4-20mA Transmitter for Oxygen Sensors
072-0126 Issue 2

1 INTRODUCTION

The Transmitter PCB includes circuitry for an electrochemical oxygen sensor to convert the μA output signal from the sensor to a 2-wire 4-20mA signal. The transmitter board is shipped with four mounting pillars and hardware that may be used if required

Alphasense 4-20 mA transmitters offer convenience and easy maintenance for gas sensors:

- Transmitters are shipped pre-calibrated for immediate use.
- Circuitry includes onboard voltage regulator and uses low power two-wire transmitter systems, allowing the simplest wiring format.
- Small circuit board size allows smaller sensor housing.
- Conformally coated circuit board gives environmental protection of circuit.
- Low power circuitry with excellent performance means no degradation of sensor performance due to electronics.
- Close PCB tracking and buffer circuit reduces noise pick-up and RFI/EMI susceptibility.

Besides periodic sensor re-calibration, the transmitter electronics require no maintenance throughout the lifetime of the sensor. The sensor can be replaced at the end of the two-year sensor working life. Re-calibration is required when the sensor is changed. See section 7.

Please read these instructions to ensure correct installation, use and calibration of your gas sensor/ transmitter.

2.1 Transmitter Specification

Input Voltage Required	+7.5 to + 35 VDC
Output at 15% oxygen concentration	4mA
Output at 20.9% oxygen (ambient)	13.44 mA
Output at 25% oxygen concentration	20mA
Setability / stability	<0.1mA (<0.5% FS)
Maximum load @ 20 mA, 24 VDC	825 ohms (see section 3.3)
Supply voltage dependence	< ±0.2% output from +7.5 to +35 VDC
Connector on PCB	2 pin Molex plug (ref. 22-27-2021)
PCB current requirement	<100 μA
PCB dimensions	39mm x 39mm x 19 mm (height)
Operating conditions	See sensor specification (90%rh maximum)
Calibration (shipped pre-calibrated)	multi-turn zero and span potentiometers
Power supply protection	Diode protection for voltage regulator

2.2 Range/Options

Sensor and transmitter boards are shipped from Alphasense pre-calibrated. You may wish to confirm calibration. Standard available range is listed below:

Sensor	Oxygen Concentration Range (%)
O2-A2	15 to 25

Table 1. Oxygen Transmitter ranges

Although the sensor and transmitter are pre-calibrated and the ranges are preset, it is possible to modify the range by adjusting the zero and gain potentiometers, which changes the circuit gain and offset. Contact Alphasense before proceeding.

3 Set Up

Oxygen sensors are packed separate from the transmitter board to prevent loss of lifetime during shipping and storage. The sensor and transmitter are matched, so to reconnect the sensor and transmitter board:

1 Remove the oxygen sensor from the clear bag.
2 Plug the sensor into the board.
3 Wait one hour for the sensor to stabilise before checking that the output in ambient air is 13.3 to 13.6mA.

3.1 Mechanical Mounting

Transmitters should be mounted to your housing using the pillars provided. These pillars should first be attached to the PCB using the supplied screws and washers.
(**Important note:** Ensure that a washer is fitted on **BOTH** sides of the PCB – see figure 3).
Two sets of mounting holes are provided so that the assembly can be fixed to either the housing top, (using the locating holes in the corner of the PCB), or to the base of the housing, (using either set of locating holes – Note: Long pillars will be required for this configuration, Alphasense Pt No: 034-0005-00). Figure 1 below shows mounting hole locations (dimensions are in mm). Figure 2 diagrams the locating holes; normally the outer holes are used for mounting, while the inner holes are in the same location as the earlier issue of this PCB, allowing backward compatibility with the earlier PCB design.

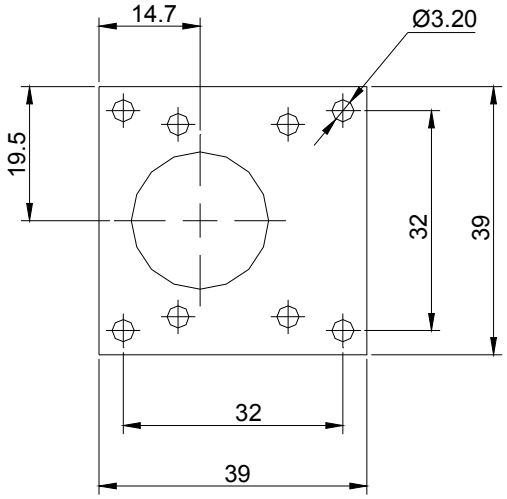


Figure 1. Mounting hole locations.

