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THIS MONTH'S FRONT COVER

WONDER®'s vision is to be a leading instrument brand in the oil & gas and energy industries by swiftly embracing cutting-edge technologies in process applications; consistently delivering flexible and efficient instrument solutions; and creating profits via continuously adding value in bridging the gaps between market expectations and user needs, technology advancements and industrial practices.

SELECTING COST-EFFECTIVE MOV ACTUATORS

Michael Li PanFeng, Wonder Engineering Technologies Ltd, Singapore, explains the importance of motor operated valve (MOV) actuators in process plants and addresses key selection criteria.

Selecting the right motor operated valve (MOV) actuator for a specific application within a process plant can be a complex task, involving various factors. Many users tend to play it safe by replicating past specifications, but this approach can lead to the plant being locked into a private communication protocol from a single manufacturer, resulting in compatibility issues and increased expenses. This article aims to provide an overview of MOV actuators, highlighting essential selection criteria. It also aims to demystify communication protocols, and explore industry advancements. The goal is to enhance user understanding of MOV actuator selection and empower users to make well-informed decisions.

An introduction to MOV actuators

An MOV actuator is used to control the operation of a valve using an electric motor. The MOV actuator transforms a control signal into physical movement, allowing the valve to perform actions such as opening, closing, or changing its position.

MOV actuators are widely used in industrial processes, heating, ventilation, and air conditioning (HVAC) systems, water treatment facilities, and other scenarios requiring precise control over fluid flow. They automate valve operations, potentially enhancing efficiency, accuracy, and enabling remote control capabilities.

Control signals for an actuator can be generated from various sources, including manual switches, programmable logic controllers (PLCs), or distributed control systems (DCS).

Considerations

The optimal MOV actuator, from a user's perspective, depends on the specific needs and requirements of their application. Besides typical industry certifications, a solid track record and proven reliability, users commonly prioritise the following commercial factors during the selection process:

- Budget considerations and cost-effectiveness: an ideal actuator should balance features and performance with associated costs while maintaining quality.
- Compatibility and scalability: the actuator should be compatible with the user's existing control system, communication protocols, and necessary accessories.
- Local support and maintenance costs: access to local post-sales support, including technical assistance and on-site troubleshooting, is crucial. Additionally, minimising maintenance expenses during turnarounds is essential for overall cost assessment.

By carefully evaluating these factors, users can navigate the complexities of selecting an MOV actuator that aligns with their operational goals, ultimately improving efficiency and system performance.

Selecting the appropriate MOV actuator

Choosing the right MOV actuator requires consideration of several critical technical factors to ensure a suitable match for the intended purpose. For in-kind replacement projects, sharing existing MOV specifications with the vendor may suffice. However, for new installations, the following technical aspects should be considered:

- Valve type and application: identify the valve type (e.g., ball valve, gate valve, butterfly valve) and its intended application (on-off control, modulating control, emergency shutdown).
- Load, torque, and thrust requirements: different valves have varying torques and movement requirements. It is important to consider both standard and extreme conditions to determine the forces or torques needed to operate the valve load in the specific application. This assessment will help users to choose an actuator with the appropriate rating and capacity.

Figure 1. Field commissioning of Wonder MOV actuators.

- Speed and response time: evaluate the desired valve operation speed and response time. Some situations require rapid, high-speed action, while others demand precise, controlled movements or closing in stages.
- Communication protocol: identify the communication protocol necessary for seamless integration with your control system, whether it is Modbus, PROFIBUS, DeviceNet, or other private protocols.
- Control system compatibility: ensure the selected actuator aligns with your existing control system, whether it is manual switches, PLCs, DCS, or other setups.
- Integration with accessories: verify compatibility and ease of integration with accessories such as positioners, limit switches, feedback devices, and the coupling adapter with the existing valve stem.
- Power source: verify the required actuator's power source to fit the site requirements, considering availability and appropriateness.
- Mounting and space: consider available installation space and mounting options tailored to your valve and application specifics, including factors such as handwheel access, LCD screen orientation, and fireproof jacket installation.
- Operating environment: account for environmental conditions where the actuator will operate, including temperature, humidity, dust, and corrosive substances, which influence material selection and actuator construction.

By meticulously assessing these factors, the process of selecting an MOV actuator becomes a strategic endeavour, aimed at achieving seamless functionality and optimal performance in process plants.

