STATUS SCIENTIFIC CONTROLS

Issue: 10

Date: 21/1/19

Firmware: V2.1.0

Installation, Commissioning & Routine Gas Testing Manual

Gas Detector
Type FGD10A-M

Declaration of Conformity

We declare that, on the date the equipment accompanied by this declaration is placed on the market, the equipment conforms with all technical and regulatory requirements of the directives listed below.

Description of Equipment:

The FGD10A-M Series of Fixed Gas Detectors for the detection of Oxygen, Toxic or Flammable gases.
ATEX Flameproof Certified for use in Group IIC hazardous locations.

Directive 2014/34/EU ATEX

The following harmonised standards were used in support of this declaration:

EN 60079-0:2012+A11:2013 Explosive atmospheres Part 0: Equipment – General requirements
The FGD10 was originally certified to standard **EN 60079-0:2006.** This standard has been compared with the above harmonised standard and no significant changes have occurred that are applicable this equipment.

EN 60079-1:2014 Explosive atmospheres Part 1: Equipment protection by flameproof enclosures 'd'.
The FGD10 was originally certified to standard **EN 60079-1:2007** but is considered compliant with the above harmonised standard because both the instrument housing and GSH4 sensor housing are certified to that standard.

Notified Body for Hazardous Area Certification:	**Notified Body for ATEX Quality Assurance Notification:**
SIRA Certification Service Rake Lane, Eccleston, Chester, CH4 9JN. Notified Body Number: 0518	Baseefa Rockhead Business Park Staden Lane, Buxton SK17 9RZ, UK Notified Body Number: 1180
Hazardous Area Certificate Number: SIRA 08ATEX1031X II 2 G Ex d IIC T4 (Ta = -20°C + 60 °C) T5 (Ta = -20°C + 50 °C) * T5 & T6 ratings are not valid for T6 (Ta = -20°C + 35 °C) versions fitted with an externally mounted sensor.	**ATEX Quality Assurance Notification Number:** 2056
Place of Manufacture: Mansfield, Nottinghamshire, UK. Date mark applied – see product	**ISO 9001:2015 Quality Management System:** Certificate No. GB93/1938

2014/30/EU – Electromagnetic Compatibility

Harmonised Standards:

EN50270:2006 Electromagnetic compatibility - Electrical apparatus for the detection and measurement of combustible gases, toxic gases or oxygen.

Authorised Signatory to this declaration, on behalf of the manufacturer:

Name: David Stuttard Title: Managing Director

Address: Status Scientific Controls Ltd, Hermitage Lane Industrial Estate, Kings Mill Way
Mansfield, Nottinghamshire, NG18 5ER, United Kingdom

Signature  Date: 21/1/19

CONTENTS

1. FIRMWARE REVISION

V2.1.0 29/04/14	New features and bug fixes. Bug fix for Hydrogen (Toxic) in Gain Set Menu. SSCL (only) factory setup menu. RTC calibration in TIME menu. Extra diagnostic menu and diagnostic functions
V2.0.4 29/01/14	Fix for diagnostics –Oxygen-display span data.
V2.0.3 22/12/13	Pellistor support added. Enhanced menu system. Modbus support added.
V2.0.2 08/11/13	Enhanced context sensitive menus. Modbus NOT supported in this release
V2.0.1 06/09/13	Release for Exhibition. Flammable gases list
V2.0.0 28/06/13	Initial release – Modbus version

2. PACKAGE CONTENTS

The FGD10A-M is supplied in a box containing the following items:-

Description
FGD10A-M Gas Detector
Magnetic pen
Installation manual
Calibration certificate

Optional:-

Weather guard

3. SCOPE OF THE MANUAL

This manual relates to versions of the FGD10A-M gas detector with one of the following sensor types:-

- An Infrared sensor for the detection of Hydrocarbon (HC) or CO2 gases
- A Pellistor sensor for the detection of hydrocarbon and hydrogen gases
- A Toxic sensor
- An Oxygen sensor

Note – Infrared sensors are unsuitable for the detection of Hydrogen. However, this gas can be detected using a version of the FGD10A-M fitted either with pellistors or suitable electro-chemical sensors.

4. DESCRIPTION

FGD10A-M GAS DETECTOR

FGD10A-M GAS DETECTOR FITTED WITH PROTECTIVE WEATHERGUARD

The FGD10A-M is an explosion protected ATEX and IECEx certified fixed gas detector for use in potentially explosive atmospheres. The unit may be optionally fitted with a protective weather guard as shown in the photograph.

IMPORTANT – When used in hostile environments (e.g. oil platforms where the instrument is exposed to salt spray or diesel) it is recommended that the FGD10A-M is always fitted with its protective weather guard. The weather guard is attached with tamperproof screws to ensure that it is not inadvertently removed.

The unit comprises an instrument housing having two cable gland entries and containing the connection terminals, electronics and display window.

The housing containing the gas sensor has an M27 thread and is screwed into the bottom of the unit. The sensor housing itself is a certified component and must not be removed in service.

Behind the display window are:-

- A 160x128 graphics OLED display
- Four magnetically operated switches that are activated through the display window using a magnetic pen that is supplied with the unit.
- LED indicators for POWER

The magnetically operated switches allow the unit to be calibrated whilst power is still applied without the need to remove the cover from the unit.

The main electrical features of the unit are:-

- Power supply – 8 to 24 volts dc (non-intrinsically safe)
- Analogue output – 4 to 20mA dc
- RS485 communications output.
- Relay contact outputs for Alarm 1, Alarm 2 and Fault.
- Gland entry threads available – 20mm, ½” or ¾” NPT

4.1. Relays

The FGD10A-M relay version has 3 factory-fitted relays. Each provides a set of voltage free changeover contacts to perform the following control functions:-

- Alarm Level 1
- Alarm Level 2
- Fault

Versions without relays fitted are also available.

The self-adhesive label on the outer surface of the enclosure indicates whether or not the relays are fitted as shown below:-

GAS DETECTOR TYPE FGD10
NO CONTROL RELAYS FITTED

GAS DETECTOR TYPE FGD10
CONTROL RELAYS FITTED

5. INSTALLATION

It is important that the correct cable and gland types are used when installing the FGD10A-M in a hazardous location.

The cable entry devices and blanking elements of unused apertures shall be of a certified flameproof type, suitable for the conditions of use and correctly installed.

With the use of conduit, a suitable certified sealing device such as a stopping box with compound shall be provided immediately at the entrance to the flameproof enclosure.

In order to prevent dangerous overloading of the FGD10A-M gas detector, it is important that the installer observes the relay contact rating and ensures that external circuits connected to the relay contacts are suitably protected from exceeding that rating and associated cabling is adequately rated and suitably installed.

Guidance on the correct installation of systems is provided by EN60079-14: 2008. It is the responsibility of the installer to ensure compliance with the relevant standards.

To ensure effective gas detection, the FGD10A-M must be located at a height appropriate to the density of the target gas relative to air. For example, Methane (relative density 0.55) is lighter than air and so it will tend to accumulate at a high level within a confined space. Whereas Petroleum (relative density 2.8) is heavier than air and it will tend to accumulate at around ground level.

European standard EN 60079-20-1:2010 provides comprehensive flammability data (including relative density) on approximately 300 types of gases.

5.1. Cable entries

The cable entry threads are 20mm, ½" or ¾" NPT female.

The FGD10A-M enclosure is manufactured from die cast aluminium. Therefore, the use of glands, conduit fittings and blanks made from brass should be avoided because if moisture is present, bi-metallic corrosion may occur due to the chemical reaction between the two materials.

Glands and fittings plated with nickel, tin or zinc will provide improved protection but in harsh environments the use of stainless steel is recommended.

When connecting the cores inside the unit it is beneficial to use pointed-nose pliers to carefully guide the cable cores from the cable entries at the rear of the enclosure towards the PCB mounted terminal connections situated near to the front of the enclosure.

5.2. Mounting and terminal access

The FGD10A-M should be mounted and secured using the mounting holes on the main unit.

Figures 2 and 3 shows details of the FGD10A-M terminal connections – these can be accessed as follows:-.

1. Switch OFF the supply to the FGD10A-M.
2. Release the grub screw located near the lip of the enclosure cover.
   Note: It is not necessary to completely remove the grub screw to release the enclosure front cover.
3. Remove the enclosure front cover by rotating it several times in an anti-clockwise direction.
4. Unplug the top display board from within the enclosure by pulling it forwards. The board is captivated by means of a nylon wire in order to prevent it falling from the unit – take care to ensure that the board is not damaged during installation. See Figure 1.
5. The terminals can now be accessed.

Store the front cover such that it cannot be damaged or the thread contaminated with dirt.

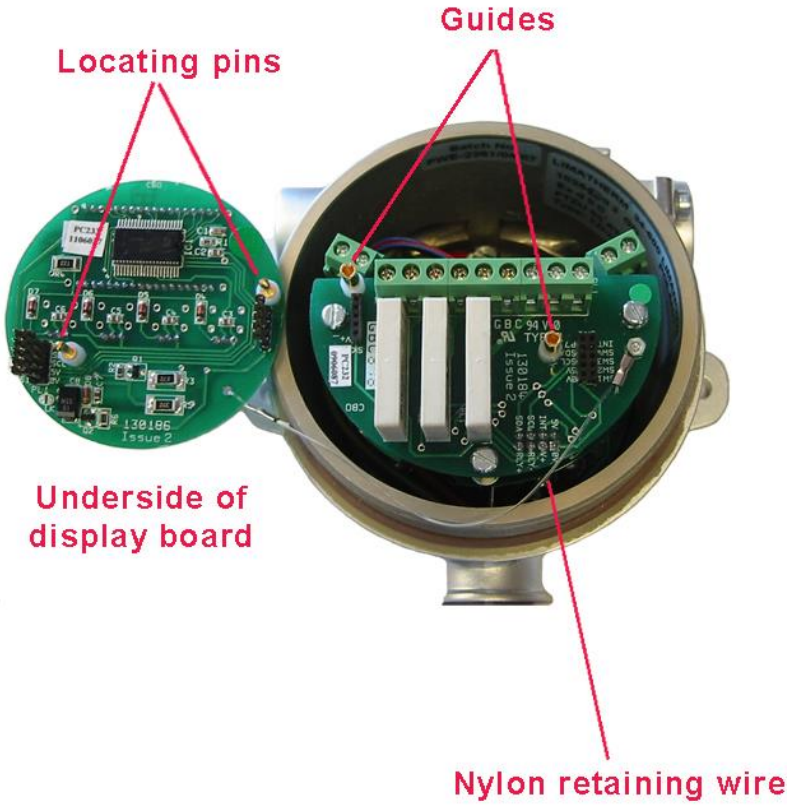


Figure 1 – Unplugging the display board for connection purposes

5.3. FGD10A-M connections

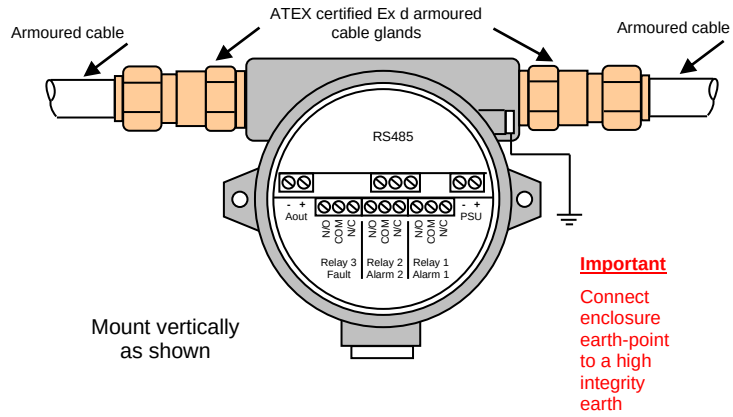


Figure 2 – Armoured Cable Gland Installation

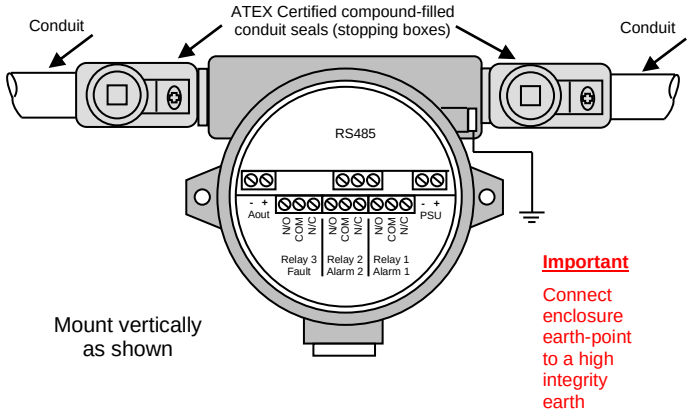


Figure 3 – EEx d Conduit Installation

5.4. Power Supply

The FGD10A-M is powered from a 8 – 24 volt dc, 5 W maximum output supply. This may be either:-

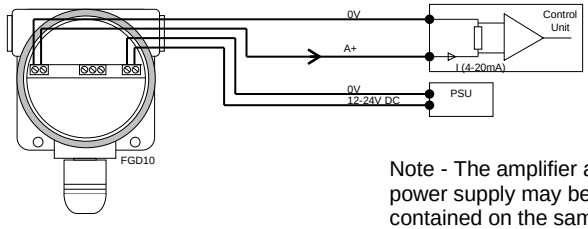
a) An independent supply powering one or more units.

b) A supply that is an integral part of a control card within a monitoring panel.

5.5. Analogue Output

The analogue output provides a means of indicating to external equipment (e.g. data loggers, remote displays, control cards) the gas levels currently being detected by the system. The output is in the form of the industry standard 4 to 20mA current source.

The analogue output is factory set such that 4mA represents zero gas and 20mA represents the full scale gas level of the FGD10A-M.



Note - The amplifier and power supply may be contained on the same control card.

Figure 4 – Analogue Output

5.6. RS485 Output

This output is designed to be compatible with a suitable controller fitted with an RS485 serial communications port.

6. COMMISSIONING

Following completion of the installation:-

a) Replace the top display board using the locating pins on the underside of the board to ensure that it makes connection with the remainder of the electronics - see Figure 1.

b) Ensure that the front cover has not been contaminated with dirt - paying particular attention to the thread. Replace the cover by rotating it several times clockwise until it reaches its limit then secure using the grub screw – do not over tighten.

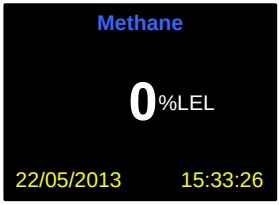
6.1. Applying power

Once the installation is complete and the covers are secure then power can be applied. The power source should be between 8 and 24 volts dc.

When power is first applied to the FGD10A-M, an initialisation procedure is performed as follows:

The FGD10A-M now displays the time remaining before the unit is fully functional, usually 45 seconds, in the form of a progress bar. After the warm-up time the detected gas level present is displayed and the FGD10A-M becomes operational.

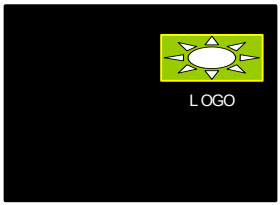
The normal screen is shown below:



6.2. Screen Saver

The OLED display can shown signs of display retention when areas of the screen are constantly illuminated. These effects reveal them selves when the background is a colour other than black.

The screen defaults to a screen saver mode where the display alternates between the display logo and the actual gas readings, as seen below:



The logo and the gas readings alternate and appear at random positions on the screen.

The screen normally will display the normal screen for 1 minute then will show the screen saver for between 1 and 10 minutes.

The screen saver mode can be set up using the menu options as described later

The screen saver is deactivated for the following conditions

1) During alarm conditions
2) During a fault condition
3) On a key press, resets the normal display to 1 minute
4) During the menu options

6.3. Indicators

Green Led for power.
Display colour changes to red for alarms and Yellow for faults.

Colour	Identity	Operation
Red Display	Alarm	Display flashes a coloured box when an alarm level has been reached.
Green LED	Power	Always ON when power is connected.
Yellow Display	Fault	Display flashes a coloured box when a fault is a detected.

7. RELATIVE RESPONSE CHARACTERISTICS

Unless otherwise specified, the FGD10A-M infrared hydrocarbon gas detector is calibrated to provide an output signal linearised for methane (CH_4) during manufacture.

