

E-SENSE

Electrochemical Gas Detector Operating Manual



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1 Proprietary

1.1 Statement

The Gas Detection (Australia) E-Sense Series gas detector described in this document is the property of Gas Detection (Australia) Pty Ltd. It is furnished under a license agreement and is to be used only in accordance with the terms of the agreement.

No part of the hardware or documentation may be reproduced, transmitted, transcribed, stored in a retrieval system, or translated into any language or computer language, in any form or by any means, without prior written permission of Gas Detection (Australia) Pty Ltd.

1.2 Disclaimer

While Gas Detection (Australia) Pty Ltd has made every effort to assure the accuracy and clarity of this manual, we assume no liability resulting from any omissions in this document, or from misuse of the information contained within it. The information contained with this document has been carefully checked and is believed to be entirely reliable with all the necessary information included. Gas Detection (Australia) Pty Ltd reserves the right to make any changes and update this document whenever it deems necessary with no obligation to notify any person or company of the revisions or changes. The newest and most updated Documents will be available to download on www.gasdetectionaustralia.com.au. Gas Detection (Australia) Pty Ltd does not assume any liability arising out of the application or any use of any product of circuit described herein; neither does it convey license under its patent rights or the rights of others.

2 Warnings, Cautions and Notes

Detector must be installed within 30 days of purchase to retain the calibration certificate.

For safety reasons, the E-Sense gas detector must be installed, operated, and serviced only by competent personnel. To avoid instrument damage please read the manual before operating or servicing this product. Do not disassemble your detector, there are no user serviceable parts inside, refer all servicing repairs to Gas Detection (Australia) Pty Ltd. These detectors use critically aligned optical benches and should not be subjected to vibration or mechanical shock. Do not mount on a vibrating surface. This detector is not designed for outdoor use. Handle with care.

THIS PRODUCT IS NOT HAZARDOUS AREA CERTIFIED.

3 Introduction

3.1 Purpose And Contents of Manual

This manual contains installation operation and servicing instructions for the GDA E-Sense Series gas detector. Users of this product should read and understand the contents of this manual to gain safe use and optimum performance from the product.

3.2 Product Identification

The product name is GDA E-Sense Electrochemical Gas Detector.

The serial number of the unit is located on the right side and on the inside of the enclosure.

The target gas that the Detector is calibrated to is printed on the front lid label and on the serial number label.

3.2.1 Contents of Package

GDA detectors are issued tested & pre-calibrated under controlled lab conditions.

The package should contain:

- E-Sense Electrochemical Gas Detector
- User manual
- Calibration Certificate

The documentation will be in one envelope if there are multiple units purchased.

3.2.2 Enclosure Types

The E-Sense Electrochemical Gas Detector is an “on wall” mounted model. The enclosure has four external mountings. Gland entries are not pre-cut allowing the installer flexibility when deciding cable entry.

3.3 Product Description

3.3.1 Purpose of Product

The E-Sense Electrochemical Gas Detector's function is to detect the presence of the target gas in the air surrounding it. The E-Sense detector is designed to connect to a GDA Gas detection controller or similar BMS system to control alarm systems and/or ventilation to warn of gas loss and potential harmful situations.

3.3.2 Description of Operation

The E-Sense Electrochemical Gas detector can be configured as a loop powered 4-20 milliamp (mA) transmitter or as a 3-wire 0/4-20 mA transmitter. The analogue output is representative of the gas concentration over the range of the detector for the target gas, operating via natural diffusion. Each detector is factory calibrated to the target gas with certified calibration gas.

This product contains an electrochemical gas sensor element made by DD Scientific UK.

E-Sense detectors accept a range of electrochemical sensor elements, see specifications for gas types and ranges. The electrochemical sensor element is enclosed in a Brass or PTFE sensor module which is replaceable. The sensor element will expire over time and are easily replaced by unscrewing the lid and swapping the sensor element.

The detector has a removable four pin connector providing connection to positive supply (24 VDC), zero-volt supply, mA current output and an Earth pin for the cable shield.

If a voltage output of 0-10 V is required select 3-wire mode and remove the 4 mA jumper for connection to 3rd party controllers. A 500 Ohm resistor is required at the controller end to convert the mA to a voltage.

Gas characteristics, air flow, concentration of leaked gas, volume of room, etc. all contribute to the detectors ability to detect the target gas.

4 Installation

4.1 Sensor Placement:

The recommended sensor installation height is determined from:

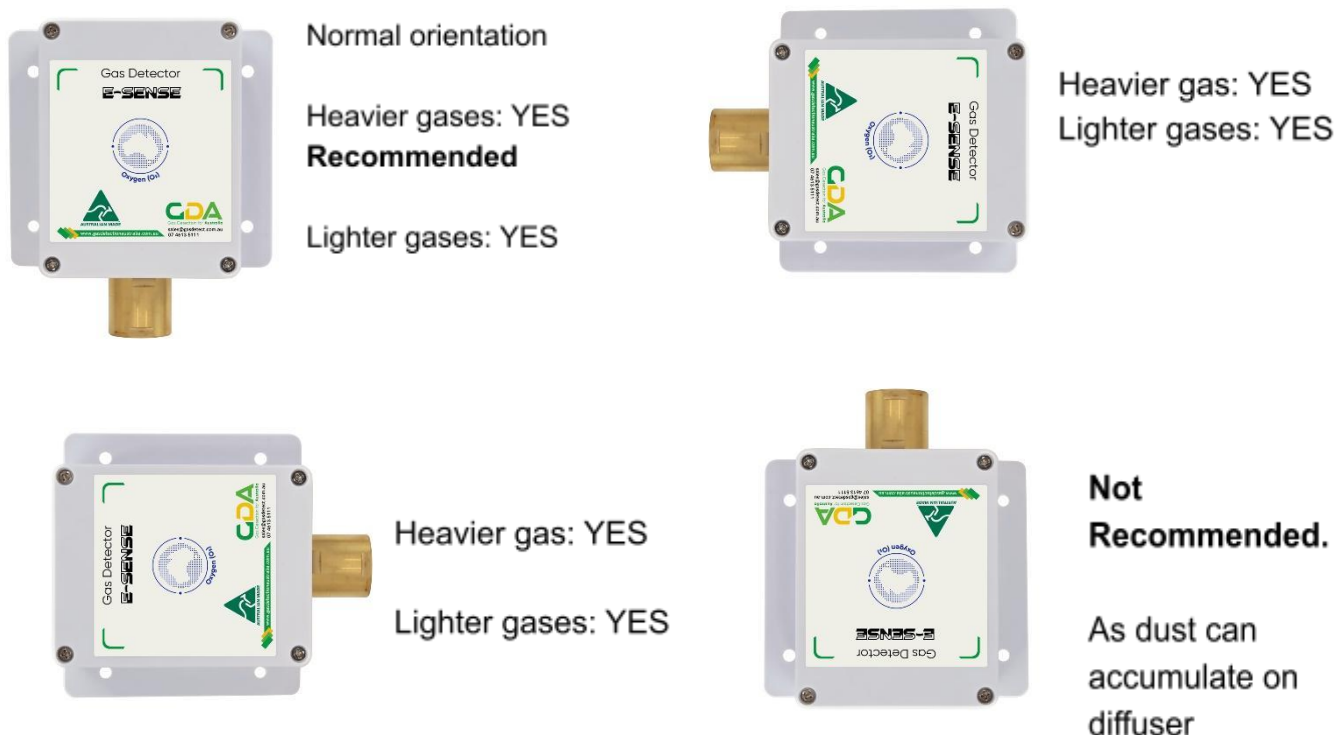
- The properties of the target gas see table in section 10.3.
- Properties of other gases present.
- The temperature of the gasses present.
- Air flow in the detection space.
- If the space is occupied or unoccupied.

