Secure your advantage and create new potential with proportional pneumatics

FESTO

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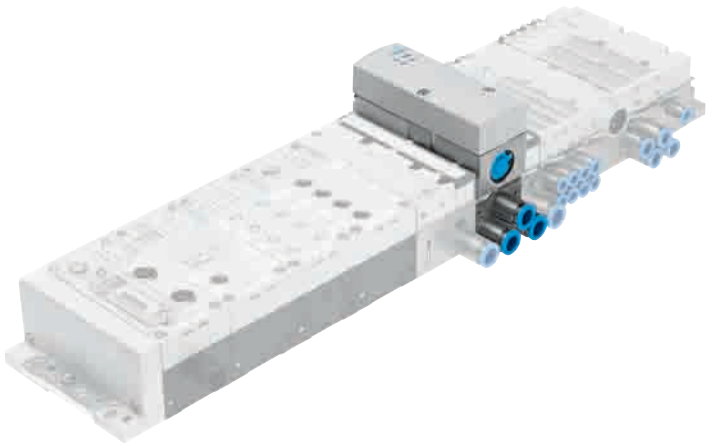
Boost your technology advantage!

Boosting your competitive advantage has always been, and always will be, Festo's goal. Our extensive range of individual solutions and functions is attractively priced and helps to keep installation, parameterisation and commissioning to a minimum. Proportional pressure regulators and directional control valves make light work of implementing and controlling even highly complex applications. Everything is already set up with the help of presets and integrated technologies eliminate the need for time-consuming, routine tasks.

More performance thanks to function integration with VPPM-MPA



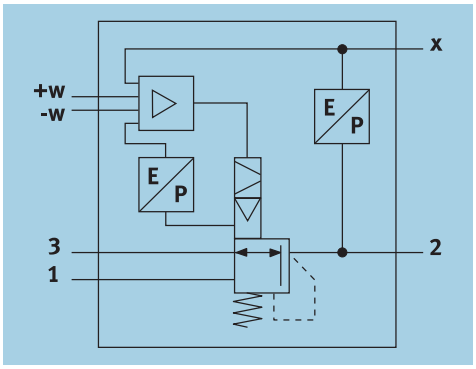
Technological benefits

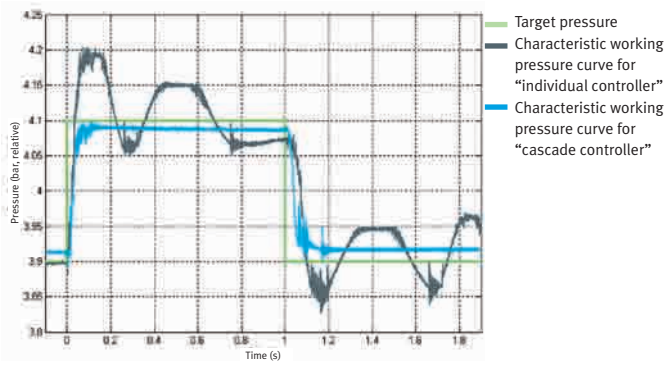
- Multi-sensor control for outstanding precision
- Electrical and pneumatic function integration and expansion with VPPM on CPX/MPA
- Variable pressure zone regulation for increased flexibility
- 3 presets for simple control

Concentrated performance

Unique in the market: cascade control with integrated multi-sensor control
Only VPPM proportional valves from Festo are equipped with this intelligent control technology with integrated sensors. Multi-sensor control is based on the advanced concept of cascade control. It is characterised by having several control circuits that are nested within each other, in contrast with conventional direct-action controllers that only have one. The overall system is thus subdivided into smaller, task-specific subsystems that are easier to control. The significant benefit is that both diaphragm pressure in the valve and output pressure are monitored. This leads to an extremely stable and accurate control response, even in demanding applications.

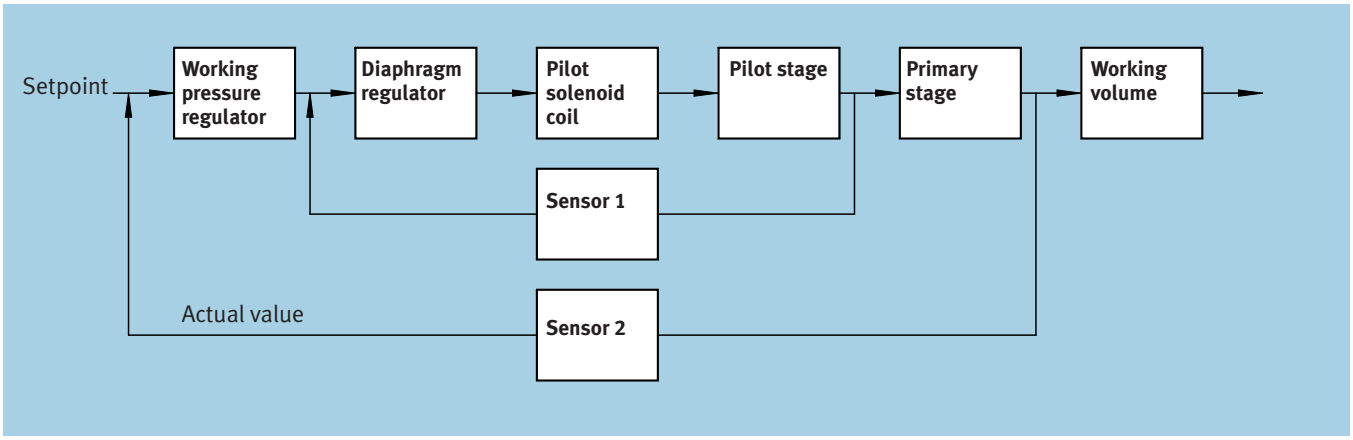
Increasing your productivity systematically
Control accuracy and dynamics are greatly improved with multi-sensor control. Overshooting is a thing of the past, even with low-level signals. Your application runs accurately, flexibly and precisely, even over considerable distances and regardless of changes in temperature!





