**STATUS SCIENTIFIC CONTROLS**

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# FGD14 Single Channel Environmental Monitor.

STATUS SCIENTIFIC CONTROLS LTD.
Hermitage Lane Industrial Estate,
Kings Mill Way,
Mansfield,
Nottinghamshire.
NG18 5ER
England
Tel : 01623 651381
Fax : 01623 421063
Internet : www.status-scientific.com

# 1 INTRODUCTION

The FGD14 is a self-contained unit designed to detect environmental conditions by fitting suitable sensors. It also provides the user with local and remote indication of alarm / fault conditions.

The FGD14 can be fitted with a display unit that allows non-intrusive calibration / configuration via concealed push buttons and local readout of gas levels.

A remote keypad can be temporarily fitted to gain access to the calibration / configuration data when the unit is supplied without a display.

The FGD14 is fitted with two relays, which are linked to user definable alarm set points.

The FGD14 may be connected to an interface unit that will allow direct connection to a PC.

## 1.1 Sensors

The unit can be fitted with a range of sensor modules allowing it to be tailored to individual needs.

### 1.1.1 Infrared

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.

There are currently two IR sensors: -

1) Carbon Dioxide
2) Hydrocarbon.

### 1.1.2 Oxygen

The oxygen type fitted is the ‘4’ series type.

### 1.1.3 Toxic

The toxic type fitted is the ‘4’ series 3 electrode type.

# 2 INSTALLATION

**IMPORTANT**
It is important that the instrument has been installed and powered for a minimum of 10 minutes before it is used to monitor the gases concentration in the environment.

## 2.1 Siting the 'FGD14'

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

- Sensors for detecting gases that are lighter than air should be positioned at a high level.
- Sensors for detection of gases heavier than air should be located as low as practically possible.
- Ensure all sensors are mounted to allow 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.
- 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).

## 2.2 Power Supply Options

The FGD14 is available with one of two power supply options.

### 2.2.1 Mains Powered

A universal power supply is fitted that operates in the range of 85-265Vac, 47-400 Hz. This allows worldwide use without the need to configure for location specific mains voltage requirements.

### 2.2.2 DC Powered

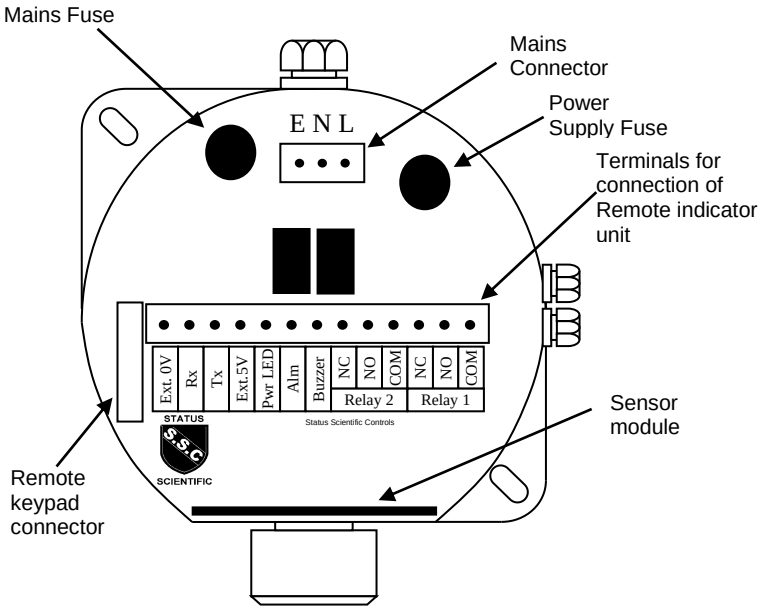
Alternatively a DC power supply can be installed capable of accepting voltages in the range of 8-30V DC.

## 2.3 Wire Termination

All connections should be made according to the diagram below. It is advised that 'Bootlace Ferrules' or 'flat blade crimps' be used for tidy and reliable connections of wires into the Detector Head connectors.

