Advanced handling systems
Mechatronic Motion Solutions

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

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

Motion
Stands for the comprehensive, multi-dimensional range of linear and rotary drives as well as a large variety of mechanical and vacuum grippers. It boasts general and specific benefits. The general and specific benefits of all movement components include high speed, dynamic response and precision.

Solutions
Represents the decades of experience Festo has in the field of handling technology across all industries and continents. This includes first-class expertise in developing components and sophisticated systems. They range from pre-designed and calculated components to subsystems and complete systems.

Forward-looking:
the Bionic Handling Assistant.

Designed using many innovative products that are already part of the Festo product range and that have been proven in practice, such as the adaptive gripper DHDG or the robotic controller CMXR.

⇒ More details on page 22

winner 2010
Advanced handling systems

The new generation of handling systems represents a giant step forward. It is not intended as a replacement for the many conventional handling systems which are available but as a useful complement to these. And one which offers a big increase in productivity. See for yourself!

Flexibility
- Perfect load, dynamic response and precision characteristics
- Different sizes and working spaces
- Communication interfaces for integration into the user’s control hierarchy for (flexible) decentralised control tasks
- Peripheral equipment for the front unit with suction and gripping technology
- Function expansions integrated in the control package

Performance
- Maximum acceleration and high effective load
- High pick rates and maximum working strokes
- Optimum working space coverage, compact mounting geometry
- Standardised and tested safety concept in accordance with the EC Machinery Directive

System
- Complete decentralised system package
- Standardised high-speed handling systems
- Standardised interfaces in the control system, suitable safety concept for machine integration
- Everything from a single source – Festo plug and work

H-gantry EXCH
Planar surface gantry with rectangular working space
- Flat with very rigid XY kinematics
- Small moving mass
... From page 8

T-gantry EXCT
Linear gantry with rectangular vertical working space
- Very slim with rigid and compact Z-axis
- Small moving mass
... From page 12

Tripod EXPT
Parallel kinematics with cylindrical working space
- Rigid pyramidal base system
- Minimal moving mass
- Maximum dynamic response and pick rates
... From page 16

Control package CMCA
Solution package with multi-axis/robotic controller, motor controller and harmonised safety concept, optional with compact vision system
- Ready-to-install complete package
- Control cabinet or mounting plate
... From page 20

Peripheral solutions
- Gripping solutions and vacuum
- Standard handling systems and ready-to-install solutions
... From page 24
Advanced handling systems

**H-gantry EXCH**
The Cartesian high-speed handling system with robotic functionality via CMCA has superb dynamic response with up to 70 picks/min and makes optimum use of the installation space.

Extremely compact and flat, the large rectangular working space of the XY planar surface gantry makes handling highly flexible with free planar movement. When supplemented with a Z-axis or the rotary lifting module, it can also be extended to 3D applications.

**T-gantry EXCT**
The Cartesian high-speed handling system with robotic functionality via CMCA has superb dynamic response with more than 90 picks/min and makes optimum use of the installation space.

As a compact and slim YZ linear portal with rectangular working space, it is an ideal pick and place handling system for flexible handling with free movement in the vertical plane wherever installation space is limited.

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**Features**

- Parallel kinematic principle with two stationary motors, recirculating toothed belt and low moving mass
- Large rectangular working space
- Flat design and low centre of gravity
- Integrated energy chain concept
- Configurable system solution

**Benefits**

- High dynamic response (70 picks/min)
- At least 30% more performance compared to conventional gantry systems
- Optimum ratio of working space to installation space
- 1 EXCH covers the working space of 2 SCARA robots
- Optimum installation, hardly any vibrations = low demands on the frame, low costs
- Easy and safe installation even when the system is modified or expanded
- Festo plug and work: easy to integrate into the system concept and commission

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**Features**

- Parallel kinematic principle with two stationary motors, recirculating toothed belt and low moving mass
- Slim design with very compact Z-axis
- Low-Z-axis inertia and small moving mass
- Integrated energy chain concept
- Configurable system solution

**Benefits**

- High dynamic response (90 picks/min)
- At least 30% more performance than conventional solutions
- Large working space coverage in the vertical plane, particularly in tight working and installation conditions
- High precision with maximum dynamic response and delay
- Minimal vibrations
- Reduced demands on the support frame
- Easy and safe installation, even in the front unit
- Festo plug and work: easy to integrate into the system concept and commission
**Features**

• Parallel kinematic principle with carbon fibre rods

• The pyramid shape results in a closed mechanical system with high rigidity

• Broad construction and broad attachment to the frame

• Configurable system solution

• Safety concept for rod loss detection

**Benefits**

• Minimum moving mass – maximum dynamic response of drives (150 picks/min)

• High process reliability and precision for joining and inserting applications

• Optimum flow of reaction forces into the machine frame

• Low vibration tendency of the frame

• Festo plug and work: easy to commission

• Detaching the rods does not damage the tripod or the system

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**Control package CMCA**

The control package with robotic functionality and optional PLC is used for free 3D path control with demanding and highly dynamic kinematics.

