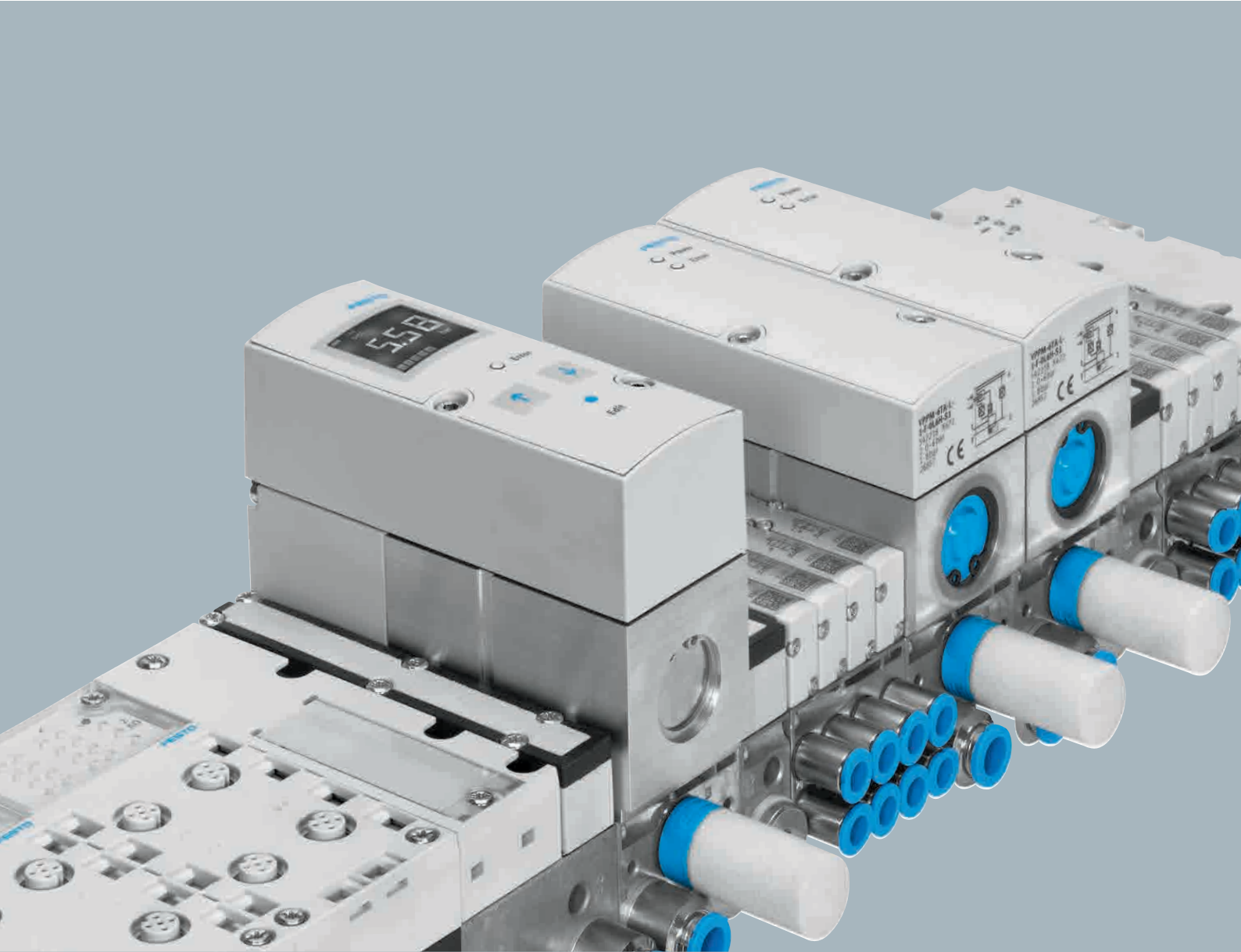


Proportional pneumatics



Secure your advantage and create new potential

You want expertise.
You are looking for innovation.
We are the specialists in your industry.

→ **WE ARE THE ENGINEERS
OF PRODUCTIVITY.**



Page 4

Introduction and operational principle

Page 6

Product descriptions

Build on your technological advantage!

Enabling you to gain that extra edge over the competition has always been our main objective at Festo. As a driver of innovation in the field of pneumatics, Festo thus offers a wide range of proportional pressure and directional control valves. This will allow you to realise even the most complex of applications safely and easily.

Page 22

**The complete product range
at a glance**

Page 24

Application examples



Aim for higher productivity ...

... with our expertise in proportional technology. You will benefit from a huge choice of individual solutions and functions at the best possible price while keeping installation, parameterisation and commissioning to a minimum. Everything is generally preset at the factory, and the built-in technology also takes time-consuming routine tasks off your hands. Our new proportional valve VPPX is recommended ...

... if you ...

... want to keep your prices competitive.

... want a high level of control precision.

Reliable communication!

VPPM with IO-Link interface communicates using a point-to-point connection. The benefit to you is that there are no conflicts, since the communication only takes place between the valve and the master.

The fieldbus connection is also quick to set up: every master that communicates with the VPPM IO-Link can be connected to an existing bus system.

Stable control behaviour, three presets

VPPM IO-Link offers the same performance as an analogue valve. Stable control behaviour, even in the small signal range, is guaranteed by the tried-and-tested cascade control system with two sensors. The version with IO-Link also has three presets that can be used as required.

Open to all fieldbus protocols

The convenient bridge to individual fieldbus connection: with an I-Port or IO-Link interface, the individual valves are open to all fieldbus protocols. The high-speed data rate of 230 kB/s and cycle times of 0.4 ms between the master and the device mean that even complex data packets can be transmitted quickly and securely. The valves can also be controlled using the CTEL from the CPX or any IO-Link module commonly found on the market.

Large product portfolio

The familiar VPPE and VPPM series are part of the new generation of proportional valves. And now a new range of valves, based on the VPPM and VPPX series, has been developed

with a built-in IO-Link interface. These operate in the “standard pressure control range” of up to 10 bar. Another new product is the high-pressure valve VPPL for up to 40 bar. With a nominal width of 2.5, the VPPL can be operated as a stand-alone valve, as a pilot valve with a directly flange-mounted booster PREL, or with another pressure control valve piloted using external air, such as the MS9 -LR...PO.



Proportional valve
VPPM-12L ... LK



Proportional pressure
regulator VPPM



Proportional pressure
regulator VPPM
IO-Link

... prefer valves with low internal air consumption.

... always want the latest valve technology and electrical communication.

... want to optimise your control process and regulate pressure reliably, precisely and with high dynamic response using proportional pressure regulators.

... want to control not only the pressure, but also other physical variables. With VPPX, you can control almost any physical variable that is affected by air or an actuator.



Proportional pressure regulator VPPL

Pressure or flow rate

Whether the pressure rise for your application is highly dynamic or subtle, and the pressure range standard or customised – with proportional technology from Festo, you can't go wrong.

User-friendly

With a selection of 3 different presets, we can offer the right parameters for almost any application – fast, normal or slow.

Integration possible

Integrating VPPM into the valve terminal combination CPX/MPA opens up a host of new possibilities for you – in terms of both electrical communication and pneumatics.

Versatile and high-performance

With settings such as pressure range and digital outputs, the VPPM can easily be adapted to suit your process. The VPPX offers top process quality and versatility with individual adjustment options such as PID controller, nominal and actual inputs and outputs, and an external sensor output.

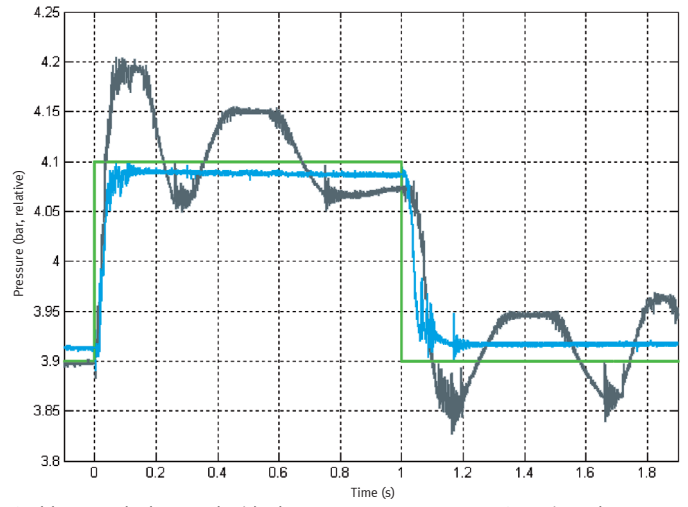
Your technological advantages in detail:

- Multi-sensor control for maximum precision
- Electrical and pneumatic function integration and extensions with VPPM on CPX/MPA
- Variable pressure zone regulation for greater flexibility
- 3 presets for simple control
- Multiplexing with CPX/MPA
- External sensor input for VPPX
- IO-Link

Performance with maximum precision

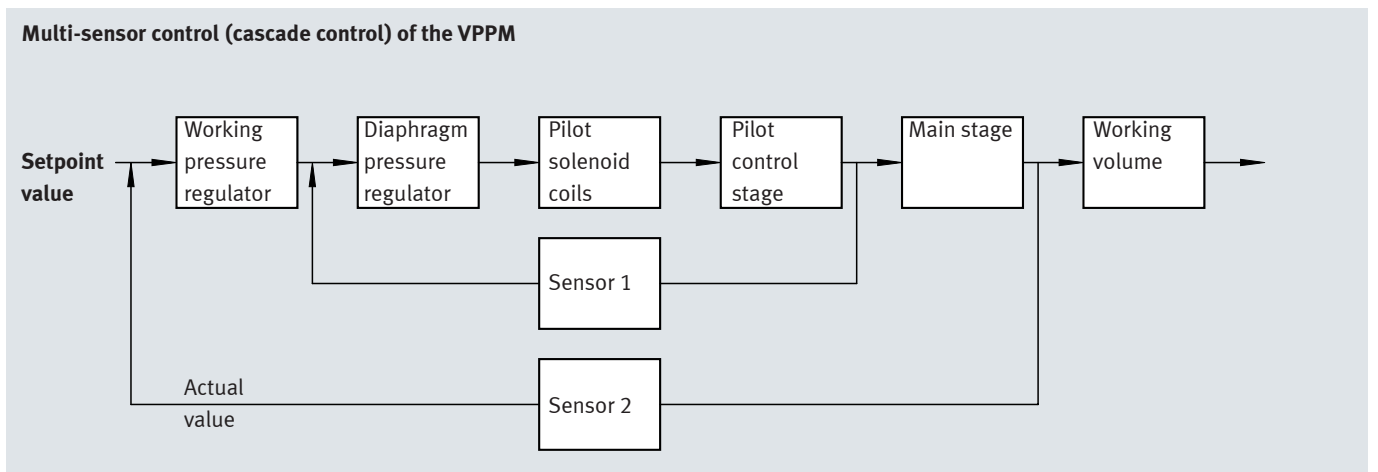
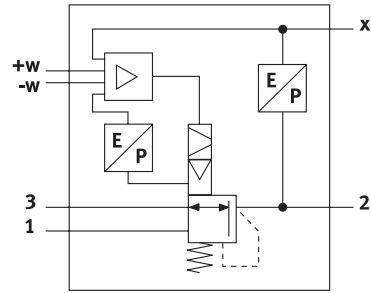
Unique on the market:
Cascade controller with integrated multi-sensor control
 With this technology, built-in sensors provide steady control, even in the small signal range. The controller is also temperature-compensated so there is no drifting when the temperature fluctuates. This is based on the principle of cascade control. Multiple control circuits are nested inside each other, and the entire controlled system is divided into two smaller sub-systems that are easier to control. This greatly increases the control precision compared to conventional, simple "standard controllers".

