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Tech for OEM Design Engineers

Multi-functional single pressure devices measure up

System integrators can now use one multi-functional single pressure device to measure both upstream and differential pressure with one process connection

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The arrival of new materials, innovative sensing technologies with a high signal-to-noise ratio, and Application Specific Integrated Circuit (ASIC) technology is opening new opportunities for both sensor manufacturers and system integrators. The need to provide more than one output from a single sensing device is gaining popularity due to reductions in inventory, installation costs, and process penetration.

In typical hydraulic, power-generation, water, and refrigeration systems, the need for remote process monitoring brings significant benefits to the end-users in reducing costly downtime and equipment failure. For example, manufacturers find value in the ability to monitor filtration of the process media using wireless-, satellite-, or land-based systems, and trending the captured data in terms of overall system performance, scheduling maintenance, and system failure prevention.

The availability of a sensing device that can provide pressure and differential pressure from one process connection is of a great importance to manufacturers of off-road, refrigeration, and hydraulic equipment. Upstream pressure generated by a pump and the pressure drop across the filter can be read simultaneously with a single device as shown in Figure 1.

Figure 1: Photo of a typical P + dP transducer with Hirschmann "DIN" connector and NPT ports

Principle of operation

The pressure sensing device (or P + dP transducer) has two pressure connections, P1 and P2, for the measurement of pressure. P1 is used to measure the upstream pressure before the filter, while P2 reads the pressure after the filter (shown in Figure 2). The signal-conditioning electronics and connector are protected in a metal housing and constructed with Faraday cage protection against electrical noise and interference. This interference can be Electromagnetic Interference or Radio Frequency Interference. The ASIC-based electronics read both the P1 and P2 readings and provide two independent linear voltage outputs (such as 0.5 to 4.5 V or 1 to 5 V) and the EMC filtering network. This output signal is free of noise. The supply voltage to the transducer is 10 to 28 VDC, unregulated.

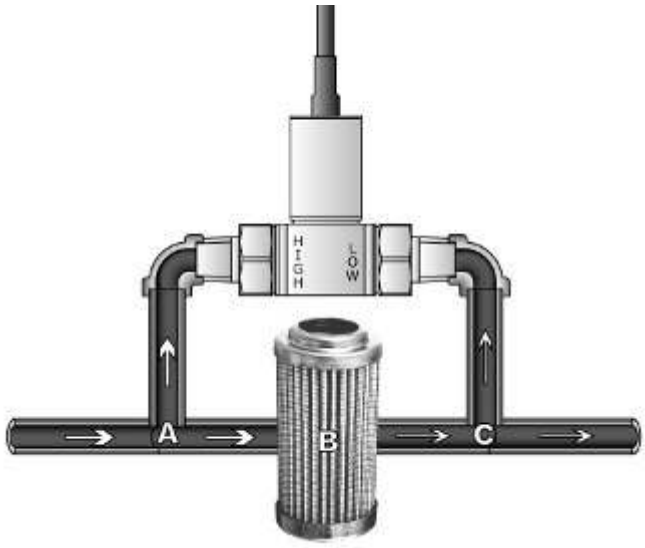

Figure 2: P + dP device connected across a filter.

Sensing technology

Pressure sensing is achieved by the use of silicon bulk Micro Electro Mechanical system (MEMs) strain gages, 0.02 x 0.04 in. (0.5 x 1 mm), that are inorganically bonded to the metal diaphragm using a high-temperature process called Krystal Bond. Bulk silicon offers high Gage Factor (GF), approximately 140, in comparison to 2 for metal foil and thin-film technologies. This advantage allows the use of a thick pressure sensing element with high proof and burst pressure ratings.

Pressure-sensing elements are machined from a seamless, single piece of metal that is free from internal welds, oil-filled cavities, and O-rings, making it ideal for critical processes such as hydrogen and oxygen service along with a host of wet applications. The construction of the sensing element ensures high electrical isolation with excellent long-term isolation. For media compatibility, the metal diaphragm can be fabricated using 17-4PH or 316L stainless steel for water and hydraulics applications. For corrosive media, nickel alloys such Inconel 718 can be used. Figure 3 shows a picture of the MEMs strain gage.

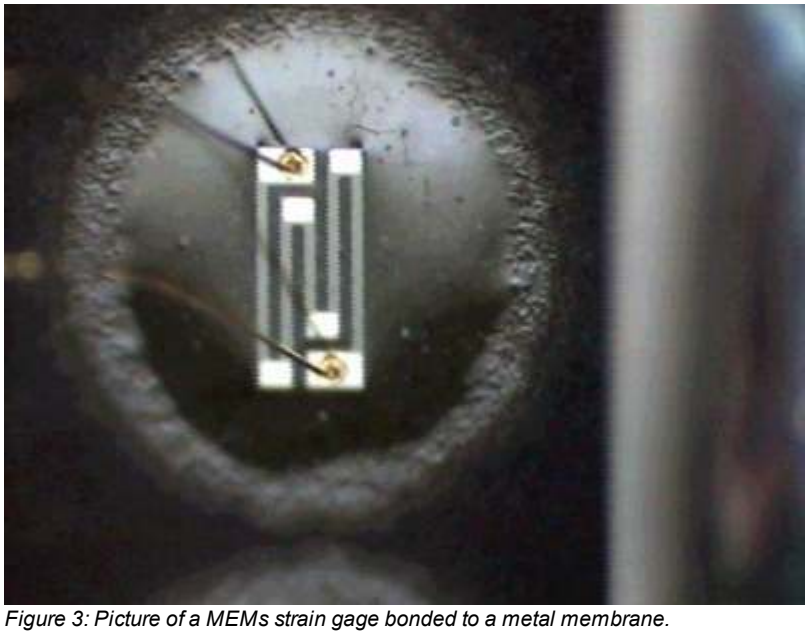

Figure 3: Picture of a MEMs strain gage bonded to a metal membrane.

Performance

The performance of the P + dP device is split into two categories. For the upstream pressure measurements, the output has a 14-bit resolution and ±1.0% total error band from -10° to 70°C. The total error band includes zero offset, thermal zero effects, span tolerance, thermal span effects, pressure hysteresis, non-repeatability, and non-linearity. The dP output is dependent upon the ratio of the line to a desired dP range. For a turndown ratio of 10:1, the output resolution drops to 12 bits. At a maximum turndown ratio of 15:1, the output resolution is 10 bits. At 15:1 turndown ratio, the total error band is ±2.5% from 0° to 60°C. The ambient temperature range is -50° to 85°C with a media temperature of -55° to 125°C. The

EMC protection is rated to 100 V/m from 01.5 MHz to 2 GHz.

Even with line pressures up to 10,000 psi (700 bar), this device is free from zero offset change due the common mode casing pressure.

Benefits

When using the P + dP device with respect to two individual sensors, there are several advantages:

- Reduced installation time due to fewer process and electrical connections.
- Reduced piping cost.
- Weight reduction.
- Reduction in component requirements, resulting in less inventory.
- Less process media penetration.
- Oil-free operation allows wide operating temperature with hermetic seal against media contamination.