Sensors and Flexible Heaters in Infusion Pump Applications

BACKGROUND

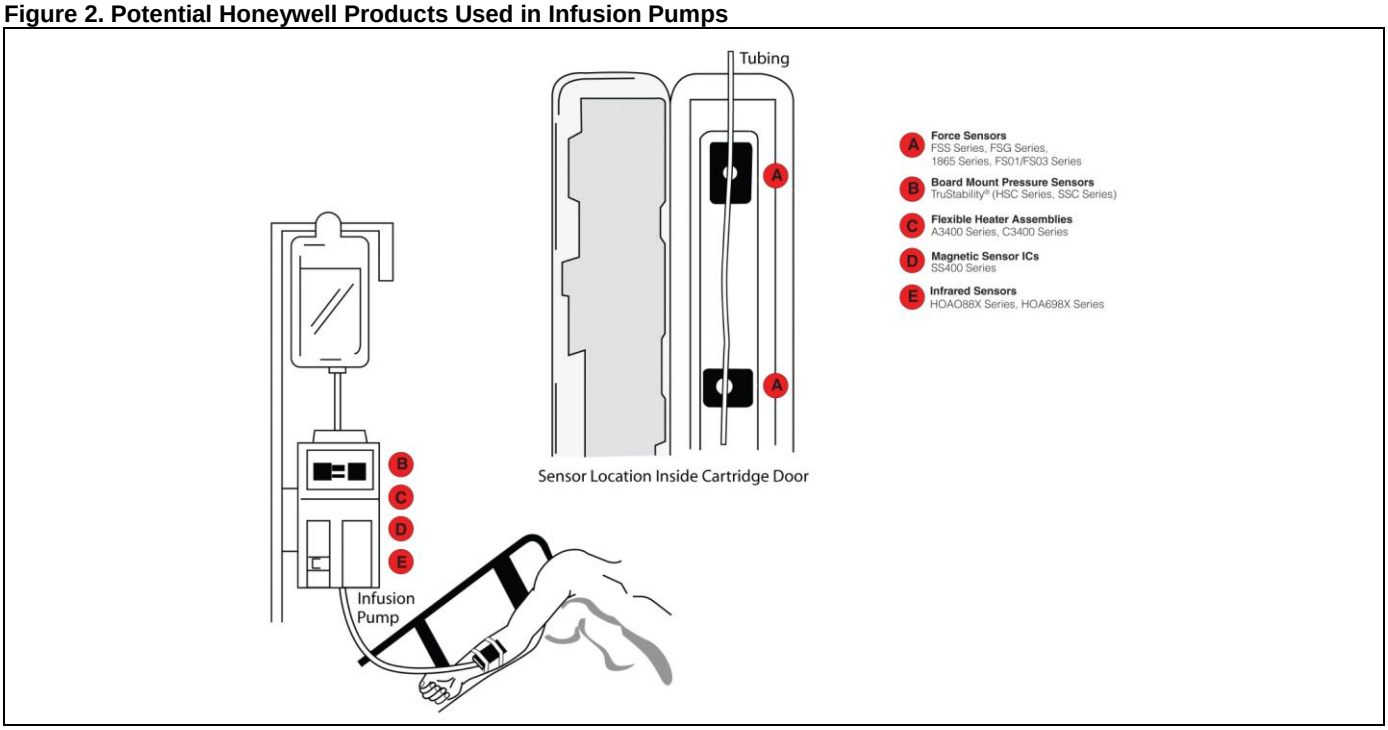
An infusion pump, typically a screw pump that pushes on a syringe or cartridge, is used to deliver small amounts of medication to a patient intravenously. (See Figure 1.)

SOLUTIONS

Honeywell manufactures many products that may be used in infusion pumps. They are designed to provide occlusion detection, monitor fluid flow, maintain specific temperatures at desired levels, and provide output for smooth motor control. (See Figure 2.)

Figure 1. Infusion Pump

Figure 2. Potential Honeywell Products Used in Infusion Pumps



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Force Sensors

These sensors provide occlusion detection to ensure there isn't a blockage in the tube that delivers the medication to the patient.

If the tube becomes blocked, the force sensor alerts the patient, nurse or doctor via an audible alarm that the therapy isn't being delivered. (See Table 1.)

