

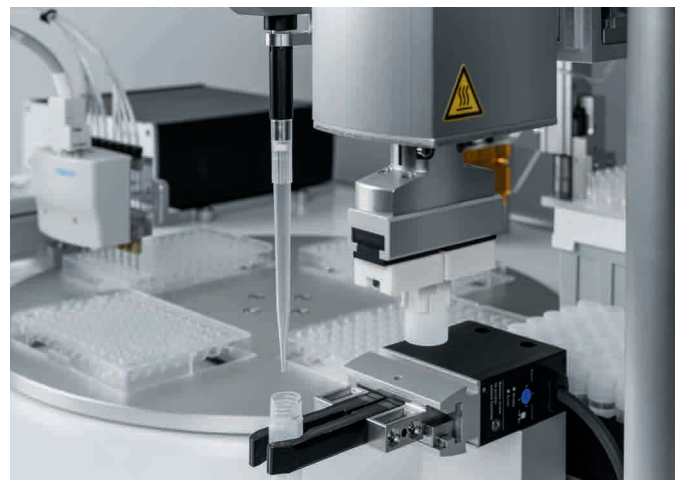
Liquid handling

FESTO



LifeTech – Intelligent solutions for life sciences

Transporting, identifying, opening, and closing sample vials, pipetting, dispensing and aspirating liquids – with Festo, you can automate and customize your entire liquid and sample handling process. Based on our extensive automation know-how, we integrate all the steps into subsystems with the appropriate kinematics.



Automation solutions – for all areas of sample analysis

The modular system solutions operate quickly, accurately, consistently, and efficiently, while the results of the automated processes are always reproducible and verifiable. The degree of automation can be flexibly adapted to your individual requirements, and thus every stage of the process, from single steps to linking complex individual processes, can be automated.

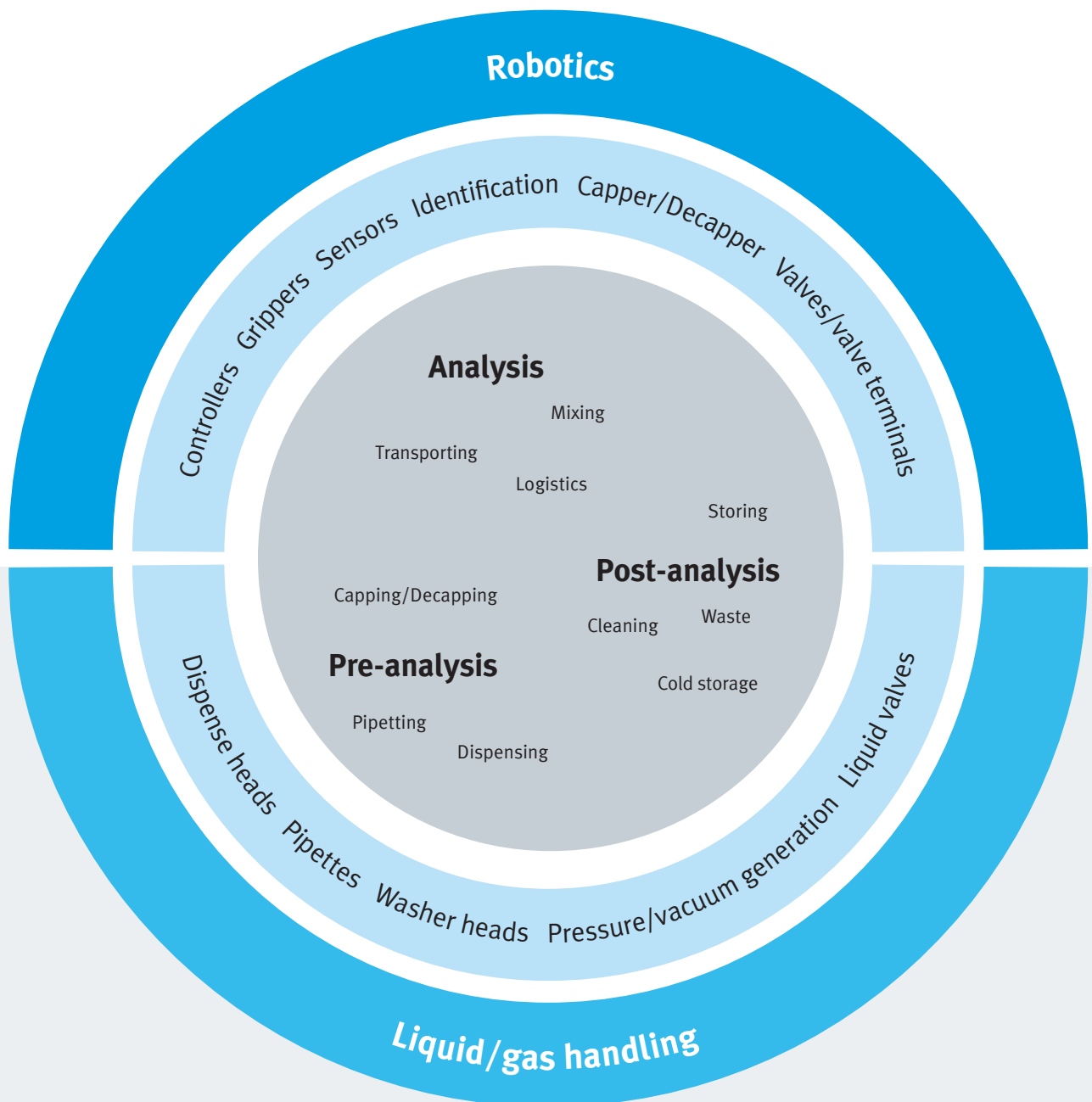
Festo provides you with everything from a single source, from conceptualization and joint development to delivery of subsystems. Combining this with our handling systems creates ready-to-install complete solutions that simplify engineering and increase productivity.

The benefits at a glance

- Flexible and adaptable degree of automation
- Clear interfaces for fast integration
- Pre-assembled and tested modules with a single order number
- Perfectly matched components



All information about LifeTech
can be found at:
www.festo.com/lifetech



Your individual system – our comprehensive portfolio

For all areas of sample analysis, Festo offers you solutions that allow you to increase the level of automation, and improve productivity and reliability at every step of the process. For example, laboratories can process significantly more samples in the same amount of time by implementing well-designed automation. In addition, Festo develops components and subsystems for medical devices, such as extremely compact and energy-saving valves with piezo technology for precise gas handling.

Four steps to your liquid handling system

During pressure-controlled fluid handling, the medium is transported using pneumatic energy. The properties of the medium then determine the pressure level accordingly. The target volume is set via the valve activation time. The open and flexible system can be adapted to specific tasks and individually expanded.

