.  
Replace plug-in sensor.

### **Unstable Output/ Sudden spiking**

Possible Causes: Unstable power supply, inadequate grounding, or inadequate RFI protection  
Verify power source is stable.  
Verify field wiring is properly shielded and grounded.  
Contact Detcon to optimize shielding and grounding.  
Add Detcon's RFI Protection Circuit accessory if problem is proven RFI induced.

### **Nuisance Alarms**

Check conduit for accumulated water and abnormal corrosion on terminal blocks.  
If nuisance alarms are happening at night, suspect condensation in conduit. Add or replace Detcon's Condensation Prevention Packet P/N 960-202200-000.  
Investigate the presence of other target gases that are causing cross-interference erroneous readings.  
Determine if cause is RFI induced.

### **Processor and/or Memory Faults**

Recycle power in attempt to clear problem  
Restore factory defaults - This will clear the processor's memory and may correct problem. Remember to re-enter all customer settings for range and cal gas level after Restore Factory Defaults.  
If problem persists, replace the plug-in transmitter module.

### **Unreadable Display**

If due to excessive sunlight, install a sunshade to reduce glare.

### **Nothing Displayed – Transmitter not Responding**

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

### Faulty 4-20mA Output

If sensor has a normal reading with no faults displayed, and the 4-20 mA signal output is 0mA....

Check that wiring is properly connected at terminal blocks and through to controller inputs.

The 4-20mA output loop must be closed (resistance of < 1000 ohms) to avoid the Loop Fault.

Perform a “Signal Output Check” sequence via Section 3.5.6 and verify 4-20mA output with current meter.

Swap with a known-good transmitter module to determine if the transmitter module’s 4-20mA output circuit is faulty.

If the 4-20mA current loop is still out of tolerance, contact Detcon at [Service@detcon.com](mailto:Service@detcon.com), or contact Detcon customer service.

## 7. Customer Support and Service Policy

Detcon Headquarters

Shipping Address: 4055 Technology Forest Blvd, Suite 100, The Woodlands Texas 77381

Mailing Address: P.O. Box 8067, The Woodlands Texas 77387-8067

Phone: 888.367.4286, or 281.367.4100

Fax: 281.292.2860

- [www.detcon.com](http://www.detcon.com)
- [service@detcon.com](mailto:service@detcon.com)
- [sales@detcon.com](mailto:sales@detcon.com)

All Technical Service and Repair activities should be handled by the Detcon Service Department via phone, fax or email at contact information given above. RMA numbers should be obtained from the Detcon Service Department prior to equipment being returned. For on-line technical service, customers should have ready the model number, part number, and serial number of product(s) in question.

All Sales activities (including spare parts purchase) should be handled by the Detcon Sales Department via phone, fax or email at contact information given above.

### Warranty Notice

Detcon Inc. warrants the Model FP-524D-HRT combustible gas sensor to be free from defects in workmanship of material under normal use and service for two years from the date of shipment on the transmitter electronics and for a 2-year period on the plug-in combustible gas sensor. See Warranty details in Section 8 FP-524D-HRT Sensor Warranty.

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

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

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

Except for the express warranty stated above, Detcon Inc. disclaims all warranties with regard to the products sold. Including all implied warranties of merchantability and fitness and the express warranties stated herein are in lieu of all obligations or liabilities on the part of Detcon Inc. for damages including, but not limited to, consequential damages arising out of, or in connection with, the performance of the product.

## 8. FP-524D-HRT Sensor Warranty

### Plug-in Combustible Gas Sensor Warranty

Detcon Inc. warrants, under normal intended use, each new plug-in combustible gas sensor (PN 365-037020-160). The warranty period begins on the date of shipment to the original purchaser and ends 2 years thereafter. The sensor element is warranted free of 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., 4055 Technology Forest Blvd, Suite 100, The Woodlands, Texas 77381, for necessary repairs or replacement.

#### Terms & Conditions

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

### Transmitter Module Warranty

Detcon Inc. warrants, under intended normal use, each new transmitter module to be free from defects in material and workmanship for a period of two years from the date of shipment to the original purchaser. All warranties and service policies are FOB the Detcon facility located in The Woodlands, Texas.

