

**FESTO**



**Progress** in Motion

**Highlights**

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2022/23

“We want to make automation of your application easier, more reliable and, at the same time, more efficient.”

Dr. Ansgar Kriwet,  
Member of the Management Board Sales

Dear Customers,

What is it that drives us? We want to make automation of your application easier, more reliable and, at the same time, more efficient. That is why we are passionate about developing hardware, software, services and technologies at all our locations. In the Highlights brochure, we not only show you several of these products, but we also give you a compact overview of the topics that move us and that are important for us this year.

As one of the leading companies in automation technology, we also consider it our duty to lead the way when it comes to sustainability – in our own production facilities and with a wide variety of solutions for our customers. These might include piezo technology, with all the possibilities this offers, or light versions of our products or even Energy Saving Services. The online tool CO<sub>2</sub> & TCO Guide will help users to find the right drive technology and reduce CO<sub>2</sub> and the total cost of ownership at the same time.

Piezo technology is a keyword. Experts from the semiconductor and electronics industry or the life sciences know that precision, safety and durability requires high standards. Piezo valves are fast, extremely precise and quiet, and are impressive regulators of flow and pressure. They are used for pilot control in the Motion Terminal VTEM, and reliably regulate the air supply on Norwegian fish farms, for example.



Moving from open water to the road – electromobility. We have been focusing extensively on the requirements – sometimes quite special – of production environments, worked together very closely with users and enthusiastically developed new products together. We now offer a product portfolio that has been adapted for virtually all areas, from battery manufacturing to electrification of the powertrain.

And on to the cloud. Because we always keep moving for you. Our Festo Automation AX provides you with an easy-to-use tool that analyses data, models processes and proposes decisions.

All this and much more can be discovered in “Highlights 2022/23”. I hope you will have many inspiring moments that move you. We look forward to exchanging ideas with you – at trade fairs, online or in one of our new Festo Engineering Centers.

Dr. Ansgar Kriwet,  
Member of the Management Board Sales

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# Progress in Motion

Topics that are moving

## Hannover Messe

The new stand concept from Festo reflects the company's focus on specific areas, in particular those areas of technology that will be the strategic focus of the company in the future. On its stand, Festo shows in which fields the company is particularly active and what portfolio customers can expect. Topics that are highlighted are smart automation through digitalisation, robotics and LifeTech as an industry with great automation potential.

Other focal points include Didactic for lifelong learning and a section about Festo's corporate responsibilities that demonstrate the company's ambitious goals in terms of sustainability and efficiency. And finally, of course, there are the products and solutions with which Festo wants to inspire its customers. By following this path, you will get an up-to-date and very varied picture of Festo as a company.



### Smart automation for a smart transformation

The aim of industrial intelligence as per Industry 4.0 is to always find the best solution for the application and the environment. The best resource for this is data. Data provides facts. Its evaluation using artificial intelligence improves the quality of production, reduces costs, shortens production times and increases the robustness of processes. You can read more about this on page 48. One example of this is the remote IO system CPX-AP-I. It takes on the communication from the workpiece to the cloud in the production of battery cells for cars. See pages 35 and 44/45.

### Technology for humans – innovative solutions for LifeTech

Demographic change and an increase in the quality of life, as well as regulatory developments have resulted in a growing need for automation in the area of LifeTech. Festo develops products that enable laboratories and manufacturers of medical devices to work even more productively and cost-efficiently in the future, but also more safely. Piezo valve technology for highly precise dosing of extremely small gas flows, for example, is one of the keys to effective automation. See page 18.

### Technical education – enjoying lifelong learning

In the future, lifelong learning will be an integral part of everyone's professional life. Sometimes so-called small learning nuggets are enough, sometimes comprehensive further training is needed. New forms such as blended learning are a response to these changes. Festo LX is a new learning platform from Festo Didactic that integrates all of this. The training offer ranges from factory or process automation to LifeTech, from environmental technology and energy topics to water management.



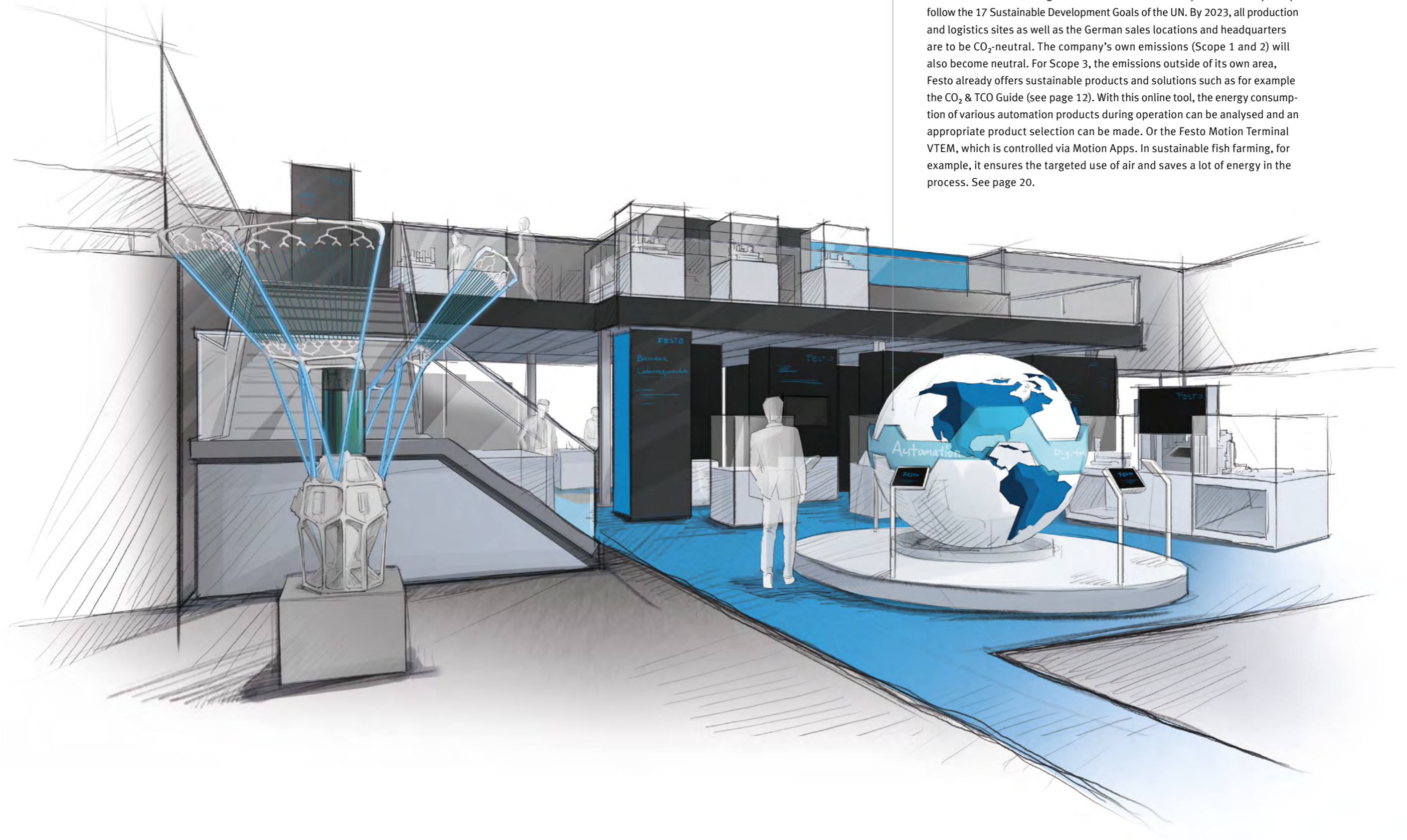


# Progress in Motion

Topics that are moving

## ■ Festo Blue World for sustainability and efficiency

Festo has set itself clear goals in terms of sustainability and efficiency. They follow the 17 Sustainable Development Goals of the UN. By 2023, all production and logistics sites as well as the German sales locations and headquarters are to be CO<sub>2</sub>-neutral. The company's own emissions (Scope 1 and 2) will also become neutral. For Scope 3, the emissions outside of its own area, Festo already offers sustainable products and solutions such as for example the CO<sub>2</sub> & TCO Guide (see page 12). With this online tool, the energy consumption of various automation products during operation can be analysed and an appropriate product selection can be made. Or the Festo Motion Terminal VTEM, which is controlled via Motion Apps. In sustainable fish farming, for example, it ensures the targeted use of air and saves a lot of energy in the process. See page 20.



## 01 Sustainability

Automate. Save energy.  
Protect the climate.

Festo has clear goals when it comes to sustainability

Sustainability is a question of social responsibility. Festo is taking on this responsibility – with a comprehensive approach that is aligned with the relevant UN Sustainable Development Goals. This touches every part of our business, from procurement to production at our sites to the use of our products by customers. Correct sizing at the engineering stage, energy- and production-efficient products, Energy Saving Services and our range of technical education help to reduce CO<sub>2</sub> emissions and thus improve the ecological footprint – all the way to carbon-neutral production. Festo sees automation as an opportunity and enabler for efficiency improvements in a sustainable industry.

# Software Services





# CO<sub>2</sub> & TCO Guide

The online tool for sustainable technology decisions

Choosing the right drive technology in automation saves money and, at the same time, protects the climate. So how do users find the right technology that enables them to reduce carbon dioxide emissions in the long term? The CO<sub>2</sub> & TCO Guide helps machine and system manufacturers make the right decision.

There is no question about it: motion tasks in industrial automation always need energy, whether it's electricity or compressed air. The intelligent use of suitable drive components plays a decisive role in reducing the energy consumption of machines and systems and thus also in lowering the CO<sub>2</sub> footprint. But which drive technology is the most efficient and sustainable for which application?

## Pneumatic or electric?

The CO<sub>2</sub> & TCO Guide compares the electric and pneumatic drive components based on the required application data. To do this, you simply enter the application's parameters. The software then creates and visualises energy-efficient and sustainable suggestions for the motion task in next to no time, using the portfolio of the most common drive components from Festo. As part of this process, it also provides a clear comparison of the pneumatic and electric applications.

The online tool shows the energy consumption and the CO<sub>2</sub> emissions per year as well as the procurement costs and the total cost of ownership for each solution. Based on this information, machine and system manufacturers can decide for themselves which parameters are the most important for them and which drive technology they should choose.

## Retrofit or replace

In addition to deciding on the right drive technology, the intelligent use of other Festo components can also reduce energy consumption in systems. Here are a few examples:



Smart products such as the vacuum generator **OVEL** with integrated pressure reduction.



The energy efficiency modules of the **MSE6** series shut off the compressed air during non-productive times after a certain amount of time.



The Motion Terminal **VTEM** uses **piezo valves**, which consume up to 90% less energy in the valve pilot stage, and Motion Apps for energy-efficient control.



Artificial intelligence can be used to predict and calculate how energy consumption will change: more on “**preventive energy management**” in chapter 6.

With the CO<sub>2</sub> & TCO Guide, users can find the right solution and thus reduce CO<sub>2</sub> and the total cost of ownership at the same time.

You can find more information at:

> [www.festo.com/energyefficiency](http://www.festo.com/energyefficiency)

> [www.festo.com/co2-tco](http://www.festo.com/co2-tco)



# Compressed Air Energy Efficiency Audit

## Service for sustainable production

Using compressed air more efficiently and reducing CO<sub>2</sub> emissions in production are becoming increasingly important. It is often not clear where the weak points in a compressed air system are. With the TÜV-certified Compressed Air Energy Efficiency Audit, potential savings can be identified and operating costs reduced by up to 60%.

