

## Sensors and Switches in Valves and Flow Meters

An Application Note

### Background

Valves control or regulate the flow of gasses or fluids by partially obstructing, opening or closing the pipeline that carries the media. Valves are often used in oil and gas, mining, chemical manufacturing, water reticulation and mining applications. In many of these applications, the valves are operated manually by a lever, pedal or wheel. Automatic valves with diaphragms or pistons are often actuated by changes in pressure, temperature or flow.

Flow meters can measure and regulate volumetric flow, velocity from which the volumetric flow is determined, and mass flow. The turbine flow meter translates the mechanical action of the turbine rotating in the liquid flow around an axis into a user-readable rate of flow (gpm, lpm, etc.). The turbine wheel is set in the path of a fluid stream. The flowing fluid impinges on the turbine blades, imparting a force to the blade surface and setting the rotor in motion. Nearly all flow meters must be installed so that there is a significant run of straight pipe before and after the location of the flow meter. This is intended to allow the straight pipe run to “smooth out” any turbulence produced by the presence of valves, chemical injectors and diffusers, and changes in pipe direction. (See Figures 1 and 2.)

### Solutions

Honeywell manufactures many electronic sensors and electromechanical switches that may be used in valves and flow meters. They are designed to deliver system control, fluid level indication, temperature regulation, along with protection from overheating and starting/stopping the compressor. Honeywell components provide enhanced reliability, minimize down time, and improve robustness in most harsh environments. (See Figures 3 and 4.)

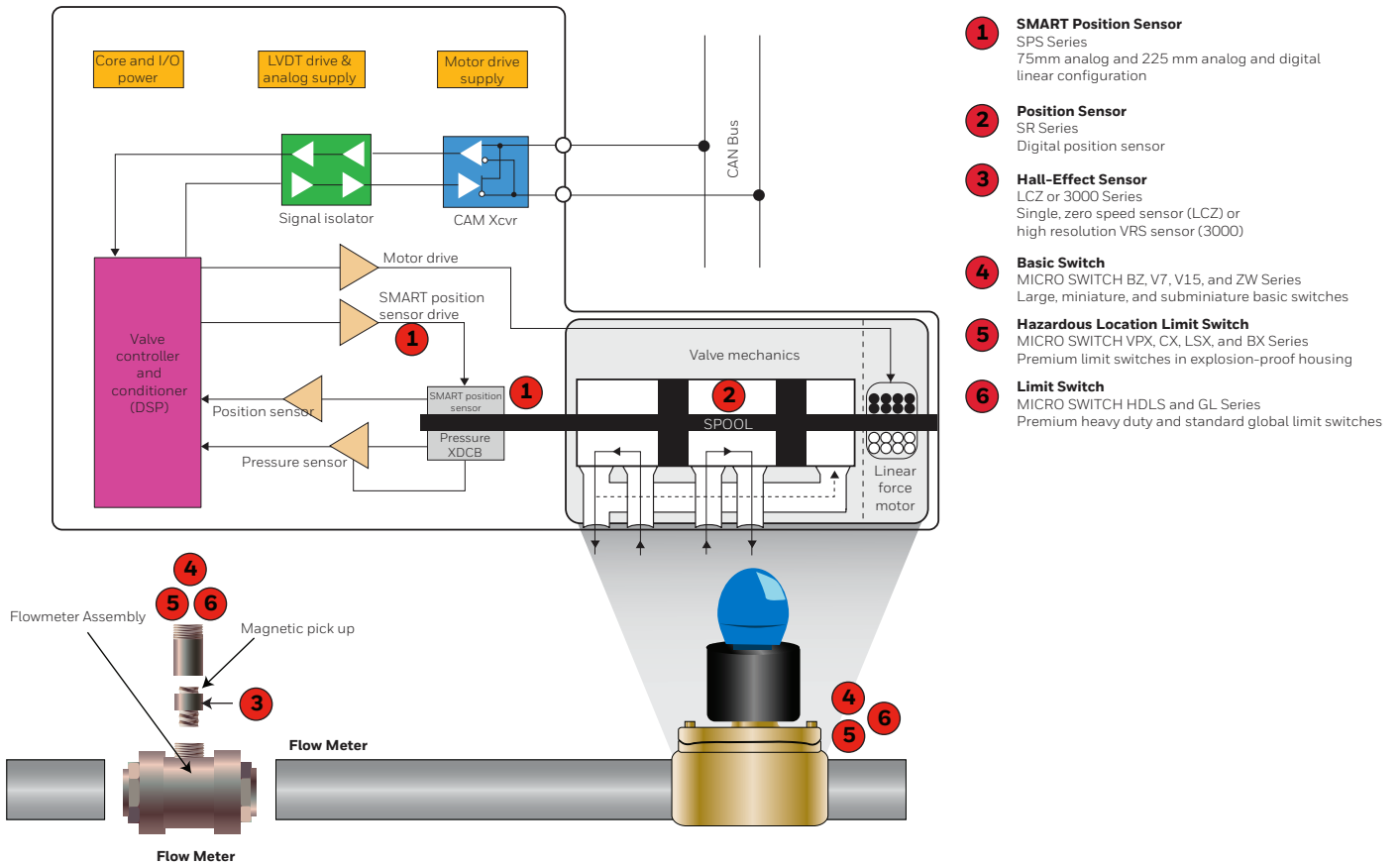
**Figure 1. Valves in a Bottling Factory**