#### Terms & Conditions

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

## 9. Appendix

### 9.1 Specifications

Sensor Type:	Continuous diffusion/adsorption type Matched-Pair Catalytic Bead type True plug-in replaceable type
Sensor Life:	3-5 years typical
Measuring Ranges:	0-100% LEL
Accuracy/ Repeatability:	± 3% LEL in 0-50% LEL range, ± 5% LEL in 51-100% LEL range
Response Time:	T50 < 10 seconds, T90 < 30 seconds
Performance Testing:	Complies with CSA C22.2 No. 152-M1984, ANSI/ISA S12.13
Electrical Classification:	CSA and US (NRTL) Class I, Division 1, Groups B, C, D
Approvals:	cCSA <sub>US</sub>
Applicable Standards	CSA C22.2 No. 30-M1986 CSA C22.2 No. 142-M1987 CSA C22.2 No. 152-M1984 UL Std. No. 916 UL Std. No.1203 ANSI/ISA S12.13
Warranty:	Electronics – 2 years Sensor – 2 years

### Environmental Specifications

Operating Temperature:	-40°C to +75°C
Storage Temperature:	-40°C to +75°C
Operating Humidity:	0-100% RH (Non-condensing)
Operating Pressure:	Ambient ± 10%

### Electrical Specifications

Input Voltage:	12-28 VDC
Power Consumption:	Normal operation = 68mA (<1.7 watt); Maximum = 87mA (2 watts)
RFI/EMI Protection:	RFI Complies with ISA 92.0.01
Output:	Linear 4-20mA DC current with HART <sup>®</sup> Communication Protocol

	1000 ohms maximum loop load @ 24VDC
	0mA All Fault Diagnostics
	2mA In-Calibration
	4-20mA 0-100% full-scale
	22mA Over-range condition
HART Version	7.0
Manufacture ID	0x6007
Device ID	0xE08B
Status Indicators:	4-digit LED Display with gas concentration, full-script menu Prompts for AutoSpan, AutoZero, Set-up Options, and Fault Reporting
Faults Monitored:	Loop Fault, Input Voltage Fault, Zero Fault, Sensor Fault, Processor Fault, Memory Fault, Calibration Fault(s)
Cable Requirements:	Power/Analog: 3-wire shielded cable Maximum distance is 13,300 feet with 14 AWG
<b>Mechanical Specifications</b>	
Length:	5 inches (200mm), including Splashguard
Width:	6.1 inches (140mm)
Weight:	2.7lbs (3.4Kg)
Mechanical Connection:	¾" Male NPT threaded connection
Electrical Connection:	three 14 gauge (maximum) wire terminal landings

## 9.2 Spare Parts, Sensor Accessories, Calibration Equipment

Part Number	Spare Parts
925-525HD0-100	FP-524D Plug-in Transmitter Module with HRT Bridge
365-037020-160	Replacement Plug-in Sensor
600-02056-0	FP-P Plug-in Hsg Threaded Insert 316SS
612-820000-000	Replacement LEL sensor housing (includes threaded insert)
500-005065-007	Standard Connector PCB
960-202200-000	Condensation prevention packet (for J-Box replace annually)
<b>Sensor Accessories</b>	
897-850800-010	NEMA 7 Aluminum Enclosure less cover – 3 port
897-850500-010	NEMA 7 Aluminum Enclosure Cover w/glass lens (Blank)
897-850801-316	NEMA 7 316SS Enclosure less cover – 3 port
897-850701-316	NEMA 7 316SS Enclosure Cover w/glass lens (Blank)
613-120000-000	Sensor Splashguard with integral Cal-Port
943-002273-000	Harsh Location Dust guard 1.5”
327-000000-000	Programming Magnet
960-202200-000	Condensation prevention packet (for J-Box replace annually)
<b>Calibration Accessories</b>	
943-000006-132	Threaded Calibration Adapter
943-020000-000	Span Gas Kit: Includes calibration adapter, In-Line Humidifying Tube, 200cc/min fixed flow regulator, and carrying case. (Does Not include gas).
942-520124-050	Span Gas cylinder: 50% LEL Methane balance air Contains 104 liters of gas and is good for 175 calibrations
943-090005-502	200cc/min Fixed Flow Regulator for span gas bottle
<b>Recommend Spare Parts for 2 Years</b>	
925-525HD0-100	FP-524D Plug-in Transmitter Module with HRT Bridge
365-037020-160	Replacement Plug-in Sensor
600-02056-0	FP-P Plug-in Hsg Threaded Insert 316SS
612-820000-000	Replacement LEL sensor housing (includes threaded insert)
500-001794-004	Standard Connector PCB
960-202200-000	Condensation prevention packet (for J-Box replace annually)

## 9.3 Revision Log

Revision	Date	Changes made	Approval
0.0	12/01/2010	Initial Release	LBU
0.1	04/23/12	Updated Section 2.6 Field Wiring, load resistor.	LU
0.2	10/31/13	Add setting LED Alarm Levels	LU
0.3	10/25/17	Updated Sensor Drawings and Dimensions	LU
0.4	06/05/18	Update conduit seal requirement	MM