Application Note AN-111

Integration Guidelines for SPEC Sensors

Scope

This application note describes mechanical design and integration guidelines to achieve the best results from SPEC Sensors' electrochemical gas sensors.

Design Considerations for Fast and Accurate Gas Measurements

An example of a good mechanical design for diffusion sensing applications is shown in Figure 1.

- A gas-permeable membrane (e.g.: PTFE) protects the sensor and electronics from dust, oils, and condensed moisture ingress.
- A gasket minimizes the dead volume around the sensor's gas inlet port
    - The gasket shall be made from closed-cell inert materials (e.g.: Viton or EPDM) to avoid both (i) outgassing of VOCs that may impact the sensor measurement, and (ii) adsorption & absorption of measurand gases.
    - The gasket shall have a low durometer. Too much pressure may damage the gas sensor.
- Temperature (T) and relative humidity (RH) sensors are often used to compensate the gas sensor measurements. Figure 1 also shows design considerations for the T & RH sensors.

The gas permeable membrane needs to be clear of dust, oils, and condensed moisture for the measurand gases in the environment to reach the sensor. If accumulation of dust and oil is expected in the application, it may be necessary to design the gas permeable membrane as a replaceable part.

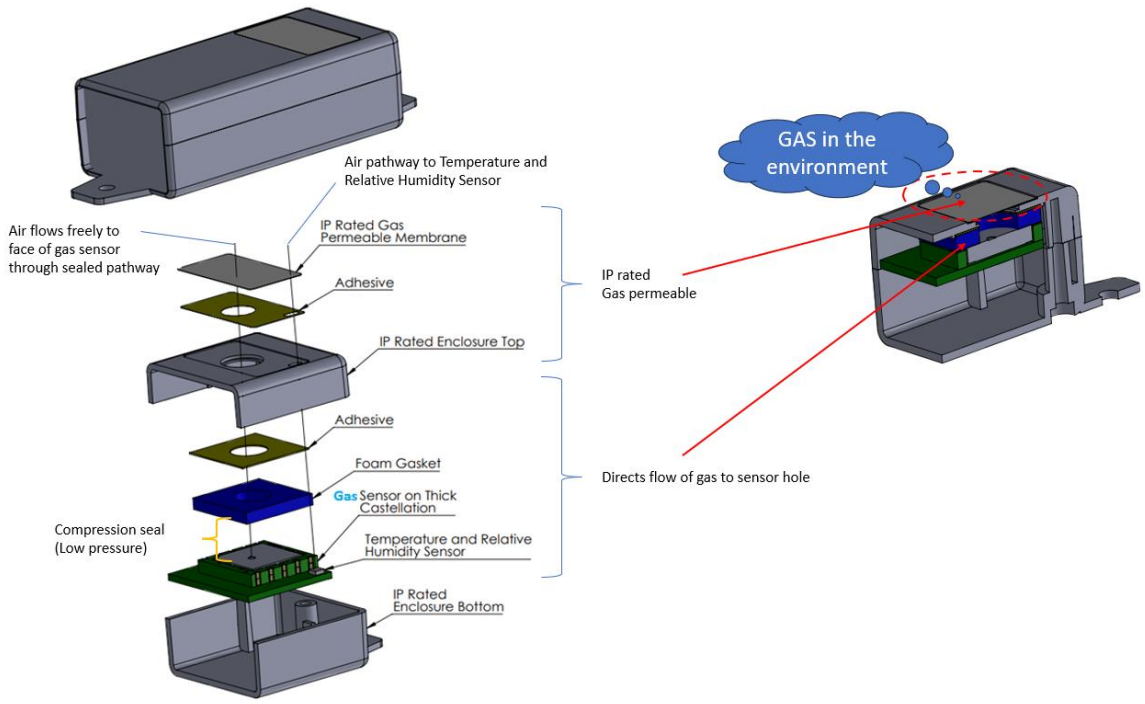

Figure 1: Mechanical Design Considerations

Sensor

- In most applications, the orientation of the sensor (faceup/facedown/sideways) will not affect the sensor performance.
- If the sensor is implemented in a fan or pump flow system, the direction of flow should be parallel to the sensor face. Flow or turbulence perpendicular to the sensor face may impact the system noise, accuracy, and response time.
- Sensor sensitivity and response time are characterized in a system that approximates diffusion conditions with a gas flow that is <0.2 m/s, parallel to the sensor face.
- Minimize the diffusion path between the gas source and the gas sensor.
    - Minimize the materials to which the gas is exposed before reaching the sensor.
- Utilize gaskets to minimize the volume within which the sensor sits inside the instrument to enhance the response and recovery times of the system to gas diffusion.
- Use inert materials near the sensor to enhance the accuracy of the gas measurement.
    - Minimize the use of materials that outgas - this includes (but is not limited to) materials with a noticeable odor.
    - Minimize materials that will adsorb or absorb the measurand gases.
- For highest accuracy, it is always recommended to calibrate the sensors in the intended usage and environmental conditions.

