STATUS SCIENTIFIC CONTROLS

STATUS S.S.C SCIENTIFIC
Incorporated since 1988

INSTALLATION & CALIBRATION MANUAL

INTRINSICALLY SAFE INFRARED GAS DETECTOR TYPE FGD3

Certificate No.
BAS01ATEX2300

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Issue:	1.3c
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Firmware:	V6.83i

FGD 3 Infrared Gas Detector

Stock No. SS412 – Carbon Dioxide
Stock No. SS413 - Hydrocarbon

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STATUS S.S.C SCIENTIFIC

ISO 9001:2000

Certificate No. GB93/1938

Manufacturer's EC Declaration of Conformity

We declare, under our sole responsibility, that we believe the products identified in this declaration, and to which this declaration relates are in conformity with the requirements of the following Council Directives:

1. 89/336/EEC as amended by 92/31/EEC on the approximation of the laws of the Member States relating to Electromagnetic Compatibility.
2. 94/9/EC on the approximation of the laws of the Member States concerning equipment and protective systems intended for use in potentially explosive atmospheres.

Description of Equipment:

The FGD3 Infrared Fixed Gas Detectors for the detection of either Carbon Dioxide or Hydrocarbon gases.
ATEX Certified intrinsically safe for use in Group IIC hazardous locations.

Standards applied:

Electrical apparatus for potentially explosive atmospheres -General requirements.	EN50014:1997 + Amds 1 & 2
Electrical apparatus for potentially explosive atmospheres -Intrinsic safety 'i'.	EN50020:1994
Electrical apparatus for potentially explosive atmospheres -Flameproof enclosure 'd'.	EN50018:2000
Electromagnetic compatibility - Electrical apparatus for the detection and measurement of combustible gases, toxic gases or oxygen.	EN50270:1999
Electromagnetic compatibility. Generic emission standard. Industrial environment.	EN61000-6-4:2001
Electromagnetic compatibility. Generic standards. Immunity standard for industrial environments.	EN61000-6-2:1999

Notified Body for Hazardous Area Certification:	***Notified Body for ATEX Quality Assurance Notification:***
Baseefa Rockhead Business Park Staden Lane, Buxton SK17 9RZ, UK Notified Body Number : 1180	Baseefa Rockhead Business Park Staden Lane, Buxton SK17 9RZ, UK Notified Body Number : 1180
Product Hazardous Area Certificate Number:	***ATEX Quality Assurance Notification Number:***
BAS 01ATEX2300	2056
Place of Manufacture:	***ISO 9001:2000 Quality Management System:***
Mansfield, Nottinghamshire, UK. Date mark applied 05	Certificate No. GB93/1938

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

Name: W. R. Baxter Title: Managing Director

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STATUS SCIENTIFIC CONTROLS

FGD3 Infrared Detector Heads

FGD3 Infrared
Gas Detector

Optional
Weatherguard

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1 Firmware Revision History

Version 6.83i 03 May 2005

CH4t added to list:
used to select methane scale using the temperature compensated sensor.

Version 6.82i 08 Dec 2004

Default bulb rate of 18, was 14
Default target gas to 40.0

Version 6.81i 26 Nov 2004

New sensor type from Dynament - HCC
no temperature compensation required.

Version 6.8ir 11 Mar 2004

CO2H sensor added to list bug:
sensor details not actually initialised after selection in menu, fixed

Version v6.7ir 26 Feb 2004
CO2H sensor added to list

Version v6.6ir 9 Sept 2003

Max Xref changed from 150 to 500.

2 Introduction

The FGD 3 Infrared Gas Detector Head incorporates the latest generation of compact sensors incorporating infrared technology (see section 2.1).

Warning – Infrared sensors will not detect Hydrogen gas.

There are two current detectors in use, one for Hydrocarbon gases and the other for Carbon Dioxide.

