

## Honeywell's MicroPressure board-mount pressure sensors give OEMs lots of options for wearables, medical and commercial applications

Wearables, battery-powered applications, non-invasive medical devices, and a range of IoT mini-systems are presenting design engineers with new challenges that involve the entire breadth of the design cycle: everything from getting the application running quickly to selecting the best configuration options to reducing time to market.

Honeywell's MicroPressure MPR Series of piezoresistive sensors offers OEMs impressive performance characteristics. But what also makes them stand apart from the competition are features such as integrated stainless-steel pressure ports, medical- and food-grade gel options, digital outputs, a wide range of configurations, and easy-to-use evaluation kits that can be up and running in less than a half-hour.

For most OEM designers, performance is where the rubber meets the road, and here, the MPR Series stacks up with the best in the miniature category.

- **Size:** The 5 × 5 mm package is the smallest in its competitive range, yet it has 12 pins on the board compared to as few as four for some rivals. This gives the customer access to the bridge output for antialiasing filtering, End of Conversion Indicator (EOC) as well as a reset-pin.
- **Pressure range:** The ±60 mbar to ±2.5 bar (±4 kPa to ±250 kPa) operating range simplifies integration into multiple system-level products.
- **Accuracy:** MR Series sensors use an onboard ASIC to calibrate and compensate each device over a specific temperature range for sensor offset, sensitivity, temperature effects, and non-linearity. As a result, accuracy is ±2.5% FSS (best fit, straight line). FSS, or full-scale span, is the algebraic difference between the maximum and minimum sensor outputs specified operating pressure limits.
- In addition, OEM designers can mitigate accuracy loss caused by the soldering process (as an example) by implementing an autozero in the customer systems software either in the factory as part of the manufacturing process or in the field during start up. Total error band after auto-zero calibration can be as low as ±1.5% FSS.
- **Digital output:** The 14-bit digital output offers high sensitivity compared to the competition and is compatible with both I<sup>2</sup>C and SPI interfaces. The data transfer rate is 200 samples per second.
- **Power consumption:** The MPR Series is a good fit for battery-powered applications (<10 mW typ. in active mode). A standby current of 0.5 µA further reduces system power requirements and extends battery life.
- **On Board diagnostics** to indicate the status health of the sensor which is important in Medical and other critical applications to know if there is an issue in the measurement taken.

The operating temperature range over which the sensor will function properly is –40°C (–40°F) to 85°C (185°F). The product's *compensated temperature range* — the range over which the sensor will produce an output proportional to pressure within the specified performance limits — is 0°C (32°F) to 50°C (122°F).

Honeywell's specified performance limit — known as total error band (TEB) — is indicative of the worst error that the sensor could experience. This single specification includes all possible error sources. It should not be confused with accuracy, which is just a component of TEB.

### Application-driven features

The pin-out configurations available in the initial range of MPR sensors have been carefully chosen to match up with both trending applications and the special features available in the series. The number of pin-outs — a dozen — gives Honeywell the opportunity to add some useful features not usually seen in micro sensors, such as enabling design engineers to execute anti-aliasing filtering in the application for noise immunity.

In the consumer application space, single-cup coffee makers utilize pressure sensors at several points during brewing. Honeywell offers a food-grade gel option perfect for this application. Flow rate can be sensor-controlled to enhance taste, flavor, and aroma. Pressure sensors also help measure water level in the holding tank to within  $\pm 2$  mm. Other sensor locations include measuring inlet pressure for a hard-plumbed system, output pressure from the system pump, and heater system pressure. An added benefit: The sensor's IoT interface makes design easier for "smart home" coffee makers.

### Wound therapy

Precise pressure measurements in highly compact, non-consumer medical applications are well-matched to specific configurations of the MPR Series. (See Figure 1.)



Figure 1: Portable negative pressure wound therapy promotes healing.

Physicians have found that the time required to heal a wound can be significantly decreased by applying a negative pressure over the wound. Measuring the pressure accurately is, of course, crucial to success, which makes an MPR sensor configuration that includes the medical-grade gel option and stainless-steel pressure port a good fit. Bidirectional sensing takes place at a level of  $-300$  mmHG ( $-5.8$  psi). Benefits accrue across the design cycle, including the sensor's small size, which makes it easy to mount on the main PC board. The steel pressure port comes in two options: long port ( $\sim 5$  mm high) and short port ( $\sim 3$  mm high).

### Washing machines

MPR sensors can measure absolute or gauge pressure, which is a valuable asset for many consumer applications — a good example is high-efficiency washing machines. These environmentally friendly appliances are designed to minimize water use, which, in turn, can reduce the amount of energy and detergent needed to wash clothes thoroughly. Accurate water level readings are key to meeting these

goals. A sensor integrated into the washer's liquid-level measurement assembly at the end of the air tube column controls water level by measuring pressure changes in the air column. If high-resolution water-level measurements are made continuously, the washer uses significantly less water and energy.

#### *Other applications*

Wearable devices such as ambulatory blood pressure monitors are also candidates for MPR Series devices. At the other end of the system-size spectrum, crop irrigation systems can reap significant water-saving benefits by integrating pressure sensors into their design. The list of additional applications is long and includes navigation systems, pneumatic controls, flow calibrators, and drone aircraft.

#### **Technical support**

To match the care with which the MPR sensor family has been conceived and designed, Honeywell has paid a good deal of attention to providing development tools and technical support.

An evaluation kit is available to simplify testing and reduce design time. The HON SEK002 evaluation kit puts designers on a fast track for measuring and recording the system's performance — often in as little as a half-hour. The kit utilizes the Arduino Uno-based platform.

Honeywell software, which is free and downloadable, controls the Arduino. Sensor measurements displayed on the user's PC can be recorded to a .csv file for further analysis. Designers can choose between mounting the sensors directly on the SEK002 or connect to the SEK002 via wire leads, an approach that allows sensor testing in adverse environments or as a prototype product for proof-of-concept testing.

#### **Summary**

Honeywell's initial entry into the micro pressure sensor market has all the earmarks of being a winner in the space. Performance specifications are impressive, and pin-out configurations make the sensors exceptionally flexible in terms of meeting the requirements of a range of diverse applications.

MPR Series sensors offer a digital output for reading pressure over the specified full-scale pressure span and temperature range. Using its on-board ASIC, the sensor can be calibrated and compensated over a specific temperature range for offset, sensitivity, temperature effects, and non-linearity.

The MPR Series has all the attributes of a product that will meet or exceed the requirements of higher-volume medical (consumer and non-consumer) devices as well as a wide range of IoT-enabled commercial appliance applications.