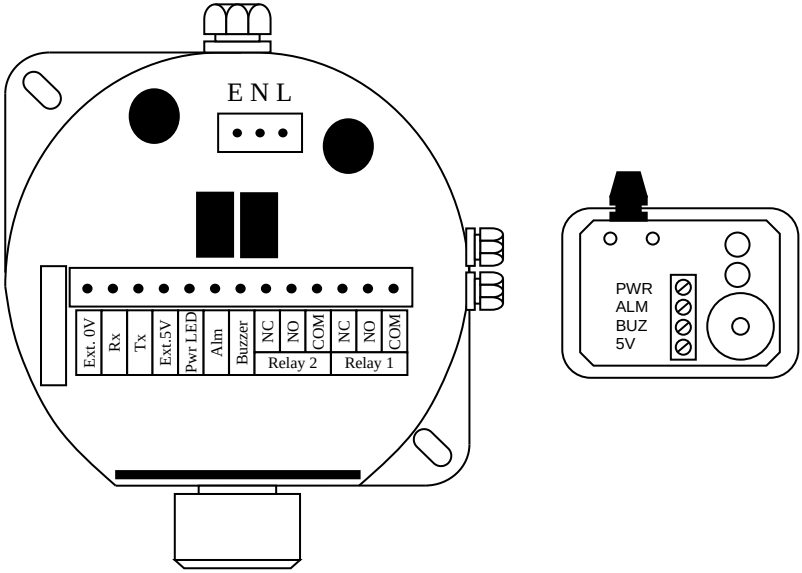
Note: The yellow mains cover must be removed to gain access to the mains input connector.
Isolate the mains supply before removing cover.

Ensure that the protective cover is securely replaced after terminating the mains input




Note:
When a DC Power Supply is fitted within the FGD14, the terminals marked L and N on the above diagram will be identified as +Ve and –Ve.

### 2.3.1 Remote Indicator Connection




To gain access to the terminals within the remote indicator assembly, remove the screw located at each corner of the assembly when viewed from below (4 in total).

The units should then be wired as follows:

| **FGD14** | **Remote Indicator** |
|---|---|
| Ext5V | 5V |
| Pwr LED | PWR |
| Alm | ALM |
| Buzzer | BUZ |

A cable tie is provided within the remote indicator assembly to strain relieve the terminals.

# 3 MENU SYSTEM

**Important**
**Whenever the menu system is entered the instrument will cease to measure current gas levels. However normal operation is always returned following a period of keypad inactivity (or when the menu system is exited).**

## 3.1 Display Unit

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. The buttons are designated as follows:


## 3.2 Menu Mode Selection

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

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

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

The following features are available via the 'FGD14' menu system: -

| Cal number | Function | Enabled | Section |
|---|---|---|---|
| **1** | Zero Sensor | Yes | 3.3.2 |
| **2** | Span Sensor | Yes | 3.3.3 |
| **3** | Set Sensor F | Yes | 3.3.5 |
| **6** | Set Display Mode | Yes | 3.3.6 |
| **7** | Display Firmware version | Yes | 3.3.7 |
| **8** | Restore | Yes | 3.3.8 |
| **9** | View Engineer/Diagnostics Data | Yes | 3.3.9 |
| **10** | Sensor Frequency | Yes | 3.3.10 |
| **13** | Set Relay 1 Mode | Yes | 3.3.12 |

| | | | |
|---|---|---|---|
| **14** | Set Relay 2 Mode | Yes | 3.3.13 |
| **15** | Set Alarm Level 1 | Yes | 3.3.14 |
| **16** | Set Alarm Level 2 | Yes | 3.3.15 |
| **26** | Sounder enable | Yes | 3.3.16 |
| **27** | Alarm hysteresis | Yes | 3.3.17 |

**Note: The MENU numbers have gaps, this is to maintain compatibility with other products that have different features.**

### Alarm Test

The FGD14 is equipped with an alarm test function. During alarm the relays, Leds and sounder will operate, see section 3.4

In order to gain access to the alarm test switch see section 3.1.
When the FGD14 is operating normally press the UP button to activate the alarm system. The alarm will continue to operate whilst the UP button is pressed and for a further 5 seconds when it is released.

## 3.3 Calibration

The infrared sensors used within the Status Scientific Controls 'FGD14' Detector Heads do not respond linearly with respect to gas levels to which they are exposed. The FGD firmware contains complex mathematical formulae to allow a linear response to be calculated and indicated on the instrument display.

Care should be taken to ensure that calibration procedures are followed and any notes included are read and understood. Failure to adhere with the recommendations within this manual may seriously impair the instruments ability to accurately indicate the gas levels to which it is being exposed.

### 3.3.1 Calibration Gas Flow Rates

Most gas sensors including the infrared sensors are 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.