The auditors examine the compressed air generation, the utilisation of the compressors, the compressed air preparation and quality as well as the compressed air network. They also carry out a representative leakage detection test on selected pneumatic systems, investigate potential savings and check the pneumatic efficiency. They look at whether drives, valves and tubing are optimally sized, whether blowing and vacuum applications are efficiently designed and whether installation and control concepts should be optimised. And to round things off, the experts create a concept for monitoring the condition of the complete compressed air system or individual sections to obtain transparency about flow, pressure and humidity in real time.

### After the analysis:

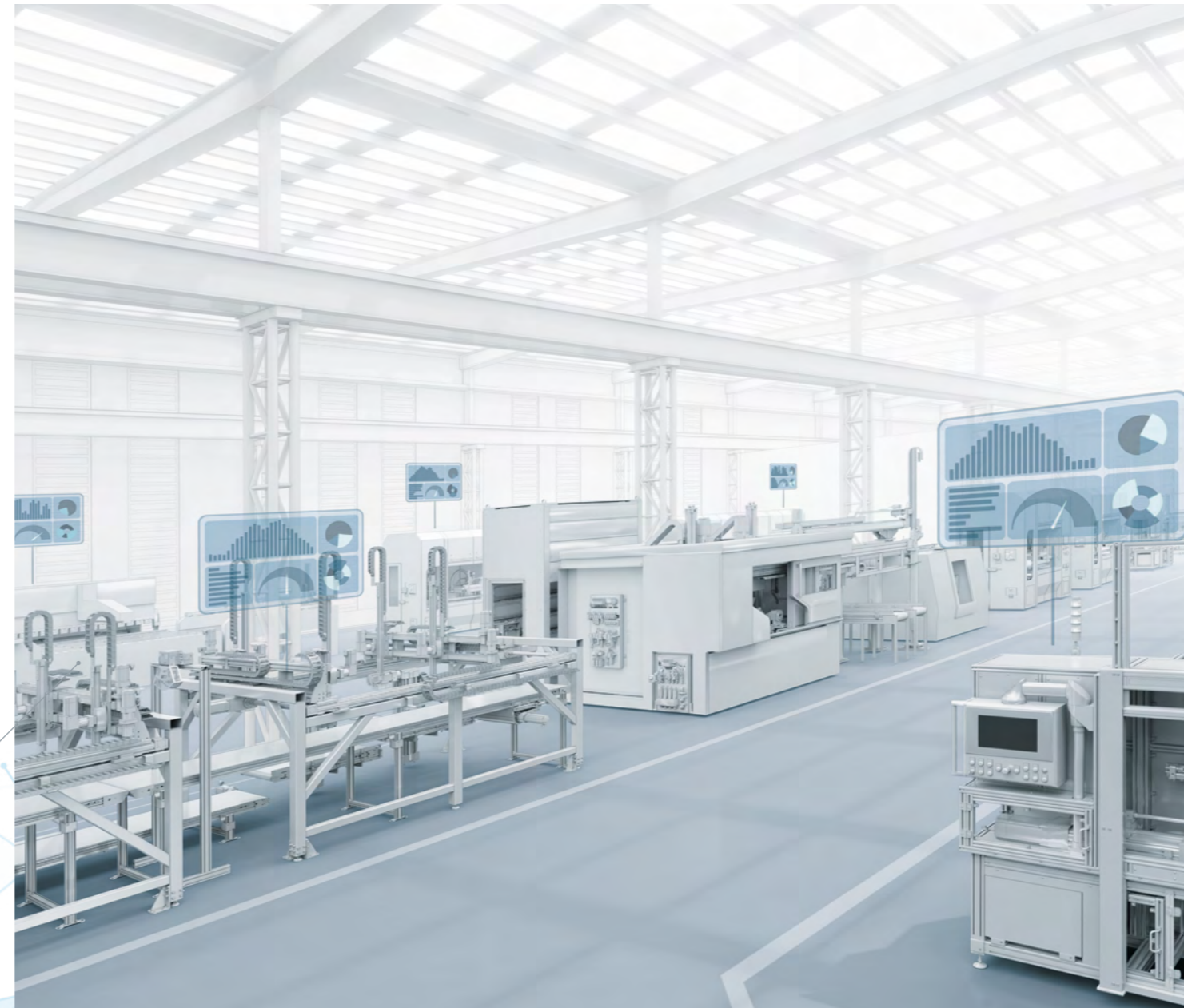
#### the recommended actions

All the data is precisely documented in a detailed report which forms the basis for defining recommended actions, ranked in order of priority, for optimising the compressed air energy efficiency and their savings potential. The maintenance measures that are required, including recommended spare parts, are also listed in detail. This simplifies the decision-making process for finding the most effective starting point for system integrators to improve the energy efficiency. The final report with all the measurement results can be used for energy management in accordance with ISO 50001. Festo can also provide support with implementing specific improvement measures, if required. Experience shows that savings of up to 60% on the operating costs of pneumatic systems can be made.



#### Leakage detection:

The energy efficiency experts from Festo detect leaks with highly sensitive ultrasonic detectors.



### Artificial intelligence meets energy efficiency

By using artificial intelligence, it is possible to permanently monitor energy consumption and make predictive calculations about how the system's condition will change. A suitable solution is then created for the machines or entire production plants together with the customers. Once it has been validated in a pilot project, the solution can then, if requested, be scaled up for the entire production plant. **The Festo Automation Experience software (Festo AX)** forms the basis for this approach. More on this on page 48.



### Competency development as a success factor

As a leading specialist in technical education, Festo Didactic provides the specialists of today and tomorrow with the knowledge and skills they need to identify potential savings in their work and implement them systematically. **The digital learning portal Festo LX** provides the ideal basis for this, as it combines industry expertise with educational know-how and offers multimedia learning content for many technology topics to create unique learning experiences.

<https://lx.festo.com>

You can find more information at:

> [www.festo.com/energyefficiency](http://www.festo.com/energyefficiency)

> [www.festo.com/gfaa](http://www.festo.com/gfaa)



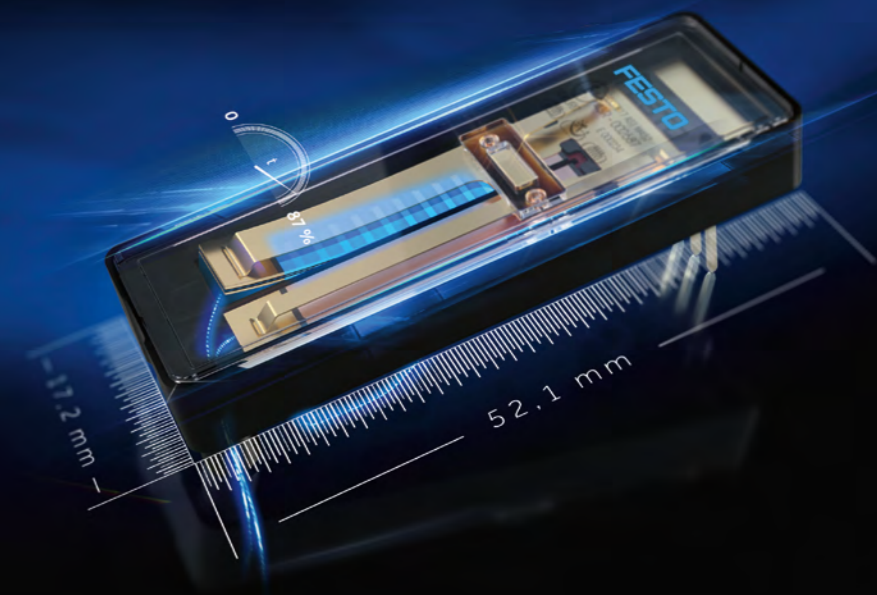
## 02 Piezo technology

# New directions for a familiar principle

Piezo technology is driving automation in many industry sectors

An unremarkable little device is changing the world of valves forever: the piezo bender. It is the core of piezo valves, and what makes them small, low-energy, efficient, fast and inherently proportional. Thanks to their numerous benefits, such as the ability to meter, mix or dispense gases and liquids with high precision, piezo valves are right on trend. Piezo valves are therefore popular in life sciences, the electronics as well as other industries, and in near-patient mobile end devices. Their compact dimensions and very low heat generation also make them suitable for pilot control in the smallest of spaces, as in the Motion Terminal VTEM.

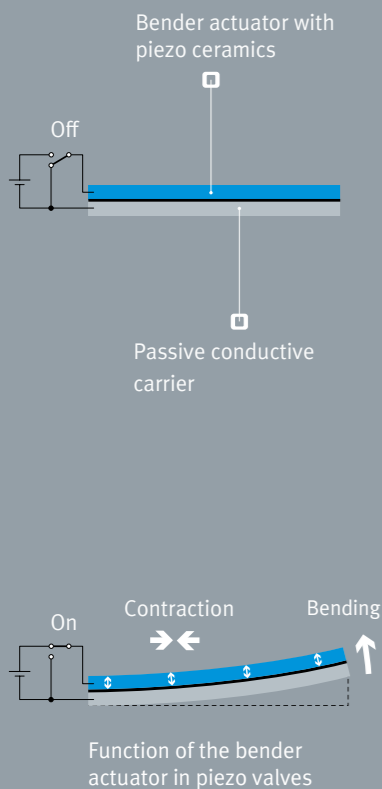
# Low-energy Silent



# Cleverly regulating pressure and flow

Piezo valves push the limits of pneumatics

Festo uses the piezoelectric characteristics of certain ceramics that mechanically deform when a voltage is applied. Since the control electronics and sensors are integrated in most piezo valves from Festo, these valves can be opened continuously and thus the pressure and flow can be regulated by comparing the setpoint/actual values.



**Precision is one of the key concepts in modern manufacturing. Industries such as the semiconductor and electronics sector or life sciences cannot operate without it. Piezo valves are one of the answers to this requirement. They enable solutions to be realised that are effective as well as slim and elegant.**

This is because piezo technology is, among other things, highly accurate and can quickly reach the specified pressure and vacuum setpoints in a valve. Piezo valves ensure that even the smallest volumes of air or other gases can be precisely dosed. This makes them advantageous for laboratories and industry, but also for surgical instruments. Depending on the requirements of the process, different valves are needed.

As the pressure can be very accurately controlled, it is easier to handle fragile workpieces and to polish wafers without damaging them or, for example, for the precise dosing in adhesive applications. Since the energy consumption is low, there is no heat generation, thus ensuring the integrity of samples in laboratory applications or personalised medicine and offering people with mobile ventilator breathing devices greater quality of life. An additional plus in all cases is the quiet operation.

## Benefits of piezo technology

- Low energy requirement, no self-heating**  
 Compared to solenoid valves, proportional valves with piezo technology require virtually no energy to maintain an active state. Current is only needed at the start to charge the ceramics and therefore the valves generate no heat. They consume up to 95% less energy than solenoid valves.
- Small and light**  
 The design of the piezo valve is light as it has no solenoid or electrical coils. This, together with its compact dimensions, make it optimally suited for applications with low weight.
- Very quiet operation**  
 Proportional valves with piezo technology are quieter than solenoid valves – the bender actuator moves freely and makes no impact noise. Pulse-width modulation is also unnecessary.

## Flow control



**Proportional flow control valve VEMD**  
 The dynamic and lightweight mass flow controller records, controls, and proportionally meters the flow rate of air and inert gases.