- Benefits**
- Greater control precision and dynamic response compared to single-acting controllers
 - Unaffected by temperature fluctuations
 - Precise, even over long distances



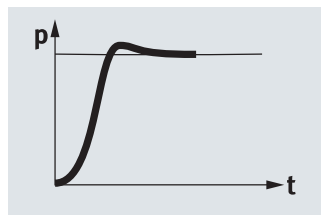
Stable control: close to the ideal setpoint curve with multi-sensor control

- Setpoint value
- Working pressure curve "single controller"
- Working pressure curve "cascade control"

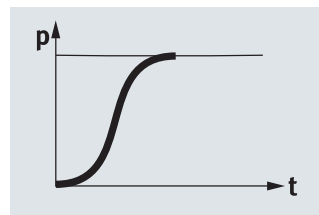


Ease of use

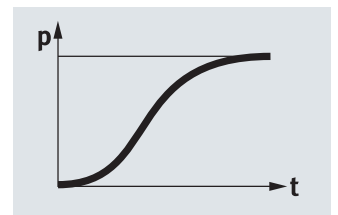
Functional and clear



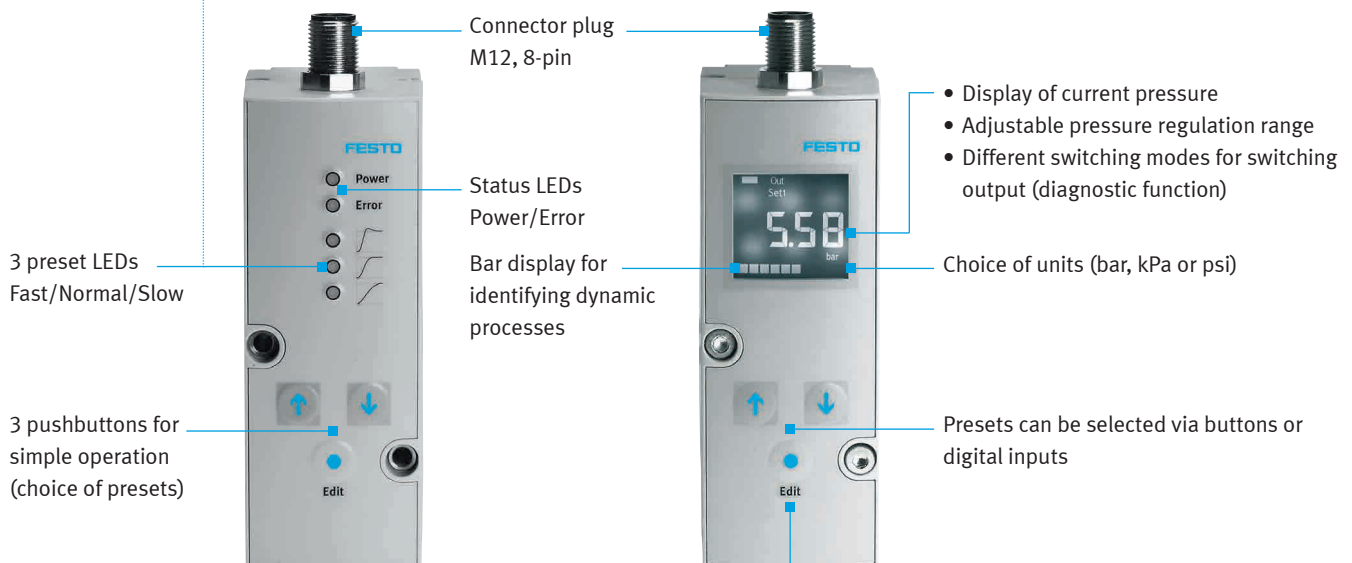
“Fast” mode
For applications that require large volumes of air for pressure adjustment.



“Normal” mode
For applications with medium air volumes.



“Slow” mode
For applications that only need small volumes of air to be supplied or vented within a set control time.



Maximum ease of use
The right parameters for each application – simply choose from 3 presets at the press of a button, activate, and you're done!

High-tech, user-friendly and functional: make the most of it!

Custom solutions with the modular system

The proportional pressure regulator VPPM can be adapted to suit your requirements perfectly. It has everything you need for reliable, precise control: presets and a multi-sensor control system. Choose from the inline or flanged version, LED or LCD display or setpoint specification in current or voltage.

New: our VPPM IO-Link for simple point-to-point connection.

Want more? Integrated into the electrical terminal CPX-MPA, VPPM enables many additional diagnostic functions and variable pressure zones.

Operational safety, easy service and assembly

- Pressure is maintained if the supply voltage fails
- Wire break monitoring
- Long service life, tested units
- Choice of assembly methods: manifold block, H-rail mounting or individual mounting using mounting brackets

- Easy valve replacement and extension of the valve terminal
- Energy efficient:
 - Holding current reduction in pilot valves
 - Minimum power consumption in corrected state
 - Pressure zone regulation to the exact pressure required
 - Once the setpoint value has been reached, no further power is required to maintain the pressure

Add extra value to your processes with VPPM and its custom expansion options.



Proportional valve VPPM-LED



Proportional valve VPPM-LCD



Proportional valve CPX-MPA

Multiplexing: same functionality with fewer proportional valves

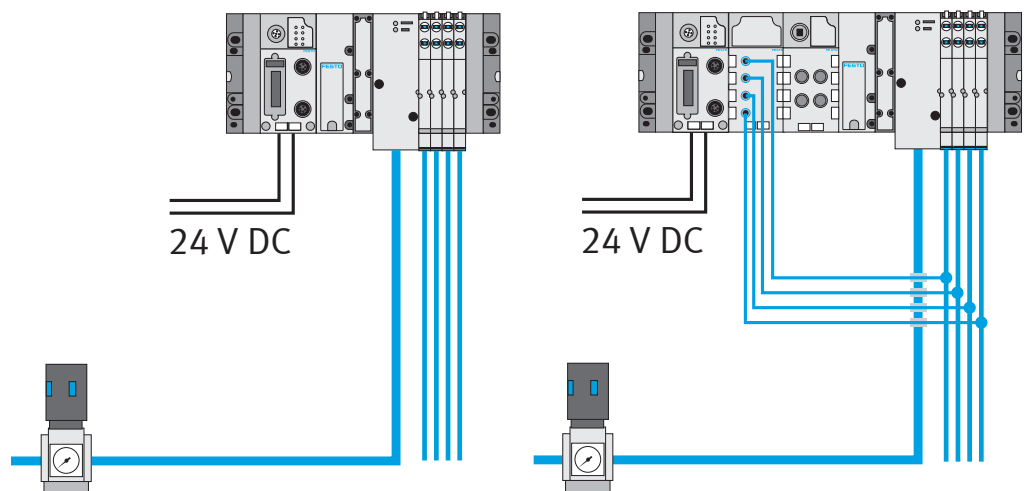
Added performance with functional integration

- Significantly reduced system costs
- Less installation effort
- Tested and preassembled module

Multiplexing saves up to 8 proportional valves per valve terminal. The process is simple: with multiplexing, multiple pressures are sequentially transferred to various actuators through downstream directional valves. This makes it possible to control up to 8 directional control valves on the valve terminal MPA with one proportional valve, depending on the application

and connection frequency. Multiplexing is significantly cheaper and more efficient than a conventional design.

There are two types of multiplexing: time-controlled and pressure-controlled.



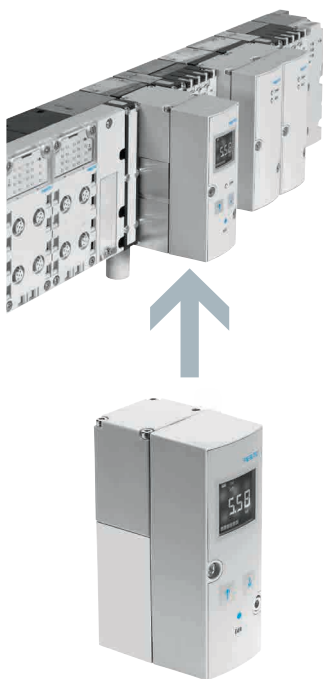
Time-controlled

The output pressure of the VPPM is assigned to a suitable consumer via a 3/2 or 5/3-way valve. Instead of being monitored, the pressure is adjusted according to a specific time schedule.

Pressure-controlled

The output pressure of the VPPM is assigned to a suitable consumer via a 3/2 or 5/3-way valve. The pressure is monitored by a sensor module and adjusted depending on how much it drops.

VPPM in combination with CPX/MPA: Perfect interaction for added functionality



Proportional pneumatics on the fieldbus: innovation through functional integration

When integrated into the electrical terminal CPX/MPA, the VPPM/MPA opens up a variety of additional pneumatic and electrical functionalities to the user. Individual, modular and configurable at all levels.

These include the fast operating status check on the VPPM-MPA 1/4" with display for

- Pressure
- Setpoint/actual value
- Error codes

Optional: the display can be shut off.

Communication on all levels

The VPPM-MPA on the valve terminal CPX/MPA offers access to all conventional, open fieldbus and Industrial Ethernet systems.

Thanks to

- PROFIBUS
- DeviceNet
- InterBus
- CANOpen
- Sercos III
- POWERLINK
- CC-Link
- Modbus/TCP
- EtherNet/IP
- PROFINET
- EtherCAT

communication is standardised and consistent, from the operation and management level to the field level. All in all, this allows an optimum connection to the relevant control concept.



Maximum functionality – minimal space requirements: VPPM-MPA integrated into the electrical terminal CPX/MPA

Valve terminal MPA with terminal CPX

The CPX terminal is used for the flexible connection of pneumatic and electrical control chains to automation systems.

With CPX, you have all the options for serial, real-time-capable communication over long distances on the valve terminal MPA:

- Transferring numerical data, e.g. for diagnostics and parameterisation
- Controlling the complete pneumatic and electrical control chain using I/O modules and valves on a fieldbus connection

Thanks to its IP65/IP67 degree of protection, your automation platform is perfectly suited to the harsh realities of day-to-day industrial work.