However, the gas detector will also respond to a range of hydrocarbon gases. The characteristics shown in Figure 5 demonstrate the relative response to some of the common hydrocarbons.

If the expected target gas is other than methane then either:-

a) The characteristics can be used as a guide when setting up the alarm levels in the associated control unit, e.g. where a general hydrocarbon response is required.

b) The FGD10A-M can be calibrated using a test gas for any of the gases shown in Figure 5, using the span setting procedure as described in Section 9.1.3.

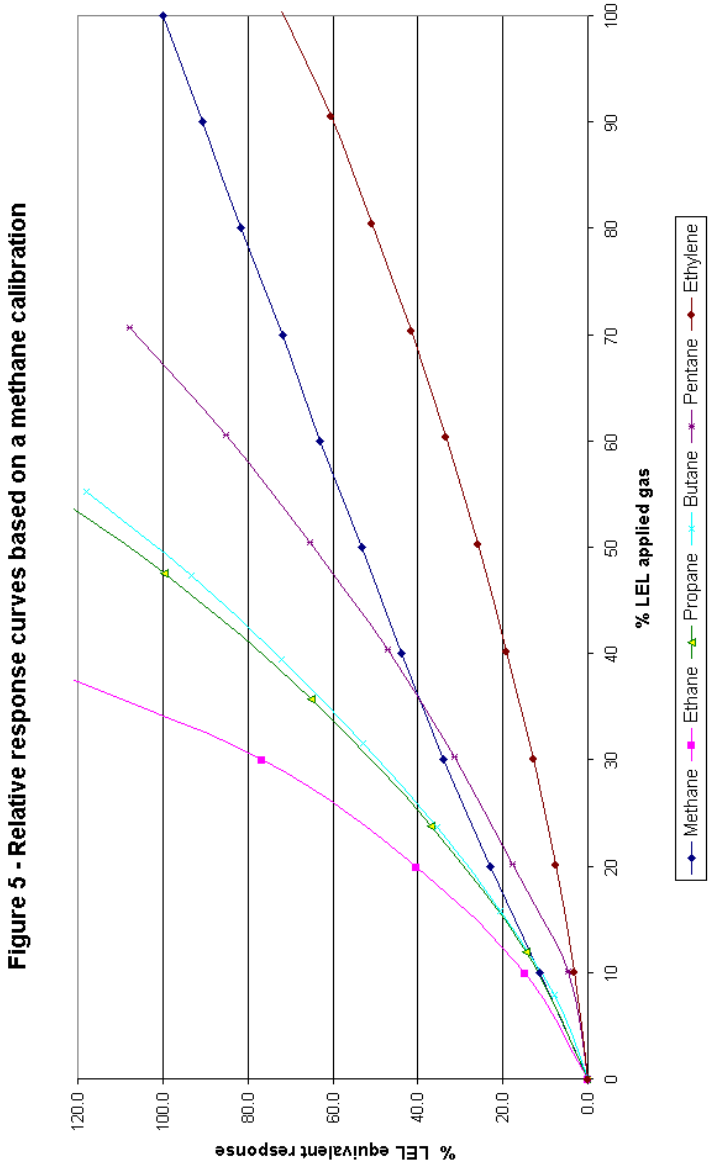


Figure 5 - Relative response curves based on a methane calibration

8. INITIAL GAS TESTING

FGD10A-M units are factory calibrated as detailed on the calibration certificate supplied with the instrument. However, it is always advisable after installation to confirm that the instrument reads zero with no gas present and responds accurately when presented with an appropriate concentration of the target gas.

The FGD10A-M display becomes operational within 60 seconds however, the sensor should be allowed to stabilise for the period specified on the associated calibration certificate before attempting to check the zero setting and gas response, usually 30 minutes.

8.1. Zero gas

With no gas present check that the instrument reads zero on the display *.

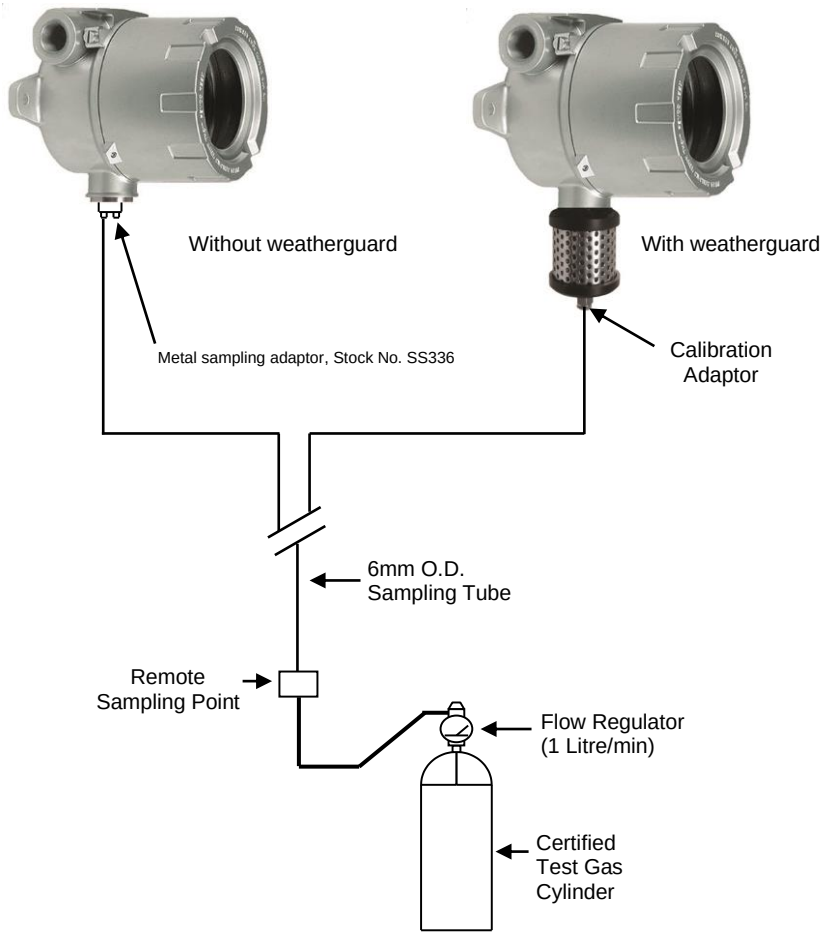
a) If the instrument reads zero then no adjustment is required and gas response testing may now be carried out as described in Section 8.2.

b) If the instrument does not read zero then adjustment of the zero setting is required as described in Section 9.1.2. - Sensor Zero.

c) If the analogue signal is connected to an associated control panel, confirm that when the FGD10A-M display reads zero, the control panel display also reads zero or, adjust as necessary in accordance with the control panel manufacturers' instructions.

** Note – If there is the possibility of a background gas being present then zeroing of the detector should be carried out using a test gas cylinder of air in nitrogen.*

Figure 6 – Arrangement for Application of a Certified Test Gas



8.2. Test gas

Figure 6 shows a typical arrangement for the application of a certified test gas.

The purpose of the test gas response check is to confirm that that the reading on the instrument corresponds with the test gas concentration.

a) If the instrument reads correctly then no adjustment is required.

b) If the analogue signal is connected to an associated control panel, confirm that the reading corresponds with that on the FGD10A-M or adjust as necessary in accordance with the control panel manufacturer's instructions.

c) If the above checks are satisfactory then the installation is now complete.

d) If the instrument does not read correctly then adjustment of the sensor span setting is required as described in Section 9.1.3. - Sensor Span.

8.2.1. Gas connection points

Certified test gas can be applied either:-

a). directly to the FGD10A-M via the appropriate sampling/calibration adaptor.

or

b). remotely, by connecting a test gas sampling tube to the appropriate sampling/calibration adaptor and installing a test point at the remote end of the tube.

Method b) avoids the need to gain direct access to the unit in order to carry out routine gas testing. The sample tube should be taken to a convenient point and sited such that the risk of contamination is minimised. A means must be provided to 'cap off' the tube when not in use in order to prevent blockage.

The weather guard is provided with a 6mm O.D. push in tube connector to allow connection of a gas sampling tube. Firstly, remove the blanking plug by depressing the coloured plastic ring whilst pulling on the plug; now push in the gas sampling tube. The standard fitting is a push fit connector for 6mm O.D tubing. The connector is screwed into a 1/8" BSP thread; other fittings are available on request.

Where a weather guard is not fitted, the use of a sampling adaptor (Stock No. SS336) is required in order to present the gas to the FGD10A-M sensor.

8.2.2. Sampling time

Apply the test gas and allow a sufficient time for the sample to reach the gas detector. The response time will vary according to the length of the sampling tube.

8.2.3. Suggested calibration gas levels.

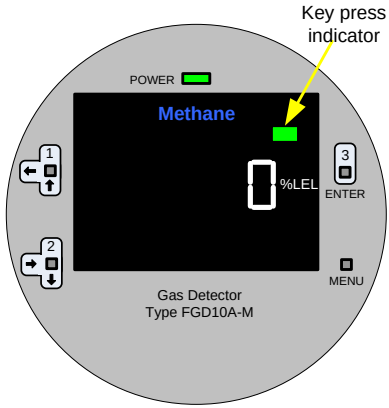
Hydrocarbon sensor:

Zero gas free air.

Span 50% of the measuring range.

9. SOFTWARE FEATURES

The menu system featured within the FGD10A-M allows all calibration and configuration activities to be performed.



The magnetic keypad has the following functionality:

Button	Function	Alternate Function
MENU	Open / Close Menu	Password
1	Left / Next / Increase	1
2	Right / Previous / Decrease	2
3 ENTER	Accept selection	3

This section of the manual discusses how the available menu options can be accessed, how the associated parameter may be changed via the selected menu option and what effect the change to the parameter has on the operation of the FGD10A-M.

The FGD10A-M incorporates magnetically operated switches to allow non-intrusive operation of the menu system. To *'press'* the switch requires movement of the stylus pen over the appropriate button. In some instances it may be necessary to hold the pen over the button for sufficient time to allow the microcontroller to determine the key that has been *pressed*.

A green square is shown on the display every time a key is 'pressed'.

Note: It is important that that the FGD10A-M is correctly configured for the sensor in use, prior to performing any feature available in the menu system.

9.1. Menu Selection

The FGD10A-M uses a password system to restrict the end user from carrying out certain changes that may compromise the use of the equipment.

Setting the password to OFF will give the user access without compromise.

9.1.1. Password Enabled Menu

The following options are available, without a password:

Press the MENU button, the display will ask for a password, press the MENU button again.

Zero
Span
Loop 4 mA
Loop 20 mA
Version

If the correct password is entered after the first MENU button press then the full MENU system is available to the user. Note: the following table lists all the menu options. The type of sensor fitted, will determine the menu options displayed as shown:

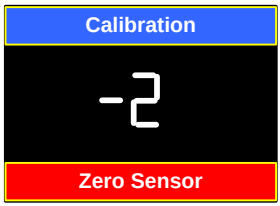
			"Restore" Menu sensor types				
Menu Option	**Access**	**Comments**	**Infra Red (flam)**	**Infra Red (CO2)**	**PELL**	**OXY**	**TOX 1-8**
Zero Sensor	Always		√	√	√	√	√
Span Sensor	Always		√	√	√	√	√
Sensor Fsd	Via password 1	Set by user	√	√	√	√	√
Loop 4 mA	Always		√	√	√	√	√
Loop 20 mA	Always		√	√	√	√	√
Version	Always		√	√	√	√	√
Alarms Levels	Via password 1	Set by user	√	√	√	√	√
Relay Modes	Via password 1	Set by user	√	√	√	√	√
Latching Relays	Via password 1	Set by user	√	√	√	√	√
Password Enable	Via password 1	Set by user	√	√	√	√	√
Set Password	Via password 1	Set by user	√	√	√	√	√
Diagnostics	Via password 1	Set by user	√	√	√	√	√
Hysteresis	Via password 1	Set by user	√	√	√	√	√
Display	Via password 1	Set by user	√	√	√	√	√
Warm-up Timer	Via password 1	Set by user	√	√	√	√	√
Pos Zero	Via password 1	Set by user	√	√	√	√	√
Neg Zero	Via password 1	Set by user	√	√	√	√	√
Time	Via password 1	Set by user	√	√	√	√	√
Screen Saver	Via password 1	Set by user	√	√	√	√	√
Restore	Via password 1	Set by user	√	√	√	√	√
Sensor Type	Via password 1	Set by user	√	√	√	√	√
Sensor Bias	Via password 1	Set by user					√
Gain Det	Via password 1	Set by user					√
Sensor Units	Via password 1	Set by user	√	√	√	√	√
Modbus Address	Via password 1	Set by user	√	√	√	√	√
Set Flam.Gas Type	Via password 1	Set by user	√				
Set Flammable LEL	Via password 1	Set by user	√				
Set.Flam.Corr.F	Via password 1	Only SSCL	√				
Default.LEL & CF	Via password 2	Only SSCL	√				

Note: The password 2 is only for Status Scientific Controls Ltd personnel.

Key: √ Menu option available.
Menu option not displayed in this context.
Infrared Premier IR sensor V7 firmware and above.
Flam Gases on the Flammable menu
PELL Pellistor type sensor
OXY Oxygen type sensor
TOX Toxic type sensor.

9.1.2. Sensor Zero

- From the menu system select menu option: **Sensor Zero** and press ENTER.



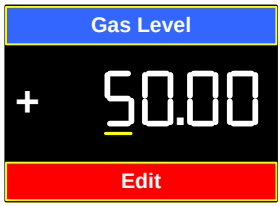
- Ensure the sensor is in a zero-gas environment.
  Note:
  1. Carbon Dioxide sensors cannot be zeroed in air due to the background levels of CO_2 present. These sensors are best zeroed whilst being exposed to 100% nitrogen.
  2. Where a purging gas has to be applied, use a flow rate of between 500 and 1000cc/min. Allow sufficient time for the sensor to respond.
- Press ENTER to zero the sensor, **Updated** will be displayed to confirm the sensor zero has been performed.
  Note:
  Pressing MENU rather than ENTER exits the zero feature without performing the calibration.
- Press MENU to close the menu system.

9.1.3. Sensor Span

The following description applies to Pellistor, Toxic, Oxygen, IR Methane and IR propane gases. For other IR flammable gases e.g. propylene, see below. Always zero the sensor prior to performing a span operation, even if the display shows zero. IR sensors will not accept Span values less than 10% of FSD.

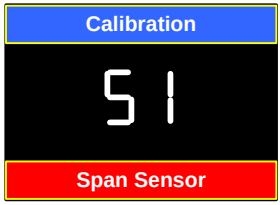
- Apply a known concentration of gas (applicable to sensor type) at a flow rate of between 500 and 1000cc/min. Allow time for the sensor to respond.

- From the menu system select menu option: **Sensor Span** and press ENTER.



- Use the ➡ button to select an individual digit then use the ⬆ button to change the digit to 0 through 9, continue for all digits until the desired gas level is set.
- Press ENTER to accept the new gas level **Updated** will be displayed to confirm the new gas level.

- Press the MENU button to exit the gas editing menu. The display shows

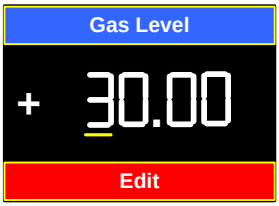


- Press ENTER to span the sensor, **Updated** will be displayed to confirm the sensor span has been performed.
  Note: pressing MENU rather than ENTER exits the span feature without performing the calibration.
  Wait until the reading is stable, if necessary press ENTER again to span the sensor.
- Press MENU to close the menu system.
- Turn off and disconnect the calibration gas.

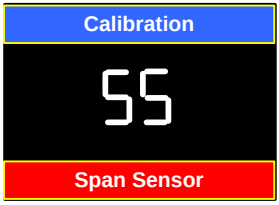
For gases on the "Flammable" menu other than methane, the Span operation must be carried out with propane.

- Apply a known concentration of Propane e.g. 55% LEL at a flow rate of between 500 and 1000cc/min. Allow time for the sensor to respond.

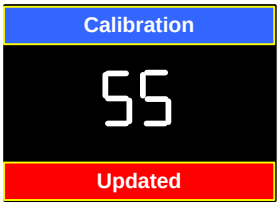
- From the menu system select menu option: **Sensor Span** and press ENTER.