It comprises a robotic control system, motor controllers, control cabinet or backplate. Additional functions can be integrated. The complete package with kinematics and basic parameterisation of the entire system is supplied ready for installation.

**Features**

• Ready-to-install control system from a single source, in a control cabinet or on a mounting plate

• Basic function or extended control functionality

• Precise fit for integration into the kinematic frame

• Easy to operate and maintain the entire system, including control package and mechanics

• Harmonised safety concept with “safe stop” function and safe torque deactivation

**Benefits**

• Easy project management with a single partner, including application-specific integration into the complete system

• Control solution appropriate for the application and kinematic requirements

• Optimum use of available space

• Quick and easy commissioning and maintenance

• Teach pendant

• Reliable system operation

• Fulfils the requirements of the EC Machinery Directive

• Easy integration into the user’s protective circuit

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**Tripod EXPT**

The high-speed handling unit with robotic functionality via CMCA for free movement in three dimensions provides precision in movement and positioning as well as a high dynamic response of up to 150 picks/min.

The very rigid kinematics has a pyramid-shaped layout: the drives which are securely connected to one another and their motors do not move.
Simple and complete: everything from a single source
1 Kinematics
Highly dynamic mechanics for various working spaces, available in several sizes and stroke ranges. An innovative design and optional calibration ensure increased precision.

H-gantry EXCH: 2 sizes with rectangular horizontal working space measuring max. 2300 x 1500 mm
T-gantry EXCT: rectangular vertical working space measuring max. 1000 x 300 mm
Tripod EXPT: 4 sizes with a working diameter up to max. 1200 mm at a working height of 100 mm

Standard for all kinematics: energy chain for simple and safe assembly and operation

2 Front unit
Our solutions for rotating, gripping or vacuum are dynamic, lightweight, precise and/or powerful. They are also highly precise and adaptive for minimum gripping cycles, e.g. for vacuum.
  • Special features of the tripod: highly accurate, infinitely rotating rotary drive with energy through-feed for optimum positioning accuracy.
  • Special features of the H-gantry: virtually contactless gripping with a rotary lifting module and the Bernoulli gripper

3 Control solution
Standardised decentralised control package CMCA for easy commissioning with a category 3 safety concept and a suitable connection to the higher-level system controller.
  • Flexible mounting in a control cabinet or on a mounting plate
  • Robotic controller and motor controller, electrical components and display elements, optional additional functions with peripheral equipment
  • Optional teach pendant with teach-in function
  Alternative: T-gantry control solution via CPX terminal for simple pick and place tasks

4 Vision system
Intelligent compact vision system for 100% quality control and conveyor tracking for handling moving objects. It is directly integrated in the control package with robotic controller CMXR and has comprehensive evaluation software.
  • Inspection of the orientation/rotational position of parts
  • Inspection of the geometry and type of parts
  • Surface and edge inspection
  • Precise part measurement and pass/fail evaluation

5 Frame solutions
Support frame suitable for kinematics and many application requirements, including user-specific applications
  • Checked and operationally reliable solution – Festo plug and work

6 Services
Choose from pure engineering services or special services for complete handling solutions
  • Commissioning service for axis systems
  • Detailed system documentation, operating instructions, parts lists
  • CAD drawings, circuit diagrams
Maximum dynamic response with up to 70 picks/min and optimum utilisation of the installation space is what characterises the Cartesian high-speed handling system with robotic functionality. The XY planar surface gantry, which is extremely compact and flat, exhibits an excellent installation space to working space ratio.

It also has a suitable frame and control package for precise point-to-point or path-controlled movements. The H-gantry is a genuine cost-effective alternative to robotic systems with delta kinematics. It is economical to purchase and operate, boasts a long service life thanks to proven series components and also has low power consumption thanks to the low moving mass.

**H-gantry EXCH**

**Integrated energy chain concept:** for easy and safe installation, even in the event of subsequent modification or expansion

**Reliable series components:** low-friction and durable operation with maximum dynamic response

**Front panel can be freely equipped**
with either a Z-axis or a rotary lifting module

**Large rectangular working space:** scaleable in X and Y-direction. For example, for handling up to 10 solar wafers

**30% higher efficiency due to a lower moving mass:**
drive for positioning the front panel is unnecessary

**Two sizes:** for optimal utilisation of installation space and workpiece mass

**High dynamic response:**
stationary motors on the X-axes and a rotating toothed belt for movement of the X and Y-axes. Servo motors and suitable motor controllers provide high dynamic performance

**Extremely flat:** perfect for small assembly or test cells and a clear overview of the system

**Low centre of gravity:**
low overshoot, enhanced positioning accuracy and reduced demands on the frame
Optional additional movement
The front panel accommodates the Z-axis or rotary lifting module for free movement in the space (3D).

