

Product data sheet: carbon monoxide sensor

Range	0 - 500
Overload	500 ppm
Filtering	Carbon
Expected life	5 years in non-corrosive atmosphere
Output signal	Typically 35 nA/ ppm (2 mm aperture)
Temperature range	-20 to +50C (75C version under development)
Pressure range	Withstands 10 atmospheres pressure
Pressure coefficient	TBA
T90 response time	60 seconds at 20°C
Relative humidity range	15% - 90% non-condensing
Typical baseline offset (20°C)	1 ppm CO equivalent
Typical baseline offset (40°C)	4 ppm CO equivalent
Typical long term output drift	< 10% per year, < 25% over 5 years
Interfacing requirements	Refer to datasheet
Repeatability	< +/- 2%
Output linearity	Linear to 500 ppm
Temperature coefficient of response	Refer to graph
Position sensitivity	None
Storage life	Two years at 20°C
Warranty	Two years in non-corrosive atmosphere
Weight	10g
Dimensions	40mm x 35mm x 9.5mm

CROSS SENSITIVITY DATA (duration of exposure 30 minutes)		
Chemical	Exposure	CO equivalent
Isopropanol	100ppm	4
H ₂	100ppm	75
H ₂ S	50ppm	10
SO ₂	100 ppm	1

Gases and vapours to which the sensor is not inherently sensitive include: saturated and aromatic hydrocarbons, acetone, ammonia, nitrogen, oxygen, chlorine, water vapour, and carbon dioxide.



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Introduction

The Dart sensor for carbon monoxide (CO) is simple design aimed at giving adequate performance at low cost. It is of the fuel cell (two electrode) electrochemical type, and is suitable for most ambient (-20°C to +50°C) uses. It has a unique combination of six desirable design and performance features which no competing product can offer.

Low cost

Simple design, ease of construction and few parts enable competitive pricing.

Long life

It uses well-established components from breath alcohol sensors whose accuracy, stability and durability have been demonstrated world-wide in almost 30 years of experience.

Stability

Exceptional stability allows very long intervals between calibration checks (see 5 year data below).

Low power requirement

Using the fuel cell principle it needs no power, electricity being consumed only in signal processing and display, so a compact unit using small batteries is possible.

Good low temperature kinetics

Having the benefit of our proprietary high activity platinum catalyst, it gives a sustained response at sub-zero temperatures (see data below), and hence a low temperature coefficient across a wide temperature range.

Withstands high pressures

Being of membrane-less construction, it contains no fragile components to rupture under wide pressure swings, and it has been shown to withstand ten atmospheres pressure.

How it works

The sensor chamber contains a conventional two-electrode fuel cell sensor. The working electrode oxidises carbon monoxide to carbon dioxide liberating two electrons per molecule which are delivered via the external circuit to the counter electrode, where they are consumed by the reduction of oxygen. The circuit is completed by ion flow within the electrolyte. A carbon filter enables the sensor to be adequately specific to carbon monoxide for many applications.

Careful design enables the ebb and flow of the electrolyte, which expands and contracts with changes in ambient temperature and humidity, to take place without affecting the calibration.

Interfacing the Dart CO sensor

The Dart CO sensor will deliver a current with a linear relationship to atmospheric CO from zero to very high concentrations. This output will require amplification and, depending upon the accuracy required, temperature compensation.

Amplification

The preferred method of amplification is to use an operational amplifier configured as a direct current-to-voltage amplifier. This will operate the sensor in its fastest possible mode. The gain is determined by the value of the feedback resistor: with a value of 1000 ohms, a sensor output of (say) 5 microamps will appear as an amplifier output of 5 millivolts.

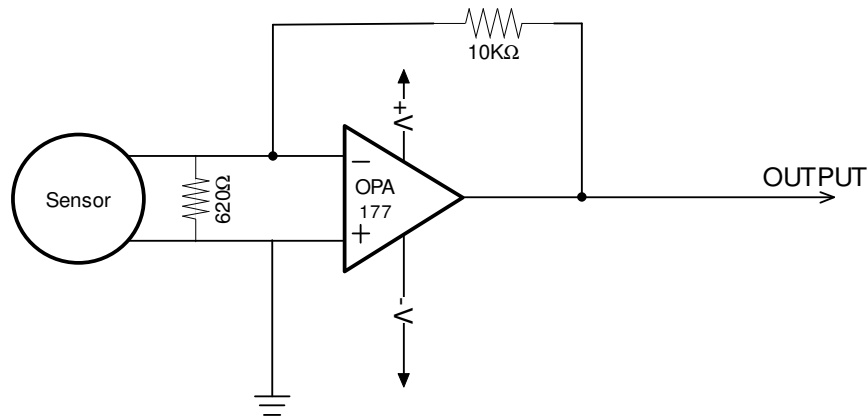
A sensor left on open circuit will gradually develop an offset. No harm will be done but it may take some time to discharge on reconnection. For this reason, the output terminals are normally short-



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circuited during storage. There should be no significant permanent offset. In use, to avoid the build-up of an offset when the amplifier is switched off, a low value resistor (typically 620 ohms) can be placed permanently across the terminals. Alternatively, a good solution is to keep the amplifier permanently powered.