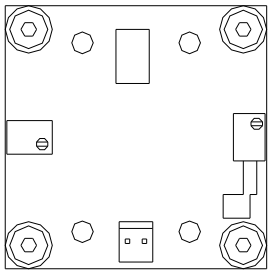


Figure 2. Inner and outer mounting holes.

The pillars are tapped to accept an M3 screw. We recommend a screw length that is at least 8mm to ensure rigid fixing. It is good practice to hold the pillar when screwing into the pillars to stop the pillar from rotating on the PCB. It may be easier to remove the sensor whilst screwing the circuit board pillars to your housing. If you move the pillars, ensure that, if mounting to the lid of your housing that you include the washer between the pillar and PCB to ensure correct height of the pillar assembly. See figure 3.

Allow 60 minutes after plugging the sensor back into the board for the output to stabilise before calibrating or checking performance.

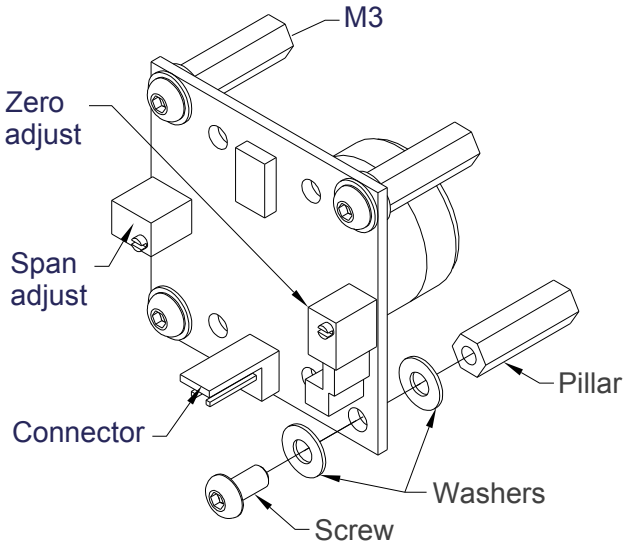


Figure 3. Mounting pillar configuration for attaching to the lid of an enclosure.

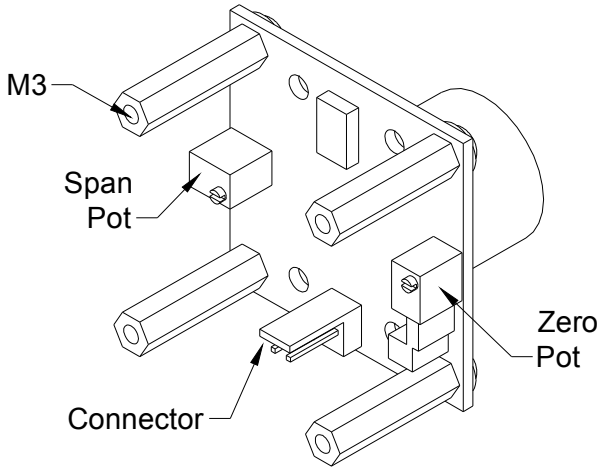


Figure 4. Mounting pillar configuration for attaching to the base of an enclosure.
(Long pillars required Pt: No 034-0005-00)

Figure 5. Side view of mounting to lid of an enclosure.

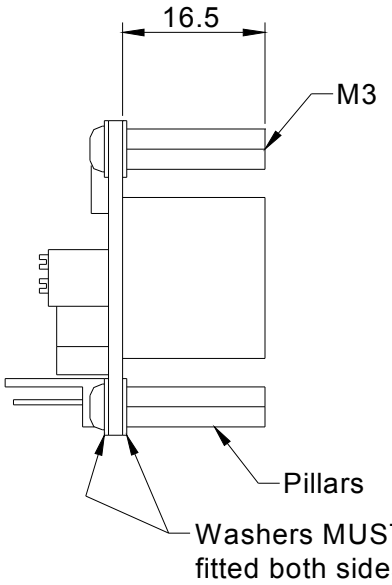
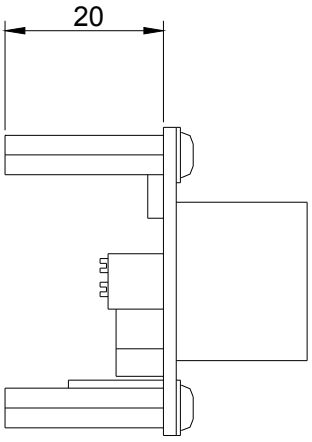


Figure 6. Side view of mounting to the base of an enclosure.