The kinematic chain:
- 2 stationary servo motors $M_1$ and $M_2$
- 1 recirculating toothed belt ZR
- 2 very rigid X-axes, 1 very rigid Y-axis

H-gantry EXCM
The planar surface gantry in two sizes with strokes up to 700 mm is characterised by its high level of functionality in a very small installation space. The recirculating toothed belt moves the slide and is driven by stepper motors in 100% servo operation.

Size 10:
- Low-cost system solution

Size 30:
- Matching controller package optional

Function
The two stationary motors and the recirculating toothed belt characterise the planar surface gantry. The toothed belt, which is secured to the front panel of the Y-axis, runs along the 3 rigid main axes. The resulting parallel kinematic structure enables free movement in the space. The direction of movement, acceleration and speed are realised via simultaneous control of both motors. The superposition of both motor outputs and the reduced moving mass enable the high dynamic response of the XY movement.

Kinematics in detail:
- The superposition of both motors enables the front panel to move in an X or Y-direction
- Both motors together ensure maximum acceleration and speed for exclusive movement of the front panel in an X or Y-direction

EXCM-10 with functional drive and controller package for max. 0.5 kg effective load
EXCM-30 with motor mounting at top (optionally underneath) for max. 3 kg effective load
Features

Technical data for H-gantry EXCH-60 EXCH-40
Max. acceleration 50 m/s² 50 m/s²
Max. speed 5 m/s 5 m/s
Repetition accuracy: ± 0.1 mm ± 0.1 mm
Absolute accuracy* ± 0.5 mm ± 0.5 mm
Path accuracy (0.5 m/s) ± 0.5 mm ± 0.5 mm
Max. effective load on the front panel 6 kg 4 kg
*System perfectly aligned and calibrated

Technical data for rotary lifting module (for EXCH-60)
Max. effective load 0.8 kg
Max. vertical force 480 N
Nominal force 97 N
Max. torque 2.8 Nm
Nominal torque 0.56 Nm
Perm. mass moment of inertia 400 kg mm²

Maximum working space and installation space

Max. dimensions and strokes in mm

Stroke in X-direction [mm] Pick rate [picks/min] Cycle time [ms]
400 69 870
500 65 920
700 60 1,000
1,600 43 1,385

- The specified cycle rate refers to a double stroke
- Double stroke cycle [mm] 400/500/700/1,600

• Gripping and waiting times are not taken into consideration

Note
For load masses up to 4 kg, it is possible to reduce the installation space for the EXCH-40 with the same working space.
**Separation and inspection**

**The challenge**
Separate and visually examine wafers at high speed without damage.

**The solution**
H-gantry for separation and compact vision system SBO..-Q for inspection.

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**Inspection and stacking**

**The challenge**
Unload, stack, test and qualify wafers gently with optimised cycle times.

**The solution**
Inspection with compact vision system SBO..-Q, stacking in blister boxes with H-gantry and rotary lifting module. Suitable for up to 5000 wafers per hour depending on the configuration.

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**System functions**

1. The gripper system is positioned exactly above the magazine
2. The Bernoulli gripper removes the wafer from the magazine with virtually no contact
3. The wafer is positioned and checked by the intelligent compact vision system:
   - Exact position control
   - Quality of the contour and edges
4. The rotary lifting module rotates and positions the wafer precisely in line with the respective track
5. The wafer is placed on the moving conveyor in a defined sequence
6. Complete, highly dynamic position control via robotic controller CMXR

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*Working space of H-gantry*

*Working space of 2 SCARA*

*Installation space comparison* in solar module production
The Cartesian high-speed pick and place handling system stands for maximum dynamic response with over 90 picks/min, high flexibility and a compact design. As a complete solution, it is the most dynamic alternative to conventional solutions with free movement. The corresponding control package ensures precise point-to-point or path-controlled movements in the vertical plane.

Overall, it is an excellent system thanks not only to low purchase costs but also low operating costs, as the low moving mass reduces energy consumption. Reliable series components and reduced vibrations contribute to a long service life.

**T-gantry EXCT**

**Low moving mass and inertia of the Z-axis:** for precision positioning with high acceleration and deceleration, as well as minimal vibration

**Flexible working space:** through scaleable strokes in the Y and Z-direction

**Universal:** front unit interface for mechanical or vacuum-assisted rotating and gripping solutions

**Compact design:** with large working space coverage in the vertical plane – particularly interesting where installation space is limited

**Minimum space requirement:** simple and safe assembly, minimal installation effort required thanks to an integrated energy chain concept on the Y and Z-axis

**High dynamic response:** thanks to the superposition of the two stationary servo motors on the Y-axis and the recirculating toothed belt
Optional front unit
The front unit interface, the so-called front panel, can be equipped with optional rotating, gripping or vacuum solutions.

