All Sensors **Pressure Points** are application tips to simplify designing with microelectromechanical systems (MEMS) pressure sensors and avoid common pitfalls.

Pressure Point #9: Pressure Sensor Technologies

System designers have many choices when it comes to selecting a technique for measuring pressure. Microelectromechanical systems (MEMS) technology is widely discussed and implemented for numerous sensing applications. For pressure measurements, there are several other technologies, many that are not well known or commonly used today.

Techniques for Measuring Pressure
In Global Pressure Sensor Market 2012 - 2017: Forecast, Trend & Analysis - Segmentation by Technology, Applications & Geography, analysts at Research and Markets report that 8.7 billion pressure sensors shipped in 2011 and expect the level to reach 16.37 billion units by 2017, at an estimated compound average growth rate (CAGR) of 11.3% from 2012 to 2017. During this same period, the market size is expect to grow at an estimated CAGR of 6.3%.

With billions of units being sold, there are wide extremes in the devices offered for sensing pressure. Criteria for selecting a specific technology can include whether the sensor is used for flow, liquid level, depth, altitude or barometric measurements. In addition, the need for absolute verses gauge or differential technology can help determine the technology choice as well. (See Pressure Point #1 for more details.)

Two essential aspects of any pressure sensing device are a force collector and transducer technology. In the earliest pressure measurements, the transducer technique converted pressure into mechanical motion of a gauge or height of a liquid column. Aneroid cells, Bourdon tubes, bellows, diaphragms, deadweight testers and manometers provide the historical basis for the force collector in many pressure measurements. New semiconductor methods have been applied to previous vacuum sensing technology such as the Pirani gage (thermal conductivity) device.

Some of these technologies are used for high pressure measurements. Some are used for very low pressure measurements, such as the McLeod gauge or Pirani gauge which apply to vacuum measurements (i.e. ionization gauges). System engineers with applications in these areas should investigate these alternate technologies more closely.

Converting Pressure into an Electrical Signal
With sensing playing an active role in modern control systems, pressure sensors must provide more than a readout for monitoring. The need for an electrical output that can provide feedback in a control system is solved by the following sensing techniques:

- Capacitive
- Magnetic, such as a linear variable differential transformer (LVDT)
- Optical
- Piezoelectric
- Piezoresistive
- Potentiometric/Resistive

- Resonant frequency

Some of these techniques address specific applications such as sensing very high pressure (i.e., fiberoptic technology or the high precision and accuracy requirement of instrument grade sensors.

MEMS Technology for Sensing Pressure
Today, sensor experts estimate that MEMS technology is used in over 90% of the pressure sensors. Piezoresistive and capacitive sensing are commonly used in MEMS-based pressure sensors.

In the [Global MEMS Pressure Sensors Market 2012-2016 report](#) from TechNavio, analysts project the global MEMS pressure sensors market to grow at a CAGR of 8.84% over the period 2012-2016.

With their small size and small external packaging, MEMS sensors of all types have created new applications and provided new features in many end products. In addition, semiconductor manufacturing provides consistency high yields, low cost and a path to even lower cost.

For pressure measurements, piezoresistive bulk micromachined sensors are most commonly used technology due to the ease of signal conditioning, broad selection and low cost. These MEMS sensors are used in most common pressure ranges from 0-4 in to 0 to 100 psi. Advancements, such as All Sensors' CoBeam^2™ technology improve the force collector capability of piezoresistive sensors. This allows piezoresistive MEMS sensors to achieve a high level of pressure sensitivity, especially in lower pressure applications, without increasing the die size or using costly boss structures.

Application Choices
There are many technologies available for sensing pressure but the choices narrow for specific applications. For low cost measurements in the 0-4 in to 0 to 100 psi ranges, the capabilities of piezoresistive MEMS-based sensors should be considered.

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