

# Media Compatibility for IPS PRT Pressure Sensors

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## INTRODUCTION

What is the term Media Compatibility, and how does it affect Pressure Sensors? Media is any chemical compound, in liquid, solid or gas which interacts with the sensor where the sensing of pressure is done either directly through this chemical, or by measuring the pressure of a gas containing a certain amount of this chemical. Media Compatibility is presented here as the various media that our sensor can sense pressure with, either directly or through an air column. While this document will lay groundwork for compatible chemical media, it will not serve as a qualification guarantee. The only method we endorse fully is the utilization of a pressure sensor with clean, dry air.

This document will cover the Media Compatibility of these Integrated Pressure Sensors (IPS) Piezo-Resistive Transducer (PRT) technology Pressure Sensors. Looking at the cross section of a Unibody pressure sensor in [Figure 1](#), the gel layer is evident over the die. Force or pressure is transferred through the gel to the sensing element on the die. The gel coat protects the die and wire bonds that are encapsulated within and is available as a standard Fluorosilicone or Media Resistant gel. The Media Resistant option is the default choice in sensor selection for an application that may call for added protection over the Fluorosilicone gel. When a corrosive is introduced to the sensor that is not compatible, it has the potential to dissolve, or be absorbed by the gel and corrupt the die surface or lead to wire-bond breakage. Some types of media will take longer to corrupt the die than others, so a disposable application is possible. Knowing how to make the sensor last for longevity with/without media can accelerate or slow down the lifetime of the sensor.

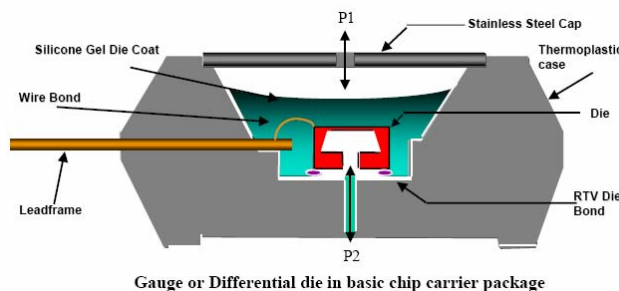


Figure 1. Cross Section of Unibody Pressure Sensor

## RELIABILITY

Reliability of the sensor can be improved by Pulse biasing the pressure sensor. This turns the sensor on and off to improve the lifetime of the sensor and is a typical standard practice for PRT sensors. With corrosive media, this will not improve sensor lifetime if the media is expected to eventually corrupt the sensor. The sensor will also not survive in a corrosive or non-corrosive environment with direct contact with liquid media. Eventually the die or wire-bonds will be compromised by the chemical interaction in the long term. This is not to say that Pulse biasing should be avoided completely. This is standard practice to improve typical sensor lifetimes in typical applications.

Another method to prolong lifetime is to un-bias the sensor during sudden cold to hot cycling. The gel layer is a good protection layer against liquid moisture from contacting wire-bonds or die level. However if this is saturated in a harsh environment during cold-hot cycling, condensation can build up. During the hot cycle this can lead to the possibility of

shorting wire-bonds. Waiting to take a reading at the warmer, temperature after the moisture may have evaporated is ideal. The gel is designed to protect against this instance, but while we are focusing on media and harsh environments, this is an issue to consider. A lower bias voltage also tends to prevent the faster decay of wire-bonds that have been compromised. Think of the sensor with compromised saturated gel as a simple electrolytic corrosion cell. Wire-bonds that are biased and grounded act as anodes and cathodes respectively. The gel that has absorbed a chemical can act as an electrolyte, and corrode wire-bonds. In the lower voltage bias, the lower current will slow the electrolysis, prolonging broken wire-bonds.

How is the ideal application of a PRT IPS pressure sensor to interact with media of questionable nature? The ideal method is the media separated from the sensor by a column of clean, dry air as seen in Figure 2. Some vaporization of the media will occur in the air column, but for most applications Media Resistant gel will provide adequate protection here. Corrosive media that would normally corrupt the sensor, when implemented with an air column, has been proven by customers to survive product life cycles in their application.