Function
The linear gantry is characterised by its two stationary motors on the Y-axis and the recirculating toothed belt. The toothed belt, which is secured to the front panel of the Z-axis, runs completely around the two rigid axes. The resulting kinematic structure enables the coordinated and free movement of the front panel in the vertical plane. The direction of movement, acceleration and speed are realised via simultaneous control of both motors. The superposition of both motor outputs and the reduced moving mass enable the high dynamic response of the YZ movement.

The kinematic chain:
- 2 stationary servo motors M₁ and M₂
- 1 recirculating toothed belt ZR
- 1 very rigid Y-axis, 1 rigid yet lightweight Z-axis

Kinematics in detail:
- The superposition of both motors enables the front panel to move in a Y or Z-direction
- Both motors together ensure maximum acceleration and speed for exclusive movement of the front panel in a Y or Z-direction

Alternatives for decentralised control of the pick and place function for the T-gantry:
- Control package CMCA with robotic controller CMXR and synchronous 3D interpolation for complex applications and maximum requirements for dynamic response

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... From page 23

- Intelligent CPX terminal in IP65/IP67 with CoDeSys embedded controller CPX-CEC-M1 for synchronous movements and 2.5D interpolation for simple applications

... From page 23

- Intelligent compact vision system SBOx-Q with integrated CoDeSys PLC for direct control of electric drives for simple process sequences
Features

Technical data
Max. acceleration 50 m/s²
Max. speed 5 m/s
Repetition accuracy ± 0.1 mm
Absolute accuracy ± 0.5 mm
Path accuracy (< 0.5 m/s) ± 0.5 mm
Max. effective load 3 kg

Optimisation of cycle times

Optimum cycle times and fastest possible motion sequences by motion path smoothing with robotic controller CMXR

Pick rate as a function of the effective load and horizontal stroke

<table>
<thead>
<tr>
<th>Effective load [kg]</th>
<th>Stroke along Y-direction [mm]</th>
<th>Pick rate [picks/min]</th>
<th>Cycle time [ms]</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.1</td>
<td>200</td>
<td>94</td>
<td>640</td>
</tr>
<tr>
<td></td>
<td>400</td>
<td>78</td>
<td>770</td>
</tr>
<tr>
<td></td>
<td>800</td>
<td>56</td>
<td>1,070</td>
</tr>
<tr>
<td>3</td>
<td>200</td>
<td>92</td>
<td>650</td>
</tr>
<tr>
<td></td>
<td>400</td>
<td>71</td>
<td>850</td>
</tr>
</tbody>
</table>

- The specified cycle rate refers to a double stroke
- Gripping and waiting times are not taken into consideration
- Double stroke cycle [mm]
**Features**

### Inspection of chip cards

**The challenge**
Remove chip cards quickly, turn for inspection and load them back into the magazine.

**The solution**
High-speed T-gantry with semi-rotary drive DSM-B and long-stroke gripper HGPL.

### System functions

1. Identification and inspection of parts with regard to position and rotary orientation by the intelligent compact vision system
2. Positioning and gripping with speeds synchronised with the conveyor
3. Exact orientation alignment by the rotary unit during transport
4. Transport at a high speed and with reduced cycle times thanks to motion path smoothing
5. Precise approach of the deposit position and rapid set down, supported by ejector pulse
6. Complete highly dynamic position control with robotic controller CMXR

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**Packaging**

**The challenge**
Highly dynamic packaging of various parts without changing the gripper technology.

**The solution**
T-gantry with suction gripper and OVEM for vacuum generation directly on the Z-axis.

**System functions**

1. Identification and inspection of parts with regard to position and rotational orientation by the intelligent compact vision system
2. Positioning and gripping with speeds synchronised with the conveyor
3. Exact orientation alignment by the rotary unit during transport
4. Transport at a high speed and with reduced cycle times thanks to motion path smoothing
5. Precise approach of the deposit position and rapid set down, supported by ejector pulse
6. Complete highly dynamic position control with robotic controller CMXR

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**Placing**

**The challenge**
Removing components from magazines at high speed and placing them on a tray.

**The solution**
T-gantry with parallel gripper, controlled by a controller with embedded CoDeSys.

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**Inspection of chip cards**

**The challenge**
Remove chip cards quickly, turn for inspection and load them back into the magazine.

**The solution**
High-speed T-gantry with semi-rotary drive DSM-B and long-stroke gripper HGPL.
Tripod EXPT

The high-speed handling system with robotic functionality for free movement in 3D space provides precision in movement and positioning, combined with high dynamic response up to 150 picks/min. The control package with robotic control, together with the extremely rigid pyramid structure, ensures high path and positioning accuracy. It is perfect for pick and place applications, sorting and palletising tasks, as well as bonding applications.