For heavier gas the sensor should never be mounted with the sensor head pointing upwards, as gas can pool in the sensor and cause constant high or false readings. Take into account drafts and air movements when mounting the sensor.

The three recommended installation heights depending on the target gas and the environment are;

- Lighter gases rise, install detector within 300 mm of the ceiling
- Gases similar to air are to be installed in the Breathing Zone 1.0m to 1.8m from the ground.
- Heavier gases fall, install detector 300 mm from ground

Below shows allowable mounting orientations for the GDA 2500 depending on the target gas.



Note the IP rating is only maintained in the **normal orientation**.

5 Wiring Instructions

The sensor is a two-wire loop-powered 4-20 mA device. The sensor is designed to work with 24 V_{DC} from a regulated power supply. The sensor transmitter is wired to the GDA range of control units with a 2 core cable with an overall screen/shield or a 3 core 18 AWG cable.

The screen or third wire should be connected to the Earth connection of the sensor.



5.1 Electrical Connections

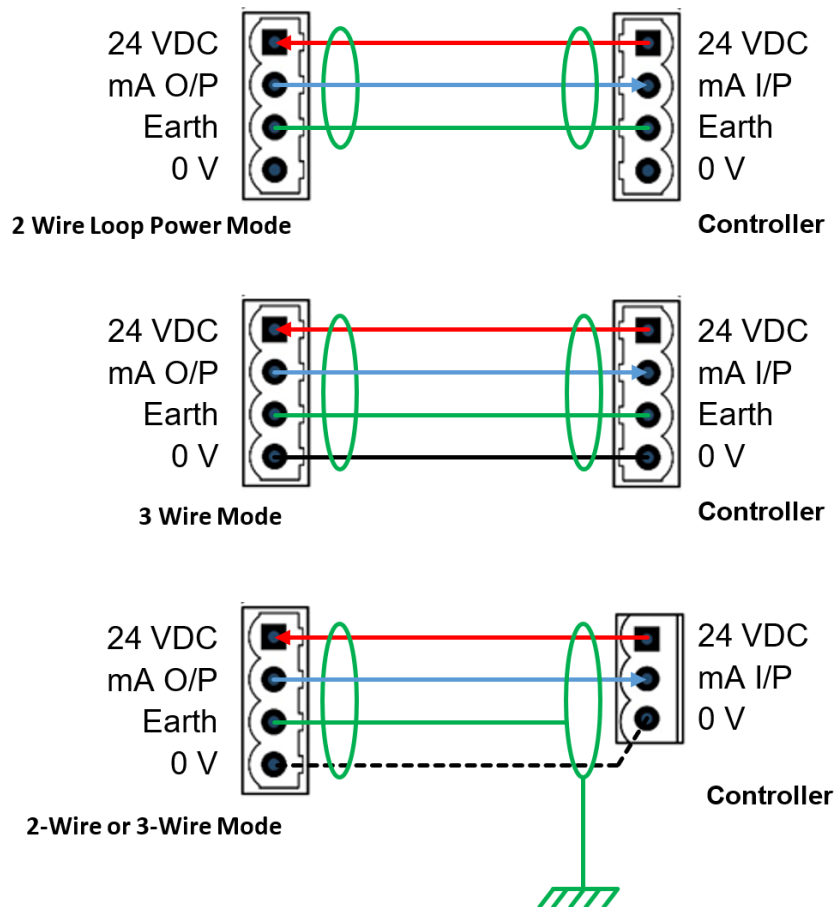
Electrical connections.

| Sensor Mode | Terminal Name | Description | Cable Type |
|-------------|---------------|----------------------|---------------------------------|
| 2-Wire | 24 VDC | +24V / Power (+) | 2 core screened or 3 core cable |
| | mA O/P | 4-20 mA Return | |
| | Earth | Cable screen/shield | |
| | 0V | Not connected | |
| 3-Wire | 24 VDC | +24V / Power (+) | 3 core screened or 4 core cable |
| | mA O/P | 4-20 mA Output | |
| | Earth | Cable screen/shield | |
| | 0V | 0V,GND / Power (-) | |

