

SENSORS & SWITCHES FOR VALVES AND FLOWMETERS

Application Note

Flow meters measure and regulate volumetric throughput and velocity providing critical information needed for optimum design and control of complex fluid and gas systems. Valves control or regulate the flow of gases or fluids by partially obstructing, opening, or closing the pipeline that carries the media.

BACKGROUND

When paired with a control element, flow meters and valves form the fundamental components of a control loop, essential for automated process control systems in industries like manufacturing, water treatment, and oil and gas, ensuring precise and reliable management of fluid and gas dynamics. Within the closed-loop control system:

- **Flow Meter (Measurement/Feedback):** Measures the actual flow rate and sends this process variable (PV) as a signal to a controller
- **Controller (Decision/Logic):** Compares the PV to the desired set point (SP) and calculates the necessary adjustment
- **Valve (Actuation/Correction):** Acts as the final control element, receiving the controller's signal to open or close, thereby adjusting the flow back to the desired set point

This synergistic operation allows industrial processes to maintain stability, safety, and product quality.

Often found at the heart of these complex and critical closed-loop systems are rugged, reliable, and proven Honeywell sensors and switches meeting the challenges of the most demanding environments.

APPLICATIONS

These switches and sensors are used across virtually all industries that rely on automated fluid control

- **Oil and Gas:** In pipelines, refineries, and offshore platforms to control the flow of hydrocarbons
- **Chemical Processing:** Regulating flow and ensuring safe isolation of various chemicals
- **Power Generation:** Used in control systems for boilers, turbines, and water treatment
- **Water and Wastewater Treatment:** Controlling valves for isolation and flow regulation
- **Manufacturing and Food & Beverage:** For various process automation tasks requiring reliable valve status

Honeywell



Electromechanical basic and limit switches are primarily used in the valve and actuator market segments for position sensing and feedback in automated industrial processes. Their main function is to provide a binary (ON/OFF) signal to a control system (like a PLC or DCS) to confirm that a valve or its actuator has reached a specific, predefined position, most commonly:

- Fully open
- Fully closed
- A specific intermediate position (e.g., for partial stroke testing or safety interlocks)

Key Applications in Valves and Actuators

Electromechanical switches are indispensable components in various industrial control applications:

1. Position Indication and Feedback

The most critical role is confirming the end-of-travel positions for automated valves operated by electric, pneumatic, or hydraulic actuators.

- On/Off control: For isolation or block valves, limit switches help ensure the valve is completely open or closed before the next step in a process sequence can begin
- Visual and remote status: Some products provide signals for remote monitoring and can be integrated into accessory units that offer local visual indication of the valve's status

2. Safety and Interlocks

Switches act as safety interlocks, preventing equipment from operating unless the valve is in the correct and safe position.

- System protection: In critical systems, an electrical signal from a limit switch can be used to trigger emergency shutdown procedures if a valve fails to reach its desired position or if an abnormal condition is detected
- Actuator protection: In electric actuators, specialized torque limit switches monitor the torque applied by the motor. If the torque exceeds a safe, set threshold (indicating the valve is seated, or there's an obstruction), the switch cuts power to the motor to prevent damage to the valve or the actuator itself

3. Actuator Movement Control

Within the actuator mechanism itself, basic or limit switches are often used to manage the motor's operation.

- Travel limits: In linear actuators, mechanical limit switches are installed at the ends of the travel path to automatically shut off the motor and prevent the actuator from over-extending or over-retracting beyond its designed limits, protecting the mechanical components

SOLUTIONS

Honeywell manufactures a wide range of sensors and switches, from simple on/off switches to electronic sensors 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.

Various package options are available, including stainless steel, and those designed for hazardous and harsh-duty applications.



Click here to view
Hazardous Area Limit Switches

Hazardous-location limit switches – These specialized switches perform a number of functions, including monitoring the position of the valve stem, actuator or wheel position, providing on-off position on manual process valves, providing real-time valve status information for improved productivity and safety. 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 the 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.



