SS PCB APPLICATION NOTES
QUESTIONS & ANSWERS

EURO-GAS MANAGEMENT SERVICES LTD, CHURSTON HOUSE,
BASCOMBE ROAD, CHURSTON FERRERS, DEVON, TQ5 0JJ, UK
☎: +44 (0)1803 844414 Fax: +44 (0)1803 844224
sales@euro-gasman.com www.euro-gasman.com

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MANAGEMENT SERVICES LTD

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QUESTIONS & ANSWERS

1. What is the SS PCB?

A sensor component needs to be mounted into a circuit board to amplify the bare sensor information into a useful output for you to read like voltage, current or digital output.

Our SS PCB is a circuit board that is provided precalibrated correctly with an individual sensor of your choice to give you a raw data output that you can use to measure the gas.

2. Which sensors can we choose to go with the SS PCB?

Any 3-electrode, 4 series size sensor or 3-electrode, micro size sensor can be selected from our sensor product ranges.

We can also consider 2-electrode, 4 series sizes and 3-electrode, 7 series size sensors with a minimum order quantity. Please ask for more details if of interest.

3. Can I swop different sensors between one SS PCB?

Different sensors require different circuit design, depending on their nature, like bias and polarity. Therefore a sensor will be matched and precalibrated at manufacturing with appropriate circuit board. The same gas model sensor (like 4-SO2-2000) can be replaced on these boards and recalibrated when a new one is required. But the different gas types should not be interchanged on the circuit (example: do not interchange 4-SO2-2000 with 4-NO2-2000 boards). Therefore you should purchase dedicated circuit per sensor model.

4. Can I purchase an SS PCB without a matching sensor?

We offer the SS PCB calibrated individually with our gas sensors. This ensures that the correct circuit board and adjustments are provided for the sensor type. We issue a calibration certificate and warranty for a sensor combined with SS PCB. We can offer SS PCB board only but unfortunately we would not be able to include a warranty in this case without accompanying sensor.

5. How do we connect the board?

You will need to provide a power supply and wiring connections for the SS PCB. This will power up with 5Vdc as standard and a battery supply can be used.

3.3Vdc is also an option for power supply but if you are supplying lower power than 5Vdc, please let us know on your order.

You can use unbiased sensors on the standard model of SS PCB with a supply voltage of either 5V or 3.3V, like SO2, H2S, CO, NH3 and VOC. There is no problem here. These sensors have no bias potential and are calibrated with output signal at 3V for the requested measurement range.

But sensors like O2, NO, NO2, ETO, THT and HCl have bias potential or negative polarity requirements. For these sensor types, you need to use 5V power supply as standard. Otherwise a different board needs to be supplied that can specifically run on power supply of 3.3V or other. Here a modified board needs to be supplied, so we will need to know in writing on your purchase order that you are supplying a lower power of 3.3V or other.

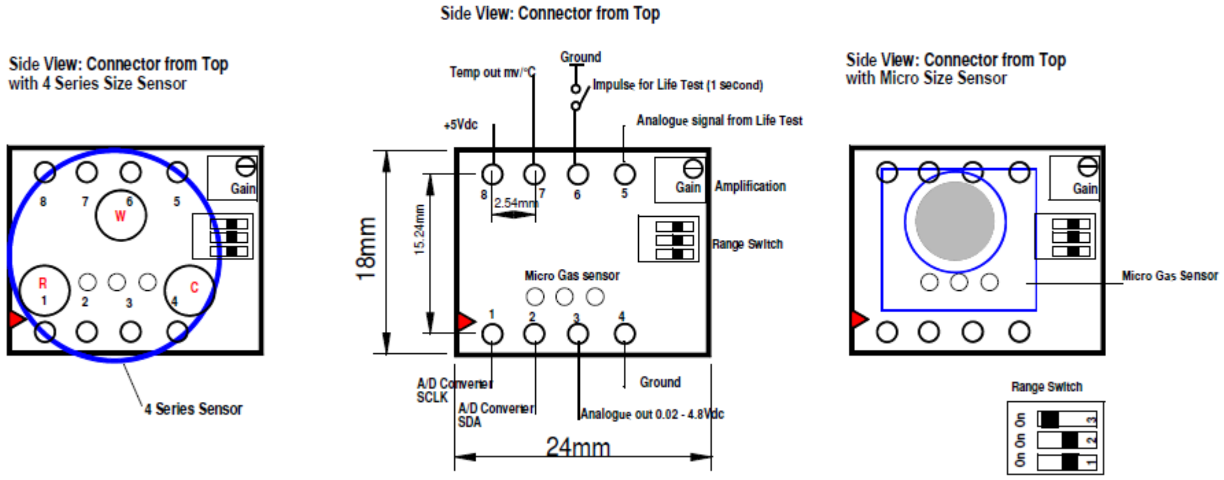
6. What are the dimensions and PIN connections of the SS PCB?

