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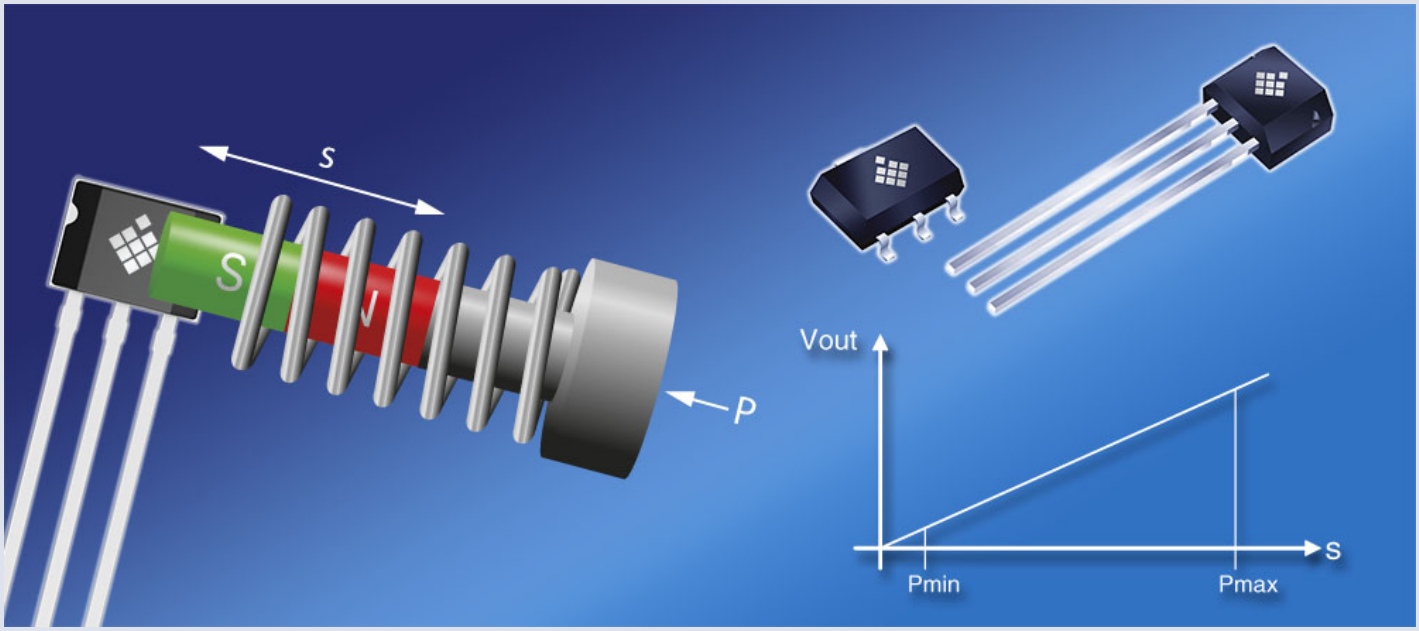

Robust Pressure Measurement on Industrial Applications by Applying Contactless Hall-Effect Technology

Requirement

The user needs to measure the pressure of gases or liquids in an industrial environment, e.g. to monitor the water pressure in a boiler or a pipe, the exhaust gas pressure in a boiler, the level or the flow rate of gases or liquids in an HVAC (Heating, Ventilation and Air Conditioning) system. The main requirements are as follows:

1. Cost-effective system solution
2. Compliance to various pressure ranges
3. Operation in harsh environment
4. Operation in environments with highly varying temperatures
5. Safety and diagnostic features

Micronas Solution

Measuring the pressure of a gas or a liquid, nowadays required by a variety of common applications in automotive, white goods and industrial applications, is inexpensively accomplished by the electromagnetic sensing technique based on the Hall-effect.

This solution consists of a pressure system element, a magnet and a linear Hall-effect sensor acting as a transducer, i.e. generating an electrical signal as a function of the pressure imposed.

The pressure system element converts pressure information into a physical displacement. It can be either made of diaphragm with a spring or a bellows. The magnet is stuck to the pressure-sensing assembly. According to the pressure imposed, the diaphragm (bellows) expands or contracts and the magnet is moved. The Hall sensor, placed in close proximity to the system, provides an output voltage proportional to the displacement of the magnet, in turn corresponding to the expansion/contraction of the diaphragm/bellows on which the pressure is exercised.

Micronas' linear Hall sensor family HAL 8xy offers several programmable devices satisfying the user requirements. Application with less stringent accuracy requirements can be addressed by the programmable HAL 1820 with good cost efficiency. All of them feature a temperature-compensated Hall plate with choppered offset compensation, an A/D converter, digital signal processing, a D/A converter with output driver, an EEPROM memory with redundancy and lock function for the calibration data, a serial interface for programming the EEPROM, and protection devices at all pins.