1

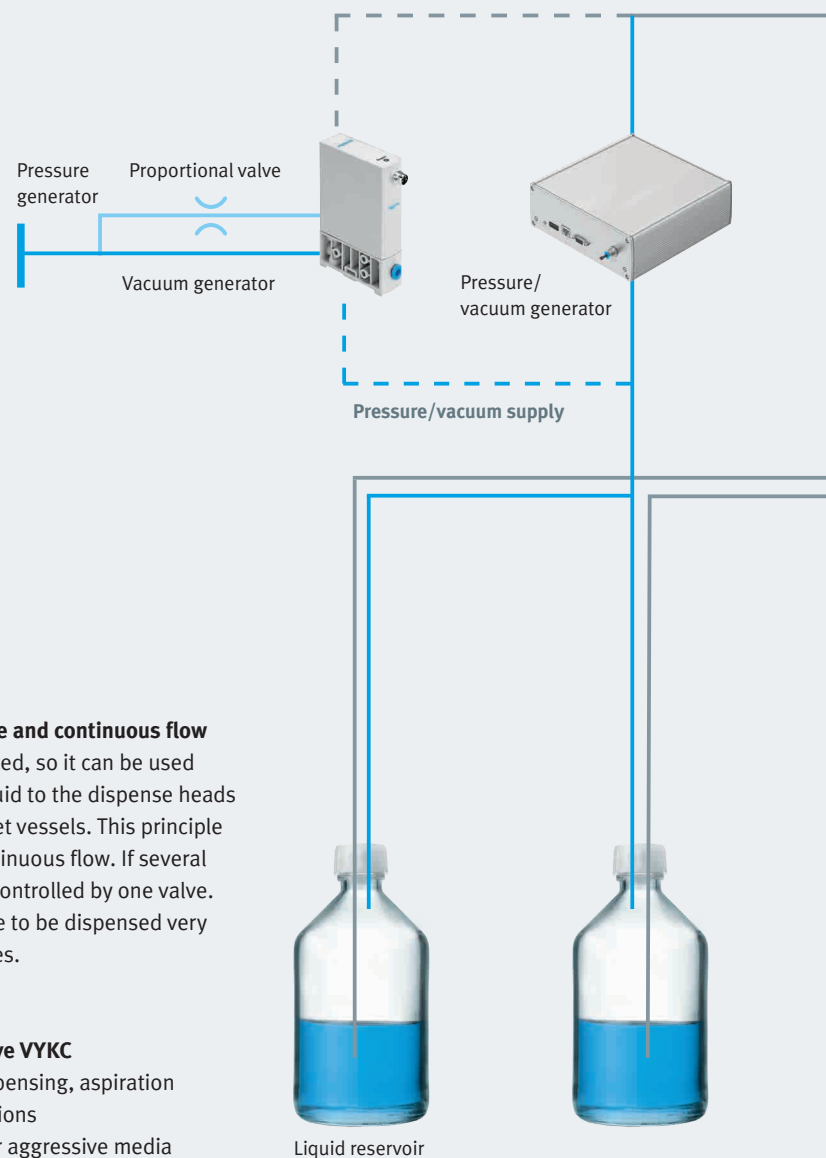
Compressed air supply for precisely controlling pressure and vacuum

If you have an external compressed air connection, you just need a proportional valve. Otherwise, you can use a mobile solution for generating compressed air. You can connect these directly to your PC and set them up using the graphical user interface (GUI). The pressure/vacuum generator can also be integrated into your higher-level control system after the initial setup, facilitating the efficient use of the entire system.

Product example:

Decentralized pressure/vacuum generator PGVA

- Adjustable pressure/vacuum range:
–500 mbar ... +500 mbar
- Power supply: 24 V
- Ethernet port for Modbus TCP
or an RS 232 serial interface



3

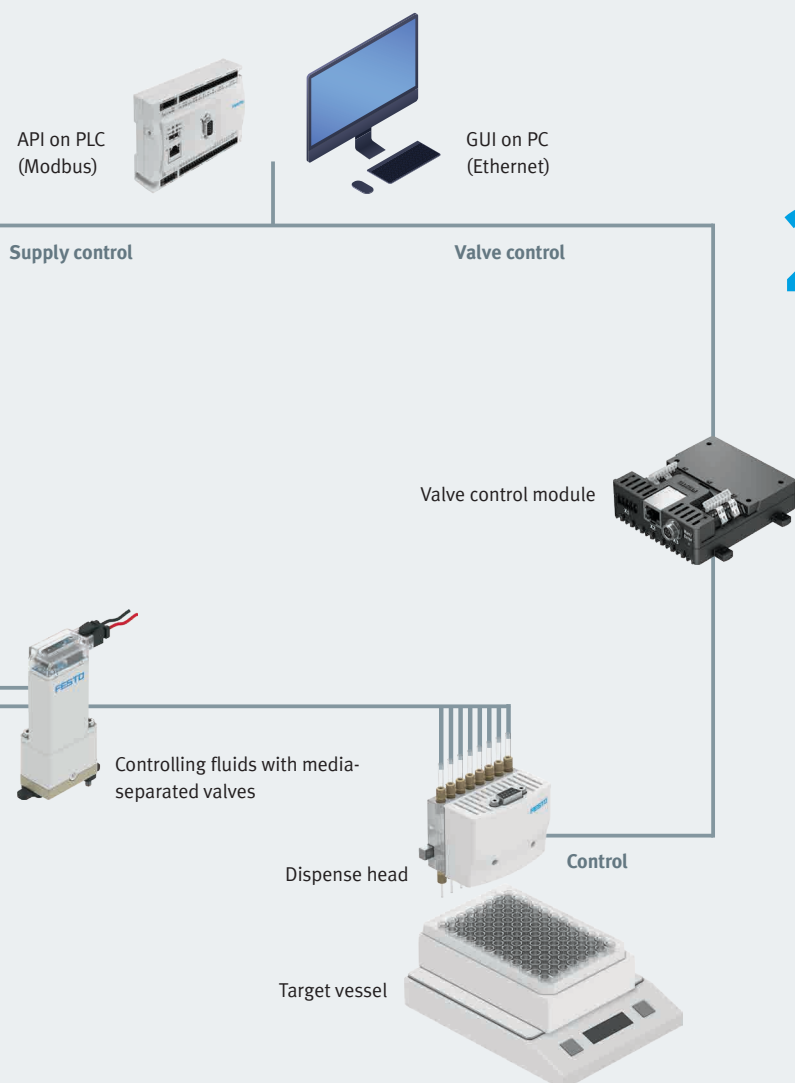
Controlling fluids for pulse-free and continuous flow

The liquid reservoir is pressurized, so it can be used as a pump that conveys the liquid to the dispense heads before it is dispensed into target vessels. This principle promotes a pulse-free and continuous flow. If several fluids are dispensed, they are controlled by one valve. This allows the required volume to be dispensed very precisely, even for large volumes.

Product example:

Media-separated solenoid valve VYKC

- Various nominal sizes for dispensing, aspiration and continuous flow applications
- Reliable media separation for aggressive media
- Minimized heating effect



2

Controlling the valves for extremely precise adjustment of the valve opening times on the dispense head

For really high levels of precision, a second factor comes into play too, namely valve control. The valve opening time can be adjusted very precisely with a valve control module, so that up to eight channels can be controlled individually and with great precision. In addition, the integrated holding current reduction optimizes the energy requirement of the controlled valves and reduces the associated self-heating of the valves to a minimum. This allows you to prevent the dosing volume from changing during the process and ensure precision.

Product example:

Valve control module VAEM

- Control up to eight channels individually and with high precision
- Very fast valve control with a temporal resolution of 0.2 ms
- Integrated holding current reduction

4

Dispense head for precisely dosing liquids

Do you want to dispense different fluids and different target volumes? Then you need a dispense head with which you can control the channels individually. It can be used either to dispense individual volumes or to improve the tip-to-tip precision via the channels.

If you need to achieve higher flow rates and an efficient distribution of the liquid in a microwell plate, we recommend a dispense head where all eight channels are controlled by just one valve. This type of dispense head also allows you to quickly aspirate excess liquids into a waste reservoir if you operate it under vacuum.