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

Multi-sensor control (cascade control) for the VPPM



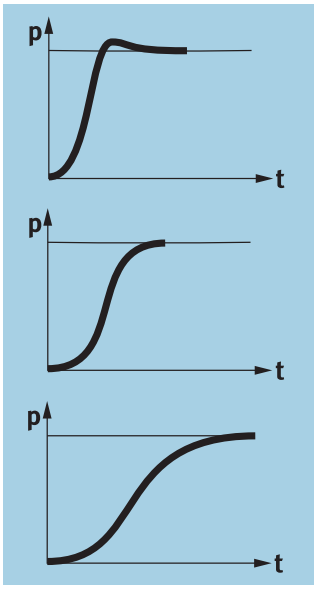
Operating principle

High priority for ease of operation
No need for specialist knowledge: simply select the appropriate parameters for any application from 3 presets, activate them by pressing a button and you're finished.

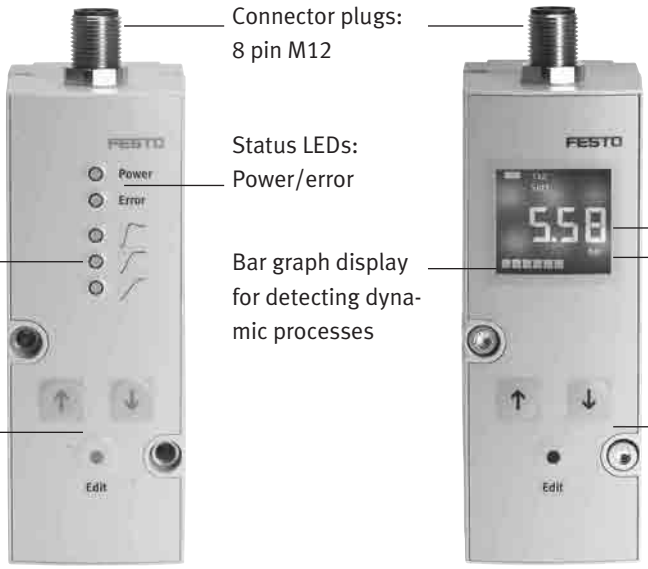
"Fast" mode:
For applications which require large volumes of air in order to adjust pressure levels

"Universal" mode:
For applications with medium-sized air volumes

"Precision" mode:
For applications in which only small quantities of air may be added or removed within a specified control time



Clear, highly functional operation



Connector plugs: 8 pin M12

Status LEDs: Power/error

3 preset LEDs: fast/universal/precise

Bar graph display for detecting dynamic processes

3 pushbuttons for easy operation (selection of presets)

- Display of current pressure value
- Adjustable pressure regulation range
- Various switching modes for the switching output (diagnostic function)

Selectable units of measure (bar, kPa, psi)

Presets can be selected with keys or via digital inputs

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

Proportional pneumatics at the fieldbus: innovation through function integration
Integrating the VPPM-MPA into the CPX/MPA terminal creates a highly individual, modular and configurable unit that opens up a wide variety of pneumatic end electrical functions.

Communication at all levels
The combination of CPX/MPA with VPPM-MPA also paves the way for all common, open fieldbus and industrial Ethernet systems. Compatibility with the following protocols ensures uniform, consistent communication, from the operating and control levels right up to the fieldbus level:

- Profibus
- DeviceNet
- Interbus
- CANopen
- CC-Link
- Modbus/TCP
- EtherNet/IP
- ProfiNet
- EtherCAT

All in all, this guarantees optimum integration into any control concept.

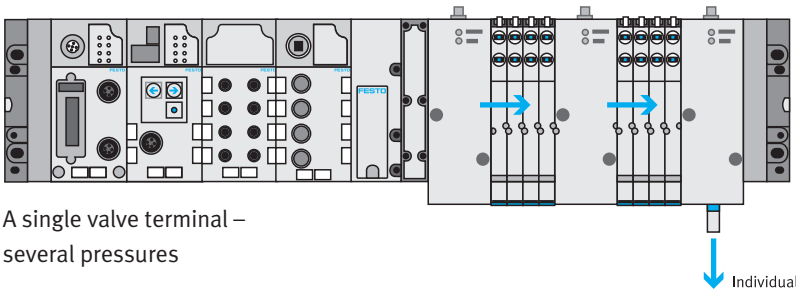
Maximised functionality – minimised footprint: VPPM-MPA integrated into the CPX/MPA electrical terminal

MPA valve terminal with CPX terminal
The CPX terminal ensures easy, flexible connection of pneumatic and electrical control loops to automation systems. It provides all the options of serial, real-time communication on the MPA valve terminal, even over considerable distances:

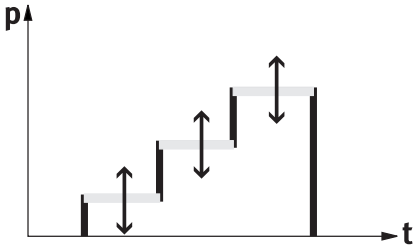
- Transmission of numerical information, e.g. for diagnostics and parameterisation
- Control of the entire pneumatic control loop system with I/O modules and valves at a single fieldbus connection

Thanks to IP65/IP67 protection, your automation application won't be affected by daily exposure to harsh industrial environments.