The Hydrocarbon sensor can be set to either methane or general hydrocarbons. These two settings use different calculations to convert the sensor signals to gas readings, **it is important to select the correct gas type to give accurate readings.**

The detectors use the industry standard 4-20mA current loop to convey the gas levels detected to a control unit. This means that under *zero gas* conditions 4mA is drawn from the supply, and under *full scale* gas conditions 20mA is drawn from the supply. The current varies linearly for gas levels between zero and full scale.

The detector heads require a three-wire connection (see section 3.4). While the loop current supplies the power required by the detector head electronics within the detector head, a second supply must be provided to power the infrared sensor and its associated circuitry.

Additional features of the latest generation of FGD3 Heads include:-

- The terminal block for wire termination is located within an EMC enclosure within the FGD3 Detector Head. This has greatly improved the instruments immunity to radio and electromagnetic interference.
- The software has been redesigned to allow more data to be accessed by the knowledgeable user.

An optional weatherguard (Stock No. SS 475) is available for installations exposed to the atmosphere or contaminants and is also suitable for use in other areas where hosing down takes place. The weatherguard is attached with tamperproof screws to ensure that it is not inadvertently removed.

2.1 Background

The infrared sensors use the proven non-dispersive infrared principle (NDIR) to detect and monitor the presence of gases. This technique relies upon the target gas having a unique, well-defined absorption signature within the infrared region of the electromagnetic spectrum.

3 Installation

IMPORTANT
The instrument will monitor the gases in the environment after being powered for a few minutes, however it should be left for a minimum of 2hrs before it is calibrated.

3.1 Siting the Sensors

Mounting positions for detector heads need to be considered individually, some points for consideration are:

- Ensure all sensors are mounted to allow routine calibration and maintenance to be carried out as required.
- Ensure the proposed site will not interfere with movement of existing equipment, e.g. cranes, doors etc
- Install all cables neatly and securely.
- Sensors for detecting gases that are lighter than air should be positioned at a high level.
- Sensors for heavier than air gases should be located at a low level.
- Avoid siting the sensors adjacent to potential sources of radio frequency interference, e.g. radio transmitters, control switchgear, motors etc.
- Avoid mounting the instrument where it may be subjected to sudden transients in ambient temperature (e.g. above a heater/radiator).

3.2 Wire Termination

All connections should be made according to the appropriate sensor or loop diagram for the configuration required. It is advised that ‘Bootlace Ferrules’ or ‘flat blade crimps’ be used for tidy and reliable connections of wires into the Detector Head connectors.

3.3 Cable Routing

Due to the low signal levels generated by gas detectors it is recommended that all wiring to the sensors be segregated away from AC mains or other high voltage/power lines to avoid interference.

3.4 Cable & Screening

The use of a screened cable is recommended for the installation of all detector heads. The correct strategy for connecting the screens depends upon the area in which the detector head is to be used (i.e. hazardous/non-hazardous). In all cases the screen should not be connected at the detector head. Refer to the connection diagrams on the following pages for further information.

The FGD3 infrared detector heads require a three-wire connection to the control unit:

Sig +	current loop to head	8.0-28V (25mA max)
0	0V return to control unit	
Pwr +	supply for sensor	5.8-7.5V (60mA approx)

The infrared sensor requires a current of typically 60mA but draws this in pulses at a frequency of 2Hz (approx).

Note:
Sig and + terminals must not be connected together. Although the detector head will appear to function correctly, it will no longer be able to indicate detected gas levels to the control unit.

3.4.1 Connection Instructions

With the head disconnected adjust the control unit output so that 5.8 – 7.5V can be measured at the detector head between the wires '0' and 'Pwr +'. Connect the head and ensure that the voltage remains within the limits, readjust if necessary.