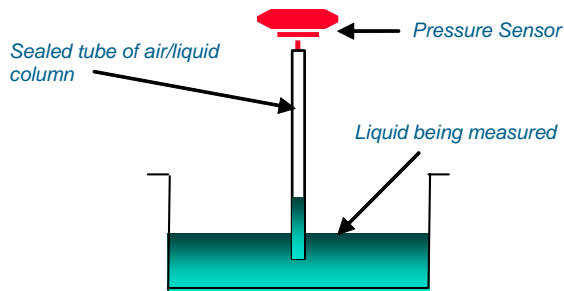


Figure 2. Media Separated by a Column of Clean Dry Air

## RELIABILITY LIFETIME TESTING

Our sensors are qualified and undergo an Accelerated Lifetime testing. This incorporates the following conditions: High Temperature Output Lifetime (HTOL) and Temperature Humidity Biasing (THB) testing. The HTOL test is representative of a 10 year accelerated lifetime test. It requires the part to be tested at 125°C for 1000 hrs at full biasing voltage. The THB is also another 60°C at 90% relative humidity for 1000 hrs. These tests prove reliability of Freescale sensors for high humidity and for high temperature, and give an indication of how long the sensor can last in such an environment. They are tested at 100% duty cycle of biasing the sensor. If the parts are tested at a lesser duty cycle, it will prolong the life cycle and last much longer.

## Media Evaluations and Risks

| Media                   | Florosilicone Gel    | Media Resistant Gel | Long-Term Direct Exposure | Air Column              | Disposable - 24hr Application (SSOP ONLY) |
|-------------------------|----------------------|---------------------|---------------------------|-------------------------|---|
| Water                   | Not Tested           | Tested              | Likely to have issues     | Unlikely to have issues | Probably Okay (Customer to Validate)      |
| Ethanol (Ethyl Alcohol) | Not Tested           | Tested              | Likely to have issues     | Unlikely to have issues | Probably Okay (Customer to Validate)      |
| Diesel                  | Tested--Worse Result | Tested              | Likely to have issues     | Unlikely to have issues | Probably Okay (Customer to Validate)      |
| Brake Fluid             | Not Tested           | Tested              | Likely to have issues     | Unlikely to have issues | Probably Okay (Customer to Validate)      |
| Windshield Washer Fluid | Not Tested           | Tested              | Likely to have issues     | Unlikely to have issues | Probably Okay (Customer to Validate)      |
| Transmission Fluid      | Not Tested           | Tested              | Likely to have issues     | Okay                    | Probably Okay (Customer to Validate)      |
| Power Steering Fluid    | Not Tested           | Tested              | Likely to have issues     | Unlikely to have issues | Probably Okay (Customer to Validate)      |
| Engine Coolant          | Not Tested           | Tested              | Likely to have issues     | Unlikely to have issues | Probably Okay (Customer to Validate)      |
| Differential Fluid      | Not Tested           | Tested              | Likely to have issues     | Unlikely to have issues | Probably Okay (Customer to Validate)      |
| Fuel C                  | Tested--Poor Result  | Tested              | Likely to have issues     | Likely to have issues   | Likely to have issues                     |
| Fuel C + M              | Tested--Poor Result  | Tested              | Likely to have issues     | Likely to have issues   | Likely to have issues                     |
| Engine Oil              | Tested               | Tested              | Likely to have issues     | Unlikely to have issues | Probably Okay (Customer to Validate)      |
| Detergent and Bleach    | Tested               | Tested              | Need More Data            | Unlikely to have issues | Probably Okay (Customer to Validate)      |
| Human Breath            | Okay                 | Okay                | Okay                      | —                       | Probably Okay (Customer to Validate)      |
| Gases- Nitrogen         | Okay                 | Okay                | Need More Data            | Okay                    | Okay                                      |
| Gases-High Oxygen       | Need More Data       | Need More Data      | Likely to have issues     | Need More Data          | Need More Data                            |

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