

GASTRACK – Gas Analyzer Probe (GAP-100) Installation, Operation and Maintenance Guide

To ensure the best performance from your equipment it is important that it is installed, operated and maintained correctly.



The Gas Analyzer Probe (GAP-100) is a pressure compensated oxygen analyzer probe designed to monitor the oxygen concentration in combustion gases, in boilers and industrial furnaces.

The GAP-100 is designed to allow direct installation of the probe in the wall of a flue or furnace to measure the concentration of oxygen in the stack gas with temperatures up to 700°C.

The GAP-100 uses a highly stable and reliable zirconium dioxide (ZrO_2) sensing element which can be replaced without the need to remove the probe from its installation.

Single-point calibration can be simply performed using fresh air or a known reference gas.

NOTE: This guide is valid for product configuration **GAP-100**.

Please fill out the form(s) below for each instrument that has been purchased.

Use this information when contacting CO2Meter, Inc. for service purposes.

Instrument	
Code	
Serial Number	
Invoice Date	
Location of Instrument	
Tag No.	

Instrument	
Code	
Serial Number	
Invoice Date	
Location of Instrument	
Tag No.	

Instrument	
Code	
Serial Number	
Invoice Date	
Location of Instrument	
Tag No.	

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1 DEFINITIONS

The following definitions apply to WARNINGS, CAUTIONS and NOTES used throughout this manual.



WARNING:

The warning symbol is used to indicate instructions that, if they are not followed, can result in minor, serious or even fatal injuries to personnel.



CAUTION:

The caution symbol is used to indicate instructions that, if they are not followed, can result in damage to the equipment (hardware and/or software), or a system failure occurring.

NOTE: Highlights an essential operating procedure, condition or statement.

2 SAFETY INSTRUCTIONS

- This equipment may only be installed by a suitably qualified technician in accordance with the instructions in this manual and any applicable standards associated with the country or industry.
- Failure to correctly adhere to these instructions may result in serious injury or death and in this regard the manufacturer will not be held liable.
- This equipment may only be operated and maintained by trained technical personnel. The technical personnel must strictly adhere to the instructions given in this manual, and any prevailing standards/certificates (depending on application).
- Where instructed, you must read the User Guides and Datasheets referenced within this manual. There, you can find detailed information on the equipment.
- The operator may only perform modifications and repairs to the equipment/system with written approval of the manufacturer.
- Do NOT operate damaged equipment.
- If faults cannot be rectified, the equipment must be taken out of service and secured against unintentional commissioning.

3 TECHNICAL SPECIFICATIONS

Electrical Specifications

- Supply voltage; 24V_{DC} ±10% LPS (Limited Power Supply)^a
- Current consumption; 700mA maximum

Output Options

- LCD screen; on-board 16-character x 2 lines
- Analogue output; one^b – 4–20mA; load 10 – 550Ω (maximum)
- Digital Output; Modbus RTU^c
- Relay output; two – SPST normally open
 - Relay 1 – alarm; user configurable
 - Relay 2 – fault; factory set

Sensor Specifications

Zirconia O₂ sensing element:

- Operating pressure range; 750–1250mbar absolute
- Measurement range^d; 0–25%
- Accuracy; 0.5% vol. O₂
- Resolution; 0.01% vol. O₂
- Sensor warmup time; < 60s
- Stabilisation time; < 5mins
- Sensor response time (10–90% step); < 4s (once process gas has reached the sensing element)
- Internal heater operating temperature; 700°C
- Gas temperature at sensing element; 400°C maximum
- Temperature sensor; Pt-100 (for gas temperature measurements at the sensing element)

Environmental Specifications

- Temperature limitations in process area; up to 700°C
- Ambient operating temperature; -20°C to 55°C
- Humidity range; 0 to 95% RH (non-condensing)

Mechanical Specifications

- Sealing rating; designed to IP65
- Probe construction; 316 stainless steel and Macor[®] ceramic
- Probe length from flange; 400mm
- Flange; refer to [4.3 Flange Dimensions](#) on [page 4-1](#).
- Dimensions; refer to [4.2 External Dimensions](#) on [page 4-1](#).
- Weight; < 6.5kg (14.3lbs)

^a Limited power supply (LPS).

^b One analogue output fitted as standard; a second analogue option can be specified at time of order.

^c Refer to *GAP-100, Modbus Register Set* for details.

^d Prolonged operation below 0.1% O₂ will damage the sensing element.

4 PRODUCT OVERVIEW

4.1 Components

1. Head housing
2. Clamp
3. Mounting flange
4. Probe body
5. Gas sampling tubes

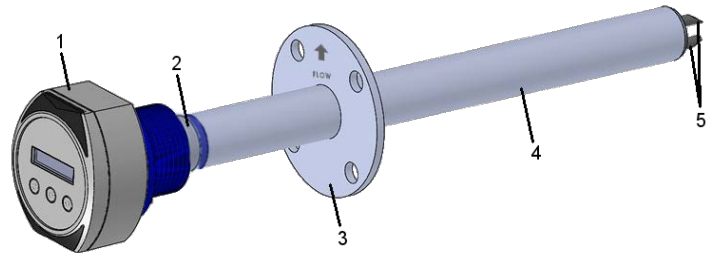


Figure 4-1 – Main Components

4.2 External Dimensions

Dimensions in mm unless otherwise stated; tolerance ± 1 mm unless otherwise stated.

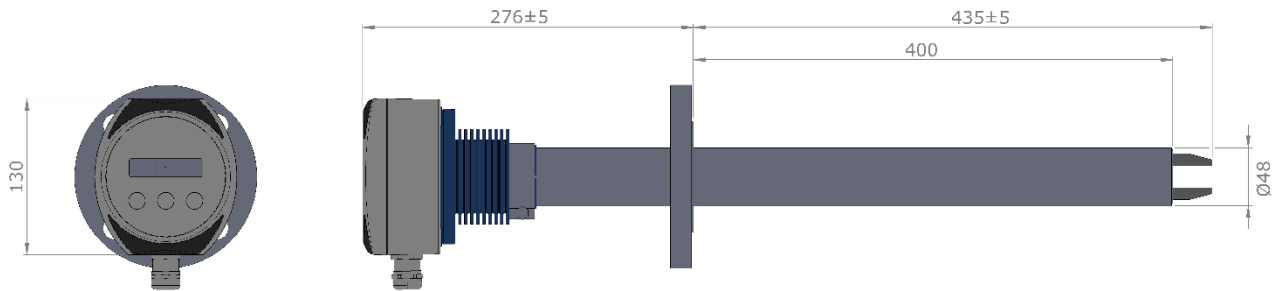
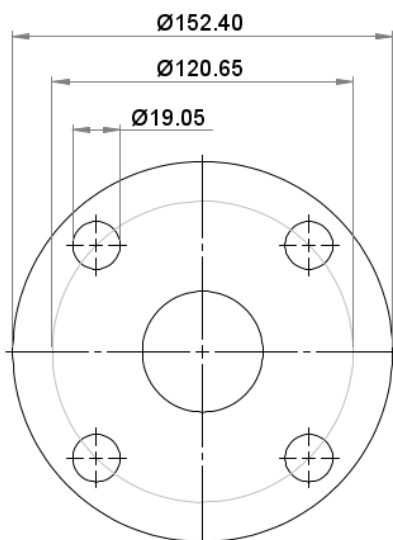


Figure 4-2 - External Dimensions

4.3 Flange Dimensions

Dimensions in mm unless otherwise stated.



Flange profile to match ANSI Class 150 lb.

Nominal pipe size	2"
External diameter	152.40 (6.000")
PCD	120.65 (4.750")
Flange thickness	19.05 (0.750")
No. of holes	4
Bolt hole diameter	19.05 (0.750")

NOTE: The flange is NOT pressure retaining.

Figure 4-3 - 2" ANSI Class 150 lb. Flange

5 INSTALLATION

To ensure the best performance from your equipment, it must be installed correctly.