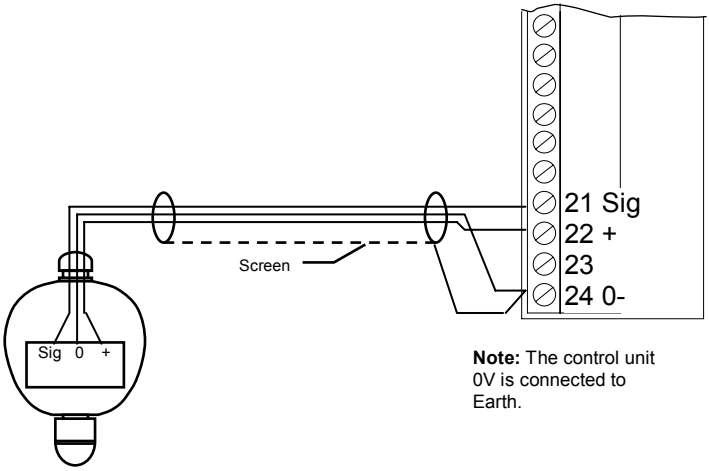
3.5 Installation in a non-hazardous location

When a detector head is installed in an area where there is no potential of an explosive gas hazard present, the cable lengths to the detector are limited solely by the resistance of the cable. The infrared gas detector requires a minimum of 8.0V at its Sig terminals, and 5.8V at its + terminal to allow it to operate correctly.

The maximum current loop resistance can be calculated. For systems operating at 20V, the maximum cable loop resistance (Sig) will be:

(Voltage available – minimum voltage) / max current = max loop resistance
(20-8.0) / 0.025 = 480Ω.

The voltage at the + supply needs to be 1 volt greater than the required 5.8V minimum for every 16Ω of cable resistance. At all times the voltage measured between the + and 0V terminals at the detector head must fall within the range 5.8-7.5V.



Note: The control unit 0V is connected to Earth.

The diagram above shows connection for FGD3 Infrared Detector Head in a non-hazardous location. The pin numbers shown at the control unit refer to pin numbers on the Status Scientific Input Modules within the MCU Control Units. Refer to manufacturer if alternative control unit is used.

3.6 Installation in Hazardous Areas

When using barriers to create an I.S. supply, certain restrictions are imposed on the parameters of the interconnecting cables used. These parameters are defined by the manufacturer of the barrier and limit the maximum capacitance, inductance and inductance to resistance ratio of the cable. The installation is only intrinsically safe when the combination of the barrier and connecting cables comply with the manufacturer's specification.

As with a non-I.S. installation, the cable length is restricted by the cable loop resistance. With the introduction of a barrier or the FGDIO module (refer to the MCU System Installation and Hardware Configuration Manual), the cable loop resistance is reduced because of the internal resistance of the barrier. The end-to-end resistance of the barrier must therefore be subtracted from the overall cable loop resistance when calculating cable lengths.

Barriers must be selected to restrict the parameters of the I.S. supply to the gas detectors within the following limits:

Terminals	U_{max}	I_{max}	P_{in}	Ci	Li
0V and SIG	30V	0.15A	0.81W	10nF	0
0V and +	7.5V	0.75A	1.4W	9.7μF	0

When considering the capacitance and inductance allowable across the barrier output terminals, note:

There is 10nF and zero inductance between terminals 0V and SIG on any model of FGD Detector head.

There is an equivalent of 9.7μF capacitance and zero inductance between terminals 0V and + on the FGD3 Infrared gas detector.

When used in a hazardous area, the FGD3 detector requires an intrinsically safe (I.S.) power supply. This can be provided in 2 ways:

1. By using the MCU Control Unit incorporating the I.S. Output Module Type FGDIO. The FGDIO module is incorporated within the MCU control unit enclosure and provides intrinsically safe outputs for all versions of the FGD range of gas detectors.

2. By using proprietary safety barriers.

Guidance on the correct installation of I.S. systems is provided by EN60079-14:1997

3.6.1 Installations using Proprietary Safety Barriers.

For wiring details refer to manufacturers specific data sheets.

