Product data sheet: sensor for environmental alcohol vapours

Range	0-250 ppm
Overload	250 ppm
Filtering	None
Expected life	5 years in non-corrosive atmosphere
Output signal	See table below
Temperature range	-20ºC to +50ºC (+75ºC version available)
Pressure range	Withstands 10 atmospheres pressure
Pressure coefficient	TBA
T90 response time	Refer to text
Relative humidity range	15% - 90% non-condensing
Typical baseline offset (20ºC)	25 nA
Typical baseline offset (40ºC)	75 nA
Typical long term output drift	10% per year
Interfacing requirements	Refer to datasheet
Repeatability	< +/- 2%
Output linearity	Linear to 500 ppm ethanol
Temperature coefficient of response	See graph on page 4
Position sensitivity	None
Storage life	Two years at 20ºC
Warranty	Two years in non-corrosive atmosphere
Weight	10g
Dimensions	40mm x 35mm x 9.5mm

SENSITIVITY DATA (1 mm aperture)	
Chemical	**Sensitivity nA/ppm**
Methanol	20
Ethanol	15
Isopropanol	5
Carbon monoxide	10
H2	7
SO2	7
Acetaldehyde	5
Phenol	10
Dimethyl ether	Sensitive
Ethylene	Sensitive

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Introduction

The Dart sensor for environmental monitoring of alcohol vapours has been derived from the well established breath alcohol sensor. It is an electrochemical sensor and is suitable for most ambient (-20ºC to 50ºC) uses (a special formulation capable of resisting higher temperatures is also available). It has six desirable design features.

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 30 years' experience.

Fast response
A short, low-resistance diffusion pathway enables a rapid reaction time.

Low power requirement
Fuel cell principle means no power requirement, electricity being consumed only in signal processing and display, so a compact unit using small batteries is possible.

Stability
Exceptional stability allows very long intervals between calibration checks.

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 liberates electrons via the external circuit to the counter electrode, where they are consumed by the reduction of oxygen. The internal circuit is completed by ionic flow within the electrolyte.

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.

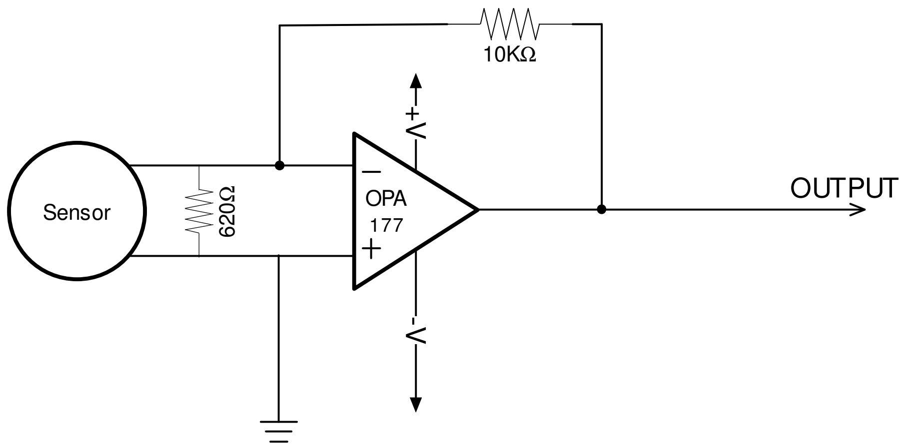
Interfacing the sensor

The Dart alcohol sensor will deliver a current with a linear relationship to alcohols concentrations in air from zero to 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-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.

A typical circuit is shown below.



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 incorporating an offset trimmer to tune out residual offset.

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 generation of a negative supply by means of an IC such as the ICL 7660.

Temperature compensation

If a high degree of accuracy is required, then a temperature-dependent compensation should be applied. Historically, in simple electrical circuits, this was achieved by incorporating a suitable thermistor with trimming series and parallel resistors in the op-amp feedback loop. If a microprocessor circuit is employed, thermistor driven compensation can be more accurately addressed in the software. A standard negative-coefficient thermistor will provide a suitable signal.

There are two components to the temperature-dependent behaviour:

1. The rate of diffusion of the gas increases with temperature.
2. Particularly at low temperatures, the efficiency of the electrocatalyst is impaired and this becomes the rate-determining factor.

In practice we find that temperature-dependent behaviour depends on the aperture size and the identity of the alcohol under consideration.

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

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 (and smallest practical aperture) is a single central hole of 1 mm diameter, but this can be altered to suit customer requirements. 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.

Response time

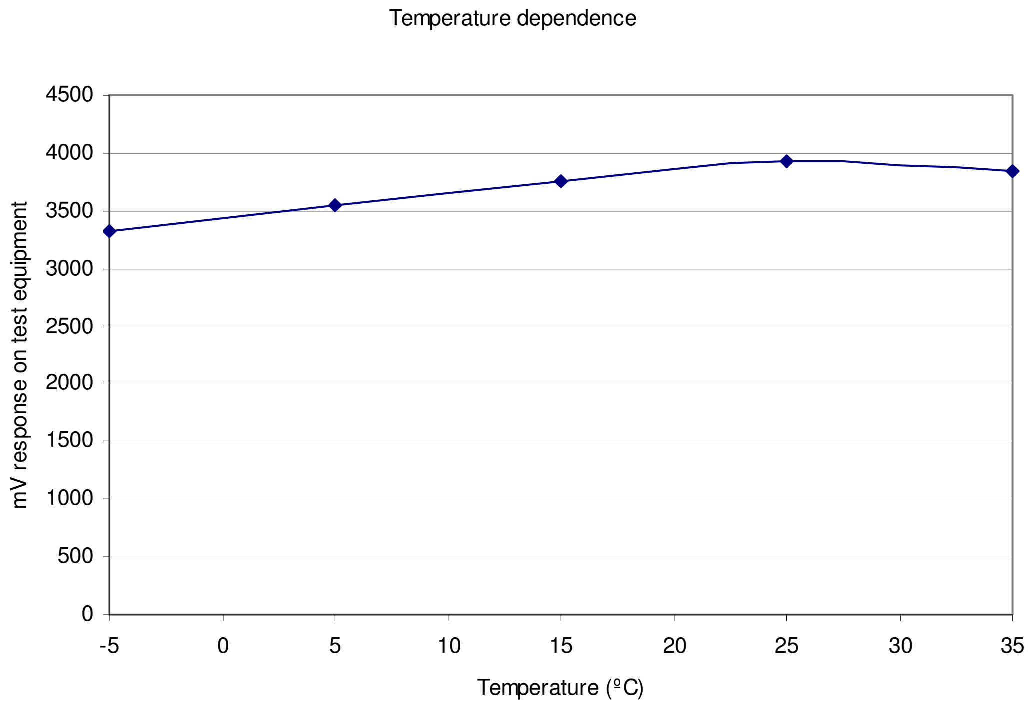
Typical T90 times for the more common alcohols at 20C are :

methanol	45 seconds
ethanol	25 seconds
isopropanol	30 seconds

Cross-sensitivities

The alcohol sensor is principally sensitive to volatile alcohols but also has some sensitivity to other gases and vapours (refer to the table on page 1). Gases and vapours to which the sensor is not inherently sensitive include: saturated and aromatic hydrocarbons such as toluene; acetone, ammonia, nitrogen, oxygen, chlorine, water vapour, and carbon dioxide.

Temperature coefficient of response



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:

customer.service@dart-sensors.com