Product example:

Dispense head VTOE

- High precision of up to 1% and small volumes up to 1 μl
- EtherNet/IP with Modbus TCP or RS232

Product example:

Dispense head VTOI

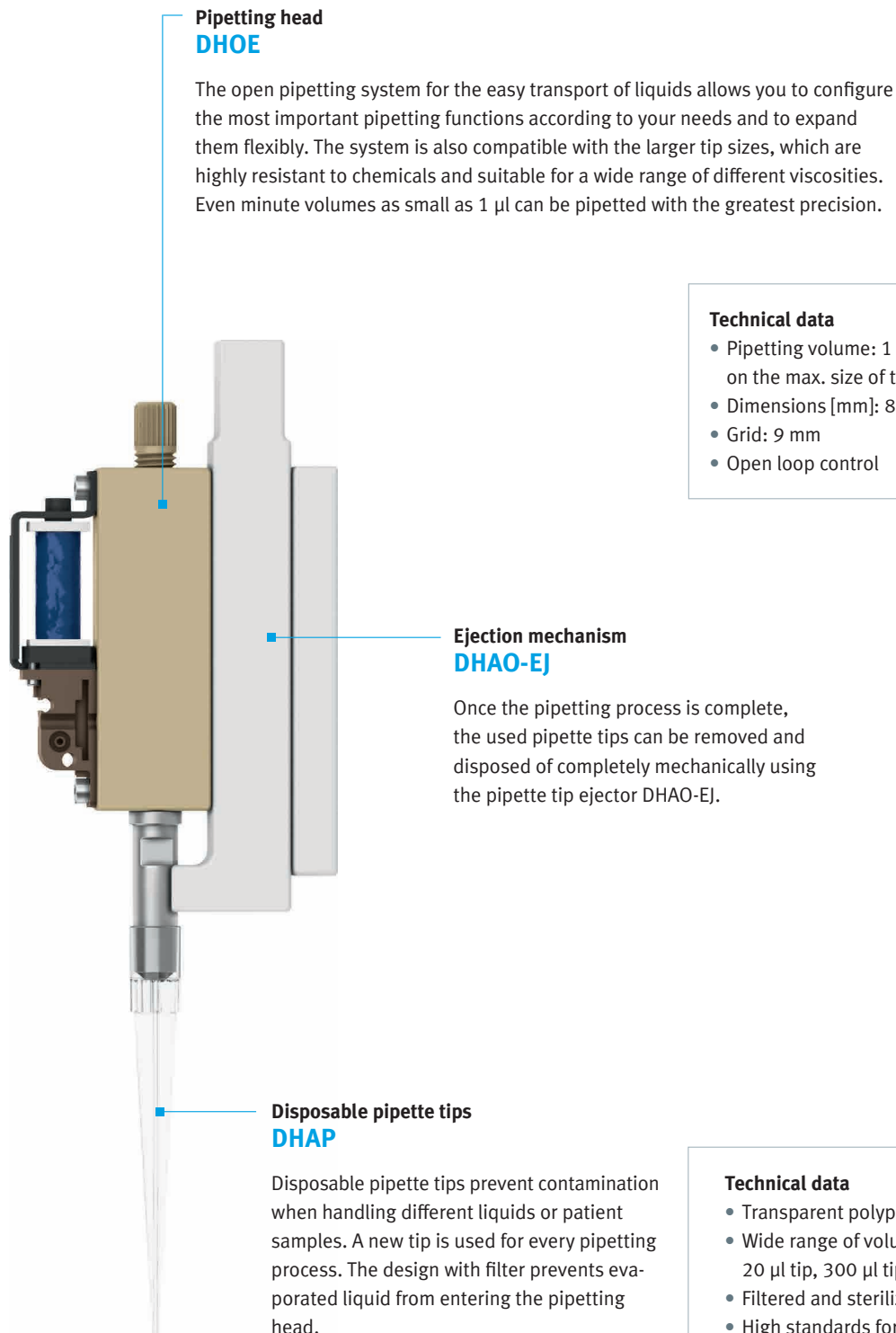
- Grid dimension 9 mm
- High-performance materials for handling aggressive media



Safe pipetting

Controlling the complete pipetting process is central to the design of the systems, and to the reliability of processes. With this pipetting system, you can implement all the important process steps, and in addition detect fill levels or track the handling of the pipette tips. We also offer an integrated monitoring function for the pipetting process to ensure the pipetting volume is correct at all times.

Flexible open loop pipetting system



Technical data

- Pipetting volume: 1 µl ... 25 ml (depending on the max. size of the pipette tip)
- Dimensions [mm]: 8.1 x 76.2 x 30
- Grid: 9 mm
- Open loop control

Technical data

- Transparent polypropylene tip
- Wide range of volumes: 20 µl tip, 300 µl tip, 1000 µl tip
- Filtered and sterilized tips
- High standards for the bioburden
- Very low forces of less than 10 N required for pickup
- Stacked packaging
- Sold in units of 960 tips in 10 boxes
- Global availability

For pipetting on site: decentralized preparation of compressed air

The pressure and vacuum generator PGVA integrates the compressor, air preparation including filtration and buffer storage. The pressure and vacuum supply is either individually controlled or via predefined values.

Pressure and vacuum generator PGVA-1

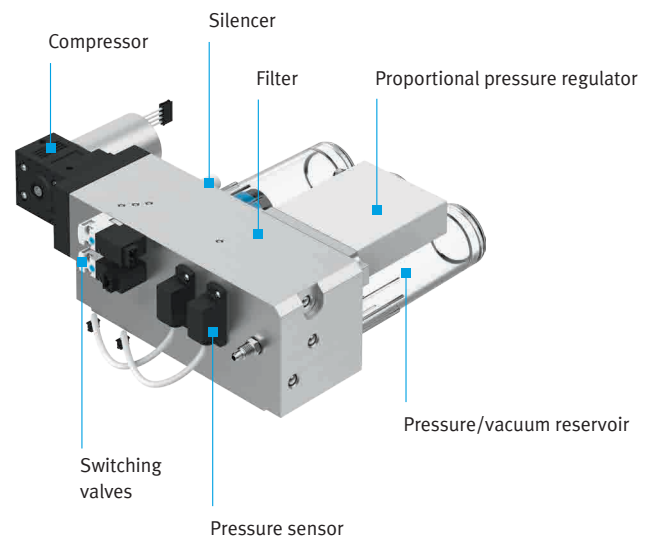
Regulated pressure/vacuum generation

The pressure and vacuum are generated in a closed control loop with integrated compressor, buffer reservoir, microfilter, pressure sensors and proportional valve. The pressure and vacuum are provided via the same duct at the outlet. The digital communication interface enables you to specify the required pressure level via the integrated GUI or a controller.

Pressure-controlled handling of liquids

You set the required volume for dispensing or aspiration at the digital output via the opening time of the valve, as well as via the pressure/vacuum level at the output of the pressure and vacuum generator PGVA-1.

Technical design



Pressure and vacuum generator PGVA-2

Constant pressure/vacuum generation

The pressure and vacuum are provided via two independent ducts at the output. The pressure and vacuum levels are generated on the basis of preset fixed values. This eliminates the need for a communication interface for adjusting the regulation within the pressure/vacuum generator.