5.1.1 Cable Shield Wiring

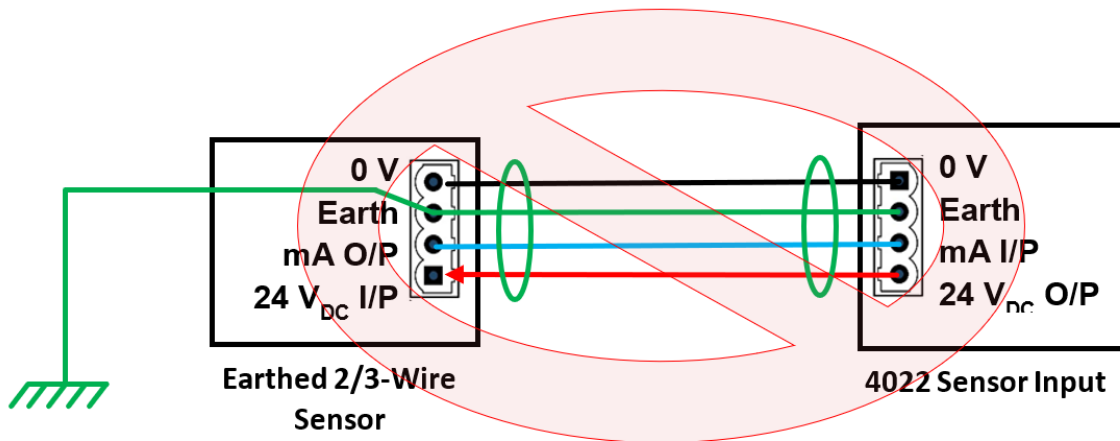
Shielded cables are required to be used for sensors to reduce RFI and EMI pickup along the cable which may be up to 1 km away. Installing unshielded cables will **VOID WARRANTY**. The figure below shows how to connect a 2700 detector in 2-wire or 3-wire mode to the GDA controller.

Cable Shield connections.



DO NOT connect the controller earth to a remotely earthed sensor. This will cause an earth loop and inject noise and unknown potentials onto the cable and sensor input.

Incorrect connection of Cable Shield.

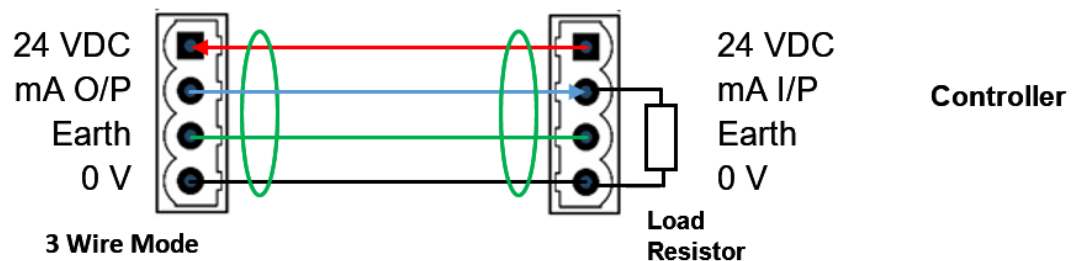


To convert the output of a 3-wire detector from current to voltage a resistor is required to be connected across the input of the controller. This is so that the 0-20 mA signal is transmitted over the cable distance and converted to the 0-10 V at the controller. This is to take advantage of the noise reduction ability and the lack of voltage drop of the mA transmission. Below is a table of the common load resistor values for converting a current to voltage output. See figure in section 8.1.1 for how to change the detectors mode from 2-wire to 3-wire and jumper location for changing from 4-20 to 0-20 mA output.

Load Resistor values for voltage out.

| Resistor | 0-20 mA Output | 4-20 mA Output |
|----------|----------------|----------------|
| 100 Ω | 0 - 2 V | 0.4 - 2 V |
| 250 Ω | 0 - 5 V | 1 - 5 V |
| 500 Ω | 0 - 10 V | 2 - 10 V |

Load Resistor wiring.



6 Verification of Installation

The Verification of Installation procedure is performed after the E-Sense detector has been installed and electrically connected.

Ensure that the power to the detector(s) is switched off at the controller.

- Visually check that the mechanical mounting of the detector is correct as to details in this manual.
- Visually check that the electrical connections within the detector are correct. Conductors should be marked / colour coded and their function must match those given in the Electrical connections Table in section 5.1 of this manual.
- Visually check that the electrical connections at the controller match the function of the Electrical connections Table in section 5.1 of this manual. And that the conductor markings correspond correctly to those at the detector.
- Isolate the power to the detector (temporarily unplug the detector connector at the controller).
- Isolate any alarms.
- Turn on the system power and check that the supply voltage from the controller system meets the requirements given in the specifications table at the end of this manual.
- Turn off the power and reconnect the detector at the controller.
- Turn the power on to power the detector
- Please note: Following power on the detector goes through a warmup of approximately 60 seconds during this period the mA output may vary until it stabilizes.
- Following warmup check that the power supply is still within specification.
- Allow the system to settle for at least 30 minutes for the temperature to stabilise.
- Observe the controller readings from the detector and ensure that they are as expected. For Carbon Monoxide the reading should be 0 ppm and Oxygen 20.9% vol. Be aware that the air around the detector may contain a level of the target gas.
- Observe that the detector reading is stable.

7 Commissioning

7.1 Initial Commissioning

It is necessary to commission your newly installed E-Sense detectors.

Full system commissioning is not covered in this manual as every installation is different.

Below is a recommended sequence of checks to ensure correct operation of the detector.

A basic system will have a gas detector, controller and alarms.

Notify the appropriate people that the alarms will be activated during the commissioning process.

The detector must be bump tested with the target gas to ensure that its output corresponds to the gas concentration. The recommended minimum concentration of the bump test gas is 25% above the required minimum alarm level. Apply gas with a gassing cap for 1-2 minutes at 0.5 LPM flow rate.

Observe that the sensor is now showing gas detected by checking with a multimeter on the mA test points. Also you will want to check your controller / BMS unit at this point to make sure that it is also showing the correct gas concentration and alarm level.

Walk around and check that all alarms are functioning correctly.

Testing of the Fault condition is also required for correct commissioning.

To cause a fault condition you will want to disconnect the power connector of the newly installed sensor and then see the state of the controller to make sure your FAULT condition is working correctly. Reconnect the detector power to clear the fault.

If you require commissioning, please contact Gas Detection (Australia) Pty Ltd on (07) 4613 5111.