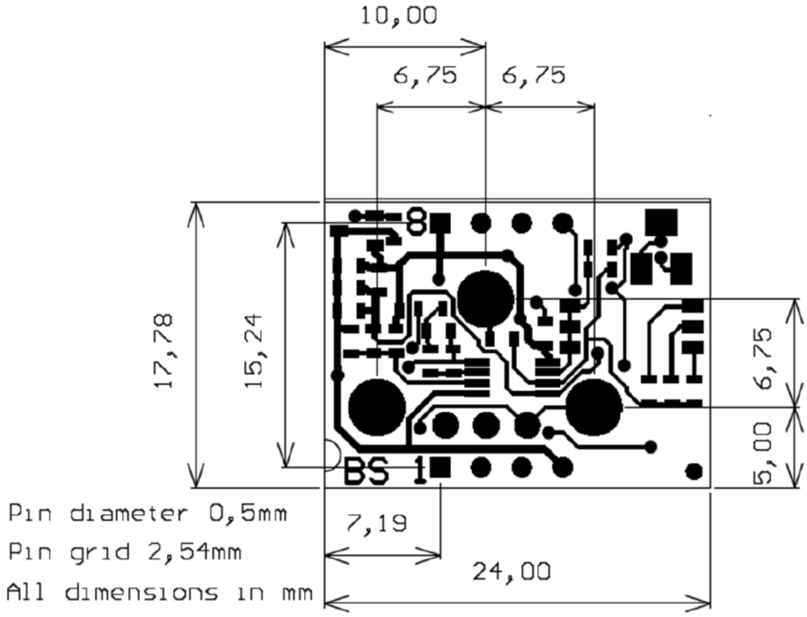
Pin 1 = A /D Converter SCLK   Pin 2 = A/D Converter SDA   Pin 3 = Analogue signal 0.02 - 4.8 Vdc

Pin 4 = Ground   Pin 5 = Life Test Signal   Pin 6 = Start pulse for Life Test

Pin 7 = Temperature output 0.1-1750mVdc   Pin 8 = Input Voltage +5.0Vdc recommended (3.3Vdc on request)

Pin Spacing: 2.54 mm





7. What if a higher power supply is used than recommended?

Take care! If the electronics are supplied with more than the recommended 5 volts dc, the electronics can be destroyed.

8. What output is provided by SS PCB?

The board gives you options of both direct voltage or i2C output, which you must convert downstream to equivalent ppm reading of gas.

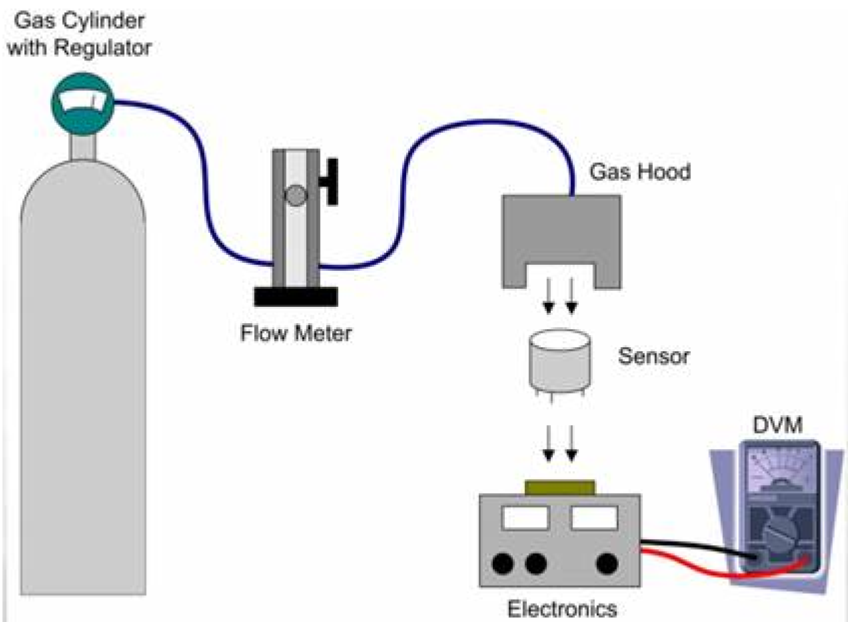
Voltage: If using simple voltage output, you could wire to a volt meter and read off the raw values in voltage and convert manually to equivalent ppm. For example, if you are measuring 0-100ppm of Carbon Monoxide (CO):
0.02Vdc = zero gas concentration
3.00Vdc = 100ppm CO corresponds to 3Vdc as the required full measuring range
3V / 100ppm = 0.03V per ppm

9. How do we convert the raw readings out from the SS PCB into meaningful gas range?

Voltage Output

If using simple voltage output, wire to a volt meter and read off the raw values in voltage. Then convert manually to equivalent ppm: 0.02V = zero gas concentration; 100ppm CO corresponds to 3Vdc as the required full measuring range (3V / 100ppm = 0.03V per ppm).

