Application Note

Lose the Switch… Find the Sensor

January 2010

As more systems benefit from microprocessor based controls, many system developers/integrators are now specifying pressure sensors or transducers into applications that have previously been dominated by pressure switches. Incorporating a sensor/transducer instead of switch allows systems to be more efficient as well providing the end-user with more features and flexibility.

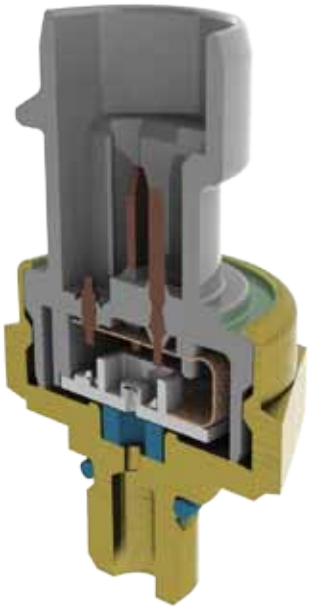
A pressure sensor/transducer provides a linear DC output voltage change that is proportional to the pressure applied, allowing for a calibrated and accurate output voltage provided over the entire pressure range that a system may experience. On the other hand, pressure switches typically provide only two output voltages, on or off, corresponding to a specific pressure point. In many cases the switches "switching" point is not nearly as accurate as a sensor/transducer, and it can drift over time with thermal exposure. In addition, the accuracy of the switching pressure is typically not better than 3% of the maximum pressure value applied. In contrast, a pressure sensor/transducer typically provides accuracies of 1.5% (of pressure span) or better over a broad thermal range of 0ºC to 100ºC. The sensor/transducer output also offers resolution down to 0.025%, providing the system developer an expanded capability in control or trigger points. In theory, a developer could design in as many switching points as may be needed with a single sensor/transducer. More advanced systems can be designed when using a pressure sensor /transducer to measure the rate at which pressure is changing to accelerate a systems response to the changing condition, a task that can not be done with a pressure switch.

Several control systems rely on accurate pressure sensors to perform properly. For instance, in the HVAC industry, pressure sensing is utilized for control of the refrigerant during the compression and expansion phases of the media. Over the years, this industry has developed more energy efficient, modulated systems that can operate in several modes to allow rapid change as well as low demand, sustained control. This could only have been accomplished with the integration of a pressure sensor/transducer.

In the transportation sector, one application in particular that has benefited from converting from switches to sensors/transducers is that of air filtration, specifically for heavy duty on and off road vehicles. Historically, pressure switches have been used to signal when an air filter is clogged and needs to be serviced. Now, new systems are using pressure sensors/transducers to allow the pressure drop across a filter to be used for more than just filter condition. Now, the rate at which a filter becomes clogged can be monitored and used to offer other diagnostic features with respect to engine health.

Kavlico, as well as other sensor manufacturers produce a wide variety of pressure sensors/transducers that can provide a calibrated output voltage directly to a microprocessor based system. For low to medium gage pressure applications, Kavlico's P4055 product family can easily be integrated into most pressure systems. The P4055 product family uses a piezo-resitive based sensing technology which is compatible with a broad selection of liquid and gaseous media. The piezo-resistive sense element is ideal for high-volume, low-cost applications. The sense element is bonded directly to a thick film screened ceramic hybrid that contains the entire compensation and amplification circuit (see images 1 and 2).

Image 1 (Cut-away of Kavlico P4055 Pressure Sensor)



Piezo-resistive Sensor & Hybrid Assembly

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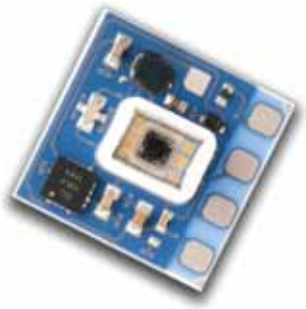
Image 2 (Hybrid Assembly for Kavlico P4055 Pressure Sensor)

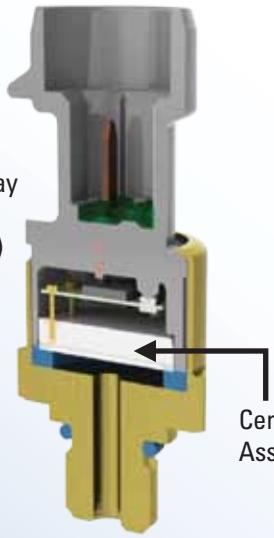


With the entire transducer circuit on one hybrid a high level of reliable is realized from the minimum number of circuit interconnects. The pressure ranges for this sensor can go as high as 300 psi or 20 bar.

If a system requires a sealed or absolute reference pressure reading Kavlico's P528 product family provides a robust solution for operating pressure ranges from 50 psi to 1,000 psi. The P528 product utilizes a ceramic capacitive sensing element, which features excellent overpressure capability. The sensor can be matched with a variety of seal ring materials to meet specific customer's media compatibility needs. This particular sensor's pressure measurement ranges can be configured with a change in the specified thickness of the ceramic diaphragm with the rest of the sensor architecture remaining the same (see image 3).

System developers and integrators are constantly being presented with the challenge to provide more capability at a lower cost while providing solutions that consume less energy. To accomplish this task, many will turn to the advantage that sensors will offer over the more out-dated switch approach. Simply dusting off the old idea will not work anymore… when all is said and done, it's time to loose the pressure switch and start converting to pressure sensors for a more cost effective and efficient measurement approach.

Image 3 (Cut-away of Kavlico P528 Pressure Sensor)



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