## Motion control



**Motion Terminal VTEM**  
 Digitised pneumatics: the VTEM regulates compressed air consumption via apps. The piezo valves in the pilot control allow pneumatic movements, pressures and flow rates to be regulated extremely specifically in the smallest of spaces, right down to each single valve connection.

## Pressure control

### Proportional pressure regulators VEAA/VEAB

Both valves regulate the set pressure extremely precisely, quietly and reliably. They have very short switching times, very low energy consumption and are extremely durable.



### Real-life application:

On the next page you can read how the Motion Terminal VTEM with piezo pilot control regulates the air supply on Norwegian fish farms.





# Intelligent solutions for fish farming

Data-based air supply with the Terminal VTEM



Innovasea specialises in data-driven technology and equipment for fish farms. The aquaControl solution uses the intelligent technology of the Motion Terminal VTEM to help fish farm operators aerate and oxygenate fish pens. The VTEM is the first standardised platform with valves controlled by Motion Apps that Innovasea is using.

Open ocean aquaculture is a complex undertaking. Numerous factors such as wind, waves, salinity, but also the oxygen content influence the fish farmers' success. As consumer demand for fish and other aquatic animals continues to grow, there are more and more of these aquaculture farms in fenced pens measuring up to 30 metres in diameter – it's a big new market.

## Digitalisation in aquaculture

Automation and the simultaneous digitalisation of the supply of air make an important contribution to reducing the complexity of aquaculture. Until now, every step had to be done manually, including tasks such as reading the sensors to determine the oxygen content. This is very important, because too little oxygen is just as harmful to the sensitive fish as too much. The adjustment itself was done via manually operated ball valves. This approach – measure, readjust, measure again and readjust if necessary – made aquaculture prone to errors. With the Motion Terminal VTEM, the supply can now be automated and controlled remotely and reliably.

The VTEM, which is housed in control cabinets and has four valves and piezo pilot control, uses the Motion App "Flow control" to precisely regulate the air supply and thus the oxygen content in up to eight basins to the optimum value. At the same time, this data from the oxygen sensors is transmitted to the fish farmers' control centre. The fish farmers also monitor the supply via dashboards. If the values approach a critical range, they can intervene immediately via remote control to ensure maximum safety. John Arve Kleppe, Global Product Manager Aeration and O<sub>2</sub> Injection, realises what the benefits of the VTEM for his company are: "Festo understands our challenges and solves them. With the VTEM, we are now considered the global leader in technical solutions for fish farming."

Perfectly placed: the Motion Terminal VTEM with the Motion App "Flow control".



You can find more information at:

> [www.festo.com/vtem](http://www.festo.com/vtem)

> [www.festo.com/vtem/application](http://www.festo.com/vtem/application)



03 LifeTech

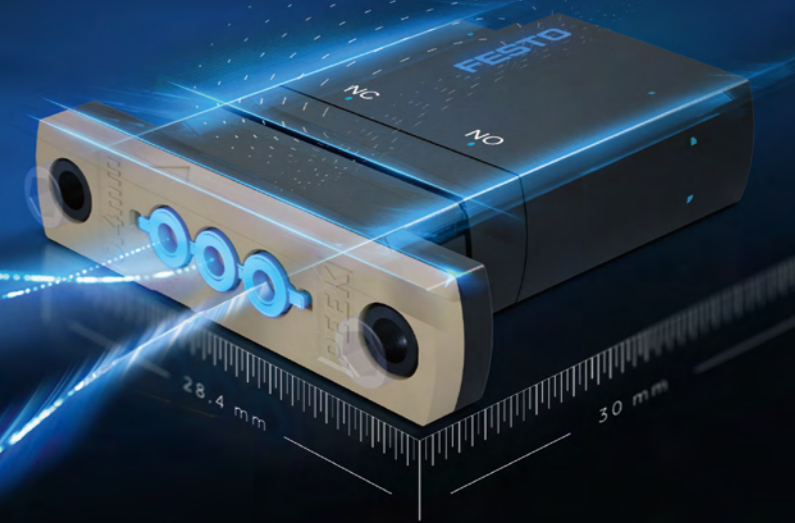
## Automation for the life science sector

A mix of standard components and specially developed industry-specific solutions

Festo offers an attractive mix of standard automation components and specially developed industry-specific solutions, whether for laboratory processes, manufacturing medical equipment or in vitro diagnostics. Our fluid and motion technology is perfectly tailored to the needs of modern laboratory environments. And our innovative products, systems and services for the diagnostic market reduce the validation time and speed up the time to market. Our products, systems and services enable us to realise precisely the flexibility, quality and safety that each industry sector demands. This also includes maximum efficiency.

# Precision

## Media separation





# Liquid handling in laboratory automation

Precisely control even the smallest flows

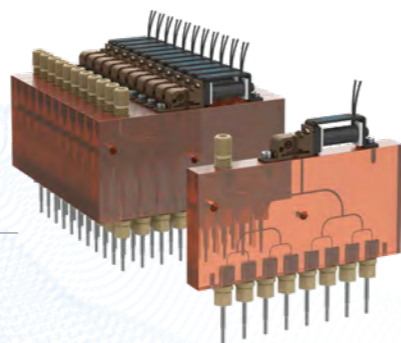
Dispense head

## VTOI

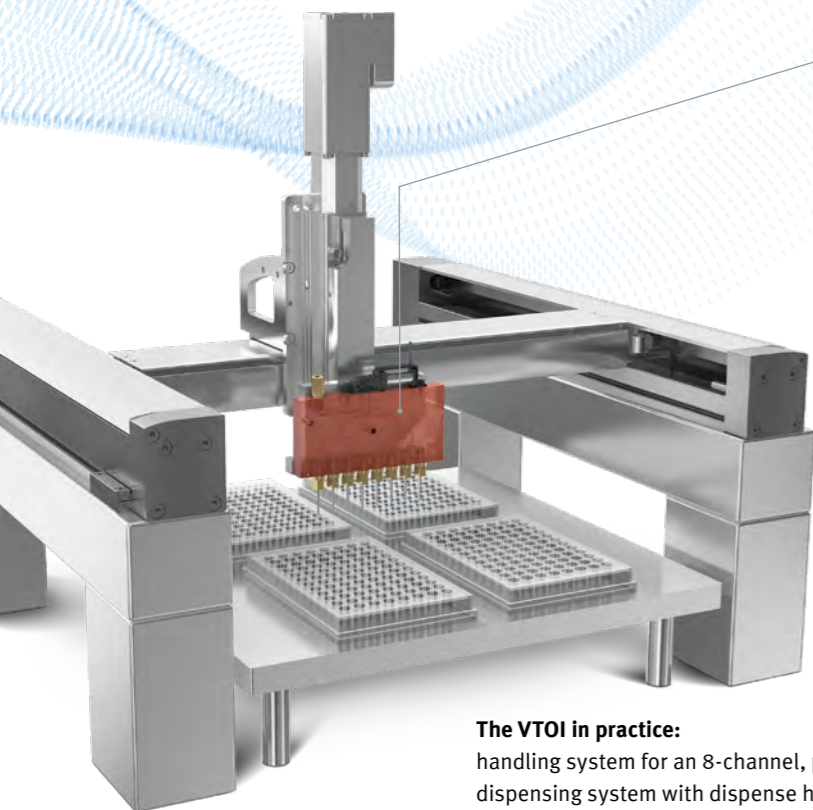
The extremely precise dispense head VTOI significantly increases throughput with just one valve for eight outputs. Thanks to the 9 mm grid dimension and one valve for eight outputs, the VTOI is an extremely precise 8-channel dispense head for microwell plates. It is optimised for applications that require a high throughput.

- Minimum dispensing volume of 1 µl
- Dispensing precision CV ≤3% (intra-run) and ≤5% (tip-to-tip)
- Also for aggressive media
- Ideal in pressure-controlled dispensing systems
- Complete dispense head using just a few parts

The additional vacuum function means that in addition to dispensing, liquids can now be aspirated down to the smallest microlitre range. The design allows several dispense heads to be mounted side by side, so that 96 wells can be dosed at the same time using just 12 valves.



**For increased throughput with the same dispensing volume:** with only 12 valves, 96 fields can be dispensed at the same time.



**The VTOI in practice:** handling system for an 8-channel, pressure-controlled dispensing system with dispense head VTOI.



Proportional valve

## VYKA

- Dosing, aspirating and continuous flow
- Media separation
- Kv value: 0.35 l/min
- Nominal width: 1.2 mm
- Very compact

Optimised nozzles for good rinsability

Proportional valves

## VYKB, VZDB

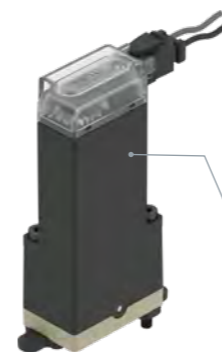
- Dosing, aspirating and continuous flow
- Kv value: 0.35 l/min (F10) and 0.97 l/min (F12)
- Nominal width: 1.6 and 2.0 mm
- Holding current reduction included
- Pneumatically actuated version



Proportional valve

## VYKC

- Dosing, aspirating and continuous flow
- Nominal width: 1.2, 1.6 and 2.0 mm
- With or without integrated holding current reduction
- Very cost-efficient



Electrically actuated

### Media separated valves VYKA/VYKB/VYKC and VZDB

The media separated valves from Festo use three different operating modes. The very compact, powerful valves don't just precisely dispense and aspirate any volume, right from the very smallest, their uniquely impressive pressure and nominal width specifications also make them perfect for flow control.

The holding current reduction in VYKA, VYKB and the larger VYKC prevent the valve, and thus also – media, from heating up. The VZDB is pneumatically actuated and does not require any electronics.

### At a glance

- Perfect for very small volumes of liquids or aggressive gases
- FDA-listed materials
- Developed to ISO 13485
- Very easy to clean and suitable for aggressive liquids thanks to safe media separation
- Small widths of 7, 10 and 12 mm, VYKC: also 16 mm

You can find more information at:

- > [www.festo.com/liquidhandling](http://www.festo.com/liquidhandling)
- > [www.festo.com/lab](http://www.festo.com/lab)
- > [www.festo.com/catalogue/vyka](http://www.festo.com/catalogue/vyka)
- > [www.festo.com/catalogue/vykb](http://www.festo.com/catalogue/vykb)
- > [www.festo.com/catalogue/vzdb](http://www.festo.com/catalogue/vzdb)

# Gas handling in medical technology

## Proportionally controlling very small gas flows

Piezo electronics module

### VAVE-P

By installing the electronic module VAVE-P for the actuation of piezo valves, proportional solenoid valves can be easily replaced. The electronics module has a flexible power supply of between 12 and 24 volts instead of the usual 310 volts. The voltage generation required for the piezo valves and the 2-channel driver stage with current limitation are built in. Thanks to the low power consumption, there is almost no heat generation. It is ideal in applications where energy efficiency or avoiding heat generation is important.