The myth of actuator selection

In industries like oil and gas, tradition often reigns supreme, with a preference for sticking to what is already in place. When it comes to picking MOV actuators, technical engineers often find themselves puzzled by private communication protocols. The traditional private or labelled as 'proprietary' protocols are sometimes wrongly believed to be a must-have. Unfortunately, this mindset limits choices to certain dominant manufacturers and drives up costs.

In reality, the key to choosing any field instrument, including an MOV actuator, lies in open protocols and compatibility. This approach prevents users being locked into a single manufacturer, where proprietary protocols will force users to rely solely on them for instruments and support, ultimately leading to higher costs and often deteriorated levels of support over time.

The confusions surrounding traditional private communication protocols contribute to this issue. Users lack a complete understanding on this matter, leading to conformity to try and avoid issues. In the following discussion, some aspects of the mysterious private protocol used by the MOV actuator will be uncovered.

The traditional private protocol for MOV actuators is based on a current loop communication architecture. This approach emerged at a time when advanced bus technologies and high-quality communication cables were yet to be developed. This protocol relies on a current loop to transmit signals and control commands between the control system and MOV actuators.

In a current ring loop, each actuator connects to a current loop that carries control signals. The current level in the loop corresponds to a specific setpoint or command for the actuator. While this communication method was common in industrial applications due to its ability to transmit signals over long distances before the development of the digital communication, it has limitations in terms of information capacity and data transmission speed when compared to modern digital communication methods.

- Slow data transmission: compared to modern digital communication methods such as Modbus, current loop communication is relatively slow. It does not support real-time data transmission. A typical current loop operates at a baud rate of only 2400 when connecting fewer than 15 units. If more than 15 units are connected, the baud rate drops to just 1200 to 300. On the other hand, with the Modbus protocol, the typical baud rate is 9600, or rising to 19 200 when connecting within 30 units. The refresh rate is 500 msec. for quantities ranging from 30 to 60 units per loop. Such speeds are unattainable in current loop communication.
- Scalability and hardware dependency: the viability of current loop communication largely depends on the compatibility of hardware components, including both actuators and control equipment. The ongoing development and evolution of private protocols are entirely at the discretion of the manufacturer. Without consistent investments in development, this protocol inevitably becomes outdated.
- Cost implications: current loop protocols come with added expenses including licensing fees, specialised hardware, and software requirements, which can increase costs, including ongoing maintenance expenses. Notably, the lack of competition in the realm of communication protocol isolation can lead to higher prices. For instance, a typical actuator overhaul by such a manufacturer can cost as much as half the price of a new unit due to limited alternatives with the same communication protocol. Moreover, transitioning to a new protocol or system can prove to be even more complex and costly, necessitating the replacement of existing infrastructure.
- Manufacturer dependency and integration challenges: while new actuator manufacturers have embraced open protocols as the industry standard, traditional manufacturers continue to produce actuators that rely on outdated current loop communication. Unfortunately, these protocols offer no discernible benefits to end-users. The continued use of current loop-based design limits compatibility with third-party actuators, leading to integration challenges and compatibility issues. Consequently, this fosters a reliance on a single manufacturer for hardware, software, and maintenance support.

In reality, all MOV actuators available on the market are able to support open protocols. However, some manufacturers may not actively promote open protocols unless explicitly requested by the user. In some cases, certain manufacturers may try to steer users toward defining current loop protocol as mandatory, potentially positioning themselves as the exclusive vendor. This is a common sales tactic often seen in the MOV actuator market.

Advancements in the industry

In recent decades, the industry and technology have made significant progress, bringing about substantial improvements through the adoption of open protocols. This progress is especially evident in bus technologies such as Modbus, Profibus, and Foundation Fieldbus. These advancements have enabled MOV actuators to establish direct connections with DCSs or operate through a master station based on the open Modbus protocol.

Successful implementations

Wonder Engineering has recently completed successful revamp projects in Malaysia and Singapore. These projects involved replacing existing MOV actuators and adding new ones onto manual valves. Communication was established with various DCSs, including those from Honeywell, Emerson, and Yokogawa, using various protocols such as hardwired connections, Modbus, and FOUNDATION Fieldbus.