Unique: acquisition of pressure values and pressure regulation in a single solution
Whether controlled manually on-site or remotely, with VPPM-MPA on CPX/MPA pressure zone regulation is just as flexible as it is variable. With the help of digitised analogue values, pressure and force can be simultaneously controlled at several actuators and processes, even over long distances. Various static pressures can thus be set, for example by multiplexing – even at the same time for different MPA manifold blocks if sequential connection is used. And readjustments are no problem as the pressure can be corrected at any time during the process.

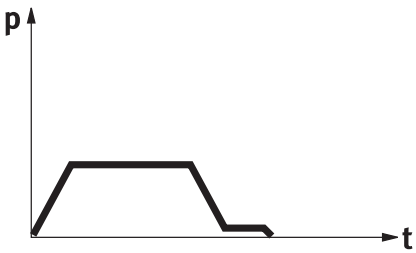


A single valve terminal – several pressures



Pressure zones on the CPX/MPA

Individual pressures within the process



Performance benefits thanks to function integration
- Reduction of system costs by up to 20%
- Reduction of installation time of up to 60%
- Everything is 100% tested and pre-assembled

Lots of room for manoeuvre

Parameterisation, configuration and diagnostics in no time at all

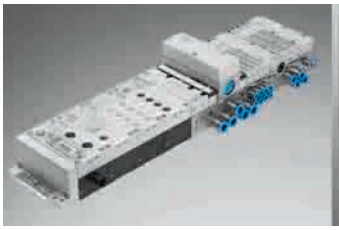
With the VPPM-MPA on CPX/MPA you can reduce your daily workload by keeping everything under control, directly, conveniently and reliably:

- Serial control of the valves and transmission of digitised analogue values for the pneumatics, even over great distances
- Diagnostics directly at the fieldbus: all values can be controlled and monitored remotely, even upper and lower limit values such as, for example, unachieved target pressure at the output
- Parameterisation with automatic adaptation of current or voltage interfaces to pressure units of measure and/or digitised formats

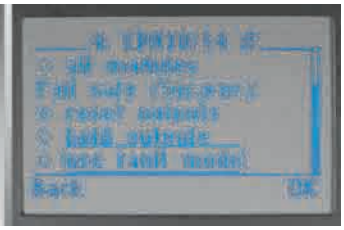
Even more convenient? It goes without saying!
Unscheduled machine and system downtime is expensive. That makes it all the more important to detect, localise and eliminate errors quickly or, even better, to avoid them. Festo offers a complete package of diagnostic solutions with which you can gain an overview of the entire valve terminal at a single glance, and control it.

Make your choice: CPX-MMI for simple solutions. For a look at the entire picture: CPX-FMT.

Festo display and operating unit CPX-MMI
The CPX-MMI hand-held control unit has been developed for commissioning and diagnostics without fieldbus, such as, for example, for servicing. Just enter analogue data in plain text, read out and set the limit values. It's child's play with the LED display.


Service and commissioning...


...with the hand-held CPX-MMI ...


... without programming

The entire valve terminal at a glance: Festo maintenance tool CPX-FMT
All the valve terminal's modules are visible at the Festo maintenance tool for CPX. Parameters can be changed, setpoints and actual values can be viewed and error messages can be displayed without any need for programming skills.

More security: save your CPX configuration to memory
You can reduce time and effort by up to 30 % by saving your CPX configuration at the fieldbus node. An ideal situation if your bus system doesn't provide adequate support for configuring and parameterising modular products.

Optimised performance: parameterising the CPX
Cycle times and signal processing quality can be optimised by changing CPX module parameters that are easily, quickly and verifiably documented.

Avoid downtime: CPX diagnostics
Whether for diagnostic and status information, error traces or specifications for condition monitoring, with CPX-FMT you can manage all relevant values in a uniquely comprehensive fashion directly from the PC. In addition, a condition counter provides you with the opportunity of specifying a particular number of switching cycles. The user is notified when this number has been reached – all in the spirit of prognostic maintenance.

Comprehensive diagnostic concept – from condition monitoring and single-channel diagnostics up to integrated IT services – for up to 35 % less downtime.

New: CPX-CEC-C1 CoDeSys controller from Festo.
A complete programming service for diagnostics/condition monitoring projects. Includes a diagnostics library and can be seamlessly integrated into existing host systems.

USB adapter at the fieldbus ...