Parameterisation, configuration and diagnostics in no time at all
 VPPM-MPA on CPX/MPA takes on specific tasks to make your work easier. Direct, convenient and reliable – you will have all your tasks under control.

- Serial valve control and transfer of digitised analogue data for pneumatics – even over long distances
- Diagnostics at the fieldbus itself: all values can be controlled and monitored remotely, including upper and lower limits (e.g. to determine when the nominal outlet pressure has not been reached)
- Parameterisation with automatic adaptation of voltage and current interfaces, on pressure units and/or in digital format

Reduce your standstills by up to 35%

Unplanned machines and system standstills are expensive. This makes it even more important to detect, localise and eliminate errors quickly – or better yet, to avoid them. Festo offers a full package of diagnostic solutions precisely for this purpose, which you can use to collect data from and manage the entire valve terminal at a glance.

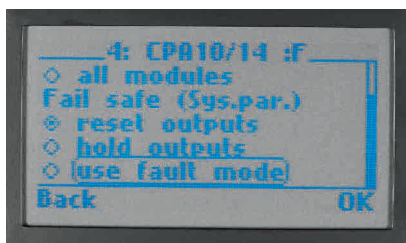
Festo display and operating unit CPX-MMI

The handheld terminal CPX-MMI is designed to carry out commissioning and diagnostics without a fieldbus, e.g. during servicing. Simply enter and read out analogue data in plain text and parameterise limit values. LED support makes the whole process child's play.

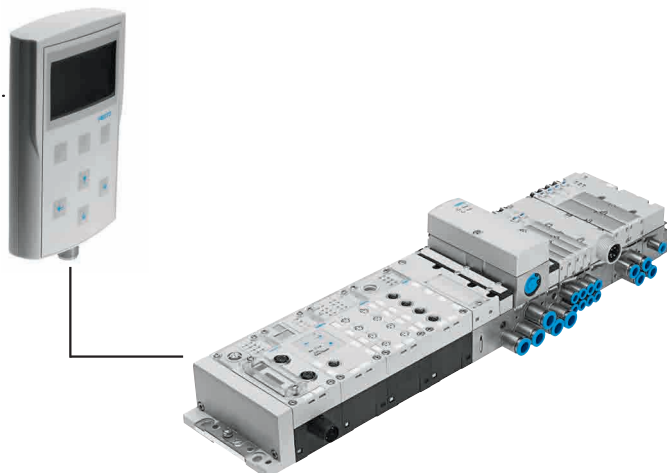
The entire valve terminal at a glance: Festo Maintenance Tool CPX-FMT

The Festo Maintenance Tool for CPX makes all the modules of a valve terminal visible. Parameters can be easily altered, setpoints and actual values read and error messages displayed – no programming skills required.

For simpler solutions, choose the CPX-MMI. If you prefer to keep an eye on the bigger picture, go for the CPX-FMT.



Service and commissioning using the handheld CPX-MMI without programming



Regulator VPPI: silent control made easy

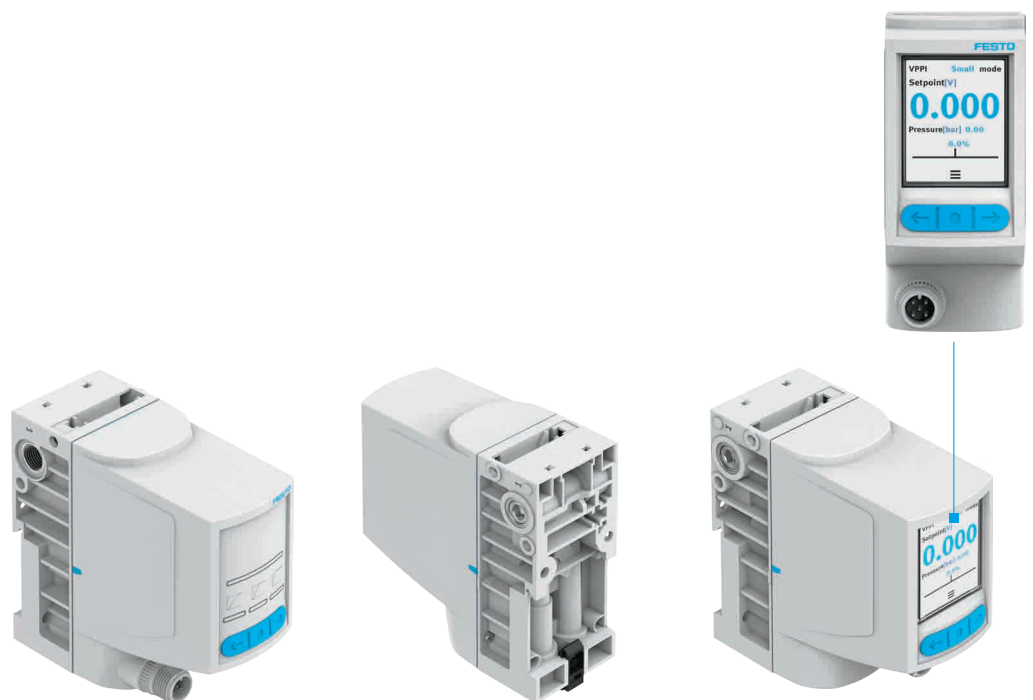
Direct actuation of all nominal widths – without the need for preliminary stages or pilot valves

The regulator VPPI gets its high dynamic response from a powerful and low-friction moving coil actuator, while the subordinate position controller ensures optimum stability. All the necessary settings can be made on a full graphic TFT display, many in plain text.

In PWM mode, internal control electronics enable the VPPI to detect PWM signals generated by any machine controller fully automatically. But there's more: this solution with an IO-Link interface as well as a fieldbus connection for controlling the valves via CTEU is state of the art.

Highlights

- Silent
- Flexible
- Highly dynamic up to 30 Hz
- Precise and stable
- Many pressure ranges: -1 ... 12 bar



The display is always easy to read as it can be rotated depending on the mounting position.

Proportional valve VPPE: a valve for the basics

For the VPPE with display

- Menu navigation
- Display switch-off
- Pressure range adjustment
- Password protection
- 3 available presets
- Digital electronic control
- Rotating exhaust flange
- Compatible P-rails

A simply classic alternative for basic applications

A proportional valve adapted for the functions you really need for your application. With or without the convenient display, the VPPE offers the exact features required for basic applications.

Benefits

- Attractive entry price
- Good control behaviour for simple tasks
- Degree of protection IP65
- Suitable for flanged connection
- High EMC resistance (Class A)



Proportional valve VPPE



Proportional valve VPPE Display



The proportional valves VPPE are simply connected in series

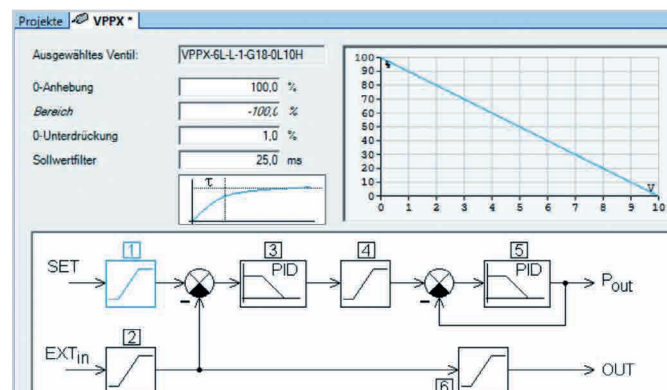
Proportional valve VPPX: maximum performance, top process quality, total flexibility

The proportional valve VPPX can be easily configured for your requirements and your application using the FCT configuration software and a plug-in specially developed for this purpose. This greatly simplifies pressure or flow control. And the current or voltage supply is then just a question of adjusting a software setting. Even setpoint inversions are easy with the new plug-in. These are exactly the features a modern, multi-purpose standard regulator needs to provide.

Free choice of setpoint and actual values for inputs and outputs

Whether for new applications or as a replacement valve, you can't go wrong with the VPPX. Once the parameter record has been stored in the configuration software it is always available and – if necessary – can be adapted at any time. Simply save it in the valve, and you're ready for the next task.

Enhanced efficiency with software from Festo



Configuration using setpoint scaling and sign change



Proportional valve VPPX-12L...

Proportional valve VPPL: pressure control up to 40 bar

Control at a high level

The VPPL has been specifically designed for higher pressures of 10 ... 40 bar. As an individual device with threaded connections, the proportional valve can be used in a variety of applications, such as stretch blow moulding of PET bottles in the food and beverage industry or on tyre and brake test benches in the automotive industry.

Flexible actuation

The VPPL can be actuated with either current or voltage via a standardised M12 plug connector (In). The regulated pressure can also be read out as a current or voltage signal via a second standardised M12 connector (Out).

Higher flow rate

When coupled directly with the flow rate booster PREL, the VPPL increases your flow rate. With this combination in nominal sizes of 25 and 45, the flow rate can be increased from about 300 l/min to a maximum of 6,000 m³/h.

More accurate control

For a higher-order control circuit, the proportional valve VPPL in the series PREL also has a second pressure sensor with which the outlet pressure and pilot pressure of the PREL are monitored and controlled. This further improves the control precision of the entire pressure regulator.

Please note: you can only order VPPL using the type code. For more information, contact your sales engineer.



For example for tyre and brake test benches in the automotive industry



VPPL-3L-3G14-...

Proportional flow control valve VEMD: ideal for mass flow control

Small space requirement and low energy consumption

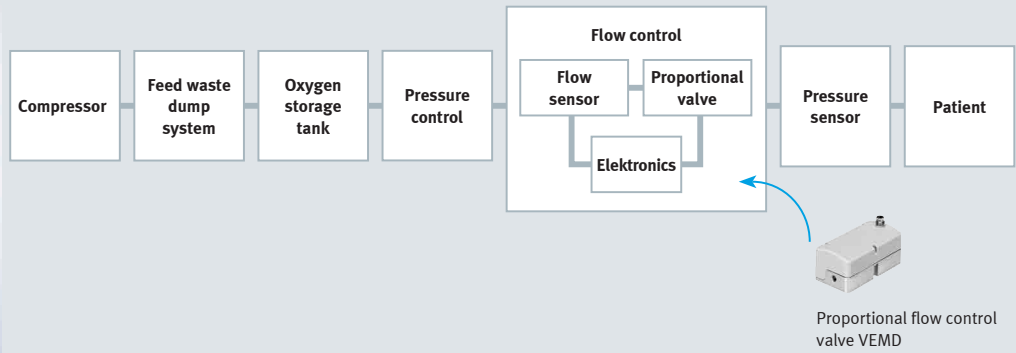
The valve VEMD has compact installation dimensions. Its light weight makes it ideal for use in portable devices for controlling flow rates.