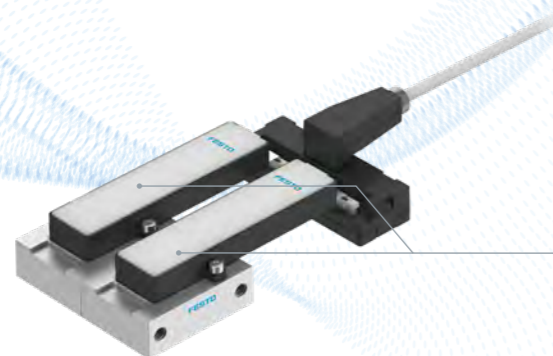


- For all Festo piezo valves VEMR, VEMC, VEMP, VEAE
- 2 channels, for two 2/2-way piezo valves (VEMR, VEAE) or one 3/3-way piezo valve (VEMC, VEMP)
- 2 analogue inputs 0 ... 10 V or pulse width modulation 10 V, 0 ... 100% pulse width
- Flexible power supply of 12 ... 24 V ±10%



#### VEMP

Electronics module for direct connection to piezo valves



#### VEAE

Electronics module and plug-in base for two piezo valves VEAE

2/2-way valve

### VEAE

- Nominal width 1.2 mm, 1.5 mm or 1.7 mm
- Supply pressure up to 3 bar or 6 bar
- Max. flow rate: 60 lpm or 81 lpm at 6 bar or 55 lpm at 3 bar
- Reaction time <10 ms
- Product size 64 x 24 x 12 mm



3/3-way valve

### VEMP

- Nominal width 1.3 mm or 1.6 mm
- Supply pressure up to 0.7, 1.1, 1.7 bar (10, 16, 25 psi)
- Flow rate 28 lpm at 20 psi (1.5 bar)
- Reaction time <10 ms
- Product size 52 x 12 x 12 mm



#### Flow control: 2/2-way valve

The piezo valve has one piezo bender and two ports. The greater the voltage that is applied, the further it opens.



#### Pressure control: 3/3-way valve

The piezo valve has two piezo benders and three ports. A complete pressure regulation system can be set up with this compact solution. There's one piezo bender for pressurisation and a second one for exhausting. The third state is closed, thus maintaining the pressure.

Proportional valve

### VPWS

When flow rates of up to 270 litres per minute are required, the proportional cartridge valve VPWS regulates gas flows reliably and precisely, whether for oxygen, carbon dioxide, air, nitrous oxide or inert gases. This lightweight valve can be used in a variety of ways, for example in ventilator breathing and anaesthetic systems where respiratory gases need to be mixed with oxygen. It is also suitable for other application areas and industry segments.



- Cartridge with 15 mm diameter, 33 mm long
- Stainless steel, grease-free, FKM seal
- 2/2-way NC for flow control
- Different variants for 50 to 270 lpm at max. 2 ... 8 bar
- Media: air, oxygen, nitrogen, inert gases

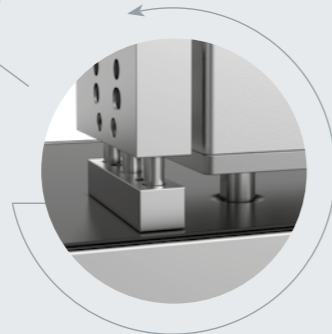
You can find more information at:

- > [www.festo.com/medtech](http://www.festo.com/medtech)
- > [www.festo.com/catalogue/vave-p](http://www.festo.com/catalogue/vave-p)
- > [www.festo.com/catalogue/vemp](http://www.festo.com/catalogue/vemp)
- > [www.festo.com/catalogue/veae](http://www.festo.com/catalogue/veae)
- > [www.festo.com/catalogue/vpws](http://www.festo.com/catalogue/vpws)



# In vitro diagnostics

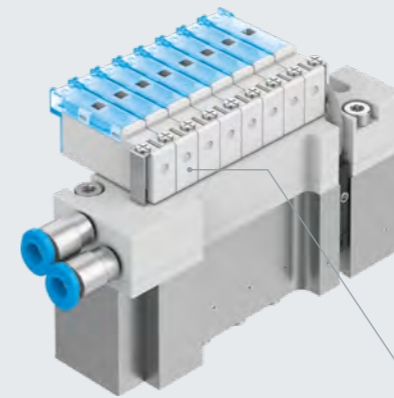
Automating point-of-care applications



**Example of a point-of-care device with integrated solution from Festo:** A small slide fixes the microfluidic chip, while a miniature piston rod presses on one of the microfluidic chip's membranes, enabling it to transport the reagents inside.

There is a growing demand for mobile analytical devices for rapid and reliable tests that enable patient samples to be analysed directly at the medical practice – this in turn increases the demand for new lab-on-a-chip devices. Festo supports the development of ready-to-install automation solutions with individual components that have the usual high-quality industrial standard.

Festo is increasingly favouring miniaturization for their design. The very small components work extremely reliably, with minimal heat generation. This is particularly important when the chemicals used are sensitive to heat. Additional components for cooling are not required, while built-in pressure and vacuum generation means there is no need for external air supply.



Example of a ready-to-install subsystem

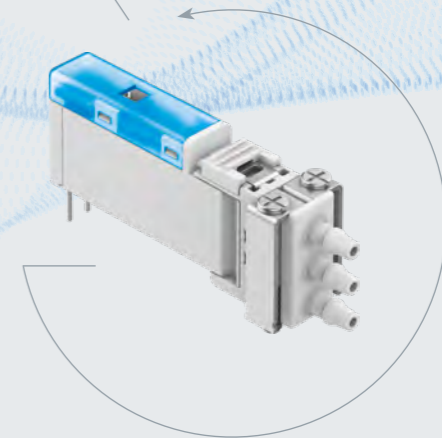
- Miniature valve VOVK: extremely small at just 6 mm wide
- Valve block and manifold duct plates: customised and modular
- Proximity switch SMT: space-saving and reliable
- Piston of the compact cylinder EG-2.5: strong and sturdy
- Push-in fitting QS and tubing

Miniature valves

## VOVK

Ideal for small point-of-care devices: the miniature valves VOVK are perfect for operating a large number of switching valves side by side in the smallest of spaces. The 3/2-way NC valve with a flow rate of up to 5.8 l/min can even be expanded to a valve block with a maximum of 20 positions. Its extremely low energy consumption of just 0.5 W and a switching time of 6 ms also allow a very compact design and enable a large number of small gas flows to be switched side by side.

- Very wide pressure range: –0.9 ... 7 bar
- Vacuum operation up to 0.9 bar possible
- Suitable as a pilot valve or for direct control



You can find more information at:

> [www.festo.com/ivd](http://www.festo.com/ivd)

> [www.festo.com/catalogue/vovk](http://www.festo.com/catalogue/vovk)



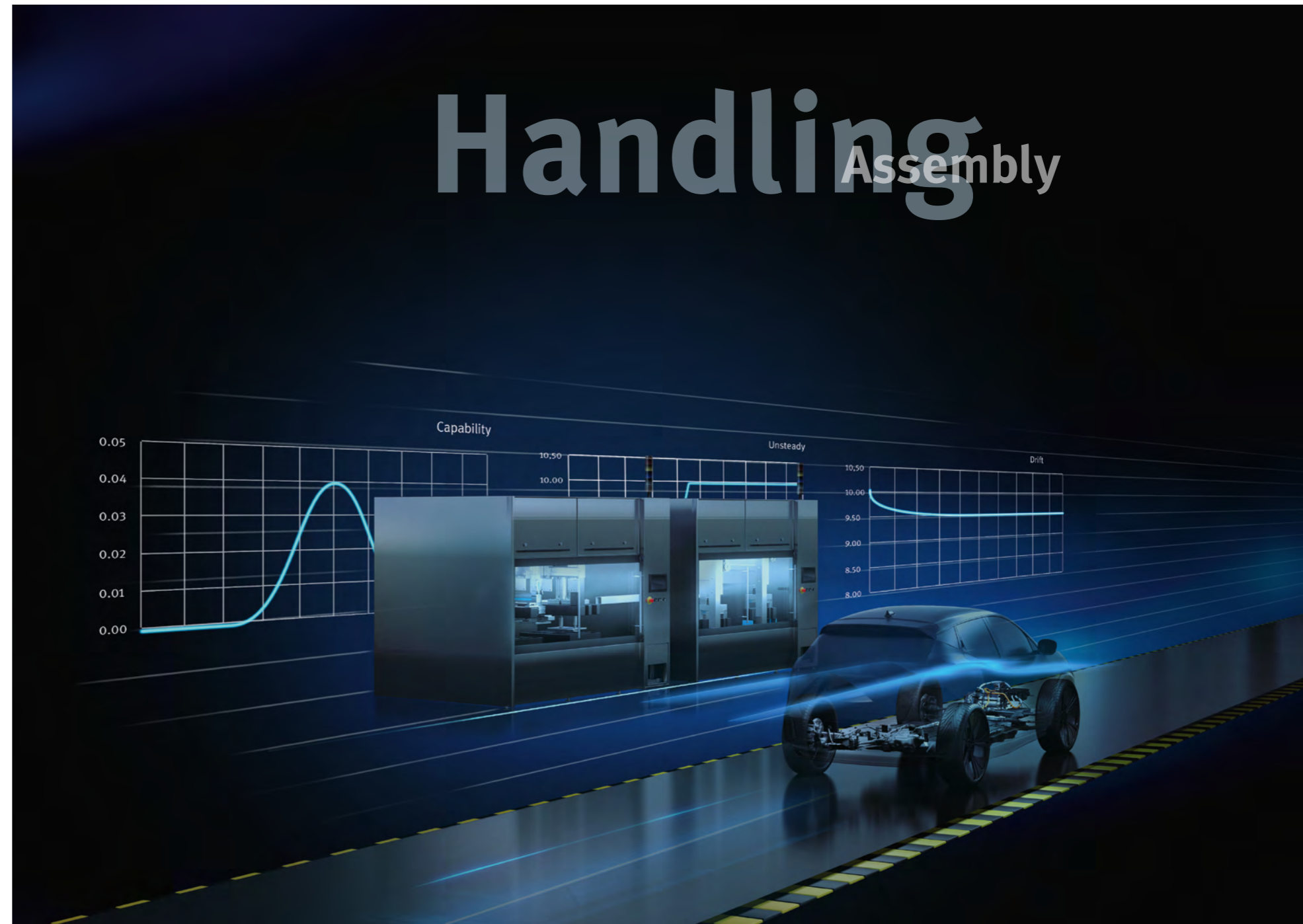
Here you can see how the ready-to-install subsystem works.

## 04 Electromobility

## Solutions for every production step

From manufacturing batteries to inserting them in the electric vehicle

Electromobility is a growing trend: never before have as many electric cars been registered as in 2021. At the heart of every electric vehicle are lithium-ion batteries for energy storage. These are still the only available scalable technology that can be used for motion. Solutions from Festo ensure that these expensive components are produced safely and end up in the car without getting damaged.





# Automation for battery manufacturing

Copper, zinc and nickel-free automation products in handling solutions



**Manufacturing battery cells is a highly sensitive process. There are three factors for the automation components that require special attention: the dry-room environment, cleanroom requirements and possible interfering particles such as non-ferrous metals.**

## Dry room

A dry-room environment with a pressure condensation point of  $-50^{\circ}\text{C}$  down to sometimes  $-80^{\circ}\text{C}$  is typical for lithium-ion cell production. The dry-room environment inhibits the hydrophilic tendency of many electrolytes and prevents the risk of harmful hydrofluoric acid forming through reaction with humidity in the ambient air. Catalogue products from Festo can be used in the dry room without restriction. The reason for this is the exclusive use of water-free lubricants and GRP/CFRP-reinforced polymers in components subject to abrasion. None of the approx. 60 different greases from Festo contains water as part of the lubricant's formulation – which is why these greases do not dry out.

## Cleanroom

The products used must comply with the specified cleanroom class during operation. All cleanroom products from Festo are certified in accordance with ISO 14644-14. However, the cleanroom class depends on where in the application the product is used. Cylinders, valves, grippers and drives, all handling, vacuum and compressed air systems, sensors, filters, controllers and fittings from more than 80 product series from Festo can be used in ISO class 7 cleanroom environments. Most of them are also suitable for classes 6 and 5, some even for class 4.