... direct via Ethernet:

"Easy Config" at the PC

Application examples

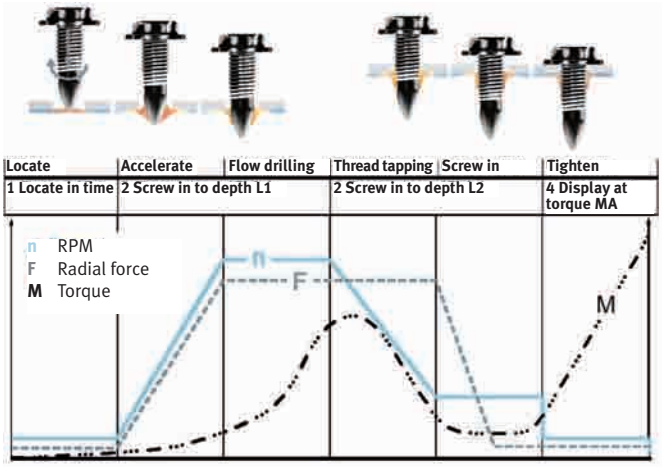
Automotive industry

Proportional valve VPPM for controlling radial force in automatic screwdrivers

Pre-processing components, such as pre-drilling and stamping, is no longer necessary thanks to the use of special screws which do part of the drilling themselves during the screwing process. The usual tolerance problems are eliminated as well. Radial force is applied using an ADVU tandem cylinder during flow drilling and is controlled by a VPPM proportional valve. The controller adapts the force applied by the cylinder individually, depending on process status and material.

Controlling highly complex processes at just a single station made possible by the VPPM.

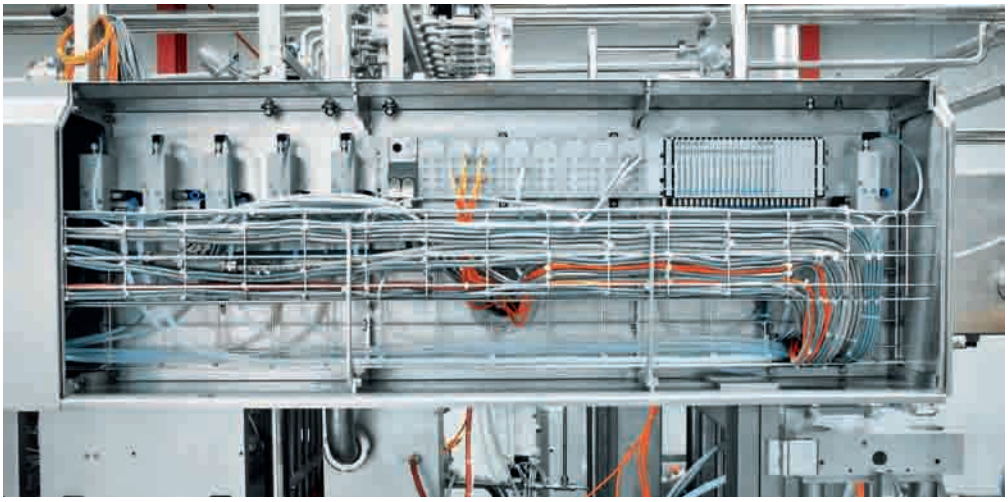
The right level of performance in the right place, at the right time



Filling and packaging technology

VPPM proportional valves for controlling vacuum, pressure and cylinder force
Lids are transported with a suction cup in a lid aligning station. The vacuum pressure must be proportional to the size and the material of the lids in order to supply the right amount of ejector air. VPPM proportional valves are used to control pressure for the venturi nozzles. They're also used at the sealing station, where the lids are pressed onto the containers.
Here they're used to control cylinder force in order to adjust the pressing power to each individual product.

Food and chemical products – efficiently filled and packaged.



Application examples

Machinery and equipment manufacturing

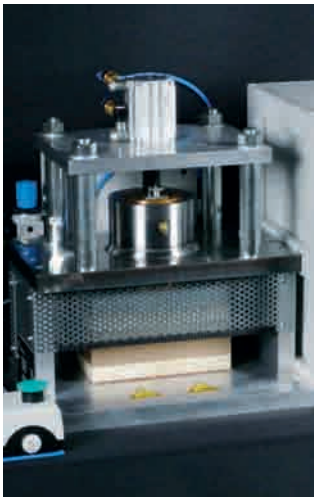
VPPM proportional valves for web tension control
Constant web tension is crucial for good results in winding machines. The friction roller must always be precisely decelerated relative to the diameter of the roll which is being wound up. The VPPM regulates braking force based on the setpoint provided by the machine's controller.

Testing machines

VPPM proportional valves for controlling pressing power
The adhesive forces of glues are tested with the help of laboratory presses. The test objects are pressed together at a specified force using heated pressing plates and are examined after they've cooled down. Pressing power can be varied individually with the VPPM.

Rubber and plastic processing machines

VPPM proportional valves for regulating back pressure
VPPMs contribute to precisely controlling profile haul-off in extrusion machines. They ensure continuous, uniform manufacturing speeds for thermoplastics processing.



The printing and paper industry

VPPM proportional valves for setpoint control
A so-called contact winding roller is equipped with an expandable profile in order to ensure that rolls of paper in roller cutters don't slip during the winding process. The clamping pressure of the contact winding roller adjusts itself to, for example, the material to be wound, web tension or the quality of the paper rolls with the help of compressed air pressure controlled by the VPPM.

Laminating and coating machines

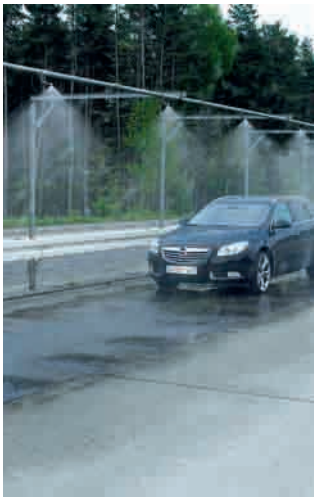
VPPM proportional valve for pre-tensioning sheet materials
In industries ranging from automotive to sports equipment and packaging, coating or laminating a great variety of materials uniformly and in the desired quality requires various web tensions. These can be easily selected with VPPM proportional valves.