**Figure 2. Flow Meter in a Gas Pipeline**

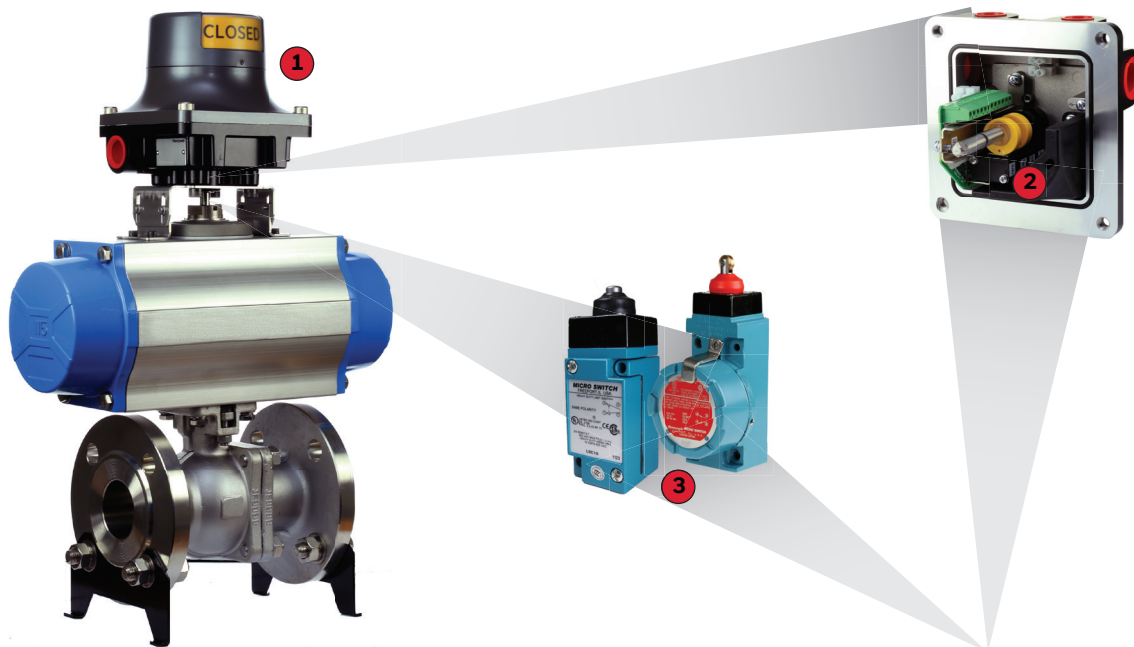


**Figure 3. Sensing and Switching Products Used in Valves and Flow Meters**



- 1 SMART Position Sensor**  
SPS Series  
75mm analog and 225 mm analog and digital linear configuration
- 2 Position Sensor**  
SR Series  
Digital position sensor
- 3 Hall-Effect Sensor**  
LCZ or 3000 Series  
Single, zero speed sensor (LCZ) or high resolution VRS sensor (3000)
- 4 Basic Switch**  
MICRO SWITCH BZ, V7, V15, and ZW Series  
Large, miniature, and subminiature basic switches
- 5 Hazardous Location Limit Switch**  
MICRO SWITCH VPX, CX, LSX, and BX Series  
Premium limit switches in explosion-proof housing
- 6 Limit Switch**  
MICRO SWITCH HDLS and GL Series  
Premium heavy duty and standard global limit switches