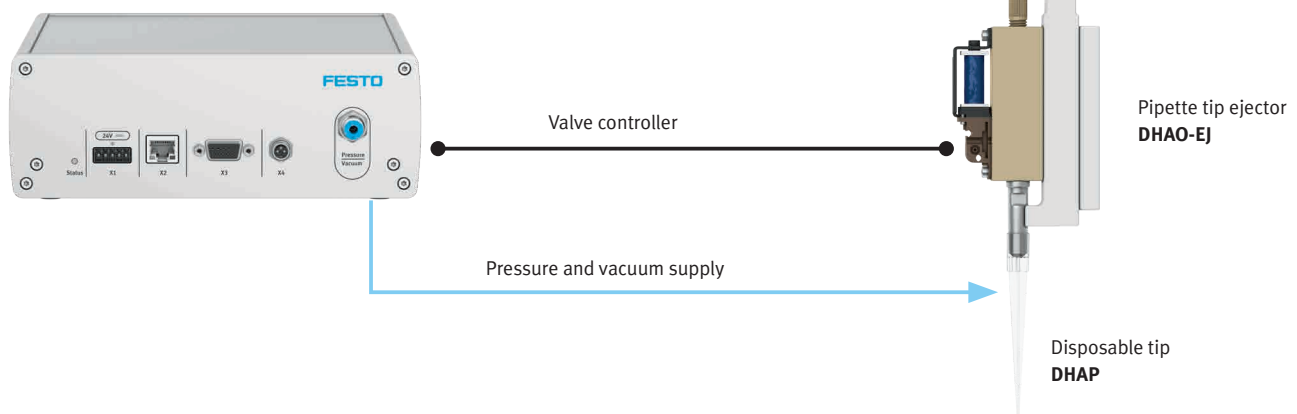
Technical data

- Constant pressure supply of 800 mbar
- Constant vacuum supply from –620 mbar
- Nominal flow rate range up to 1.2 l/min
- Internal air filtration grade of 0.01 µm
- Separate pressure/vacuum output
- Only 24 V power supply with 11 W

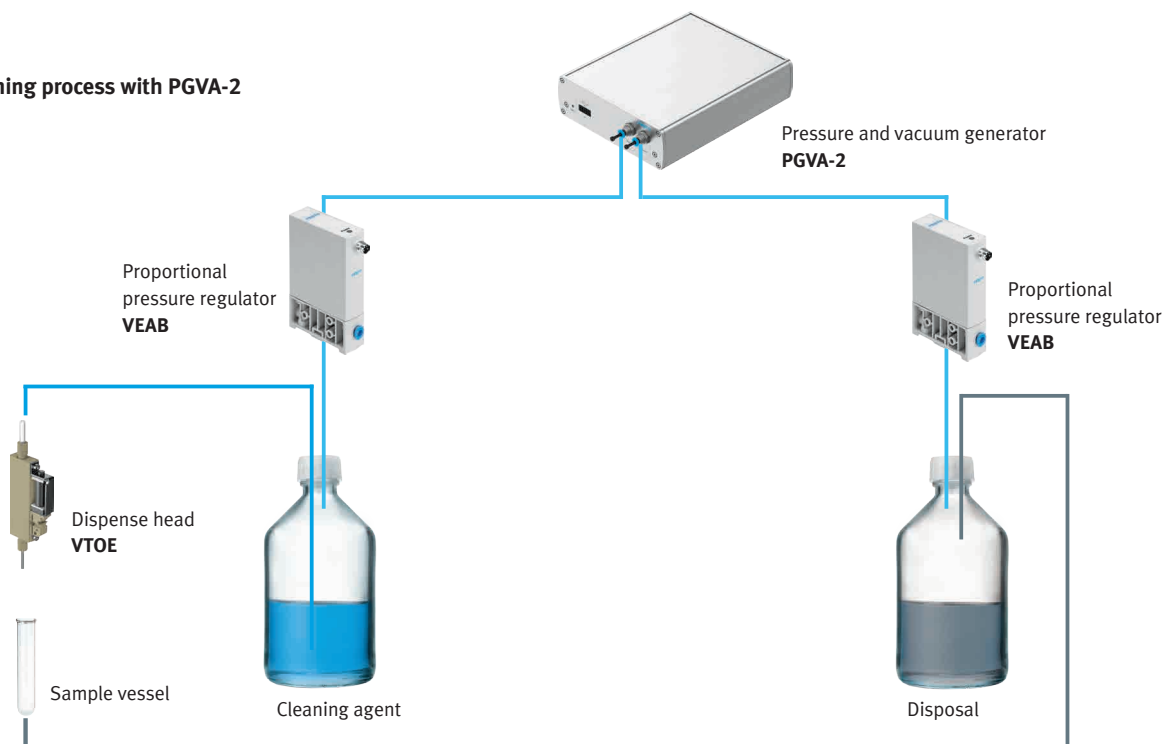
Technical data

- Pressure/vacuum range –450 ... +450 mbar
- Control accuracy ± 5 mbar (1% FS)
- Nominal flow rate up to 1.0 l/min
- Internal air filtration grade of 0.01 μ m
- Combined pressure/vacuum output
- Supply of up to 8 DHOE channels
- Integrated quick exhaust function
- Analog input for pressure compensation
- Digital output for single channel control
- Integration via Modbus and RS232
- Simple commissioning via WebGUI
- 24 V fixed power supply with 19 W

Pressure and vacuum generator
PGVA-1



Cleaning process with PGVA-2





Dispensing and aspirating

The dispense heads VTOx combine highest dispensing precision with typical CVs < 1% in the dispensing area, compact dimensions in a 9 mm grid and maximum flexibility. The small internal volume makes it easy to rinse. All in all, they are the ideal dispense heads for a wide range of applications. The pressure and vacuum generators PGVA for the decentralized supply of compressed air or vacuum to the dispensing systems are also included.

Precise handling of liquids

Dispense head

VTOE

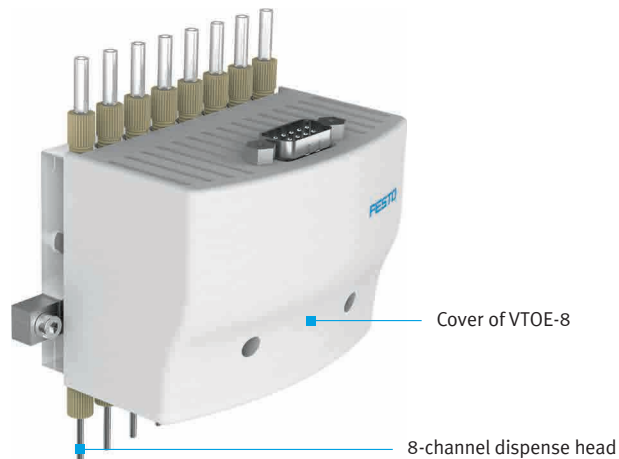
The system is optimally coordinated for microwell plates and enables a very high throughput as well as dosing of various fill quantities and liquids. This multi-channel system is ideal for preparing dilutions and nutrient solutions. The liquids can be dispensed quickly and the microwell plates filled in parallel.

Maximum precision

For the greatest accuracy, the channels are adjusted to one another via the individual control of the valves, reducing channel-to-channel variability and ensuring maximum dispensing precision. The Sub-D plug makes the connection very easy.