Process engineering

Proportional valves VPPM for diaphragm valve control
In order to be able to simulate a broad range of road surface conditions at an automobile proving ground, the required amount of water is selected at the potentiometer and transmitted to VPPM proportional valves. The valves build up pneumatic pressure which activates the diaphragm valves.

Welding machines

Proportional valves VPPE for setpoint control
Precisely matched welding and contact pressures are required in ultrasonic welding technology for different materials and material thicknesses. Retooling and setup times can be shortened and productivity increased with the help of the machine controls – controlled by VPPE proportional valves.



All proportional valves at a glance

Key features

	Connection		Input pressure	Control range	Flow rate	Max. power consumption	Internal air consumption	Filtering	Repetition accuracy	Design	Safety setting
	Electrical	Pneumatic									
Pressure regulators											
VPPM-LED	M12 8-pin	G1/8	0 - 11 bar	0 - 2 bar 0 - 6 bar 0 - 10 bar	max. 1400 l/min.	7 W	max. 5 l/h	40 µm	0.50 %	Pilot actuated diaphragm regulator	Pressure retained in case of power failure
VPPM-LCD	M12 8-pin	G1/8	0 - 11 bar	0 - 2 bar 0 - 6 bar 0 - 10 bar	max. 1400 l/min.	7 W	max. 5 l/h	40 µm	0.50 %	Pilot actuated diaphragm regulator	Pressure retained in case of power failure
VPPM - MPA	Fieldbus/ MPA system	G1/8	0 - 11 bar	0 - 2 bar 0 - 6 bar 0 - 10 bar	max. 1400 l/min.	7 W	max. 5 l/h	40 µm	0.50 %	Pilot actuated diaphragm regulator	Pressure retained in case of power failure
VPPE	M12 4-pin	G1/8	7 bar	0 - 6 bar	max. 600 l/min.	3.6 W	max. 5 l/h	40 µm	2.00 %	Pilot actuated diaphragm regulator	Pressure retained in case of power failure
VPPE display	M12 5-pin	G1/8	0 - 11 bar	0 - 2 bar 0 - 6 bar 0 - 10 bar	max. 1250l/min.	4.2 W	max. 5 l/h	40 µm	2.00 %	Pilot actuated diaphragm regulator	Pressure retained in case of power failure
MPPE	DIN 45326 M16x0.75 8-pin	G1/8 G1/4 G1/2	0 - 11 bar	0 - 1 bar 0 - 2,5 bar 0 - 6 bar 0 - 10 bar	max. 8800 l/min.	3.6 W	max. 5 l/h	40 µm	0.50 %	Pilot actuated piston regulator	Pressure retained in case of power failure
MPPE-S	DIN 45326 M16x0.75 8-pin	G1/8 G1/4 G1/2	0 - 12 bar	0 - 2 bar 0 - 6 bar 0 - 10 bar	max. 8500 l/min.	20 W	max. 5 l/h	40 µm	0.50 %	Pilot actuated piston regulator	Exhausted in case of power failure
Volumetric flow control valves											
MPYE	M12x1 4-pin	M5 G1/8 G1/4 G1/2	0 - 10 bar	–	max. 2000 l/min.	2.4 W Mid-position 26.4 W Full stroke	7 - 35 l/min.	5 µm	0.50 %	Piston spool	tion in case of power failure Closed mid-
VPWP	M8 4-pin Socket	G1/8 G1/4	0 - 10 bar	–	max. 1400 l/min.	28.8 W	20 - 30 l/min.	5 µm	1 %	Piston spool	position

Selection table

	Regulation		Application			Operating medium				Special features
	Pressure	Flow rate	Few setpoint changes	Continuously changing setpoints	Low-level signal control	Filtered compressed air	Neutral gases	Lubricated	Unlubricated	
	x		x		x	x	x		x	Multi-sensor control
	x		x		x	x	x		x	LCD panel, clear menu, multi-sensor control
	x		x		x	x	x		x	Setup via fieldbus, multi-sensor control
	x		x			x	x		x	Low-cost valve
	x		x			x	x		x	Red LED display, setup menu
	x		x			x	x	x	x	External actual value input
	x		x	x	x	x	x	x	x	Directly actuated 1/8" variant, SA variants for vacuum
		x	x	x	x	x	x		x	Highly dynamic, even for positioning control
		x	x	x	x	x	x		x	Soft-stop, position and force control

Proportional valves are suitable for a great variety of applications, for example handling and assembly tasks, in machine tools and in welding technology. With Festo a perfectly matched, cost-efficient solution is available for every requirement. Just make your selection based on individually required characteristics, functions and features – it greatly simplifies decision making.

Make the most of high-tech and user-friendly solutions!

Individuality based on a modular system
The proportional pressure regulator VPPM is entirely adaptable to your requirements. Presets and multi-sensor control are included for a reliable and accurate control response. Choose between the inline or flanged version, LED display or LCD panel, or entry of setpoints in current or voltage. Furthermore, pressure values and individual diagnostics functions are shown on the optional display for convenient viewing.

