You need maximum productivity.
You want excellent process flexibility.
We make sure your intralogistics are fit for the future.

→ WE ARE THE ENGINEERS OF PRODUCTIVITY.

MCS – the technology at a glance:
Freely configurable for your requirements 4

MCS applications
Applications in assembly technology 6
Applications in filling and packaging technology 8
Applications in packaging technology 10

Basic carrier movements 12

Integration of the MCS into transfer systems
System overview 14
Section layout 16
elcom transfer system 17
Technical data 17
Section configuration and operating modes 18

Integration of the MCS into plastic chain conveyors
System overview 22
Section layout 24
FlexLink plastic chain conveyor 25
Technical data 25
Section configuration and operating modes 26
Maximum machine flexibility

How do you keep up with markets that are developing ever faster? How do you meet customer needs that are becoming ever more individualised? And how do you adapt to product lifecycles that are becoming ever shorter? To master these challenges, you need solutions that provide maximum flexibility and efficiency in production processes.

With the innovative Multi-Carrier-System MCS, a joint development by Festo and Siemens, you are on the right track. The modular transport system can be integrated as appropriate into existing intralogistics and thus complement and in some cases replace classic transport solutions.

The carriers can be freely transferred inwards and outwards. They offer smooth acceleration and extremely precise positioning. The high dynamic response minimises changeover times during the process, while virtually seamless format changeovers and shorter retooling times significantly increase productivity and therefore market success. The powerful motion control systems from Siemens integrate controller and motion control tasks for the entire system.

The system is quick and easy to configure. Adaptations can be made flexibly in the digital model, while reconfigurations and format changeovers are carried out at the push of a button.

Experience the Multi-Carrier-System at www.festo.com/mcs
The Multi-Carrier-System is an innovative and flexible transport system based on linear motors. It is thought ahead for standard applications, has a modular structure and can be freely configured and adapted to your specific requirements – with or without an end-to-end transport system. There are standardised carriers and matching guides for transfer systems from elcom and plastic chain conveyors from FlexLink. However, you can also design your own carriers and guides using the flexibly usable magnetic plate. All carrier types can be placed on or taken off at any time without the need for tools. An optimally matching displacement encoder for closed-loop operation is included.

Freely configurable for your requirements

Your individual solution with the MCS

- As well as the predefined and standardised MCS solutions, the system can be adapted flexibly to your own requirements and combined with your transfer solutions
- The MCS section can be easily combined with your conveyor and you have almost total freedom when it comes to designing your custom carrier
- Use our technical knowledge and application experience for your individual solution

Intralogistics systems

Transfer system based on the double belt conveyor from elcom

Plastic chain conveyor from FlexLink

Motor with a length of 306 mm, with one or three motor segments

Guide systems on the MCS section

Track roller guide for the transfer system from elcom

Carrier guide system for the plastic chain conveyor from FlexLink

V-guide of the carrier in the closed recirculation system

Guide system matched to your individual carriers
Motor with a length of 102 mm, with one or two motor segments

Contactless absolute displacement encoder for closed-loop operation, maximum dynamic response and precision, including DRIVE CLiQ connection

Motor cable for the drive system (SINAMICS)

Cooling unit
- For maximum performance of the MCS
- Perfectly matched to the linear motors
- Air cooling via fans (standard)
- Customer-specific cooling concepts compatible with the ambient conditions, for example simple convection or water cooling

Carriers
- Workpiece carrier for double belt conveyor
- Carrier for plastic chain conveyor
- Carrier for the closed recirculation system
- Freely customisable carrier with magnetic plate

Controllers and motion control in the MCS
- SINAMICS: modular drive system for single-axis and multi-axis applications
- SIMOTION and SIMATIC: scalable and modular motion control systems for highly dynamic applications

Engineering software
- Mechatronics Concept Designer (MCD) for the simulation
- MCS-Creator for configuration
- SIMOTION SCOUT for the entire application programming including MCS
Applications in assembly technology

Optimised system layout and minimal changeover times for maximum productivity

A production system with different assembly stations is particularly challenging for material transport. Different processing times require a combination of single and double cycles, continuous movement, high-precision positioning in screwing and testing stations or 3D movement to a gluing station – all on one line. This is easy to achieve with MCS while installation space and retooling times can be kept to a minimum. MCS offers you an optimal process sequence with maximum productivity, among other things by reducing downtime and changeover times.