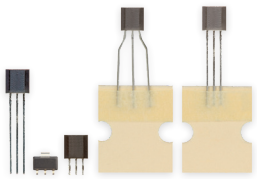
Read more about
MICRO SWITCH Limit Switches

Limit Switches – Employed to monitor the position of the valve stem or actuator, limit switches are primarily used on valves in non-explosive environments such as waste water treatment plants, power generation plant or other factory applications. —They also allows users to remotely monitor the valve stem, actuator lever, or wheel position for improved productivity and reduced total installed cost in hazardous locations.





Click here to view
MICRO SWITCH Basic Switches



Learn more about
Hall-effect Magnetic Sensor ICs

Basic Switches – "Basic" in name only, these 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 both non-explosive environments such as waste water treatment plants and/or other factory applications and also explosive/hazardous applications. In valve monitoring applications, basic switches perform position sensing on cams with no power consumption. In addition to valves, the Honeywell V15W2 Series is suitable for use in hazardous environments such as refrigeration, HVAC appliances, and paint booths.

Hall-effect Speed Sensors and Sensor ICs – 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. In valve monitoring application, Hall-effect sensor ICS measure position sensing on cams.

Position Sensors – In flow meter applications, Hall-effect magnetic position sensors are used to determine valve position. In valve monitors, position sensors deliver continuous position status with enhanced reliability and accuracy.

Pressure Transducers and Switches – In valve actuator applications, pressure transducers and switches measure the pressure of the diaphragm to help regulate and control the flow within the pipeline. The sensors can measure differential pressure by comparing values across the valve. They can also give an indication of valve position related to opening and closing by measuring the pressure value at that time.

Figure 2. Sensing and Switching Products Used in Manual Process Valves

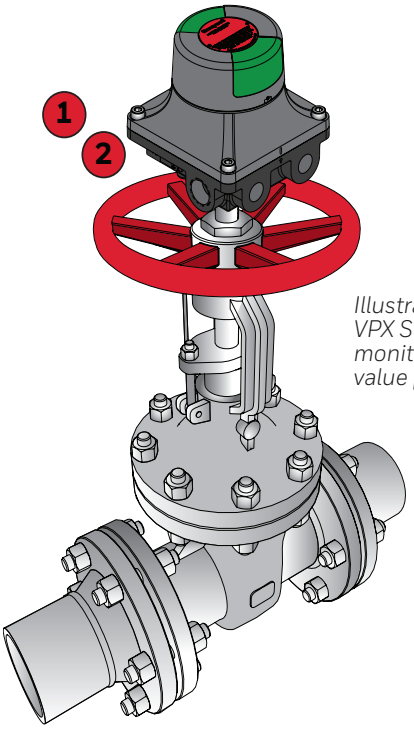


Illustration shown with VPX Series switch monitoring value position

1 **Hazardous Area Limit Switch**
MICRO SWITCH VPX/LSX/CX/BX/EX Series
Monitors valve stem, actuator lever, or wheel position, providing real-time position status for improved productivity and safety in hazardous locations

2 **Limit Switch**
MICRO SWITCH HDLS, GLS, and Double Break Series
Monitors valve stem, actuator lever, or wheel position, providing real-time position status for improved productivity and safety

INTEGRATED VALVE AND FLOW CONTROL SYSTEMS

In integrated valve and flow control systems, essential categories of components work together to regulate, actuate, monitor, and ensure hygienic flow of fluids:

1. Manual process valves
2. Valve actuators/positioners
3. Valve monitors/indicators
4. Valves and flowmeters
5. Sanitary and food/beverage valves

Manual Process Valves – Manual process valves in industrial facilities control the flow of liquid, gas, slurry, or steam. Eighty percent require operators to manually open, close, or otherwise control the valve. At any given time, users may not know the actual position of the valve. Process plants, including refineries, chemical, pharmaceutical, and water treatment plants as well as power generation installations, all need a better way to verify status with or without human intervention, especially in hazardous or hard-to-reach locations. (See Figures 2 and 3)

Valve Actuators/Positioners – A valve actuator is a pneumatic or electric mechanism used in process control systems to automatically open or close valves. Actuators can be used with either linear or rotary valves in industrial, medical, food/beverage, and transportation applications. In standard valves, when the valve is given a command to open to a certain point, there is no feedback to verify that it has opened to that position. Valve positioners utilize a source of power to operate and continuously adjust a valve. The power source can be a manual gearbox or an electronic device with control and measuring devices; Available with hydraulic, pneumatic, and electric operating mechanics, these are often used in pipelines, process plants and in remote areas. Postioners can be used for opening or closing a valve to control the rate of fluid flow based on a signal from a central control system. With a valve positioner, the command is given and the valve positioner reads the opening, verifies position, and readjusts (if necessary) to the exact position needed which allows for excellent precision in the valve setting. (See Figures 4 and 5)