## Free from copper, nickel and zinc

Depending on the application, products in battery cell production must not emit any interfering particles such as copper, zinc or nickel. Otherwise there is a risk that the quality of the batteries is reduced or that they are unusable. That is why Festo has defined criteria restricting the use of copper, zinc and nickel in its product development: metallic materials with copper, zinc or nickel as a main component are excluded from use.

A detailed definition and overview of the copper/zinc/nickel-free portfolio from Festo can be found in the **brochure "Automation solutions for battery production"** at

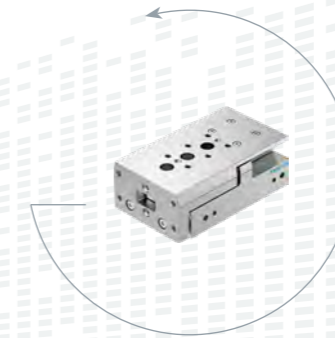
> [www.festo.com/battery](http://www.festo.com/battery)

## Top products for battery manufacturing

### Mini slide

## DGST

- Whenever precision, dynamic response and load capacity are required, e.g. when stacking the electrodes
- The most compact slide drive on the market
- Integrated shock absorber and sensor mounts, integrated basic cushioning
- Slide and yoke made from a single part



### Compact cylinder

## ADN

- Can be used universally thanks to a large number of variants
- Cylinders to ISO 21287 for easy replacement and spare parts management
- Piston diameters from 12 to 125 mm



### Spindle axis for cantilever systems

## ELGT

- Ideal for reliable, vertical handling of battery cells
- Integrated double guide for high load bearing capacity and rigidity
- Extremely sturdy connectors



### One-way flow control valve

## VFOE

- Lightweight and compact
- Easy and safe to adjust with push-to-lock function
- Reliably controls the speed of the cylinders used



### Pressure sensor

## SPAN

- Ideal for economical pressure monitoring for dancer rollers, filling tasks or vacuum control
- Maximum flexibility thanks to switchable electrical outputs
- Very wide range of pressure measuring values



You can find more information at:

- > [www.festo.com/battery](http://www.festo.com/battery)
- > [www.festo.com/catalogue/dgst](http://www.festo.com/catalogue/dgst)
- > [www.festo.com/catalogue/adn](http://www.festo.com/catalogue/adn)
- > [www.festo.com/catalogue/elgt](http://www.festo.com/catalogue/elgt)
- > [www.festo.com/catalogue/vfoe](http://www.festo.com/catalogue/vfoe)
- > [www.festo.com/catalogue/span](http://www.festo.com/catalogue/span)



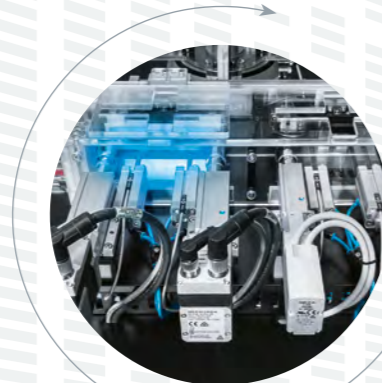
# Degassing and sealing

Safely extracting forming gases and resealing battery cells

Degassing and sealing are core processes in battery manufacturing. They take place immediately after initial contacting of the battery cells with electrical voltage, the so-called formation process. The forming gas produced during contacting is extracted. The cells of the batteries stored in shelving systems are pierced with hollow lances in the degassing chamber. The gas is evacuated until the first electrolyte is drawn off too. The system then switches over and blows the drawn off electrolyte back into the battery cell, while the remaining amount of gas is permanently removed. Once all the gas has been extracted, the cells are sealed again. This is typically done using thermal welding or ultrasonic welding. Handling solutions from Festo ensure a reliable and dynamic process, all the way to inspection and labelling.

## In demand: high speed and high throughput

High speeds and a high throughput as well as reliability and repeatability are important for economical manufacturing. A cantilever handling system based on the spindle axes ELGT from Festo ensures dynamic and reliable loading and unloading of the process chambers. The compact and low-cost spindle axes ELGT from Festo with integrated double guide are perfect for combining into 2D and 3D cantilever systems. With a copper and zinc content of less than one percent, the axis is a perfect fit for use in assembly systems in battery manufacturing or in small parts handling.



**Pneumatic and electric actuators** are used for piercing and sealing the battery cells in the process chamber.



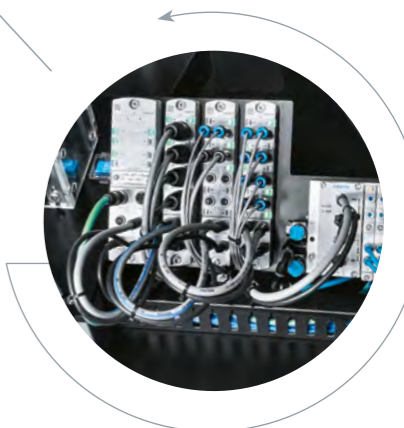
During the degassing process, the process chamber is evacuated using pinch valve **VZQA** and proportional pressure regulator **VPPI**. The pressure sensor **SPAN-B** monitors the atmospheric pressure.



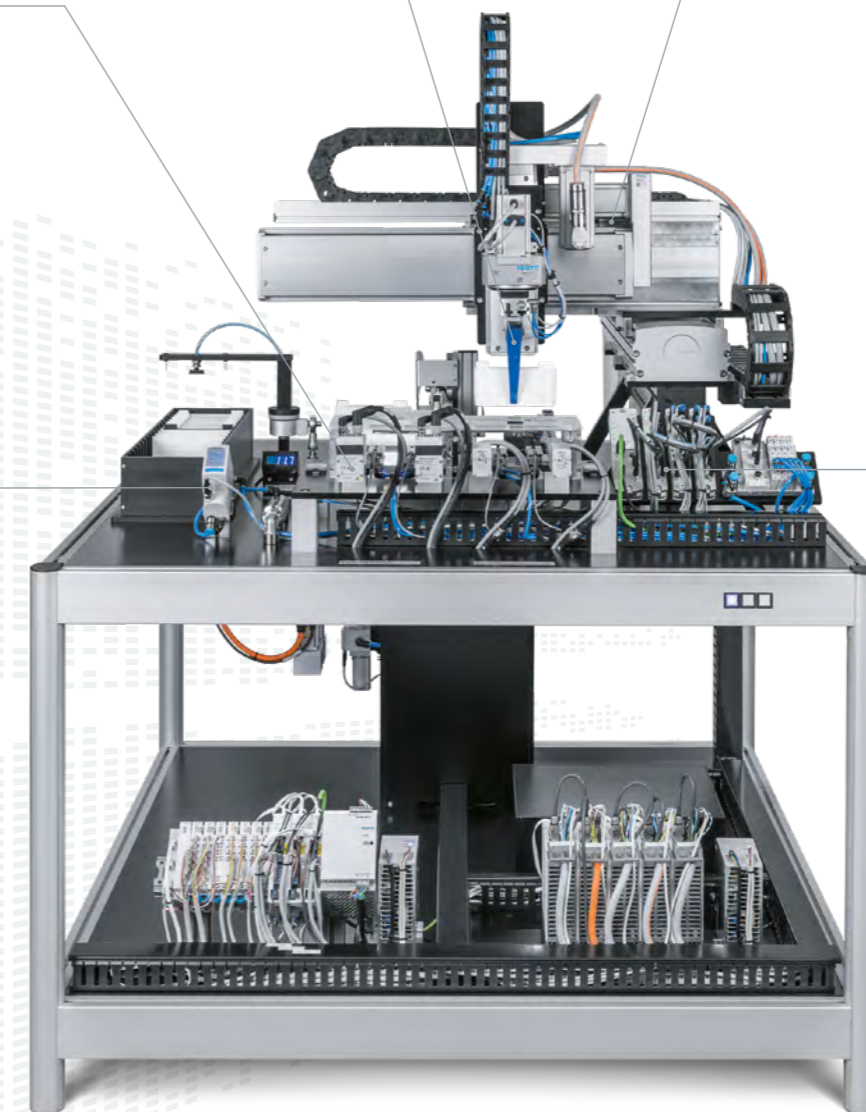
The adaptive gripper fingers **DHAS** adapt to the workpiece. This means that even workpieces that are easily bent out of shape such as pouch cells can be gripped securely and without damaging them.



**Handling systems** with long strokes and high speeds for loading and unloading the battery cells.



The remote I/O system **CPX-AP-I** seamlessly integrates all I/Os and IO-Link® stations such as sensors and valve terminals into the system's communication network.



You can find more information at:

> [www.festo.com/battery](http://www.festo.com/battery)



# Electrification of the powertrain

Variable, standardised and highly efficient production processes

The efficient production of components for the electric powertrain is a deciding factor in the economic success of electromobility. The electric motor together with the battery pack form its central part.

The challenges in battery module and pack assembly are varied: changing production volumes and component geometries as well as the highest standards of occupational safety have to be taken into account, and everything has to be continuously monitored to minimise risks. The high degree of automation of the individual process steps also results in a wide range of requirements for drive technology and sensors.

The key to increased efficiency is the use of suitable cross-technology handling solutions so the battery cells can be gripped and transported safely, precisely and reliably. In combination with a standardisation strategy, which already pays off at an early stage of the project, economies of scale can be exploited for batch sizes of just 2 or larger. Reproducible and transferable process parameters optimise commissioning. In addition, reduced component variety guarantees an efficient supply of spare parts and at the same time decreases downtimes that could be caused by critical, process-relevant components.

## Benefits of a mix of electrics and pneumatics

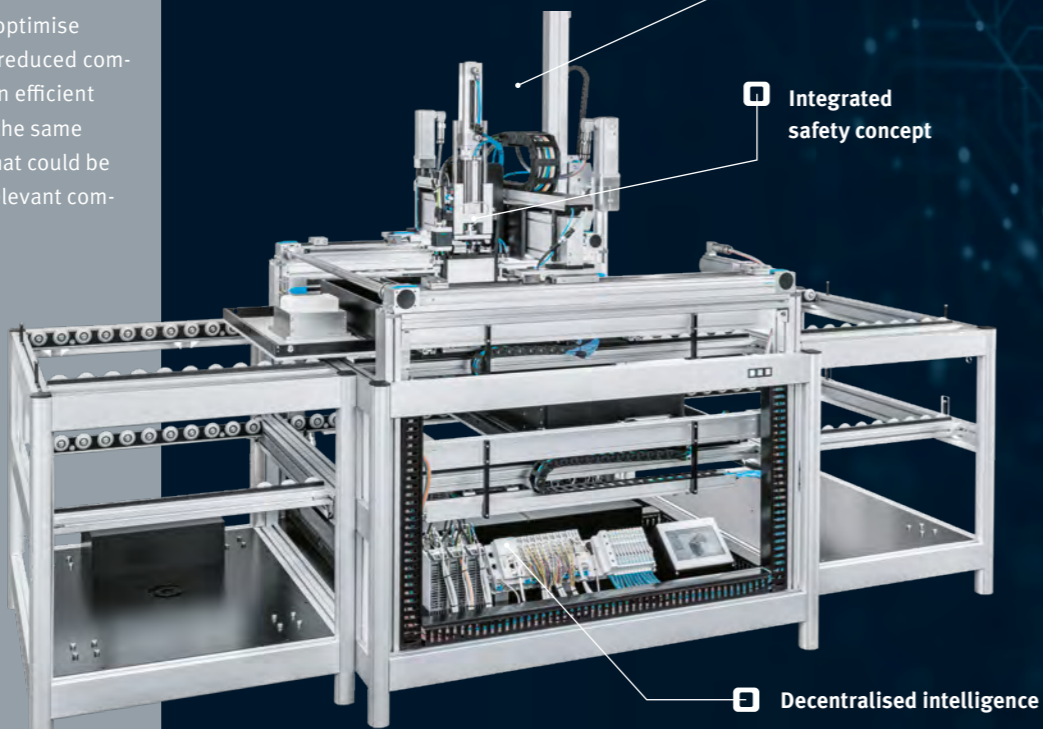
Perfect interaction for added efficiency and flexibility. The pneumatic cylinder DSBC with integrated position transmitter SDAT, displacement encoder FENG and safety brake DACS, in combination with the electric cantilever axis ELCC and a servo motor EMMT, offers a number of advantages:

- Inline process control
- Early error detection and traceability
- Optimally matched motor and axis for the specific process
- Lower energy demand



Combined:  
electrics and pneumatics

Integrated  
safety concept



Decentralised intelligence



## Integrated safety concept with inline quality control

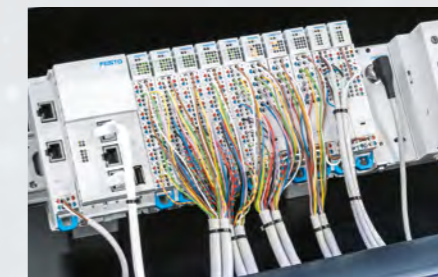
Suitable automation technology makes a significant contribution to functional safety and greater system availability during battery module assembly:

- Active locking of the cell by pneumatic actuators
- Pneumatic axes with position encoders, the sensors can be easily parameterised and configured via the IO-Link® interface
- Redundant design of all safety-relevant functional groups and components
- Intelligent components for data generation as well as data acquisition and processing for transparent production concepts
- Comprehensive condition monitoring helps to avoid downtime and optimises maintenance procedures

## Decentralised intelligence including SoftMotion

A decentralised control concept with stand-alone solutions makes sense in order to achieve the highest possible plant and machine availability (OEE). This means independent stations instead of sequential, permanently installed line concepts. This is where the control and automation system CPX-E-CEC with Motion Control (CODESYS V3) opens up new possibilities.

- Decentralised control architecture
- Reduces the workload of the main controller, frees resources that can be used for data analysis, for example
- Networked production for complete data acquisition and tracing of components
- Digital twin for simulation purposes



You can find more information at:

> [www.festo.com/e-mobility](http://www.festo.com/e-mobility)



## 05 Electric automation

### Seamless connectivity

Perfectly matched in every respect –  
from the workpiece to the cloud

Moving away from pneumatics and moving towards electrics or a mix of the two: one of the big automation trends in recent years has been electric automation. Demand continues to rise rapidly. Festo is responding to this demand with an offer that covers most movement options: from cost-effective and simple movement between two end positions to highly complex and flexible servo drive solutions with many synchronised axes or dynamic Cartesian robots.

This portfolio is characterised by seamless connectivity: mechanic, electric and intelligent. From the shop floor to the master controller, everything fits together. Innovative servo drive technology, direct integration in networks and clever software solutions, in combination with state-of-the-art communication and control concepts, already represent tomorrow's automation solutions.



# Servo drive solutions

From simple to highly complex: drives and motors for every task

Many factors have to be taken into account to ensure optimal motion performance at the front end. With the portfolio from Festo, automation modules can be connected in such a way that they interact seamlessly at all times, mechanically, electrically and intelligently.

## Mechanical connectivity

The extensive portfolio of mechanical linear axes and rotary modules offers a rich variety for automating motion, and is compatible with your in-house standard.

## Electrical connectivity

The range of servo motors and servo drives that can be directly integrated into the network forms the ideal link between the mechanical system and the control technology.

## Intelligent connectivity

Decentralised control of individual process modules, free and flexible communication with other control devices and integrated motion control solutions open up a wide range of solutions for industrial automation tasks.

**CMMT-AS** for point-to-point and interpolating motions



Servo drive package with controller

## CMMT-AS

and servo motor

## EMMT-AS

- Very compact and space-saving thanks to one cable solution (OCP)
- Quick to commission with Festo Automation Suite
- EMMT-AS in two additional sizes: 150 with 47.5 Nm and 190 with maximum torque of 93 Nm

**EMMT-AS** for dynamic and powerful movement

Servo motors

## EMMB-AS

For very economical positioning with simple tasks, especially in the electronics industry and small parts assembly, as well as in test stations.

- Compact and inexpensive synchronous servo motor series
- Several power levels
- Single-turn or multi-turn encoder, EMMB with battery adapter
- IP65 for motor housing and cable connections



High performance and unbeatable efficiency: combination of low-voltage and extra-low-voltage servo drives

New: multiprotocol. One device for EtherCAT®, EtherNet/IP and ProfiNet

Extended power range: the CMMT-AS with seven stages from 350 W to 6 kW (in future 12 kW)

Ideal for simple point-to-point movements: extremely compact and inexpensive CMMT-ST

Quick and error-free commissioning in just a few steps with the Festo Automation Suite

For very low power ratings from less than 50 W to 300 W at 48 V DC: extra-low-voltage servo drive CMMT-ST

Servo drive combines  
**CMMT-AS** and  
**CMMT-ST**

This comprehensive servo drive platform is characterised by seamless integration into the system environment of many controller manufacturers, is easy and convenient to engineer and operate, and requires very little space in the control cabinet. Low-voltage and extra-low-voltage servo drives can be perfectly combined for high performance and excellent economic efficiency.

You can find more information at:

> [www.festo.com/ea](http://www.festo.com/ea)

> [www.festo.com/catalogue/cmmt-as](http://www.festo.com/catalogue/cmmt-as)

> [www.festo.com/catalogue/emmt-as](http://www.festo.com/catalogue/emmt-as)

> [www.festo.com/catalogue/emmb-as](http://www.festo.com/catalogue/emmb-as)

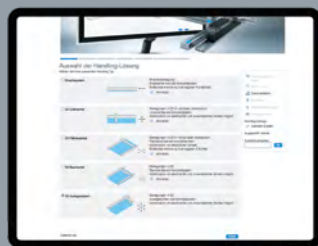


# Handling Guide Online

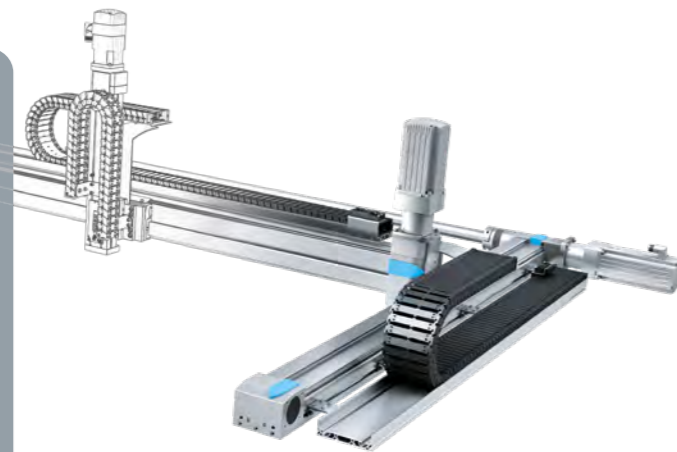
Configure and order handling systems at top speed

The Handling Guide Online is the ideal tool for selecting the perfect solution from an extensive range of handling systems and Cartesian robots.

Engineering times are significantly reduced. With the Handling Guide Online, Festo provides support from the design stage through to installation and commissioning so that customers can fully concentrate on their core business and increase productivity. The result is tailored, economical, dynamic and flexible solutions.



- The right handling system, including CAD model and commissioning file, in 20 minutes
- Intuitive to use, with minimal engineering time and effort
- Calculates and gives a system price
- Shorter time to market, now even with highly dynamic and compact handling systems
- New in HGO: servo drive CMMT/ servo motor EMMT and electric axes ELGC/EGSC



Spindle axis for cantilever systems

## ELGT

- Compact and low-cost
- Perfect for 2D and 3D cantilever systems thanks to integrated double guide
- Suitable for a wide range of applications: in the electronics industry, with desktop applications as well as in battery manufacturing
- Also for test and inspection systems, small parts handling and assembly systems



Automation system

## CPX-E Motion

with "Motion and robotics" software licence

Handling applications for the CPX-E-CEC-M1 in industrial and process automation can be created quickly and conveniently using two licences that are available in the Festo AppWorld.

PTP licence

- Point-to-point interpolation
- Actuation of simple kinematic systems

CART licence

- Cartesian linear and circular interpolation as well as interpolation of orientation
- Actuation of complex kinematic systems



The toothed belt and spindle axes **ELGC** together with the mini slide **EGSC** form a scalable modular system.

- For the electronics industry and small parts handling
- Extremely compact: optimum ratio of installation space to working space
- For economic positioning and excellent flexibility
- Unique one-size-down assembly system in the scalable modular system
- Stainless steel cover strip

### □ Toothed belt axis **ELGC-TB**

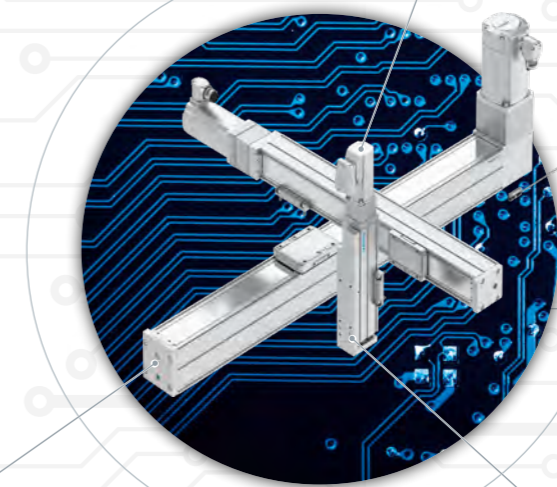
- Precise and resilient guide
- Internal guide and toothed belt
- Flexible motor mounting

### □ Mini slide **EGSC**

- For highly precise pushing, picking and inserting
- With integrated, durable and precise linear guide
- Extremely compact design, high load capacity and quiet operation

### □ Spindle axes **ELGC-BS**

- Internal recirculating ball bearing guide
- Protected by a stainless steel cover strip