If you are testing with specific test gas, a set up could look like, for example:



Digital Output

If you are using the digital i2c, the SS PCB features an MCP3221 I2C Microchip and the relevant part number is MCP3221AOT-E/OT. The Address Option is '000', SOT-23-5. The individual address out for the i2c will be listed on your order and certificate.

Further current/details of the chip are included in the datasheet "SS PCB DIGITAL CONVERTER OPTION.PDF". The datasheet chapter 5, page 15-17, describes the functions of R and W.

Using 0-100ppm CO as example gas range:

The Analogue output signal of SS PCB is 0.02 to 4.8V with a 5V supply Voltage and 0.02V to 3.2V with 3.3V supply Voltage. The Analogue output is measurable at Pin 3.

So the maximum Output signal is always a little bit less than the supply voltage. Please see datasheet for more information. The device operation is described in chapter 4.0 of the MCP3221 datasheet with the information of characteristic and working of the ADC3221.

The Input of the ADC is according to the supply Voltage.

The solution of the 12 bit is 4096 steps. By supplying with 3.3V or 5V, the voltage per step is dependent upon the supply Voltage. This needs to be considered in your programming.

The ADC is always reading 0.02V as minimum signal. 0ppm is 0.02V and 100ppm is 3V, no matter whether you have the 3.3V or 5V Power supply.

There is an Offset to consider on the pcb - with Analogue output this is 0.02V. So this should also be considered when you read the Digital Signal of ADC:

If the ADC is supplied with 5.0V

The maximum Input signal for the ADC is 5.0V
So 12 bit are 4096 steps
Resolution Voltage per step = 5.0V/4096 = 0.001220703V/step
Offset = 0.02V/0.001220703V/step= 16.4 steps.
Analogue signal for 100ppm = 3V = 2457 steps.
100ppm/2457steps = 0.04070004 ppm/step
16.4 * 0.0407004ppm/step = 0.67ppm
Your digital measurement range is from 16 to 4096.

But the maximum Analogue output signal of the Amplifier is 4.989V when the amplifier is oversteered. This is also the maximum Input signal for the ADC Converter.

For normal measuring, use the span from 17 to 4014 steps.

ADC	Voltage	PPM
17	0.02V	0ppm
Y = 2457	X = 3.00V	100ppm
4014	4.90V	Z = 163ppm

equation y= x / (5.0V/4096 = 0.001220703V/step)
equation z= 4014 * (100ppm/2457steps = 0.04070004 ppm/step)

ie. The ADC is 0.02V as the minimum signal. When the board is turned on, a ground voltage of 0.02Vdc should be present.

0ppm is 0.02V, 17 steps (5V supply voltage)
3V are 2457 steps
0.02V are 17 steps
100ppm / (2457-17) = 0.04ppm per Step

X = value of output reading in steps
Y = full ppm range value of calibrated transmitter

$$\frac{X - 17}{2457 - 17} \times \text{Y is 100ppm} = \text{Z (actual ppm reading)}$$

If the ADC is supplied with 3.3V

The maximum Input signal for the ADC is 3.3V
So 12 bit are 4096 steps
Resolution Voltage per step = 3.3V/4096 = 0.000805664V/step
Offset = 0.02V/0.000805664V/step= 24.8 steps.
Analogue signal for 100ppm = 3V = 3723 steps.
100ppm/3723steps = 0.026860059 ppm/step
24.8 * 0.026860059ppm/step = 0.67ppm
Your digital measurement range is from 24 to 4096ppm.

The maximum Analogue output signal of the Amplifier is 3.25V when the amplifier is oversteered. This is also the maximum Input signal for the ADC Converter.
But the solution of 12bits is calculated for 3.3V supply voltage.

For normal measuring, use the span from 25 to 3971 steps.

ADC	Voltage	PPM
25	0.02V	0ppm
Y = 3723	X = 3.00V	100ppm
3971	3.20V	106ppm

equation y= x / (3.3V/4096 = 0.000805664V/step)
equation z= 3971 * (100ppm/3723steps = 0.026860059ppm/step)

ie. The ADC is 0.02V as the minimum signal. When the board is turned on, a ground voltage of 0.02Vdc should be present.

0ppm is 0.02V, 25 steps (3.3V supply voltage)
3V are 3723 steps
0.02V are 25 steps
100ppm / (3723-25) = 0.02ppm per Step

X = value of output reading in steps

Y = full ppm range value of calibrated transmitter

$$\frac{X - 25}{3723 - 25} \quad x \quad Y \text{ is } 100\text{ppm} \quad = \quad Z \text{ (actual ppm reading)}$$

Please Note:

The equations are calculated for 'ideal' conditions without any type of environmental influence. In practice, there will always be some environmental influence and tolerance to consider. The supply voltage of the pcb is also dependent upon the voltage regulator in use. The pcb does not have its own voltage regulator. Voltage regulators have some small tolerances and may affect the voltage per step.