Valve Monitors/Indicators – Mechanical or electrical valve monitors and indicators are used in process control to show valve position. They provide an electrical signal, and sometimes visual feedback, to accurately monitor and verify that a valve is in the correct position. Valve monitors are mostly used in conjunction with a valve positioner/actuator to provide information from remote locations that are not easily accessed, or where power isn't readily available. Potential applications include chemical, pharmaceutical, power generation and oil and gas processes. (See Figures 4 and 5)

Valves and Flowmeters – 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, 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 Figure 5)

Sanitary and Food/Beverage Valves – Sanitary and food and beverage valves are engineered for pressure control in sanitary (or "clean") environments. They are usually manufactured with stainless steel for sanitary and high-purity applications. These valves are often constructed as a ball valve around a fullbore design that ensures the product passes through the valve with no restrictions on the flow with minimal pressure drop.

Sanitary and food and beverage valves are often found in pharmaceutical, biotechnology, food and beverage, cosmetics, chemical and other industries where sanitary process control is required for steam, gases, and liquids such as water-for-injection systems.

Figure 3. Sensing and Switching Products Used in Manual Process Valves with Actuators

1. **Basic Switch**
   MICRO SWITCH BZ, ZW, V7, V15W2, and V15 Series
   Provides position sensing on cams with no power consumption
2. **Position Sensor**
   SMART Position Sensor
   Provides continuous position status with enhanced reliability and accuracy
3. **Hall-Effect Position Sensor IC**
   Hall-effect Series: 2SS, SS40A, SS41, 2SS52M, etc.
   Provides position sensing on cams

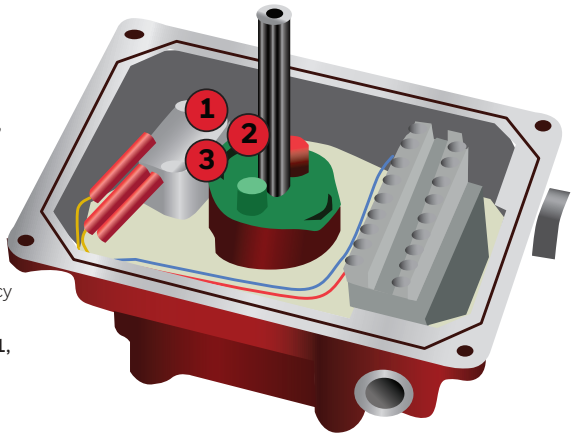
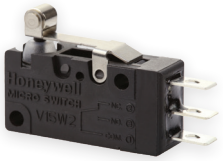
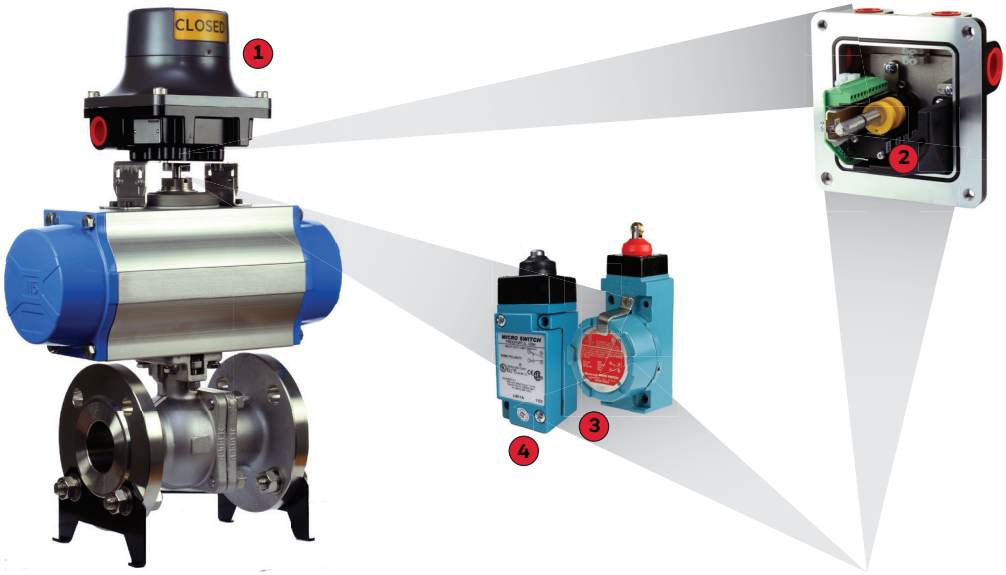


