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Selecting the right pressure sensor for your application

This guide from Acal BFi details the key factors that you must consider when selecting a pressure sensor for your application.

Selecting the best pressure sensor for your application is a complex task. The choice of pressure sensor for a specific application depends on the complexity of environment where it will be used, the job it's being asked to perform and, of course, the cost. With so many variables there are now many different types of pressure sensors to choose from, so how can you make sure you select the right one to meet the performance requirements of your application?

Read on to find out which type of pressure sensor would be right for the requirements of your application.

Factors to consider

- Measurement factors
- Production factors
- Environmental factors

Pressure sensors

- Board mount sensors
- Heavy duty pressure sensors
- Advanced board mount sensors
- Pressure transducers

consult. design. integrate.

Factors to consider

Every application has its own unique considerations and requirements so it is important to make sure that you understand these factors so that you can choose the pressure sensor that best fits your criteria.

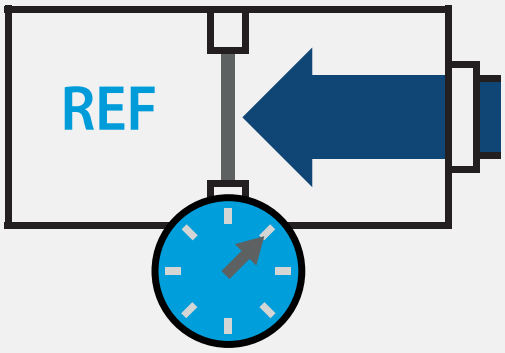
Measurement factors

Pressure range:
What pressure range do you need to measure? If you need to measure very low pressure changes from ±2.5 mbar, such as those seen in an anaesthesia machine, you will need to select an ultra low pressure solution whereas if you are measuring larger pressure changes such as those seen in a hydraulic system you need to select a solution that can accurately measure across that range of pressures to ensure you get repeatable, accurate measurements.

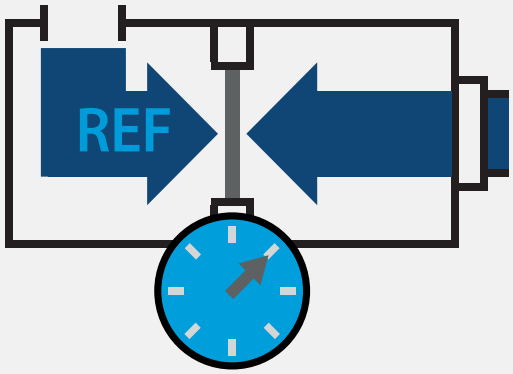
Output:
What type of signal is needed? Analog or digital? Amplified or non-amplified?

The output of most industrial board pressure sensors are amplified with analog or digital outputs (Ratiometric or I2C and SPI).

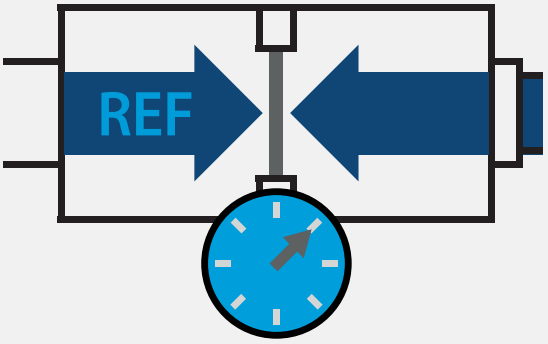
Pressure type:
What type of pressure needs to be measured? To select the right pressure sensor engineers need to understand the type of pressure they are measuring. It can be absolute pressure, gauge pressure or differential pressure.



- **Absolute pressure** references the pressure in a vacuum (0Pa), a measurement used in applications such as altimeters.



- **Gauge pressure** references the ambient atmospheric pressure to provide a pressure measurement that excludes the effects of atmospheric pressure. This method is used in blood pressure monitors and when measuring tyre pressure.



- **Differential pressure** references a different dynamic pressure in the system rather than atmospheric pressure. This method is used to maintain a relative pressure between two vessels such as compressor tanks.

Accuracy:
How accurate does your measurement need to be? Accuracy is always important but the higher the accuracy, the higher the cost of the sensor. However, if a sensor with the incorrect accuracy is used it can cause expensive efficiency problems.

Environmental factors

Temperature range:
What is range of temperature that your pressure sensor must be able to operate under? If your sensor needs to be able to consistently operate at high temperatures above 100°C or at extremely low temperatures below -50°C you will need to choose a solution that is durable enough to cope with those demands and one that is designed to compensate for temperature extremes to avoid reliability issues and drift.

Corrosion:
How corrosive is the nature of the gas or liquid that is being measured? Your choice of pressure sensor must be durable enough to withstand the corrosive nature of the media being measured or you risk the component deteriorating and failing, but if your application is measuring a harmless media then you will not need a robust solution.

Vibration:
Does the environment present a vibration challenge? Vibration from the internal components of your application and the external environment can cause a drift in the accuracy of measurements due to the sensitivity of the component. If your environment is prone to vibration you will either have to work out how to protect your sensor from vibration or choose a sensor that is rugged enough to withstand the vibrations to ensure that your measurements are accurate.