7.2 Function Checks

Function tests are a required check to make sure that your investment is working correctly and people and machinery are safe to rely on this equipment.

7.2.1 Equipment required for Function Checks

Certified Gas: Certified calibration gas matching the Target Gas of the detector see table below.

Regulator: 0.5 LPM

Tube: Tygon E-3603 (Recommend)

Gassing Cap: Available from GDA: GC-ESENSE

Multimeter: Multimeter with a milliamp DC range

Recommended calibration gas concentrations and safe levels

| Chem. Formula | CO | NH ₃ | NO ₂ | O ₂ | H ₂ S | SO ₂ | |
|-----------------------------------|-----------|-----------------|-----------------|----------------|---------------------------|-----------------|---------|
| Sensor Range | 0-200 ppm | 0-300 ppm | 0-10 ppm | 0-25% vol. | 0-100 ppm | 0-10 ppm | |
| Calibration gas | value | 100 ppm | 250 ppm | 10 ppm | 18% vol. | 25 ppm | 5 ppm |
| | mA | 12.0 mA | 17.33 mA | 20 mA | 15.5 mA | 8.0 mA | 12.0 mA |
| Full Range Calibration gas | value | 200 ppm | 100 ppm | 10 ppm | 20.9% vol. (Fresh Air) | - | 10 ppm |
| | mA | 20.0 mA | 20.0 mA | 20.0 mA | 17.38 mA | - | 20.0 mA |
| TWA* | 30 ppm | 25 ppm | 3 ppm | - | 10 ppm | 2 ppm | |
| STEL* | - | 35 ppm | 5 ppm | - | 15 ppm | 5 ppm | |

*workplace_exposure_standards_for_airborne_contaminants_-_1_october_2022

7.2.2 Bump Test Conditions

Bump test may be carried out with a certified test gas to ensure that the 4-20 mA output corresponds with the gas level. This should be undertaken with the GC-ESENSE gassing cap at a flow rate of 0.5 LPM of the target gas. The detector requires a 1 min warm up period if it has been turned off before you commence the Bump Test.

Test gas and equipment are available from Gas Detection Australia.

7.2.3 Bump Test Procedure

- Connect the regulator to the cylinder of certified calibration gas.
- Attach the tube to the regulator and gassing cap.
- Attach the gassing cap to the detector.
- Flow the certified gas at 0.5 LPM for 1-2 minutes.
- Observe the change in the mA output on a multimeter connected to the mA test points as the gas concentration increases.
- Check that the controller is showing the correct concentration approximating the cylinders concentration.

7.2.4 Failure of Bump Test

- Check the cylinder and tube connections and that the gassing cap is fitted securely to the detector with no gaps.
- Check that the flow rate of the regulator is 0.5 LPM
- If the detector's Zero point is above 0 ppm a calibration of the Zero point is required.
- If the detector fails a bump test then you will need to calibrate the detector as per section 8.

7.2.5 Fault Condition

The detector does not have a fault condition indicator light. A sensor fault will change the mA current output to below 2.0 mA which will cause a fault condition on the controller.

8 Calibration Procedure

Calibration of your detector is required **annually** or sooner if it fails at your 6 monthly Bump Test. It is the recommendation from GDA that the detector has a bump test period in accordance with the building requirements of where it is installed. Electrochemical sensors have a limited life span and will require replacement.

8.1 The Purpose of Calibration

You need to calibrate your detector to ensure the unit is working correctly and keeping staff and equipment safe and working efficiently. If your detector is not working properly then you may risk losing gas and also causing injury to staff and visitors.

Inherently detectors will have an amount of Drift over time, this is also a reason that Bump testing and Calibrations are required.

Calibrating your detector will make sure you are always safe and your equipment is kept in the best possible working order.