3.2 Connection and Wiring

Power to the transmitter board is via a Molex 2-pin mini plug (type 22-27-2021: supplied with the transmitter). Connect using a screened, two-core cable to the wires (black is ground, red is positive) by either soldering or using a screw terminal block. These leads can be shortened or extended as needed.

3.3 Power Supply

Your power supply must be between 7.5 and 35 VDC with less than 0.2V ripple.

Do not supply mains AC power to this unit: this will destroy the transmitter and void the warranty.

The transmitter is protected against incorrect polarity, but will not function if you have reversed the power supply wires by connecting the Molex plug incorrectly to the transmitter board socket.

When selecting the power supply voltage, you must not exceed the maximum total loop resistance, which includes your measuring resistor used to change the 4-20 mA current into a measured voltage.

The transmitter requires a minimum of 7.5 volts to operate; therefore, the maximum potential drop allowed across your sensing resistor and cable is:

(power supply voltage) -(7.5V)

Assuming full-scale deflection at 20 mA, use Ohm's law to calculate the maximum loop (cable plus sensing resistor) allowed resistance.

4 Correct Usage and Maintenance

Ensure that there is a good gas seal between the sensor and the housing; also if the sample is pumped, then ensure that the flow rate is sufficient. Alternatively, the sample gas can be allowed to diffuse to the front face of the sensor. Alphasense recommends 250 to 500 standard cubic centimetres per minute (sccm) flow rate if pumped. Higher flow rates may be used, but beware that pulsing flow and higher-pressure drops may lead to erratic readings.

No maintenance is required, but if the top dust/ oil filter has become badly contaminated, then contact Alphasense for replacement dust filter. See table 2 below.

Part Number	Description
024-0023-00	Self-adhesive dust/oil filter
010-0178-00	Cable assembly
034-0005-00	20mm long Spacer

Table 2. Replacement part numbers

5 Calibration

The 4-20mA transmitter is shipped pre-calibrated to the range shown in 2.1. Periodic re-calibration is required for all gas sensors, especially in safety-critical applications. Full calibration requires a nitrogen bottle and accurate blending equipment to generate 15% oxygen to set zero, but because the zero and span adjustments are interactive, we strongly recommend that the output is checked in ambient air (13.44mA) and if the output is less than 12.7mA or greater than 14.1mA, then re-calibration may be frustrating and we recommend that the transmitter board is returned to Alphasense and a new sensor will be fitted and re-calibrated. For small re-calibrations follow the instructions below. The transmitter and sensor were calibrated at 25°C. If the sensor will be constantly exposed to a temperature significantly different than 25°C, then allow the sensor to stabilise at that temperature, then recalibrate as explained below.

To Recalibrate:

1 First ensure that the power supply is connected correctly. Ensure that the sensor has been powered for at least one hour before checking calibration.

2 **Ambient air calibration** Either pump or allow clean air to diffuse to the sensor for ten minutes. Adjust the zero potentiometer (RP2: see figure 3) with a small screwdriver until the reading is within ± 0.05 mA of the Air Calibration Point shown in Table 3.

Sensor	Full-scale % oxygen	(20.9% oxygen) Air Calibration Point (mA)
O2-A2	25	13.44

Table 3. 4-20 mA Transmitter Air Calibration

Mass flow oxygen sensors are used in these transmitters. With low temperature and pressure dependence, these are well suited for fixed system applications. This type of oxygen sensor has a small non-linearity, which can normally be ignored. Table 4 below lists the output error (measured output – actual concentration) due to non-linearity.