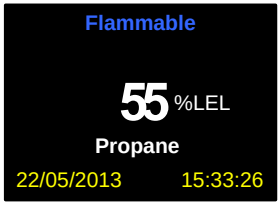
- For calibration gas 1.1% this corresponds to a gas level of 55% at the default LEL of 2.0%v/v. Change the gas level to 55% and press ENTER.



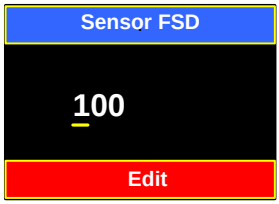
- To accept the calibration value, press ENTER.



- Press Menu to exit



9.1.4. Sensor FSD



The sensor measuring range is set by this menu.

- Use the ➡ button to select an individual digit then use the ⬆ button to change the digit to 0 through 9, continue for all digits until the desired FSD is set.

.

- Press ENTER to accept the new gas level **Updated** will be displayed to confirm the new FSD.

Note: Pressing MENU instead of ENTER will exit the menu without changing the value.

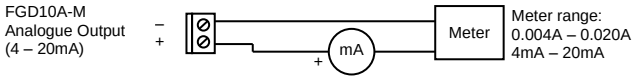
Press MENU to close the menu system.

Note: changing the FSD must be used with caution. The setting must be within the capability of the sensor.

9.1.5. 4 – 20 mA Current Loop

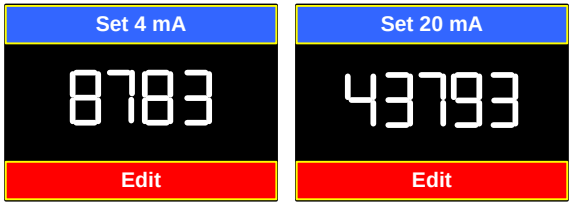
The analogue output is that of a current source. In order to calibrate the output it is necessary to monitor the output signal. This can be performed as follows:

Connect an ammeter (or multi-meter set to measure current in the mA range) in series with the analogue output.



Note: the 4mA range should always be set prior to adjusting the 20 mA range

- From the menu system select menu option: **Loop 4 mA** or **Loop 20 mA** and press ENTER.



- Using the ⇅ buttons to increase / decrease the loop current
- Press ENTER to accept the new loop current setting, **Updated** will be displayed
  Note: Pressing MENU instead of ENTER leaves the setting unchanged.
- Press the MENU button to exit the loop current option menu. On exit the display will show **No change** if no changes have been made or **Data updated** if changes have been made.

9.1.6. Alarm Levels

Alarm level 1 is associated with Relay 1, setting between 1 and 100% FSD
Alarm level 2 is associated with Relay 2, setting between 1 and 100% FSD
Alarm level 3 is associated with Relay 3, setting between -1 and -10% FSD

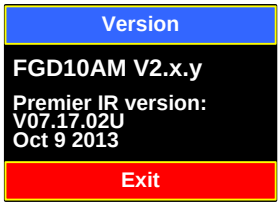
- From the menu system select menu option: **Alarm Levels** and press ENTER.

- Using the ➡ button to select the desired alarm level and press ENTER. The Edit window will appear

- Use the ➡ button to select an individual digit or the + sign the use the ⬆ button to change the + to a – and the digit to 0 through 9, continue for all digits until the desired alarm set point is set.
- Press ENTER to accept the new alarm level, **Updated** will be displayed
  Note: Pressing MENU instead of ENTER leaves the alarm set point unchanged.
- Press MENU to return the instrument to the Alarms level select menu option.
- Use the Using the ➡ button to select the next desired alarm level and press ENTER.
- Press the MENU button to exit the alarms option menu. On exit the display will show **No change** f no changes have been made or **Data updated** if changes have been made.

9.1.7. Firmware Version

- From the menu system select menu option: **Version** and press ENTER.
  If a Premier IR sensor is fitted, both the FGD10AM firmware version is displayed and the Premier IR sensor version is displayed as in the following example:



  If the sensor fitted is not a Premier Infrared type, then only the FGD10AM firmware version is displayed.

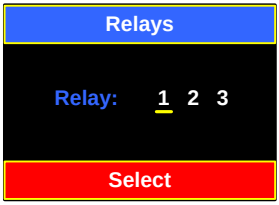
- Press MENU to close the menu system.

9.1.8. Relays

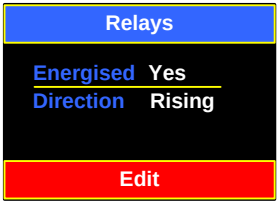
Relay 1 is associated with Alarm level 1
Relay 2 is associated with Alarm level 2
Relay 3 is associated with Alarm level 3

The user can select if the relay is normally Energized, E' or normally de-energised, 'd' when the unit is **not** in an alarm condition.

- From the menu system select menu option: **Relay Modes** and press ENTER.



- Using the ➡ button to select the desired relay and press ENTER. The Edit window will appear

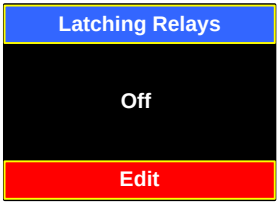


- The mode of operation can be changed by pressing the ➡ button.
- The function can be changed by pressing the ⬇ button.
- Press ENTER to accept the new setting, **Updated** will be displayed
  Note: Pressing MENU instead of ENTER leaves the relay setting unchanged.
- Press MENU to return the instrument to relays select menu.
- Press the MENU button to exit the alarm options. On exit the display will show **No change** if no changes have been made or **Data updated** if changes have been made.

9.1.9. Latching Relays

The user can select if the relays are latched or non-latched. If the relays are latched then they can only be cleared when the alarm condition no longer exists and the ENTER button has been pressed during the normal screen.

- From the menu system select menu option: **Latching Relay Modes** and press ENTER. The following display is shown:

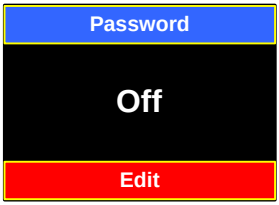


- Use the ↑ button to select On and the ↓ button to select Off.
- Press ENTER to accept the new setting, **Updated** will be displayed
  Note: Pressing MENU instead of ENTER leaves the latching relay setting unchanged.
- Press the MENU button to exit the Latching Relays options. On exit the display will show **No change** if no changes have been made or **Data updated** if changes have been made.

9.1.10. Password Enable

Use this menu option to enable / disable the password feature.
Place the FGD10A-M in the password menu as follows:

- Press the MENU to open the menu system.
- Using the NEXT and PREVIOUS buttons, select menu option: **Password Mode**
- Press ENTER. The display shows



- Press the ➡ button to select either On or Off.
- Press ENTER to accept the setting.
  Note: Pressing MENU instead of ENTER leaves the unit without change.
- Press the MENU button to exit the hysteresis option menu. On exit the display will show **No change** if no changes have been made or **Data updated** if changes have been made.

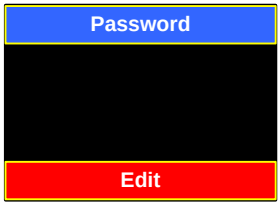
Note: if the password is in operation then the user will be prompted to enter the Password when ever the menu key is pressed. Pressing the MENU key without entering a password will result in the restricted user access. Entering the correct password will give access to the full menu facility.

9.1.11. Set Password

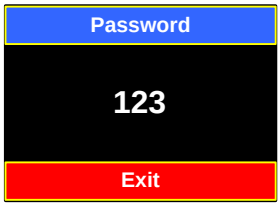
Use this menu option to set the user password. The password can only be digits 1, 2 or 3, with a maximum of 6 digits.

Place the FGD10A-M in the password menu as follows:

- Press the MENU to open the menu system.
- Using the NEXT and PREVIOUS buttons, select menu option: **Set Password**
- Press ENTER. The display shows



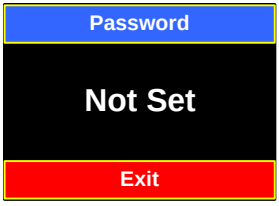
- Press the 1, 2 or 3 buttons to set the desired password.
- Press MENU to exit the edit window. The display shows:



- Press ENTER to store the changes.

  Note 1: Pressing MENU instead of ENTER leaves the unit without change.

  Note 2: Pressing ENTER when the password is blank will result in the password being 0 and as such that the user can effectively by-pass the password mechanism. The display will show:

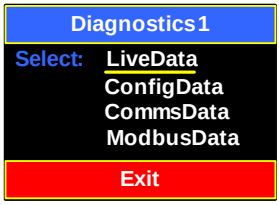


- Press the MENU button to exit the set password option menu. On exit the display will show **No change** if no changes have been made or **Data updated** if changes have been made.

9.1.12. Diagnostics

This feature is a view-only feature. No configuration changes are possible from within this menu.

- From the menu system select menu option: **Diagnostics** and press ENTER.
- The options displayed are as follows:

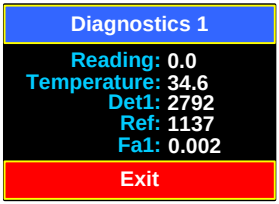


- Press MENU to close the menu system.
- Select the desired option via the UP/DOWN keys and press ENTER

9.1.12.1 LiveData:

Consists of Several pages of data for IR sensors. Each page is displayed automatically for several seconds. The displayed values are as follows:

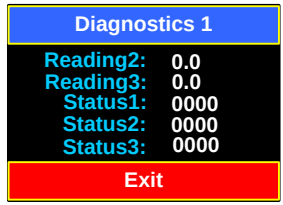
Screen1 (IR):



0

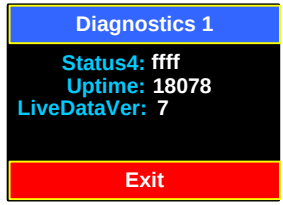
Reading is the computed gas reading.
Temperature is the sensor temperature in °C.
Det1 is the AtoD counts for the detector1 signal.
Ref is the AtoD counts for the reference signal.
Fa1 is the computed fractional absorbance for Pyro 1.

Screen2 (IR):



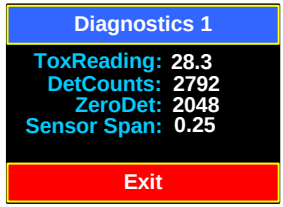
Reading2 is the computed gas reading for channel 2 e.g. CO2 for dual sensor.
Reading3 is the computed gas reading for channel 3 e.g. Propane
Status 1,2 and 3 are the status bits as defined in TDS0045 “Premier Sensor Communications Protocol

Screen3 (IR):



Status 4: Status bits as defined for the displayed LiveData version:
Uptime: Number of seconds power has been applied to the IR sensor.
LivedataVer: version of livedata structure used in the IR sensor.
For more details on data structures and status bit please refer to the latest version of TDS0045 “Premier Sensor Communications Protocol”

For non-IR sensors there is just one diagnostic screen available e.g. . Toxic sensor:

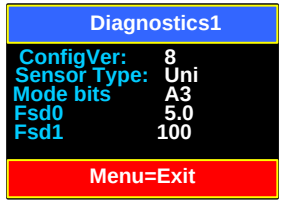


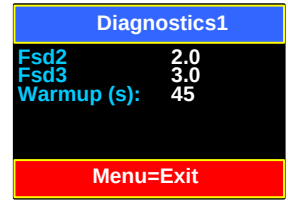
ToxReading is the gas level computed from the Toxic sensor
DetCounts is the present A/D converter reading counts
ZeroDet is the A/D converter reading when the sensor was zeroed.

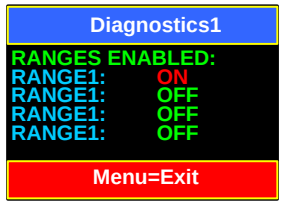
Sensor Span is the calculated span factor for the sensor.

9.1.12.2 ConfigData:

The parameters displayed via 'cycling pages' are as follows for IR sensors only: The ConfigData option will be "greyed out" for non IR sensors and if thus selected, the message "***ConfigData is for Infra Red Sensors only***!" will be displayed instead.



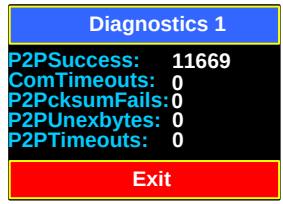




ConfigVer is the version of Config data structure as detailed in TDS0045
Alarm count gives the total number of alarm events since the FGD10AM was powered up. The counter can only be reset by cycling the power supply to the FGD10AM. For further information on config data refer to

9.1.12.3 CommsData

This option is primarily for use by SSCL in diagnosing any possible comms issues with Dynament IR sensors. In summary P2Psuccess shows the number of successful requests serviced by the IR sensor. The other parameters are errors specific to the Premier Sensor Communications Protocol.firmare. All these counters can only be reset by cycling the power supply to the FGD10AM.
Note: This option is only available if a Premier IR sensor is fitted. The ConfigData option will be "greyed out" for non IR sensors and if thus selected, the message "***CommsData is for Infra Red Sensors only***!" will be displayed instead.

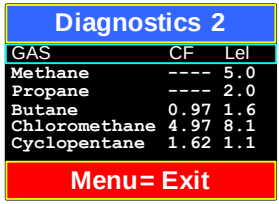


9.1.12.4 Display LEL and CF

This is selectable via Diagnostics 2 screen and applies to IR flammable sensors only.

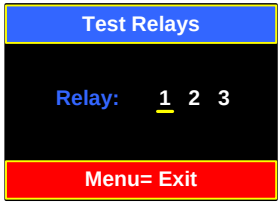
Cycling pages of all the IR flammable gases with correction factor and Lel is displayed via a table e.g.:

Page 1 only is shown here:



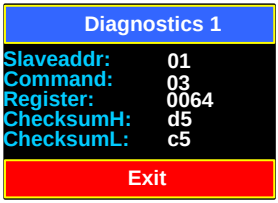
9.1.12.5 Test Relays

Each relay may be selected in turn for testing. Press ENTER to momentarily activate the Relay.



9.1.12.6 Modbus Data

This is useful for diagnosing the Modbus communications problems by displaying some bus data in real time. The displayed parameters are as follows for received data only by the FGD10AM from the Modbus master controller. All values in are in hex:

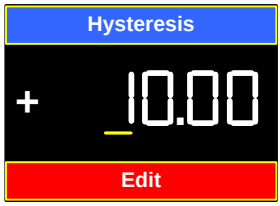


Slaveaddr: Modbus node address of target FGD10AM e.g. 01
Command: Modbus command e.g. 03 “Read holding register”
Register: Target register to read e.g. 64H =100d
ChecksumH: High order byte of CRC for incoming message
ChecksumL: Low order byte of CRC for incoming message

9.1.13. Hysteresis

This option sets the alarm hysteresis. The relays will chatter if this level is set to 0. The usual setting is 10%.

- From the menu system select menu option: **Hysteresis** and press ENTER.

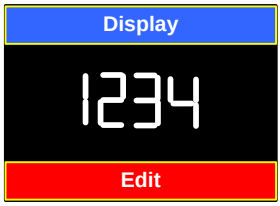


- Use the ➡ button to select an individual digit or the + sign the use the ⬆ button to change the + to a – and the digit to 0 through 9, continue for all digits until the desired alarm set point is set.
- Press ENTER to accept the new hysteresis level, **Updated** will be displayed
  Note: Pressing MENU instead of ENTER leaves the hysteresis level unchanged.
- Press the MENU button to exit the hysteresis option menu. On exit the display will show **No change** if no changes have been made or **Data updated** if changes have been made.

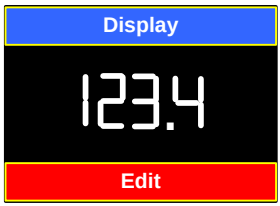
9.1.14. Display Resolution

The number of decimal places that are used to display the detected gas levels can be changed via this menu option.

- From the menu system select menu option: **Display** and press ENTER.



- Using the ← → buttons to move the decimal point to the desired position, e.g.

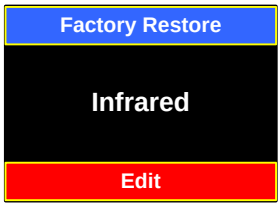


- Press ENTER to accept the new alarm level, **Updated** will be displayed
  Note: Pressing MENU instead of ENTER leaves the display setting unchanged.
- Press the MENU button to exit the display option menu. On exit the display will show **No change** if no changes have been made or **Data updated** if changes have been made.