4 Relative Response Characteristics

This section is applicable to FGD3 gas detectors fitted with an infrared **Hydrocarbon** sensor.

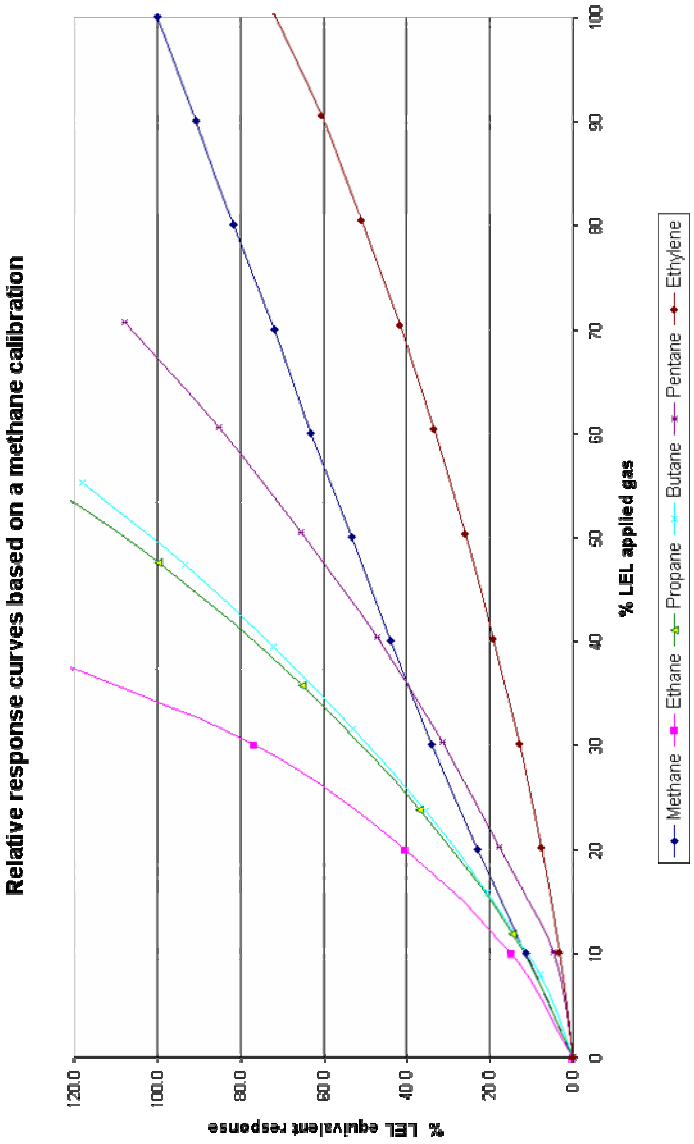
Unless otherwise specified, the FGD3 infrared hydrocarbon gas detector is calibrated to provide an output signal linearised for methane (CH_4) during manufacture.

However, the gas detector will also respond to a range of hydrocarbon gases. The characteristics shown on the following page 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 FGD3 can be calibrated using a test gas for any of the gases shown in the characteristic, using the span setting procedure as described in Section 5.2.2

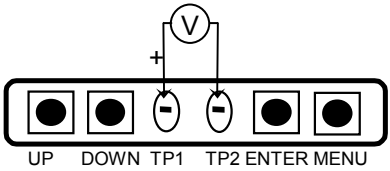

Relative response curves based on a methane calibration
% LEL equivalent response
120.0
100.0
80.0
60.0
40.0
20.0
0.0
% LEL applied gas
0
10
20
30
40
50
60
70
80
90
100
Methane
Ethane
Propane
Butane
Pentane
Ethylene

5 Calibration and Menu System

The recommended calibration interval is 6 months. Under no circumstances should it exceed 12 months.

Important
Whenever the menu system is entered the instrument will cease to indicate the gas levels that it detects to the control unit. However normal operation is always returned following a period of keypad inactivity (or when the menu system is exited).

