WHITE PAPER

The Importance of Pressure Sensors in HVACR Systems

How TE Connectivity's (TE) M3200 Meets New Performance Standards — It's Simple, Reliable, Robust

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INTRODUCTION

Sensors are an integral part of most heating, ventilation, air-conditioning, and refrigeration (HVACR) systems — helping to not only maintain a comfortable indoor climate but also to increase the efficiency of the HVAC systems. They also enable integration of HVAC systems with building automation systems.

Traditional HVAC systems used pressure and temperature sensors and switches to control basic operations of the system such as turning it on or off or for opening or closing valves or vents. As HVAC systems have had to become far more efficient, there has been a comparable need and push for much finer control of the various subsystems. This has led to advances such as variable refrigerant flow, variable speed motors and blowers, electronic expansion valves, and many other control methodologies to finely tune the system and minimize the overall energy use.

Sensors have played a big role in improving the efficiency of these systems by monitoring various parts of the system and confirming that all parts are functioning properly. In fact, an ever-increasing number of sensors are being installed in these systems to monitor the process and maintain accuracy. Reliability has become absolutely key to providing precise and consistent data.

The most common sensing types in HVACR systems include temperature and pressure along with a strong push toward using humidity sensors as well as gas and other sensing technologies. So, what happens when these sensors aren't reliable or robust enough? Systems can fail causing thousands of dollars in damages for the most serious cases. More often, sensor failures result in loss of system efficiency, erratic operation, and uneven environmental controls in the building or home. In some cases, the system provides inadequate cooling or heating and causes comfort issues with personnel, resulting in poor productivity and equipment issues. In a worst-case scenario, when temperatures are critical for computer equipment, food preservation or for medicine, drug or organ maintenance, system issues can contribute to expensive equipment failure or even the loss of life. In addition, service calls to diagnose and repair the issues can be very expensive and time consuming.

In this paper, we will concentrate our discussion on pressure sensors and, specifically, on the needs of heavy-duty pressure sensors and how TE addresses the challenges faced in this market.

TOUGH ENVIRONMENTS REQUIRE RUGGED, ROBUST, RELIABLE SENSORS

While a range of board mount pressure sensors are used in HVAC systems for filter monitoring as well as pressure monitoring throughout a forced air system, the bulk of the pressure sensing is accomplished using heavy duty pressure sensors to monitor refrigerant pressure in compressor-based systems as well as water or other liquid pressures in large commercial chillers and other refrigeration systems.

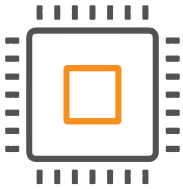
The environment found in commercial and residential HVACR systems can be one of the most challenging industrial environments. With large temperature swings, high moisture levels and, often, electrical noise, the HVACR system requires sensors that are rugged enough to function continuously while providing accurate and repeatable readings.

MICROFUSED™ TECHNOLOGY

TE offers the M3200, the latest in a long line of pressure sensors designed and manufactured using our Microfused™ technology. Derived from demanding aerospace applications, our technology employs micro-machined, silicon piezoresistive strain gages fused with high temperature glass to a stainless-steel diaphragm. Our technology is a unique construction of the sensor front end made from a single piece of steel. The result is a hermetic fitting that is free from failure-prone welds and o-rings. Bottom line – it's more reliable.

The M3200 is an industrial pressure transmitter that reaches a new price performance standard for demanding HVACR pressure applications. Available with a wide range of threaded pressure port and connector options, it has standard pressure ranges available from 100 to 5000psi or 7 to 350bar. The M3200 is designed for ease of installation and reliable performance in harsh environments.

What follows is a technical description of our technology and key benefits for an HVAC application. At TE, we believe these are important features for design engineers to consider when creating next-generation HVACR systems.



SENSING TECHNOLOGY — SIMPLE AND RELIABLE

At the heart of every pressure transmitter is a pressure sensing element. The M3200 uses our Microfused™ technology to provide a simple and reliable robust pressure sensor. Manufactured from a solid piece of stainless steel, the part does not require any welds or O-rings that could come in contact with the pressure media. This makes it compatible with a wide range of fluids including most refrigerants in use today as well as those being proposed for future use. With no moving parts, the cycle life is essentially infinite. The element is robust and offers high over-pressure and burst resistant capability. These technology features result in a simple, elegant design that is suited for harsh industrial applications used in HVACR systems.