Note that when the sensor type is first selected, the optimum number of decimal places for a given sensor type and range is automatically selected. Increasing the number of decimal places to which detected gas levels are displayed does not increase the sensitivity or accuracy of the instrument and in some cases may degrade the instruments perceived stability.

9.1.15. Restore

- From the menu system select menu option: **Display** and press ENTER.



- Using the ⇅ buttons to select the desired sensor type, see list below.
- Press ENTER to accept the new sensor type, **Updated** will be displayed
  Note: Pressing MENU instead of ENTER leaves the display setting unchanged.
- Press the MENU button to exit the display option menu. On exit the display will show **No change** if no changes have been made or **Data updated** if changes have been made.

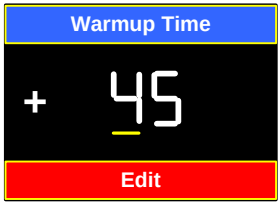
The available types are as follows:

Infrared	Pellistor	Oxygen	
Toxic 1	Toxic 2	Toxic 3	Toxic 4
Toxic 5	Toxic 6	Toxic 7	Toxic 8

9.1.16. Warm-up timer

The sensor goes through a stabilisation period when power is first applied. This option allows the user to adjust the time that is applied before readings are displayed / transmitted.

- From the menu system select menu option: **Hysteresis** and press ENTER.



- Use the ➡ button to select an individual digit or the + sign the use the ⬆ button to change the + to a – and the digit to 0 through 9, continue for all digits until the desired alarm set point is set.
- Press ENTER to accept the new hysteresis level, **Updated** will be displayed
  Note: Pressing MENU instead of ENTER leaves the hysteresis level unchanged.
- Press the MENU button to exit the hysteresis option menu. On exit the display will show **No change** if no changes have been made or **Data updated** if changes have been made.

Note: the infrared sensor takes up to 45 seconds to stabilise – do not set this time lower than 45 seconds.

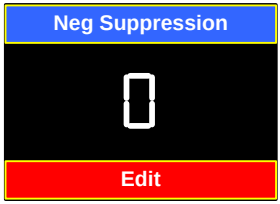
9.1.17. Zero Suppression

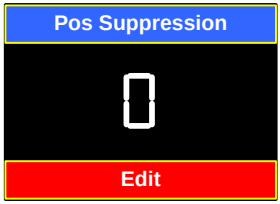
The zero of the sensor may drift from time to time and as such it may be desirable to suppress small fluctuations. These menu options allow the user to hide these small variations on the display.

The Neg Zero suppression is used to mask readings below zero while the Pos Zero suppression masks readings above zero.

The setting can be set between 0 and 10% of the sensor range as set by the FSD value.

- From the menu system select menu option: **Pos Zero** **or** **Neg Zero** and press ENTER. The following screen will be displayed:





- Using the ⇅ buttons increase or decrease the reading to the required value.

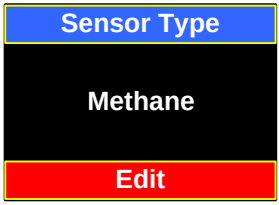
- Press ENTER to accept the new alarm level, **Updated** will be displayed
  Note: Pressing the MENU button rather than the ENTER button exits without any change.

- Press the MENU button to exit the alarms option menu. On exit the display will show **No change** if no changes have been made or **Data updated** if changes have been made.

9.1.18. Sensor Type

This menu is used to display the type of gas measured by the sensor.

- From the menu system select menu option: **Sensor Type** and press ENTER. The following screen will be displayed:



- Using the ⇅ buttons select the desired type, see list below.

- Press ENTER to accept the new sensor type, **Updated** will be displayed
  Note: Pressing the MENU button rather than the ENTER button exits without any change.

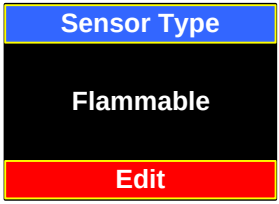
- Press the MENU button to exit the sensor type option menu. On exit the display will show **No change** if no changes have been made or **Data updated** if changes have been made.

The available types displayed, depend on the type of sensor fitted as follows:

IR sensor	TOXIC sensor	PELLISTOR	OXYGEN
Carbon dioxide	Ammonia	Hydrogen *	Oxygen **
Flammable	Carbon monoxide	Methane *	
	Chlorine		
	Ethylene oxide		
	Hydrogen		
	Hydrogen chloride		
	Hydrogen cyanide		
	Hydrogen sulphide		
	Nitric Oxide		
	Nitrous Oxide		
	Ozone		
	Phosphene		
	Sulphur Dioxide		
	VOC		

* FGD10AM linearised specifically for Nemoto Pellistors only
** FGD10AM linearised specifically for Alphasense O2-A2 sensor only

If Flammable option (Infrared sensor V7 and above firmware only) is selected,



selection from a further list is possible as follows:

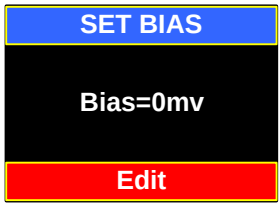
Flammable gas type:	Propane correction factor	Default LEL
Methane	**Not applicable**	**5.0**
Propane	**1.0 (by definition)**	**2.0***
Butane	0.97	1.6
Chloromethane	4.97	8.1
Cyclopentane	1.62	1.1
Ethane	1.01	3.0
Ethanol	1.95	3.0
Ethylene Oxide	3.43	2.7
Ethylene	0.845	3.6
Hexane	0.80	1.1
Pentane	0.89	1.4
Propylene	1.69	2.4
Toluene	1.16	1.2
Xylene	1.32	1.0
User Defined	1.0	1.0

This provides measurement of flammable gases corrected with respect to the propane IR channel. *Note SSCL adopts the default propane LEL of 2.0%
For example, if chloromethane is selected from the “Flammable” menu, the normal measurement display would appear as follows:

See also menus:
Set Flammable gas type.
Set Flammable LEL.
Set Flammable correction factor.

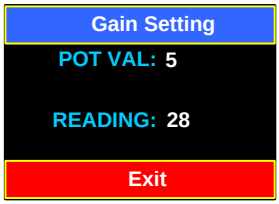
Set Default LEL and correction factors

9.1.19. Sensor Bias (Toxic sensor only)



Use the ⇅ buttons select the desired bias.
This option sets the bias voltage to match the sensor fitted. Available options are: no bias, 250 mV and 300 mV bias
The normal level is 0, no bias.

9.1.20. Gain Setting (Toxic Sensor only)



Allows adjustment of the electronic gain potentiometer of the Toxic sensor electronics.
Use the ⇅ keys to change the potentiometer setting.

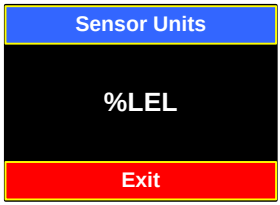
- Press ENTER to accept the new setting, **Updated** will be displayed

The sensor reading is also displayed in real time.
This is normally only done by SSCL personnel.

9.1.21. Sensor Units

This menu is used to display the units of parameter measured by the sensor.

- From the menu system select menu option: **Sensor Units** and press ENTER. The following screen will be displayed:



- Using the ⇅ buttons select the desired units, see list below.
- Press ENTER to accept the new sensor type, **Updated** will be displayed.
  Note: Pressing the MENU button rather than the ENTER button exits without any change.
- Press the MENU button to exit the sensor type option menu. On exit the display will show **No change** if no changes have been made or **Data updated** if changes have been made.

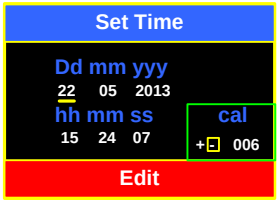
The available units are as follows:

%LEL	" "	----
PPB	PPM	%v/v

9.1.22. Time

This menu is used to display the data and time.

- From the menu system select menu option: **Time** and press ENTER. The following screen will be displayed:



- Use the ➡ button to select an individual digit or the then use the ⬆ button to change digits, continue for all digits until the desired date / time is set.
- Press ENTER to accept the new time, **Updated** will be displayed, this will synchronise the time to the selected seconds.
  Note: Pressing MENU instead of ENTER leaves the date / time unchanged.

- Use the ➡ button to select the cal box if the RTC is running fast or slow. Use the ⬆ button to subtract or add the calibration factor.

- Press the MENU button to exit the time option menu. On exit the display will show **No change** if no changes have been made or **Data updated** if changes have been made.

9.1.23. Screen Saver

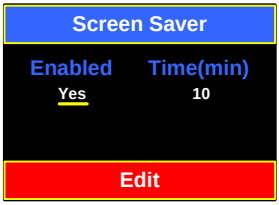
The screen saver has two parameters, Enabled and Time.

The Enabled setting can be either Yes or No, selecting No disables the screen saver function.

The time setting can be between 1 and 10. This is the time that the screen saver will be active. The normal display will always be 1 minute.

This menu is used to display the units of parameter measured by the sensor.

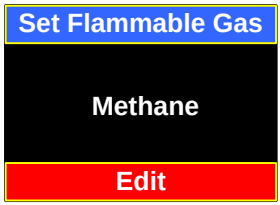
- From the menu system select menu option: **Screen Saver** and press ENTER. The following screen will be displayed:



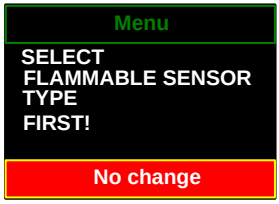
- Use the ➡ button to select Enabled or Time then use the ⬆ button to change the readings, continue for all digits until the desired date / time is set.
- Press ENTER to accept the new settings, **Updated** will be displayed, this will synchronise the time to the selected seconds.
  Note: Pressing MENU instead of ENTER leaves the settings unchanged.
- Press the MENU button to exit the sensor type option menu. On exit the display will show **No change** if no changes have been made or **Data updated** if changes have been made.

9.1.24. Set Flammable Gas Type

Note: This menu is only accessible if an IR sensor is fitted and “Flammable” is selected from the Sensor Type menu. See menu description “Set Sensor Type”.

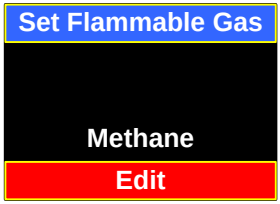


Note: If the Flammable gas option is has not been previously selected (e.g. Carbon dioxide) from the “Sensor Type” menu then the following warning message will appear and no changes will be allowed:

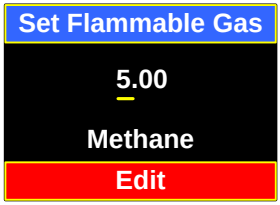


9.1.25. Set Flammable Gas LEL. (Infrared sensor only)

This option allows the LEL for any of the flammable gases on the list to altered.
NOTE: With the exception of methane, flammable gas readings are computed with respect to the Propane IR channel.



Use the ↑↓ keys Select the desired flammable gas and select ENTER
The current LEL is then displayed above the gas name



Use the ↑↓ keys to change the digit. Select the next digit using the ←→ keys.

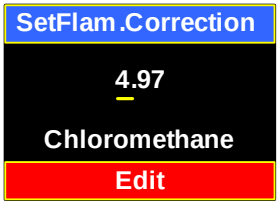
- Press ENTER to accept the new value **Updated** will be displayed.
  Note: Pressing MENU instead of ENTER leaves the settings unchanged.

- Press the MENU button to exit the sensor type option menu. On exit the display will show **No change** if no changes have been made or **Data updated** if changes have been made.

9.1.26. Set Flammable Gas Correction Factor

NOTE: This option is for use by SSCL only and is password protected.
It is used to set the Flammable gas reading, corrected for Propane, when using a propane sensor.

Use the ⇅ keys Select the desired flammable gas and select ENTER
The current correction factor is then displayed above the gas name.

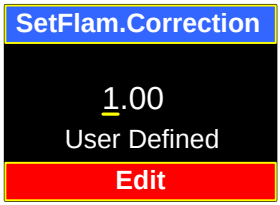


Use the ⇅ keys to change the digit. Select the next digit using the ← → keys.

- Press ENTER to accept the new value **Updated** will be displayed.
  Note: Pressing MENU instead of ENTER leaves the settings unchanged.

- Press the MENU button to exit the sensor type option menu. On exit the display will show **No change** if no changes have been made or **Data updated** if changes have been made.

There is also a User Defined option to cater for any flammable gases not on the list which have a usable propane response. The correction factor (and LEL) may be set by the user.

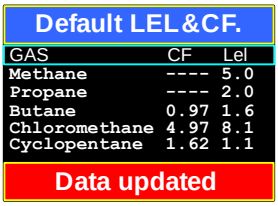


9.1.27. Set Flammable Gas Default LEL and Correction Factor

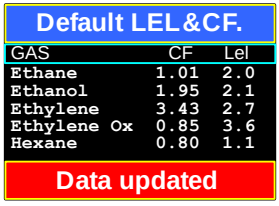
NOTE: This option is for use by SSCL only and is password protected.
This option restores the factory-set default LEL and propane correction factors for all gases on the Flammable list.
Selecting ENTER for this option will produce following warning:

As stated on the screen, selecting MENU will exit without any changes. Selecting ENTER key will reset all propane correction factors and LEL settings to their factory-set default values. These will be displayed on a series of screens that update consecutively every few seconds.

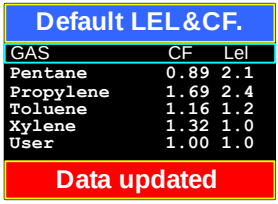
Screen 1:



Screen 2:



Screen 3:



Note: This will also reset the User defined option back to 1.0 CF and LEL.

10. MODBUS INTERFACE

The FGD10A-M is supplied with an RS485 interface which provides control of the FGD10A instrument via the Modbus RTU protocol. Remote calibration and setup are possible as well as remote monitoring of the gas level and all the other operational parameters of the FGD10A. Nearly all the front panel menu (with the exception of the Modbus address) can be achieved remotely via the Modbus protocol.

The Modbus node address must be set via the Menu option.

Note: For safety reasons the FGD10AM will NOT respond to Modbus commands while in “Menu mode”. If the FDG10AM is left accidentally left in menu mode it will time out after several minutes and Modbus communications will be re-established.

Modbus (ISO/IEC 7498-1 Physical layer) description.

EIA RS485	9600 BAUD 8 data bits 1 start bit, 1 stop bit, no parity
2 WIRE	TWISTED PAIR UP TO 1.2 km in length depending on number of devices connected.

10.1. Modbus (ISO/IEC 7498-1 Application layer) description.

Modbus RTU Frame Format	
START	>=3.5 character width
ADDRESS	8 Bits
COMMAND	8 Bits
DATA	Multiples of 8 bits dependent on command
CRC	16 bits
END	>=3.5 character width

Typical Network operating parameters	
Slave response timeout	2000 (ms)
Turnaround delay	2000 (ms)
Message to message delay	10 (ms)
Number of retries	2

10.2. Modbus Register list.

Note:16 bit hexadecimal notation is represented by: 0x000A =10 decimal
R/W = READ/WRITE access
MSB/LSB: most/least significant byte
INT16 = signed 16 bit integer
uINT16 = unsigned 16 bit integer
MSFP16 = Most sig. 16 bits of IEEE574 32 bit floating point number
LSFP16 = Least sig. 16 bits of IEEE574 32 bit floating point number
RTC= Real Time Clock

Modbus register notation:
The memory map used is the “read holding register” map (command 0x03H) Starting from logical address 40001. This corresponds to physical address 0x0000
More detailed examples are given below.

Some registers e.g. gas reading are read only. Other registers have full read/write access.

Zero and span are achieved by writing any value to the appropriate register. Note: zero and span are not allowed via a broadcast message.