The trend is towards ever smaller production batches and medical devices

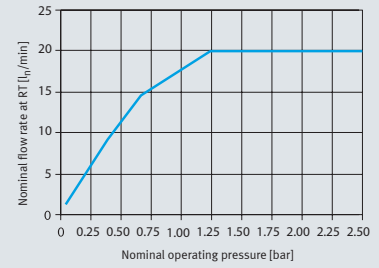
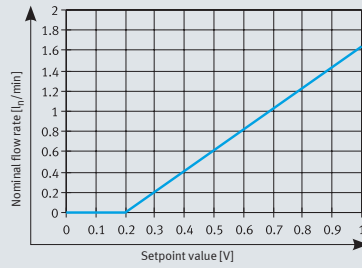
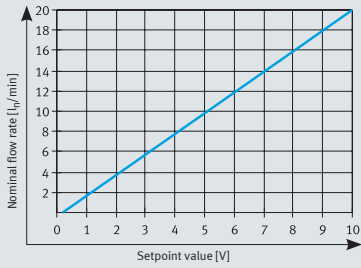
In the health sector, minimal energy consumption and low weight are right at the top of the list of requirements, especially for mobile applications like portable oxygen system devices. These are coupled with high standards for reliability and performance. A key technology that offers decisive advantages here is piezo technology as it is surprisingly cost-efficient.

With a setpoint specification between 0.2 ... 10 V, the gas flow at the output of the mass flow controller VEMD can be adjusted very simply and controlled in linear mode. The integrated control circuit with thermal sensor makes the valve dynamic and precise. It reacts very quickly to a setpoint change and is almost immediately ready for operation.

Sample application: portable oxygen concentrator



Characteristic curves



$$\text{Setpoint value} = \frac{9,8 * (\text{nominal flow rate} + 4/9,8)}{20}$$

Formula for calculating the setpoint value depending on the required nominal flow rate

Piezo valves VEAA/VEAB: innovative drive elements at their best

Piezo technology combined with digital closed-loop control technology

What makes these piezo benders unique is the combination of digital control electronics and the piezo technology. They are characterised by a sensitive response in the small signal range and high control dynamics. Another special feature is the pressure regulation range for vacuum of up to 10 bar. Their

special design principle makes the valves interesting for many application areas:

- Pressure regulation
- Testing
- Suctioning and dosing
- Pressing
- Press-fitting

They boast outstanding properties such as:

- Efficient pressure regulation characteristics
- Long-term stability
- High repetition accuracy
- Low hysteresis
- Silent operation
- Extremely low energy consumption



VEAA



VEAB

Proportional flow control valve VPCF: greater productivity straightaway

Lightweight, compact, universally mountable

The compact dimensions, easily accessible pneumatic connections and easy actuation mean that the proportional flow control valve can be flexibly positioned and mounted just about anywhere, even in existing applications.

Significant reduction in production costs

Short response time, high repetition accuracy, compact size, freedom from PWIS and certification for ATEX 3GD are features that make the proportional flow control valve VPCF unique. It is perfect for demanding uses like inert gas applications and for controlling air flow rates and speed in painting and flow-through systems; and it meets the highest requirements for dynamic response, repetition accuracy and linearity of the characteristic curve. Thanks to shorter cycle times, it can also help to increase unit quantities and output volumes.

Cost savings for compressed air and tubing

Because VPCF can be used directly in the Ex zone, both the length of the tubing and the compressed air consumption are reduced. The reduced air volumes also increase the dynamic response that can be achieved.

PWIS approval included

VPCF is PWIS-free. The possibility of contamination of components with PWIS substances is therefore excluded.



Motion Terminal VTEM: a head start with digitised pneumatics

World's first app-controlled valve

The Motion Terminal VTEM combines a large number of functions in one identical piece of hardware. Complicated modifications, the installation of further parts and tedious installation work are a thing of the past. Whether it's a simple change to the directional control valve functions, soft

movement into the end position, energy-efficient movements or proportional behaviour with motion profiles, with the appropriate Motion App you can change functions at the press of a button. The principle behind this is the perfect combination of electric and pneumatic automation.

Benefits

- Many functions in one component – thanks to apps
- Combines the advantages of electric and pneumatic technologies
- Highest possible level of standardisation
- Reduced complexity and time to market
- Greater profitability and knowledge protection
- Less installation effort
- Increased energy efficiency

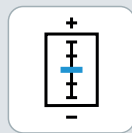
The apps are the key to almost limitless function integration in valve terminals.

This approach will:

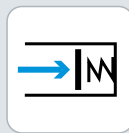
- Reduce the complexity of your systems
- Speed up your engineering processes
- Enable you to continuously and flexibly adjust your machine throughout its entire lifecycle.



Directional control valve functions



Proportional directional control valve



Soft Stop



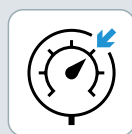
Proportional pressure regulation



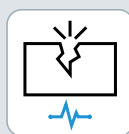
Model-based proportional pressure regulation



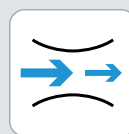
ECO drive



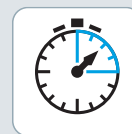
Selectable pressure level



Leakage diagnostics



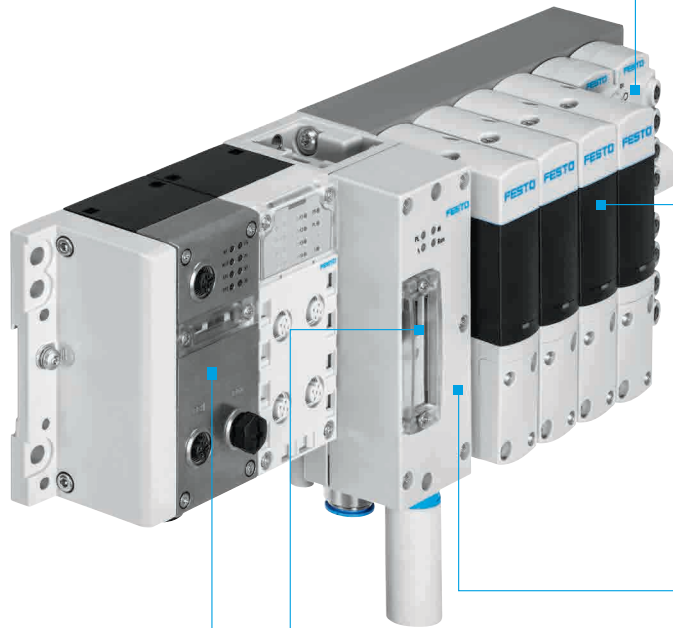
Supply and exhaust air flow control



Presetting of travel time

Standardised in preparation for Industry 4.0

A wide range of products, functions and complete solution packages are integrated into the Festo Motion Terminal. The combination of one valve technology with a powerful controller and smart apps points to a new era in terms of flexibility.



CPX module

CPX supports all standard bus protocols. This gives you the option of using many different controllers and end user specifications, as well as all the usual digital and analogue input/output modules. An integrated CODESYS controller and OPC-UA for Industry 4.0 are available onrequest.

CPX-CTEL

The installation system allows you to integrate up to 4 standard valve terminals cost-effectively as no extra bus nodes are required. This makes combining different technologies effortless.

Input module

Up to 16 analogue or digital inputs for direct control applications such as Soft Stop. The necessary data is recorded and transmitted by sensors mounted directly on the actuator.

Valve

The app-controlled valve comprises four 2/2 diaphragm poppet valves, which are controlled by four piezo pilot valves. The integrated stroke and pressure sensors provide optimal control and transparent condition monitoring.

Controller with Motion App

The core of the Festo Motion Terminal offers decentralised intelligence and rapid control. From here, the motion apps are assigned to the individual valves.

Ethernet WebConfig interface

When it comes to efficient parameterisation the choice is yours: you can either use an intuitive WebConfig user interface via the PC's web browser or easily access the (PLC) machine control system as usual – without the need for additional configuration software

Features

	Connection		Input pressure [bar]	Control range [bar]	Max. flow rate [l/min]	Max. power consumption [W]	Internal air consumption	Filtration [µm]	Repetition accuracy [%]	Design	Safety position
	Electric	Pneumatic									
Pressure regulators											
VEAA	M8 4-pin	QS4	0 – 11	–	7	1	< 1 l/min	40	0.4	Directly actuated piezo valve	Pressure maintained in case of power failure
VEAB	M8 4-pin	QS4	0 – 6.5	–	20	1	< 1 l/min	40	0.4	Directly actuated piezo valve	Pressure maintained in case of power failure
VPPI	M12 5-pin	R1/8"	0 – 13	–	1000	14.5	< 2 l/min	40	0.4	Directly actuated piezo valve	Closed in case of power failure
VPPM-LCD VPPM-LED	M12 8-pin	G1/8	0 – 11	0 – 2	1400	7	Max. 5 l/h	40	0.50	Piloted diaphragm regulator	Pressure maintained in case of power failure
VPPM IO-Link		G1/4		0 – 6	2750						
	M12 5-pin	G1/2		0 – 10	7000	11					
VPPM-MPA	Fieldbus/MPA system	G1/8	0 – 11	0 – 2	1400	7	Max. 5 l/h	40	0.50	Piloted diaphragm regulator	Pressure maintained in case of power failure
		G1/4		0 – 6	1650						
VPPE	M12 4-pin	G1/8	7	0 – 6	600	3.6	Max. 5 l/h	40	< 0.70	Piloted diaphragm regulator	Pressure maintained in case of power failure
VPPX	M12 8-pin	G1/8	0 – 11	0 – 10	1400	7	Max. 5 l/h	40	0.50	Piloted diaphragm regulator	Pressure maintained in case of power failure
		G1/4			2750						
		G1/2			7000						
VPPE display	M12 5-pin	G1/8	0 – 11	0 – 2 0 – 6 0 – 10	1250	4.2	Max. 5 l/h	40	< 0.70	Piloted diaphragm regulator	Pressure maintained in case of power failure
VPPL*	2x M12 5-pin		0 – 50	0.2 – 20 0.4 – 40	350 l/min at 6 bar	27	Max. 20 l/h at 40 bar	40	1	Directly actuated control valve	Exhausting in case of power failure
Flow rate control valves											
MPYE	M12 x 1 4-pin	M5 G1/8 G1/4 G1/2	0 – 10	–	2000	2.4 W mid-position 26.4 W full stroke	7 – 35 l/min	5	0.50	Piston slide	Mid-position closed in case of power failure
VEMD	M8 4-pin	QS4	0 – 2.5	–	20	1	< 1 l/min	40	1	Directly actuated piezo valve	Last flow rate value maintained in case of power failure
VPCF	M12 5-pin	R1/4"	0 – 10	–	1500	36	6 l/min	5	1	Directly actuated piston spool valve	Blocked in case of power failure
VPWP	M8 4-pin Socket	G1/8 G1/4	0 – 10	–	1400	28.8	20 – 30 l/min	5	1	Piston slide	Mid-position blocked
Proportional valve terminal/multi-function platform											
VTEM	Industrial fieldbus systems	R1/8"	0 – 8 (vacuum control via port 3)		To DIN 1343: Qn 480 l/min Qn 6 – > 0 840 l/min Qn 1 – 2 1000 l/min Qn 2 – 3 650 l/min	1.5	< 1 l/min	40	40 mbar	Piezo-piloted poppet valve	Blocked in case of power failure

* Please note: you can only order VPPL using the type code. For more information, contact your sales engineer.