Typical applications

- Production of dilutions
- Addition of nutrient solutions
- Dispensing of reagents
- Sample preparation
- Preparation of liquids in microwell plates



The advantages of the dispense heads at a glance

- Compact 9 mm grid, dimension of individual add-ons > 9 mm available on request
- Maximum flexibility
- Ideally suited for dispensing applications
- Easy to rinse thanks to small internal volume



Dispense head

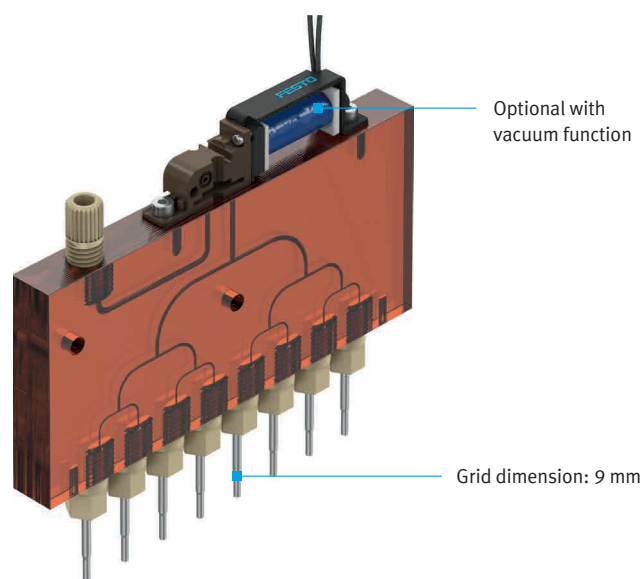
VTOI

The dispense head VTOI significantly increases your throughput, while at the same time reducing the number of valves you need. For a 96-channel dispense head, you need just 12 valves, 84 fewer than for a conventional design. High-performance materials make the VTOI suitable for use with aggressive media.

Higher throughput

Thanks to the 9 mm grid dimension and a valve with 8 outputs, the VTOI is an optimum 8-channel dispense head for microwell plates. With just a few other components from Festo, you can have a complete, pressure-controlled dispensing system. And the vacuum function enables you to use the VTOI for both dispensing and aspirating.

All components that come into contact with the media are made exclusively from high-performance materials such as PEI (ULTEM), PPS, FKM, ETFE and high-alloy steel. This means that even aggressive media can be dispensed.



Different materials for a range of applications

The dispense head VTOE is available in two different variants: with a manifold duct plate made from polycarbonate (PC) and with a manifold duct plate made from PEEK. Both variants offer three different dosing tips with three different internal diameters as standard. For both, the voltage is 24 volts. PEEK and PC can be mounted in the same grid.

Transparent: polycarbonate

- The transparent design allows visual inspection of the ducts
- Parts in contact with fluid are made of PEEK, stainless steel, PC, FPM and PPS

High quality: PEEK

- Ideal for applications involving aggressive media
- Parts in contact with fluid are made of PEEK, stainless steel and FPM

Maximum dosing precision for reliable results

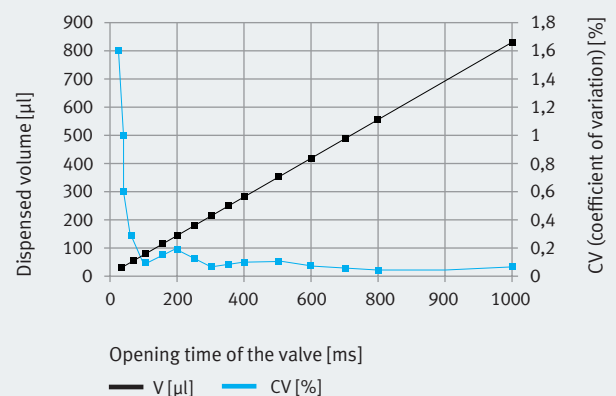
The dispense head VTOE offers excellent precision and enables a multitude of specific dosing volumes as a function of pressure and opening time for maximum flexibility.

High linearity

The precision of the dispense heads is indicated by a typical variation coefficient of <1% in the range from 10 to 1000 µl and a very high linearity.

Measuring specifications

- 250 mbar
- Room temperature (23 °C)
- Aqueous solution
- 24 V without a holding current reduction



Precise switching and control of fluids

Valve control module VAEM

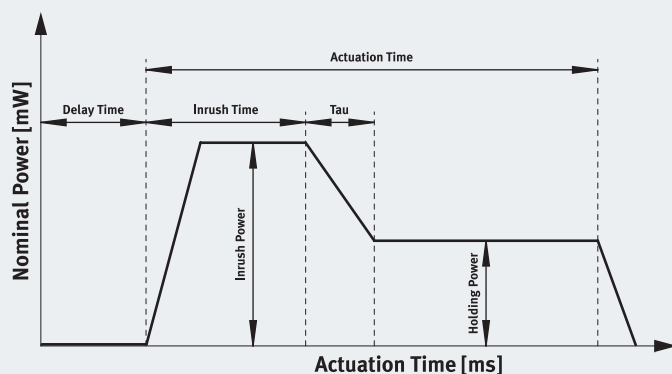
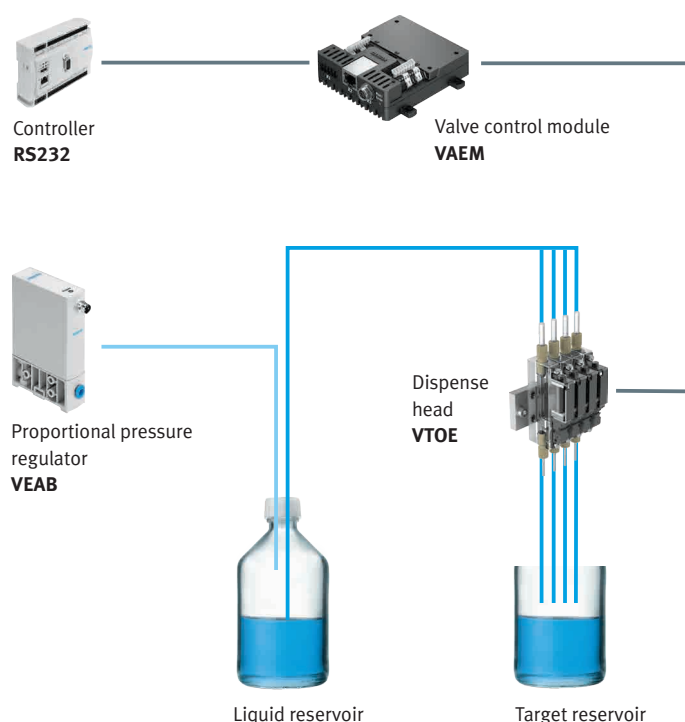
The valve control module VAEM makes precise switching of solenoid valves easier than ever. Up to 8 channels can be parameterized individually. A time resolution of only 0.2 ms and control of the valves via current – not voltage – enable extremely high precision, e.g., for dispensing applications. The holding current reduction saves energy and minimizes heat input.



Perfect interaction

The VAEM is ideal for controlling the dispense head VTOE. Each channel can be controlled individually. This allows you to calibrate even the smallest manufacturing tolerances or viscosity differences and achieve an excellent tip-to-tip coefficient of variation.

The VAEM can not only be used in combination with the dispense head VTOE, but can also be used flexibly with other valves (e.g., VYKA).