LOGICAL ADDRESS	(R/W)	DATA TYPE	DESCRIPTION
40001	R	INT16	**GAS READINGx10** e.g. 0x01F4=500= 50%LEL
40002	R	uINT16	**FAULT STATUS** FGD10A fault code Returns the bitwise OR of any of the following fault conditions: 0x0000 normal operation ERROR_CSUM = 1, ERROR_SENSOR_NEG_DRIFT = 2, ERROR_SENSOR_ZERO = 4, ERROR_SENSOR_SPAN = 8, ERROR_SENSOR_NO_COMMS = 16

LOGICAL ADDRESS	(R/W)	DATA TYPE	DESCRIPTION
40003	R	uINT16	**TEMPERATURE** of sensor (IR only) in Kelvin(e.g. 303)
40009	R	uINT16	**Sensor "Restore" Type:**
			1=IR / 2=Pellistor / 3=Oxygen
			4=Tox1 / 5= Tox2 / 6= Tox3
			7=Tox4 / 8=Tox5 / 9= Tox6
			10=Tox7 / 11=Tox8
40011	R/W	uINT16	**Calibration Gas Level** e.g. (50 % LEL)
40022	R/W	INT16	**ALARM1 LEVELx10** e.g. 0x0064 =100=10%LEL
40023	R/W	INT16	**ALARM2 LEVELx10** e.g. 0x00c8=200=20%LEL
40027	R/W	uINT16	**FSD range** (e.g. 0x0014=100%)
40101	R	uINT16	**Sensor Type** : LSB holds instrument Modbus address MSB holds: 0x04 for TOX 0x05 for Oxygen 0x07 Pellistor/Catalytic 0x13 for NDIR sensor.
40102	R	INT16	**GAS READING** identical to 40001
40103	R	uINT16	**GAS TYPE and Decimal Places.** Ammonia = 0x0d Butane = 0x16 "Flammable" Carbon Monoxide = 0x01 Carbon Dioxide = 0x20 Chlorine = 0x05 Ethane = 0x16 "Flammable" Ethanol = 0x16 "Flammable"" Ethylene Oxide = 0x36"Flammable" Flammable = 0x16 "Flammable" Hexane = 0x16 "Flammable" Hydrogen = 0x09 Hydrogen Chloride = 0x0e Hydrogen Cyanide = 0x07 Hydrogen Fluoride = 0x21 Hydrogen Sulphide = 0x02 Methane = 0x15 Methanol = 0x16 "Flammable" Nitric Oxide = 0x0c Nitrous Oxide = 0x22 Oxygen = 0x14

			Ozone = 0x23 Pentane = 0x16 “Flammable” Phosphene = 0x24 Propane = 0x16 “Flammable” Sulphur Dioxide = 0x03 Toluene = 0x16 “Flammable” VOC = 0x25 default =0xff
40106	R	uINT16	**Operating mode:** 0x0001=Normal 0x0003=warm up Note: no Modbus response in “menu mode”
40107	R	uINT16	Bit 1 Alarm2 active Bit 0 Alarm1 active

Note all gases on the “flammable” list return value 0x16

LOGICAL ADDRESS	(R/W)	DATA TYPE	DESCRIPTION
40115	R	uINT16	**Last Alarm date** (mmdd) MSB=month (0x01 to 0x0C) LSB=day (0x01 to 0x1F) returns zero if no alarm has ever occurred.
40115	R	uINT16	**Last Alarm date** (mmdd) MSB=month (0x01 to 0x0C) LSB=day (0x01 to 0x1F) Returns zero if no alarm has ever occurred.
40116	R	uINT16	**Last Alarm date** (00yy) LSB=0 MSB=year e.g. 0x0D for 2013.
40117	R/W	uINT16	**RTC** (mmdd) MSB=month (0x01 to 0x0C) LSB=day (0x01 to 0x1F)
40118	R/W	uINT16	**RTC** (00yy) LSB=0 MSB=year e.g. 0x0D for 2013.
40119	R/W	uINT16	RTC (hhmm) MSB = hour e.g. 0x0A for 10am LSB = minutes e.g. 0x3B for 59 mins.
40124	R/W	INT16	**ALARM1 Level x10 see 40022**
40125	R/W	INT16	**ALARM2 Level x10 see 40023**
40126	R/W	INT16	**Gas Calibration Level see 40011**
40152	W	uINT16	**SPAN SENSOR** Write any value to this register to span the sensor according to the Gas Calibration Level
40154	W	uINT16	**ZERO SENSOR** write any value to this register to zero the sensor.
40203	R	MSFP16	**Sensor temperature Float:** Most significant 16 bits of IEEE574 floating point value.
40204	R	LSFP16	**Sensor temperature Float** Least significant 16 bits of IEEE574 floating point value.
40211	R/W	MSFP16	**Gas Calibration Value Float** Most significant 16 bits of IEEE574 floating point value.
40212	R/W	LSFP16	**Gas Calibration Value Float** Least significant 16 bits of IEEE574 floating point value.

LOGICAL ADDRESS	(R/W)	DATA TYPE	DESCRIPTION
40213	R/W	uINT16	**RELAY MODE** Bit assignments: REL3 REL2 REL1 XXXX XX00 XX00 XX00 (X=don't care) bit 1 and 0 assignments: 00 E:R energised rising 01 D:R de-energised rising 10 E:F energised falling 11 D:F de-energised falling
40224	R/W	INT16	**ALARM3 Level** integer e.g. 0xFFF6= -10%
40225	R/W	MSFP16	**ALARM1 Level Float** Most significant 16 bits of IEEE574 floating point value.
40226	R/W	LSFP16	**ALARM1 Level Float** Least significant 16 bits of IEEE574 floating point value.
40227	R/W	MSFP16	**ALARM2 Level Float** Most significant 16 bits of IEEE574 floating point value.
40228	R/W	LSFP16	**ALARM2 Level Float** Least significant 16 bits of IEEE574 floating point value.
40229	R/W	MSFP16	**ALARM3 Level Float** Most significant 16 bits of IEEE574 floating point value.
40230	R/W	LSFP16	**ALARM3 Level Float** Least significant 16 bits of IEEE574 floating point value.
40231	R/W	MSFP16	**Gas Reading Float** Most significant 16 bits of IEEE574 floating point value.
40232	R/W	LSFP16	**Gas Reading Float** Least significant 16 bits of IEEE574 floating point value.

LOGICAL ADDRESS	(R/W)	DATA TYPE	DESCRIPTION
40235	R/W	MSFP16	**Hysteresis Value Float** Most significant 16 bits of IEEE574 floating point value.
40236	R/W	LSFP16	**Hysteresis Value Float** Least significant 16 bits of IEEE574 floating point value.
40237	R/W	uINT16	**Warm up Timer**: e.g. 0x002d=45s
40238	R/W	uINT16	**Screen On Time** e.g. 0x0001= 1 min
40239	R/W	uINT16	**Screen Off Time** e.g. 0x000A= 10 min
40251	R/W	uINT16	**RTC Seconds** e.g. 0x002F= 47
40252	R/W	uINT16	**RTC Minutes** e.g. 0x001C= 28
40253	R/W	uINT16	**RTC Hours** e.g. 0x000D =1 pm
40254	R	uINT16	**RTC Weekday** not yet implemented
40255	R/W	uINT16	**RTC Day** e.g. 0x0013 =19th
40256	R/W	uINT16	**RTC Month** e.g. 0x0006= June
40257	R/W	uINT16	**RTC Year** e.g. 0x000D= 2013
40301	R	uINT16	**Alarm1 Year** The year the most recent alarm1 occurred e.g. 0x000D= 2013
40302	R	uINT16	**Alarm1 Month** The month the most recent alarm1 occurred e.g. 0x0006= June
40303	R	uINT16	**Alarm1 Day** The day the most recent alarm1 occurred e.g. 0x0013 =19th
40304	R	uINT16	**Alarm1 Hours** The hour the most recent alarm1 occurred e.g. 0x000D =1 pm
40305	R	uINT16	**Alarm1 Minutes** The minute the most recent alarm1 occurred e.g. 0x001C= 28

LOGICAL ADDRESS	(R/W)	DATA TYPE	DESCRIPTION
40306	R	uINT16	**Alarm1 Seconds** The second the most recent alarm1 occurred e.g. 0x002F= 47
40307	R	uINT16	**Alarm2 Year** The year the most recent alarm1 occurred e.g. 0x000D= 2013
40308	R	uINT16	**Alarm2 Month** The month the most recent alarm1 occurred e.g. 0x0006= June
40309	R	uINT16	**Alarm2 Day** The day the most recent alarm2 occurred e.g. 0x0013 =19th
40310	R	uINT16	**Alarm2 Hours** The hour the most recent alarm2 occurred e.g. 0x000D =1 pm
40311	R	uINT16	**Alarm2 Minutes** The minute the most recent alarm2 occurred e.g. 0x001C= 28

Note: When Alarm level values are changed, the corresponding time/date event register is set to zero.

LOGICAL ADDRESS	(R/W)	DATA TYPE	DESCRIPTION
40312	R	uINT16	**Alarm2 Seconds** The second the most recent alarm2 occurred e.g. 0x002F= 47
40313	R	uINT16	**Alarm3 Year** Not implemented. Returns 0.
40314	R	uINT16	**Alarm3 Month** Not implemented. Returns 0.
40315	R	uINT16	**Alarm3 Day** Not implemented. Returns 0.
40316	R	uINT16	**Alarm3 Hours** Not implemented. Returns 0.
40317	R	uINT16	**Alarm3 Minutes** Not implemented. Returns 0.
40318	R	uINT16	**Alarm3 Seconds** Not implemented. Returns 0.

LOGICAL ADDRESS	(R/W)	DATA TYPE	DESCRIPTION
40319	R	uINT16	**Zero Year** The year the instrument was last zeroed e.g. 0x000D= 2013
40320	R	uINT16	**Zero Month** The month the instrument was last zeroed e.g. 0x0006= June
40321	R	uINT16	**Zero Day** The day the instrument was last zeroed e.g. 0x0013 =19th
40322	R	uINT16	**Zero Hours** The hour the instrument was last zeroed e.g. 0x000D =1 pm
40323	R	uINT16	**Zero Minutes** The minute the instrument was last zeroed e.g. 0x001C= 28
40324	R	uINT16	**Span Seconds** The second the instrument was last Spanned e.g. 0x002F= 47
40325	R	uINT16	**Span Year** The year the instrument was last Spanned e.g. 0x000D= 2013
40326	R	uINT16	**Span Month** The month the instrument was last Spanned e.g. 0x0006= June
40327	R	uINT16	**Span Day** The day the instrument was last Spanned e.g. 0x0013 =19th
40328	R	uINT16	**Span Hours** The hour the instrument was last Spanned e.g. 0x000D =1 pm
40329	R	uINT16	**Span Minutes** The minute the instrument was last Spanned e.g. 0x001C= 28
40330	R	uINT16	**Span Seconds** The second the instrument was last Spanned e.g. 0x002F= 47
40350	R/W	uINT16	**Reset Latched Relays** Reads 0x0000 if no latched alarm active. Reads 0x0001 if latched alarm active. Writing any value to this register will reset all latched alarm relays.

LOGICAL ADDRESS	(R/W)	DATA TYPE	DESCRIPTION
40351	R/W	uINT16	**Set Latched Relays** 0x0000 = NO latched alarm function 0x0001 = latched alarm ACTIVE

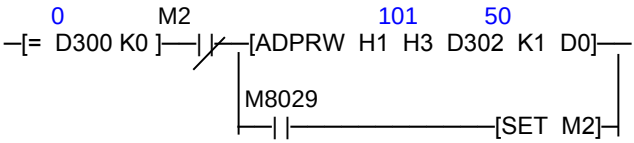
Note: If Set Latched Relays is disabled during a Latched Alarm condition, the Latched Alarm must still be reset via register **40350**

10.3. Modbus Programming examples:

10.3.1. Example 1: Read Gas Level command.

Mitsubishi FX3U PLC ladder diagram:

Read Gas Level from FGD10AM at Modbus Address 1 when 50% LEL calibration gas is present. Numbers in blue are actual monitored PLC register values



Explanation:
PLC register D300 is assigned as the step control register. The value here determines which part of the overall ladder sequence is executed in which order. In this case, “Read gas level” was assigned a step sequence value of 0 (k0 in FX3U syntax).

Flag M2 is assigned as “Modbus command in progress”
ADPRW is the special Modbus read/write command for the FX3U Modbus interface module.
M8029 flag is the FX3U “modbus command complete” which stays turns on when the modbus command is complete.

H1 is the modbus address FGD10A in hexadecimal.
H3 is the modbus “read register command” in hexadecimal.
K1 is the number of bytes to be read i.e. 1 in this case.
D302 contains the physical address of the modbus register to read in hexadecimal. In this case 101 decimal. This equates to logical address

40102 in the Modbus register map. In other words Logical address 40001 in the Modbus memory map equates to holding register physical address 0.

D0 is the PLC register assigned to hold the gas level reading = 50 (%LEL) The ADPRW command automatically takes care of CRC generation and checking.

In terms of a conventional Modbus packet sent to the FGD10AM this would look like:

Slave address	**Function command**	Target Register		Number of registers		CRC checksum	
0x01	0x03	0x00	0x65	0x00	0x01	0x94	0x15

10.3.2. Example 2: Method for recalculating CRC checksum:

The following code is used by the FGD10AM to check the incoming message CRC. The incoming message was stored in an array called **aucModbusRxBuffer[RXBUFFERSIZE]**
The length of the incoming message ucMsgLength is the number of bytes received not including the 2 byte CRC.

```
unsigned integer RecalcModbusChecksumRx(unsigned integer
ucMsgLength)
{
   unsigned integer uiRecalcChksum;//checksum to be recalculated
   unsigned integer uiMBTemp;
   unsigned char  ucLoop1;
   unsigned char  ucLoop2;

   uiRecalcChksum = 0xFFFF; //Load CRC reg with FFFF
   for (ucLoop1 = 0; ucLoop1 <= ucMsgLength; ucLoop1++)
   {
     uiRecalcChksum = uiRecalcChksum^
aucModbusRxBuffer[ucLoop1];
     // XOR 1st byte of msg with LSbyte of CRCreg and put result in
CRCreg

      for (ucLoop2 = 0; ucLoop2 <= 7; ucLoop2++)
      {
         uiMBTemp = (uiRecalcChksum & 0x0001); //mask off LSB
         if (uiMBTemp == 0)// test LSB
         {
            uiRecalcChksum = uiRecalcChksum >> 1; // if LSB was 0 do a
shift
         } else
        {
            uiRecalcChksum = uiRecalcChksum >> 1; //shift CRCreg on
bit right
            uiRecalcChksum = uiRecalcChksum^0xA001;
            // if LSB was 1, XOR CRCreg with 0xA001
         }
      }//repeat for 8 bits
   }//repeat for all ucMsgLength bytes

   return uiRecalcChksum;
//the CRC has been regenerated. Now compare this with the received
CRC.
}
```

An identical method was used to generate the CRC for transmitted messages.

10.3.3. Example 3: Received Modbus frame from FGD10AM

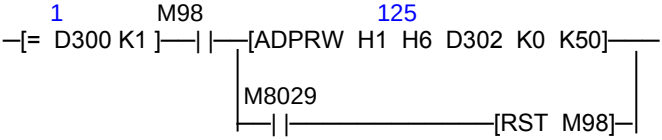
An typical response packet received from the FGD10AM to the command sent in Example 1 would be:

Slave address	**Function command**	Byte Count	Byte1	Byte 2	CRC checksum	
0x01	0x03	0x02	0x00	0x32	0x39	0x91

i.e. a Gas reading of 0x0032=50% LEL from FGD10AM at network address 1.

10.3.4. Example 4: Write Calibration gas level to Modbus register 40126

Mitsubishi FX3U PLC ladder diagram:
Flag M98 is set to trigger the write process which is then reset automatically by M8029
Once the write command is completed D300 controls the ladder sequence.
H1 is the Modbus device node address.
H6 is the write single register command.
D302 contains the logical address of the Modbus register to be written to.
K0 is “don't care”
K50 “change the calibration gas level to 50%”



In terms of a conventional Modbus packet sent to the FGD10AM this would look like:

Slave address	**Function command**	Target Register		Data to be written		CRC checksum	
0x01	0x06	0x00	0x7D	0x00	0x32	0x98	0x07

10.4. Broadcast Messages.

The FGD10AM will accept broadcast messages (node address 0) for the "Write Single Register" (06H) command only. This is useful for example, in setting the real time clock for all devices on the network, or resetting all Latched Alarms.
The exceptions are **SPAN SENSOR** and **ZERO SENSOR** commands. For safety reasons, each device on the network must be addressed individually via it's Modbus node address to Zero or Span. Alternatively Zero and span may done manually via the Menu display on the front of the instrument.