10. How do we convert the raw readings out from 0-30% Volume Oxygen O2 SS PCB into meaningful gas range?

Please note: O2 SS PCBs require a specific model version subject to the power supply. As standard, the O2 SS PCB will be supplied suitable for standard 5.0V power supply. If a lower power supply will be used by the customer, please confirm in writing on your purchase order so that the suitable model can be supplied for lower power supply, for example 3.3V.

0-30% Volume O2 - Voltage Output

The SS PCB is precalibrated correctly with individual O2 sensor to give you a raw data output that you can use to measure the gas.

If using simple voltage output, wire to a volt meter and read off the raw values in voltage - then convert manually to equivalent ppm: 0.02V = zero gas concentration; 30% vol O2 corresponds to 3Vdc as the required full measuring range (3V / 300000ppm = 0.00001V per ppm). 20.9% vol O2 corresponds to 2.09Vdc.

0-30% Volume O2 - Digital Output

If you are using the digital i2c, the SS PCB features an MCP3221 I2C Microchip and the relevant part number is MCP3221AOT-E/OT.

The Address is 0x48.

Further current/details of the chip are included in the attached datasheet (SS PCB DIGITAL CONVERTER OPTION.PDF). The datasheet chapter 5, page 15-17, describes the functions of R and W.

The Input of the ADC is according to the supply Voltage.

The solution of the 12 bit is 4096 steps. The ADC is always reading 0.02V as minimum signal.

0ppm is 0.02V and 30% vol O2 is 3V.

There is an Offset to consider on the pcb - with Analogue output this is 0.02V. So this should also be considered when you read the Digital Signal of ADC.

If the ADC is supplied with 5.0V

The maximum Input signal for the ADC is 5.0V
So 12 bit are 4096 steps
Resolution Voltage per step = 5.0V/4096 = 0.001220703V/step
Offset = 0.02V/0.001220703V/step= 16.4 steps.
Analogue signal for 20,9%vol is 209000ppm = 2.09V = 1712 steps.
209000ppm/1712 steps = 122.07 ppm/step

The maximum measurement range for O2 Analogue signal
Analogue signal for 30% = 300000ppm = 3.0V = 2458 steps

ADC	Voltage	%
17	0.02V	0%
Y = 1712	X = 2.09V	20.9%
2458	3.0V	Z = 30%

equation y= x / (5.0V/4096 = 0.001220703V/step)
equation z= 2458 * (209000ppm/1712 steps = 122.07 ppm/step)

If the ADC is supplied with 3.3V

The maximum Input signal for the ADC is 3.3V
So 12 bit are 4096 steps
Resolution Voltage per step = 3.3V/4096 = 0.000805664V/step
Offset = 0.02V/0.000805664V/step= 25 steps.
Analogue signal for 20,9%vol is 209000ppm = 2.09V = 2594 steps.
209000ppm/2594steps = 80.57 ppm/step

The maximum measurement range for O2 Analogue signal
Analogue signal for 30% = 30000ppm = 3,0V = 3723steps

ADC	Voltage	%
25	0.02V	0
2594	2.09V	20.9%
3723	3.0V	30%

20,9% = 2,09/(3,3/4096) = 2594 steps
30% = 3,0/(3.3/4096) = 3723 steps

11. How do we convert the raw readings out from 0-25% Volume Oxygen O2 SS PCB into meaningful gas range?

Please note: O2 SS PCBs require a specific model version subject to the power supply. As standard, the O2 SS PCB will be supplied suitable for standard 5.0V power supply. If a lower power supply will be used by the customer, please confirm in writing on your purchase order so that the suitable model can be supplied for lower power supply, for example 3.3V.

0-25% Volume O2 - Voltage Output

If using simple voltage output, wire to a volt meter and read off the raw values in voltage - then convert manually to equivalent ppm: 0.02V = zero gas concentration; 25% vol O2 corresponds to 2.5Vdc as the required full measuring range (2.5V / 25% = 0.1V per %). 20.9% vol O2 corresponds to 2.09Vdc.

0-25% Volume O2 - Digital Output

If you are using the digital i2c, the SS PCB features an MCP3221 I2C Microchip and the relevant part number is MCP3221AOT-E/OT.

The Address is 0x48.

Further current/details of the chip are included in the attached datasheet (SS PCB DIGITAL CONVERTER OPTION.PDF). The datasheet chapter 5, page 15-17, describes the functions of R and W.

The Input of the ADC is according to the supply Voltage.