5.1 General Guidelines

There are no rules governing specific installation locations for fixed gas analysis equipment therefore each site should be evaluated individually. However, the following factors should be taken into account when evaluating site requirements:

- Select a position where the intake is located in the main stream of gas (within a flue or other mounting position).
CAUTION: Gas temperature must not exceed 700°C.
- The device should be mounted such that the alignment arrow on the flange is in the same direction as the sample gas flow. Refer to [Figure 5-1](#) showing alignment arrow.
- Avoid positions where:
 - obstructions or bends create turbulence in the gas flow and/or hinder probe insertion and removal.
 - vibration induced by other plant could result in damage or mechanical failure of the product.
- If mounting in an area where excessive contamination or dust flows are likely, fit a particulate shield to prevent contamination build-up in the gas sampling tubes.
- Select a position that is accessible for maintenance purposes; make allowances for access to the wiring and piping inlets, which are at the base of the head housing.

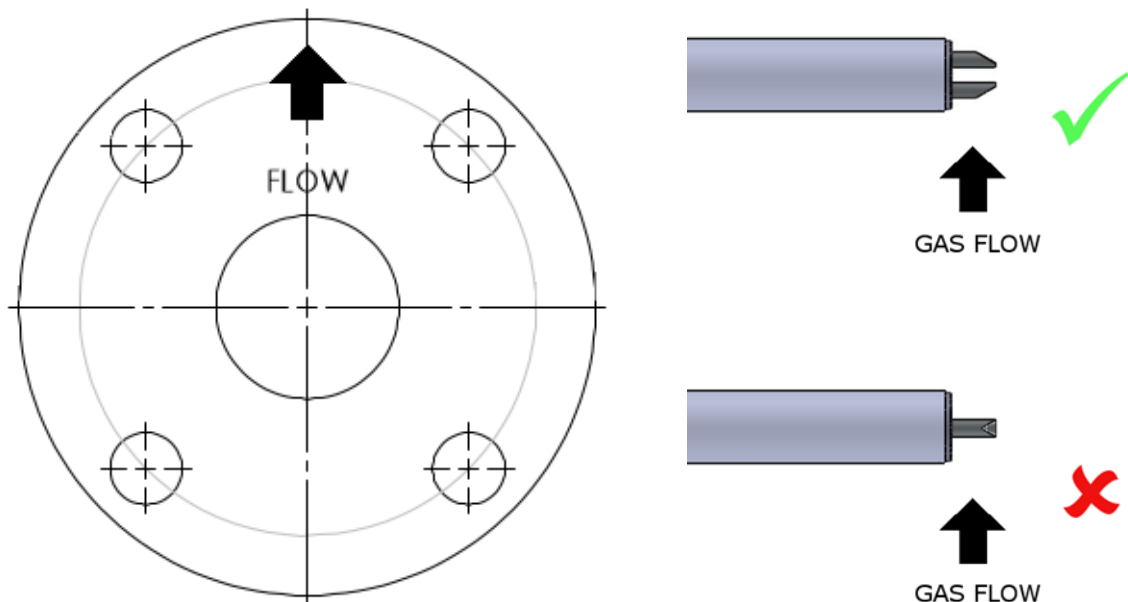


Figure 5-1 – Gas Flow Alignment

5.2 Electrical Connections



WARNINGS:

All wiring **MUST** be in accordance with the National Electrical Code and any local codes, ordinances, and regulations.

Disconnect and lock out power before connecting the equipment to the power supply.

The device wiring should be in a separate conduit. Do **NOT** install wiring in any conduit or junction boxes with high voltage wiring.



CAUTION:

- Do **NOT** install the device suspended from the cable.
- Do **NOT** twist the cable(s).
- Avoid exerting excessive tensile force on the cable (e.g. tugging).
- Do **NOT** leave any wires loose; accidental shorting may cause product damage.
- Make sure the terminals are wired as shown in [Figure 5-3](#) on [page 5-3](#); failure to connect power correctly could result in irreversible product damage that is **NOT** covered by warranty.



Always handle the interface board using the correct ESD handling precautions.

1. If fitted, remove the front panel; refer to [Figure 5-2](#) below:
 - a. If fitted, carefully remove the two screw covers (2) from the front panel (1).
 - b. Remove the four Phillips/slot-head screws securing the front panel (1) to the housing.
 - c. Carefully ease the front panel (1) from the housing.
CAUTION: Do **NOT** pull forcefully.
 - d. Disconnect the ribbon cable from the panel and remove panel.

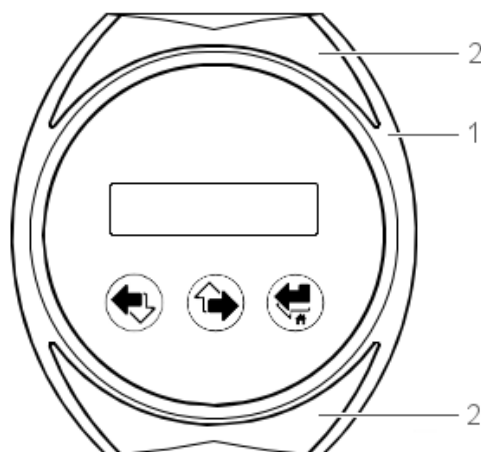


Figure 5-2 - Front Panel

2. Select a suitable cable depending on your device specification; refer to [3 TECHNICAL SPECIFICATIONS](#) on [page 3-1](#).

3. Ensure your cable is prepped and ready for connection; shielding should be exposed and wire ends trimmed.
4. Carefully feed the cable through the cable gland at the bottom of the head housing; pull through enough length to allow easy fitting of the terminal block connector.
5. Connect the wires as follows; refer to [Figure 5-3](#) below:

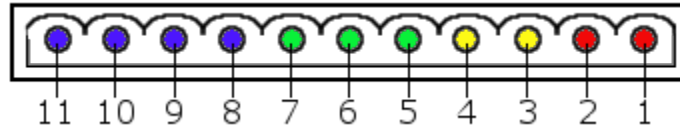


Figure 5-3 - Connector Pins

Power Supply

- PIN 1: 24V_{DC} (LPS)
- PIN 2: 0V

Digital Output^e

- PIN 3: RS485 A(+)
- PIN 4: RS485 B(-)

Analogue Output

- PIN 5: Analogue GND
- PIN 6: Analogue Out1
- PIN 7: Analogue Out2^f

Relay Output

- PIN 8: Relay 1 In
- PIN 9: Relay 1 Out
- PIN 10: Relay 2 In
- PIN 11: Relay 2 Out

6. Carefully pull the cable back through the gland until the connector and board are aligned; fit the connector to the board.



CAUTION: Make sure the shielding is intact and correctly positioned to ensure the device is grounded properly as shown in [Figure 5-4](#) below.

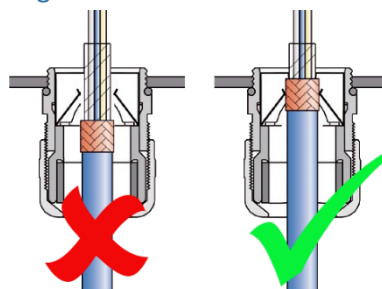


Figure 5-4 - Cable Shielding

7. Using a 24mm spanner, torque-tighten the cable gland nut to 12Nm maximum.

NOTE: Be careful not to over-tension the wires or over-tighten the gland.

^e Care should be taken when connecting the RS485 A and B connections to your system. The TIA-485 signaling specification states that signal A is the inverting or '-' pin and signal B is the non-inverting or '+' pin. This is in conflict with the A and B naming used by a number of differential transceiver manufacturers, including the transceiver used in the interface board. Therefore, always ensure the '+' of the interface board is connected to the '+' input of the RS485 Bus and the '-' of the interface board connected to the '-' input of the RS485 Bus.

^f Only available if second analogue option is specified at time of order.

8. If you have Modbus fitted, set the 4-way dip switches:



Manual address selector (0-15):

Switch positions are read at power up and override saved address in memory

Switch 1 = LSB, Switch 4 = MSB

All switches down = 0 = Default or current saved address in memory

Example = Switch 1 UP & Switch 4 UP = 9

9. Reconnect the ribbon cable to the front panel (1).
10. Refit the front panel (1) to the housing and secure in place using the four Phillips/slot-head screws.
11. Fit the two screw covers (2).

5.3 Mounting Instructions

The device should be installed in a suitable location, taking into account factors including those detailed in [5.1 General Guidelines](#) on [page 5-1](#).

The probe can be installed in a horizontal or downward angled position.