**Figure 4. Switches in Valves**



- 1 Explosion-Proof Valve Position Indicator**  
MICRO SWITCH VPX  
Valve position indicator in explosion-proof housing
- 2 Basic Switch**  
MICRO SWITCH™ BZ, V7, V15, and ZW Series  
Large, miniature, and subminiature basic switches
- 3 Hazardous Location Limit Switch**  
MICRO SWITCH LSX, CX, and BX Series  
Premium limit switches in explosion-proof housing
- 4 Limit Switch**  
MICRO SWITCH HDLS and GL Series  
Premium heavy duty and standard global limit switches



*BZ Series Large Basic Switch*

## MICRO SWITCH Basic Switches

MICRO SWITCH BZ, V7, V15, and ZW Series basic switches: Snap-action switches monitor the position of the valve handle by indicating if the switch is actuated. These switches are employed on valves used in non-explosive environments such as waste water treatment plants and/or other factory applications. (See Table 1).

Accepted as the world-wide standard “large basic” switch, MICRO SWITCH BZ Series switches are used for simple or precision on/off application needs. Through the use of optional seal plungers and covers, the BZ Series is capable of an IP67 rating and carries UL, CSA, ENEC, and CE global approvals.

With world-wide package size acceptance and designed to withstand 100k operations at full load, MICRO SWITCH V7 Series switches are used for simple or precision on/off, end of limit, presence/absence, pressure, and manual operator interface application needs. The V7 Series has CE, CSA, and ENEC approvals.

MICRO SWITCH V15 Series switches are similar to our V7 series, but are designed for applications requiring greater than or equal to 100 g of operating force and electrical ratings ranging from 16 A to 22 A. They have a water-tight option (V15W Series), and well as UL, cUL, ENEC, and CQC approvals.

MICRO SWITCH ZW Series subminiature basics are used for simple or precision ON/OFF application needs. These switches combine small size and light weight with ample electrical capacity and long life. This water-tight series seals to IP67 and has UL, cUL, CE, and ENEC approvals.

## Hall-Effect Speed Sensors

LCZ Series single zero speed sensor or 3000 Series high resolution VRS sensor: In flow meter applications Honeywell’s speed sensors measure flow by monitoring revolutions of the impeller (an inside propeller). Each revolution of the impeller equates to the delivery of a certain amount of fluid. For example, if the user sets a fluid level of five gallons per minute, the speed sensor counts the impeller rotation so that the correct amount of fluid is delivered.

Honeywell’s Hall-effect speed sensors use multiple technologies to detect a change in magnetic field to create an electronic signal for control system interface. These technologies offer the ability to detect speed, direction, or position of a moving ferrous metal or magnetic target. Sensing is accomplished without contacting the target, and there are no moving parts. This eliminates mechanical wear of the sensor or target.

The LCZ Series Hall-effect Single Zero Speed Sensor provides reliable information for flow control. Its fail-safe and diagnostics functions (variable reluctance technology) signal the control system to take contingency actions if there is a failure in the system.

The 3000 Series High Resolution VRS Sensor features self-powered operation and direct conversion of actuator speed to output frequency. It has simple installation and no moving parts.

## MICRO SWITCH Hazardous Location Switches

Hazardous-location limit switches in explosion-proof housings monitor the position of the valve stem or actuator. As these limit switches are enclosed in an explosion-proof housing, any flame path is extinguished inside which mitigates the risk of causing an explosion at the switch part. These switch components provide feedback for user to take action in order to prevent explosions in hazardous environments. Hazardous-location switches are employed in valves in outdoor, above-ground, potentially explosive environments such as oil and gas or water treatment applications.

Honeywell’s hazardous location switches are designed specifically for dangerous indoor and outdoor locations – where reliability and repeatability are essential.

MICRO SWITCH VPX valve position indicators are built especially for outdoor use in potentially hazardous atmospheres as they are rated to IP66, NEMA 4, 4X, 6, and 13. The switch enclosures are constructed to withstand the pressure of an internal explosion. Flame paths cool the exploded gases to a point less than the lowest safe operating temperature of the surrounding



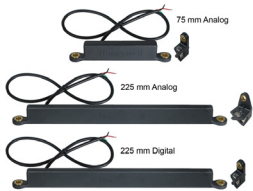
*LCZ Series Speed Sensor*



*VPX Series Valve Position Indicator*



HDLS Series Heavy-duty Limit Switch



SMART Position Sensor

gas. The VPX Series versions equipped with the inductive proximity switches has the Intrinsically Safe (IS) rating. VPX indicators carry cULus, ATEX (CE), IEC Ex, NEPSI, and KOSHA global approvals.