Selection table											
Regulation		External sensor	Application			Operating medium				Special features	
Pressure	Flow rate		Few setpoint value changes	Constantly changing setpoint values	Small signal regulation	Filtered compressed air	Neutral gases	Lubricated	Unlubricated		
x			x	x	x	x	x		x	Proportional pressure regulator with piezo technology	
x			x	x	x	x	x		x	Proportional pressure regulator with piezo technology	
x			x	x	x	x	x		x	Directly actuated 2x 2-way proportional valve	
x			x		x	x	x		x	LCD version with display and clear menu, multi-sensor control	
x			x		x	x	x		x	LCD display (G1/4"), setting via fieldbus, multi-sensor control	
x			x			x	x		x	Low-cost valve	
x	x	x	x	x	x	x	x	x	x	Multi sensor, external sensor input, free plug-in for FCT software	
x			x			x	x		x	Red LED display, settings menu	
						x	x		x	Flow rate booster PREL for 6000 l/h	
	x		x	x	x	x	x		x	Highly dynamic, including for position control	
	x		x	x	x	x	x		x	For nitrogen and oxygen	
	x		x	x	x	x	x		x		
	x		x	x	x	x	x		x	Soft stop, position control and force control	
x	x	X (for flow rate) virtual sensor via model-based pressure regulation	x	x	x	x	x		x	Proportional pressure regulator with piezo technology. Multi-channel pressure and flow controller for 2 to 16 channels. Different functionalities by varying software with the same hardware. Different media including compressed air, nitrogen, CO2 and argon.	

Proportional valves are suited to a wide range of applications, such as assembly and handling tasks, or in machine tools and welding technology. With Festo the choice is yours: there is a well-matched, efficient solution for any requirement. Simply search based on the characteristics, functions and features that you define, and the decision will practically make itself.

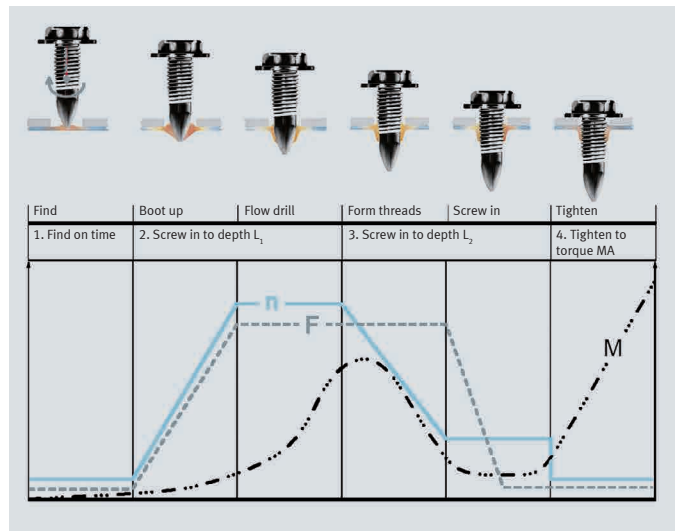
What we can control for you: application examples

Automotive industry

Proportional valves VPPM to regulate axial forces in automatic screwdrivers

The use of specialised screws in the drilling and screwing process means preparatory work such as pre-drilling or punching is no longer necessary. The usual tolerance problems are also eliminated. The axial force for

flow drilling is applied via a tandem cylinder ADVU and regulated by a proportional valve VPPM during the process. The control system adapts the force applied via the cylinder individually depending on the process status and the material.

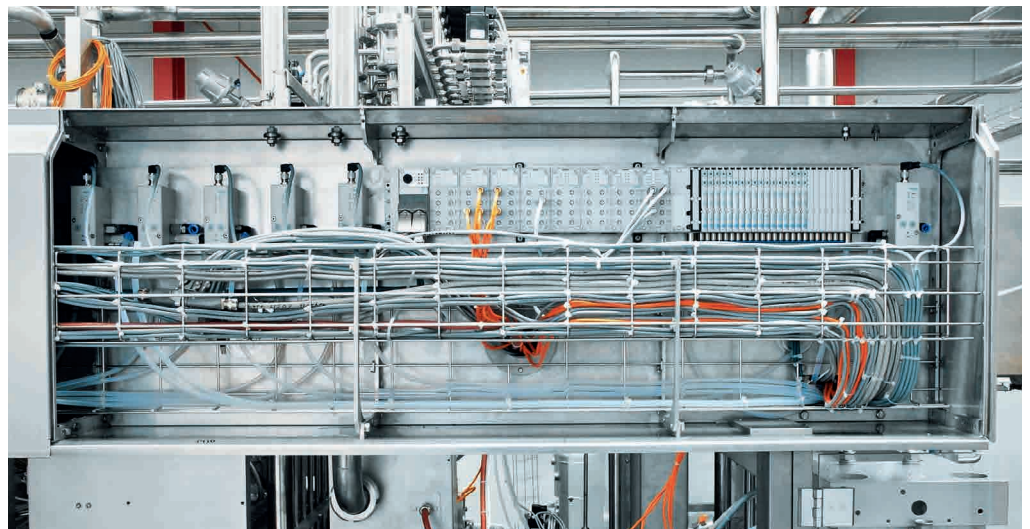


Filling and packaging technology

Proportional valves VPPM for vacuum, pressure and cylinder force control

In a lid fitting station, suction cups are used to convey the lids. The vacuum pressure must be adjusted in proportion to the ejector supply, depending on the lid size and material.

Proportional valves VPPM control the pressure for the Venturi nozzle. They are also used in the sealing station where the lids are pressed onto the containers. Here, they control the cylinder force so that the contact pressure can be adjusted to suit the product in question.



Machine and system building

Proportional valves VPPM for web tension control

A consistent web tension is critical for good results in winding machines. To achieve this, the friction roller must always be braked optimally in accordance with the roller diameter. The VPPM controls the braking force according to the setpoint it receives from the machine controller.



Test machines

Proportional valves VPPM for contact pressure regulation

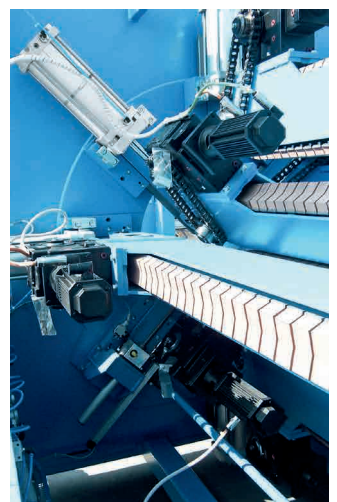
Laboratory presses are used to test the adhesive forces of adhesives. The test specimens are compressed at a specific force by heated press plates, then allowed to cool and examined. VPPM allows the contact pressure to be varied for each test.



Rubber and plastics machines

Proportional valves VPPM for back pressure regulation

In extrusion machines, proportional valves VPPM allow precise control during removal of the profile. They ensure a continuous, constant speed when processing thermoplastics.



Printing and paper industry

Proportional valves VPPM for setpoint control

In order to prevent the cardboard rolls in roll slitters from slipping during the winding process, a contact winding roller is fitted with a ductile profile. The pressure increase regulated by the VPPM is used to adjust the clamping pressure according to the material, the web tension or the surface quality of the cardboard rolls, for example.

Laminating and coating machines

Proportional valves VPPM for pre-tensioning the material webs

Coating and laminating a variety of different materials for every industry from automotive to sports and packaging in a way that ensures uniform results and meets the required quality standards is no easy task. It requires a variety of web tensions, which can be set using the proportional valves VPPM.

Process engineering

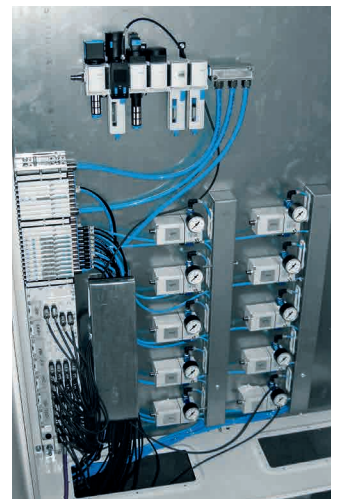
Proportional valves VPPM for diaphragm valve control

In order to simulate a wide variety of different road conditions on an automobile test track, the required amount of water is signalled by a potentiometer to proportional valves VPPM. These build up a pneumatic pressure, which then activates the diaphragm valves.

Welding machines

Proportional valves VPPE for setpoint control

In ultrasonic welding, different materials and particular material thicknesses require welding and contact pressures to be precisely matched. Retooling and set-up times can be reduced via the machine control system – and controlled by proportional valves VPPE.



The latest directional control valves: from proportional pneumatics to servopneumatics

5/3-way proportional valve MPYE

The directly actuated proportional directional control valve has a position-controlled spool. This transforms an analogue input signal into a corresponding opening cross-section at the valve outputs. In combination with an external position controller and displacement encoder, a precise pneumatic positioning system can be created.

Benefits

- Short machine cycle times: fast switching of programmed flow rates
- Flexible cylinder speeds: achieving variable flow rates
- Use as the final control element: dynamic and fast changing of flow rates

Example: proportional directional control valves in use

To ensure the Japanese robot woman's movements are as realistic as possible, like those of a real human, the Japanese manufacturer uses 50 proportional directional control valves type MPYE. These control the small drives that move the limbs under her fine silicone skin. No other automation supplier was able to provide proportional valves like those developed specially by Festo based on the series product. They were tailored specifically to meet

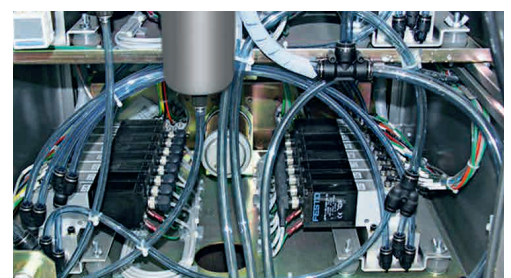
the individual requirements as part of a joint project by Festo and the client.

Other key criteria included the special flow control system that allowed even more precise control in spite of the larger tubing lengths, together with the fast response time of the series product MPYE.

The Japanese client was also impressed by the durability and relatively low costs of the MPYE.



Fast, durable and low-cost: each of the drives that move the limbs under the robotic woman's fine silicone skin are controlled by 50 tailor-made proportional directional control valves MPYE.