NOTE: Do NOT mount with the probe tip higher than the head housing (i.e. angled upwards) as this can lead to pulling of condensate in the sensor probe.

NOTE: Do NOT mount the probe vertically.

NOTE: Ensure the gas flow is not going straight into the gas sampling tubes; refer to [Figure 5-5](#).

NOTE: The cable gland at the base of the head housing should always face downwards.

The device must be securely fitted to a suitable surface using the mounting flange (four-mounting holes; refer to [4.3 Flange Dimensions](#) on [page 4-1](#)) incorporated in the assembly.

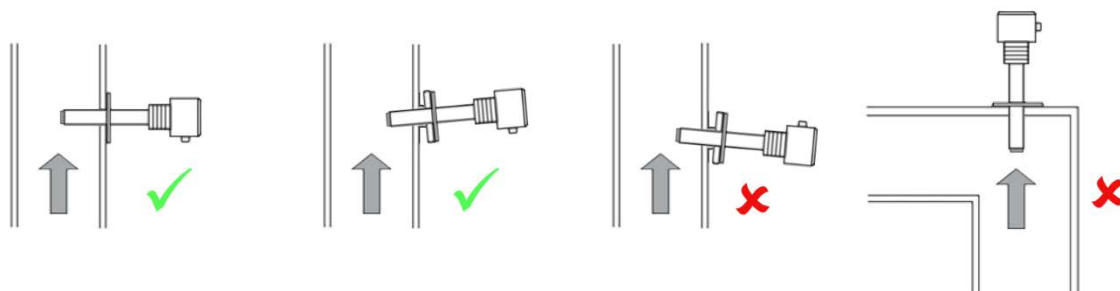


Figure 5-5 - Mounting Examples

5.3.1 Probe Mounting Aperture

CAUTION: The probe should be mounted horizontally, or at an angle of approximately 5° to the flue wall as shown [Figure 5-6](#).

NOTE: A suitable 2" ANSI flange mounting adaptor is required.

1. Cut a 50mm (2" nom. pipe) diameter hole in the flue wall (or other mounting position).
2. Either:
 - Weld the mounting adaptor into place, concentric with the hole in the flue.
 - Drill and bolt the mounting adaptor to the flue.

NOTE: If bolting in place, fit a suitable gasket between the adaptor and the flue wall.

CAUTION: Selecting the wrong type of gasket may lead to accidental poisoning of the zirconia sensor; refer to [8.2 Cross Sensitivity](#) on [page 8-2](#).

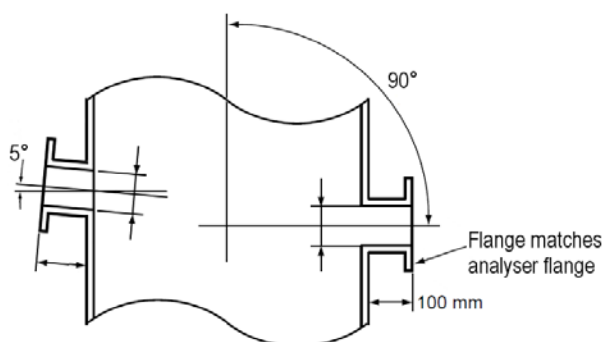






Figure 5-6 - Mounting Adaptor Details

5.3.2 Probe Installation

-  **CAUTION:** Protect the device from accidental shocks or vibrations as this may damage the sensor or alter sensor properties resulting in the need for recalibration.
 -  **CAUTION:** Always install the gasket supplied with the device between the mating flanges to prevent gas leakage.
 -  **CAUTION:** Using the wrong type of gasket may lead to accidental poisoning of the zirconia sensing element; refer to [8.2 Cross Sensitivity](#) on [page 8-2](#).
1. If your device is already fully assembled, proceed to [Step 2](#) on [page 5-7](#), if not, assemble as follows:
 - a. Ensure housing is wired correctly; refer to [5.2 Electrical Connections](#) on [page 5-2](#).
 - b. Ensure the gasket is in position in the head housing.
 - c. Fit sensing module to the head housing and gently push to secure the module in place; refer to [Figure 5-7](#).

NOTE: The connector is keyed to aid alignment.

 **CAUTION:** Do NOT force the module otherwise you may damage the terminals or other components within the housing.

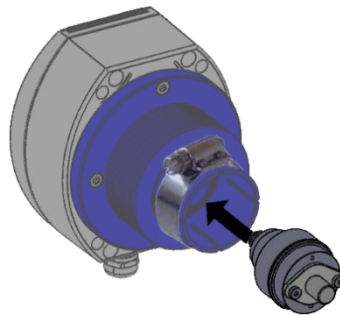


Figure 5-7 - Insert Sensing Module

- d. Ensuring the clamp is fitted over the head housing shoulder and with the flow direction arrow on the flange pointing upwards, carefully slide the probe body into the head housing; refer to [Figure 5-8](#).

NOTE: Ensure the probe is inserted fully (housing shoulder aligns with the indicator line on the probe).
- e. Ensuring the cable gland is facing downwards, tighten the clamp; torque to 5Nm.

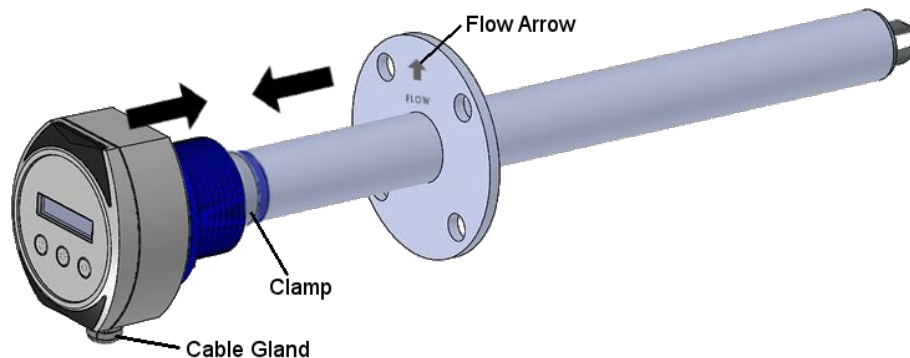


Figure 5-8 - Assemble Head Housing to Probe Body

2. Install the gasket over the probe shaft and onto the mounting flange.
NOTE: If the mating adaptor is fitted with studs, carefully fit the gasket over the studs.
3. Carefully insert the probe into the hole in the flue (or other mounting position).



CAUTION: Take care not to bump or shock the probe.

CAUTION: Ensure the gasket is not damaged when inserting the probe.

NOTE: Ensure the gas sampling tubes are correctly aligned with the direction of the gas flow. Refer to [Figure 5-1](#) on [page 5-1](#).

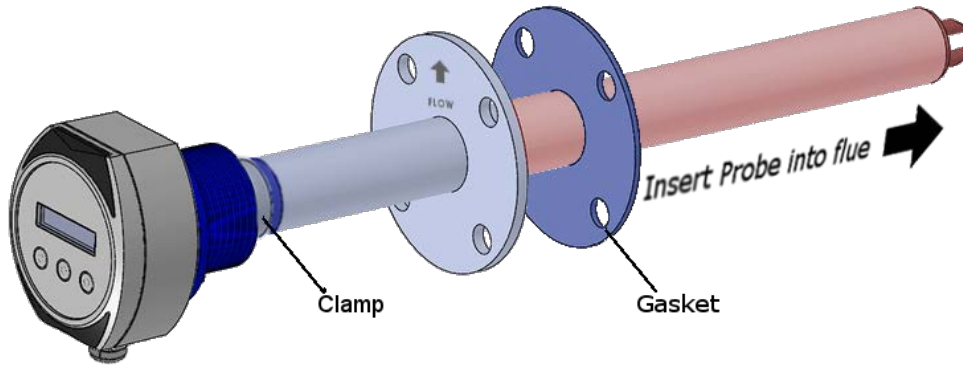


Figure 5-9 - Probe Installation

4. Secure the probe into place using suitable mounting hardware.
NOTE: If the mounting adaptor is fitted with studs, secure the probe into place with spring washers (if required) and nuts.
NOTE: If the application temperatures will exceed 200°C, use an anti-seize compound on any bolt/stud threads to ease future removal of the probe.
5. Ensure the head housing is orientated such that the cable gland faces downwards. If necessary, loosen the clamp and carefully adjust the housing orientation; refer to [Figure 5-9](#). Tighten the clamp securely; torque to 5Nm.
6. Connect power and input/output connections to the controller; refer to [Figure 5-3](#) on [page 5-3](#).