### 3.3.2 Zero Sensor

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

- Apply target free gas to the sensor inlet and allow enough time for the sensor to respond and all gas to be purged (typically 2 minutes dependent upon flow rate).
- Select calibration mode **C: 1** (refer to section 3.2) 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.*

### 3.3.3 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 Hydrocarbon gas (typically 20% LEL pentane) to the sensor inlet and allow enough time for the sensor to respond. I.e. until the reading remains constant.
- Select calibration mode **C: 2** (refer to section 3.2) 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.*

### 3.3.4 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 | Notes |
|---|---|---|---|---|---|
| **HC** | **ZERO** | 0.800 | 1.000 | 1.200 | |
| | **SPAN** | TBA | 1.70 | TBA | |

| | | | | | |
|---|---|---|---|---|---|
| **CO2** | **ZERO** | 0.800 | 1.000 | 1.200 | |
| | **SPAN** | TBA | 0.45 | TBA | |
| | | | | | |
| **Oxygen** | **ZERO** | 0 | 0 | 20 | |
| | **SPAN** | TBA | 0.3 | TBA | Non-linearised |
| | **SPAN** | TBA | 2559 | TBA | Linearised |

### 3.3.5 Set Sensor FSD

This option is used to match the sensor's operating range with the electronics so that over-range conditions can be detected.

- Select calibration mode **C: 3** (refer to section 3.2) and press ENTER.
- Using the UP and DOWN buttons, adjust the displayed reading so that it matches the desired FSD.
- Press ENTER to accept the new FSD. Pressing MENU instead of ENTER aborts the feature.
- Press MENU to return the instrument to its standard mode of operation.

### 3.3.6 Set Display Mode

Menu mode **C: 6**

- Select calibration mode **C: 6** (refer to section 3.2) and press ENTER.
- Using the UP and DOWN buttons, adjust the display to match the number of decimal places required.
- Press ENTER to accept the new setting. Pressing MENU instead of ENTER aborts the feature.
- Press MENU to return the instrument to its standard mode of operation.

Note: increasing the display resolution will not make the sensor more accurate.

### 3.3.7 Display Firmware Version

Menu mode **C: 7**
This option is not available in this version – it is used for compatibility with other products.

### 3.3.8 Restore

This feature is used to restore all the settings to the factory default settings. **Warning all current settings and sensor calibration will be lost – use with extreme caution**

The information that can be displayed using this feature is usually only required during initial assembly and testing of the detector head

- Select calibration mode **C: 8** (refer to section 3.2) and press ENTER.
- The display will show HC.
- Press UP to select the different types of sensor.
- Press ENTER to restore the factory default settings for the selected sensor type. Pressing MENU instead of ENTER leaves the unit without change.
- Press MENU to return the instrument to its standard mode of operation.

#### 3.3.8.1 Sensor types

| MENU | TYPE | RANGE | COMMENTS |
|---|---|---|---|
| HC | Infrared | 0-100%LEL | General hydro carbons |
| CO2L | Infrared | 0-5%Vol | Carbon Dioxide |
| CO2A | Infrared | 0-2%Vol | Carbon Dioxide |
| CH4L | Infrared | 0-100%LEL | Methane |
| CH4H | Infrared | 0-100%Vol | Methane |
| Elt1 | Oxygen | 0-25%Vol | |
| Elt2 | Toxic | 0-1ppm | Positive output sensor |
| Elt3 | Toxic | 0-1ppm | Negative output sensor |
| Elt4 | Toxic | 0-20ppm | |
| Elt5 | Toxic | 0-50ppm | |
| Elt6 | Toxic | 0-200ppm | |
| Elt7 | Toxic | 0-500ppm | |
| Elt8 | Toxic | 0-1000ppm | |
| Elt9 | Toxic | 0-9999ppm | |

### 3.3.9 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 calibration mode **C: 9** (refer to section 3.2) and press ENTER.
- The display will alternate between the current value and code **C: 9x**: where x is:
  - 0 Sensor reading.
  - 1 Calibration temperature, degC.
  - 2 Sensor temperature, degC.
  - 3 Detector AtoD counts.
  - 4 Reference AtoD counts.
  - 5 Fractional absorbance, IR only.

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

### 3.3.10 Sensor Frequency

Menu mode **C: 10**
This option is not available in this version – it is used for compatibility with other products.

### 3.3.11 Cross Reference

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.

- From the menu system select menu option: **C: 12** and press ENTER.
- Using the INCREASE and DECREASE buttons, set the required cross-reference factor.
- Press ENTER to store the new value.
  Note:
  Pressing MENU rather than ENTER exits the cross-reference feature without saving any changes.
- Press MENU to close the menu system.