All in all, the tripod is an excellent system thanks not only to low purchase costs but also low operating costs, as the low moving mass reduces energy consumption. Reliable series components and reduced vibrations contribute to a long service life and extended maintenance intervals.

**Highly dynamic and precise movement:** accurately adjusted, powerful servo motors, coordinated with a robotic controller for free movement in 3D. Configurable motor position for optimum installation

**Standard components:** economical thanks to simple, quick and low-cost spare parts

**Minimal moving mass:** Carbon fibre rods connect the front panel to the rigid axes, the drives convert their performance directly into dynamic response

**Rod loss detection:** Any detachment of the rods is detected by the pneumatic circuit, minimising the risk of damage to the system and tripod in the event of a malfunction

**Sturdy basic frame:** wide connection to the support frame for optimum power flow and reduced vibrations

**Pre-assembled installation concept:** line and tubing guide for a non-fatigue critical solution with maximum dynamic response; flexible expansion possible

**High rigidity:** the pyramid shape results in a closed mechanical system for maximum precision and process reliability, e.g. for joining applications and insertion operations

**Standardised front panel:** Interface for easy connection of gripper and vacuum solutions from Festo

**Rotary drive with high power density:** precise, highly dynamic and infinite rotation with a low dead weight
**Function**
The tripod with robotic functionality has four degrees of freedom for path and positioning applications in space, with additional position control. The tripod’s range of movement is characterised by the pyramid-shaped arrangement of 3 standard linear drives. The front panel is connected to the drives by parallel glass-fibre-reinforced plastic rods, which reduce the moving mass to a minimum.

The driving force can almost be used entirely for the introduction of dynamic response. Vibrations are simultaneously minimised.

**Optional front unit**
The high-performance and extremely precise rotary drive which is mounted on the front panel completes the tripod as a 4-axis system.

**Working space**

![Diagram of working space](image)

**Diameter of the cylindrical working space at a working height = 100 mm**

<table>
<thead>
<tr>
<th>Type/size</th>
<th>Diameter D</th>
</tr>
</thead>
<tbody>
<tr>
<td>EXPT-45</td>
<td>450</td>
</tr>
<tr>
<td>EXPT-70</td>
<td>700</td>
</tr>
<tr>
<td>EXPT-95</td>
<td>950</td>
</tr>
<tr>
<td>EXPT-120</td>
<td>1200</td>
</tr>
</tbody>
</table>

**Dependence of diameter on the working height:**

- The more working space required, the smaller its diameter
- The possible working space is described using the diameter and the height of cylinders, the actual working space is larger and corresponds to a three-sided pyramid
Features

Technical data for tripod EXPT

<table>
<thead>
<tr>
<th>Feature</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Max. acceleration</td>
<td>110 m/s</td>
</tr>
<tr>
<td>Max. speed</td>
<td>7 m/s</td>
</tr>
<tr>
<td>Repetition accuracy</td>
<td>± 0.1 mm</td>
</tr>
<tr>
<td>Absolute accuracy</td>
<td>± 0.5 mm</td>
</tr>
<tr>
<td>Path accuracy (&lt; 0.3 m/s)</td>
<td>± 0.5 mm</td>
</tr>
<tr>
<td>Effective load at max. dynamic response*</td>
<td>1 kg</td>
</tr>
<tr>
<td>Maximum effective load*</td>
<td>5 kg</td>
</tr>
</tbody>
</table>

* including front unit (rotation/gripper/vacuum solution, axis of rotation)

Technical data for axis of rotation (4th axis)

<table>
<thead>
<tr>
<th>Feature</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of sizes</td>
<td>2 (motor capacities)</td>
</tr>
<tr>
<td>Max. torque (size 1/2)</td>
<td>1.8 / 4.5 Nm</td>
</tr>
<tr>
<td>Nominal torque (size 1/2)</td>
<td>0.75 / 1.8 Nm</td>
</tr>
<tr>
<td>Max. speed</td>
<td>200 rpm</td>
</tr>
<tr>
<td>Nominal rotary speed</td>
<td>117 rpm</td>
</tr>
<tr>
<td>Repetition accuracy</td>
<td>± 0.01°</td>
</tr>
<tr>
<td>Weight (size 1/2)</td>
<td>0.69 / 0.9 kg</td>
</tr>
</tbody>
</table>

Pick rate as a function of the effective load

<table>
<thead>
<tr>
<th>Effective load [kg]</th>
<th>Pick rate [picks/min]</th>
<th>Cycle time [ms]</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>150</td>
<td>400</td>
</tr>
<tr>
<td>1</td>
<td>116</td>
<td>520</td>
</tr>
<tr>
<td>2</td>
<td>96</td>
<td>630</td>
</tr>
<tr>
<td>3</td>
<td>85</td>
<td>710</td>
</tr>
<tr>
<td>4</td>
<td>78</td>
<td>770</td>
</tr>
<tr>
<td>5</td>
<td>72</td>
<td>830</td>
</tr>
</tbody>
</table>

