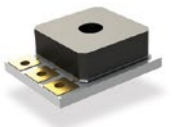
Meeting Harsh Media Pressure Sensor Requirements in New Electronic Control Modules

WHITE PAPER

Bourns® Model BPS130
Single Port



Bourns® Model BPS130
Manifold Mount

INTRODUCTION

Many mechanical applications are increasingly employing electronics. These types of applications previously used multiple modules to manage multiple functions or simple electrical controls such as switches. Because designs are getting more complex and users demand improved switch functionality, greater system efficiency and smarter, more sensitive operational controls, developers are looking for more advanced component solutions. Component miniaturization, higher levels of integration and sophisticated sensor technologies are required to meet these demands.

Of particular importance are new pressure sensors that can replace less accurate pressure switches in, for example, thermal cycling processes to improve efficiency and to allow further system automation. For a wide range of industrial applications in areas such as energy, heavy equipment, transportation, food & beverage or in certain medical environments there is a need to integrate pressure sensors.

A key consideration for selecting the right pressure sensor for these applications is whether they must frequently operate in severe conditions where dust, chemicals, shock and vibration and temperature all threaten performance, reliability and longevity. So, whether it is an application where aggressive cleaning solvents at elevated temperatures are used or an oil pressure sensor integrated into an electronic control unit, these applications require sensors that meet demanding specifications in terms of media compatibility, temperature range and package size.

But what should a designer look for in terms of a sensor's structure and features to ensure that it can handle extreme conditions?

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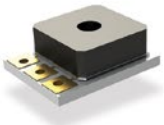

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DETERMINING PRESSURE SENSOR REQUIREMENTS

Sensors have become one of the most critical elements of information collection where the demand for real-time data analytics is a major driver in the evolution of sensors and sensor networks. Self-diagnostics, network compatibility, small form factor designs and integrated signal conditioning are considered essential sensor features for new applications.

Pressure sensors work by converting the pressure of the air, gas or liquid to which they are exposed into an electrical signal. When evaluating pressure sensors, there are a couple of important attributes to consider. The pressure range of the sensor and its media compatibility compared to the application's pressure measurement and feedback requirements are the first considerations. Pressure sensor accuracy is another important performance feature to review. Package size and power consumption are also critical in many space-constrained applications.

OUTDATED PRESSURE SENSING SOLUTIONS ARE NO LONGER SUFFICIENT

In existing applications, designers currently employ mechanical pressure switches or stainless steel and ceramic pressure transducers in a robust and large-scale housing to be mounted with threads into pipes or manifolds. In some cases, designers opted simply for no sensor-based component at all. And, the large majority of PCB-mount sensors offered today are designed with limited harsh media capabilities. Their resistance is often limited to dry gases or non-corrosive liquids, with narrowly calibrated temperature and pressure ranges.

It is easy to see why these solutions no longer fit into upcoming applications. Their size and form factor, narrow functionally, harsh media resistance and limited performance simply do not satisfy next-generation application requirements.

SOLVING PRESSURE SENSING NEEDS

A new generation of pressure sensors is available that combine a small form factor PCB-mount package together with technologies and features capable of handling wide temperature ranges with proven harsh media/chemical resistance. Advanced technologies also offer cutting-edge technology sensors to support increased integration levels, delivering increased functionality in today's more complex applications.

There have been a number of sensor design innovations. Electrical output, accuracy and extended environmental operation are key advancements. These technology improvements have also led to greater stability and repeatability of pressure sensor responsiveness.

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THE RIGHT COMBINATION OF FEATURES

Pressure sensors that deliver a combination of harsh media compatibility, a wide temperature operating range and a high pressure range capability all in a single small form factor device offer an ideal solution for most developers. Figure 1 illustrates the compact sensor form factor available today.