**Infrared sensor**

| Target gas | Calibration gas | Cross Reference Factor |
|---|---|---|
| Methane | Methane | 1.00 |
| Propane | Propane | 1.00 |
| Toluene | Methane | 1.30 |
| Ethanol | Propane | 1.20 |
| IPA | Propane | 1.72 |
| Hexane | Propane | 1.00 |
| Acetic Acid | Methane | 2.00 |
| Methanol | Propane | 1.00 |
| Acetone | Methane | 1.50 |

**Note: Oxygen sensors.**

Cross reference = 0, oxygen sensor is linearised
Cross reference not 0, oxygen sensor is not linearised

### 3.3.12 Set Relay 1 Mode

The unit is fitted with a relay that is operated in conjunction with the alarm level. The user can select if the relay is normally energised, E' or normally de-energised, 'd' when the unit is **not** in an alarm condition.

- Select calibration mode **C: 13** (refer to section 3.2) and press ENTER.
- The display will show the following:
  - E:r Normally energized, rising alarm
  - d:r Normally de-energized, rising alarm
  - E:F Normally energized, falling alarm
  - d:F Normally de-energized, falling alarm
- The mode of operation can be changed by pressing the UP button.
- Press ENTER to accept the new relay mode of operation. Pressing MENU instead of ENTER leaves the unit without change.
- Press MENU to return the instrument to its standard mode of operation.

### 3.3.13 Set Relay 2 Mode

The unit is fitted with a relay that is operated in conjunction with the alarm level. 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.

- Select calibration mode **C: 14** (refer to section 3.2) and press ENTER.
- The display will show the following:
  - E:r Normally energized, rising alarm
  - d:r Normally de-energized, rising alarm
  - E:F Normally energized, falling alarm
  - d:F Normally de-energized, falling alarm
- The mode of operation can be changed by pressing the UP button.
- Press ENTER to accept the new relay mode of operation. Pressing MENU instead of ENTER leaves the unit without change.
- Press MENU to return the instrument to its standard mode of operation.

### 3.3.14 Set Alarm Level 1

- Select calibration mode **C: 15** (refer to section 3.2) and press ENTER.
- Using the UP and DOWN buttons, adjust the displayed reading so that it matches the desired alarm set point.
- Press ENTER to accept the new alarm level. Pressing MENU instead of ENTER aborts the feature.
- Press MENU to return the instrument to its standard mode of operation.

### 3.3.15 Set Alarm Level 2

- Select calibration mode **C: 16** (refer to section 3.2) and press ENTER.
- Using the UP and DOWN buttons, adjust the displayed reading so that it matches the desired alarm set point.
- Press ENTER to accept the new alarm level. Pressing MENU instead of ENTER aborts the feature.
- Press MENU to return the instrument to its standard mode of operation.

### 3.3.16 Sounder Enable

The sounder has three modes of operation:
Always off
Always on
Timed.

The display shows OFF, On or a number between 1 and 600. The timed mode is in seconds.

This option is used to enable or disable the sounder. Note the Leds and display operate normally.

- Select calibration mode **C: 26** (refer to section 3.2) and press ENTER.
- Set the option to OFF, On or timed by pressing the UP / DOWN buttons.
- Press ENTER to accept the change. Pressing MENU instead of ENTER aborts the feature.
- Press MENU to return the instrument to its standard mode of operation.

### 3.3.17 Set Alarm Hysteresis

Hysteresis is applied during alarm checking to stop the alarm relays chattering when the gas level is at the alarm set point. The hysteresis level is expressed as a percentage of the alarm setting. For example if the alarm setting is 10% vol. $CO_2$ and the hysteresis setting is 1% then the alarm relay would be activated at 10% gas and de-activate at 9.9% gas.

- Select calibration mode **C: 27** (refer to section 3.2) and press ENTER.
- Using the UP and DOWN buttons, adjust the displayed reading so that it matches the desired alarm hysteresis level.
- Press ENTER to accept the new level. Pressing MENU instead of ENTER aborts the feature.
- Press MENU to return the instrument to its standard mode of operation.

## 3.4 'FGD14' Indications

**Start up Conditions**

The FGD starts up with the following conditions:

The GREEN power led on the remote indicator flashes.
The LCD shows:
All segments.
Firmware version.
Sensor type.
'----' flashes for remaining start up time.

The GREEN power led on the remote indicator is continuously lit.