- The specified cycle rate refers to a double stroke in a 12" cycle
- Double stroke cycle [mm] 305
- Gripping and waiting times are not taken into consideration

Maximum dimensions

<table>
<thead>
<tr>
<th>Dimension</th>
<th>EXPT 45</th>
<th>EXPT 70</th>
<th>EXPT 95</th>
<th>EXPT 120</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>1086</td>
<td>1238</td>
<td>1392</td>
<td>1556</td>
</tr>
<tr>
<td>B</td>
<td>947</td>
<td>1077</td>
<td>1213</td>
<td>1355</td>
</tr>
<tr>
<td>C</td>
<td>658</td>
<td>726</td>
<td>828</td>
<td>947</td>
</tr>
<tr>
<td>D</td>
<td>493</td>
<td>560</td>
<td>653</td>
<td>710</td>
</tr>
</tbody>
</table>
**System functions**

1. Inspection of workpieces and conveyor tracking by the compact vision system
   - Parts type and quality
   - Position and rotary orientation
2. The tripod approaches the exact gripper position in synchronisation with the conveyor
3. The parts are removed from the conveyor by the suction gripper
4. Exact orientation alignment by the axis of rotation during transport
5. Robotic controller CMXR: complete, highly dynamic position control of the tripod, processing of object data for the vision system and the palletising function

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**Packaging**

**The challenge**
Correctly stacking randomly positioned workpieces and placing them in the moulds with high dynamic response.

**The solution**
Compact vision system SBO..-Q with conveyor tracking, pick & place with tripod and gripping/rotating solution with suction gripper.

**Assembly**

**The challenge**
Application of sealing compound to free-form surfaces with a constant path speed.

**The solution**
Tripod with robotic controller CMXR-C2 for 3D contour movement in the space.

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**Bonding**

**The challenge**
Application of sealing compound in of pin contacts in plastic housings

**The solution**
2 EXPT with gripper/swivel unit, robot-controlled for path-optimised movements.

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**High speed sorting**

**The challenge**
Sorting unsorted cans and cans of various sizes on a conveyor belt.

**The solution**
High speed tripod with suction gripper, as well as object detection with vision system SBO..-Q.
Control package CMCA

All in one with the CMCA, which is both a robotic controller and motor controller, complete with harmonised safety concept. It rounds off the ready-to-install solution package for all advanced handling systems. The system is delivered together with the selected kinematics and basic parameterisation for the entire system. The CMCA offers complete control functionality for demanding applications, ready for installation either in a control cabinet or on a mounting plate.

- 3D path control, optionally available with integrated PLC
- Programming system FTL/CoDeSys
- Activation of up to 4 axes
- Easy integration into the customer’s safety hierarchy
- Attractively priced standard solution
- Space-saving: precise fit with the frame of the respective kinematics
- Easy to operate and maintain the entire system

Performance and options
- Complete system for immediate operation – Festo plug and work
- Pre-programmed basic projects
- Safe stop SS1 in automatic mode with PL “d”
- Safe torque deactivation
- Additional digital inputs and outputs optional
- Protection class IP54

Supported kinematics for demanding and highly dynamic handling tasks:
- Tripod EXPT
- H-gantry EXCH
- T-gantry EXCT

Supported Cartesian systems for easier handling tasks:
- Three-dimensional gantries
- Cantilever gantries
- Linear gantries
- Pick & place

Compact vision system SBOx-Q
Teach pendant CDSA with teach-in function

Supported kinematics for demanding and highly dynamic handling tasks:
- Tripod EXPT
- H-gantry EXCH
- T-gantry EXCT

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Teach pendant CDSA with teach-in function
Safety@Festo
As partners for safety we realise that quality has many aspects. One of these is handling machines safely. Using safety-oriented electric and control components from Festo provides you with the security of implementing safety measures in compliance with the EC Machinery Directive.

Safety concept
Safe stop SS1 according to EN 60204-1 in automatic mode with PL “d”, category 3

Emergency stop
When an emergency stop is triggered and the signal is transferred to controller, the command to reduce speed true-to-path is transmitted from the controller to the motor controller via the CANopen Drive Bus.

Case 1
- Stopping true-to-path within the application-specific target time \( t_v \):
- After stopping the kinematics, the controller enable function is deactivated via the CANopen Drive Bus (= brake applied).

Case 2
- The dual-channel safety circuit 4 is activated at the same time, see case 1, despite the residual speed of the kinematics.
- The speed is then further reduced to a stop, but without path control so that the specified path position can be exited in certain circumstances.

