Mechatronic Motion Solutions

Mechatronic Motion Solutions from Festo is a worldwide unique system which comprises components, modules and software. It combines all types of pneumatic, servopneumatic and (electro)mechanical motion, geared to your task. Irrespective of the control system you use, Mechatronic Motion Solutions provides the appropriate interfaces.

Mechatronic
Guarantees mechanical and electrical compatibility at all levels. All pneumatic and electric drives are equipped with suitable interfaces for mechanical, data and energy transmission, thus ensuring that different technologies can be combined in one system. It also enables complex handling and positioning systems to be set up easily and safely.

Motion
Stands for the comprehensive, multi-dimensional portfolio of linear and rotary drives as well as a large variety of mechanical and vacuum grippers. They provide a host of benefits, such as high speed, precision, etc.

Solutions
Represents the decades of experience Festo has in the field of handling technology, across all industries and continents, as well as its expertise in the development of components and sophisticated systems. They range from pre-designed and calculated components to sub-systems and complete systems, making them the logical answer to the demand for pre-installed and customised systems and solutions.
The Festo product range, from controllers to drives, makes it extremely easy to implement servopneumatic systems. It is also perfect for integration into the CPX environment with universal fieldbus connection.

One of the latest intelligent CPX terminal modules: the positioning module CMAX. With this module, you can use a wide range of drives such as DGCI, DNCI and DSMI, as well as control their position and force.

→ More information on page 9
→ Application examples on pages 16–19

Brings drives to the right position gently and quickly and then accelerates even more quickly: the electronic end-position controller CMPX. It is also new in the CPX terminal and protects the drive and handling unit through gentle pneumatic braking.

→ More information on page 10
→ Application examples on pages 16–19

The proportional directional control valve VPWP with integrated pressure sensors doesn’t just give you the best control results; in addition to the sensor data, it also sends diagnostic data to the CMAX and CMPX.

→ More information on page 11

Drives with displacement encoder DGCI, DNCI or DSMI: drives with linear or rotary motion that also give you the advantages of pneumatics. They offer dynamic response, force and versatility – all with a positioning accuracy of ± 0.2 mm!

→ More information on pages 12–15

Note:
For additional information on our products, visit our website at www.festo.com
Good reasons to choose servopneumatics

As the global market leader for servopneumatic systems, Festo now presents the third generation of servopneumatic drive systems. This includes groundbreaking innovations such as the proportional directional control valve VPWP, which will open up new fields of application and make familiar solutions even simpler and more stylish.

Perfectly matched
It goes without saying that the individual Festo servopneumatic components are perfectly matched to each other, whether they are used as stand-alone units or together with pneumatic or electric components. This makes Festo servopneumatics an important part of the mechatronics kit.

Versatile positioning of large loads
• Maximum power density in automation – dynamic response, force and versatility are guaranteed with servopneumatics based on controlled pneumatics.
• Position control or force control? Why not both? Also with positioning accuracy of up to ±0.2 mm or 5% of the force setpoint value for a wide range of drives.

Commissioning at the push of a button
• The integration of the position controller CMAX and the electronic end-position controller Soft Stop CMPX into the modular electrical terminal CPX reduces the time and effort you spend on installation, configuration and commissioning.
When is it right to use servopneumatics? Your application decides!

Pneumatic, servopneumatic, electrical or in combination? The decision is yours. Our expert consultants give you the freedom of choice, as Festo can provide you with all three technologies.

This means that you can always be sure that you’re using the best possible technology.

Servopneumatics is recommended whenever the following criteria and advantages are important to you:

If you ...
- ... prefer sturdy, compact, low-cost solutions
- ... want a repetition accuracy in the tenth-of-a-millimetre range
- ... want to reduce air consumption by up to 30% in comparison to standard pneumatics
- ... do not require maximum precision and speeds as priorities but are looking for cost advantages of up to 50% compared to electrical solutions and for combining positioning and force control to enable new approaches to problem solving.
- ... place great value on the use of diagnostics to optimise machine availability and reduce downtime. Each device in the control circuit supplies differentiated diagnostic data.
- ... already have compressed air available.
The entire world of servopneumatics at a glance

The range of servopneumatic products in the modular mechatronic system leaves nothing to be desired.