10.5. Wiring:

Use shielded twisted pair cables for connecting communication equipment operating in accordance with MODBUS RS-485. Typical characteristics for RS485 cable are listed below:

Cable type	Shielded cable
Conductor resistance (20°C)	88.0 Ω/km or less
Insulation resistance	10000 MΩ-km or more
Dielectric withstand voltage	500VDC, 1minute
Electrostatic capacitance (1 kHz)	60nF/km or less by an average
Characteristic impedance (100 kHz)	110±10 Ω

A termination resistor should be provided at the end of the line.

10.6. Modbus references:

A more detailed reference source is to be found at www.modbus.org

11. ROUTINE GAS TESTING

Refer to Figure 6 in section 8. showing the arrangement for applying the test gas to the FGD10A-M.

1. Before application of the test gas, check that the FGD10A-M reads zero with no known gas present in the atmosphere. If necessary, carry out adjustment of the zero setting as described in section 9.1.2.

2. Apply the test gas and allow a sufficient time for the sample to reach the gas detector. The response time will vary according to the length of the sampling tube.

3. Record the time taken for the gas detector to provide a reading of 90% (T_{90}) of its final value (e.g. to reach 27% when using a 30% CH4 test gas). This reading should be retained for future reference as it can provide an indication of the health of the sinter (flame arrestor). This is situated in the base of sensor housing and it is through this device that the gas passes in order to reach the sensor itself. If necessary, carry out adjustment of the span setting as described in section 9.1.3.

Carrying out the above procedure, and comparing the results with previous readings, will confirm that the FGD10A-M is functioning correctly, both physically and electrically. There is therefore no requirement for any further maintenance other than to clean the display window as required.

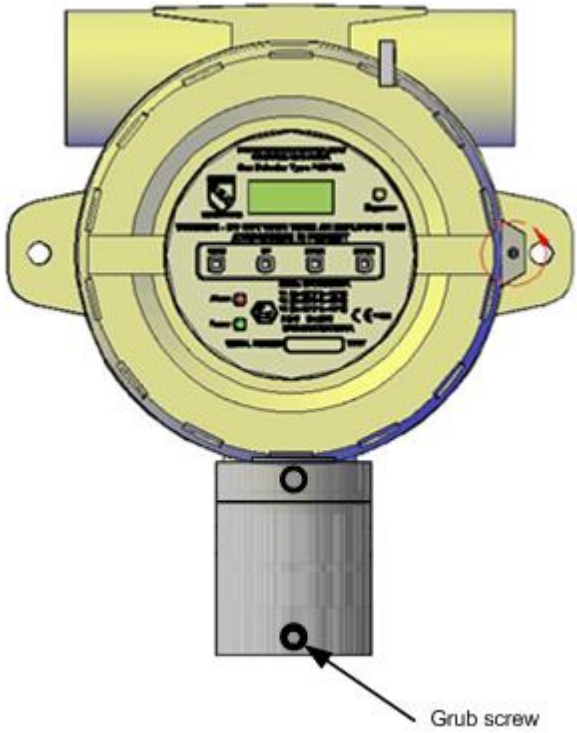
In the unlikely event that the response time is seen to be increasing, when comparing periodic readings, it is advisable to change the unit so that it can be checked.

The period between carrying out routine gas testing shall be in accordance with the customer's specification.

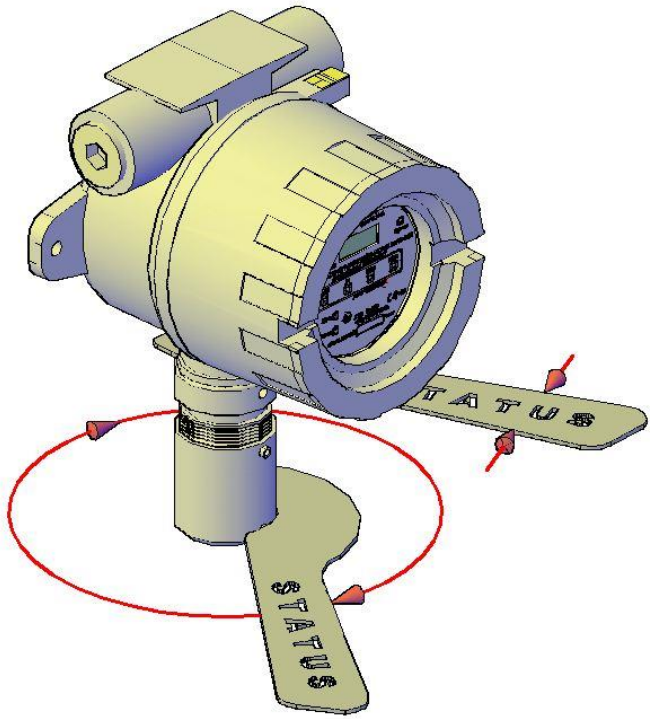
12. SENSOR REPLACEMENT

12.1. Infrared sensor

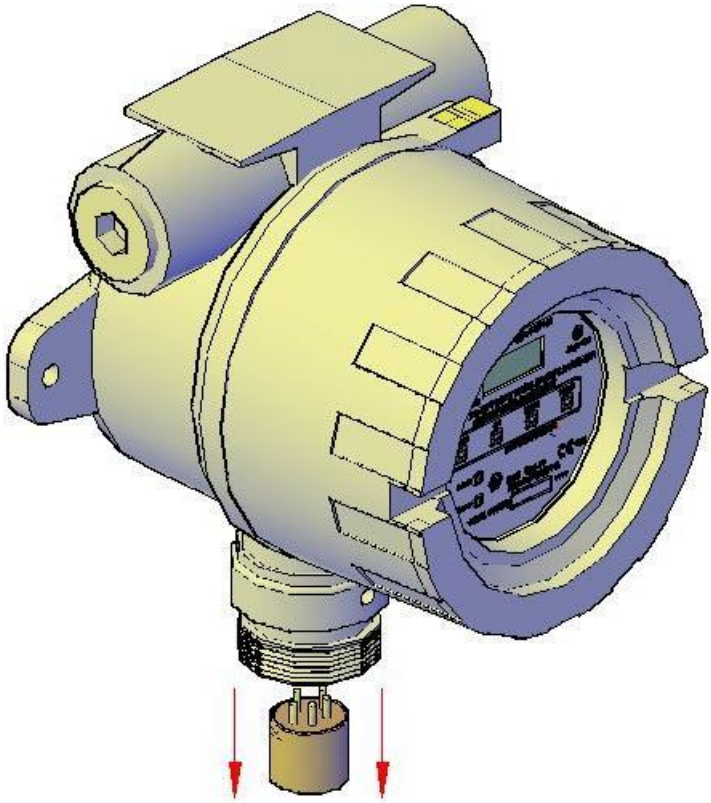
Step1
Remove the grub screw in an anti-clockwise direction.



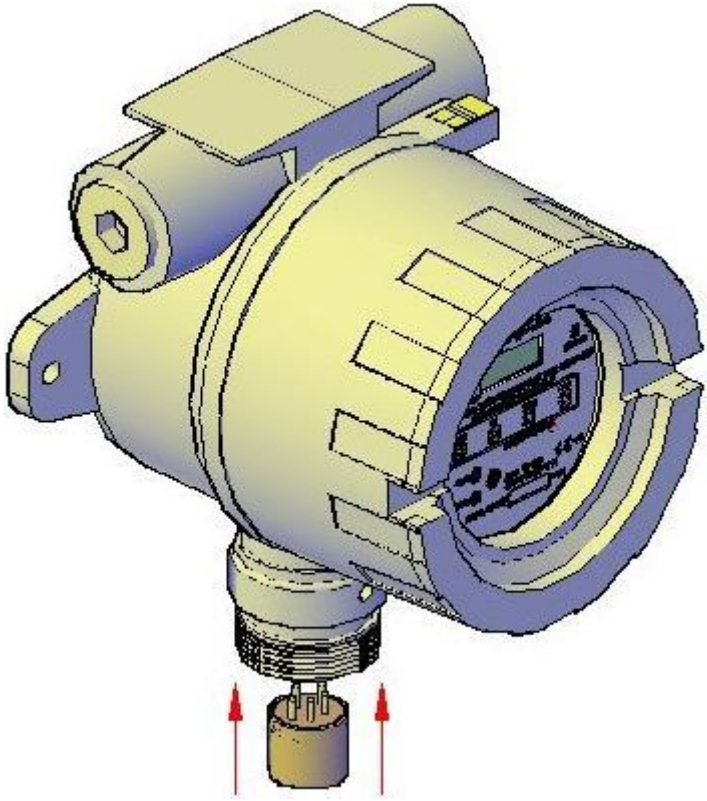
Step2
Turn cover securing stud anti-clockwise to allow cover to open.



Step 3
Remove the sensor by pulling downwards

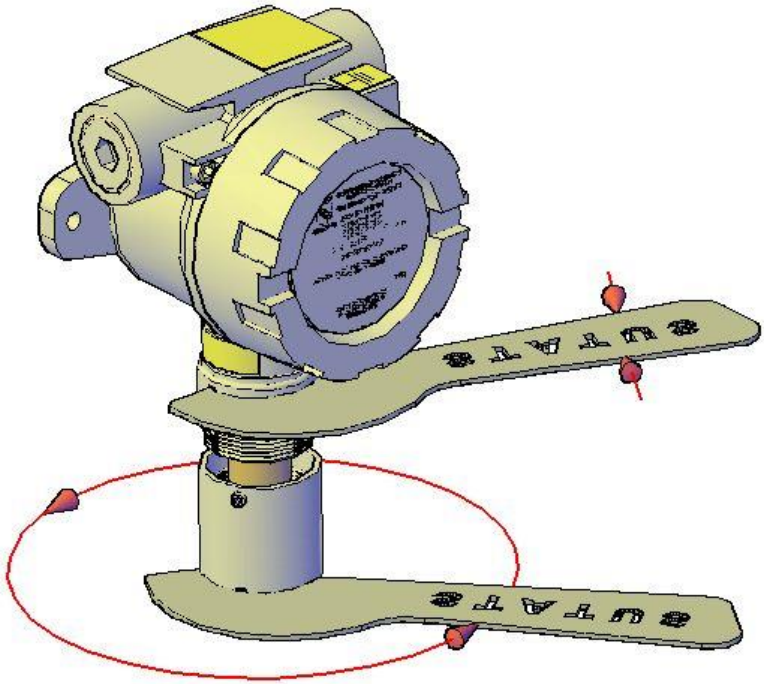


Step 4
Carefully locate the pins in the sockets then push the new sensor upwards.

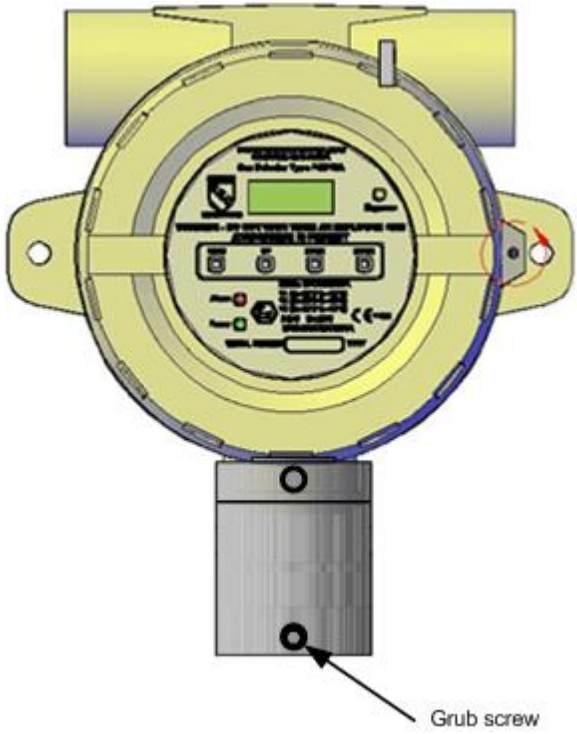


Step 5

Replace the sensor housing by rotating in a clockwise direction untill fully tightened.

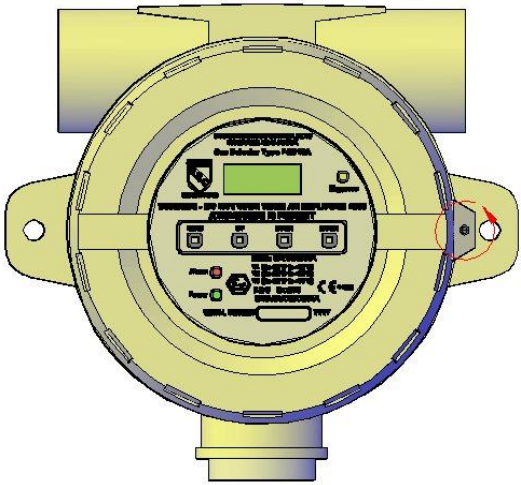


Step 6
Rotate the grub screw in a clockwise direction until fully tightened.

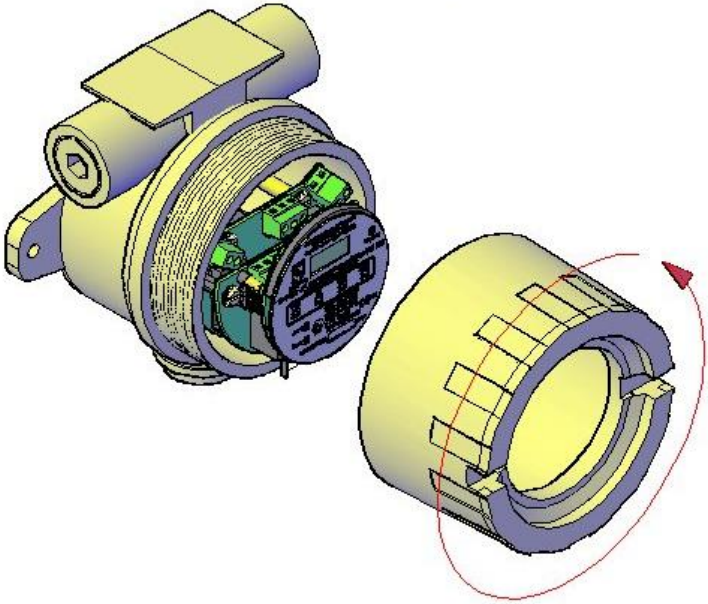


12.2. Oxygen / Toxic sensor

Step1
Turn cover securing stud anti-clockwise to allow cover to open.