In order to gain access to the calibration switches and test points, release the screw situated between the letters A and T of the chrome STATUS label on the Detector Head front panel. The screw does not need to be completely removed, only release it far enough so that the STATUS label can rotate revealing the calibration switches and test points. The buttons and test points are designated as follows:



Note:
Where possible, disable the channel at the control unit so that the calibration feature used does not cause an alarm condition to be indicated. Refer to control unit manufacturers user manual for further details.

5.1.1 Calibration Gas Flow Rates

The infrared sensors are known to be sensitive to pressure transients and therefore it is important that the flow rate of gas into the sensor housing is not excessive during calibrations. Care must also be taken to ensure the exhaust from the sensor housing is not restricted. The recommended flow rate of calibration gases is 500 - 750cc/min.

5.2 Menu Mode Selection

Several calibration modes exist in the detector head and these are accessible via the instruments simple menu system. To select a menu mode follow this procedure:

- Press the MENU button and **C: 1** appears on the display.
- Press UP or DOWN until the required menu mode is displayed on the screen.
- Press ENTER to select the menu mode.
- To exit the menu mode press MENU.

While the instrument is in a menu mode – any data displayed on the screen will alternate between the menu number and the reading.

The following features are available via the 'FGD3' menu system: -

Cal number	Function	Section
1	Zero Sensor	5.2.1
2	Span Sensor	5.2.2
3	Select FSD	5.2.4
4	Set 4mA Loop Current	5.2.5
5	Set 20mA Loop Current	5.2.6
8	Restore	5.2.7
9	View Engineer/Diagnostics Data	5.2.8
10	Sensor Frequency	5.2.9
15	Set Cross reference	5.2.10

5.2.1 Zero Sensor

This is a calibration feature. It allows the instrument to determine the sensor output under zero gas conditions.

- Apply zero gas to the sensor inlet and allow enough time for the sensor to respond and all the gas to be purged (typically 2 minutes minimum dependent upon flow rate).
- Select menu mode **C: 1** (refer to section 5.2) and press ENTER.
- Press ENTER to perform the ZERO calibration. Pressing MENU instead of ENTER aborts the calibration (the ZERO factor will still be displayed on exit).
- Press MENU – the display will show the ZERO factor for the instrument before returning to its standard mode of operation.

The ZERO factor should be recorded on any calibration certificates completed.

Note: For Hydrocarbon sensors
If there is 0% Hydrocarbon gas present in the atmosphere then the instrument can be zeroed in air.

Note: For Carbon Dioxide sensors
There is Carbon Dioxide gas present in the atmosphere and as such zero gas must be applied before the instrument can be zeroed.

5.2.2 Span Sensor

This is a calibration feature. It allows the instrument to determine the sensor output when it is exposed to a know concentration of gas.

- Apply a known concentration of gas to the sensor inlet and allow enough time for the sensor to respond.
- Select menu mode **C: 2** (refer to section 5.2) and press ENTER.
- Using the UP and DOWN buttons, adjust the displayed reading so that it matches the calibration gas concentration.
- Press ENTER to perform the SPAN calibration. Pressing MENU instead of ENTER aborts the calibration (the SPAN factor will still be displayed on exit).
- Press MENU – the display will show the SPAN factor for the instrument before returning to its standard mode of operation.

The SPAN factor should be recorded on any calibration certificates completed.

5.2.2.1 Suggested calibration gas levels.

Hydrocarbon sensor: (refer to section 1)
20 to 50%LEL Methane
20 to 50%LEL Pentane

Carbon Dioxide sensor
1 to 2% vol. Carbon Dioxide

5.2.3 Calibration Factors

During the ZERO sensor and SPAN sensor calibrations a factor is displayed that allows the calibration personnel to have confidence with their calibration.