You will find section examples and achievable changeover times starting on page 16.

ESD-safe transport of printed circuit boards

When transporting electrostatically sensitive devices, such as printed circuit boards, special protection against electrostatic charging is necessary. That is why all standard components of the MCS are made from conductive material. This applies to both the metals and the plastics. The system is therefore suitable for ESD-safe transport.

Synchronisation of stations with different cycle rates on one line

The application

In this system example, a specific amount of sealant is dispensed and applied first. This is followed by partial assembly. Dispensing takes twice as long as assembly. Two dispensing stations are therefore required upstream of the assembly stations so line cycle times are consistent and there are no waiting times.

The challenge

Ensuring a continuous flow of material, an optimal supply and full utilisation of the maximum cycle rate of each individual station.

The solution

With the Multi-Carrier-System, production can take place on one line without any mechanical segmentation or separation of the sections. The optimised mechanical design saves space in the system as there are no parallel sections with deflectors.

One wait position with minimal clearance is integrated into the end-to-end conveyor. Very short distances and the high dynamic response of the carriers ensure extremely short changeover times and downtimes. The movement of the carriers – individually and as a group – can be freely configured as appropriate for the station. Other advantages are the reduced programming effort and the easy commissioning.

The benefits to you

You shorten your cycle times and optimise the process sequence. At the same time you maximise productivity by reducing the workpiece changeover times and optimising processes tailored to your tasks.
Easy and cycle time-optimised multi-stop function

The application
In the screwing station, screws have to be inserted in the workpiece at different positions at short intervals.

The challenge
Approaching several closely spaced screwing positions with minimal mechanical effort and taking up as little space as possible – and doing so at a screwing station for changing workpieces with different screwing positions.

The solution
With the MCS several stop positions can be reached in a very small installation space and with a very short travel distance, without the need for mechanical indexing of the stop position. Even smallest distances between the screwing positions (<1 mm) can be realised without complicated screwdriver solutions using a third axis or additional screwing stations. The high dynamic response of the carriers and minimised downtimes ensure a faster cycle rate. Products are changed over at the push of a button via software, without any mechanical retooling.

One less process axis for 3D path movements

The application
A sealant is applied to a workpiece by moving the dispense head horizontally over the workpiece in a defined path.

The challenge
Compactly and cost-effectively integrating three axes into the system, combined with the tracking accuracy of the dispense head.

The solution
The precise forward and backward movement (reversing) of the carrier allows the Multi-Carrier-System to assume the function of an axis. Having one axis less makes the dispensing/handling system more compact and cost-effective. The required path movement of the dispense head is achieved by synchronising the movement of the handling axes and the carrier. The required tracking accuracy is guaranteed by the combined control of the MCS and the dispensing/handling system.
Applications in filling and packaging technology

Maximum flexibility for continuous production processes and maximum productivity

The filling and packaging processes require a combination of continuous movement and cyclic operation on one line. The Multi-Carrier-System moves both individual carriers as well as carrier groups of any size synchronously with the process, whereby acceleration and speed, positioning and direction of movement can be freely defined at any point along the section. Positioning at the processing stations, for example when packaging, is carried out extremely precisely. All this leads to an optimal production process with maximum productivity and output. At the same time, wear of the production modules and the noise level are minimised.

You will find examples of sections and achievable changeover times starting on page 24.

Combination of continuous operation and cyclic operation on one line

The application
The bottles are loaded while the carriers are continuously moving on the MCS and then flexibly grouped for the subsequent filling process. Capping takes place later in cyclic operating mode, since the bottles are stationary during this process step.

The challenge
The combination of continuous and cyclic operation in one system without separating the sections into different zones and without additional queuing sections and transfer functions.

The solution
The Multi-Carrier-System combines cyclic operation and continuous movement on one line. The movement and grouping of the carriers on the section are freely configurable, as appropriate to the station. This optimises the system design and process sequence.

