

SPEC Sensor™ Selectivity and Cross-Sensitivity

Scope

This application note discusses the selectivity of the different SPEC sensors to a list of common gases and air pollutants, and considerations for different applications.

SPEC Sensors are design to be selective to compounds or specific classes of compounds. However, in cases where the presence of electrochemically similar compounds is possible, there may be potential errors in the measurement of the target compound. The following table includes a list of common gases and air pollutants and the typical effect they would have on the measurement of our various sensors.


| | Sensor>> | CO | H2S | O3; -200mV | O3; 0mV | NO2 | SO2 | EtOH | NO | TOX | Tred |
|------------------|------------|--------------|-------|------------|---------|------|-------|-------|------|-------|-------|
| Gas | ppm tested | ppm Measured | | | | | | | | | |
| Carbon Monoxide | 400 | 400.0 | 1.1 | <0.05 | <0.05 | <0.1 | 7.3 | 251.4 | 4.0 | 400.0 | -2.8 |
| Hydrogen Sulfide | 25 | <1 | 25.0 | -5.8 | -12.5 | -5.8 | 142.3 | 63.2 | 78.6 | 92.1 | -67.6 |
| Ozone | 5 | <1 | -0.9 | 5.0 | 5.0 | 5.0 | -3.3 | <5 | -1.8 | -3.6 | 3.8 |
| Nitrogen Dioxide | 10 | <1 | -2.0 | 10.0 | 5.0 | 10.0 | 1.4 | <5 | 0.8 | -5.5 | 10.0 |
| Sulfur Dioxide | 20 | <1 | 1.7 | 0.1 | tbd | <0.1 | 20.0 | 11.6 | 11.0 | 14.7 | -13.9 |
| Ethanol | 200 | 5.4 | -1.9 | 2.3 | tbd | 2.3 | -1.8 | 200.0 | -1.0 | 285.3 | 12.7 |
| NO | 50 | 26.1 | 1.2 | 0.2 | tbd | 0.2 | 90.5 | 54.5 | 50.0 | 40.8 | 0.1 |
| Chlorine | 10 | <1 | -2.2 | 9.4 | 10.0 | 9.4 | -2.8 | -14.3 | -1.6 | -5.5 | 6.5 |
| n-Heptane | 500 | <1 | <0.05 | -0.2 | -0.2 | -0.2 | -0.7 | -12.6 | -0.4 | <0.1 | -0.3 |
| Ammonia | 100 | <1 | 0.1 | <0.05 | tbd | <0.1 | <0.2 | <5 | <0.1 | 0.3 | -0.3 |
| Methane | 500 | <1 | 0.1 | <0.05 | <0.05 | <0.1 | 0.7 | <5 | 0.4 | <0.1 | 0.4 |
| Hydrogen | 100 | 17.0 | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Carbon Dioxide | 5000 | <1 | --- | --- | --- | --- | --- | --- | --- | --- | --- |

Improving Selectivity

To improve selectivity, several approaches are possible:

Chemically Selective Filters

In the 15x15 package, SPEC currently offers a filter for the CO sensor. This filter removes potentially interfering gases before they reach the working electrode. The capacity of this filter corresponds to more than 20,000 ppm-hours of H₂S, or several years of typical ambient levels of interfering concentrations. With this filter in place and operating properly, the sensor will respond to CO and have no response to ppm levels of H₂S.

 **NOTE:** For highest accuracy in cases where continuous operation of the sensor in areas of elevated or fluctuating concentrations of interfering gases is needed, it is recommended that a larger, perhaps even external, replaceable filter be used. Replacement of the filter at routine intervals, or before any critical measurement, is recommended so that the minimum interference is observed.

SPEC Sensors can assist in the design of special high capacity filters for special applications. Please consult SPEC engineers with any questions about interferences and potential solutions to these kinds of application problems.

Using Multiple Sensors

Improving selectivity using multiple sensors are provided by the following examples:

- i. It is desired to measure a gas in an environment where it is expected an interfering species will be present. **Example:** measuring CO in a sample where NO is also present. NO exhibits an approximate 50% cross-sensitivity on the CO sensor; while CO exhibits virtually no response on the NO sensor. By including an NO sensor in the detector, the CO readings can be automatically compensated for the measured NO.
- ii. Applications where it is desired to measure two or more gases for which both sensors exhibit cross-sensitivity to the other gas. **Example:** measuring O₃ and NO₂ in the air: These sensors both exhibit cross-sensitivity to the other gas. By carefully measuring the response of each sensor to precise concentrations of the individual gases, it is possible to include compensation terms (simultaneous equations) in the calibration algorithms.

Revision History

| Rev Date | Description of Rev | Approved by: |
|-----------------|--|---------------------|
| 2015-03-24 | Working Draft | M. Findlay |
| 2015-04-20 | Rev 0.01 with Title change and Brian K comments | M. Findlay |
| 2015-05-06 | Rev 0.02 revised x-sensitivity table | M. Findlay |
| 2015-11-17 | Rev 0.03 Added 0mV bias O3 snsr x-sensitivity data | M. Findlay |
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