The ideal ZERO and SPAN factors are as follows:-

Sensor	Factor	MIN	TYP	MAX
HC	**Zero**	TBA	1.850	TBA
HC (Pentane)	**Span**	TBA	0.660	TBA
HC (Methane)	**Span**	TBA	0.140	TBA

Carbon Dioxide	**Zero**	TBA	0.75	TBA
	Span	TBA	0.42	TBA

5.2.4 Select FSD

Menu mode **C: 3**
This option should only be used after advice from Status Scientific Controls. Changing this value will affect the 4 to 20mA output and possibly make the FGD3 unsuitable for its intended use.

5.2.5 Set 4mA Loop Current

This is a calibration feature. It allows the instrument to simulate a condition of zero gas so that the 4mA output can be set.

- Attach a multimeter (set to measure DC voltage) between test points TP1 and TP2.
- Select menu mode **C: 4** (refer to section 5.2) and press ENTER.
- Using the UP and DOWN buttons, adjust the reading displayed on the multimeter to 40mV ±0.5mV
- Press ENTER to store the 4mA calibration data. Pressing MENU instead of ENTER aborts the feature.
- Press MENU – the display will show the DAC 4mA calibration factor for the instrument before returning to its standard mode of operation.

5.2.6 Set 20mA Loop Current

This is a calibration feature. It allows the instrument to simulate a condition of full-scale gas so that the 20mA output can be set. A control unit connected will indicate full-scale gas also and may enter its alarm state.

- Attach a multimeter (set to measure DC voltage) between test points TP1 and TP2.
- Select menu mode **C: 5** (refer to section 5.2) and press ENTER.
- Using the UP and DOWN buttons, adjust the reading displayed on the multimeter to 200mV ±0.5mV
- Press ENTER. Pressing MENU instead of ENTER aborts the feature.
- Press MENU – the display will show the DAC 20mA calibration factor for the instrument before returning to its standard mode of operation.

5.2.7 Restore

The firmware for the detector head is common to both CO_2 and HC instruments. This feature allows the type of sensor fitted to be selected.

IMPORTANT

The instrument supplied with this manual has either an infrared HC sensor or an infrared CO_2 sensor installed.
Changing the setting within this menu will not change the gas to which the sensor is sensitive.

*CH4L and *HC settings are for sensor types MSH HC, the rest are for MSH HC/TC and CO2 TC devices. Check the sensor type before selecting.

This menu option allows the sensor type to be selected. The available sensor options are listed below:

OPTION	TYPE	RANGE	COMMENTS
CO2L	Infrared	0-5%Vol	Carbon Dioxide
CO2A	Infrared	0-2%Vol	Carbon Dioxide
CO2H	Infrared	0-25%Vol	Carbon Dioxide
ACET	Infrared	0-100%LEL	Acetone
CH4t	Infrared	0-100%LEL	Methane
*CH4L	Infrared	0-100%LEL	Methane
CH4H	Infrared	0-100%Vol	Methane
*HC	Infrared	0-100%LEL	General hydro carbons
HCtC	Infrared	0-100%LEL	General hydro carbons

The sensor type is selected as follows:

- Select menu mode **C: 8** (refer to section 5.2) and press ENTER.
- Use the UP button to toggle the sensor type (options are CH4t, CH4L, CH4H, ACET, HC, HCTC, CO2L, CO2A or CO2H).
- Press ENTER. Pressing MENU instead of ENTER aborts the feature.
- Press MENU to return the instrument to its standard mode of operation.

This feature will erase all the configuration settings of the detector head and replace them with the instruments default values for the sensor selected. Following the use of this feature the instrument must have a full calibration (including the 4-20mA loop).

5.2.8 View Engineer/Diagnostics Data

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

This information is for the use of Status Scientific Controls.