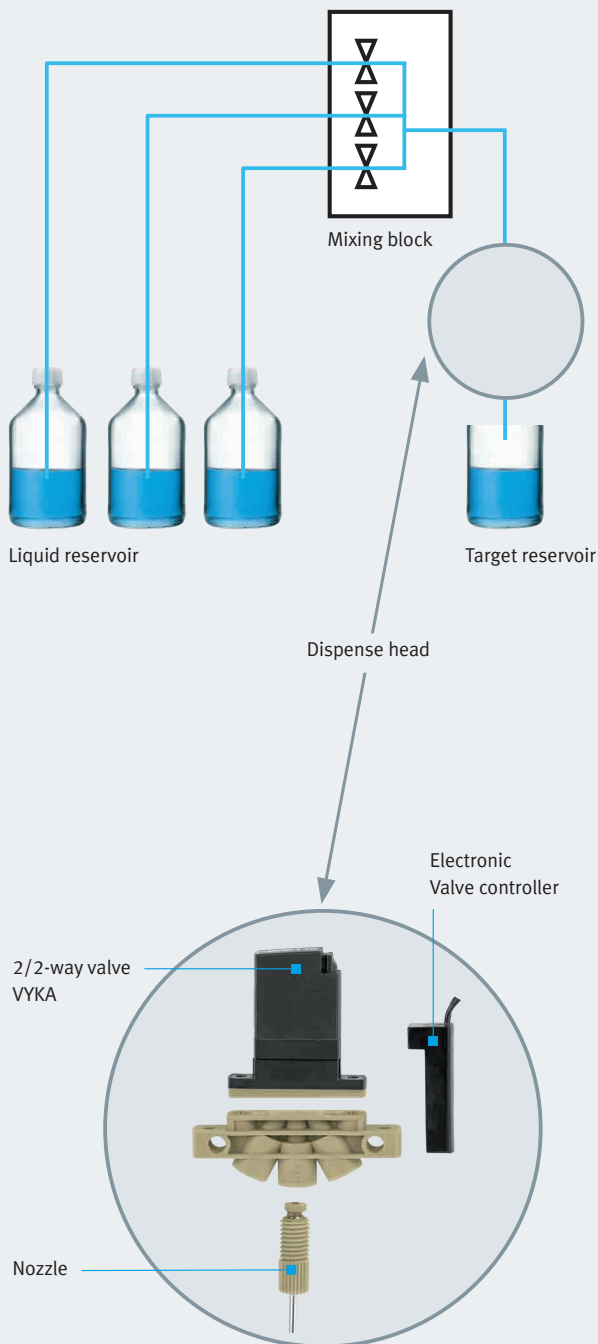
Holding current reduction: the working principle

The parameterization of each of the 8 individually controllable channels is extremely simple: just set the inrush current, the holding current and the actuation times – and it's done!

Communication is via RS232 or Ethernet, a 24 V DC trigger input, or a graphical user interface (GUI). This allows the dispense head VTOE to be pre-calibrated and the control parameters to be saved for stand-alone operation.

Controlling liquids in three operating modes

Dispensing, aspirating or continuous flow? With media-separated valves from Festo, you can choose between these three operating modes. These compact, powerful valves dispense and aspirate any quantity, right from the very smallest, with great precision. Their uniquely impressive pressure and nominal width specifications also make them perfect for flow control, for example in manifold duct plates.



Maximum performance density

The valves can easily handle a pressure range of $-0.75 \dots 3$ bar and flow rates up to 2,070 ml/min. Their small grid dimensions also make them suitable for a wide range of applications, such as VYKA with microwell plates.

Media separation for reliable safety

The high-performance polymers EPDM, FKM and FFKM used for the separating diaphragms can withstand even aggressive media, protect the interior of the valves, and simultaneously prevent corrosion. Their low internal volume makes the valves very easy to clean, which is ideal especially for sensitive applications. The clever design also makes it easy to rinse.

Very flexible control options

The VYKA, VYKB, VYKC and VZDB are actuated in different ways. With the VYKA, the 12 ... 26 V DC actuation of the plug-in electronics (E-box) VAVE or the valve control module VAEM reduces the holding current. The electronics on the VYKB are integrated and can be controlled using 12 V or 24 V. The VYKC can also be controlled via the optional on-board electronics or via the valve control module VAEM. The VZDB, however, is actuated using compressed air.

At a glance

- FDA-listed materials
- Developed according to ISO 13485
- Safe media separation: for aggressive liquids and gases
- Very easy to clean
- Flexible in use thanks to 3/2 and 2/2 (NC/NO)
- Various nominal diameters (1.2 mm, 1.6 mm and 2.0 mm) for dispensing, aspiration and continuous flow applications



Media separated solenoid valves

VYKA

- Flow rate: 350 ml/min
- For dispensing and continuous flow applications, such as filling microwell plates
- Compact design width of 7 mm
- FDA-listed materials
- Developed according to ISO 13485
- Very flexible in use thanks to 3/2 and 2/2 variants (NC/NO), as well as 12 ... 26 V DC control with plug-in electronics (E-box) VAVE-K1



VYKB

- Flow rates: 570 ml/min (F10) and 970 ml/min (F12)
- For dispensing, aspiration, and continuous flow applications
- Compact design width of 10 and 12 mm
- Very flexible in use thanks to 3/2 or 2/2 variants (NC), as well as 12 or 24 V DC control



VYKC

- Flow rates: 1080 ml/min (1.2 mm), 1690 ml/min (1.6 mm and 2070 ml/min (2.0 mm)
- For dispensing, aspiration, and continuous flow applications
- Very flexible in use thanks to 3/2 or 2/2 variants (NC, NO), as well as 10.8 ... 26.4 V control
- Optional smart holding current reduction

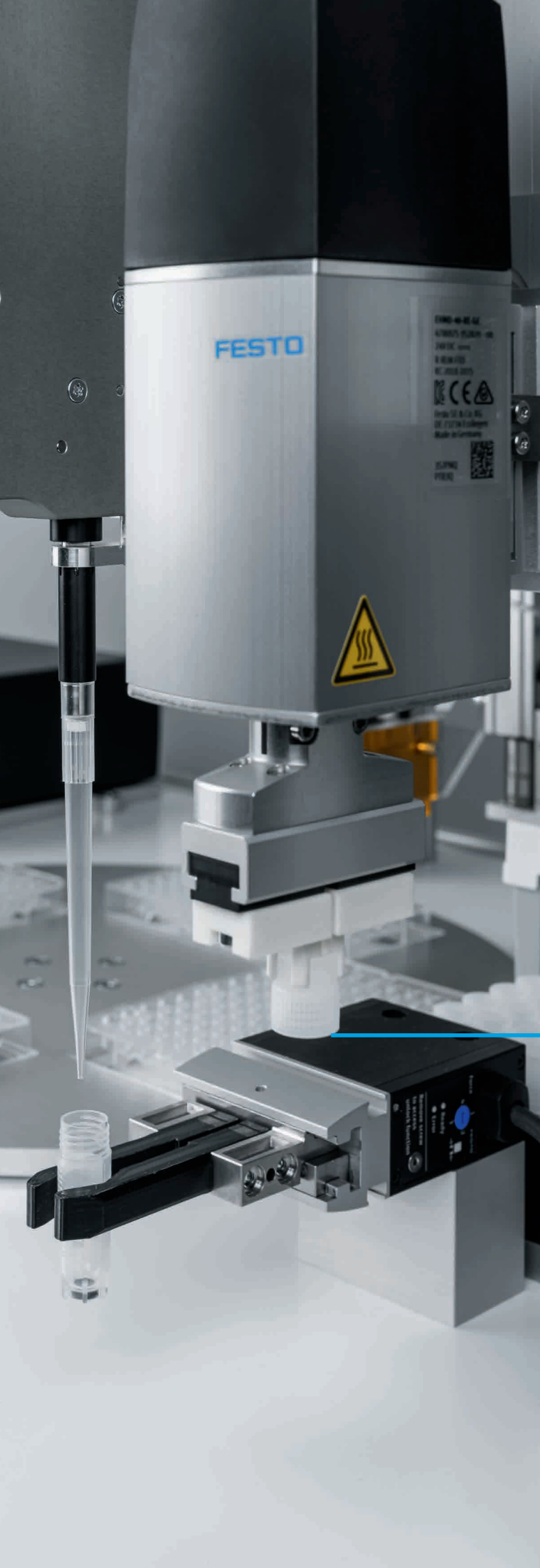


Media separated pneumatic valve

VZDB

- Flow rate: 570 ml/min
- For dispensing, aspiration, and continuous flow applications
- Compact design width of 10 mm
- No electronics necessary due to pneumatic control
- Very flexible in use thanks to 3/2 or 2/2 variants (NC)