CAUTION: Test the power supply to ensure it is “24V_{DC} ± 10%” before wiring to the probe.

CAUTION: Failure to test the suitability of the power supply BEFORE first power ON could cause irreversible damage that is NOT covered by warranty.

6 INITIAL STARTUP

6.1 Commissioning Checks

Before commissioning the equipment read [2 SAFETY INSTRUCTIONS](#) on [page 2-1](#) of this document.

Complete the following essential tasks BEFORE switching the system ON for the first time:

- Ensure compliance with permissible installation position.
- Verify the device is mounted securely and sealed correctly.
- Verify the device, wiring connector and calibration gas inlet port are all undamaged.
- Ensure the cables are strain-free and not twisted.
- Ensure the device is connected properly, with all its inputs and outputs complete. All screw terminals are properly tightened.

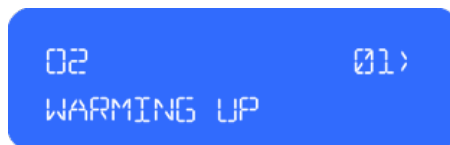


CAUTION: Test the power supply to ensure it is “24V_{DC} ± 10%” before wiring to the probe.

CAUTION: Failure to test the suitability of the power supply BEFORE first power on could result in irreversible product damage that is NOT covered by warranty.

6.2 Switching ON

When the device is powered ON, the following message is displayed on the LCD until the internal zirconia sensing element reaches operating temperature (approximately 60s):



6.3 First-time Calibration

Calibration is required when the device is powered ON for the first time or when the sensing module is replaced. Refer to [9.2 Calibrating](#) on [page 9-2](#).

7 SYSTEM CONFIGURATION

NOTE: The device can be configured via the operator panel or Modbus. This document details the configuration using the operator panel; if you wish to configure using Modbus, refer to *GAP-100, Modbus Register Set* for details.

7.1 Operator Panel

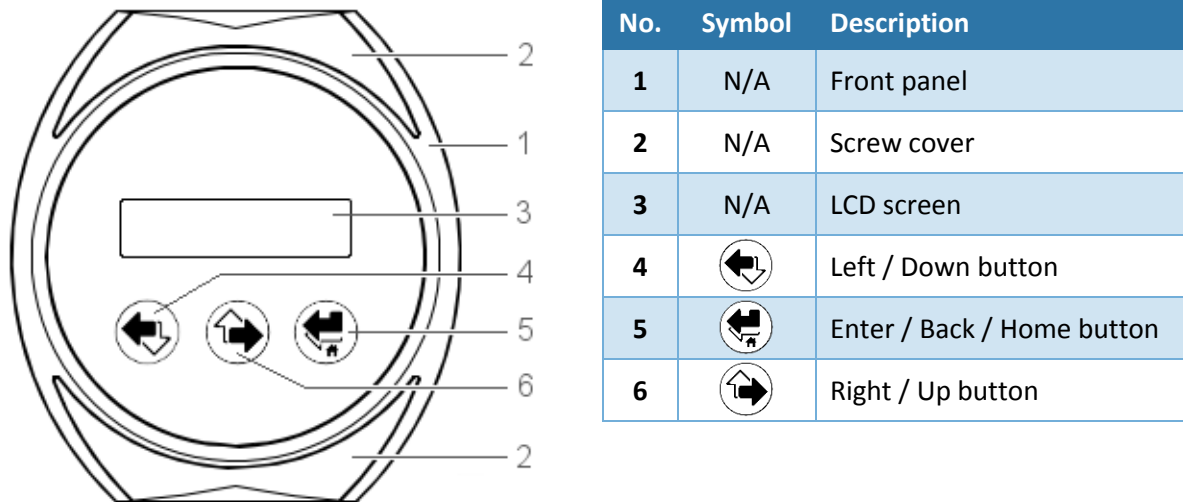


Figure 7-1 - Operator Panel

The buttons are multifunctional:

	Primary	Secondary	Tertiary
	Scroll left	Scroll down	n/a
	Scroll right	Scroll up	n/a
	Enter	Back one level. Press and hold until screen flashes twice	Return to the home screen. Press and hold until screen flashes three times

NOTE: Screen flashes once on every button press unless otherwise specified.

Throughout this guide the following conventions apply:

- Text displayed on the LCD screen is identified in COURIER NEW font
- Left / Down button press is shown as <LEFT> or <DOWN>
- Right / Up button press is shown as <RIGHT> or <UP>
- Enter / Back / Home button press is shown as <ENTER>, <BACK> or <HOME>

7.2 On-Screen Settings

The following parameters are displayed on-screen:

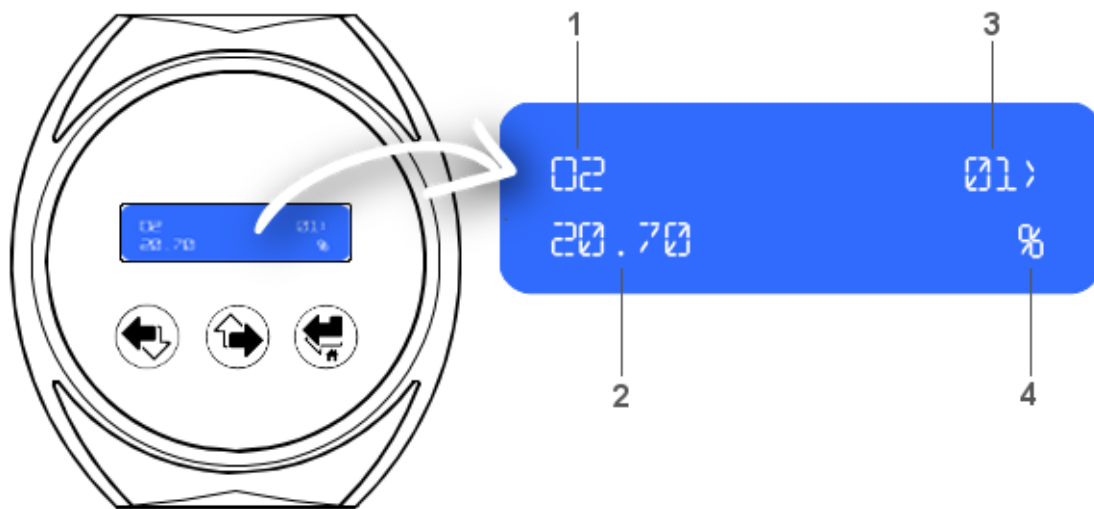


Figure 7-2 - LCD Layout

- | | |
|---|---|
| 1. Top left; Item being measured | 3. Top right; Position within the menu structure |
| 2. Lower left; Measurement value | 4. Lower right; Unit of measure |

The following on-screen conventions are used:

- * Menu option can be edited
- > Additional options available within the menu structure; press the right arrow button to scroll through the menu options
NOTE: the numeric value given before the ">" denotes the menu number for that option
- < Last entry of the menu structure has been reached; press the left arrow button to scroll back through the menu options
- <> Cursor position, i.e. digit is highlighted
- <<>> Digit is in edit mode

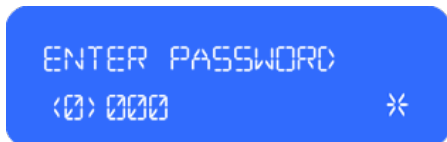
7.3 Security Password

Referring to [Figure 7-1 on page 7-1](#) and [Figure 7-2 on page 7-2](#); when the device receives an **<ENTER>** button press, it automatically displays the **ENTER PASSWORD** screen and stops displaying O₂% values.

NOTE: The password is factory set to “0000”.

Enter the security password as follows:

1. Press **<ENTER>**; the **ENTER PASSWORD** screen is displayed.



2. Input your current security password;
 - a. Press **<ENTER>** to access edit mode (double arrows “<<>>” displayed around first digit as shown below).



- b. Using the **<LEFT>** or **<RIGHT>** arrow buttons navigate to the required number.
- c. Press **<ENTER>** to input that value.
- d. Press **<RIGHT>** to tab along to the next digit.