1. The presented solution offers an optimal cost/performance ratio to realize pressure measurement. The low-end HAL 880 device and the HAL 1820 provide good drift performance and programmability at the price of non-programmable devices.
2. The magnetic field range can be selected according to the maximum magnetic field at the sensor position, from 30 mT to 150 mT for HAL 8xy, from 20 mT to 160 mT for HAL 1820.
3. The Hall sensors are designed for industrial and automotive applications: They operate in the ambient temperature range from –40 °C up to +150 °C with typically 7 mA supply current over temperature range. The internal digital signal processing is of great benefit because analog offsets, temperature shifts, and mechanical stress do not degrade the sensor accuracy. The individual calibration of each sensor during the customer's manufacturing process compensates system tolerances in the final assembly, as well as specific performances in temperature.
4. The temperature compensation of the Hall IC can be fit to all common magnetic materials by programming first- and second-order temperature coefficients of the Hall sensor sensitivity. This enables operation over the full temperature range with high accuracy.
5. HAL 8xy devices are provided with circuits for the detection of open-circuit (ground and supply line break detection), overvoltage and undervoltage.

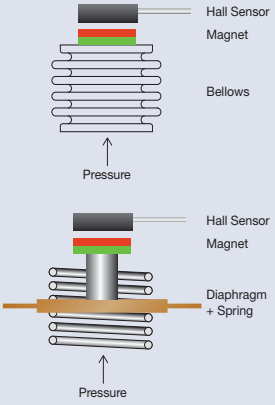

Fig. 1: System solutions based on bellows or diaphragm

Development Tools

Programming of the EEPROM and calculation of the individual sensor characteristics can easily be done with a PC and the application kit from Micronas:

For HAL 8xy:

- Micronas programmer board HAL-APB V5.1
- Visual Basic® programming software for Windows® 9x/2000/XP/Vista/7/8
- Visual Basic source code

For HAL 1820:

- Micronas programmer board HAL-APB V1.5
- LabVIEW™ programming software for Windows® 9x/2000/XP/Vista/7/8
- LabVIEW™ Sub VIs

Recommended Application Circuit

For EMC protection, it is recommended to connect one ceramic 100 nF capacitor each between ground and the supply voltage, respectively the output voltage pin.

In addition, the input of the controller unit should be pulled-down with a resistor and a ceramic 100 nF capacitor.

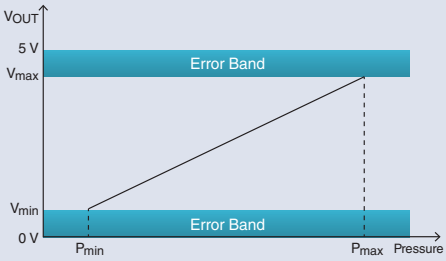

Fig. 2: Sensor output voltage versus pressure

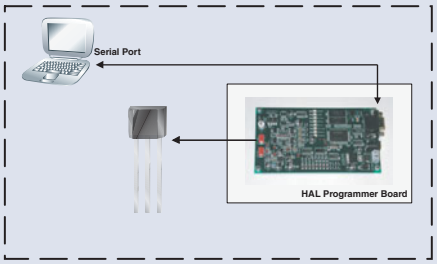

Fig. 3: Programmer board HAL-APB V5.1

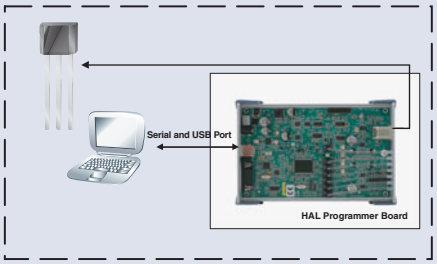

Fig. 4: Programmer board HAL-APB V1.5

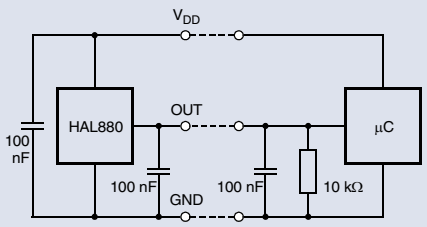

Fig. 5: Typical application circuit for HAL 880

Micronas Products Overview

Micronas offers today products with highest quality for applications such as detection of position, speed, rotation, pressure, level, fluid flow and current.

Different sensor families have been developed: The switch family includes simple switches (HAL 1xy/2xy/5xy), double-plate switches (HAL 7xy) as well as high-end programmable switches (HAL 1000). Another major family comprises linear sensors including fixed function (HAL 182x), as well as programmable (HAL 8xy, HAL1820) and also devices with direct network interfacing such as SENT (HAL 28xy). The latter represents a so-called “smart sensor” representing a further step of system integration level including a microcontroller. Finally, modern direct angle sensors allow 360° end-of-shaft (HAL 36xy) or out-of-shaft (HAL 38xy) angle measurements.

Hall-effect sensors allow contactless systems and have a high reliability and robustness regarding environmental influences such as dust, dirt, mud, and water. Due to these characteristics, Hall-effect devices are much better suited for position and rotation speed sensing than alternative methods such as optical and electromechanical sensing. Today, Hall-effect sensors have completely replaced mechanical contact switches in many different applications.

Hall sensors are increasingly establishing themselves in automated manufacturing processes, household equipment and home automation. Micronas sensor solutions are in demand for industrial applications such as robotics controllers and systems for automating manufacturing equipment. Hall sensors can also be used in many household devices, including washing machines, dishwashers, tumble driers, cooker hobs, and heating or cooling systems. They can also be found in home automation systems like rolling shutter, blinds, and garage doors.

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