The solution of the 12 bit is 4096 steps. The ADC is always reading 0.02V as minimum signal. So this should be considered when you read the Digital Signal of ADC.

0% is 0.02V and 25% vol O2 is 2.5V :

If the ADC is supplied with 5.0V

The maximum Input signal for the ADC is 5.0V
So 12 bit are 4096 steps
Resolution Voltage per step = 5.0V/4096 = 0.001220703V/step
Offset = 0.02V/0.001220703V/step= 16.4 steps.
Analogue signal for 20.9%vol is 209000ppm = 2.09V = 1712 steps.
209000ppm/1712 steps = 122.07 ppm/step

The maximum measurement range for O2 Analogue signal
Analogue signal for 25% = 250000ppm = 2.5V = 2048 steps

20.9% = 2.09V / (5/4096) = 1712 steps
25% = 2.5V / (5/4096) = 2048 steps

ADC	**Voltage**	**%**
17	0.02V	0%
Y = 1712	X = 2.09V	20.9%
2048	2.5V	Z = 25%

equation y = x / (5.0V/4096 = 0.001220703V/step)
equation z = 2048 * (209000ppm/1712 steps = 122.07 ppm/step)

If the ADC is supplied with 3.3V

The maximum Input signal for the ADC is 3.3V
So 12 bit are 4096 steps
Resolution Voltage per step = 3.3V/4096 = 0.000805664V/step
Offset = 0.02V/0.000805664V/step= 25 steps.
Analogue signal for 20,9%vol is 209000ppm = 2.09V = 2594 steps.
209000ppm/2594steps = 80.57 ppm/step

The maximum measurement range for O2 Analogue signal
Analogue signal for 25% = 250000ppm = 2,5V = 3103steps

ADC	**Voltage**	**%**
25	0.02V	0
2594	2.09V	20.9%
3103	2.5V	25%

12. What will happen if the SS PCB sees gas at a higher range then its calibrated range?

The board can only read out to its maximum limit and no further. The sensor produces a current in proportional relation to the gas concentration. The electronics limit the desired measuring range. If there is a higher gas concentration present, this cannot be displayed by the electronics. However, this will not be detrimental to the board and the sensor will be able to cope with gas concentrations up to its over-range, as stated in the sensor datasheet.

13. What is the Life Test function?

The life test signal is triggered by the operator. The signal is generated by a switching function at pin 6. The function is switched by a processor or a potential free contact to ground. The switching state is held for 1 second. During this time, a small voltage signal is supplied with a few mV to the sensor. The voltage is conducted internally to the sensor, which triggers a current signal on the sensor. The current signal simulates a stream of gas in the sensor. If the sensor is in good condition, the signal will be repeated.

With increasing age, the signal becomes smaller until it is so small, a recalibration of the sensor is no longer possible. At this point, the sensor must be replaced. A defect between the sensor electrodes can be immediately detected in this way, as the sensor signal is no longer present. The sensor output current generated through the operational amplifier at Pin 5 gives the voltage signal, which can be used to determine and evaluate the sensor. Normally, this signal is fed back to a processor. Corresponding software must be written by the operator and often, the operator will install a manual button type function in the final equipment to activate this test. The voltage signal generated can be measured with a multimeter.

For Life test, the analogue output signal is approximately equal to the voltage of the normal analogue signal. The signal is measured once from the new sensor and stored in the software. It serves as a reference signal. When new measurements are made in the life test later on, you can see the signal difference in the signal amplitude. If the sequence signal is less than the first signal, the sensor has deteriorated. When a sensor has lost sensitivity, the board should be recalibrated or the sensor replaced. If the measurement signal is less than 20% of the first signal, the board should be recalibrated in first instance. Or if not possible or signal is less, the sensor should be replaced, particularly in the case of life safety applications. Another indicator is that, when the sensor signal is so weak, it will no longer exceed the alarm level. That's why both analogue signals are measured.

Please note: The Life Test is not suitable for O2 sensors

Life test for O2 sensors is not possible because this sensor is operated with a bias voltage of 400-600 mV. Without the bias, the sensor does not work. If a test voltage is applied to this constant bias, the sensor stops working!

14. How can the Life Test function be used?

For Life Test, you will need to switch the pin 6 with a pulse to Ground. This can be done with a switch, a small signal relay or a Mosfet (BSS 138). The switching pulse should be not longer than 1s. (Please kindly note that life test cannot be used for O2 sensor.)

When the life test button is pressed, we apply a voltage of 50mV to the sensor. This has the effect that the sensor believes it is receiving a gas signal. The applied voltage is held for a second. Either it is triggered by a manual button function, or the signal comes from a processor. The signal amplitude is always the same (50 mV).

The function is not temperature-compensated. The sensor will therefore regenerate a different current with increasing temperature. It is due to its sensitivity with increasing temperature, which then increases. If the sensor is temperature compensated, the sensitivity will be approximately proportional to the current signal. This also applies to the life test, which then has a constant signal.