- e. Repeat input process until all required digits are entered.
- f. Press **<RIGHT>** to tab along to the asterisk (*).



3. Press **<ENTER>** to access the menu screens.

NOTE: If the password is entered incorrectly, access to menu screens is inhibited.

NOTE: The security password may be changed to a user specific password, refer to [7.5.1 Changing Security Password on page 7-5](#).

7.4 Menu Structure

Once you have entered the correct security password followed by the <ENTER> button press, the menu screens are accessible. Refer to 7.3 Security Password on page 7-3.

NOTE: If the password is entered incorrectly, access to menu screens is inhibited.

Table 7-1 - Menu Structure

HOME SCREEN		DESCRIPTION
O2	01>	Displays the O ₂ concentration level (%)
Pressure	<02>	Displays the pressure (mbar) at the sensing element
Temperature	<03	Displays the gas temperature (°C) at the sensing element

LEVEL 1	LEVEL 2	LEVEL 3	DESCRIPTION
CALIBRATE	01>		Calibration menu
	O2		O ₂ concentration (%)
		GAIN *	Set O ₂ concentration level (%)
CONFIGURE	<02>		Configuration menu
	Relay	01>	Relay 1 parameters
		LOWER *	Set lower limit
		UPPER *	Set upper limit
		HYSTERESIS *	Set hysteresis
	Current	<02	Current parameters
		LOWER *	Set lower limit
		UPPER *	Set upper limit
INTERFACE	<03>	UNAVAILABLE	Interface menu
TEST	<04>		Test menu
	Relay	01>	Relay 1 test parameters
		START *	Set start value
		STOP *	Set stop value
	Relay	<02>	Relay 2 test parameters
		START *	Set start value
		STOP *	Set stop value
	Current	<03	Current test parameters
		START *	Set start value
		STOP *	Set stop value
SYSTEM	<05		System menu
	SERIAL NUM	01>	Serial number
	PART NUM	<02>	Part number
	DATE CODE	<03>	Date code
	REVISION	<04>	Software revision
	PASSWORD	<05	0000 * Change password

* - denotes the value can be edited.

7.5 Configurable Options

The menu screens are primarily for information although there are user configurable options that may be changed. These are the O₂ calibration %, the current and relay output ranges. The menu security password may also be changed if required. The calibration process is detailed in [9.2 Calibrating](#) on [page 9-2](#).

The following sections reference to [Figure 7-1](#) on [page 7-1](#), [Figure 7-2](#) on [page 7-2](#) and [Table 7-1](#) on [page 7-4](#).

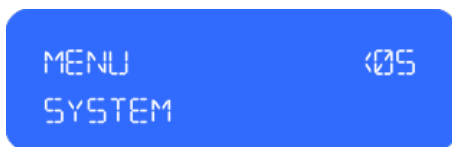
7.5.1 Changing Security Password

The password is factory set to “0000”. This however may be changed to a user specific password.

1. Press **<ENTER>**; the ENTER PASSWORD screen is displayed.



2. Input your current security password; refer to [7.3 Security Password](#) on [page 7-3](#). The CALIBRATE menu is the first menu option displayed.
3. Press the **<RIGHT>** button until the SYSTEM screen is displayed (fifth menu in the structure).



4. Press **<ENTER>** to access the SYSTEM menu.
5. Press **<RIGHT>** until the PASSWORD screen is displayed (fifth menu in the structure).



6. Press **<ENTER>** to access the PASSWORD menu.
 7. Input your new security password.
 8. Press **<ENTER>** to save.
- NOTE:** The new password is now stored in memory and is retained on power loss.
9. Press and hold the **<HOME>** button to return to the HOME screen; display will flash three times.

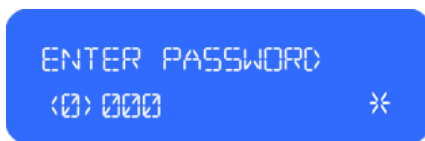
7.5.2 Current Output Range

The 4-20mA output (Analogue Out1) is factory set to represent a sensor range of 0 – 25% O₂; where 0% O₂ is equal to 4mA and 25% O₂ is equal to 20mA.

This applied sensor range is configurable; an example of changing the lower and upper sensor ranges would be in a combustion atmosphere where the O₂ range is between 5 – 21%. The user could set the lower output range to 4% and the upper output range to 22% and the 4-20mA output would vary linearly in between.

NOTE: The lower and upper ranges lock out the output at the set limits so in the example above, 4% O₂ or below would clamp the output to 4mA and 22% O₂ or above would clamp the output to 20mA.

1. Press <ENTER>; the ENTER PASSWORD screen is displayed.



2. Input your current security password; refer to 7.3 Security Password on page 7-3. The CALIBRATE menu is the first menu option displayed.
3. Press <RIGHT> until the CONFIGURE screen is displayed (second menu in the structure).



4. Press <ENTER> to access the CONFIGURE menu. From here you can access the Current configuration options.
5. Press <RIGHT> twice to display the CONFIGURE CURRENT screen.



6. Set the Current limitations;
 - a. Press <ENTER> to access edit mode; the O2% screen is displayed.
 - b. Press <RIGHT> to view the Lower value.
 - c. Press <ENTER> to edit the Lower value.
 - d. Input the Lower range value; the number must be less than the intended upper range value. Press <ENTER> to save. The Configure Complete screen displays when complete.
 - e. Press <ENTER> to return to the CURRENT configuration screen.
 - f. Press <ENTER> to access edit mode; the O2% screen is displayed.
 - g. Press <RIGHT> twice to view the Upper value.
 - h. Press <ENTER> to edit the Upper value.
 - i. Input the Upper range value; the number must be greater than the saved lower value. Press <ENTER> to save. The Configure Complete screen displays when complete.
 - j. Press <ENTER> to go return to the CURRENT configuration screen.

NOTE: The new range values are now stored in memory and are retained on power loss.

7. Press and hold the <HOME> button to return to the HOME screen; display will flash three times.

7.5.3 Relay Output Range

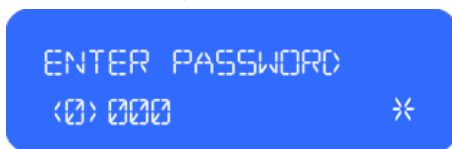
Relays provide Single Pole Single Throw (SPST) contact outputs; unless otherwise specified, relays are normally open as standard.

- Relay 1 – User configurable O₂ measurement alarm
- Relay 2 – O₂ sensor fault indication (factory set, NOT user configurable)

The relay switch points set where the relay will change state depending on the current O₂ sensor measurement. When the O₂ measurement is within the set window (between the upper and lower switch points) the relay will switch to the opposite state from the configured normal state. For example, if the relay is configured as normally open it will be open above and below the set window and closed within the set window. If only one switch point is required set the upper or lower switch point to the maximum or minimum of the sensor measurement range respectively.

Hysteresis may be added to the upper and lower switch points to avoid relay jitter when the measured O₂ value is fluctuating around one of the switch points. This value is also a function of the sensor measurement range, for example, if the hysteresis was set to 0.5 the relay switch points would have $\pm 0.5\%$ O₂ hysteresis.

1. Press <ENTER>; the ENTER PASSWORD screen is displayed.



2. Input your current security password; refer to 7.3 Security Password on page 7-3. The CALIBRATE menu is the first menu option displayed.
3. Press <RIGHT> until the CONFIGURE screen is displayed (second menu in the structure).



4. Press <ENTER> to access the CONFIGURE menu. From here you can access the Relay configuration options.



5. Set the Relay limitations;
 - a. Press <ENTER> to access edit mode; the O2% screen is displayed.
 - b. Press <RIGHT> to view the Lower value.
 - c. Press <ENTER> to edit the Lower value.
 - d. Input the Lower range value; the number must be less than the intended upper range value. Press <ENTER> to save. The Configure Complete screen displays when complete.
 - e. Press <ENTER> to go back to the Relay configuration screen.
 - f. Press <ENTER> to access edit mode; the O2% screen is displayed.
 - g. Press <RIGHT> twice to view the Upper value.
 - h. Press <ENTER> to edit the Upper value.