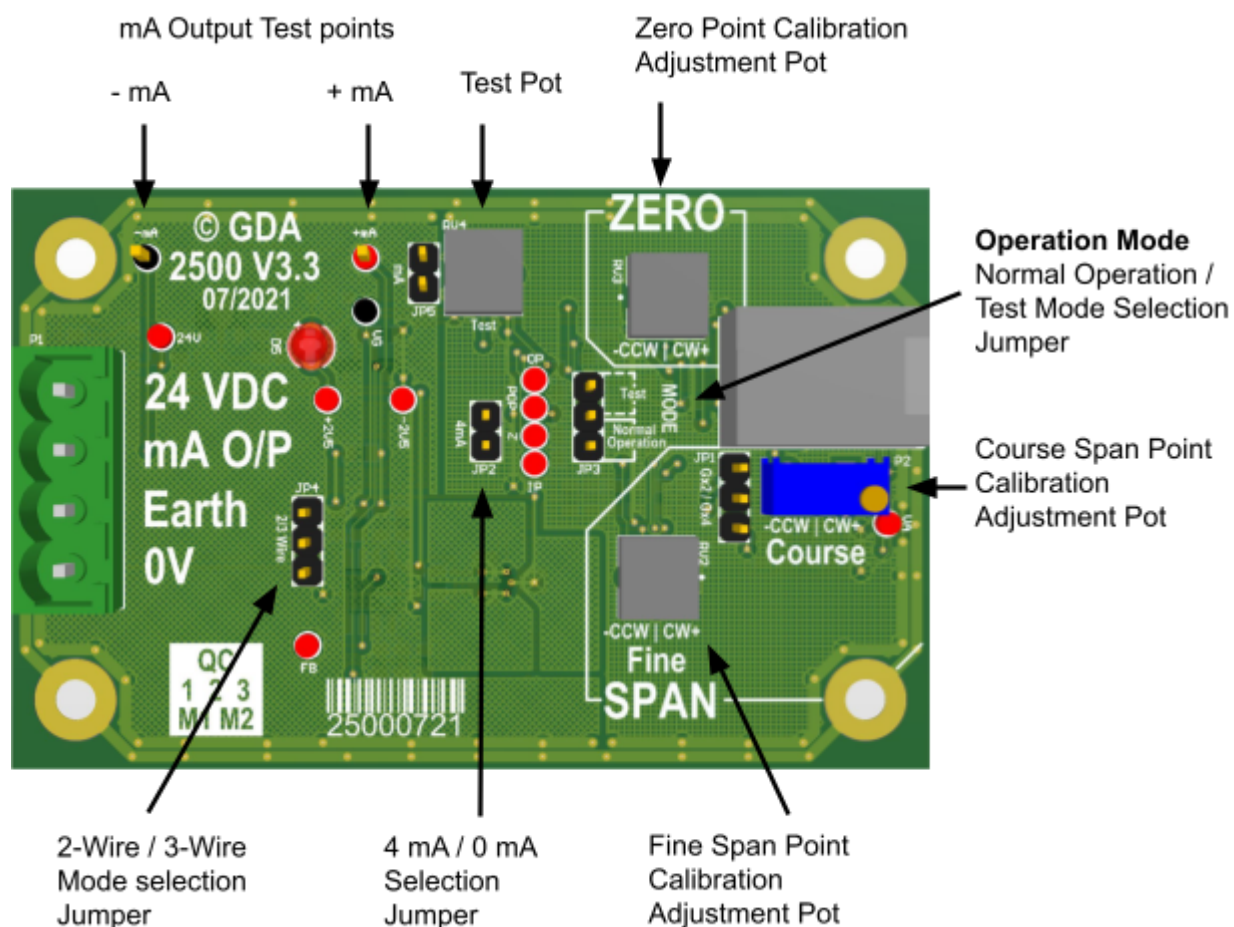
8.1.1 Preparing for Calibration

Collect all equipment that is required from the “Function Check” in section 7.2.1

Make sure that the detector has been powered on and working for at least 60 minutes, this is to allow the detector's temperature to settle.

Make sure all personnel are notified that the alarms will be activated. (Some people may like to de-activate the alarms during this procedure).

The E-Sense detector requires a two-point calibration called Zero and Span points.

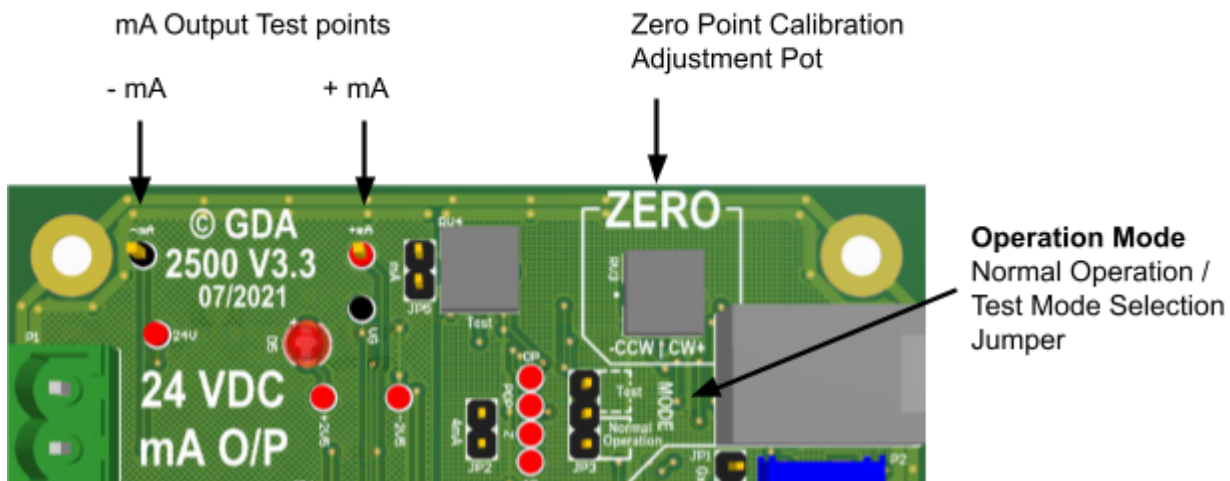


8.2 Zero Point Calibration

Changes to humidity, temperature, and other environmental factors affect the sensor accuracy and may need an adjustment of the Zero point when introduced to new environments. Zero point calibration is to be set when there is a gas concentration of zero (0 ppm) of the target gas delivered to the detector. We will refer to this gas as Zero gas. This point also represents the minimum range of the detector's output 4.00 mA (or 0 mA).

8.2.1 Perform Zero Point Calibration

- Connect the regulator to the cylinder of Zero calibration gas, Nitrogen or Synthetic Air.
- Attach the tube to the regulator and gassing cap.
- Attach the gassing cap to the detectors sensor housing firmly.
- Connect the multimeter to the mA output test points
- Flow the gas for 2 minutes at 0.5 LPM. Continue to flow gas over the detector until a successful calibration.
- Adjust the Zero potentiometer (pot) until the multimeter reads 3.90 to 4.00 mA. For Oxygen 4.00 mA
- Turn off gas and remove the gassing cap.



8.3 Span Point Calibration

Span point calibration can only be set when using a known gas concentration of the target gas delivered to the detector. Refer to the table in section 7.2.1 for recommended calibration gas concentrations and safe levels for each E-Sense model. We will refer to this gas as Span gas. If your cylinder's concentration is not listed use the calculations below to determine the mA span set point for the value of your calibration cylinder.

Gas concentration calculations:

Example calculation for a 0-200 ppm sensor using calibration gas of 100 ppm, the transmitter board output will be 12.00 mA.

Equation 1. $16mA \div Range = mA \text{ per ppm}$

$$16mA \div 200 \text{ ppm} = 0.08 \text{ mA/ppm}$$

Equation 2. $(mA \text{ per ppm} \times Cal \text{ Gas Concentration}) + 4mA = mA @ Concentration$

$$(0.08mA/ppm \times 100 \text{ ppm}) + 4mA = 12.00mA @ Concentration$$

8.3.1 Perform Span Calibration

- Determine the mA Span point value of your calibration gas before you start to flow the gas.
- Connect the regulator to the cylinder of Span calibration gas
- Attach the tube to the regulator and gassing cap.
- Attach the gassing cap to the detectors sensor housing firmly.
- Connect the multimeter to the mA output test points
- Flow the gas for 2 minutes at 0.5 LPM. Continue to flow gas over the detector until a successful calibration.
- Adjust the Course Span potentiometer (pot) until the multimeter reads close to the mA Span point value at the 2 min time.
- Adjust the Fine Span pot if the exact value can not be achieved with the course pot.
- Turn off gas and remove the gassing cap.