**Alarm Condition**

If the FGD14 detects gas levels in excess of the preset alarm level, an alarm is raised. This is indicated by:

The RED LED on the front panel of the FGD14 flashes and the sounder will be heard.
The RED LED on the Remote Indicator Unit flashes and the sounder will be heard.
The internal Relay will change state.

The alarm condition will continue to be indicated until the detected gas level falls below the alarm set point.

**Fault Condition**

If the instrument detects a fault with the sensor or the configuration data, a fault is raised. This is indicated by:

The RED LED on the front panel of the FGD14 flashes and the display flashes F xxx, where xxx is a fault code as follows

| | |
|---|---|
| 1 | checksum |
| 2 | sensor zero negative drift |
| 4 | sensor zero |
| 8 | sensor span |
| 16 | sensor reference low |
| 32 | sensor ref high |
| 64 | sensor detector high |

The RED and GREEN LED's on the Remote Indicator Unit flash alternately.

**High Condition**

If the instrument detects a gas level in excess of the FSD (+10%) then the display alternates between 'Hi' and the measured gas level, an alarm condition will be indicated.

## 3.5 Sensor Replacement

Status Scientific Controls field service personnel, or a trained engineer should only perform sensor replacement. Consult Status Scientific Controls for further details.

Following sensor replacement: -

- A full calibration must be performed.

# 4 TROUBLE SHOOTING

The 'FGD14' Infrared detectors have been extensively tested and have been found to provide reliable monitoring of hydrocarbon gas levels.

Any problems encountered by customers are usually the result of:

- Failure to adhere to recommended calibration procedures.
- Failure to ZERO the sensor in hydrocarbon free atmospheres, or insufficient purge times allowed.
- Sensor aperture obstructions
- Power supply requirements not met.
- Genuine alarms as a result of gas being present.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# 5 SPECIFICATION

## 5.1 Hydrocarbon

| | | |
|---|---|---|
| **Size** | : | 122 x 142 x 75mm nominal |
| **Weight** | : | 0.9Kg |
| **Gas Types** | : | Hydrocarbons |
| **Operating Voltage** | : | 85-265V, 47-400 Hz |
| **Alarm set points** | : | 2 user adjustable set point between 10%LEL and 60% LEL |
| **Alarm output** | : | Voltage free, single pole changeover relay contacts. User selectable for either normally energised or normally de-energised operation |
| **Alarm contact rating** | : | 1A, 30Vd.c. non-inductive load |
| **Visual alarm indication** | : | Flashing red LED on front panel and on remote indicator unit |
| **Audible alarm indication** | : | Intermittent alarm tone on front panel and on remote indicator unit |
| **Sensor Type** | : | NDIR Infra red, temperature compensated, dual element |
| **Measurement range** | : | 0-100% LEL |
| **Response Time** | : | $T_{90}$ < 30 sec |
| **Measurement Resolution** | : | 1% LEL |
| **Sensor MTBF** | : | 10 years |
| **Operating Temperature** | : | -10 to +40 °C |
| **Storage Temperature** | : | -20 to +50°C |
| **Humidity Range** | : | 0 to 95% RH non-condensing |
| **Operating Pressure** | : | Ambient + or - 10% |

## 5.2 Carbon Dioxide

| | | |
|---|---|---|
| **Size** | : | 122 x 142 x 75mm nominal |
| **Weight** | : | 0.9Kg |
| **Gas Types** | : | Carbon Dioxide |
| **Operating Voltage** | : | 85-265V, 47-400 Hz |
| **Alarm set points** | : | 2 user adjustable set points between 0.3%Vol and 5%Vol |
| **Alarm output** | : | Voltage free, single pole changeover relay contacts. User selectable for either normally energised or normally de-energised operation |
| **Alarm contact rating** | : | 1A, 30Vd.c. non-inductive load |
| **Visual alarm indication** | : | Flashing red LED on front panel and on remote indicator unit |
| **Audible alarm indication** | : | Intermittent alarm tone on front panel and on remote indicator unit |
| **Sensor Type** | : | NDIR Infra red, temperature compensated, dual element |
| **Measurement range** | : | 0-5% Vol |
| **Response Time** | : | $T_{90}$ < 40 sec |
| **Measurement Resolution** | : | 0.1% Vol |
| **Sensor MTBF** | : | 10 years |
| **Operating Temperature** | : | -10 to +40 °C |
| **Storage Temperature** | : | -20 to +50°C |
| **Humidity Range** | : | 0 to 95% RH non-condensing |
| **Operating Pressure** | : | Ambient + or - 10% |

## 5.3 Oxygen

TBA

## 5.4 Toxic

TBA