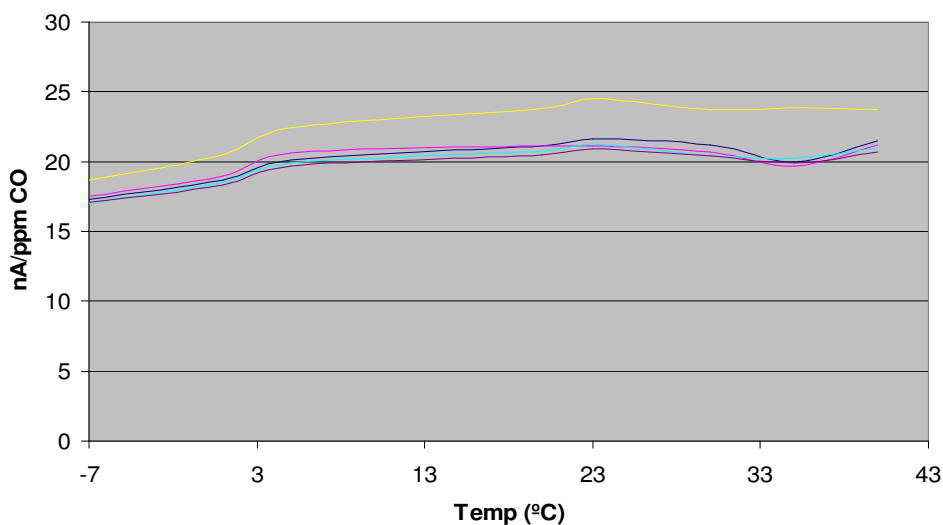
Note that this circuit uses a dual rail power supply which gives the best results. We recommend the Burr-Brown OPA177 op-amp in this and similar circuits. A good low-power alternative is the OPA 241 which is slightly noisier. Both have very low intrinsic offsets but for exceptionally sensitive work, they have the facility for incorporation of an offset trimming pot for tuning out the remainder. This will rarely be necessary as the background currents seen at 20C are around 10 nA, equivalent to about 0.5 ppm CO.

We have carried out studies on single rail supplies using dedicated op-amps such as the OP90, and recommend against their use. For 3V supplies we recommend the provision of a negative supply by means of an IC such as the ICL 7660.

Temperature compensation

The effect of temperature on response is near zero across a wide range of temperatures, but for some applications where greater accuracy is required, it will be necessary to incorporate temperature compensation to the output, which is normally addressed in instrument software.

Effect of temperature at 94ppm CO



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There is also a small temperature effect on the baseline of the sensor (the output shown when access ports are sealed) which should be allowed for in very accurate low-level CO measurement.

Effect of temperature on baseline



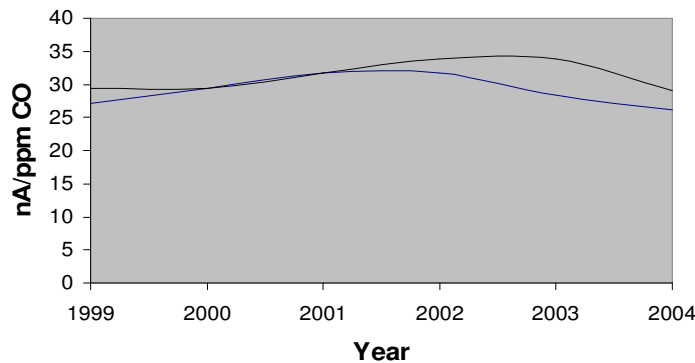
Configuration

The sensor housing is 35 mm square by 9.5 mm depth. It has four securing holes at the corners, and there is a recess on the face which will receive a 1.5 mm X 31 mm ID O-ring, to enable an airtight seal to be made to your instrument body. This will help prevent polluted air from getting behind the sensor, and subsequently re-emerging to give a false elevation of the reading.

Sensitivity and ageing

The sensitivity is determined principally by the diameter of the access aperture on the face of the sensor: the bigger the hole, the more gas can diffuse into the sensor and hence the bigger the signal. The standard arrangement has a 2mm diameter hole about 30 nA/ppm, but this can be altered to suit customer requirement (for high CO ranges, the hole diameter would be reduced and vice versa). The aperture should be chosen to give an adequate signal-to-noise ratio, but excessive amounts of gas sample should be avoided to prevent problems with non-linearity, slowness of clean-up etc. Two sensors which closely resemble the current design have been on periodical test since 1999 and their progress is shown below.

Historical data for sensitivity



Further information

Dart Sensors gives full technical support to users of its products. If you have any queries which have not been addressed above please contact us at:

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