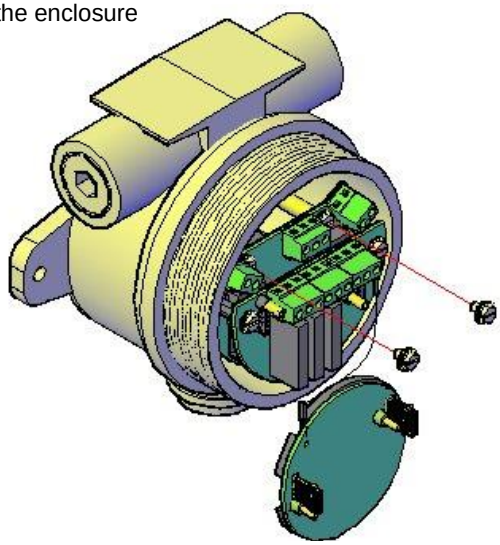


Step 2
Remove cover by rotating anti-clockwise



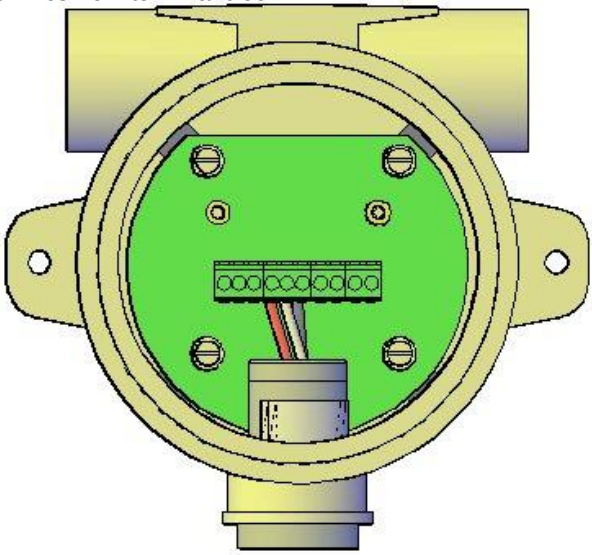
Step 3

Remove display board which can be left to dangle on its retaining wire. Remove PCBs from the support pillars and the datamate cable from the board left in the enclosure



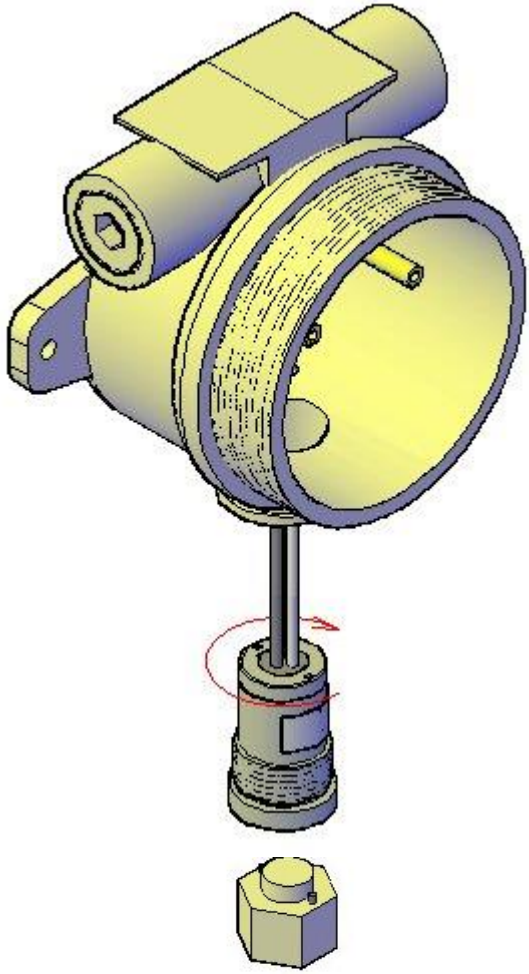
Step 4

Remove wires from terminal block



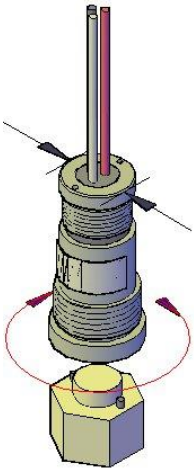
Step 5

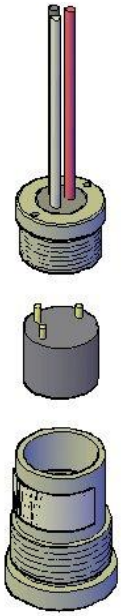
Remove sensor insert from FGD10A enclosure using extraction tool.



Step 6

Separate the two sensor insert components.

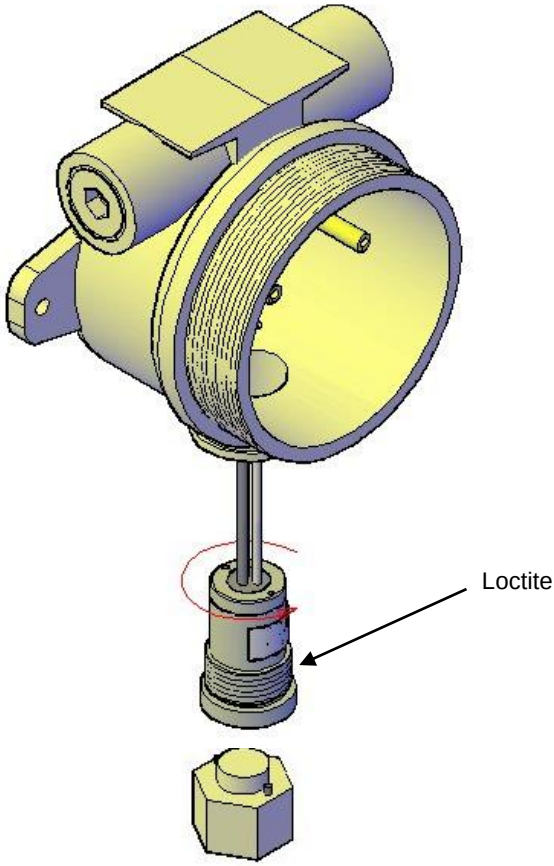




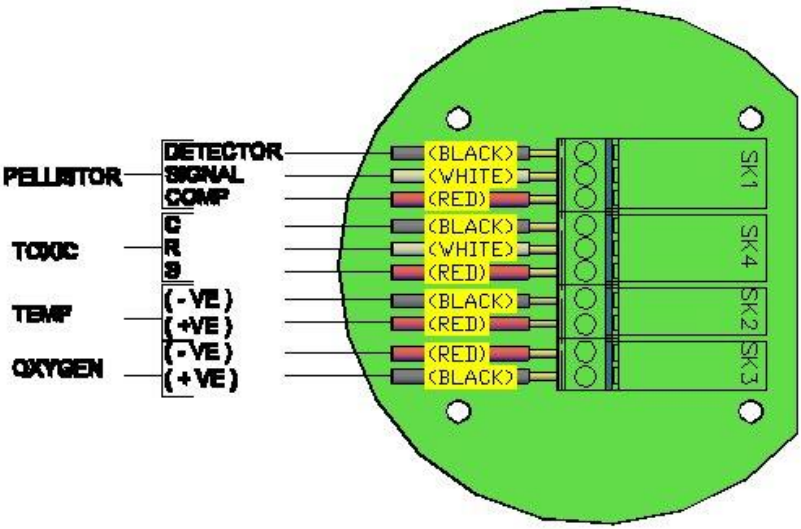
Once separated remove old sensor and replace with a new sensor and mate the two component parts

Step 7

Apply Loctite 243 or a compound equal strength to the threads Insert the sensor housing into the FGD10A enclosure using the insertion tool.

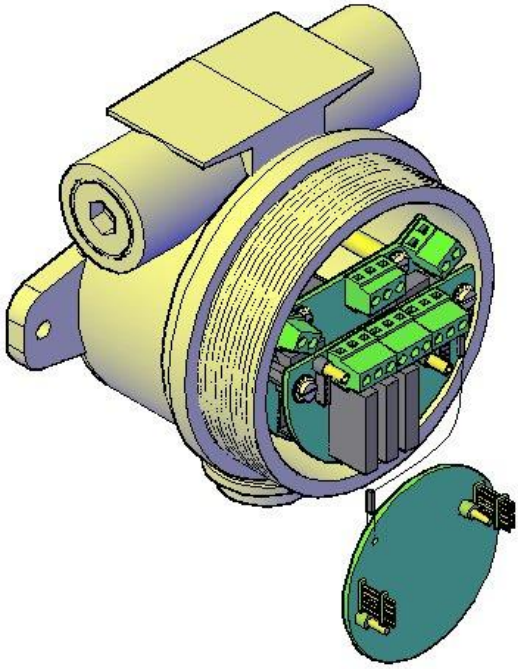


Step 8
Terminate the wires dependling on which type of gas sensor is fitted.

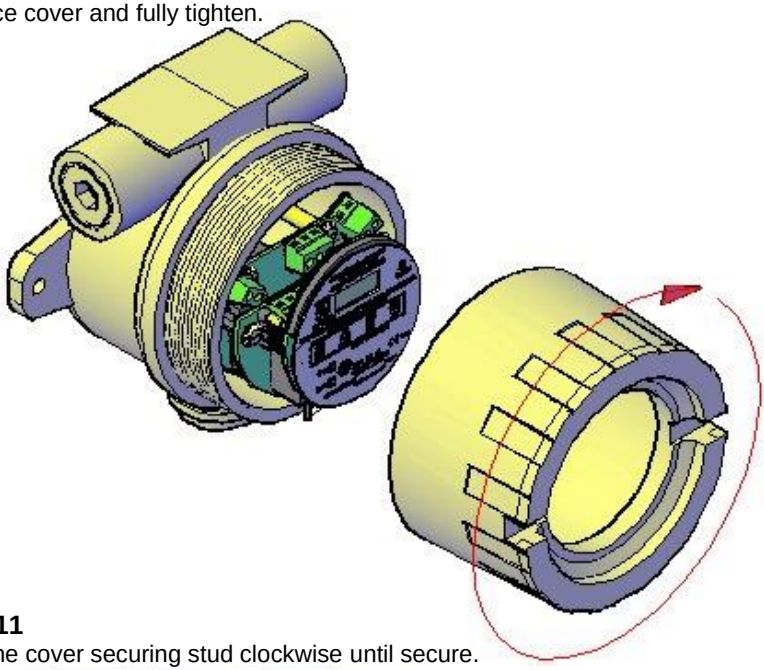


Step 9

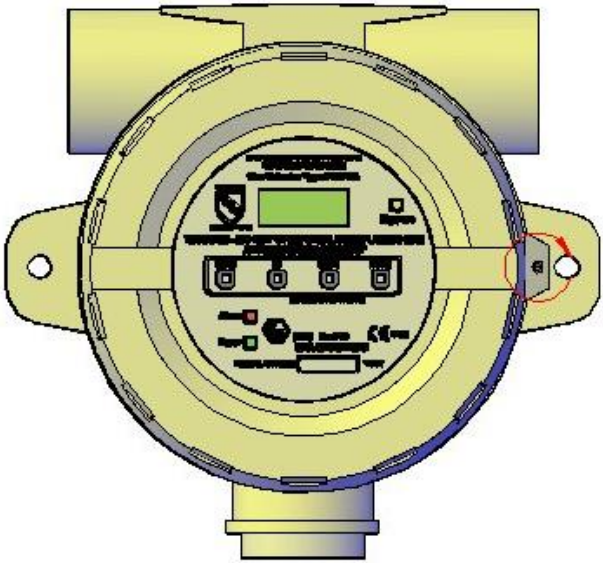
Fix datamate cable, the boards removed from the support pillars and finally the display board back into position.



Step 10
Replace cover and fully tighten.



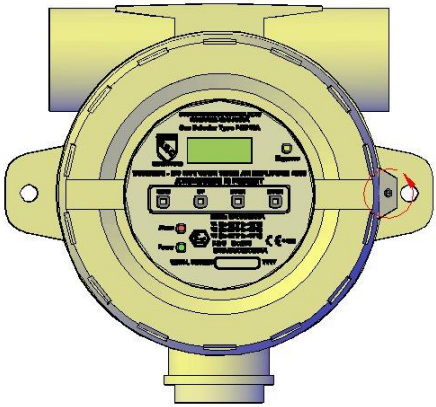
Step 11
Turn the cover securing stud clockwise until secure.



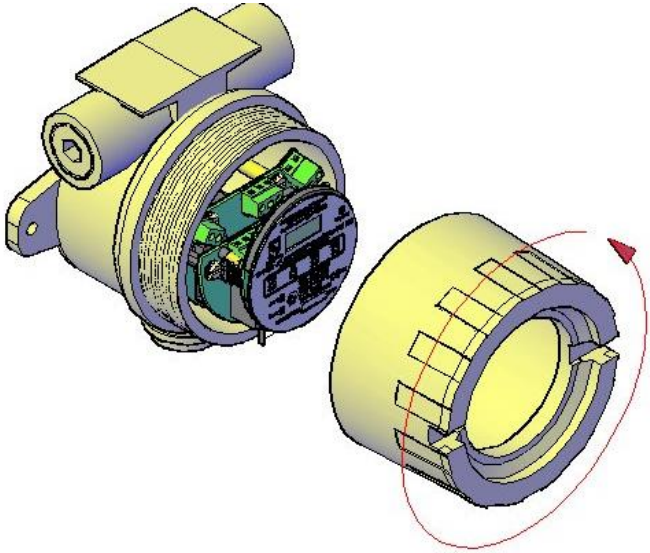
12.3. Flammable (Pellistor) sensor

To order a replacement 'pellistor' sensor, quote Stock No. SS294.

Step1
Turn cover securing stud anti-clockwise to allow cover to open.

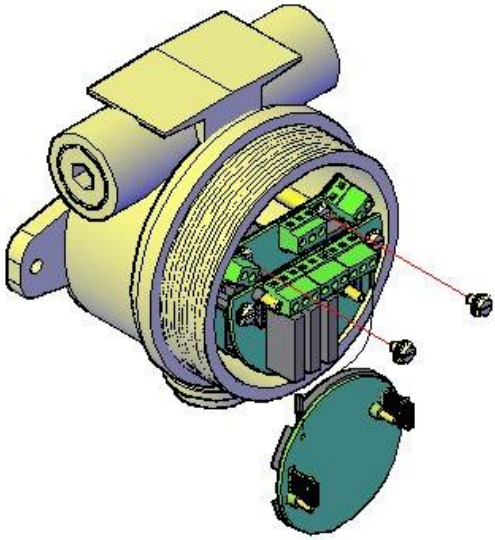


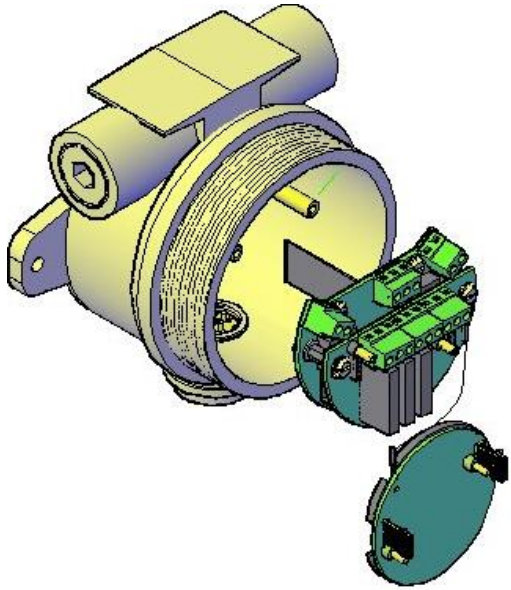
Step 2
Remove cover by rotating anti-clockwise



Step 3

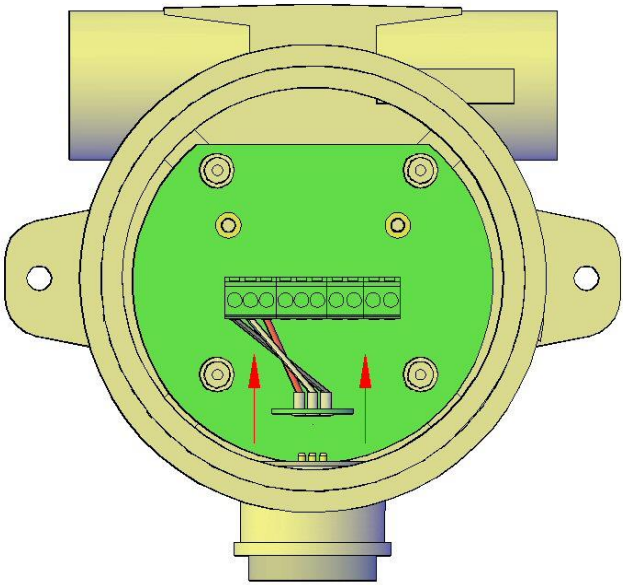
Remove the display board - which can be left to dangle on its retaining wire. Remove the PCBs from the support pillars and the ribbon cable from the board remaining in the enclosure.



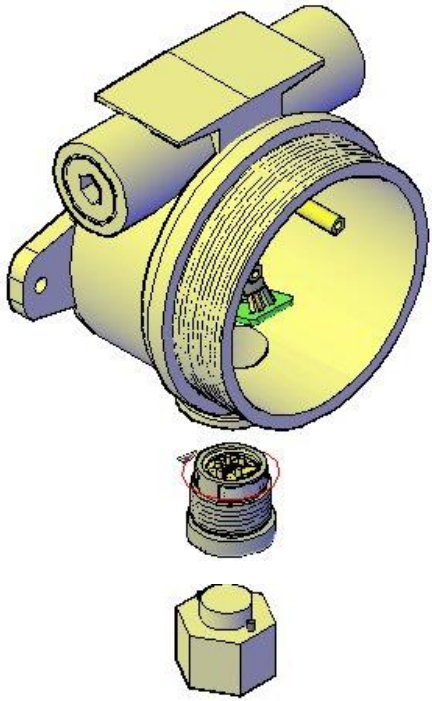


Step 4

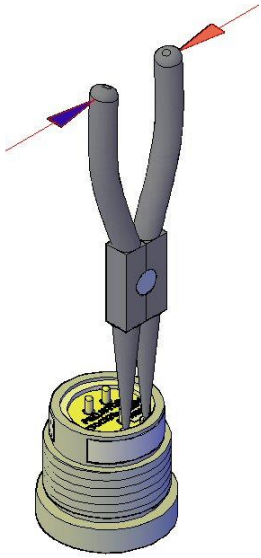
Remove the flammable (pellistor) sensor board from the rear of the sensor – do not disconnect the wires from the main board.