The life test is provided to check that the sensor is in good working order from time to time, as to whether its sensitivity lags. If the sensitivity decreases, this is a sign that the sensor has aged. With the Life Test, an error can also be detected at the electrodes. The fault may be: No reference electrode or harmful electrodes.

15. When using the Life Test function, we can see the voltage rise on the life test pin and then fall again. Should we be using the highest reading as the value of that test?

In the life test, please use only 80% of the amplitude value in the calculation.

16. What happens if the Life Test function is run too frequently?

An electrochemical sensor has a strong capacitive behaviour due to its structure. This means that in the application of the life test, the sensor is charged each time.

The discharge curve shows the behaviour of the sensor in discharge. If the sensor is triggered with a charge voltage in very short time intervals, the sensor is overcharged. The result is that the sensor takes an extremely long time to recover.

It's like walking slowly and then extremely fast. If you do this lots of times in short intervals, you will soon become out of breath and will need to take a break! This is how the sensor feels and it may take hours for the sensor to work again!

In general, the life test should only be carried out once a day as maximum to check functionality. But really a life test is carried out far less frequently.

17. How to test if the SS PCB or the sensor is defective?

When the SS PCB board is turned on, a ground voltage of about 0.02Vdc should be present. This indicates that the board is working ok! If the base voltage is not 0.02 volts, the board may be defective. Defects may occur for different reasons, as example: due to being fed a power supply of more than the recommended 5Vdc; corrosion due to environmental conditions; application wear and tear; etc.

To test whether a sensor is working on the board, it is easy to make the life test. A voltage signal must be present at the analogue output. Digitally, the signal is to be detected proportionally. If no signal is present, the sensor is defective.

Power the SS PCB. Connect a Voltmeter to the Life test output and close the Life test button for 1 second. If no button is present, simply contact a wire from the Life test terminal. 1 second and a voltage signal can be seen at the analogue output. If there is no signal, the sensor is defective.

18. How do I use the Temperature output pin?

Electrochemical sensors are subject to environmental fluctuations and temperature curve data is listed in the individual sensor sheets.

The sensor/board is not temperature compensated but a temperature output on the board is present at pin 7. The temperature range at output pin 7 is -40°C to 125°C. This corresponds to a voltage of 100 mV for -40°C to 1750mV for 125°C. Any change in temperature and humidity plays a role in the measurement process. Rapid changes in temperature lead to an altered sensitivity. The task of development of more precise measuring equipment (rather than simple gas response monitoring for life safety) is to realise the compensation needed for temperature in downstream processing.

19. Which output on the SS PCB is better - Voltage or i2C?

The analogue measurement signal is available in very high accuracy. Of course, the A / D converter is more accurate in its resolution but only because most voltmeters cannot measure 4 digits behind the comma.

The analogue signal is proportional to the measured gas signal. Advantage: It is immediately measurable and can be converted directly into ppm according to the calibration.

Here, the offset of the no-load voltage (0.02Vdc) must be taken into account in the conversion.

20. Can both Voltage and i2C output pins be used simultaneously?

Yes, it is possible to read the measured values from the analogue output as well as from the I²C bus at the same time.

21. I am reading a different offset than stated in the datasheet - is this a problem?

This is OK! You may have a lower offset than stated on the datasheet. For some sensors, because of the batch current generated, production may use a lower pin amp on the circuit which gives the lower offset. So your value can be taken correctly as your standard offset at zero.

Where we have to work with a very high amplification factor because the current generated by the sensor is very small, we have to use a slightly higher offset, for example 0.07 offset voltage.

Each developer then calculates the resolution on the basis of the data sheet for the A / D converter and then integrates the zero and offset in their device.

22. The signal out is oscillating - is this normal?

When you first turn on the product, the signal out may oscillate. This is because sensors need a warm up time when first powered before the signal settles and the product is ready to go. Please check under your application conditions to establish any warm up time needed.

If you are measuring gas concentrations in the open atmosphere, these can be unstable and reach the sensor in very different concentrations. Ambient air has many basic loads and air movement to consider.

Also to consider is that ambient air has many basic loads so that a measuring signal is already present. This is particularly true for such gases as CO, as it is always there. A sensor reading can oscillate due to the environmental load. Electrochemical sensors are subject to environmental fluctuations too like temperature.

If you are running specific testing, check that your testing equipment and sensors have clean air flushed through before running further tests, otherwise there may be residual gas in the equipment or sensors.

In the case where you are working with a very small range sensor, for example of 0-1ppm, such a small measuring range requires a very high gain because the sensor does not deliver a very large current. Here it is extremely important not to use a frequency clocked power supply. The clock frequency fades through to the sensor. A frequency-free power supply unit must always be connected here. (Series regulator circuit, extremely low noise.) This is necessary to work with such a circuit.