8.3.2 Failed Span Point Calibration

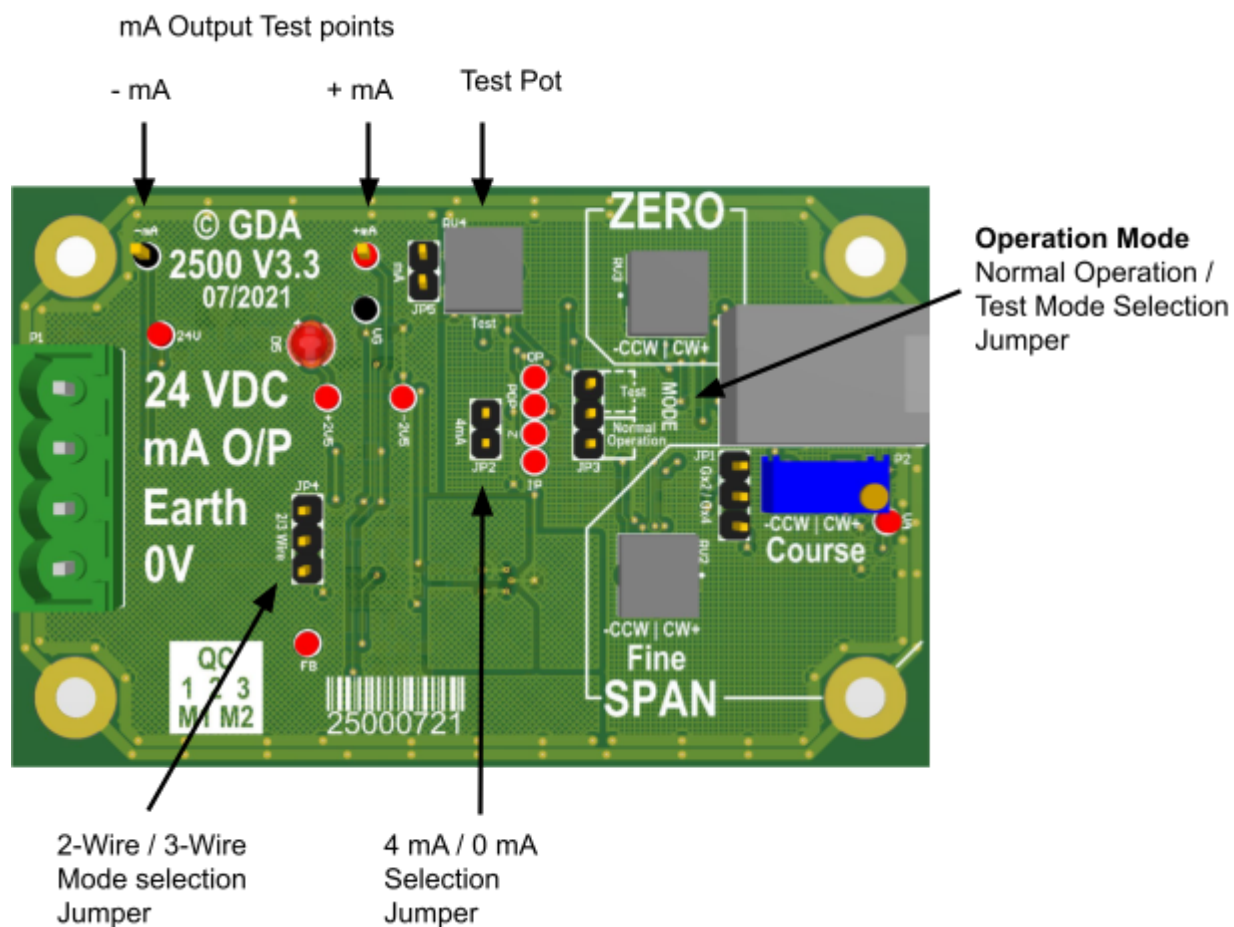
- Check that all connections are secure and firm
- Check the regulator's flow rate ensuring that it is 0.5 Liters per minute.
- If the expected Span value is not reached with full adjustment of the Span pot the sensor will be required to be replaced.

8.4 Test mA Output

The sensor transmitter board has a current output test function. This is used to simulate the current output signal of the transmitter board for functional testing of the system.

The simulated mA current has an adjustable range from 1.6 mA to 21.5 mA. To use the test current function, set the jumper of the Operating Mode from Normal Operation to Test this JP3 see figure below. The Test current pot adjustment screw can be rotated with a small flat screwdriver to increase or decrease the mA output. Which can be monitored with a multimeter using the mA output test points.

Ensure that the JP3 jumper is repositioned to its Normal Operating position after functional testing to ensure sensing operation.



9 Maintenance

9.1 User Maintenance

It is the recommendation from GDA that the detector has a bump test period in accordance with the building requirements of where it is installed. It is recommended that the minimum bump test period is 6 months and a recalibration of the Zero and Span point annually with certified calibration gas.

Ensure the detector opening is kept free of anything that may cause a reduction of air movement into the detector.

10 Specifications

10.1 General Specification

E-Sense General Specification

| Specification | Value |
|----------------------------|---|
| Recommended Supply Voltage | 24 V _{DC} (± 10%) |
| Maximum Current | 25 mA |
| Modes | 2-Wire Loop Powered 4-20 mA or 3-Wire 0/4-20 mA |
| Load Dependence | < 0.5 % of Output |
| Connection | 4 pin plug connector; 24 V _{DC} , mA O/P, 0V & Earth |
| Sensor Technology | Electrochemical Cell |
| Detection Type | Diffusion |
| Test Mode | 1.7 mA to 22mA |
| Enclosure Material | PVC plastic & Brass C385 / PTFE |
| Cable Entry | User provided |
| Dimensions | 155/145 x 130 x 70 mm (H, W, D) |
| IP Rating of Enclosure | IP56 with Brass sensor head IP53, PTFE sensor head IP22 |
| Weight | 325g, PTFE 260g |

