

The purpose of this manual is to explain how the circuit operates, how to connect power and take readings, mount the circuit board and correct the data in Excel.

### 1. How the circuit operates

Figure 1 below shows the circuit for the ISB, issue 4. This circuit is designed for use only with Alphasense B4 family of four-electrode gas sensors. The ISB uses low noise components and in order to achieve good resolution, best practice for grounding and screening is necessary. Take time to optimise your EMC environment to a low level to achieve low ppb resolution.

The ISB includes a low noise bandgap to provide a bias voltage for NO sensors and can measure both oxidising (CO, H<sub>2</sub>S, NO) and reducing (O<sub>3</sub>, NO<sub>2</sub>) gas sensors. The ISB is configured as four versions for specific sensors: NO, NO<sub>2</sub>, O<sub>3</sub> and CO/ H<sub>2</sub>S/ SO<sub>2</sub>:

Part number	Sensor
000-0ISB-00	CO-B4, SO2-B4, H2S-B4
000-0ISB -01	NO-B4
000-0ISB -02	NO2-B43F
000-0ISB -03	OX-B431

Table 1. Part numbers for the four types of ISBs

Ensure your ISB is matched to the sensor type according to Table 1 if the ISB has been supplied separate from the sensor.

The circuit uses a single op amp to provide balance current into the counter electrode. In addition, both the working electrode (WE) and auxiliary electrode (Aux- used to compensate for zero current) have equivalent two stage amplifiers: the first stage is a high gain transimpedance amplifier and the second buffer stage allows for inverting sensor signals for NO<sub>2</sub> and O<sub>3</sub> sensors. Both signals are available on the 6-way Molex socket as separate pairs, but note that the power and output ground (-) pins are connected together.

There are no adjustments on the ISB. The offset voltages for both channels have been measured and are marked on the label attached to the packing sleeve for the ISB. If the ISB was shipped with a B4 sensor, the label will include both the zero voltage (expressed as mV) and sensitivity (expressed as nA/ppm) for the sensor with ISB. If you swap the sensor and ISB then the offset voltage will change but the sensitivity will be the same ( ±1%) since sensitivity is dependent on the sensor, not the ISB.

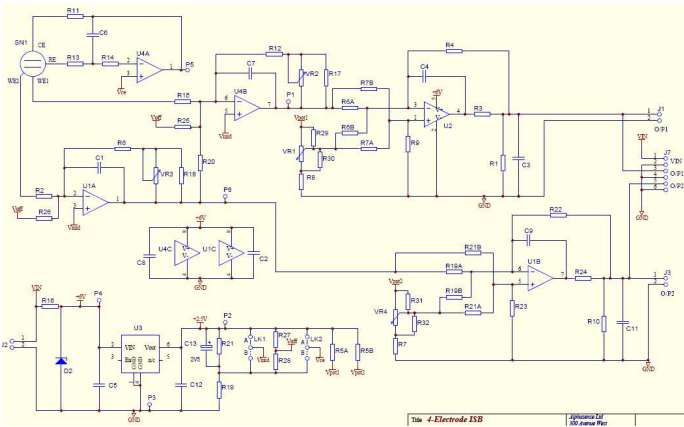


Figure 1. Schematic of Issue 4 ISB

## 2 Connecting power and taking readings

The socket for power and signals is shown in figure 2 below. The Molex socket is polarised.

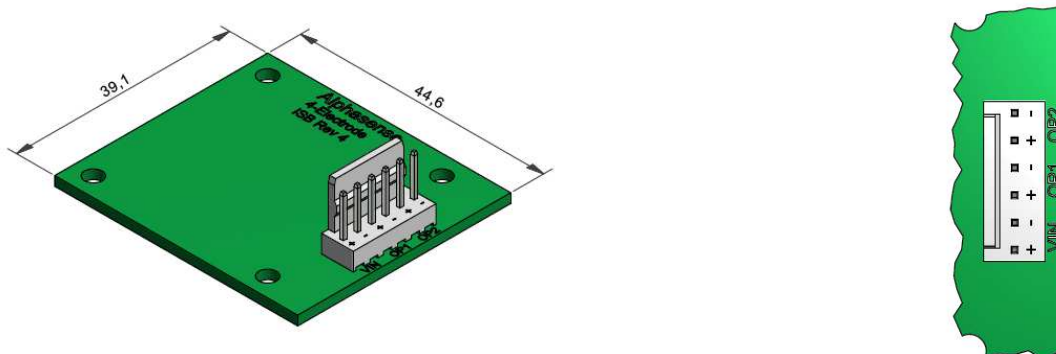


Figure 2. ISB socket for power and signals

DC power is required: 3.5 to 6.4 VDC. Ensure your power supply is low noise and decoupled, or its noise component will be added to the measured signal.