MICRO SWITCH CX switches are built especially for outdoor use in hazardous atmospheres as they are sealed to NEMA 1, 3, 4, 4X, 6, 6P, 13, and IP66. Flame paths cool the exploded gases to a point less than the lowest safe operating temperature of the surrounding gas. Suitable for global use, these switches have UL, CSA, ATEX (CE), IEC Ex, and IN METRO certifications.

The MICRO SWITCH BX enclosure is sealed for protection against corrosion, water, dust and oil as defined in NEMA 1, 3, 4, 6, 7, 9 and 13 and IP67 as defined in IEC 529. The MICRO SWITCH BX is ideal for outdoor use or in adverse environments where a combination of explosion proof plus sealing requirements is needed. BX Series switches are suitable for global applications: ATEX (CE), IEC Ex, NEPSI, IN METRO, KOSHA, EAC, and cULus approvals.

The MICRO SWITCH LSX withstands pressure of an internal explosion and cools the exploding gases below the kindling temperature of the explosive atmosphere. MICRO SWITCH LSX switches carry the same sealing rating as the BX Series, and are UL/CSa approved. They are for use either indoors or outdoors in hazardous atmospheres as they are a completely sealed, explosion-proof device.

MICRO SWITCH EX switches feature the smallest UL-listed housings available for use in hazardous locations and carry UL, CSA, ATEX (CE), and IEC Ex approvals. They are sealed to NEMA 1, 7, and 9, provide ample wiring space, and mount from four sides.

## MICRO SWITCH Limit Switches

Limit switches are employed to monitor the position of the valve stem or actuator. Primarily used on valves in non-explosive environments such as waste water treatment plants, power generation plant or other factory applications.

LSA Series heavy-duty limit switches boss-and-socket head design delivers secure head-to-body retention and unique all-metal drive

train for consistent operating characteristics even at high temperature. These switches last longer without the need for frequent adjustment. The self-lifting pressure plate terminals save wiring time. Standard switches are sealed to IP65/66/67, NEMA 1, 3, 4, 4X, 6, 6P, 12, 13, and carry UL, CE, CSA, CCC, EN60947-1, and EN60947-5-1 approvals. Stainless steel (NEMA 4X) and epoxy-filled washdown (NEMA 6P) types also available.

GLS Series switches offer a complete range of approved products and are suitable for valve applications. The IP66/67 standard product EN50041 features switch mounting centers as 30 mm x 60 mm. The miniature EN50047 offers users the choice of plastic, metal, and three conduit versions – all are mounting (20 mm x 22 mm) compatible with each other. GLS Series has global approvals: UL, CE, CSA, CCC, IEC 947-5-1, EN60947-5-1, and UL508.

## Position Sensors

In flow meter applications, Hall-effect magnetic position sensors are used to determine valve position.

SR Series non-contact position sensors are constructed from a sheet of conductive material with output connections perpendicular to the direction of current flow. Rugged, epoxy-filled plastic housing allows for potential use in corrosive environments.

In flow meter applications, the SMART Position Sensor is used to control the rate of flow going through the valve. One sensor can control flow rate by controlling valve position rather than used 100 to 200 valves throughout the plant, and reduces valve set-up time by 33 %.

SMART Position Sensors provide a self-diagnostics feature and data gathering for enhanced reliability and closed-loop feedback control.

They use a patented combination of an ASIC (Application-Specific Integrated Circuit) and an array of MR (magneto-resistive) sensors to accurately and reliably determine the position of a magnet attached to a moving object so that the object's position can be determined or controlled.

The MR array measures the output of the MR sensors mounted along the magnet's direction of travel. The output and the MR sensor sequence determine the nearest pair of MR sensors to the center of the magnet location. The output of these two MR sensors is then used to determine the position of the magnet between them.

With this sensor, Honeywell has utilized MR technology through the ASIC at a level never before accomplished.

## **⚠️ WARNING IMPROPER INSTALLATION**

- Consult with local safety agencies and their requirements when designing a machine control link, interface and all control elements that affect safety.
- Strictly adhere to all installation instructions.

**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 acknowledgment 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 that Honeywell, in its sole discretion, 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 Honeywell may provide application assistance personally, through our literature and the Honeywell web site, it is customer's sole responsibility 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 writing. However, Honeywell assumes no responsibility for its use.

### **For more information**

To learn more about Honeywell's sensing and switching products, call 1.800.537.6945, visit [sensing.honeywell.com](http://sensing.honeywell.com), or e-mail inquiries to [info.sc@honeywell.com](mailto:info.sc@honeywell.com)

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