- Select menu mode **C: 9** (refer to section 5.2) and press ENTER.
- The display will alternate between the current value and code **C: 9x**: where x is:

0	Sensor reading.
1	Calibration temperature, °C.
2	Temperature compensation value °C.
3	Sensor temperature, °C.
4	Detector AtoD counts.
5	Reference AtoD counts.
6	Fractional absorbance.

- The mode of operation can be selected by pressing the UP button.
- Press MENU to return the instrument to its standard mode of operation.

5.2.9 Sensor Frequency

Menu mode **C:10**

This menu option is used by Status Scientific Controls personnel only and allows the frequency at which the infrared sensor bulb is flashed. This setting must not be changed from the factory set value.

Warning
Changing this value may limit the instruments performance and in extreme cases, the instrument may no longer detect gas.

5.2.10 Set Cross reference

Menu mode **C: 15**
This option is used to allow the user to calibrate the sensor with a commonly available gas (e.g. methane or propane) but use the unit to detect a different gas (e.g. methanol or acetone etc.). This is achieved by adjusting the cross-reference factor according to the difference in signal that is detected for the calibration gas compared to the target gas.

- Press button 1 to open the menu system.
- Select menu mode **C: 15** (refer to section 5.2) and press ENTER.
- Press ENTER.
- Using the INCREASE and DECREASE buttons (buttons 3 & 4), set the required cross-reference factor.
- Press ENTER to store the new value.
- Press button 1 to close the menu system.

Ask Status Scientific Controls for advice on settings.

5.3 FGD3 Head Indications

The FGD3 Infrared Detector Heads will flash 'F xx' if they sense a fault with the sensor fitted. This will coincide with the head drawing a current of less than 2.5mA from the control unit, thus ensuring the control unit is aware of the fault condition.

Note: xx is a number that defines a particular fault as follows:

1	Checksum error.
2	Zero calibration error.
4	Span calibration error.
8	Sensor reference low output.
16	Sensor reference high output.
32	Sensor detector low output.
64	Sensor detector high output.

5.4 Sensor Replacement

Sensor replacement should only be performed by Status Scientific Controls field service personnel, or a trained engineer. Consult Status Scientific Controls for further details.

Following sensor replacement:-

- The sensors electronics must be set-up.
- A full calibration must be performed, (refer to section 5)

5.4.1 Sensor Electronics Verification.

Select menu mode **C:9** (refer to section 5.2.8)
Select engineer code C:93 and verify that the sensor temperature is approximately 7°C above ambient, @ 25°C.

Select engineer code C:94 and verify that the detector output corresponds with the table below.

Select engineer code C:95 and verify that the reference output corresponds with the table below.

SENSOR		MIN	TYP	MAX
HC	Ref.	TBA	700	TBA
	Det.	TBA	400	TBA

Carbon Dioxide	Ref.	750	800	850
	Det.	550	600	650

Note:

1) The sensor must be powered for at least 10 minutes before any readings are taken.
2) The sensors must be in zero gas.

6 Trouble Shooting

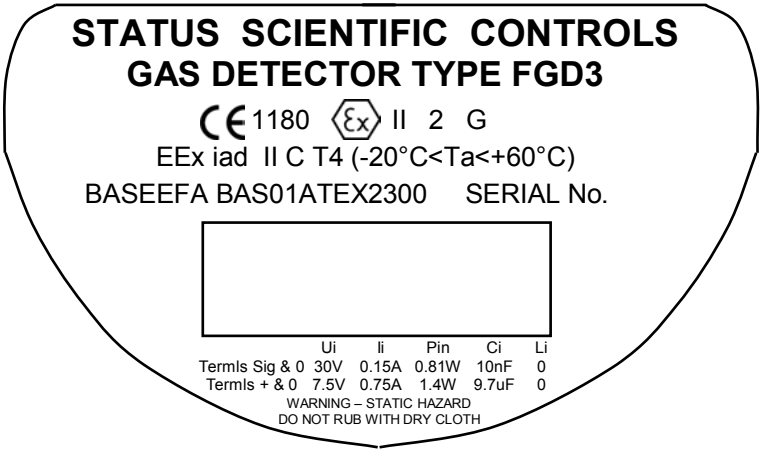
The FGD3 Infrared detectors have been extensively tested and have been found to provide reliable monitoring of target gas levels.