**Ideal for servopneumatics:
5/3-way proportional
valve VPWP**

Based on the MPVE technology, the VPWP allows you to vary the direction of movement.

Benefits

- Secure: integrated interface for digitalised data transmission
- Precise: with integrated pressure sensors and cascade control
- Operational safety: adaptive “self tuning” control algorithm
- Simple: supports auto-identification
- Productive: comprehensive diagnostic capabilities
- Flexible: integrated pressure sensors enable you to switch between position and force control

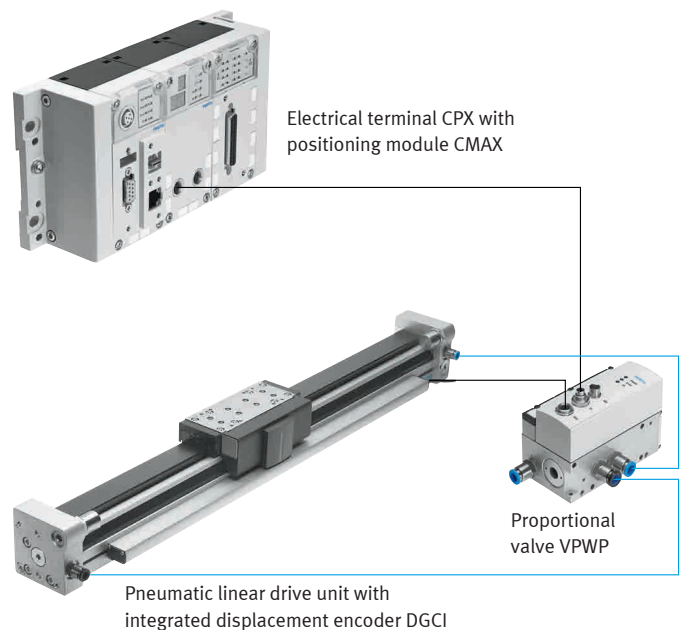
**Outstanding motion
performance**

- Direct control of a brake or clamping cartridge
- Safe stationing in the midposition thanks to new standstill control
- Integrated option for force control
- Unambiguous diagnostics in a fully digital system

Cutting-edge servopneumatics

Positioning large loads even more dynamically – with the third generation of servopneumatic systems from Festo, you can easily pull ahead of the competition. Designed for gentle, vibration-free functioning, the compact powerhouses with VPWP will reduce your positioning times by up to 30%, while also using 30% less compressed air.

Together with the automation platform CPX and the servopneumatic positioning module CMAX or the electronic end position controller CMPX for soft stop, VMMP accelerates a wide range of drives.



Proportional flow control valve VEMD: inert gas supply for guaranteed reliable infusion bags

The production of single and multi-chamber infusion bags requires maximum process reliability. To reliably protect their contents from degenerating, they are flooded with the inert gas nitrogen when they are being filled. Throughout this process, the flow rate must be adjustable to prevent spraying during injection. This is where the proportional flow control valve VEMD comes into play, since it also reliably meets the high requirements for reproducibility.



Accuracy, reproducibility and speed in production



Proportional flow control valve VEMD

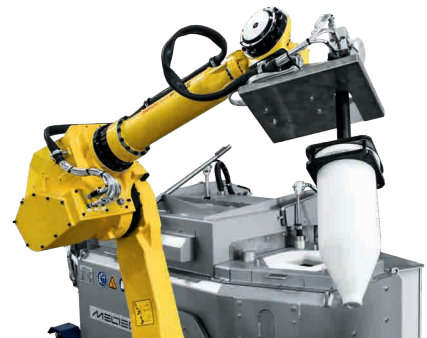
Pressure regulator VPPI: focus on precision

Meltec Industrieofenbau GmbH is one of the world's leading manufacturers of industrial furnace and dosing technology in the casting industry. It offers solutions for the three main alloys of zinc, magnesium and aluminium. The biggest challenge is the high-precision transfer of the molten aluminium using a vacuum dosing technology developed in-house.

The pressure regulator VPPI from Festo is among the components used to draw in and discharge the molten aluminium. With its extremely fast control behaviour, it enables the molten metal/vacuum to be regulated almost in real-time, ensuring dosing is accurate to the gram. This makes it unique in the world.



Pressure regulator VPPI



Vacuum dosing technology for the molten aluminium

Piezo bender VEAB: strong performer in medical research and development

TissUse GmbH is the manufacturer of a unique, pioneering and patented “human-on-a-chip” technology platform with which the development of pharmaceutical, chemical and cosmetic products can be significantly accelerated.

A HUMIMIC Starter is used to operate the pumps on a chip. It uses valves VEAB from Festo that precisely set the optimum pump pressure for organ models. Their size and sound level are especially advantageous in laboratories where space is tight.



Proportional pressure regulator VEAB



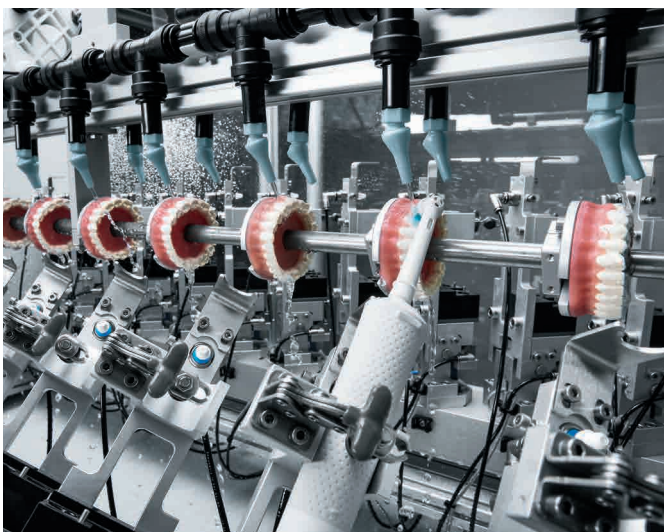
HUMIMIC Starter with Festo valve VEAB

Proportional pressure regulator VEAB: simulating teeth cleaning in tests

In addition to automation products, inotec AP GmbH also specialises in testing systems. Its SMARTTESTER is a modular and flexible carrier for a wide range of different test setups.

The latest variant of the system tests electric toothbrushes. To simulate people's behaviour as realistically as possible, 24 proportional pressure regulators VEAB from Festo control the contact pressure here in a constant and gradual process. They are very reasonably priced in comparison with other proportional solutions, extremely compact and ultra-quiet.

The one-cable installation with standard connectors also makes for easy installation of the proportional valves on a mounting plate. The space-saving valves VEAB can be placed close to the application or in a small control cabinet. They generate almost no heat thanks to their low energy consumption, and therefore can be packed extremely tightly.



VEAB regulate the contact pressure on a set of artificial test teeth

Proportional pressure regulator VEAB: energy-conscious ultrasonic welding

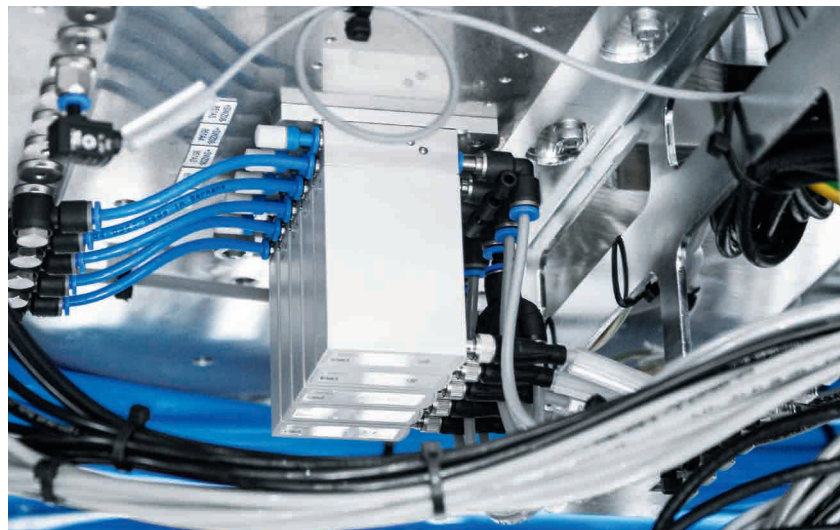
3CON Anlagenbau GmbH is an Austrian special machine builder that specialises in interior trims for cars. For welding a door with a total of 148 weld spots, the company developed a laminating system that does this fully automatically in just 30 seconds.

Festo not only supplies the system with the necessary power, but also guarantees the necessary precision. Guided drives ADNGF with position sensors SDAT ensure exact feeding of the ultrasonic welding sonotrodes, for example. The cylinders in the welding tool are controlled by innovative piezo pressure regulators VEAB; these not only permanently monitor the process data, but also ensure complete flexibility when adjusting the welding pressure.

With the piezo valves, switching times in the sub-microsecond range can be achieved. Their speed opens up complete flexibility in the machining process. They are also unbelievably light and consume very little energy. This also means they don't generate any heat themselves, which greatly extends their service life.



Proportional pressure regulator VEAB



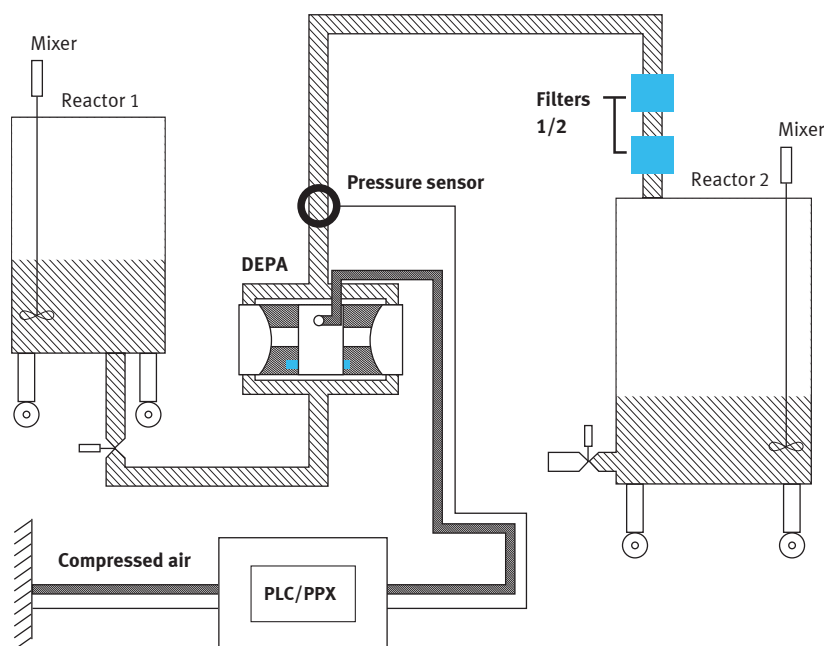
Piezo valves VEAB control welding tools on which multiple welding units are mounted.