Production factors

Package size:
What size does your sensor need to be? If your application is small it is important that the pressure sensor does not take up too much space but using small sensors to measure pressure across a large area will reduce accuracy and engineers may have to use more than one pressure sensor to cover the area.

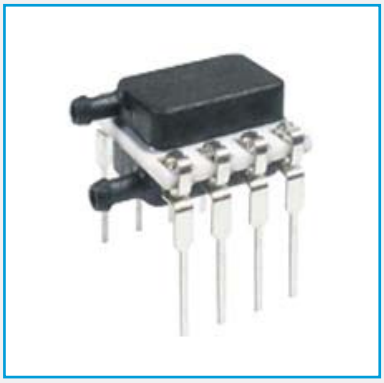
Cost:
What is the target cost per sensor? When selecting the right pressure sensor it is important to get the best balance of attributes for your application but cost is an important consideration and engineers must choose a solution that fits their application and their budget.

Ease of integration:
Do you want a full, standard solution? Production time can be increased if engineers have to temperature-compensate pressure sensors in the end application, and some solutions do not include low-noise amplifier circuitry and analogue-to-digital converters to provide a signal to the microprocessor. Some pressure sensors include these elements as standard allowing for the solution to be quickly integrated in to the application.

Pressure sensors

Once all of the previous variables are understood engineers can select the correct type of pressure sensor for their application.

Board mount sensors



Basic board mount pressure sensors are high quality but simple, cost-effective solutions that are ideal for customers looking for unamplified, uncompensated solutions for medical and industrial applications. These compact, mV output pressure sensors can be supplied in a number of different forms thanks to different porting and housing options making them easy to integrate in to your solution. Typically basic board mount sensors are used in medical and industrial applications where keeping unit costs low is a high priority.

These solutions are not suitable for pressure sensing applications where a corrosive or hostile media is being measured.

Benefits:

- Small footprint - suitable for applications where space is at a premium
- Cost effective - lower unit cost than other options

Disadvantages:

- Increased integration time - does not provide compensation, amplification or calibration capabilities
- Unsuitable for humid environments and harsh environments

Typical applications:

- Medical - airflow monitors, dialysis machines, oxygen concentrators
- Industrial - barometry, Gas chromatography, gas flow instrumentation

Heavy duty pressure sensors

For more challenging environments engineers need to use pressure sensor solutions that are rugged enough to cope with the increased demands placed on the sensor. Heavy duty pressure sensors tend to be smaller and can be used individually or as the building blocks for a complete pressure transducer.

The stainless steel construction of these components provides enhanced protection against corrosion and temperature extremes making them the right choice for measuring hostile media in harsh environments such as hydraulic controls and tank measurement systems.

Benefits:

- Long term accuracy - high level of stability and repeatability
- Durability - increased resistance to temperature extremes and increased corrosion resistance improve reliability and the life of the component

Disadvantages:

- Increased integration time - does not provide compensation, amplification or calibration capabilities

Typical applications:

- Industrial - Hydraulic controls, tank pressure control and process control systems

Advanced board mount sensors

Similar to the basic solutions these compact, board mounted pressure sensors can be used for applications where space is constrained. However, these more advanced solutions offer higher accuracy and can deliver measurements across wider pressure ranges thanks to ratio-metric analogue and digital outputs that provide accurate results across a full scale. Unlike the basic option advanced board mount pressure sensors give engineers the flexibility to leverage custom algorithms to and perform custom compensation, calibration and amplification.

These solutions also deliver high stability and repeatability even under temperature extremes and low power consumption rates help extended battery life for the rest of the application.

Benefits:

- Long term accuracy - high stability and repeatability
- Reduced time to market - delivers a complete compensated, calibrated and amplified high accuracy solution
- Protected against moisture - adheres to moisture sensitivity level 1 to avoid thermal/mechanical damage during soldering
- Accurate measurements across a full pressure - ratio metric analogue and digital output allows accurate pressure readings across a full pressure scale
- Durability - wide operating temperature range
- Power efficiency - energy efficient solutions are available (<10mW)

Disadvantages:

- Cost - higher unit price than basic board mount solutions
- Unsuitable for humid environments and harsh environments

Typical applications:

- Medical - ventilators, anaesthesia machines
- Industrial - control of pneumatic flow and system pressure, HVAC and indoor air quality systems

Pressure transducers

Heavy duty pressure transducers help reduce production time and complexity as they are complete compensated, calibrated and amplified solutions that provide engineers with a full, easy-to-integrate product. Pressure transducers offer the same protection against temperature extremes, vibration and corrosive media as heavy duty pressure sensors.

A wide choice of ports, connectors, outputs and pressure ranges gives engineers the flexibility to quickly find and integrate a suitable solution for many different types of applications.

Benefits:

- Reduced time to market - delivers a complete compensated, calibrated and amplified high accuracy solution
- Flexibility - a wide choice of port, connector, outputs and pressure ranges

Disadvantages:

- Rugged design is not necessary for all types of application

Typical applications:

- Industrial - air compressors, factory automation, pump valves, fluid pressure, pneumatics/ hydraulics