% O_2	O2-A2 (15-25%O2 range)
15	0
20	0
25	+0.5

Table 4. Transmitter non-linearity

6 Warranty

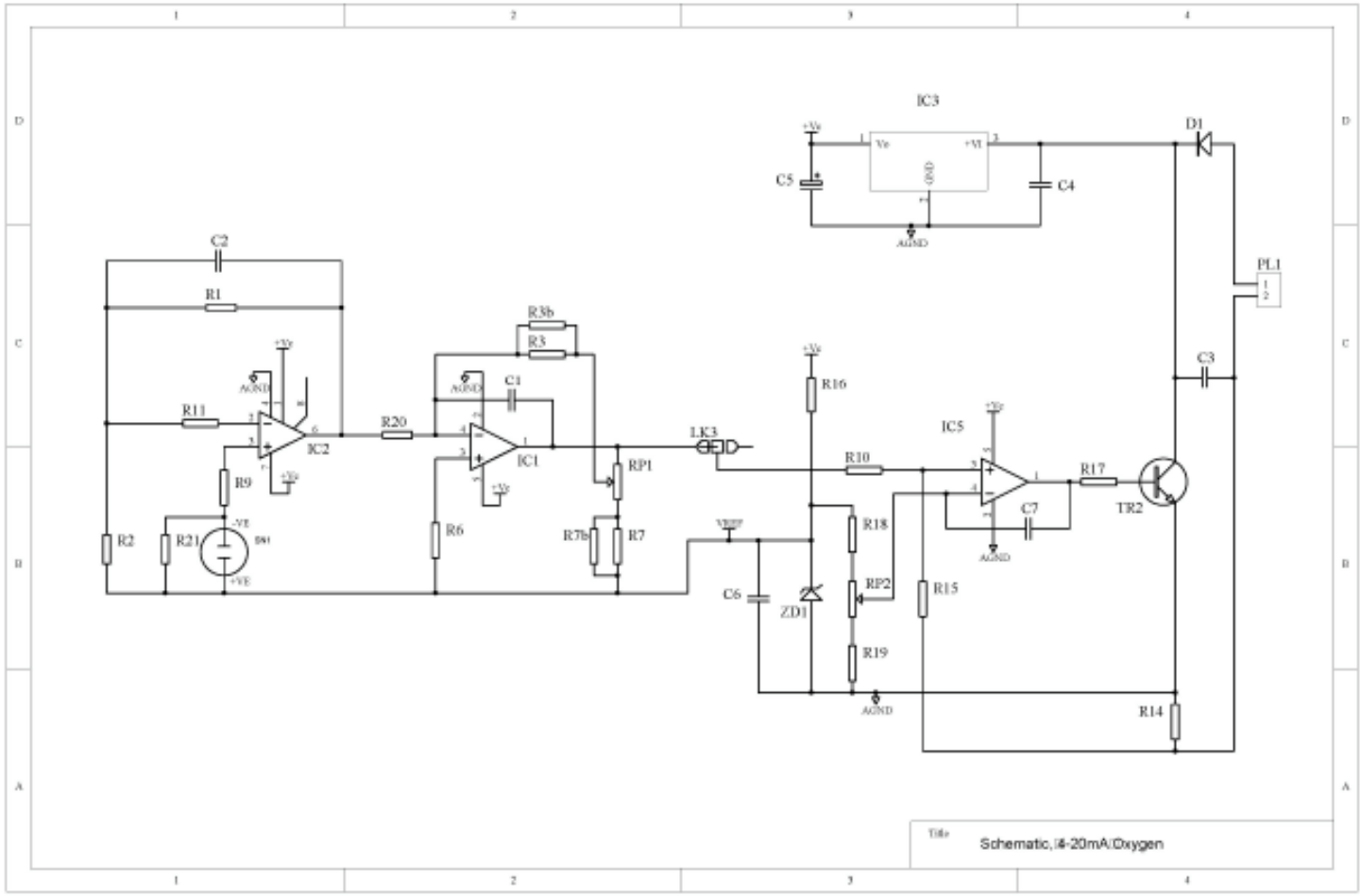
Transmitters are warranted for two years. Alphasense O2-A2 oxygen sensors are warranted for two years. If you have any difficulties or problems then contact:

Customer Support
Alphasense Limited
Sensor Technology House
300 Avenue West
Skyline 120
Great Notley
Essex
United Kingdom
CM77 7AA

Tel: +44 (0) 1376 556 700
Fax: + 44 (0) 1376 335 899
email: sensors@alphasense.com

7 Attachment

Figure 7. Circuit diagram



Alphasense Ltd

Sensor Technology House

300 Avenue West, Skyline 120, Great Notley, Essex, United Kingdom CM77 7AA

Tel: +44 (0) 1376 556 7008 Fax: +44 (0) 1376 335 899 e-mail: sensors@alphasense.com web: www.alphasense.com