Proportional valve VPPX: reliably regulating diaphragm pumps

Diaphragm pumps are used to protect sensitive liquids from mechanical influences and to ensure they are transported gently and smoothly. A proportional valve VPPX with external pressure sensor regulates the pressure in the system upstream of the sterile filter system.

Custom settings for the external PID controller in combination with an external sensor make it possible to maintain the pressure constantly at a specific level so that the sensitive filter system is not damaged. In addition, changes in the pressure ratio in the system caused by filter contamination can be quickly corrected.

The benefits are clear to see: since the valve VPPX ensures a constant pressure, the filter process is stable and guarantees optimum results with maximum flow rate.



Pressure regulation with proportional valve VPPX upstream of the filter process



Proportional valve VPPX

Motion Terminal VTEM: web tension under control at all times

The intelligent, digitised control of the dancer roller ensures a constant web tension at all times, whether for textiles, plastic film or paper. The force and thus the belt tension can be individually and dynamically adjusted during each process stage by flexibly regulating and controlling the pressure in a pneumatic cylinder.

This type of tension control is also possible using conventional pneumatics. However, the setup is much more complex since you need more components such as additional sensors, cables, communication technology, pressure supply, etc.

The Motion Terminal VTEM does this with just one piece of hardware via the Motion App “Proportional pressure regulation”. With the Motion Terminal, the pressures can even be regulated independently in two working channels per valve slice, which means that two valve slices are all that is needed to control all four cylinders.

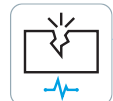
1



Proportional pressure regulation

- Quality assurance via continuous pressure information
- Integrated pressure regulation system: just 1 pressure supply and 1 fieldbus communication module for individually regulating 4 channels
- Space-saving, easy installation and troubleshooting

2

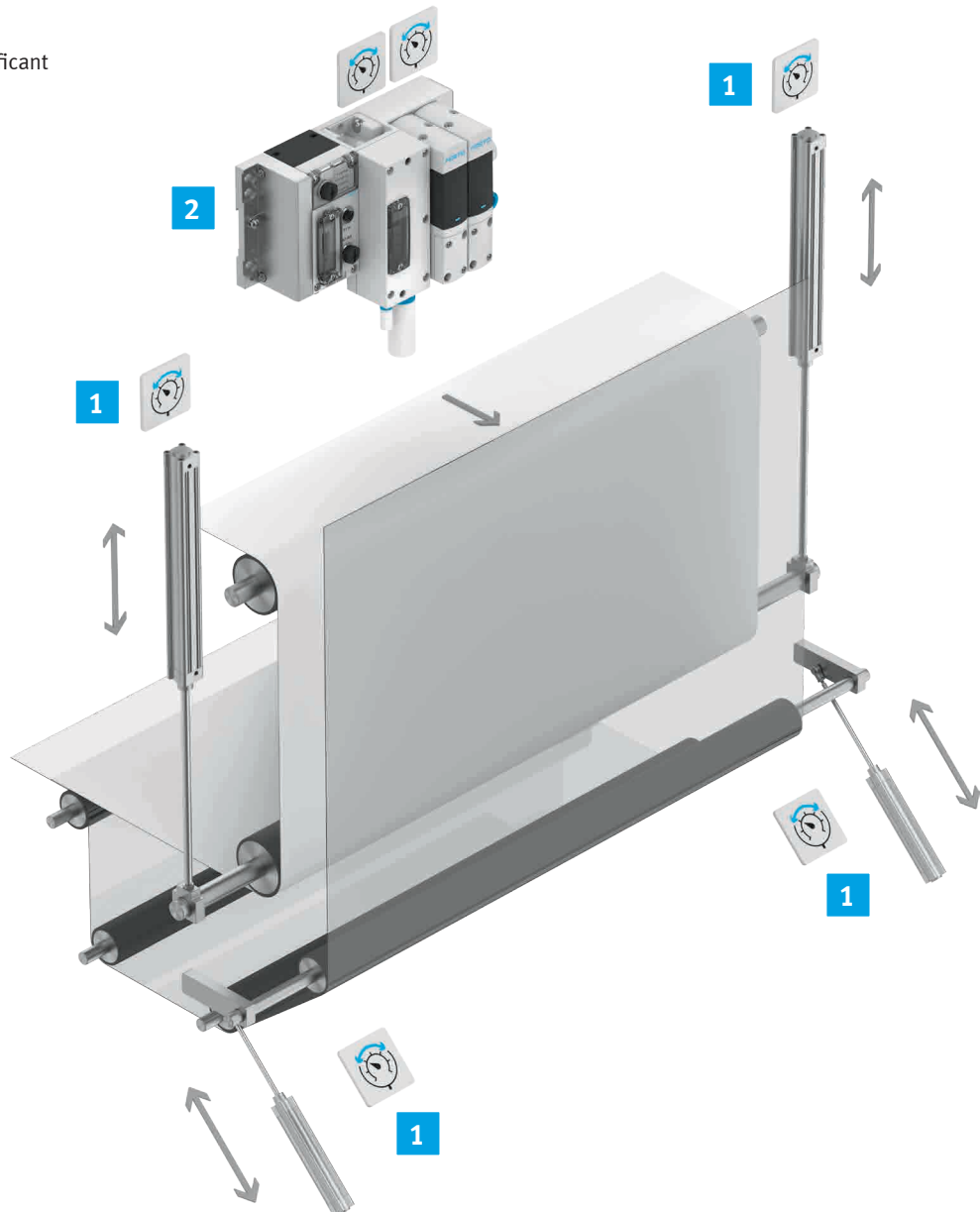


Leakage diagnostics

- Predictive maintenance
- Save energy and costs

Another benefit is that digital information about the pressure status is available in real time, and changes in the pressure are immediately visible. You can also read out this data via remote diagnostics and respond quickly should the situation demand it. A significant improvement in process reliability.

- + Dynamic parameter adjustment
- + Real-time monitoring
- + Maximum process reliability



Motion Terminal VTEM: flow control for up to 16 channels

Bottles and other product containers are often flushed out and filled with nitrogen or other gases. The Motion Terminal VTEM makes this process much more economical. Simultaneously for up to 16 channels, tamper-proof and with shorter cycle times. A quantum leap in production.

The flow in litres per minute is controlled using the Motion App “Flow control”, which enables more efficient dosing of the gas. Because the more precisely the filling quantity is defined, the more accurate the filling will be. The percentage deviation from the target quantity is detected by external sensors and evaluated directly in the app.

Another Motion App “Selectable pressure level” not only moves the filling nozzles to the bottles quickly and accurately, it also shortens the cycle times through flexible parameterisation by retracting the filling nozzles energy-efficiently and with reduced pressure after the bottles have been filled.

1

Flow control

- Flow control in l/min with and without external sensors
- Precise filling saves nitrogen and thus costs
- Control of various gases

FLOW



2

Selectable pressure level

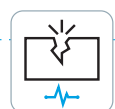
- Shorter cycle times through flexible parameterisation
- Fast travel to the working area
- Energy-saving motion through reduced pressure



3

Leakage diagnostics

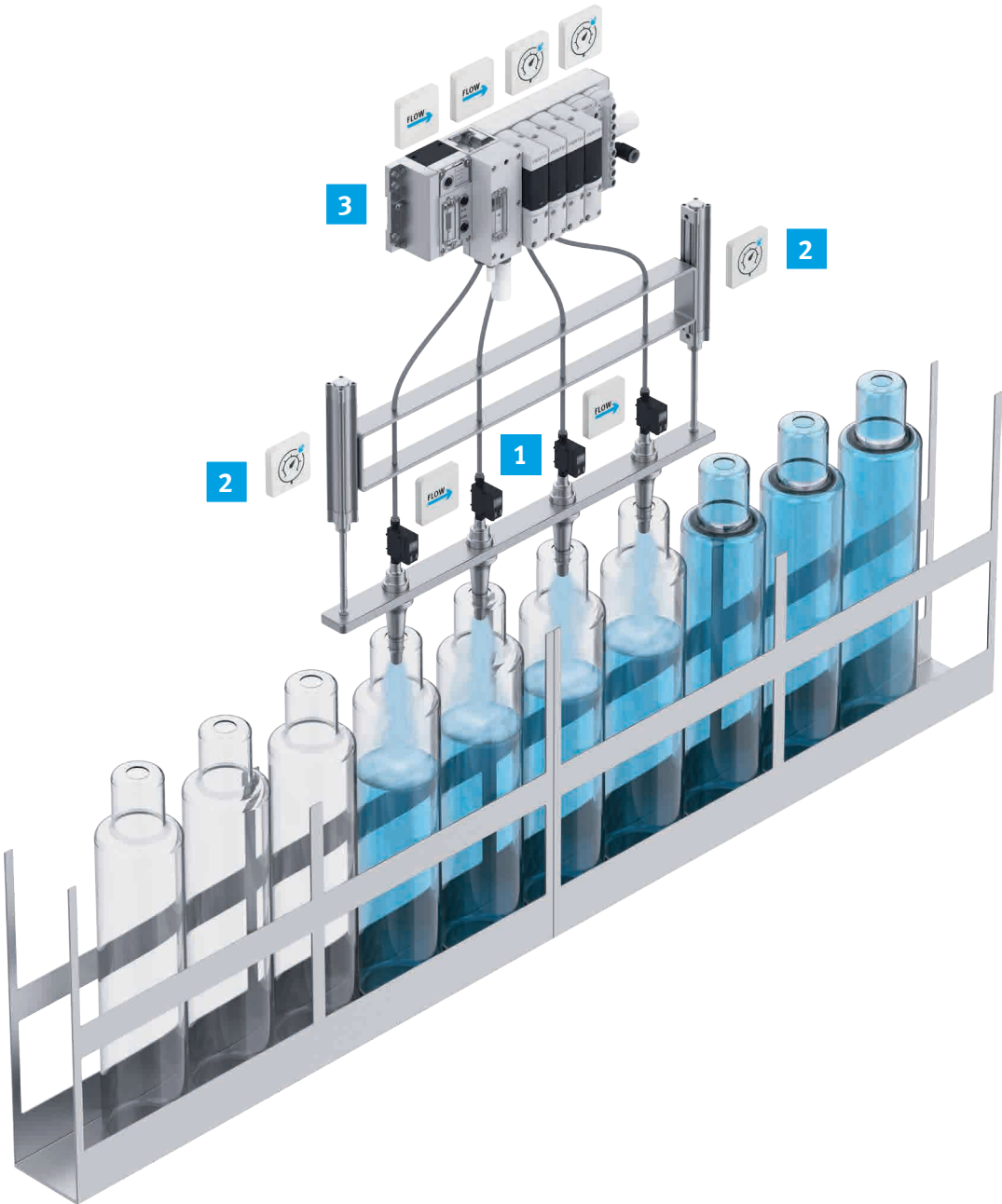
- Predictive maintenance
- Save energy and costs



+ Multi-channel control

+ Saves nitrogen

+ Shorter cycle times

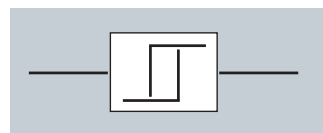


Control technology in a nutshell

Types of control

Controllers independently influence one or more physical variables at a pre-defined level. To do this, the controller continuously calculates the deviation between the setpoint signal and the actual value signal – known as the system deviation – which is reduced to a minimum by the manipulated variable from the controller. In general, a distinction is made between two different types of control:

- Discontinuous control (two-point or multiple-point control)
- Continuous control: the controller continuously intervenes in the control process.