Problems encountered by customers are usually found to be caused by:

- Failure to adhere to recommended calibration intervals.
- Failure to use Nitrogen for ZERO calibrations, or insufficient purge times allowed.
- Sensor aperture obstructions
- Incorrect control unit configuration.
- Power supply requirements not met.
- Instrument raising alarms and considered faulty - but found to be responding correctly to the gas concentration that it is detecting.

7 Certification

The FGD3 infrared gas detector carries the following markings:



8 Specification

Size	122 x 142 x 75mm nominal	
Sensor Type	NDIR Infrared, temperature compensated, dual element	
Sensor MTBF	5 years	
Operating voltage	8.0 – 30V DC (for 4-20mA Signal) 6.5 – 7.5V DC (for Sensor supply)	
Operating Temperature	-20°C to +50°C (-4°F to 122°F)	
Storage Temperature	-20°C to +50°C (-4°F to 122°F)	
Humidity range	0-95% RH non-condensing	
Operating pressure	Ambient ± 10%	
Cable loop resistance	Signal Sensor	480 Ohms at nominal 20v 41 Ohms at 8.0V DC
Degree of protection	IP65	

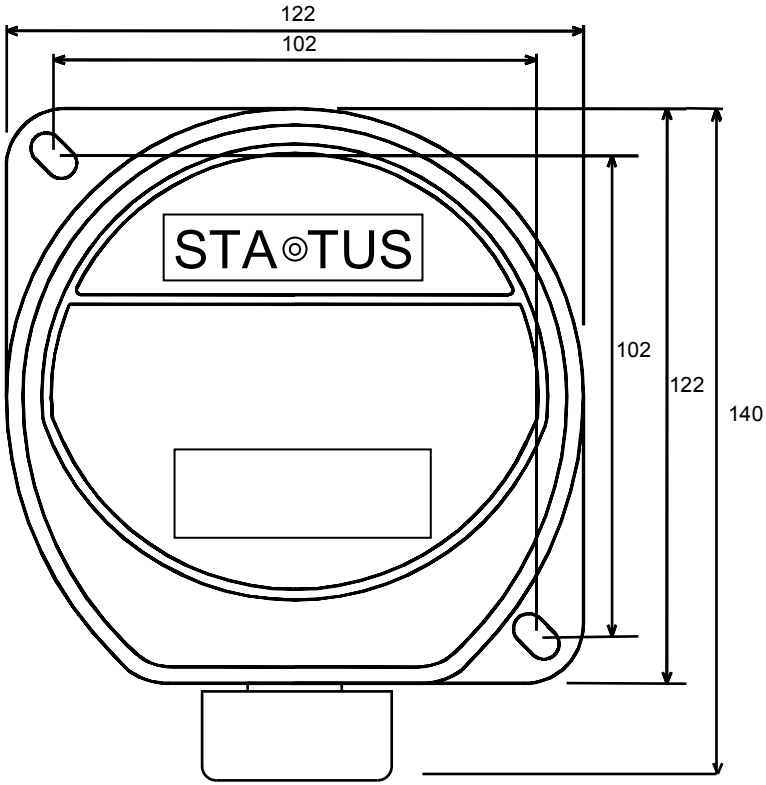
8.1 Hydrocarbon

Measurement range	0-100% LEL
Response Time	T_{90} <30 sec (methane)
Measurement Resolution	1% LEL

8.2 Carbon Dioxide

Measurement range	0-5% Vol.
Response Time	T_{90} <40 sec
Measurement Resolution	0.1% Vol.

9 Outline Dimensions



Depth = 75mm