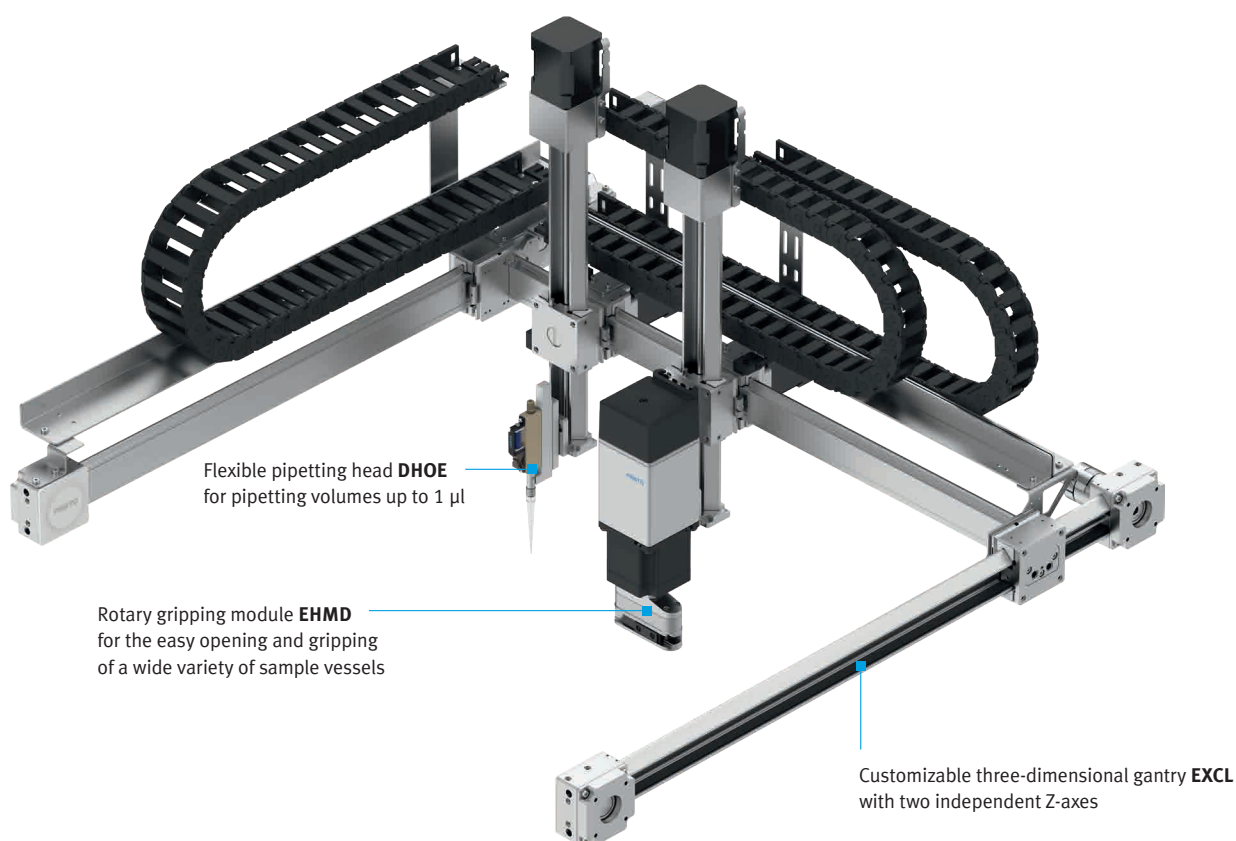


Handling small parts

Whether for transporting, positioning, or opening and closing sample vessels, you can implement sample preparation applications in the smallest of spaces with the compact handling systems and rotary gripper modules.

Accurate positioning of sample vessels

Miniaturization is an important trend in many laboratory applications. The multi-axis gantry EXCL developed by Festo has a small footprint and PCB-based motion controls precisely to save valuable space when designing systems and devices. The functionality of the system can be further extended with two independently moving Z-axes.



Three-dimensional gantry **EXCL**

It is ideal, for example, for analytical processes where sample vessels are to be opened and liquid samples pipetted in the same three-dimensional gantry. The optional second Z-axis enables two front units to move independently of each other, such as the rotary gripper module EHMD and the smart pipette DHOE.

Ready for installation via plug & play: the three-dimensional gantry with stepper motors and optional motion controller can be easily integrated in desktop systems. The maintenance-free system is tested and documented.

Technical data

- Max. stroke: X/Y-axis: 1000 x 700 mm
Z-axis: 50, 100, 150 or 200 mm with 1 or 2 Z-axes
- Max. payload: 1.5 kg (max. 2 kg with 2 Z-axes together)
- Optional 6-axis motion controller
- Programmable via G-code

Gripping, opening and closing sample vials

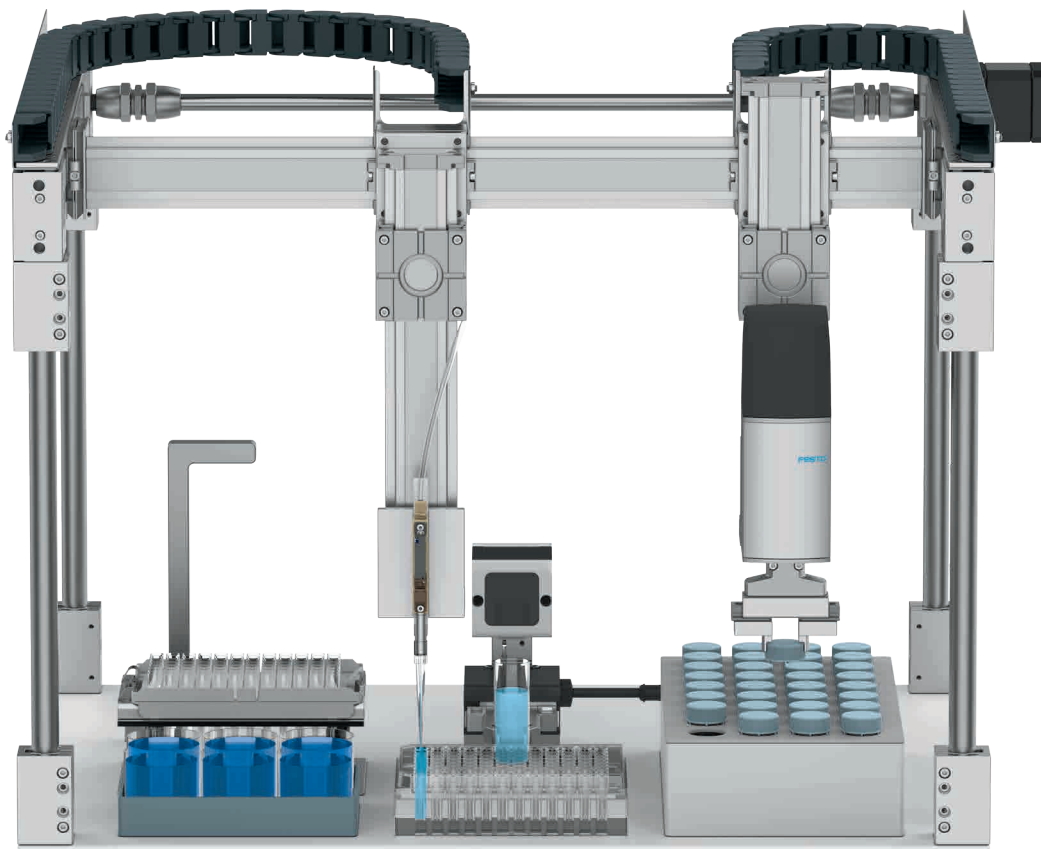
The most compact rotary gripper module in its class is ideal for handling small objects in a wide variety of applications. The EHMD is particularly suitable for laboratory automation, for example for the easy opening of a large range of sample vials. The unique Z module automatically adjusts to the thread pitches of the covers, eliminating changeover times!