OP1 is the signal from the Working Electrode and OP2 is the signal from the Auxiliary Electrode. The –ve pins are connected so you can use either 6-way or 4-way cable to connect to the ISB. OP1 and OP2 are buffered DC signals so a normal A/D converter will be fine, so long as it does not inject noise back into the ISB. If you are concerned about noise injection, then decouple using 10nF plus 100nF capacitors close to the Molex connector.

Table 2 below lists expected outputs from ISB with a typical B4 sensor.

Gas	Zero offset WE/Aux (mV)	Sensor sensitivity (nA/ppm)	ISB Gain (mV/nA)	WE Sensitivity (mV/ppm)	Noise (ppb)
CO	330/ 340	420	0.8	336	4
H <sub>2</sub> S	340/ 330	1400	0.8	1120	1
NO	270/ 270	540	0.8	432	15
NO <sub>2</sub>	230/ 230	230	-0.726	165	15
O <sub>3</sub>	240/ 230	290	-0.746	216	15
SO <sub>2</sub>	330/ 340	300	0.8	240	5

Table 2. Offset, sensitivity and noise for typical B4 sensors with ISB

### Noise

- These gas sensors are very sensitive to gas and are also very susceptible to EMC pickup. Ideally the sensors would be housed in a Faraday cage, but this is not normally practicable, so shield and ground as best you can. Nearby digital circuits can also disrupt the signal quality.
- Typical noise at Alphasense, when calibrating on a bench without additional shielding, but with good power supply is 3 mV (p-p). Digital averaging can reduce this to less than one mV, equivalent to typically 2 ppb. Further reduction of noise can be achieved by shielding.
- It is important to decouple your power supply and A/D converter from the ISB. Since the 0V line is shared by the power supply and output, any noise injected by your power supply or reading circuit will appear on the measured signal. We recommend using two decoupling capacitors close to the Molex socket: 10nF and 100nF.

## 3 Mounting the circuit board

The mounting hole locations and diameters are shown in figure 3 below.

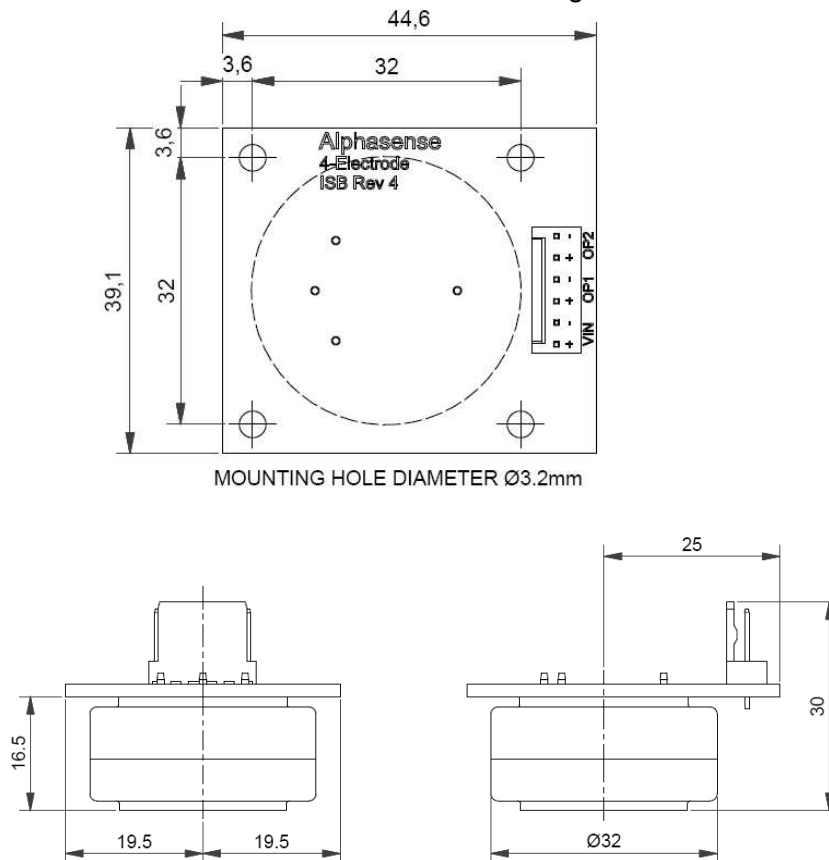


Figure 3. ISB dimensions and mounting hole locations

An optional **ISB Fitting Kit** can be purchased. Order part number **000-0ISB-KIT**. The kit includes:

- |             |  |
|-------------|--|
| 4 x pillars | 16.0 mm length, M3 tapped  |
| 8 x washers | M3: fits between pillar and ISB to achieve 16.5 mm pillar height |
| 4 x screws  | M3 x 8 button head   |
| 1 x header  | Molex 22-23-2061, 6-way, Series KK6373                           |
|             | Other Molex part references:                                     |
|             | Housing: Molex 22-01-2065, Series KK6471                         |
|             | Crimp: Molex 08-50-0032  |

End.