23. We notice that every now and then, there is a spike in output. Why is this?

If you see a sudden spike in the readings, then this could be due to high frequency signal in close proximity.

Please also take care if you are running measurement intervals very close to each other. An electrochemical sensor is very capacitive in its internal function. The sensor charges itself from the transmitter energy (short high amplitude) and then discharges again. If the sensor is triggered too frequently, it may sometimes cause as transient spike in readings.

Another possible cause could be power supply. If a frequency-switched power supply is used, signal drops can occur. Then, as the rest of the circuit draws current once a second, the sensor may be under-powered for a few milliseconds. The high data cycles generate instability in the sensor signal. Reason: the sensor is reloaded again and again and finds no operating point. The sensor should be supplied separately with a series regulator in this case.

24. The output is lower than expected?

If you are measuring gas concentrations in the open atmosphere, these can be unstable and reach the sensor in very different concentrations. Ambient air has many basic loads and air movement to consider.

Factors that may affect measurement response include: the use of good quality PTFE tubing and kit (for example, NO or NO2 is a reactive gas so will adsorb on many surfaces); using different flow and pressure rates; placing extra diffusion barriers in front of the sensor e.g. flame arrestors or ptfe membranes, especially if this creates a large dead space before the sensor; cross-sensitivities, environmental effects, etc. As example:

1. Flow rate. Recommended gas flow rate is 400~500 ml/min. Low flow rate could result in low response amplitude.
2. Good gas quality. Example, if the concentration of gas is smaller than 5ppm, or the gas mixture has interfering gases, such as H2S, SO2 or Cl2, the sensor could have low output.
3. Absorption of gas on the testing accessories and equipment.
4. Placing extra diffusion barriers in front of the sensor e.g. arrestors or membranes, especially if this creates a dead volume space before the sensor.

25. The response is slower than expected with micro sensors?

The start up time for the solid state sensors in ambient conditions is below 10 seconds. But these solid state sensors do react differently than standard electrochemical sensors that have a liquid electrolyte. When solid state sensors are in 'dry' air, they respond slower than when they are measuring in 'ambient' conditions, where they will have absorbed some atmospheric moisture.

Where the micro sensors are operated in only dry compressed air (oil-free!) or dry calibration gas, the response may become slower after some period of time - but will recover under ambient conditions. Typically the higher range sensors are more robust. Short operation under dry conditions is ok, for example where you are calibrating with cylinder gas. However, extended exposure to dry conditions - for a week or more - will affect the response time of a solid state sensor.

So firstly, if you used the sensors directly after receiving them, the sensors will have been packaged so that minimal or no air penetrates. The sensors might have been completely dry and the electrolyte therefore could not function properly. This probably explains the long-running phase of the sensors initially. After unpacking, these sensors need to be left in atmosphere to absorb moisture again. Then secondly, if you are using dry calibration gas for testing over longer periods, a 'waterbed' - a gas humidifier - can be used to speed up response, as per ambient conditions.

26. Which i2c addresses out are available?

The address for each SS PCB board is a preset at manufacturing from one of 7 choices. Standard addresses by gas type are:

CO	0x48
NO	0x49
NO2	0x4A
H2S	0x4C
H2	0x4D
O2	0x48
SO2	0x4E
NH3	0x4F

Or you can select an address out for each board from one of: 0x48, 0x49, 0x4A, 0x4C, 0x4D, 0x4E or 0x4F. You could either select a different address for each gas type or you can choose a different address for each point in your gas detection system for each location.

O2 is preset at 0x48 and cannot be changed.

27. Can an i2c address be changed?

The address for each board is a preset at manufacturing and cannot be altered, unfortunately. Please advise prior to ordering if you have a special requirement.

28. We have more than 7 detection points in our system? How can we have more addresses?

We can only assign up to 7 addresses. For more addresses, a second processor must be used. There are ways to allocate up to 127 addresses with efforts by a specialist software engineer at the client's side.

29. What is the power consumption of SS PCB?

The board has a typical current consumption of 0.8 mA. The SS PCB draws approx. 900uA current at 5V = 450uW. Then it will depend on the individual mounted sensor and the gas draw. The gas load current draw will vary according to gas level charged to the sensor.

For example, if calibrated with an O2 sensor with 100uA to 4Vdc, then the sensor + electronics have a power consumption of 1.8 mA.

30. Can the SS PCB output pins be soldered?

The 8 output pins of the SS PCB may be soldered with care or you can use pin connectors as below.

Please note: whilst the SS PCB pins may be soldered with care, the individual sensor components featured should not be soldered or glued as it will invalidate any warranty, and this could easily damage the sensor or SS PCB board.