Table 1. Force Sensors

FSS Series	1865 Series	FS01/FS03 Series	FSG Series
			
Features and Benefits			
• Piezoresistive sensing technology designed to provide precise, reliable force sensing in a compact, commercial-grade package • Wheatstone bridge circuit design provides inherently stable mV outputs over force range • Package design incorporates a patented modular construction • Innovative elastomeric technology and engineered molded plastics result in load capacities of 4,5 kg overforce • Stainless steel ball provides enhanced mechanical stability and is adaptable to a variety of applications • Output has low sensitivity to mounting stresses • High resistance to electrostatic discharge (8 KV) meets ESD Sensitivity Classification Level 3 • Electrically ratiometric output accommodates supply voltage variations, leading to low ratiometricity error • Small size minimizes space on the printed circuit board, simplifying incorporating the sensor into the customer's design • Low deflection (30 microns typical at full scale) helps reduce measurement error • Low voltage supply allows for use in battery powered applications. • Provides enhanced sensitivity without compromising signal integrity, resulting in low system noise and reducing measurement errors • Direct mechanical coupling of the actuation ball to the sense element eliminates coupling errors and keeps mechanical hysteresis to a minimum • Surface mount technology (SMT) option allows for automated assembly and may eliminate hand soldering	• Silicon pressure/force interface diaphragm • Pressure measurement for liquid media • Medical-grade materials • 8-pin DIP electrical connection • Laser trimmed • Choice of voltage or constant current excitation • Temperature compensated • Enhanced performance • Reliable replacement for older force or load cell transducers • Silicon rubber diaphragm potentially allows compatibility with liquid media applications • Laser-trimmed compensation may be specified to operate with a constant current or voltage supply	• Calibrated zero and span • Zero noise • Piezoresistive sensing technology designed to provide precise, reliable force sensing • High-level voltage output, calibrated, and temperature compensated sensors give accurate and stable output over temperature range • Integrated circuit sensor element and laser-trimmed thick-film ceramic in a small plastic housing • Enhanced corrosion resistance and isolation to external package stress	• Piezoresistive sensing technology designed to provide precise, often reliable force sensing in a compact, commercial-grade package • Wheatstone bridge circuit design provides inherently stable mV outputs over force range • Package design incorporates a patented modular construction • Innovative elastomeric technology and engineered molded plastics result in load capacities of 5,5 kg overforce • Stainless steel plunger provides enhanced mechanical stability and is adaptable to a variety of potential applications

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Low Pressure Board Mount Pressure Sensors
These products are designed to monitor and control the flow of fluid. (See Table 2.)

Table 2. Low Pressure Board Mount Pressure Sensors

TruStability® Board Mount Pressure Sensors (HSC Series and SSC Series)	Features and Benefits
	• Temperature compensation and calibration provide an amplified signal, typically allowing removal of components associated with signal conditioning from the PCB, increasing space and reducing associated costs • Industry-leading stability often eliminates need for calibration after PCB mount, and periodically over time • Digital ASIC output in either I^2C or SPI protocols from digital sensors accelerates performance through reduced conversion requirements and the convenience of direct interface to microprocessors and microcontrollers • Multiple packaging, mounting, power, and signal options combine with customized calibration capabilities increases application flexibility

Flexible Heater Assemblies
These products are designed to conform to the infusion pump's surface that requires heating. They are capable of maintaining specific temperatures at desired levels. (See Table 3.)

Table 3. Flexible Heater Assemblies

A3400 Series, C3400 Series	Features and Benefits
	Although no standard product is available for this custom application, Honeywell offers a variety of material sets in heating elements, as well as insulation, to meet our customers' needs

Magnetic Sensor ICs
The robust and durable SS400 Series is designed to provide reliable, accurate output for smooth motor control that reduces noise and vibration in the pump's motor assembly and improves its efficiency. Its solid state reliability often reduces repair and maintenance costs, and its small size allows for design into many compact, automated, lower-cost assemblies.

Table 4. Magnetic Sensor ICs

SS400 Series	Features and Benefits
	• Quad Hall-effect design minimizes effects of mechanical or thermal stress on output and promotes a stable output • Unipolar, bipolar or bipolar latching magnetics and customizable operate/release points provide application flexibility • Negative compensation slope optimized to match negative temperature coefficient of lower-cost magnets, providing robust design over wide temperature range • Band gap regulation promotes stable operation over supply voltage range • Low power consumption enhances energy efficiency

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Infrared Sensors
These products are designed to be used with an encoder wheel on the pump shaft to count shaft rotation. They contain an infrared emitter and a photo detector that are mounted facing each other inside a plastic housing. Detection occurs when an opaque object passes through the package slot, interrupting the infrared path. (See Table 5.)

Table 5. Infrared Sensors

HOA088X Transmissive Sensors	HOA698X Optoschmitt (Transmissive) Sensors
	
Features and Benefits	
• Analog output • Variety of package styles and mounting options	• Digital output • Variety of package styles and mounting options

⚠ WARNING

PERSONAL INJURY
DO NOT USE these products as safety or emergency stop devices or in any other application where failure of the product could result in personal injury.
Failure to comply with these instructions could result in death or serious injury.

WARRANTY/REMEDY
Honeywell warrants goods of its manufacture as being free of defective materials and faulty workmanship. Honeywell's standard product warranty applies unless agreed to otherwise by Honeywell in writing; please refer to your order acknowledgement or consult your local sales office for specific warranty details. If warranted goods are returned to Honeywell during the period of coverage, Honeywell will repair or replace, at its option, without charge those items it finds defective. **The foregoing is buyer's sole remedy and is in lieu of all other warranties, expressed or implied, including those of merchantability and fitness for a particular purpose. In no event shall Honeywell be liable for consequential, special, or indirect damages.**

While we provide application assistance personally, through our literature and the Honeywell web site, it is up to the customer to determine the suitability of the product in the application.

Specifications may change without notice. The information we supply is believed to be accurate and reliable as of this printing. However, we assume no responsibility for its use.

⚠ WARNING

MISUSE OF DOCUMENTATION
- The information presented in this application note is for reference only. Do not use this document as a product installation guide.
- Complete installation, operation, and maintenance information is provided in the instructions supplied with each product.

Failure to comply with these instructions could result in death or serious injury.

SALES AND SERVICE
Honeywell serves its customers through a worldwide network of sales offices, representatives and distributors. For application assistance, current specifications, pricing or name of the nearest Authorized Distributor, contact your local sales office or:

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