10.2 Mode Specifications

2-Wire Loop-Powered Mode Specifications.

| Specification | Value |
|-------------------------|--|
| Supply Voltage Range | 12 V _{DC} to 24 V _{DC} (+ 10%) |
| Output Current Range | 4 to 20 mA |
| Max. Loop Impedance | 560 Ω @ 24 V _{DC} (± 10%) 100 Ω @ 12 V _{DC} (+ 10%) |
| Head/Compliance Voltage | 10 V _{DC} |
| Mode select jumper | 2 Wire |

3-Wire Mode Specifications

| Specification | Value |
|-------------------------|---|
| Supply Voltage Range | 12 V _{DC} to 24 V _{DC} (+ 10%) |
| Output Current Range | 0 to 20 mA or 4 to 20 mA (Factory Set Option) |
| Max. Loop Impedance | 830 Ω @ 24 V _{DC} (± 10%) 500 Ω @ 12 V _{DC} (+ 10%) |
| Head/Compliance Voltage | 2 V _{DC} for mA Output |
| Modes | 0 mA minimum used for voltage input equipment or 4 mA minimum used for current input equipment (industry standard) |
| Mode select jumper | 3 Wire |

10.3 Specification

Gas Specific Specifications

| Model | 2725 | 2726 | 2727 | 2728 | 2729 | 2730 |
|--|--|---|---|--|---|---|
| Detection Gases | Carbon Monoxide | Ammonia | Nitrogen Dioxide | Oxygen | Hydrogen sulphide | Sulphur Dioxide |
| Chem. Formula | CO | NH ₃ | NO ₂ | O ₂ | H ₂ S | SO ₂ |
| Ranges | 0-100 0-200 | 0-150 0-300 0-1000 | 0-10 | 0-25 | 0-50 0-100 | 0-10 |
| Units | ppm | ppm | ppm | % vol. | ppm | ppm |
| Maximum Gas concentration Overload | 5000 | 200 500 1500 | 200 | 30 | 500 | 150 |
| Accuracy of calibration ¹ | < 0.5% F/S | < 0.5% F/S | < 0.5% F/S | < 0.5% F/S | < 0.5% F/S | < 0.5% F/S |
| Response Time T90 at SATP | <30 sec | <60 sec | ~30 sec | <10 sec | ~30 sec | <30 sec |
| Linearity | Linear | Linear | Linear | Linear | Linear | Linear up to 20 ppm and within ±5% |
| Repeatability | <±2% CO | ±10% | <±2% NO ₂ | - | < ±2% H ₂ S | < ±2% SO ₂ |
| Warm Up Time | 1 min | 1 min | 1 min | 1 min | 1 min | 1 min |
| Output Drift per annum at SATP in Fresh Air | < 5% | < 20% | < 20% | < 5% | < 15% | < 15% |
| Recommended time between Calibration operated at SATP in Fresh Air | Annually @ ~ 5% allowed drift ² | 6 months @ ~ 10% allowed drift ² | 6 months @ ~ 10% allowed drift ² | Annually @ ~ 5% allowed drift ² | 6 months @ ~ 10% allowed drift ² | 6 months @ ~ 10% allowed drift ² |
| Recommended time between Bump Test operated at SATP in Fresh Air | 6 months @ ~ 3% allowed drift ² | 3 months @ ~ 5% allowed drift ² | 3 months @ ~ 5% allowed drift ² | 6 months @ ~ 3% allowed drift ² | 3 months @ ~ 5% allowed drift ² | 3 months @ ~ 5% allowed drift ² |
| Filter Capacity | - | - | - | - | - | 1000 ppm hours @ 25 ppm H ₂ S |
| Operating Temperature | -30°C to 50°C | -40°C to 50°C | -30°C to 50°C | -30°C to 50°C | -30°C to 50°C | -30°C to 50°C |
| Operating Humidity, peak non condensing | 15% to 90% RH | 15% to 90% RH | 15% to 90% RH | 5% to 95% RH | 15% to 90% RH | 15% to 90% RH |
| Operating Pressure | 800 to 1200 mbar | 800 to 1200 mbar | 800 to 1200 mbar | 800 to 1200 mbar | 800 to 1200 mbar | 800 to 1200 mbar |
| Gas density compared to Air (1.204 kg/m ³) @ NTP | Approx. 1.165 | Lighter 0.717 | Heavier 1.880 | Approx. 1.331 | Heavier 1.434 | Heavier 2.279 |

11 Sensor Replacement

There are 2 options for sensor replacement.

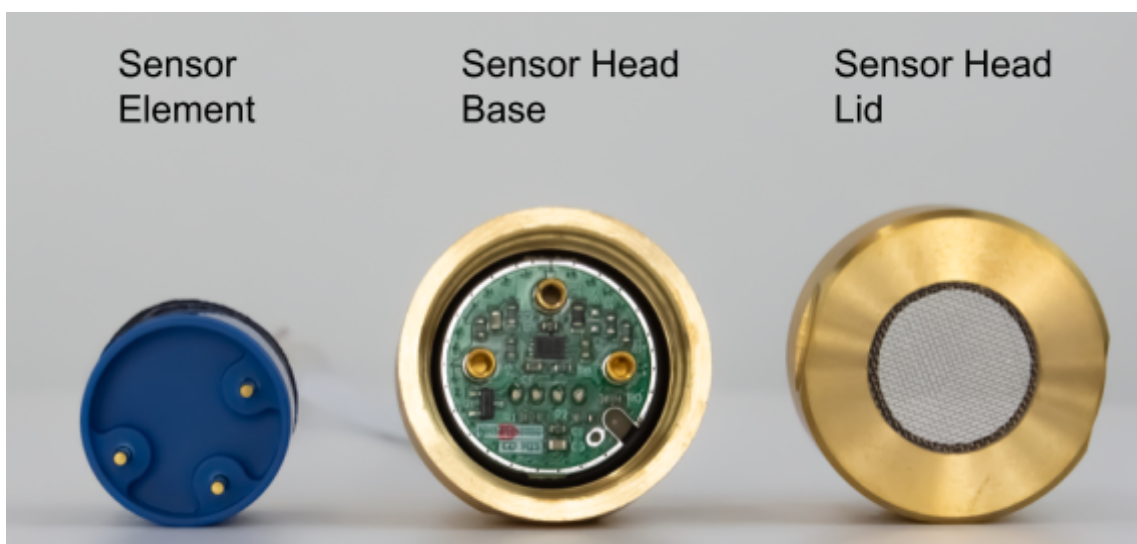
1. Replacement sensor element.
2. Replacement sensor head with sensor element.