At the end of \( t_v \), the dual-channel safety circuit 4 is activated – deactivation of the output stage enable and supply voltage for the output stage drivers.

\( t_v \) – Defined time for the true-to-path stop
Multi-axis control systems

Robotic controller CMXR-C1/-C2
The robotic controller is the core of a complete kinematic system solution and enables free path control in 3D. It enables very short travel times and path applications such as for bonding or sealing applications.

Common features:
- Optional wrist axes
- Motion path smoothing of positions
- Definition of tools and their end points (TCP)
- Different acceleration ramps
- Constant path speed
- Reduced speed in manual operation

Extended functionality: -C2
- Integrated CoDeSys PLC
- Intelligent dynamic limiter for monitoring the physical axis limits
- Speed-independent path switching points
- Individual programming of speed, acceleration and jerk
- Tracking of moving objects (path tracking)

Teach pendant CDSA
Complex applications can be programmed very easily with the integrated teach-in function.

Simple, dialogue-based teaching
When creating the movement program, the position to be approached by the gripper or the tray position is often unknown. These can be approached precisely during commissioning and taught by using the teach-in function.

Key features:
- Emergency off switch
- Two enabling buttons
- Pushbuttons for jog operation
- Integrated user management
- Integrated alarm system and signal monitor for diagnostic purposes and monitoring peripheral signals.

Convenient configuration – quick, safe and simple
The robotic controller CMXR is configured via the Festo Configuration Tool (FCT). Three parameters are defined here, namely electrical variables, mechanical variables and kinematics.

Teach pendant CDSA for robotic controller CMXR

The clear structure and user navigation function make configuring multi-axis systems quick and easy. The movement profiles are programmed using the text-based macro programming tool of the Festo Teach Language (FTL).

This powerful programming tool contains macros for
- movements
- dynamic settings
- processing of peripheral devices e.g. grippers.

Programming can be done online via the teach pendant CDSA or offline via the FTL programming editor. This is already integrated in the (FCT).
CoDeSys embedded Controller CPX-CEC-M1
The intelligent remote I/O terminal in IP65/IP67 can be mounted directly on the machine. Its PLC functionality enables decentralised control of up to 8 electric axes synchronously in 2.5D.

- Integrated CANopen master
- Synchronous control of 8 electric axes
- Diagnostics and condition monitoring
- Softmotion library for motion control and interpolation up to 2.5D
- Communication at CPX terminal via Ethernet or fieldbus

Compact vision system SBOX-Q
Intelligent camera for position and type detection, quality inspection of moving and stationary parts, OCR detection and reading of 1/2D codes, regardless of orientation and position.

The camera contains the sensor system for image data acquisition, the complete electronic evaluation unit for image processing, an integrated PLC, e.g. for precision axis adjustment, as well as interfaces for communication with higher-order controllers.

Highly flexible for inspection and sorting
- Up to 256 test programs can be stored on the camera
- Up to 256 tests simultaneously per test program

Technical highlights
- CANopen Master (with CoDeSys)
- Integrated CoDeSys PLC
- Standardised Ethernet interfaces and integrated 24 V I/O
- The CheckKon and CheckOpti software tools make configuring the image processing task very straightforward
- Monochrome and colour resolution up to 1280 x 1024
- Protection class IP65/IP67
Gripping solutions and vacuum

Everything from a single source when it comes to gripping and positioning parts.

A wide range of gripper functions, design and performance – compact, precise, flexible, powerful and sturdy.

Vacuum gripping for any application – economic, compact and wear-resistant.

Maximum flexibility with the adaptive gripper – minimum weight for maximum dynamic response.

Parallel gripper HGPT-B
Oval piston surface and precise T-slot guide of the gripper jaws for the shortest gripping times and sturdy, powerful use. Synchronous movement through a forced drive (single or double-acting).

Features
• Internal or external gripping
• Optional gripping force backup
• Up to 4 position sensing options, integrated flush in the slot
• Tubeless compressed air
• Supply via adapter plate

Technical data
• 8 sizes with a total strokes of up to 50 mm
• Opening/closing times from 8 ms
• 10 million switching cycles

Long-stroke gripper HGPL
Double-acting long-stroke gripper with precise T-slot guide of the gripper jaws for long gripping strokes and high gripping forces.

Features
• Adjustable opening stroke
• Internal and external gripping
• Both synchronised gripper fingers move in parallel and in opposite directions.

Technical data
• 4 sizes with a total stroke of up to 300 mm
• Opening/closing times from 120 ms
• 10 million switching cycles

Adaptive gripper DHDG
Innovative: complete bionic gripping solution with minimum dead weight for maximum dynamic response. The gripper enables secure and non-destructive gripping of workpieces, even if they are fragile or irregularly shaped.

Innovation meets standard parts
Adaptive gripper finger and series-produced gripper combined. The standardised interface for gripper fingers makes it easy to attach them, via adapters, to common series-produced grippers.