Figure 4. Switches in Valve Actuators and Positioners



Learn more about MICRO SWITCH Basic Switches





Click here to view VPX Series Valve Position Indicators

1. **Explosion-Proof Valve Position Indicator**
   MICRO SWITCH VPX • Valve position indicator in explosion-proof housing
2. **Basic Switch**
   MICRO SWITCH BZ, V7, V15, V15W2, 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, GL, and Double Break Series • Premium heavy duty and standard global limit switches

Figure 5. Sensing and Switching Products Used in Valve Actuators



Get details on the SMART Position Sensor family



Click here to view Pressure Sensors

1. **Hazardous Area Limit Switch**
   MICRO SWITCH LSX/CX/BX/EX Series
   Monitors valve stem, actuator lever, or wheel position, providing real-time position status for improved productivity and safety in hazardous locations

2. **Limit Switch**
   MICRO SWITCH HDLS, GLS, and Double Break Series
   Monitors valve stem, actuator lever, or wheel position, providing real-time position status for improved productivity and safety

3. **Position Sensor**
   SMART Position Sensor, SPS Series 75 mm Linear
   Monitors valve stem or actuator position

4. **Stainless Steel Media Isolated Pressure Sensor or Pressure Switch**
   MLH, PX2, or PX3 Series Pressure Sensor or LP or LE Series Pressure Switch
   Measures diaphragm pressure



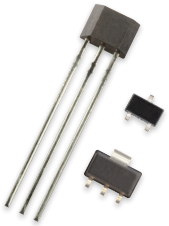
Valve Actuator

(Kammer valve actuator photo used with permission of Flowserve.)

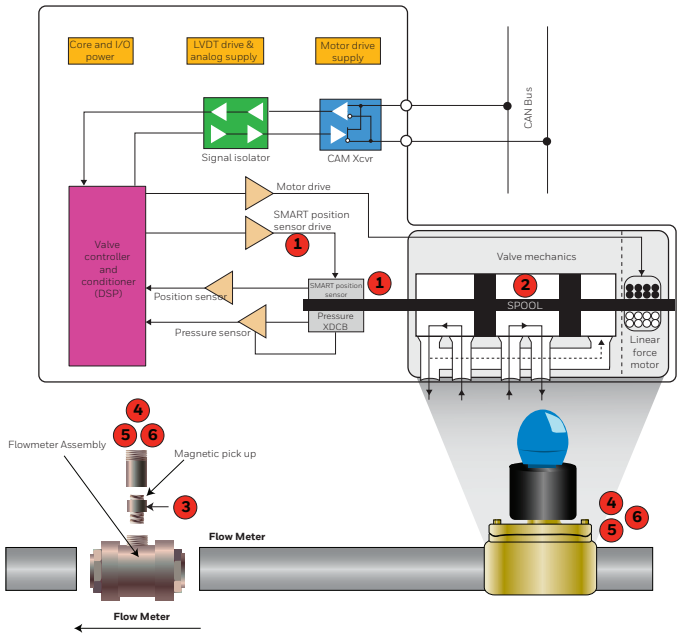
Figure 6. Sensing and Switching Products Used in Valves and Flow Meters



Find out more on Hall-effect Speed Sensors



More information available here on Hall-effect ICs



1. **SMART Position Sensor**
   SPS Series
   75mm analog and 225 mm analog and digital linear configuration

2. **Hall-effect 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, V15W2, 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, GLS, and Double Break Series
   Premium heavy-duty and standard global limit switches



⚠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 during the applicable warranty period. 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 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.**

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