Coordinating level

Control level
Control system

Field level
Actuation

Servopneumatic
Electric
Pneumatic

Front unit
Grippers
Vacuum

Coordinating system
PLC (ABB, Allen-Bradley, Rockwell, Siemens etc.)
Integrated controller CECX
Integrated controller FED-CEC

Position controller CMAX
End-position controller CMPX
Proportional valve VPWP
Sensor interface CASM

Linear drives with displacement encoder
DNCI
DGCI
End-position controller SPC11
Axis controller SPC200
Axis interface SPC-AIF
Proportional valves MPYE
Swivel modules with displacement encoder DSMI-B
Ethetnic Fieldbus AS-interface
Festo Handling and Positioning Profile FHPP
Provided by Festo
Festo Software Tool FST 4
Festo Configuration Tool FCT
Design and calculation software for electric drives Positioning Drives CoDeSys
Festo Positioning Profile
CoDeSys provided by Festo
FST 4 Festo Software Tool
FCT Festo Configuration Tool
PositioningDrives Design and calculation software for electric drives
Excellence in servopneumatics through innovative products

Maximum power density with innovative servopneumatics
As the leading provider of automation technology, Festo sets high standards for itself, especially when it comes to the product portfolio. That’s why our research and development experts have been able to consistently expand our range of servopneumatic components over the past few years. Three factors in particular are evidence of this:
- The most powerful, reliable and energy-efficient servopneumatics on the market
- Complete range of servopneumatic products: turning, gripping, linear motion, control – all from a single source
- Reasonable prices not just for the products themselves, but also when the overall life cycle costs are taken into account

The following pages contain more details about our range of servopneumatic products.
Servopneumatic positioning module CPX-CMAX-C1-1

One of a kind: The new positioning module CMAX is one of a kind. It is designed for simple servopneumatic control of various pneumatic drive families, linear or rotational. The CMAX is a positioning and force control module of the electrical terminal CPX.

Multi-purpose
Positioning technology using servopneumatics is particularly useful when compact, low-cost solutions are required for moving loads typically in excess of 5 kg and accuracy within a few tenths of a millimetre is sufficient.

Benefits
- Positioning and force control in one work step
- Compact, low-cost positioning system for sturdy applications
- Fast processes/high productivity thanks to the FCT software tool for simple commissioning with auto-identification and comprehensive diagnostics

Activation via control block CPX-CEC-C1 and all fieldbuses available in CPX.

<table>
<thead>
<tr>
<th>Technical data</th>
<th>horizontal</th>
<th>vertical</th>
</tr>
</thead>
<tbody>
<tr>
<td>Moving loads</td>
<td>[kg]</td>
<td>1-300</td>
</tr>
<tr>
<td></td>
<td>[kg]</td>
<td>1-100</td>
</tr>
<tr>
<td>Regulated force at 6 bar</td>
<td>[N]</td>
<td>30-2700</td>
</tr>
<tr>
<td>Positioning accuracy</td>
<td>[mm]</td>
<td>±0.2</td>
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<tr>
<td>Travel speed</td>
<td>[m/s]</td>
<td>Max. 3</td>
</tr>
<tr>
<td>Acceleration</td>
<td>[m/s²]</td>
<td>Max. 30</td>
</tr>
</tbody>
</table>
With CMPX, the unique Smart Soft Stop principle is finding its own way into the world of the modular electrical terminal CPX.

The electronic end-position control enables a cycle time reduction of about 30%, with virtually vibration-free travel to the mechanical end positions.

Smart Soft Stop enables highly dynamic movement of loads up to 300 kg.