- i. Input the Upper range value; the number must be greater than the saved lower value. Press <ENTER> to save.
The Configure Complete screen displays when complete.
- j. Press <ENTER> to go back to the Relay configuration screen.
- k. Press <ENTER> to access edit mode; the O2% screen is displayed.
- l. Press <RIGHT> three times to view the Hysteresis value.
- m. Press <ENTER> to edit the Hysteresis value.
- n. Input the Hysteresis value; press <ENTER> to save.

NOTE: The new range values are now stored in memory and are retained on power loss.

6. Press and hold the <HOME> button to return to the HOME screen; display will flash three times.

The example given below demonstrates the relay opening and closing as the O₂ measurement fluctuates, the relay is configured to be normally open, the lower switch point has been set to 8% O₂ and the upper to 13% O₂ with 1% O₂ hysteresis.

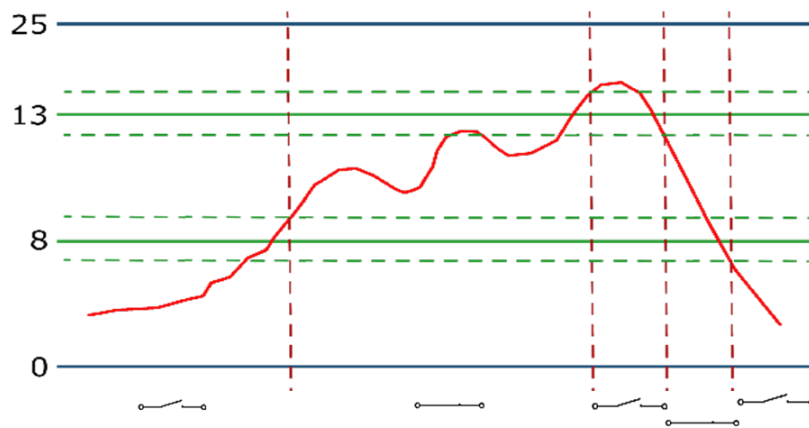


Figure 7-3

1. To begin with the sensor measurement is <7% O₂ so the relay is open.
2. When the measurement exceeds 9% O₂ (8% + 1% hysteresis) the relay will close.
3. The relay will remain closed until the O₂ measurement increases to above 14% (13% + 1% hysteresis) at which point it will open again.
4. The relay will remain open until the O₂ reading falls below 12% (13% - 1% hysteresis) at which point it will close again.
5. The relay will remain closed until the O₂ reading falls below 7% (8% - 1% hysteresis) at which point it will open again.

8 OPERATION

8.1 Environments

The application in which the zirconium dioxide oxygen sensor is operating influences the life of the sensor. To ensure the sensor does not fail prematurely, the following should be noted:

8.1.1 Operating in Aggressive Humid Environments

When operating the sensor in warm, humid environments it is important the sensor remains at a higher temperature than its surroundings, especially if there are corrosive components in the measurement gas. During operation this is not an issue as the heater operates at 700°C, however this means when the sensor or application is being powered down the sensor heater must be the last thing to be turned off after the temperature of the surroundings have suitably cooled.

Failure to adhere to these rules will result in condensation forming on the sensing element. When the sensor is re-powered the condensation will evaporate, leaving behind corrosive salts which very quickly destroy the sensing element.

8.1.2 Protecting from Excessive Moisture

In environments where excessive moisture is likely the sensor should be protected from water reaching the very hot sensor cap as this can cause massive temperature shocks to the cell and heater. For this reason, the probe must be installed in a horizontal or downward angled position to prevent moisture from filling the gas sampling tubes and coming into contact with the sensor.

8.1.3 Using the Sensor with Silicones

Zirconium dioxide oxygen sensors are damaged by the presence of silicone in the measurement gas. Vapours (organic silicone compounds) of RTV rubbers and sealants are the main culprits and are widely used in many applications. These materials are often made of cheaper silicones, that when heated still outgas silicone vapours into the surrounding atmosphere. When these vapours reach the sensor, the organic part of the compound will be burned at hot sensor parts, leaving behind a very fine divided silicon dioxide (SiO₂). This SiO₂ completely blocks the pores and active parts of the electrodes. If RTV rubbers are used we advise using high quality, well cured materials. Guidance can be provided on request.

A complete list of chemicals and gases that should be avoided can be found in [8.2 Cross Sensitivity](#) on [pages 8-2 and 8-2](#).

8.2 Cross Sensitivity

Gases or chemicals that have an influence on the life of the sensor or on the measuring results are listed in the following sub-sections:

8.2.1 Combustible Gases

Small amounts of combustible gases will be burned at the hot Pt-electrode surfaces or Al₂O₃ filters of the sensor. In general, combustion will be stoichiometric as long as enough oxygen is available, the sensor will measure the residual oxygen pressure which leads to a measurement error. The sensor is not recommended for use in applications where there are large amounts of combustible gases present and an accurate O₂ measurement is required. Gases investigated:

- H₂ (Hydrogen) up to 2%; stoichiometric combustion
- CO (Carbon Monoxide) up to 2%; stoichiometric combustion
- CH₄ (Methane) up to 2.5%; stoichiometric combustion
- NH₃ (Ammonia) up to 1500 ppm; stoichiometric combustion

8.2.2 Heavy Metals

Vapours from metals like Zn (Zinc), Cd (Cadmium), Pb (Lead), Bi (Bismuth) will have an effect on the catalytic properties of the Pt- electrodes. Exposures to these metal vapours must be avoided.

8.2.3 Halogen and Sulphur Compounds

Small amounts (< 100ppm) of Halogens and/or Sulphur compounds have no effect on the performance of the oxygen sensor. Higher amounts of these gases will, in time, cause readout problems or, especially in condensing environments, corrosion of sensor parts. Gases investigated:

- Halogens, F₂ (Fluorine), Cl₂ (Chlorine)
- HCL (Hydrogen Chloride), HF (Hydrogen Fluoride)
- SO₂ (Sulfur Dioxide)
- H₂S (Hydrogen Sulfide)
- Freon gases
- CS₂ (Carbon Disulfide)

8.2.4 Reducing Atmospheres

Long time exposure to reducing atmospheres may in time impair the catalytic effect of the Pt-electrodes and must be avoided. Reducing atmospheres are defined as an atmosphere with very little free oxygen and where combustible gases are present. In this type of atmosphere oxygen is consumed as the combustible gases are burned.

8.2.5 Other

- Fine dust (carbon parts/soot) may cause clogging of the porous stainless steel filter and could have an effect on the response speed of the sensor.
- Heavy shocks or vibrations may alter sensor properties resulting in the need for recalibration.

9 MAINTENANCE



WARNING: BEFORE performing any type of maintenance on the equipment read [2 SAFETY INSTRUCTIONS](#) on [page 2-1](#) of this document.

WARNING: Ensure the device has cooled down completely before attempting to touch or service the equipment.

9.1 Cleaning

9.1.1 Outer Surfaces

Clean the outer surfaces of the housing regularly with non-abrasive materials to prevent a buildup of contaminants. Isopropyl alcohol (IPA) and a lint-free cloth is recommended.



CAUTION: Never use any of the following for cleaning purposes:

- Chemical cleaning agents
- High-pressure water or steam

9.1.2 Gas Sampling Tubes

The gas sampling tubes allow the sample gas from the installed application to flow past the zirconia sensing element.

Clean the inner gas sampling tubes regularly to prevent a buildup of contaminants / clogging.

NOTE: If you notice that you require a higher pressure to achieve a specified flow rate, the sampling tubes may have become clogged and should be cleaned thoroughly.



CAUTION: NEVER use the calibration port as this will damage the sensing module.

1. Remove the head housing; refer to [Section 9.5.1](#) on [page 9-7](#).
2. Using a suitable pipe brush, clear out any contaminants from the sampling tubes.

NOTE: Alternatively, clear out the sampling tubes using a high-pressure air supply.



CAUTION: ALWAYS use silicone-free gas. Silicone vapours will damage the zirconia sensor; refer to [8.1.3 Using the Sensor with Silicones](#) on [page 8-1](#).

NOTE: If the probe is operating in a flue gas that is known to contain heavy contamination or the gas is “wet”, allow the air to blow through the sampling tubes for a longer period of time.