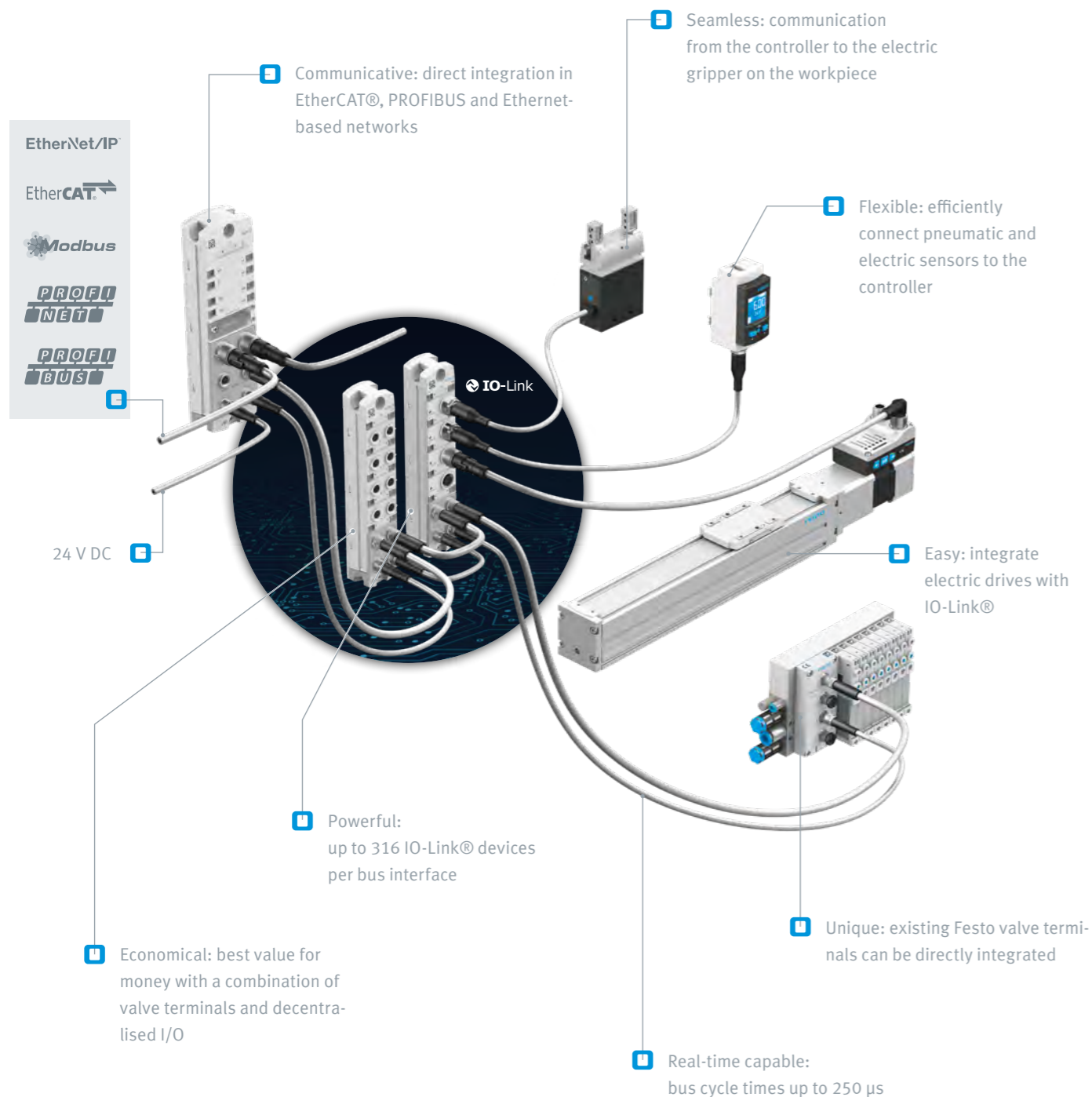


You can find more information at:

- > [www.festo.com/hgo](http://www.festo.com/hgo)
- > [www.festo.com/catalogue/handling](http://www.festo.com/catalogue/handling)
- > [www.festo.com/catalogue/elgc](http://www.festo.com/catalogue/elgc)
- > [www.festo.com/catalogue/egsc](http://www.festo.com/catalogue/egsc)
- > [www.festo.com/catalogue/cpx-e](http://www.festo.com/catalogue/cpx-e)
- > [www.festo.com/catalogue/elgt](http://www.festo.com/catalogue/elgt)

# Remote I/O system CPX-API

Control and communicate in real time



**Faster than Ethernet networks, flexible and decentralised:** with the I/O system in IP65/67 powerful I/O modules and existing valve terminals can be seamlessly integrated in the most important host systems through AP system communication.

Equipped with up to 80 modules, CPX-AP-I can be flexibly integrated into applications of any size. With its real-time capability and short bus cycles, it is particularly suitable for fast production processes and high-speed data transfers. Last but not least, its transmission speed of 200 Mbit full duplex is twice that of current Ethernet-based networks.

Robust yet compact and ultra-lightweight, the system can also be used in tight installation spaces such as in handling and tool changing systems or mobile applications. And if large distances are required in plants or intralogistics, the remote I/O system enables cable lengths of up to 50 m between the individual modules.

#### Features

- Valve terminals can be integrated directly
- Synchronous real-time connection to the controller
- Temperature and load voltage monitoring
- Error state parameterisation and short circuit shutdown
- Separate load voltage supply for connected valves, can be shut down separately
- Easy to install, space-saving new angled cables
- Quick and easy to configure with I/O tools

#### Modules of the CPX-AP-I

- Bus interfaces for Ethernet-based bus systems
- Digital I/O modules with eight inputs or with four inputs and four outputs
- Analogue 4-way input module
- IO-Link® master (for four devices)



### Seamless connectivity with IO-Link®

CPX-AP-I enables electric and pneumatic components to be connected to form an integrated network. To do this, the IO-Link® master is connected to the bus interface via the AP protocol.

It is possible to connect completely different components, even from other suppliers, whether they are electric drive units such as the Simplified Motion Series, electric or pneumatic sensors and grippers or proportional valves.



You can find more information at:

> [www.festo.com/cpx-ap-i](http://www.festo.com/cpx-ap-i)



# Simplified Motion Series

Simple concept, big impact



The drives of the Simplified Motion Series combine the simplicity of pneumatics with the advantages of electric automation and are ideal for simple movements between two mechanical end positions.

Intermediate stops can be configured via IO-Link®. Operation without any software in line with the plug and work principle via digital I/O (DIO) includes all basic functionalities of adjusting speed and force for press-fitting/clamping and selecting the reference end position and cushioning path. Extended functions and software updates are available via IO-Link®, also for retrofitting.

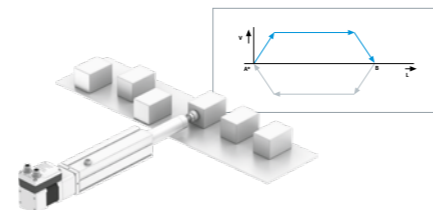
## Variety of drives

The entire Simplified Motion Series now includes electric cylinders such as the new EPCE for short strokes, spindle and toothed belt axes, mini slides and rotary drives. Parallel kits can be used.

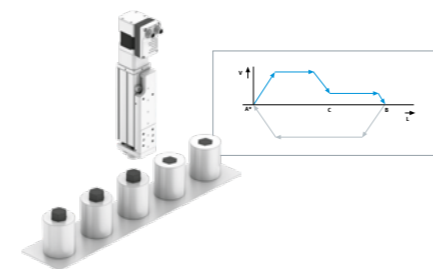
## Predefined motion profiles

Simply select and start – this makes commissioning and motion changes faster.

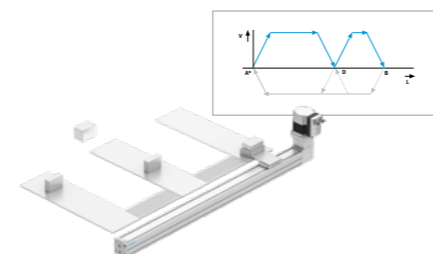
Moving and simple positioning  
Basic profile for movement between two end positions: speed control without intermediate position



Joining and press-fitting  
Extended motion profile for simplified press-fitting and clamping functions: with speed and force control



Motion with intermediate position  
(with IO-Link®)  
Basic profile for movement between two end positions: speed control with intermediate position



## Real-life application:

The engineering company Ying Chye Engineering in Singapore is a local start-up specialising in automation solutions and installations for small and medium-sized end customers. At the request of a customer, it developed an electrically operated form, fill and seal machine in which the short-stroke cylinder EPCE plays an important part.

Once the bags have been filled, the EPCE fixes them in place. They are then sealed at the top and cut. The EPCE is well suited to the compact packaging machine, as it is easy to install and commission without the need for a laptop, and equally easy to operate. There is no need for compressors and a separate compressed air network.



**Electric solution:** the simple and compact tubular bag packaging machine.

Electric cylinder unit

## EPCE

- For very short strokes from 5 mm
- Speed and installation space optimised for very high packing density
- For alignment, simple centring tasks, etc.
- Innovative toothed belt/cylinder concept



You can find more information at:

> [www.festo.com/sms](http://www.festo.com/sms)

> [www.festo.com/catalogue/epce](http://www.festo.com/catalogue/epce)

## 06 Digitalisation

## Artificial intelligence as a success factor

Reading out and correctly interpreting data  
for maximum productivity

Efficient and safe processes are the prerequisite for maximum overall equipment effectiveness (OEE). This is particularly important in highly challenging markets in order to remain competitive or even to keep ahead of the game. Artificial intelligence, or AI for short, is one of the tools that will be used to monitor and improve processes in the future. However, AI also helps to detect faults and the imminent failure of components or to improve energy efficiency. With Festo Automation Experience AX, such a tool is now available.





# Data for making good decisions

AI services for improved quality, greater flexibility and reduced costs

Artificial intelligence tools such as the **Festo Automation Experience AX (Festo AX)** can be used to achieve predictive quality assurance, predictive energy management and predictive maintenance in just four steps. Festo AX delivers the modules needed to collect data from systems and machines. Using machine learning, models are trained to detect anomalies, predict errors or downtimes and correct the energy demand.

## 2 Historical data

Evaluating and preparing data for a “healthy” machine provide the basis for detecting anomalies and establishing measures later on.

## 3 Live data

The live data is fed to the trained model during operation and this forms the basis for an assessment in real time about the status.