And if that's not enough: when integrated into the CPX/MPA electrical terminal, the VPPM provides numerous additional diagnostics functions and variable pressure zones.

Reliable operation, easy to service and install
- Pressure is retained in case of power failure
- Broken cable monitoring
- Quick checking of operating state with LED display
- Long service life, test modules
- Installation via manifold block, H-rail, or individually with mounting bracket
- Simple valve replacement and valve terminal extension
- Energy efficient:
  - Thanks to reduced holding current for pilot valves
  - Thanks to minimum power consumption when inputs are constant
  - Thanks to pressure zone regulation with exactly the required amount of pressure in each case
  - No further energy is required for maintaining pressure after the setpoint is reached

Add value to your processes with the VPPM and its modular variants.


VPPM-LED


VPPM-LCD


VPPM-MPA

Intentionally conventional: the alternative for basic applications

A proportional valve that has been adapted to those functions that are truly essential for your application: the VPPE offers exactly the right features for many basic applications.

Benefits

- Good response characteristics for simple control tasks
- IP65 protection
- Flangeable
- Good EMC characteristics (class A)

Just line them up

... connect

... and display

VPPE

VPPE Display

New for VPPE with display

- Menu prompting
- Display shutdown
- Pressure range setting
- Password protection
- 3 presets can be selected
- Digital control electronics
- Exhaust flange can be rotated
- Compatible with P strips

State-of-the-art 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 corre sponding 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 for fast switching of programmed flow rates
- Flexible cylinder speeds for variable flow rates
- Use as a final control element for constantly and quickly changing flow rates

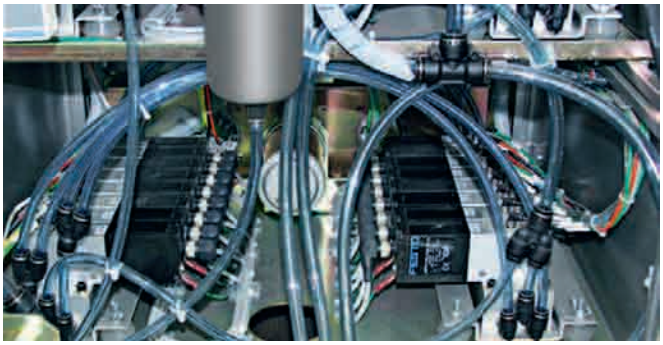
Proportional directional control valves in action

True-to-life motion: in order to ensure that the robot lady, with her human characteristics, also moves like a real human being, the Japanese robot manufacturer makes use of 50 proportional directional control valves type MPYE. They control the drives located underneath the robot's fine silicon skin that move her limbs. Festo was the only supplier of automation technology capable of supplying the required proportional valves. These were developed in collaboration with the customer by individually adapting standard products to meet actual requirements.

Fast, durable and cost-effective: 50 specially designed proportional directional control valves MPYE actuate the drives underneath the robot's fine silicon skin in order to move her limbs.

Further key criteria included special flow control which enables even more precise regulation, despite the long tubing lengths, and the short response time which is a standard feature of the MPYE.

The long service life and the comparatively low price of the MPYE were factors that also convinced the Japanese client.



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

The basis: MPYE valve with 5/3-way function for varying the direction of motion. With integrated serial interface for servopneumatic systems.

Benefits

- Reliable: integrated interface for digitised data transmission
- Precise: with integrated pressure sensors and cascade control
- Operating reliability: adaptive, self-tuning control algorithm
- Simple: supports auto-identification
- Productive: comprehensive diagnostics capabilities
- Variable: integrated pressure sensors for switching from positioning to force control

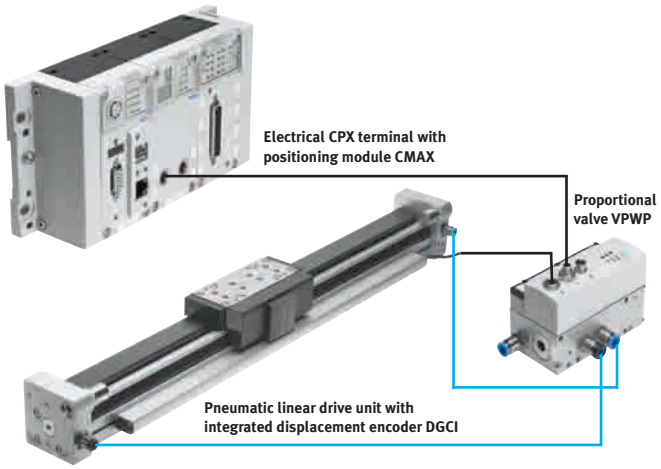
Outstanding motion performance

- Direct actuation of a brake or a clamping cartridge
- Reliable holding in the mid-position thanks to new standstill control
- Integrated option for force control
- Clear diagnostics in fully digitised system

State-of-the-art servopneumatics

Keep ahead of the game by positioning large loads even more dynamically with the third generation servopneumatic systems from Festo. These compact, top performers are designed for gentle, vibration-free operation and designed to reduce positioning time by up to 30% with the VPWP, and compressed air consumption by as much as 30%.

Combined with the CPX automation platform, the VPWP, together with the servopneumatic positioning module CMAX or the electronic soft-stop controller CMPX, speeds up a great variety of drives.