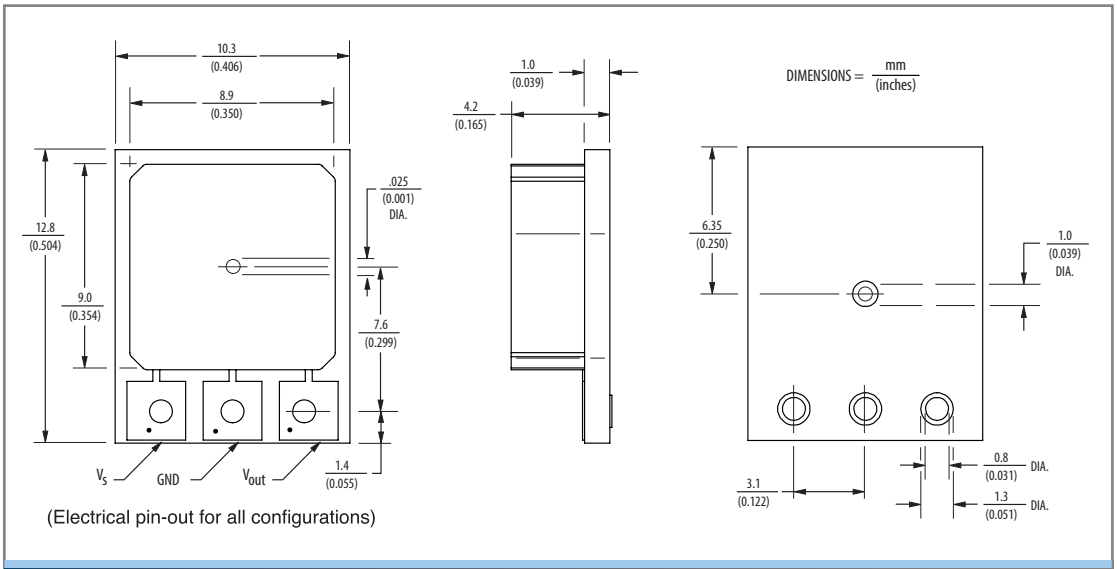

Figure 1. | *Model BPS130 Product Dimensions*

This level of integration makes new pressure sensor technologies much more attractive for applications that could previously use only media isolated pressure sensors in large and costly packages.

The construction of the sensor is a key consideration. Designs based on an adhesive-free die attach mounting process using a eutectic die bond on ceramic results in a robust device structure capable of handling high pressure ranges even at high temperatures. Another advantage of an adhesive-free design is that it can be combined with backside pressure measurement that enables construction with a small number of media-resistive wetted materials. Backside sensing is a type of pressure sensor design whereby the measured media only touches the backside of the measurement element. A distinct sensor accuracy benefit is that all electronic components and other sensitive surfaces are automatically isolated from the media. Wetted materials are all materials in contact with the measured media, therefore, the wetted materials are most critical in terms of media resistivity of the sensor.

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THE RIGHT COMBINATION OF FEATURES *(Continued)*

For example, the Bourns® Model BPS130 family of pressure sensors is constructed using only inert silicon, glass, Au/Sn and ceramic materials which are resistant to many corrosive liquids and gases. Figure 2 shows the basic construction of the Bourns® Model BPS130 pressure sensor along with a list of used wetted materials.

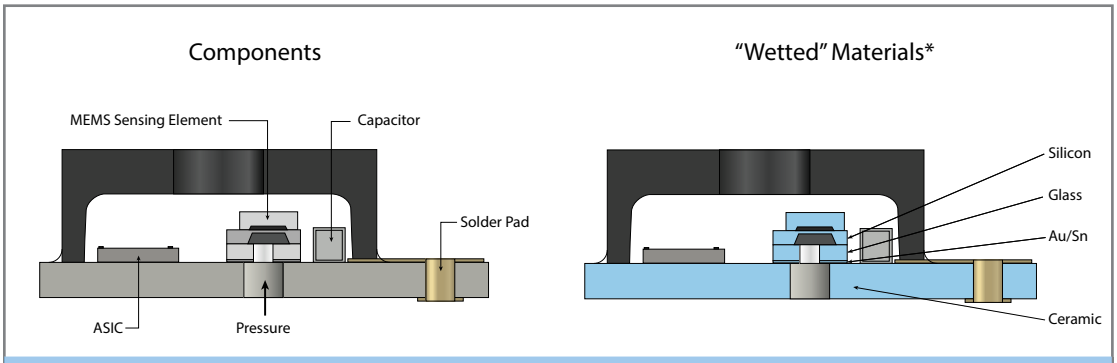

Figure 2. | *Model BPS130 Basic Construction*

Bourns® Model BPS130 pressure sensors provide multiple design benefits:

- High pressure sensing range: 15 PSI to 500 PSI (approximately 1 to 34.5 bar)
- Wide calibrated temperature range from -40 °C to +150 °C
- Exceptional media compatibility for harsh gases and fluids
- Compensated and amplified output

** Any material in contact with the media is considered a "wetted" material.*
Port versions also contain gold (Au) plating and solder.

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RELIABILITY IN HARSH PRESSURE SENSING ENVIRONMENTS

Applications for pressure sensors will continue to grow as developers realize the benefits of converting more expensive and larger mechanical pressure sensors to lower-cost, small form factor devices. Technology advancements contribute to increased sensor accuracy, sensitivity and long-term reliability which will ultimately expand their use.

Demonstrated by the unique construction of the latest Bourns® Model BPS130 pressure sensor, designers not only can get a solution that follows the trend of miniaturization and higher integration of electronics, but also one that can measure pressure of liquids in demanding or extreme environmental applications.

A further advantage of new construction techniques is that it is now possible to integrate the measurement functionality of stainless steel and media-isolated pressure sensors at the PCB level. This leap forward brings measurement functions and additional value into designs that were either impossible or very difficult to supply in the past. And by giving more functions to the PCB or one housing, today's pressure sensors contribute to reduced wiring complexity, decreased risk of signal distortion due to environmental noise and also a reduced number of sealed electrical connections. These are all important features and benefits to consider when selecting the right pressure sensor for a new harsh media application.

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