3. Replace the head housing; refer to [Section 9.5.2](#) on [page 9-8](#).

9.2 Calibrating

Due to the zirconia technology used in the device, no “zero” calibration is required and only a “span” calibration needs to be performed.

Calibration is achieved by initiating a calibration routine via the digital display, and monitoring the status of the output. The fixed reference is factory set to 20.7% O₂ for calibration with air however this value may be altered via the digital display for calibration with a reference gas of known oxygen concentration between 5 and 25%. Any new calibration value will be stored on power loss.

It is recommended that the sensing element is calibrated close to the oxygen concentration expected during normal operation.

A software delay prevents calibration from being initiated before the zirconia sensor has been powered ON for 5 minutes; CALIBRATION NOT READY will display on screen.

NOTE: The device should be operational for at least 10 minutes prior to calibration.

NOTE: The combustion / ventilation fan should NOT be operational during the calibration process.

The following process references [Figure 7-1 on page 7-1](#), [Figure 7-2 on page 7-2](#) and [Table 7-1 on page 7-4](#).

1. Remove the plug from the gas inlet port on the head housing and connect the calibration gas supply (4mm tubing) to the inlet port.

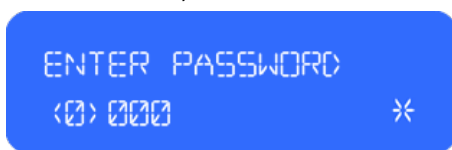


WARNING: Application gas can exhaust through the calibration inlet port, do NOT leave port open for extended periods.



CAUTION: ALWAYS use silicone-free gas. Silicone vapours will damage the zirconia sensor; refer to [8.1.3 Using the Sensor with Silicones on page 8-1](#).

2. Turn the calibration gas ON and set the flow to approximately 0.15 litres per minute.
3. Press <ENTER>; the ENTER PASSWORD screen is displayed.

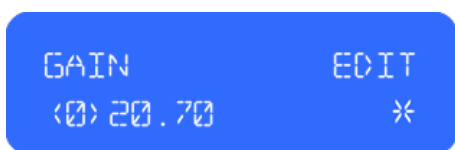


4. Input your current security password; refer to [7.3 Security Password on page 7-3](#). The CALIBRATE menu is the first menu option displayed.



5. Press <ENTER> to access the CALIBRATE O₂ screen.
6. Press <ENTER> to access the O₂ GAIN screen.
7. Monitor the uncalibrated oxygen and wait until the value has been stable to ± 0.1% O₂ for a minimum of 30seconds.

8. Press <ENTER> to access the GAIN screen.
9. Press <ENTER> to edit the GAIN value.



10. The factory default is set to 20.70% O₂; if required, input the new oxygen concentration (%) of the calibration gas as a number to two decimal places, then press <RIGHT> to tab along to the asterisk (*).
11. Press <ENTER> to apply.
12. Press <ENTER> again to confirm.

The device will run through the calibration routine and return the following status message when complete.



NOTE: The output will now track to the correct value for the calibration gas.

NOTE: The new calibration value is now stored in memory and is retained on power loss.

13. Press and hold the <HOME> button to return to the HOME screen; display will flash three times.
14. Confirm the O₂ Calibrated Value is within $\pm 0.1\%$ O₂ of the calibration gas applied. If not, repeat [Steps 3 to 13](#) and allow the O₂ Uncalibrated Value to stabilise for a longer period.
NOTE: If multiple calibration attempts do not result in an accurate calibration, contact technical@sstsensing.com for guidance.
15. Turn the calibration gas supply OFF.
16. Remove the hose from the gas inlet port and replace the inlet plug securely.



WARNING: Application gas can exhaust through the calibration inlet port, do NOT leave port open for extended periods.

9.3 Testing

From the digital display, you can access two test options; Relays and Current.

The following process references [Figure 7-1 on page 7-1](#), [Figure 7-2 on page 7-2](#) and [Table 7-1 on page 7-4](#).

9.3.1 Testing the Relays

NOTE: Unless otherwise specified, relays are normally open as standard.

1. Press <ENTER>; the ENTER PASSWORD screen is displayed.



2. Input your current security password; refer to [7.3 Security Password on page 7-3](#). The CALIBRATE menu is the first menu option displayed.
3. Press <RIGHT> until the TEST screen is displayed (fourth menu in the structure).



4. Press <ENTER> to access the TEST menu.
From here you can access the Relay test options.
5. Set the Relay test values to check the user configured relay (R1) is switching ON and OFF correctly;

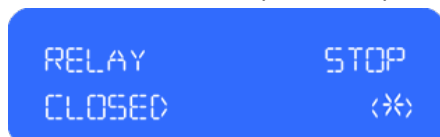
- a. Press <ENTER> to access Relay 1 edit screen.



- b. Press <ENTER> to access relay edit mode.
- c. Press <RIGHT> to change the Relay from OPEN to CLOSE, then press <ENTER> to apply.
- d. Press <RIGHT> to tab along to the asterisk (*).
Press <ENTER> to start the relay test process.



- e. Press <ENTER> to stop the test process.



NOTE: The test values are stored in memory and are retained on power loss.

6. Press and hold the <HOME> button to return to the HOME screen; display will flash three times

NOTE: Process for testing Relay 2 is identical to the above with following exception; before continuing with [Step 5](#), press <RIGHT> to display Relay 2 screen.

9.3.2 Testing the Current

1. Press <ENTER>; the ENTER PASSWORD screen is displayed.



2. Input your current security password; refer to 7.3 Security Password on page 7-3. The CALIBRATE menu is the first menu option displayed.
3. Press <RIGHT> until the TEST screen is displayed (fourth menu in the structure).



4. Press <ENTER> to access the TEST menu. From here you can access the CURRENT test options.
5. Set the Current test values to check the current output is reading correctly;
 - a. Press <RIGHT> until the TEST CURRENT screen is displayed.



- b. Press <ENTER> to access Current edit screen.
- c. Press <ENTER> to access edit mode.
- d. Input the test value; press <RIGHT> to highlight the required digit(s), then press <ENTER> to edit.
NOTE: Set value between 4 and 20mA.
- e. Once the required value is entered, press <RIGHT> to tab along to the asterisk (*).
- f. Press <ENTER> to start testing.



- g. Press <ENTER> to stop testing.



NOTE: The test values are stored in memory and are retained on power loss.

6. Press and hold the <HOME> button to return to the HOME screen; display will flash three times.

9.4 Error Conditions

If an error is detected, an error message appears on the digital display.

If the zirconia sensor is incorrectly connected or is damaged, in addition to the error message, the analogue output will default to 4mA.

If an error condition occurs the device should be powered down and all wiring checked before reapplying the power. If the error condition remains, the sensor is damaged and should be replaced. Refer to [Section 9.5.3 Replacing the Zirconia Sensing Module on page 9-8](#).



CAUTION: If any of the following errors/warnings occur, contact the manufacturer:

9.4.1 O₂ Error and Warning Bitmasks

Error Bitmask	Description
00001	Pump error
00002	Heater error
00004	Over temperature
32768	Internal network error

Warning Bitmask	Description
00001	Asymmetry warning
00002	O ₂ less than 0.1% oxygen
16384	Out of range, greater than 100%
32768	Out of range, less than 0%

9.4.2 Pressure Error and Warning Bitmasks

Error Bitmask	Description
00001	I ² C communication failure
00002	Sensor element failure

Warning Bitmask	Description
16384	Out of range, greater than 1260mbar
32768	Out of range, less than 260mbar

9.4.3 Temperature Error and Warning Bitmasks

Error Bitmask	Description
00001	SPI communication failure
00002	SVG (temperature sensor)
00004	SCG (temperature sensor)
00008	OG (temperature sensor)

Warning Bitmask	Description
16384	Out of range, over temperature
32768	Out of range, less than -50°C

NOTE: Error combinations can occur, for example, Error 00003 = Pump and Heater errors.

9.5 Replacing Parts



WARNING: BEFORE performing any type of maintenance on the equipment read **2 SAFETY INSTRUCTIONS** on page 2-1 of this document.

WARNING: Ensure the probe has cooled down completely before attempting to dismantle.

