Potentiostat Circuit for D2 Combined Co and H2S Sensor

Our D2 sensor is the world's smallest two-gas electrochemical sensor ever. This small sensor measures both CO and H_2S simultaneously. But to correctly drive and measure the output from this sensor, we offer some information and propose a circuit.

How does it work?

The D2 is effectively a combined CO-D4 and H_2S-D4 gas sensor. The working electrode is actually two working electrodes, one responding to CO, and the other responding to H_2S. Since the CO sensor will also respond to other gases including H_2S, we have included a chemical filter that scrubs out H_2S and other gases above the CO electrode. The CO and the H_2S electrodes share a common reference electrode and counter electrode.

How to drive the sensor and measure the signal?

Application Note AAN105 describes how to design an potentiostat circuit for a single gas sensor; please read this Application Note before reading this section below.

A potentiostat circuit requires one op-amp the measure the reference electrode potential, then to provide adequate current to the counter electrode to balance the working electrode's current demands. When you have two working electrodes, since you only have one reference electrode to control, you still need only one op amp to feed current to the counter electrode. However, with two working electrodes, you require two independent measuring circuits, as shown in the attached circuit diagram.

We have proposed resistor and capacitor values, which will need optimising for your instrument. Do remember these rules when choosing designing your circuit:

1. The circuit shows two resistors and one capacitor for stabilising the IC2 output to the counter electrode. You can use only one resistor, but we have found better stability with the design shown.
2. Two FETS will be needed to short the working electrodes to the reference electrode. See AAN 105 for notes on implementing a shorting FET when the instrument is powered down.
3. We specify a 10 ohm load resistor for each of the working electrodes. You should increase this value if noise is a problem; however, this will slow the response time of the sensor.
4. Remember that the op amps must be allowed to swing both positive and negative. We have shown the ideal supply design for IC2, and the same power supply is used for IC1 and IC3. Alternative single-ended supply is possible, but then the op amps must be positively biased on the + input to allow the – input to go slightly negative for IC1 and IC3, and to go up to 0.5V negative on IC2.

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Circuit layout

The hidden problem with a dual potentiostat circuit is coupling between the two measuring circuits. You must try out your circuit before committing the PCB to volume manufacturing. Although both measuring circuits may behave well in zero or low gas concentrations, DO test the circuit at high gas concentrations; for example, apply 500 or 1000ppm CO and then watch for noise on the H_2S measuring circuit, or apply 50 ppm H_2S and monitor the CO sensor for noise. If you see the noise on a channel increasing with increased gas concentration, then you have coupling and the measuring circuit tracks must be either better isolated or screened.

If you have further problems or questions, then contact us at: tech@alphasense.com or sensors@alphasense.com