Highlights
• SoftGrip: positive-locking and soft gripping
• Flexible: adaptation of gripper fingers to different shapes and contours
• Economical: the DHDG weighs 80% less than comparable series-produced grippers
Parallel gripper DHPS
Large oval piston for high gripping force with a low construction volume. Self-centring gripper jaws, high load bearing and precise T-slot guide.

Features
- Internal and external gripping
- Optional gripping force backup
- Optionally double or single-acting

Technical data
- 6 sizes with a total stroke of up to 50 mm
- Opening/closing times from 8 ms

Radial gripper HGRC and angle gripper HGWC
Reliable operation throughout the part’s entire service life thanks to a sturdy rack and pinion principle and gripper jaws fitted with low backlash.

Features
- Constant gripping force over the entire range of movement
- Internal and external gripping
- Integrated life lubrication

Technical data
- 3 sizes with total opening angles of 30°, 80° and 180°
- Opening/closing times from 35 ms

On-site vacuum generation
Vacuum generator OVEM in IP65: reliable, safe and energy-efficient vacuum generation up to −0.93 bar.
With vacuum sensor, LCD display or bar graph. The integrated non-return valve prevents pressure drops and loss of the workpiece.

Vacuum generators VN with integrated mechanical ejector pulse, electrical ON/OFF for vacuum up to 0.88 bar.
Simple installation, short commissioning process and virtually maintenance-free operation without any wearing parts.

Shorter cycle times = higher productivity
- Extremely fast evacuation near the suction gripper
- Low weight for great dynamic response
- Compact design
- Completely integrated: ejector pulse and electric control

Suction grippers ESG
5,000 combinations for each application with a wide range of suction gripper designs, materials and gripper sizes.

Range of applications
- Packaging industry
- Food industry
- Electronics industry
- Glass industry
- For rough or porous surfaces
- For oily, smooth surfaces

Suction cup insert OASI
Manufactured from porous sintered material for gentle and safe vacuum handling of brittle, fragile, unstable or flexible workpieces. Quick to install, easy to retrofit.
Standard handling systems from Festo's multi-axis modular system

**Pick & place**
Cantilever axis combined with slide or additional cantilever axis for Z movement. For applications where the gripper unit must be retracted from the area of activity.
- Can be combined with a slide or additional cantilever axis along the Z-axis
- High mechanical rigidity, sturdy design

**Linear gantries**
Gantry axis combined with slides or cantilever axes for Z movement. Rugged, for long gantry strokes combined with heavy loads.
- Can be combined with a slide or cantilever axis along the Z-axis
- High mechanical rigidity and sturdy design

**Cantilever axes**
Two parallel gantry axes plus pick & place with short Z-stroke, preferably a slide. Ideal for applications where three-dimensional gantries are too big or interfere with the area of activity.
- Short Z-stroke, preferably with mini slide
- Sturdy design

**Three-dimensional gantries**
Two gantry axes plus an additional gantry axis arranged at right angles, as well as any drive for Z-movement. For any movement in 3D space – extremely precise and very sturdy for high loads and long strokes.
- High mechanical rigidity
- Universal in use, even for very heavy workpieces and high effective loads
- Dynamic, precise, powerful – depending on axis selection.
All inclusive benefits of ready-to-install handling systems

Build it yourself, or have it built – it’s up to you. But bear in mind that complete systems can save you as much as 50%. With ready-to-install handling systems you can virtually dispense with complex processes associated with development and construction. Tell us what your requirements are and we will design, order, commission, test and deliver. We can also assemble and commission your system on request.

You concentrate on your core tasks; we take care of the rest. This not only saves time and money, but ensures maximum reliability with regard to function and optimal settings.

We offer engineering, documentation, CAD models, assembly, checking and test runs, commissioning and servicing.

From conception to commissioning, Festo will take care of it for you.

**Engineering**
Expert engineers support you right from the outset.
- Technical advice
- Expert knowledge based on the latest technological standards
- Management of the entire engineering process
- Designs from the mechatronic multi-axis modular system

**Assembly and inspection**
Fully assembled and checked
- Reduced costs thanks to single sourcing
- Reduced production depth as there is no in-house production
- Installation of third-party components
- The solution is fully checked for 100% reliability, functionality and quality
- Standards and directives expertise included

**Documentation**
Documentation for your handling system includes:
- Complete documentation
  - Parts list
  - Circuit diagrams in ePLAN®
  - Operating instructions for the components
    - Optional: assembly drawing
- CAD models can be integrated in overall documentation quickly

**Delivery and commissioning**
Quick to install and perfectly harmonised.
- Delivery directly to the place of use
- Minimum assembly and installation workload with Festo plug and work:
  - Simple assembly principles
  - Defined interfaces
  - Teach-in or parameterisation functions
- Commissioning