11.1 Replacement Sensor Element



1. Remove the lid of the enclosure (4 screws).
2. Disconnect the power connector (green 4 pin) located on the left of the main board.
3. Using a GDA spanner and a shifter remove the brass sensor head lid.
4. Gently wiggle out the old sensor element.
5. Line up the 3 pins of the replacement sensor element and push in gently to insert the sensor.
6. Once the sensor element is mounted correctly screw the sensor head lid back on and tighten with the spanner.
7. Reconnect the power connector into the socket on the main board.

8. Calibration of Sensor Head is required.



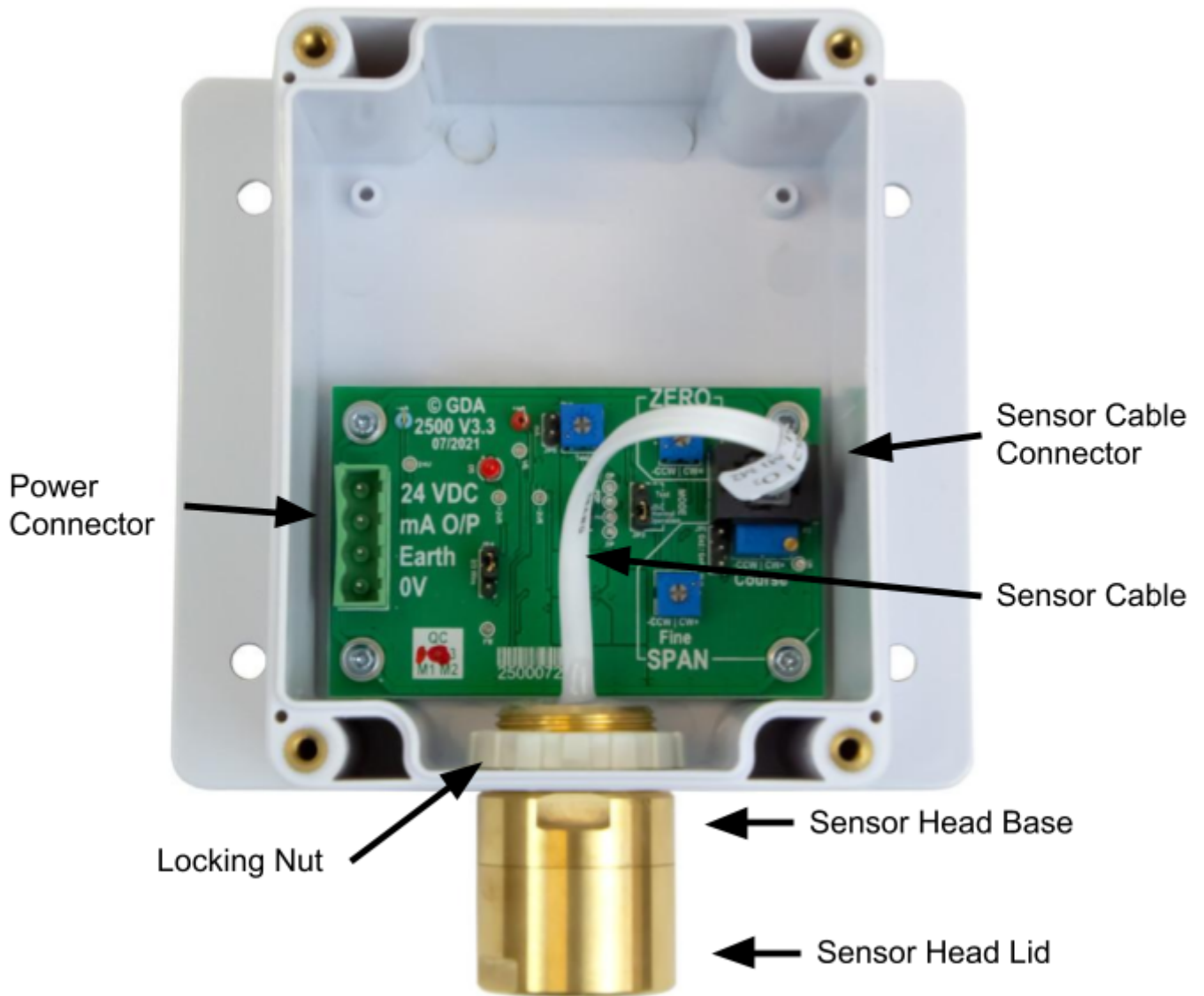
11.2 Replacement Sensor Head



When the sensor head is being replaced, the replacement sensor heads are supplied tested **but will require calibration when installed**, follow these instructions on how to remove the sensor head and install the new sensor head without damage. **Gloves are recommended when removing the brass sensor head to protect your hand from cuts.**

1. Remove the lid of the enclosure (4 screws).
2. Disconnect the power connector (green 4 pin) located on the left of the main board.
3. Disconnect the Sensor Head Connector.
4. Gently pull the sensor cable towards the top of the case to clear any obstructions from the main board and the incoming power cable.
5. Remove the locking nut
6. Remove the Sensor Head, ensuring that the cable connector does not get caught on anything while removing.
7. When installing the new sensor head, guide the sensor cable into the enclosure through the sensor mounting hole.
8. Screw on the locking nut until tight.
9. Plug in the Sensor Head connector, try to minimise twists in the cable, you may need to rotate the Sensor Head to ensure a smooth bend of the cable.
10. Reconnect the power connector into the socket on the main board.

11. Calibration of Sensor Head is required.



12 Sensor Head Replacement

| Version | Contents | Date |
|---------|--|--------------|
| 1 | Initial revision of the 2700 Manual HW: V3.3 | 22 Dec, 2022 |



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