Step 5
Remove sensor insert using extraction tool

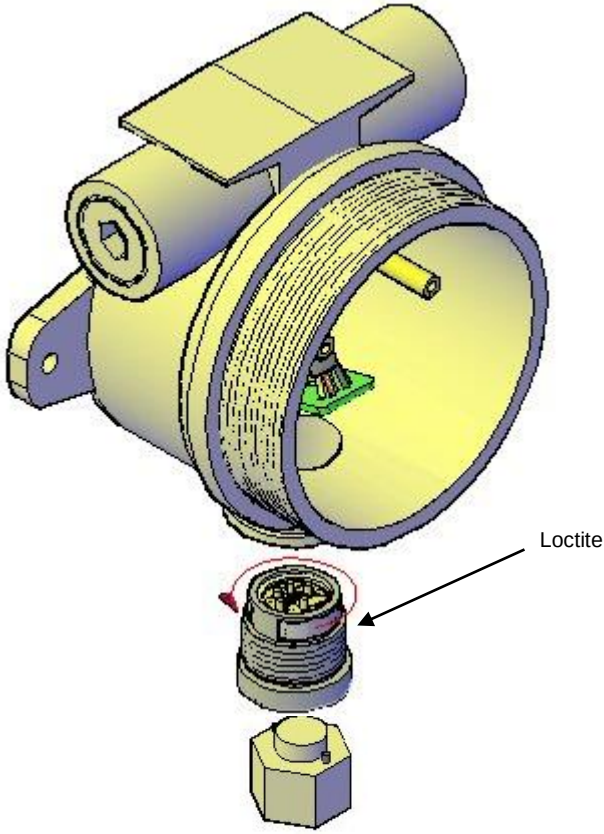


Step 6
Mark the sensor pin position & undo the circlip that retains the sensor in its housing.

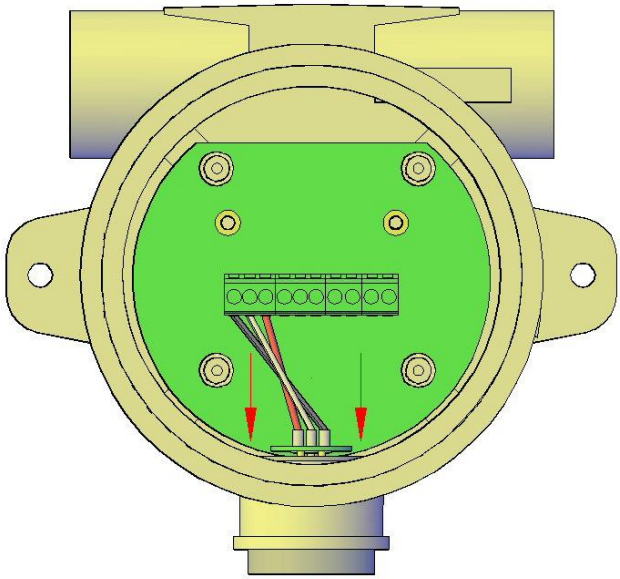


Step 7
Replace the sensor taking note of the pin marking in step 6.

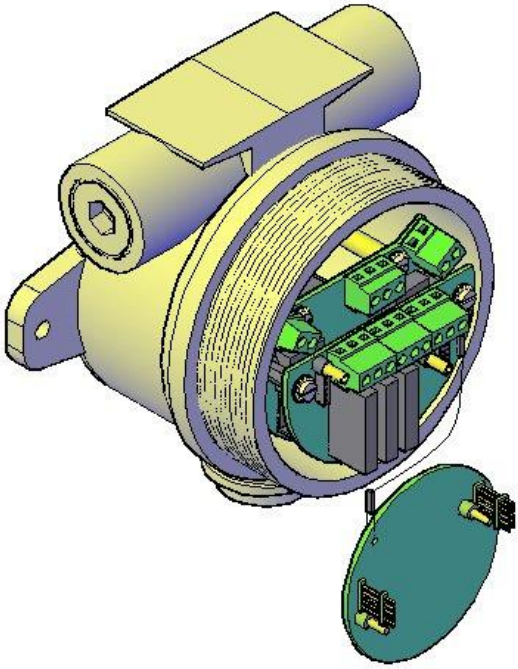
Step 8
Apply Loctite 243 or a compound equal strength to the threads. Insert the sensor housing into the FGD10A enclosure using the insertion tool.



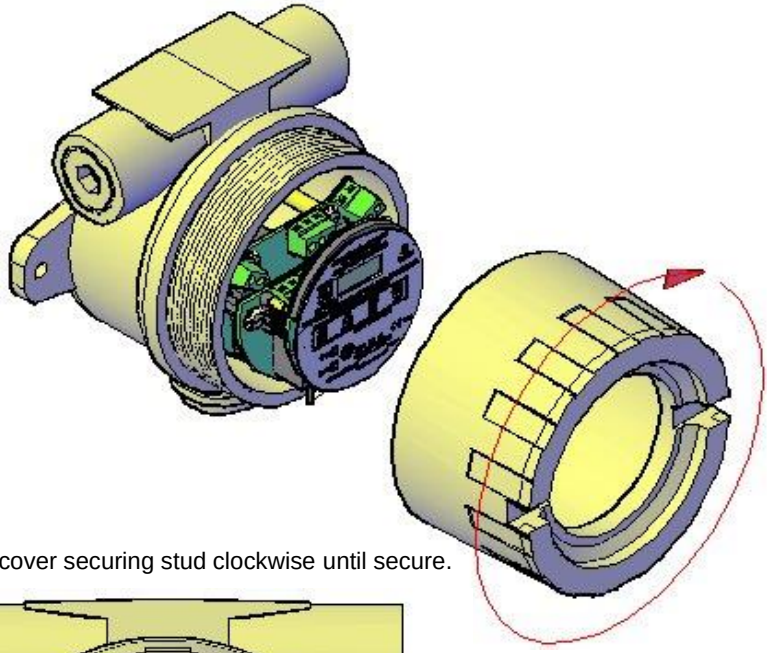
Step 9
Fix the pellistor sensor board back into postion.



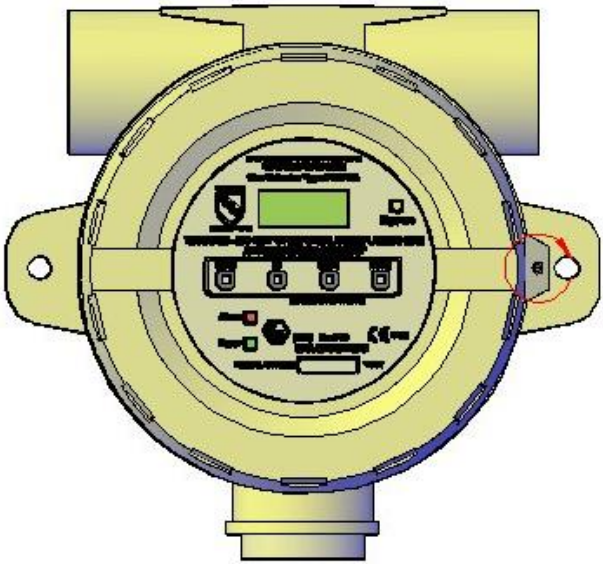
Step 10
Fix ribbon cable, the boards removed from the support pillars and finally the display board back into position.



Step 10
Replace cover and fully tighten.



Step 11
Turn the cover securing stud clockwise until secure.



13. FUSES

A 1Amp anti-surge fuse, housed within a surface mounted holder, is located within the FGD10A-M to prevent overloading of the electronic circuitry in the event of an internal fault.

In the event of the internal fuse blowing, access can be gained using the following procedure:

1. Switch OFF the supply to the FGD10A-M.
2. Release the grub screw located near the lip of the enclosure cover.
   Note: It is not necessary to remove the grub screw to release the enclosure front cover.
3. Remove the enclosure front cover by rotating it several times in an anti-clockwise direction.
4. Unplug the display board from within the enclosure.
5. Remove the 3 screws located around the edge of the next board.
6. Unplug this board.
7. The surface mounted fuse holder can now be located on the board below. Replace only with a fuse of the same type and rating:-

   1Amp Antisurge 'Nanofuse' (SSCL Code: 160153)

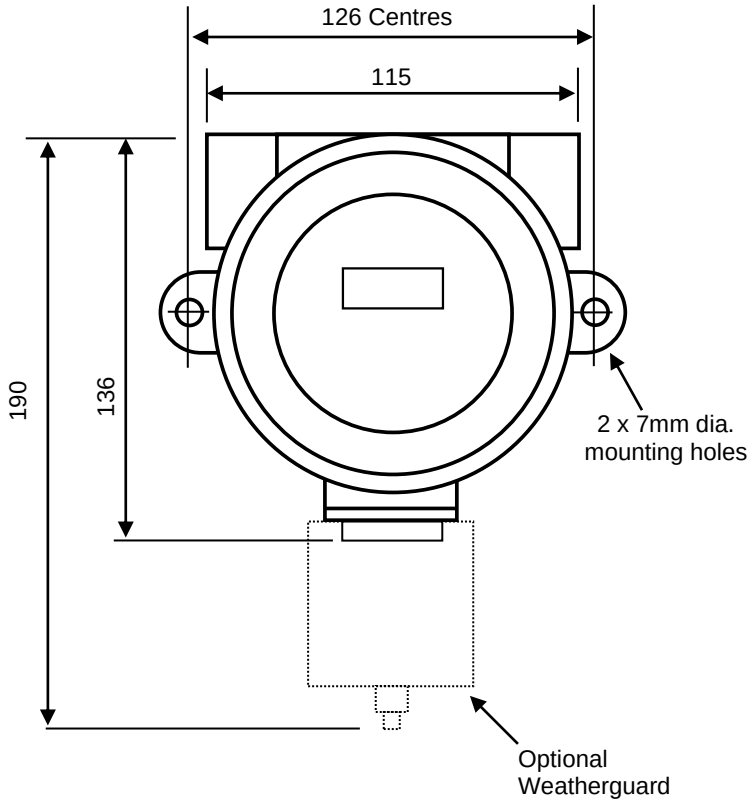
Assembly is the reverse of the above procedure.

14. SPECIFICATION

Materials	:	Instrument Body – Aluminium Pressure Die Casting Sensor Insert – Stainless Steel Grade 316 Magnetic Pen – Stainless Steel Grade 316 Weather guard – Stainless Steel Grade 304 & Nylon 66
Cable entries	:	2 x 20mm
Weights	:	FGD10A-M (excluding weather guard) – 1.5Kg Magnetic Pen – 60 grams Weather guard – 200 grams
Gas types	:	***Infrared version*** Hydrocarbons / Carbon Dioxide (Note – Infrared sensors have no response to Hydrogen)
	:	***Pellistor version*** Flammable gases including Methane and Hydrogen
	:	***Toxic / oxygen version*** Oxygen - Toxic
Input voltage	:	8 to 24 volts dc
Input power	:	5 Watts maximum
Internal fuse	:	1 Amp antisurge 'Nanofuse'
Analogue output	:	4 to 20mA (10 bit resolution)
Relays		Relay 1 – Alarm 1 Relay 2 – Alarm 2 Relay 3 – Fault Contact Rating 300Vac, 3 Amps (Non-inductive load)
RS485 output	:	Not available on this version
Sensor type	:	NDIR Infrared
Measurement range	:	0 – 100% LEL (5% vol. CH_4) or 0 – 100% volume CH_4
Response time	:	Typically T_{90} < 30 sec (CH_4)
Measurement resolution	:	1% LEL or 1% volume (CH_4)
IP rating	:	Enclosure IP66, Sensor IP65
Display	:	160x128 graphics OLED display
Keypad	:	4-Button magnetically operated
Software	:	Software configuration provided via OLED display and multifunction keypad
Operating temperature	:	- 20 to +60 ^{O}C
Humidity range	:	0 to 95% RH non-condensing
Operating pressure	:	Atmospheric + or - 10%
Performance standards	:	EN 60079-29-1:2007

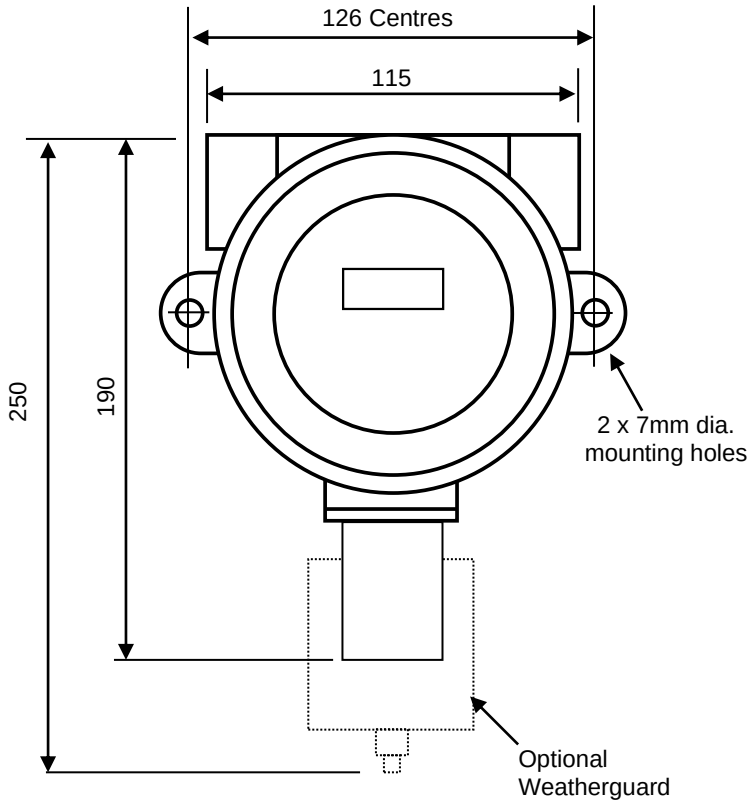
15. DIMENSIONS

15.1. Oxygen / Toxic / Pellistor versions



Maximum Depth = 127mm

15.2. Infrared versions



Maximum Depth = 127mm

16. CERTIFICATION

The FGD10 Series of Gas Detectors are ATEX and IECEx certified for use in potentially explosive atmospheres and is marked as follows:-

WARNING – DO NOT OPEN WHEN AN EXPLOSIVE GAS ATMOSPHERE IS PRESENT

GAS DETECTOR TYPE FGD10 **

STATUS SCIENTIFIC
CONTROLS LTD.
MANSFIELD
NG18 5ER.UK.

IECEx SIR 08.0009X
T4 (Ta -20°C to +60°C)
T5 (Ta -20°C to +50°C) *
T6 (Ta -20°C to +35°C) *

II 2 G Ex d IIC CE 1180

SIRA 08ATEX1031X

SERIAL No. XXXXXX
YYYY

CIRCUIT RATING: 24VDC, 5W
RELAY CONTACT RATING:
300VAC. 3A MAX.

***** T5 & T6 ratings are not valid for versions fitted with an externally mounted sensor.

****** Denotes additional characters that define the gas detector configuration e.g. Enclosure type and sensor arrangement.

YYYY – Denotes year of manufacture.

Special Conditions of Safe Use

1. The gap between the SI-IR sensor and its housing in the gas detector is 0.11mm maximum and should not be enlarged during maintenance etc.

2. Only Loctite 243 or a compound equal strength shall be re-applied to the threads of the type SI-M sensor after replacing the sensing element.

3. The SI-IR sensors shall not be installed or removed when an explosive gas atmosphere is present.

Compliance with the Essential Health and Safety Requirements has been assured by compliance with:

EN 60079-0: 2006 **EN 60079-1 : 2007**

Electrical data

Power supply - 8Vdc to 24Vdc, 5W
Relay contact rating – 300Vac, 3 Amps

Installation instructions

The cable entry devices and blanking elements of unused apertures shall be of a certified flameproof type, suitable for the conditions of use and correctly installed.

With the use of conduit, a suitable certified sealing device such as a stopping box with compound shall be provided immediately at the entrance to the flameproof enclosure.

A copy of the certificate is available for download from:-

www.status-scientific.com

CUSTOMER NOTES