31. What pin connectors should be used?

On the connectors for SS PCBs, we recommend Samtec socket strips - please ask for details via document "*Connectors for SS PCBS.pdf*". Or go to:
http://www.fischerelektronik.de/web_fischer/en_GB/connectors/G02/Female%20headers/PR/MK_01_/index.xhtml

The distance between the two contact rows must have 15.24mm.

32. What is the maximum cable length?

The I2C Bus is a bus for use on a PC Board. The maximum bus length should not be longer than 30 cm.

33. Are there pull up resistors on the SS PCB?

No, there are no pull ups resistors on the board.

Pull ups are needed for the clock and the data line. The value of the pull ups depends on I2C Bus clock frequency. For further information, please see the MCP 3221 Datasheet, chapter 6.2.

34. What are the details of the i2c chip and is there a library file for the i2c?

The board features an MCP3221 I2C Microchip and the relevant part number is MCP3221AOT-E/OT. The Address Option is '000', SOT-23-5. Further current/details of the chip are included in the datasheet: *SS PCB DIGITAL CONVERTER OPTION.PDF*.

The datasheet chapter 5, page 15-17, describes the functions of R and W.

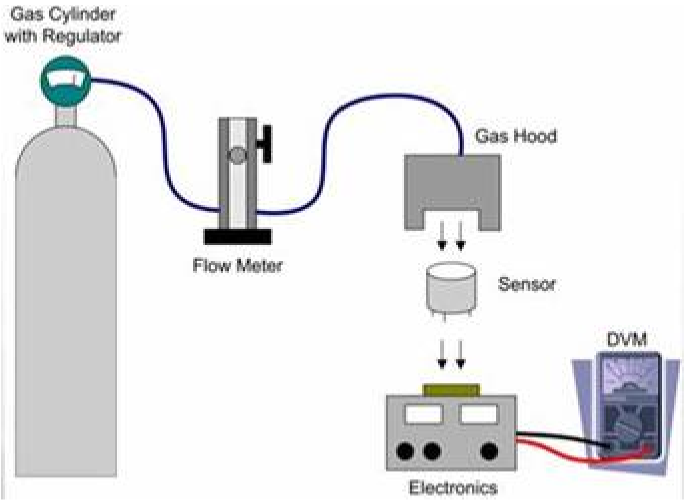
Sorry, we don't have any library file for the MCP 3221 AD Converter. The files for the I2C Communication of the MCP 3221 depend on the microprocessor used and the program language. The MCP3221 I2C Microchip provides i2c comms conversion from voltage. The developer implements the controls with their software for the data queries.

35. When and how do we calibrate the SS PCB?

All sensors with SS PCBs are precalibrated and issued with calibration certificates with your order.

Calibration intervals depend on the use of your systems. A yearly interval is good practice. Where systems are used for life critical applications, a more regular calibration programme would be recommended, for example every six months, alongside additional bump tests to ensure general functionality.

Calibration is recommended with certified gas mixtures in non-refillable small cylinders, for example:
- 110L cylinder of synthetic air (zero grade air)
- 110L half range to full range of target gas in balance gas nitrogen or air
- Constant flow regulator 0.5l/min or 1.0l/min
- Example calibration set-up:



Adjustment can be made on the electronic circuit board via trim potentiometer - please refer to SS PCB datasheet. If changing the gain, adjust the potentiometer slowly and carefully. After adjustment, allow a warm-up time until the new signal has stabilised.

To obtain higher accuracy for any calibration, please consider to keep ambient temperature in a range of 20±10°C (due to temperature dependency of sensors) and that the ambient air is completely free of target gas.

36. My question is not listed here!

Please feel free to contact us with your query by emailing: info@euro-gasman.com

37. Additional Notes

Sensors are designed to operate in a wide range of harsh environments and conditions. However, it is important to avoid exposure to high concentrations of solvent during storage, fitting into instrumentation and operation.

By the nature of the technology used, any sensor can potentially fail to meet specification without warning. Euro-Gas makes every effort to ensure reliability of all sensors but where life safety is a performance requirement of the product and, where practical, Euro-Gas recommends that all gas sensors and instruments using sensors are checked for response to gas before use.

The data contained in this document is believed to be accurate and reliable. The data given is for guidance only. Euro-Gas Management Services Ltd accepts no liability for any consequential losses, injury or damage resulting from the use of this document or the information contained in it. Customers should test the sensors under their own conditions to ensure that the sensors are suitable for their own requirements and in accordance with the plans and circumstances of the specific project and any standards/regulations pertaining to the country in which the sensors will be utilised. Performance characteristics on individual data sheets outline the performance of newly supplied sensors. Output signal can drift below the lower limit over time. Any stated warranty terms are null and void if the products are used under conditions other than those specified in the corresponding product technical datasheets.

This document is not intended to form the basis of a contract and in the interest of product improvement, Euro-Gas reserves the right to alter any sensor design features and specifications without notice. 03/20