The EHMD is absolutely reliable, whether for in vitro diagnostics, cell or genome research, or quality testing in the biotech-pharmaceutical industry. It can also be relied on when preparing and analyzing samples, when loading centrifuges, when gripping, rotating, and placing microwell plates or even when opening and closing sample vials of different sizes.

Quality inspections with cameras, bar code recognition or printing operations with label printers are easy to implement in combination with a 3D gantry, including in small parts assembly and the electronics industry or the food and beverage industry.

Wide range of accessories

These include, for example, a mounting adapter that can be used to compensate for the cover thread pitch when opening and closing vials. This means that the Z-axis does not need to be used during rotation – the capping and decapping process thus becomes easier, faster, and suitable for a wide variety of cap types and thread pitches. Further adapter plates for different Z-axes are also available.



Rotary gripper module **EHMD**

Available in different variants: rotating and gripping electrically or rotating electrically and gripping pneumatically.



**Size 40
with electric gripper**



**Size 40
with pneumatic gripper**



**Size 40
with electric long-stroke gripper**



**Size 50
with electric gripper**

At a glance

- Very compact design
- Optionally fully electric or with pneumatic gripper
- Optional compensation module for compensating for the thread pitch of covers (without moving the Z-axis) by up to 10 mm during rotation
- Simple configuration of the Festo motor controller type CMMO-ST or CMMT-ST





Customized solutions

If you develop a new solution for the automation of laboratory processes together with Festo, you can draw on an existing modular system of proven components. Festo supports you right from the initial planning phase. We transform individual and validated process steps into automated process sequences which can be perfectly integrated into your overall systems.



Real-life application #1

Automated increase in sample throughput

The demand from laboratories for a high throughput of samples is constantly growing. The new handling device PurePrep TTR from the Dutch company MolGen prepares 320 patient samples per hour for molecular processing – at a speed that cannot be matched by a single individual person.

Sample handling with precise level detection

The first robot arm of the two SACRA robots on the PurePrep TTR grasps a sample vial by the cover with an electric gripper and brings it into a position at which the cover is removed. After opening, the second robot arm uses pipetting head DHOE to transport the liquid from the sample vial to the microwell plate.

One of the highlights is that the pipetting system is even capable of precisely determining the liquid level in a sample vial by using high-precision pressure and vacuum adjustment. Concurrent to liquid handling, the first robot arm closes the open sample vial and returns it to the rack. Then it continues with the next sample vial.

Decentralized sample preparation and pressure-controlled pipetting

Key components here are the decentralized pressure and vacuum generator PGVA and the pipetting head DHOE. To enable samples to be analyzed in any location, the PGVA has an integrated compressor, air preparation including filter system, reservoir and electronic pressure and vacuum control in the smallest of spaces.

We are committed to a collaborative technical approach to ensure:

- Reliability thanks to jointly developed and tested solutions
- Reduction of planning effort
- Fast own sample setups
- Fewer development loops until series production
- Faster time to market



More information about this customer application can be found here:



High throughput testing for many pathogens

Fast MDx shows how many pathogens can be detected with unrivalled speed without the need for expensive biosafe laboratories. This London-based company developed a near-patient test system that cuts the typical waiting time of 24 to 48 hours to just one to two hours. The new system uses automation technology from Festo.

Covid-19, influenza A, influenza B, RSV-A, RSV-B: it is important to be able to reliably determine the most common respiratory pathogens in one to two hours so that infected people can quickly receive personalized treatment. The mobile test platform is usually set up close to the patient in hospitals, clinics, or doctor's surgeries. Instead of five employees, now only one person is needed to process up to 1,000 samples in eight hours.

Everything necessary on board

The Fast MDx platform automates the pipetting and dispensing processes. The fully integrated system comprises everything needed for the test, from the sample tubes and swabs to the electronic transmission of the results to the hospital or doctor's surgery.

The tests on the Fast MDx platform are also fully automated. Handling gantries with electric axes from Festo ensure precise pipette handling and robotic handling of the PCR microwell plates. Complemented by a Kbiosystems heat sealer and Fast MDx's patented, ultra-fast qPCR thermo-cycler, the NGX2's Biosero software integrates and controls all modules, greatly simplifying operation.



The automated pipetting system, consisting of the pipetting head DHOE and the disposable syringe ejector DHAO can accurately dispense volumes in the range of 10 µl.



High throughput: two three-dimensional gantries with pipetting and transport units ensure a fully automated sequence of molecular diagnostic tests.

Operating the Fast MDx test platform

The operator loads the racks with the pipette tips, the microwell plates, the assay kit with all the reagents and the patient samples. A unique barcode tracks them throughout the process.

During sample preparation, the planar surface gantry EXCM operates in the X and Y planes. The automated pipetting system, consisting of the pipetting head DHOE and the disposable syringe ejector DHAO, is mounted on the planar surface gantry in the Z direction.

Each patient sample is aspirated with a disposable tip and pipetted into the master mix. Piercing the cover without opening and closing systems saves a lot of time and money, and avoids human errors.

Using electric grippers and axes

The separate planar surface gantry EXCM-30 picks up the filled microwell plate with the electric gripper EHPS-16 and places it in the heat sealer for sealing. The conversion of the RNA into complementary DNA (cDNA) is then triggered in the RT block. The PCR reaction clarifies whether the cDNA sequence of the pathogen of interest is present.

Supply-independent pressure/vacuum generator

The pressure/vacuum generator PGVA operates with a pressure or vacuum of ± 0.5 bar, independent of an external pneumatic supply. All that is needed is a 24-volt power supply.

More information about this customer application can be found here:



Fully automated tests: a separate handling system, based on the planar surface gantry EXCM-30, uses electric gripper EHPS-16 to transport and position the microwell plate between the individual processing steps.





You need random access and batch analyses.
You want reliable error-free processes.
We make your laboratory processes faster and more precise.

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OF PRODUCTIVITY.**



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