OUTPUT OPTIONS INCLUDE DIGITAL

Most industrial pressure sensors use analog output signals, which are easy for customers to implement and are commonly used in the industry. The M3200 is available with a variety of common analog outputs including mV, 0-5V, 0-10V and 4-20mA. With an eye to the future, we also offer the M3200 with an I2C digital output. Digital sensors are becoming more pervasive in the industry. With benefits including easier integration into systems and very low power operation, they are suited for wireless and IoT designs as well as many of the new development systems being used today.

TE is one of only a handful of manufacturers which offers a digital output in a fully ruggedized industrial pressure sensor.

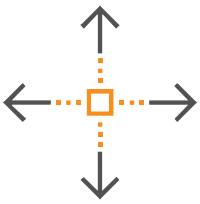
The main advantage of a digital output is that it can be read directly by a microprocessor without the additional cost and complexity of an A-to-D converter. Additionally, a digital output has the full resolution and accuracy with no signal degradation or loss of accuracy with the additional conversion circuitry. For more information, see our product data sheet.

ASIC COMPENSATION — ACCURATE AND FLEXIBLE

Pressure sensing elements require correction, or compensation, so that they can provide an accurate reading over a wide range of pressures and temperatures. For the M3200, we employ an ASIC-based solution. This uses a digital circuit to correct the raw pressure signal at multiple points in the operating range. Correction coefficients are stored in onboard memory, simplifying manufacturing and producing a very accurate product.

ROBUST DESIGN RESISTS INTERFERENCES

The HVAC environment is very harsh with temperature swings, moisture, and high levels of shock and vibration. Making matters worse, if nearby equipment is switching heavy currents, this can cause electrical and EMC spikes that can challenge the precision electronics of most sensors. The M3200 is different. It uses a simple, elegant design that enables it to survive these harsh conditions. It contains a small, light circuit board with minimal interconnects, enabling it to resist high levels of shock and vibration. Additionally, a separate circuit is used to provide protection against electrical surges and noise. The pressure port and body employ a welded steel construction that is more resistant to accidental damage than softer materials.



FLEXIBILITY FOR MODIFICATIONS AND FUTURE NEEDS

The M3200's internal design allows us to provide the same basic sensor design for a wide range of configurations or standard options in a single product line. For design engineers, this is an important advantage. It means you can use our platform to easily modify your designs or extend them to address future market needs or specific customer concerns. For example, if a manufacturer was designing a system for multiple refrigerants with a range of pressures and pipe fittings, they could select one version of the M3200 with a 500psi range and a 7/16-20 thread and another with a 170bar pressure range and a 1/4-19 BSPP thread and still utilize the same or similar firmware, drawings and other documentation.

A Solution That Grows With Your HVACR Needs

The HVACR industry is continuously expanding the use of sensor technology to provide more efficient and effective systems. The industry is pushing for sensors that are highly accurate, repeatable, able to survive the harsh HVACR environment all while being cost effective and easy to use. The new TE Sensor Solutions M3200 provides all of these features in a flexible design. It can be used by your design engineers for a variety of HVACR applications such as commercial chillers, refrigeration controls, heat pumps, beverage dispensers, electronic expansion valves, container storage and much more.

ABOUT TE CONNECTIVITY

TE is a global technology leader, providing sensors and connectivity essential in today's increasingly connected world. We are one of the largest sensor companies in the world. Our sensors are vital to the next generation of data-driven technology. TE's portfolio of intelligent, efficient and high-performing sensor solutions are used for customers across a wide range of industries including HVACR, automotive, industrial and commercial transportation and aerospace and defense, to medical solutions and consumer applications.

ABOUT THE AUTHOR

Devin Brock is the Manager for Product Knowledge and Training for TE Sensor Solutions. He has more than 25 years of sensor-related experience. Prior to joining TE Sensor Solutions, he held several roles in design engineering, product and applications engineering, and sales and marketing. His most recent role was as a Field Applications Engineer for distribution within TESS.

He holds an Electrical and Computer Engineering Degree from Clarkson University.

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