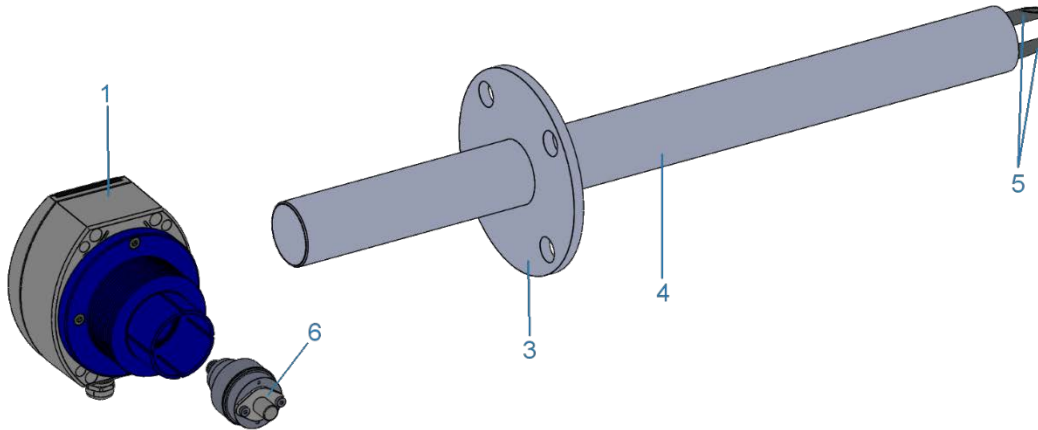


Figure 9-1 – Components

Parts List

1. Head housing
2. Clamp
3. Mounting flange
4. Probe body
5. Gas sampling tubes
6. Zirconia sensing module

Tools (If necessary)

- Small, flat-blade (terminal) screwdriver
- Phillips screwdriver
- 10mm socket (or spanner)
- 24mm spanner

NOTE: Before dismantling the device, thoroughly clean the outer surfaces to prevent contamination of the inner assemblies. Refer to [9.1 Cleaning](#) on page 9-1.

NOTE: The probe body can remain in situ.

9.5.1 Removing the Head Housing from the Probe

Refer to [Figure 9-1](#) above; component numbers given in parenthesis.

1. Shut-down and isolate the power supply and allow the probe to cool down.



WARNING: Ensure the probe has cooled down completely before trying to remove the head housing. The zirconia sensing module (6) has a PTFE seal which may be damaged if you try to force the head housing.

2. If required, remove the front panel and disconnect the wiring; refer to [5.2 Electrical Connections](#) on page 5-2 for details. Tie back the cable securely and re-fit the front panel to prevent ingress of contaminants.
3. Loosen clamp (2) and carefully withdraw head housing (1) from the probe body (4).



WARNING: The head housing (1) is a tight fit to the probe body (4); adjust your stance to ensure you are safe and stable before trying to remove the housing.

NOTE: Carefully rotate head housing (1) to assist with removal.

CAUTION: Keep the housing level to avoid accidental damage of the sensing module (6).

9.5.2 Installing the Head Housing onto the Probe

Refer to [Figure 9-1](#) on [page 9-7](#); component numbers given in parenthesis.

1. Ensuring the clamp (2) is fitted over the head housing (1) shoulder and with the flow arrow on the flange pointing upwards, carefully slide the probe body (4) into the head housing (1).
CAUTION: Keep the housing level to avoid accidental damage of sensing module (6).
2. Ensure the probe body (4) is inserted fully (housing shoulder aligns with the indicator line on the probe).
CAUTION: The head housing (1) is a tight fit to the probe body (4); do NOT use tooling of any kind to drive it home. NEVER strike the housing, this may cause irreparable damage.
3. With the cable gland at the base of the head housing (1) facing downwards, tighten clamp (2) to secure the head housing (1) in place. Torque to 5Nm.
4. If required, reconnect the wiring and re-fit the front panel; refer to [5.2 Electrical Connections](#) on [page 5-2](#) for details.

9.5.3 Replacing the Zirconia Sensing Module



WARNING: BEFORE performing any type of maintenance on the equipment read [2 SAFETY INSTRUCTIONS](#) on [page 2-1](#) of this document.

Sensing module replacement may be necessary if the sensor is no longer responding correctly to the target gas or has reached its end of life.

NOTE: Replacement sensing modules can be obtained by contacting the manufacturer.

NOTE: The old sensing module can be returned to the manufacturer for recycling.

Refer to [Figure 9-1](#) on [page 9-7](#); component numbers given in parenthesis.



CAUTION: Take care when disassembling to avoid accidental damage to the electrical connector within the head housing (1).

1. Remove the head housing (1) as described in [Section 9.5.1](#) on [page 9-7](#) and transfer to a clean bench.
2. Gently pull the sensing module (6) to ease it out from the head housing (1).
CAUTION: Do NOT twist the module as this will damage the connector within the head housing.
3. Discard the zirconia sensing module (6); refer to [9.6 Disposal](#) on [page 9-9](#).
4. Thoroughly clean the surfaces of the housing body to prevent contamination entering the inner assemblies.

5. Align and install the new zirconia sensing module (6) to the head housing (1). Gently push to secure the module in place; refer to [Figure 9-2](#).

NOTE: The connector is keyed to aid alignment.



CAUTION: Do NOT force the module otherwise you may damage the terminals or other components within the housing.

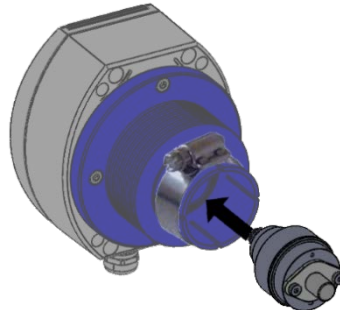


Figure 9-2 - Insert Sensing Module

6. Replace the head housing as described in [Section 9.5.2](#) on [page 9-8](#).
7. Reapply the power.
8. Calibrate the new sensing module; refer to [9.2 Calibrating](#) on [page 9-2](#).

9.5.4 Removing / Replacing the Front Panel

Refer to [Figure 5-2](#) on [page 5-2](#).

1. If fitted, carefully remove the two screw covers (2) from the front panel (1).
2. Remove the four Phillips/slot-head screws securing the front panel (1) to the housing.
3. Carefully ease the front panel (1) from the housing.
CAUTION: Do NOT pull forcefully.
4. Disconnect the ribbon cable from the old panel and connect to the new front panel.
5. Refit the front panel (1) to the housing and secure in place using the four Phillips/slot-head screws.
6. Refit the two screw covers (2).

9.6 Disposal

The device contains both electrical and mechanical components. For this reason, the head housing should be removed and disposed of as electrical waste; refer to [Section 9.5.1](#) on [page 9-7](#).

NOTE: The zirconia sensing module can be returned to the manufacturer for recycling.

The remainder of the probe can then be disposed as metal waste. Please observe your local regulations.

REFERENCE DOCUMENTS

Reference documents are listed below. The CO2Meter documentation list is not exhaustive, always refer to the CO2Meter Website, for the latest information.

NOTE: Any industry standards referenced, always refer to the appropriate website to ensure the most up-to-date version is used.

Part Number	Title
GAP-100	Gas Analyzer Probe (GAP) – Datasheet
GAP-100	Gas Analyzer Probe (GAP) – Quick Start Guide
GAP-100	Gastrack Gas Analyzer Probe (GAP) – Registration Kit

CAUTION

Do not exceed maximum ratings and ensure sensor(s) are operated in accordance with their requirements.
Carefully follow all wiring instructions. Incorrect wiring can cause permanent damage to the device. Zirconium dioxide sensors are damaged by the presence of silicone. Vapours (organic silicone compounds) from RTV rubbers and sealants are known to poison oxygen sensors and MUST be avoided. Do NOT use chemical cleaning agents.

Failure to comply with these instructions may result in product damage.

INFORMATION

As customer applications are outside of CO2Meter's control, the information provided is given without legal responsibility. Customers should test under their own conditions to ensure that the equipment is suitable for their intended application.

For more information, visit us at:

www.co2meter.com/pages/terms-conditions

For technical assistance or advice, please contact Support@CO2Meter.com

Contact us: CO2Meter, Inc. 131 Business Center Drive Ormond Beach, FL 32174 USA

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www.co2meter.com | e: sales@CO2meter.com | t: (877) 678-4259 |