Quo vadis pressure switch – mechanical or electronic?

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For decades, many manufacturers and users in the machine-building industry have trusted the proven mechanical pressure switch technology for the control of fluid circuits. Although the technically superior electronic pressure switch has been winning market share for many years, the extinction of the mechanical pressure switch is still not in sight. This article attempts to unscramble this paradox and explain why even today one cannot imagine the market without mechanical pressure switches.

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Pressure switches have always had an important role in the control of fluid circuits, especially those containing hydraulic, pneumatic or cooling fluids. But what is meant by pressure switches and why are they so essential for the control of fluid circuits?

In its simplest definition, a pressure switch is a measuring device that converts a measured system pressure into an electrical switching signal which can then be further processed by a control system (PLC). Independently of whether it is a mechanical or an electronic switch, a pressure switch always outputs a binary signal. In practice, a pressure switch is inherently inactive until a set switch point has been reached (e.g. pressure = 10 bar), at which the pressure switch outputs the switch signal and thus changes its switching status. Put simply, a pressure switch opens or closes an electrical circuit (depending on its design and/or setting) when it reaches a defined switching point.

How do mechanical pressure switches work?

Despite their identical mode of operation (opening/closing an electrical circuit), mechanical and electronic pressure switches differ significantly in their design and how the switch points and switching functions can be set.

Mechanical pressure switches convert the process pressure, via a mechanical motion, into an electrical signal. In the design of a mechanical pressure switch it can be seen that the process pressure mechanically transmits the motion of a measuring element to a plunger, thereby actuating a switch contact. The counter-force of a spring (adjustable via a grub screw) acts against this process pressure, respectively against the force of the process pressure and thereby against the plunger movement. This counter-force corresponds to the set pressure limit or the switch point at which the plunger mechanically opens or closes the contact and thus activates the defined switching signal.

01 **Mechanical OEM pressure switch (model PSM01) (left); design of a mechanical pressure switch, simplified (right)**

Functioning of electronic switches

Electronic pressure switches, however, do not require any mechanical motion by a contact to generate a switching signal. The process pressure mechanically deforms a diaphragm, and with it a resistive sensor element, within the pressure connection of the electronic pressure switch. The sensor element generates a signal from the deformation which is electronically measured, processed in a microcontroller and then converted into an electrical switching signal. Switch point, reset point and various other switching functions can be set flexibly on the pressure switch itself through buttons and a display, through external software or through a configuration module. An electronic switch is, therefore, more flexible in operation than a mechanical pressure switch and can be specifically matched to the respective application.

02 **Electronic pressure switch with display (model PSD-30) (left); design of an electronic pressure switch, simplified (right)**

Strengths of mechanical and electronic switches

Mechanical pressure switches have been proven over decades in countless applications and are indispensable within the machine-building industry. However, the rapid growth of electronic pressure switches stresses to everyone involved in the design of new systems and machinery that the critical question to be answered is whether to continue using mechanical switches or to integrate the machinery deeper into the supervisory control level. In order to find an appropriate solution for the individual application, the following key differentiators and specific strengths of the various switch technologies must be considered:

- simple construction, cost-effective
- no power supply required
- direct and alternating currents can be switched
- large switching currents can be switched without additional relays
- simple mechanical switch point setting
- electrical integration without analogue input cards – many PLCs offer pre-installed binary inputs
- cost-effective solution for redundant safety functions

The strengths of electronic switches are:

- switch and reset points, switching outputs and switching functions can be set flexibly
- switch point setting without calibration stand and pressurisation of the system
- through local adjustability without demounting
- almost unlimited number of switching cycles delete if required
- no moving mechanical components
- high reliability and long-term stability
- shock and vibration resistant
- high adjustment, switch point and repeatability accuracy

Both mechanical and electronic pressure switches have numerous strengths in themselves, which enables a wide range of applications for both technologies. However, the choice for or against a mechanical or electronic pressure switch is quite simple.

A suitable solution for any application

While the pure function of switch point monitoring can be fulfilled equally by both technologies, nevertheless, mechanical pressure switches are primarily destined for simple safety applications.

Particularly in applications where there is a safety function which is required very infrequently, mechanical pressure switches have an advantage, since they can open or close an electrical contact without a power supply (for example, in the monitoring of pumps and drives or when a system loses pressure). Last, but not least, price-sensitive applications such as simple hydraulic equipment, often still rely on mechanical pressure switches for simple control and monitoring functions.

Electronic pressure switches offer unlimited flexibility

Where mechanical products offer a very limited capacity for adaption, due to the maximum of one switching output and low control functionality, an electronic pressure switch is almost unlimited in the way it can be adapted to the respective application. From a "simple" factory-configured electronic OEM switch (with predefined switch and reset points, switch delay times and switching functions) which is primarily suited to high-volume applications, through to the flexibly adjustable pressure switch with keys and display for custom configuration to the machine, electronic pressure switches offer almost unlimited flexibility in their adaptability to the application.

Applications that require reliability, accuracy and long-term stability make electronic switches indispensable. Whenever a machine tool must cut precision geometries with the smallest tolerances, or a cooling system must be controlled accurately for maximum energy efficiency, electronic switches are the first choice.

Current trends

While mechanical pressure switches are using a proven and mature technology, most of the product adjustments from the mechanical pressure switch producers focus primarily on the issue of quality and cost. Manufacturers of electronic pressure switches, however, rely on high rates of innovation and functionality enhancements.

Electronic pressure switches featuring a display and buttons for adjustments were also introduced into the market many years ago and are still state-of-the-art. Recent innovations, in particular, improve the usability of pressure switches, extend existing functionality and improve integration into the supervisory control level.

Electronic pressure switches are based on the same design principle as a pressure transmitter. Thus, it stands to reason to combine the properties of a pressure switch and those of a pressure transmitter. In recent years, a variety of new products combine analogue output and switch output signals in one instrument as an electronic pressure switch – increasingly with an integrated display. The trend of continuously monitoring process parameters in parallel with safety functions and, additionally, a local display unit for installation and maintenance, all in a single instrument, has achieved rapid market penetration. The combination of up to three devices into a single electronic pressure switch leads to great savings in sourcing, installation costs and provision of the mechanical and electrical interfaces.

Finally, but importantly, the IO-Link protocol for configuration, diagnostics and data query "down-the-wire" via the connection cable is a prime example of how electronic sensors and pressure switches are being developed to increase the user friendliness.

Mechanical pressure switches, without a doubt, will maintain their right to exist in the future and will continue to maintain a high importance and share in the market, especially in cost-sensitive applications and with simple safety functions. Nevertheless, electronic pressure switches will continue to displace mechanical pressure switches from the market and will show a continued strong growth.

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About

Company name: Wika Alexander Wiegand SE & Co. KG
Headquarters: Klingenberg, Germany
Turnover: € 750 Mio. (Wika Group)
Employees: 7,900 (Wika Group)
Products: pressure, temperature and level measurement, primary flow elements, calibration technology