Modbus-based master station

The field communication controller for MOV actuators, often called the master station, plays a crucial role in creating a field ring loop with redundancy capability and connecting back to DCS. It is developed based on the Modbus communication protocol, ensuring full compatibility with MOV actuators from different manufacturers using the same Modbus protocol.

Communication between the master station and DCS is transmitted through either Ethernet or RS 485. The DCS extracts MOV data from the master station's real-time database, with the DCS acting as the 'master' and the master station as the 'slave'.

Based on project experiences, Wonder established that a single master station, using an open protocol, can connect to

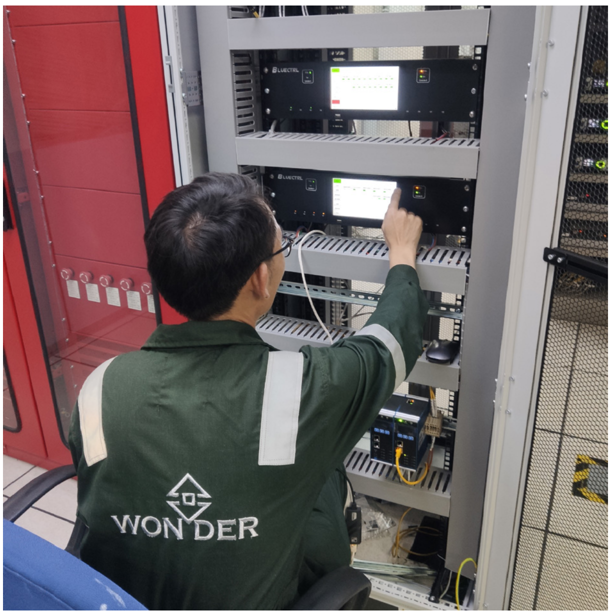

Figure 2. Field configuration for master station using Modbus RTU (RS-485).

either up to four single ring loops or two redundant ring loops. This allows for grouping of MOVs, with quantities reaching up to 120 units per ring loop. This capacity can be expanded to accommodate up to 250 units through software expansion. A redundant master station offers hot-swappable capabilities.

Each loop can communicate over a maximum distance of 30 km, thanks to the built-in repeaters in the MOV actuators. These repeaters are recommended for actuators located at distances of 750 m, as communication distances can reach up to 1.2 km for the Modbus protocol.

The long-distance communication loop maintains high baud rates of 9600 or 19 200, which is significantly faster than Current Loop communication, operating at slower baud rates of 2400 or 1200.

The scanning time for each MOV ranges from 50 msec. to 80 msec., while the response time of the MOV is approximately 50 msec. to 80 msec. after the DCS initiates the command. Cable length has a negligible influence on time, less than 1 msec., making it inconsequential in this type of loop communication.

Signal repeater module and communication board

Signal repeater modules are plug-and-play units located behind the communication board. Default settings include redundant repeaters. Slave addresses are stored on the main board behind the LCD screen, unaffected by signal repeater swaps. The modular loop communication board employs a three-way connection within each actuator, ensuring that any out-of-service MOVs will not impact communication within the same loop.

Access to the communication board(s) is possible online. Additionally, an optional built-to-order field communication connection is available, featuring a plug-and-play interface. For added safety, a separate explosion-proof-rated communication chamber can be provided, complete with matching covers for both the connection head and actuator side.

Conclusion

Considering the ongoing advancements in communication and hardware technologies, the complexity of MOV actuators has significantly decreased. Choosing an MOV actuator that adheres to an open protocol is a wise decision. This choice prevents end-users from becoming dependent on a single monopoly manufacturer or brand that operates on a private protocol.

By carefully considering the technical aspects and avoiding any private protocols mentioned in an inquiry, it is possible to position oneself as an end-user in control. This approach guarantees a cost-effective solution while maintaining mastery over a system.

The role of qualified electrical and instrumentation engineers in today's industrial sector extends beyond ensuring that the instruments selected for the plant function correctly. It involves continuously studying the overall development of electrical and instrumentation technologies in the industry. This includes gaining a clear understanding of the fundamental technical differences in instrumentation products and being able to discern any traditional, outdated practices and sales misrepresentations by a vendor. The goal is to genuinely assist operation in selecting instruments that are stable, offer high cost-effectiveness, and are suitable for the plant. This prevents plants from falling into the pitfalls of high costs, reliance on a single manufacturer, high maintenance expenses, and low-quality post-sales service.

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- Open protocol
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