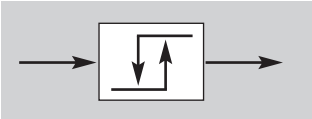


Control technology in brief

Types of control
Controllers autonomously regulate one or more physical quantities to a predefined level. The controller continuously determines system deviation by comparing the setpoint and the actual value signals and reduces system deviation to a minimum by means of the manipulated variable. In general, differentiation is made between two types of control:

- Discontinuous control (2-step control or multi-step control)
- Continuous control
  The controller intervenes in the control process continuously

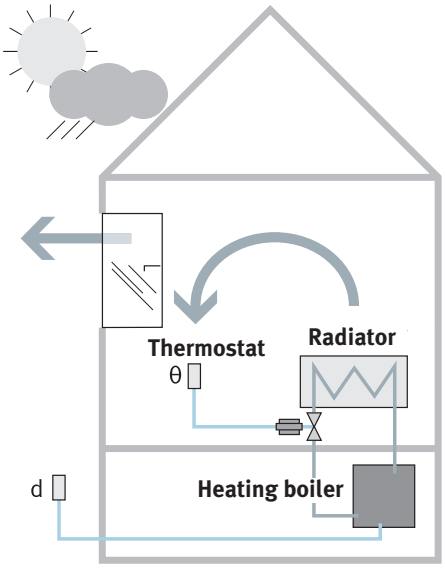
Discontinuous control
A process which is executed in jumps or steps is called discontinuous. The controller intervenes with brief switching steps and the same energy level. The difference between the "on" and "off" switching points is known as hysteresis. Pressing irons, for example, are based on this principle. If the actual temperature drops below the specified setpoint, a bimetallic element switches the heat on, and if this temperature is exceeded, the heat is switched off.



Block diagram of a 2-step controller

Continuous control
Continuous controllers intervene in the process uninterruptedly. They continuously change the control signal in order to keep system deviation as small as possible. The controller can adjust to any manipulated variable within a defined adjusting range.

Example: when regulating room temperature the thermostat setting functions as the setpoint, and the actual value is supplied by a temperature sensor which is normally integrated into the thermostat. When there is a deviation between the two, the controller regulates the flow of water within the radiator in an infinitely variable fashion by actuating the water pump. System deviation is thus reduced and the controller once again reduces water pump output.



Controlling room temperature θ

Control systems

Open-loop control circuit
With open-loop control circuits, the actual value is not fed back to the controller. Open-loop control circuits are rare in the field of proportional technology.

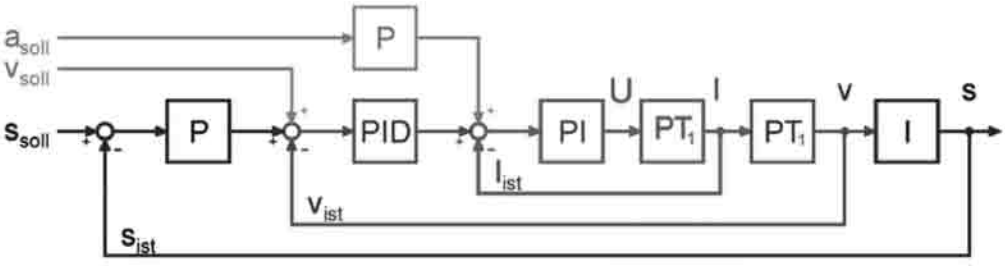
Closed-loop control circuit
Closed-loop control circuits are distinguished by the fact that the actual value is continuously fed back to the controller. The controller uses the system deviation, i.e. the difference between the setpoint and the actual value, to calculate the manipulated variable in accordance with the type of controller used, and the manipulated variable minimises system deviation.

Controller types
Different control tasks require different controllers. These range from simple P controllers, which merely arrive at a proportional weighting of control error, to the well known PID controllers, right up to ultramodern solutions like cascade controllers and status controllers.

Cascade control
With cascade control, several control circuits are nested within each other. The overall controlled system is thus subdivided into smaller, more easily controlled subsystems. In comparison with directly acting controllers, control precision and the stability of the control circuit are increased. In the case of cascade control, each controller's output quantity serves as the reference variable for the subsequent controller.

Analogue controllers
The most commonly used controller is the P controller. It's capable of correcting large system deviations with good results, but it's only used where accuracy is not an important factor.

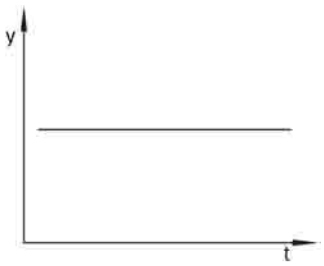
Digital control (microprocessors)
Control with the help of modern microprocessor technology offers numerous advantages. It means that modern controller types (cascade control) can be implemented in actual practice, thus leading to increased stability and improved accuracy. Further significant advantages include good flexibility (presets), bus compatibility (CPX-MPA valve terminal) and extensive diagnostic capabilities.



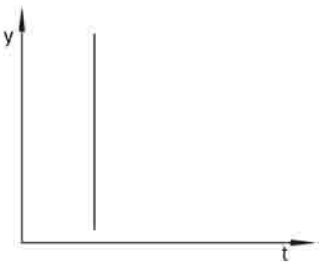
Cascade control

Control technology in brief

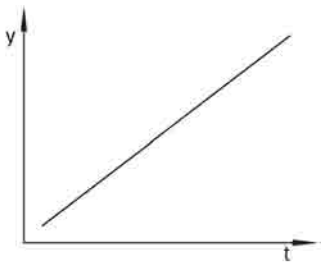
Controller types in comparison



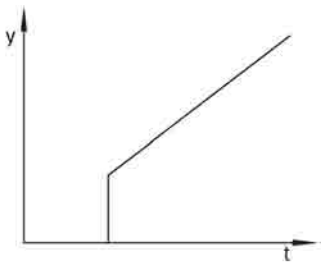
P controller
Circuits with proportional-action control are simple and moderately fast in comparison with other types of control. The drawback is that not all system deviation is eliminated.