Two-position controller in the structural diagram

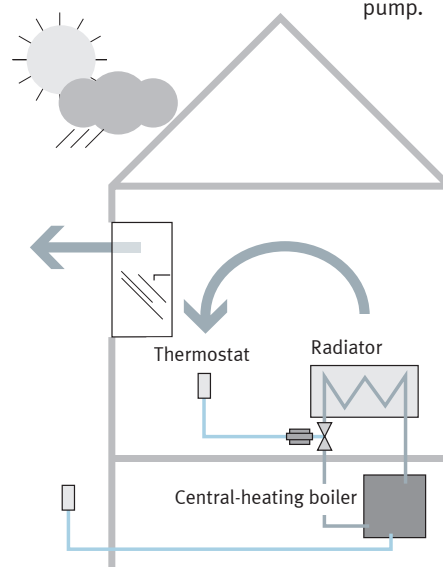
Discontinuous control

A process completed in jumps is referred to as discontinuous. In these cases, the controller intervenes in the control process with switching jumps and a constant energy level. These controllers are therefore also known as switching controllers. The difference between the two switching points “On” and “Off” is referred to as the switching hysteresis. This is how irons work, for example. If the specified temperature drops below the setpoint, a bimetal switch turns on the radiator; if the setpoint is exceeded, the radiator is switched off.

Continuous regulation

Continuous controllers intervene continuously in the process. To do this, they continuously alter the control signal in order to keep the system deviation as low as possible. The controller can accept any manipulated variable within a specific adjusting range.

When regulating room temperature, for example, the setting on the thermostat acts as the setpoint value, while the actual value is supplied by a temperature sensor, which is usually built into the thermostat. If the temperature deviates, the controller continuously alters the water flow rate by actuating the water pump. This keeps the deviation lower, and the controller also throttles the output of the water pump.



Regulation of room temperature

Control systems

Open control circuit

In an open control circuit, the control unit receives no feedback on the actual value. Open control circuits are rare in proportional control systems.

Closed control loop

In a closed-loop control circuit, the control unit receives continuous feedback on the actual value. Based on its control principle (controller type), the control unit uses the system deviation between the setpoint value and the actual value to calculate the manipulated variable, which minimises the deviation.

Controller types

A variety of controller types can be used to perform control tasks. These range from simple P controllers, which only weight the control error proportionally, to the well-known PID controller and more modern approaches, such as cascade and status controllers.

Cascade controller

In a cascade controller, several closed-loop control circuits are nested inside each other. The overall controlled system is divided into smaller circuits that are easier to control. Compared to a directly acting controller, this improves the control precision and stability of the control circuit.

In a cascade controller, the output variable of one controller acts as the reference variable for the next one.

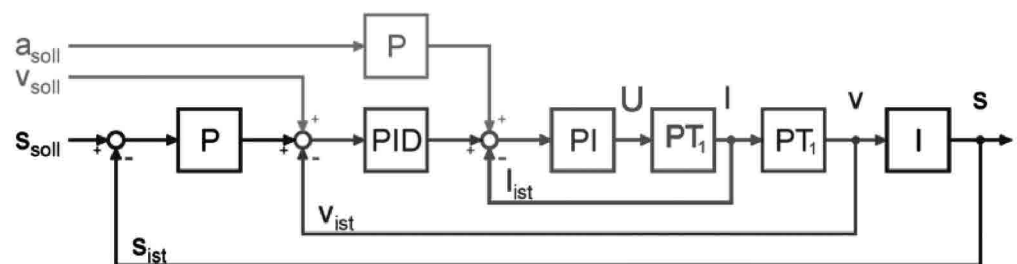
Analogue controllers

The most common controller is the P controller. It is good for balancing out large deviations, but is only used in situations where accuracy is not important.

Digital controller (microprocessor)

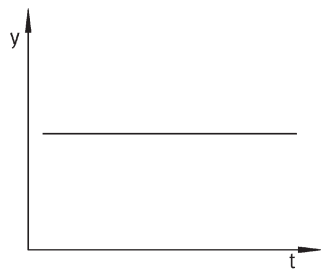
This controller uses modern microprocessor technology and offers many advantages, such as allowing modern controller types (cascade controllers) to be used in practice and thus improving stability and accuracy. Other important benefits include the high level of flexibility

(presets), bus compatibility (valve terminal CPX-MPA) and improved diagnostic capabilities.

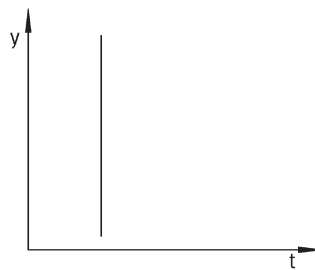


Cascade control

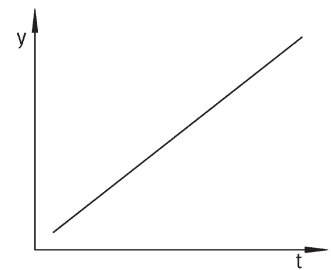
Comparing controller types



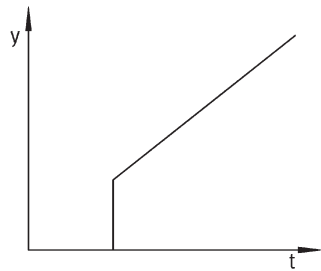
Proportionally controlled (“P”) circuits are simple and have an average speed compared to other controllers. The problem is the remaining deviation.



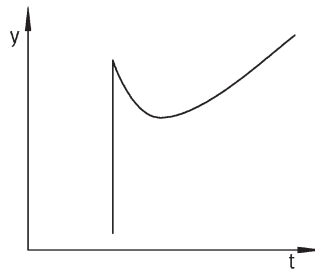
The “D” element is a derivative unit. Due to vibrations in the system, it can only be used as a controller in combination with controllers with “P” and “I” characteristics.



An integrally controlled circuit (“I”) is relatively slow, but can completely eliminate deviations.



The PI controller combines the average-speed P controller with the exact I controller. The PI control circuit is thus precise and has an average speed.

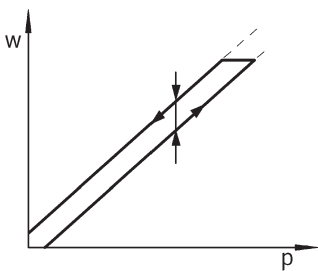


The fastest controllers are those with a derivative unit (PD and PID). These are perfect for situations that require a high dynamic response or where the controlled system itself is already unstable.

Digital controllers

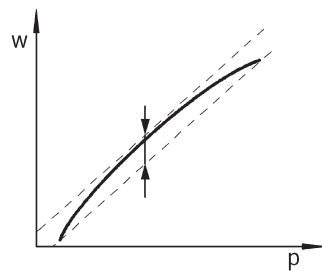
Digital controllers can save various control parameters in a table stored on the processor. They then call up these parameters based on changes in the setpoint value, disturbance variables or the trigger level. This is ideal for compensating for even the most complicated control applications, which makes systems and their processes more reliable and productive.

Terms related to the proportional pressure regulator



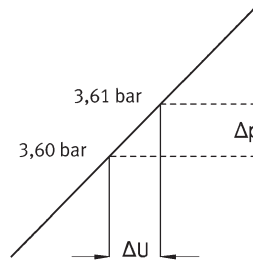
Hysteresis

There is always a linear relationship within a certain tolerance between the setpoint value entered and the pressure output. Nevertheless, it makes a difference whether the setpoint value is entered as rising or falling. The difference between the maximum deviations is referred to as hysteresis.



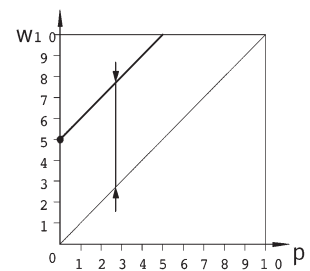
Linearity error

A perfectly linear progression of the control characteristic of the output pressure is theoretical. The maximum percentage deviation from this theoretical control characteristic is referred to as the linearity error. The percentage value refers to the maximum output pressure (full scale).



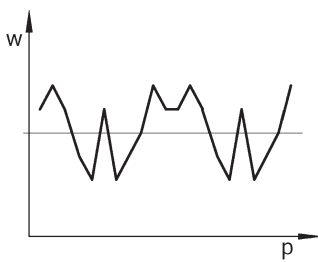
Response sensitivity

The response sensitivity of the device determines how sensitively one can change, i.e. adjust, a pressure. The smallest setpoint value difference that results in a change in the output pressure is referred to as the response sensitivity. In this case, 0,01 bar.



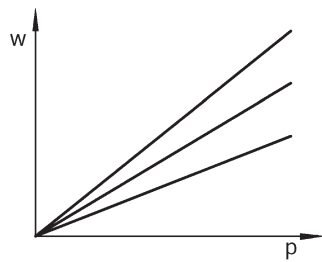
Zero offset

If, for example, a VPPM cannot be vented for safety reasons, the minimum pressure can be increased from the zero point. The smallest setpoint value is then assigned an output pressure of 5 bar, for example, and the largest setpoint value an output pressure of 10 bar. Zero point suppression is automatically switched off if the zero offset is used.



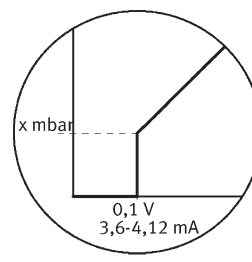
Repetition accuracy (reproducibility)

The repetition accuracy is the margin within which the fluid output variables are scattered when the same electrical input signal coming from the same direction is set repeatedly. It is expressed as a percentage of the maximum fluid output signal.



Pressure range adaptation

In the delivery status, 100% setpoint value equals 100% fluid output signal. Pressure range adaptation or adjustment enables the fluid output variable to be matched to the setpoint value.



Zero point suppression

In practice, it is possible for there to be a residual voltage or residual current at the setpoint input of the VPPM via the setpoint generator. Zero point suppression is used so that the valve is reliably vented at a setpoint value of zero.



Productivity

Maximum productivity is a question of ambition

Do you share this attitude? We will be glad to help you achieve this goal – through our four outstanding qualities:

- Security • Efficiency • Simplicity • Competency

We are the engineers of productivity.

Discover new dimensions for your company:

→ www.festo.com/whyfesto