Foam Gasket

- **Closed-cell Viton™ sponge** and **closed-cell extra soft EPDM foam** are relatively inert materials that are suitable to use for most gas sensing applications.
- Critical gasket dimensions:
    - Any gasket material must be closed-cell construction to prevent gas absorption.
    - Gasket center hole: ≥8 mm, centered on the sensor face (i.e.: do not contact the sensor within 8 mm of the face center)
    - Gasket extents: Length and width may cover the remaining gas sensor extents.
        - Gasket thickness: shall be designed to apply a light pressure seal against the face of the gas sensor (e.g.: 25% compression at 7 ± 3 psi).

Gas Permeable Membrane

- A hydrophobic, porous membrane (Zitex™, POREX™, or other PTFE membrane) is recommended to protect the sensor and electronics against dust, oils, and condensation.
- Critical specifications:
    - Typical Airflow: > 15 L/min/cm^2
- **POREX™ PMV20** or **PMV25** are validated for most gas sensing applications.

Adhesives

- **ADCHEM 256M-74-54** is a general-purpose structural adhesive that has been validated for use with gas permeable membranes, foam gaskets, and other instrument subassemblies for most gas sensing applications.

Enclosure

- For all applications, please verify the general material compatibility against the expected chemical exposure.
- **Polycarbonate** is a practical enclosure material that is suitable for most gas sensing applications.
- For applications that require the highest precision, use **Teflon™**, **Delrin™**, or **stainless steel** in the vicinity of the sensor.
- ABS may be used with caution for some applications, especially if the above materials are used in the vicinity of the sensor.
- CAUTION: Most 3D printed parts outgas VOCs that could interfere with gas sensor measurements.

Maintenance

- **Instrument Cleaning:** If necessary, it is recommended to clean the instrument enclosure's gas permeable membrane with a damp cloth. Cleaning agents and brushes may damage the membrane and/or impair measurement.
- **Sensor Cleaning:** DO NOT CLEAN the sensor face or gas inlet port as this may damage the sensor. Implement the instrument design as described in this document to protect the sensor face from accumulating dust, oil, and condensation. Do not poke, brush, rub, or press on the sensor face or membrane.

Considerations for Reactive Gases

- Reactive gases like H_2S, NO_2, SO_2 and O_3 will chemically react with common materials used for instrument/tool casing, tubing, manifolds, and even pumps and valves. The material recommendations above are suitable for use with these gases.
- Common thermoplastics such as ABS and styrene will absorb or react trace gases.
- Aluminum, copper, and polymers such as nylon and most rubber variants may react with gases and/or adsorb & desorb gases, affecting lower detection limit and response & recovery time of the sensor system.

Sensor Storage, Handling and Soldering

This information embodies various general recommendations concerning the storage, handling, and manual soldering conditions for Sensor. Moreover, sensors are NOT warranted and should NOT be used in high temperature soldering (reflow) or pre-tinning baths.

Sensor & Module Handling

Handle sensors with care. Take precautions, including but not limited to the following:

A. DO NOT apply excessive pressure to the top or bottom of the sensor module.
B. Whenever possible, handle or contact the sensor module from the sides of the PCB or substrate.
C. Light vacuum pressure is possible during handling, DO NOT apply vacuum over gas sensor port.
D. If the sealed sensor package is opened, DO NOT re-seal using vacuum or nitrogen gas. DO NOT reseal with desiccant.
E. DO NOT obstruct the gas sensor port by making direct contact with any tape, apparatus, weights, etc.
F. DO NOT use silicone or other conformal coatings around the sensor or gas portholes.
G. Operators are requested to wear powder-free antistatic gloves.

Manufacturing Assembly Floor Environment

Interlink Electronics recommends that the manufacturing assembly floor environment be maintained at controlled conditions:

A. Temperature: 18 - 26°C
B. Relative Humidity: 40 to 60%
C. Pressure: 1.0 ± 0.2 atm

Sensor & Module Storage Conditions

The shelf life for sealed, packaged components is 12 months from the pack seal date, when stored in the factory sealed bag under the following conditions:

A. Temperature: 5 to 25 °C
B. Relative Humidity: 20 to 80%
C. Pressure: 1.0 ± 0.2 atm
D. Storage Time: 12 months

When moving from Storage Conditions to the Manufacturing Assembly Floor Environment, the sensors should be allowed to equilibrate at the new conditions for at least 24 hours prior to manufacturing.

Module Attach Soldering Process

Hand solder only. Keep the soldering iron or solder process tool away from the sensor. The sensor should not see pre-heat temperatures above 70 °C. There have been suggested cases where a heat sink cover over the sensor may be applicable to protect the sensor during processing. No Application notes to this approach available. Only to be used as reference only.

A. DO NOT heat sensor above 70 °C.
B. Hand or peripheral process type approach
C. Use solder wire alloy with the lowest possible eutectic temperature.
D. Use the lowest possible soldering iron temperature.
E. Contact the host board with the soldering iron at a 45° angle on the solder pad.
F. Keep the soldering iron away from the top and bottom of the sensor module.
G. DO NOT place in reflow, wave or IR reflow type processes.
H. DO NOT place mounted board in a wash.

Intellectual Property & Other Legal Matter

Contact

United States

Interlink Electronics, Inc.
48389 Fremont Blvd, STE 110
Fremont, CA 94538 USA
Phone: +1-510-794-4296
sales@interlinkelectronics.com

www.spec-sensors.com
www.interlinkelectronics.com