Benefits
- Approx. 30% shorter travel times and 30% less air consumption than equivalent standard pneumatic solutions
- Increased cylinder service life
- No vibrations when returning to the end positions
- Suitable for use with all fieldbuses/Ethernet and CEC available in CPX
- Easy commissioning, Festo plug and work®

New functions
- Digital data handling
- Pressure sensors provide reliable downtime control
- Two mid-positions can be flexibly adjusted using the fieldbus
- Brake output on proportional valve VPWP

Electronic end-position controller Soft Stop CPX-CMPX-C-1-H1

Key features

<table>
<thead>
<tr>
<th>Moving loads</th>
<th>1 ... 300 kg horizontal</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1 ... 100 kg vertical</td>
</tr>
<tr>
<td>Actuation</td>
<td>Via all fieldbuses available in CPX</td>
</tr>
<tr>
<td></td>
<td>Front End Controller FEC and CEC-C1</td>
</tr>
<tr>
<td>Mid-positions</td>
<td>Up to two freely programmable mid-positions, also via the fieldbus</td>
</tr>
<tr>
<td>Accuracy</td>
<td>± 0.25 % of the displacement encoder length, and no less than ± 2 mm</td>
</tr>
<tr>
<td>Downtime monitoring</td>
<td>via pressure sensors in the valve</td>
</tr>
<tr>
<td>Reliable in combination with the “brake” function</td>
<td></td>
</tr>
<tr>
<td>Max. line length</td>
<td>between the controller and the drive: 30 m</td>
</tr>
<tr>
<td>Fast, vibration-free travel between two fixed stops</td>
<td></td>
</tr>
</tbody>
</table>

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Teamwork for maximum servopneumatic productivity: the proportional directional control valve VPWP with integrated, digital, serial interface for the servopneumatic positioning system CPX-CMAX and end-position controller CPX-CPMX Soft Stop. With the proportional directional control valve, the force control function is now also available for the position controller CMAX.

Integrated pressure sensors constantly monitor the pressure in the chambers of the connected drive and give you an edge in diagnostics and condition monitoring, as the fully digitised valves supply the controller not only with the sensor data, but also with valuable diagnostic values regarding their own operating status. Total process reliability!

Multi-sensor control
Integrated pressure sensors and cascade control for optimum, high-precision control results and sturdy characteristics. Optimum positioning characteristics with speed and acceleration ramps.

Additional function
Digital switching output for controlling
- A shut-off valve or
- A switching valve for a clamping unit

Further advantages
- Durable: adaptive “self-tuning” control algorithm
- Quicker to install: plug and work with auto-identification
- More productive: comprehensive diagnostic capabilities
Design options

The design of the displacement encoder differs depending on its function, use and location. Measuring absolute values, incremental and contactless or potentiometric (e.g. for retrofitting) – each option has its own strengths.

Linear motion

Rodless drive DGCI with recirculating ball bearing guide and contactless displacement encoder for measuring absolute values.

Advantage: the drive can be directly connected to CMAX or CPX without an extra interface, providing plug and work with auto-identification.

Linear motion

Standard cylinder DNCI to ISO 15552 with contactless displacement encoder and additional sensor interface CASM. As a signal converter, the sensor interface CASM establishes the connection between the incremental displacement encoder with potentiometer and the proportional valve VPWP. This digitised bus transmission is very secure.
Linear motion
Standard cylinder DNC to ISO 15552 with external displacement encoder/potentiometer. One design for all standard cylinders.

Rotary motion
Semi-rotary drive DSMI and sensor interface CASM.
With the combination of high-power drives and an integrated displacement encoder, it is possible to use the dynamic response, force and flexibility of pneumatics for many positioning tasks with a positioning accuracy of up to 0.2 mm. Linear and rotary motion is possible – servopneumatics can be used to actuate a great variety of pneumatic drives.

Advantages built in: integrated displacement encoder
- Compact and flexible, with no inconvenient external attachments
- Long service life thanks to the wear-resistant contactless displacement encoder
- Simple installation and assembly thanks to mounting accessories from the corresponding cylinder module.