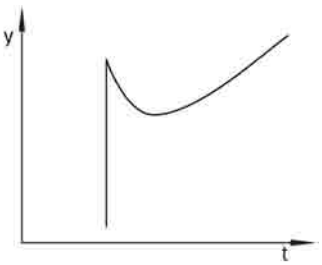
D-controller
The D element is a differentiator which, due to oscillation within the system, can only be used in combination with controllers that demonstrate proportional-action and/or integral-action characteristics.



I controller
Circuits with integral-action control are comparatively sluggish, but are capable of entirely eliminating system deviation.



PI controller
Proportional-integral controllers combine the moderately fast P-controller with the accurate I-controller. Circuits with proportional-integral control are thus accurate and moderately fast.

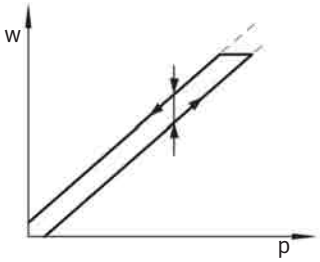


PID controller
The fastest controllers are those with a derivative component (PD and PID). These are ideal where high dynamics are required, or the controlled system itself is unstable.

Digital controllers
Digital controllers are capable of saving various control parameters to a table in the processor. These parameters are retrieved depending on set-point changes, disturbance variables or trigger threshold. As a result, even technically complicated control applications can be precisely corrected, thus making the system more reliable and productive.

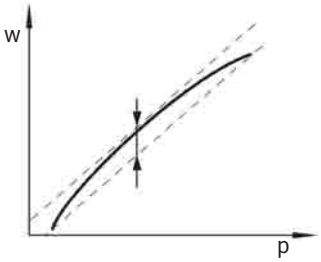
Terminology for proportional pressure regulators

Hysteresis



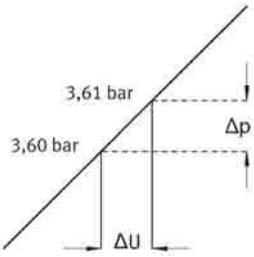
There's always a linear relationship, which lies within a given tolerance, between the specified setpoint and output pressure. It nevertheless makes a difference whether the setpoint is entered in a rising or a falling manner. The difference between the maximum deviation values is called hysteresis.

Linearity error



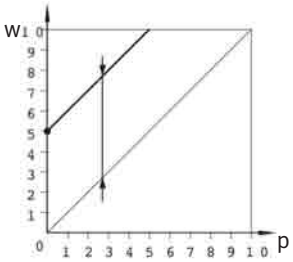
Perfect linearity for the output pressure control characteristic is only possible in theory. Maximum deviation from this theoretical control characteristic, expressed as a percentage, is known as linearity error. The percentage value is relative to maximum output pressure (full scale).

Response sensitivity



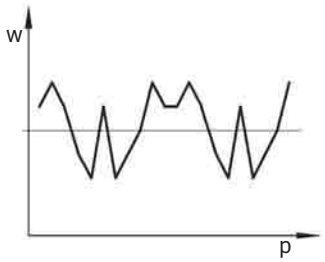
How precisely pressure can be changed, i.e. adjusted, is dictated by the respective device's response sensitivity. The smallest setpoint difference which actually results in a change to output pressure is known as response sensitivity. In this case, response sensitivity is 0.01 bar.

Zero offset



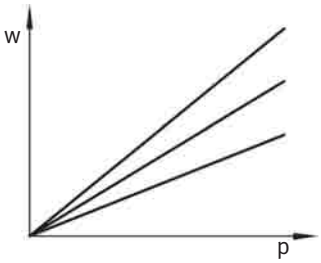
When it is not permissible for a VPPM to exhaust the system, for example due to safety considerations, minimum pressure can be shifted upward from the zero point. An output pressure of, for example, 5 bar is then assigned to the smallest setpoint, and 10 bar to the largest setpoint. If zero offset is used, zero suppression is automatically disabled.

Repetition accuracy
(reproducibility)



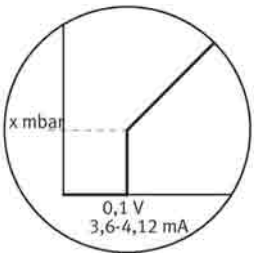
Repetition accuracy is the spread within which the fluidic output quantity is distributed when the same electrical signal, coming from the same direction, is repeatedly selected. Repetition accuracy is expressed as a percentage of the maximum fluidic output signal.

Pressure range adjustment



In new condition, 100% setpoint corresponds to 100% of the fluidic output signal. Pressure range adjustment makes it possible to adapt the fluidic output variable to the setpoint.

Zero suppression



In practice, it may happen that a residual voltage or a residual current is applied to the setpoint input of the VPPM via the setpoint transmitter. Zero suppression is used in order to ensure that, with a setpoint of zero, the valve exhausts the system reliably.

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