## 4 Anomalies and appropriate measures

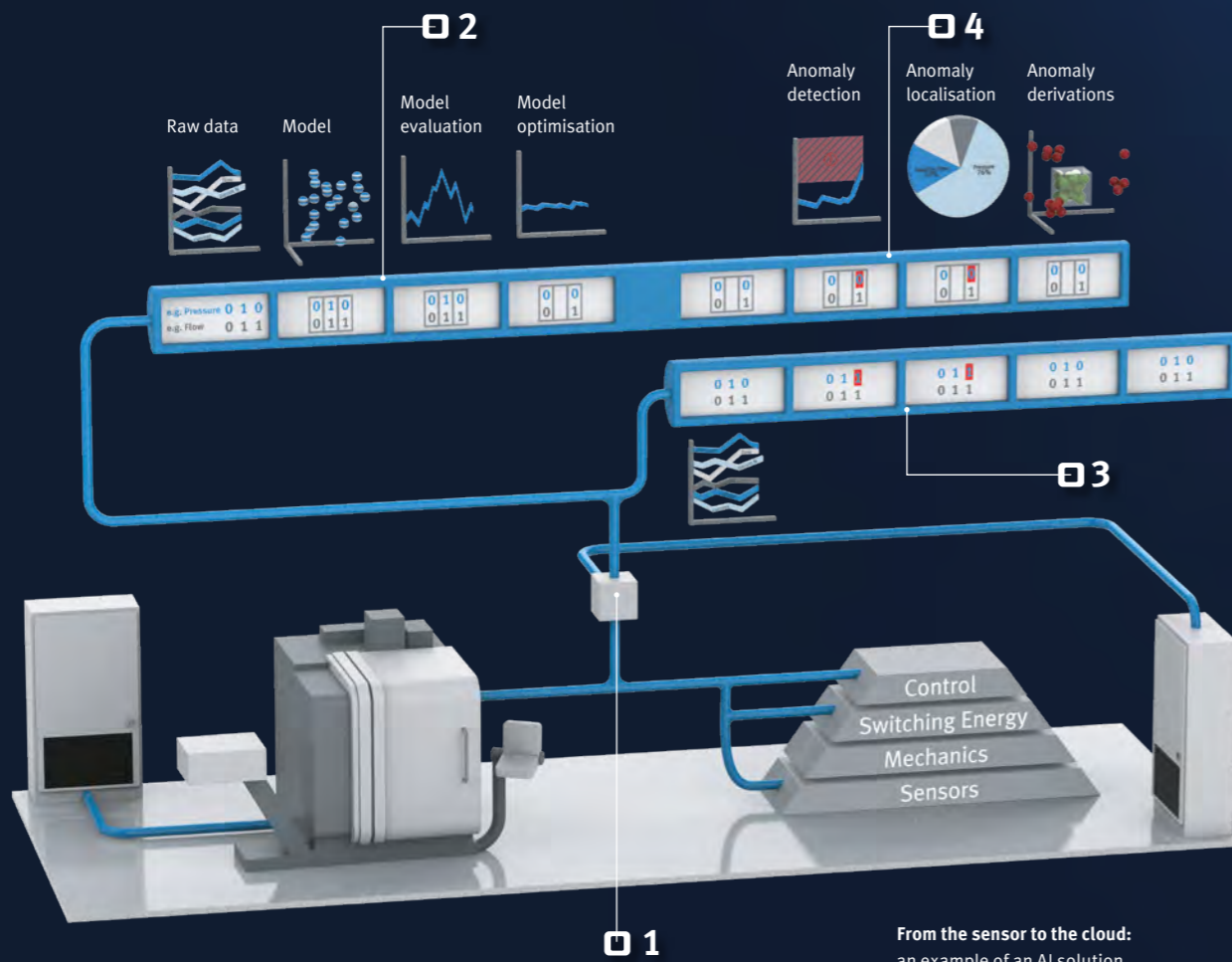
With the artificial intelligence of the Festo Automation Experience, changes to the machine can be detected before any downtime occurs. All the data that has been collected makes the AI models more sophisticated and precise over time, even if anomalies from many applications are overlapping. In addition, the knowledge is retained in the long term.

## 1 Connectivity

Relevant sensor, parameter or status data is consolidated on edge or in the cloud via an IoT gateway or other connectivity adapters. This can be done for different constellations:

- An individual actuator
- A subsystem
- A complete machine
- An entire production hall

Common protocols such as OPC-UA, MQTT and many more enable flexible integration into all systems.



01 From the sensor to the cloud: an example of an AI solution.



### The benefits of AI services:

- Reduce maintenance costs
- Decrease downtime
- Improve plant availability (OEE)
- Increase product quality
- Reduce energy consumption

Read more about the AI services on the following pages.



# Festo AX – Festo Automation Experience

The procedure for using AI engineering services

## Whether on-edge, on-premises or in the cloud:

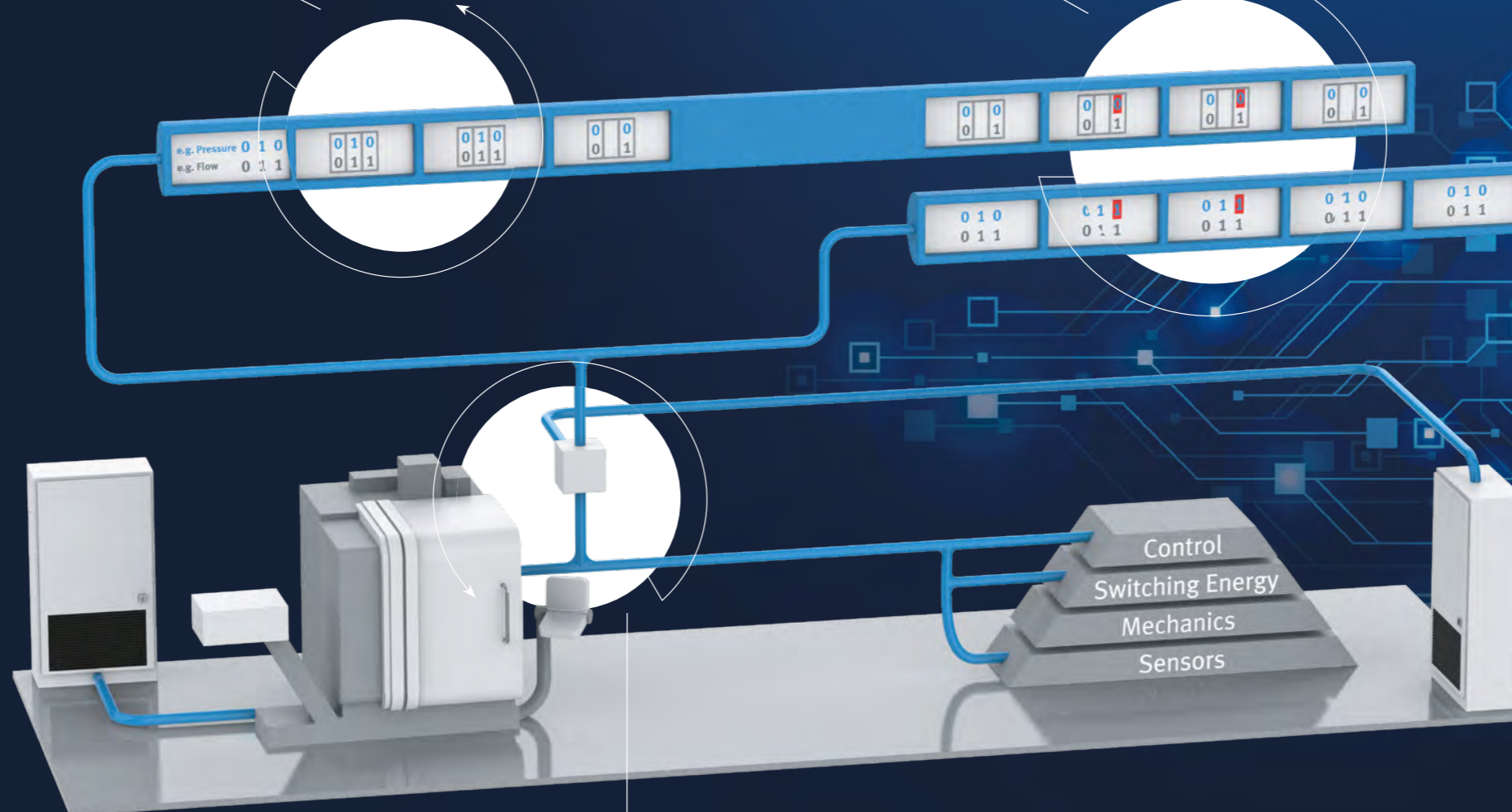
Festo Automation Experience can be run directly on the system, on your own servers or in the cloud.

### Festo AX Data Check

- Create an inventory of historical data
- If applicable, make the data persistent
- Apply the data to the Festo AI models
- Train an initial model
- Develop a rough concept for expanding or refining the trained model

### Festo AX pilot project

- Plan and implement a custom connectivity concept, build on the Festo AX Connectivity Check package, if necessary
- Develop the AI model, build on the Festo AX Data Check package, if necessary
- Document the results, optionally build dashboards
- Train employees to work with the Festo AX software and user interface



### Festo AX Connectivity Check

- Create an inventory of all relevant components
- Analyse existing hardware
- Develop a rough concept for the seamless connection of the AI software Festo AX
- Recommendation for any additional hardware needed (gateways, edge devices, sensors, etc.)



Festo Automation Experience

## Benefits at a glance



### Preventive quality assurance

Improves overall production quality by continuously monitoring and analysing production data and detecting quality problems.



### Preventive energy management

Optimises the energy utilisation by continuously monitoring and analysing the energy consumption and revealing anomalies.



### Preventive maintenance

Predicts failures and reduces unscheduled downtimes by continuously monitoring and analysing system data.

You can find more information at:

> [www.festo.com/AX-Highlights](http://www.festo.com/AX-Highlights)



Your link to a personal consultation



# Highlights at a glance

The quick way to more information



Motion Terminal  
**VTEM**



Pages 13, 19



Proportional flow control valve  
**VEMD**



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Proportional pressure regulators  
**VEAA/VEAB**



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2/2-way valve  
**VEAE**



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3/3-way valve  
**VEMP**



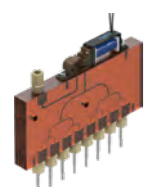
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Miniature valve  
**VOVK**



Page 29



Dispense head  
**VTOI**



Page 24



Proportional valve  
**VYKA**



Page 25



Proportional valve  
**VYKC**



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Pressure sensor  
**SPAN**



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Mini slide  
**DGST**



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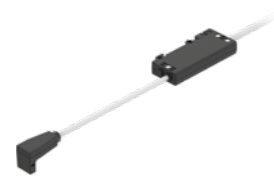
CO<sub>2</sub> & TCO Guide  
Page 12



Proportional valves  
**VYKB, VZDB**



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Piezo electronics module  
**VAVE-P**



Page 26



Proportional valve  
**VPWS**



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Compact cylinder  
**ADN**



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One-way flow control valve  
**VFOE**



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Spindle axis for cantilever systems  
**ELGT-BS**



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# Highlights at a glance

The quick way to more information



Servo motor  
**EMMT-AS**



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Servo motor  
**EMMB-AS**



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Servo drive combining  
**CMMT-AS/CMMT-ST**



Page 41



Round cylinder  
**DSNU-S**



[www.festo.com/catalogue/dsnu-s](http://www.festo.com/catalogue/dsnu-s)



Guided drive  
**DFM**



[www.festo.com/catalogue/dfm](http://www.festo.com/catalogue/dfm)



Parallel gripper  
**DHPC**



[www.festo.com/catalogue/dhpc](http://www.festo.com/catalogue/dhpc)



Automation system  
**CPX-E**



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Spindle axis/Toothed belt axis  
**ELGC-BS/ELGC-TB**



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Electric cylinder unit  
**EPCE**



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Parallel gripper  
**DHPL**



[www.festo.com/catalogue/dhpl](http://www.festo.com/catalogue/dhpl)



Pressure regulator  
**MS-LR-B**



[www.festo.com/catalogue/ms-lr-b](http://www.festo.com/catalogue/ms-lr-b)



On/off valve  
**MS-EE-B**



[www.festo.com/catalogue/ms-ee-b](http://www.festo.com/catalogue/ms-ee-b)



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Filter regulator  
**MS-LFR-B**



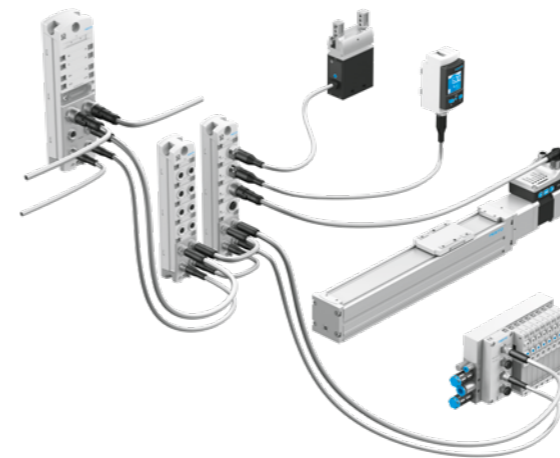
[www.festo.com/catalogue/ms-lr-b](http://www.festo.com/catalogue/ms-lr-b)



Compact cylinder  
**ADN-S**



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Remote I/O system  
**CPX-API**



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# Notes



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