Standard cylinder DNCI

Technical data
- Diameter: 32, 40, 50 and 63 mm
- Stroke length: 10 ... 750 ... 2000 mm
- Max. force: 430 ... 1680 N
- Suitable for CMAX, CMPX and as a measurement cylinder

Key features
- With contactless displacement encoder for incremental measurement
- Wide range of piston rod variants
- Standard cylinder to ISO 15552
- Optimum performance with guide and clamping unit

Linear drive DGCI

Technical data
- Diameter: 18 ... 63 mm
- Stroke length: 100 ... 2000 mm
- Max. force: 120 ... 1680 N
- Suitable for CMAX and CMPX

Key features
- With guide
- With contactless displacement encoder for absolute measurement
- Based on linear drive DGC
- Supply ports optionally on end face or front
- Wide range of options for mounting on drive units
- System product for handling and assembly technology
**Semi-rotary drive DSMI**

**Technical data**
- Diameter: 25, 40 and 63 mm
- Swivel angle: 0 ... 270° swivel angle
- Mass moment of inertia up to 6000 kg/cm²
- Suitable for CMAX and CMPX

**Key features**
- Based on swivel module DSM
- Built-in rotary encoder
- Compact design
- Wide choice of mounting options

**Displacement encoder MLO**

**Technical data**
- Stroke: profile 225 ... 2,000 mm, connecting rod 100 ... 750 mm
- Measuring principle: potentiometric, contacting and measuring absolute values
- Suitable for CMAX and CMPX

**Key features**
- Function: analogue
- System product for positioning applications and Smart Soft Stop (SPC10/SPC11)
- Version: profile or connecting rod
- Low-cost
- Ideal for retrofitting
Pressing unit for sawing wooden planks

The task
Wooden planks of different thicknesses are sawn into slats of different widths using high-speed saws. During the sawing process, each plank is pressed down by three rollers ($m = 80 \text{ kg}$) and moves at 3 m/s. The contact pressure can be adjusted according to the type of wood.

Once the plank has gone through the machine, the contact rollers must return to their initial position without coming into contact with the conveyor.

The data for the plank that is being fed into the machine are transmitted to the system by the fieldbus.

The solution
A proportional directional control valve VPWP-6 on each standard cylinder DNCI-100-100 controls the movement of the contact rollers. The core of the control unit is made up of a CPX terminal with a local CPX-FEC, a Profibus interface, three CMAX modules and an I/O module.

New for CMAX: the combinable record switch unit. This ensures reliable switching through different operating statuses. The unit switches between position control and force control on an event-controlled basis. The CPX-FEC controls the CMAX modules via I/O and fieldbus.

The advantages
- The stand-alone solution independently controls the pressing process
- Fast and flexible
- A system for position and force control, freely programmable
- Safety functions integrated into the system: emergency off and “Board fed in” signal for locking the system
- Clear error diagnostics
Areas of application
The full potential of servo-pneumatics comes to the fore in the following fields:
• Production engineering, e.g. flexible and controlled pressing of workpieces with a defined force
• Packaging technology, e.g. repositioning goods from a conveyor belt to a packaging unit
• Conveying technology, e.g. in pushing and sorting functions
• Dosing technology, e.g. in volume filler systems
• Test engineering, e.g. for positioning the test equipment
Filling in a matter of seconds

The task
The bags must be filled with 50 to 150 ml in just a few seconds. The outlet port of the dosing valve must be flexibly adjustable between 0 and 100%. A precision of ±0.5 mm is sufficient for this task. Another important requirement is that the filling liquid must not be heated up by the drive.

The solution
Four standard cylinders, each with a valve VPWP, control the filling process. A CPX terminal with a Profibus interface and four CMAX modules controls the four axes. The positioning stroke of the cylinder is set via the fieldbus, independently of the volumes to be filled.

In order to protect the cylinders against the cleaning agents, each one is individually encapsulated. The valve terminals and proportional valves are mounted in areas of the machine that are shielded from splash-water.

The advantages
• Flexible dosing of a wide range of media
• High cycle rate
• Each filling cylinder can be controlled individually
• Compact design
• Uses the existing CPX terminal
• Great value solution
• No temperature rise
• Can be controlled directly via the PLC
• No programming required
Safety – Your requirements in focus

The aim of the risk assessment is, amongst other things, to determine the hazardous situation and then estimate the risks. This applies to the entire life cycle of a machine.

For operation, this is generally split into four modes:
- Basic setting/rest
- Normal operation
- Set-up and service operation
- Emergency operation

The necessary safety functions can be derived from these operating modes:

An example: Reversing at reduced speed and with dual-channel protection against unexpected restarting.

Note:
You can find more details in our safety brochure, available in PDF format from the download area
→ www.festo.com