The benefits to you
Increased output and flexibility: the free, flexible movement and grouping of the carriers allows cyclic and continuous operation on one line.
The application
During the filling process, the carriers holding the bottles move continuously and synchronously with the filling bridge. The bottles are filled with a specific amount in a continuous and time-optimised movement.

The challenge
Adapting the transport system’s movement to the different filling quantities and therefore changing the transport speeds. For example, the filling process takes longer for a seasonal product with 25% more content and therefore the movement of the bottles is slower. This has a direct effect on the upstream and downstream lines.

The solution
The MCS enables completely free and variable adaptation of the travel speed in line with the product requirement and filling quantity. This has no effect on upstream and downstream processes, since the time differences by speeding up and slowing down are balanced out between the carriers. The combined control of the transport system and the individual modules in the overall filling system ensures that the carrier runs completely synchronised.

Synchronous movement of the carriers with the process

Flexible mixing and packaging

The application
Different products are packaged at multiple stations on one line, either one type at a time or mixed in a box. The box sizes and the mixtures can be varied. For large production volumes, several packaging stations may need to be installed in a row. Their utilisation decreases towards the end of the line.

The challenge
Flexible grouping for different box sizes and changing the variety of different products in one box. Reducing the number of packaging stations in order to shorten the length of the line and cut back on the number of handling systems or robots.

The solution
With the Multi-Carrier-System, the packing positions of different products and the group sizes or combinations can be adapted as appropriate to the process via software. The carrier is always ready at the next free packing position and will not pass through. This results in the maximum utilisation of each packaging station, thus enabling a more compact machine layout with a shorter length of the line and fewer stations. Adapting to product changeovers is simply realised at the push of a button.
Special sizes, seasonal quantity changes or different regional packaging – there are lots of reasons to change the packaging format, sometimes even daily. With conventional transport systems, these format changeovers require time-consuming reconfiguration. Time and again, this leads to long unproductive periods and production downtimes. With the Multi-Carrier-System, you can change the format at the push of a button via software – without the need for mechanical adaptation. During this process, the carriers are simply repositioned for the changed packaging. A simultaneous changeover to a different quantity is possible in combination with a product in-feed via the MCS – even during operation.

You will find examples of sections and achievable changeover times starting on page 30.

The benefits to you
Continuously transport and handle different packaging sizes on one line without any need for mechanical reconfiguration: changeover formats and batch sizes greater than 1 simply at the push of a button. The software-based solution ensures minimal downtimes, maximum productivity and optimal machine utilisation.

Different filling quantities or packaging formats on one machine

The application
The same product is filled in different quantities and bag sizes. Or, the filling quantity remains the same and the packaging format changes, for example horizontal and vertical format bag. To fill them, the bags are opened, held open and then sealed.

The challenge
Transporting different primary packaging with varying filling times and correspondingly adapted speeds. Different movements for the primary packaging’s opening and closing process as well as for the positioning at the filling station.

The solution
The carriers of the MCS can be freely adapted to each other for the relative movements, depending on the filling quantity or the size and shape of the primary packaging. The changeover takes place during operation at the push of a button, without the need for mechanical reconfiguration. The MCS allows continuous movement and cyclic operation in a space-saving combination on one line. A servo-controlled toothed belt drive enables simple and cost-effective return transport of the carriers.
Continuous processing of different packaging quantities on one line

The application
Individual packaged products are put into secondary packaging in different quantities and different box sizes, for example 4, 6 or 8 units in one box. When changing the quantity, the box feeder has to be adapted to the new box size.

The challenge
Flexible production with frequent changeovers to different box formats. Significantly reducing the changeover work on a production line by being able to adapt quickly and easily to changing formats, and minimising downtimes.

The solution
With the MCS, format changes take place at the push of a button via software. The different box sizes and the corresponding product quantities and combinations are placed directly on the system using the freely positionable carriers. Since each box is secured by two carriers, the different sizes can be safely and reliably transported. The products to be packaged are also flexibly transported to the top loader or side loader via the Multi-Carrier-System and grouped into the appropriate quantity immediately before being packaged on the MCS. Not only do you benefit from quick and easy format changes with the MCS, you also need less installation space and installation effort.
Basic carrier movements

Flexible and dynamic movement – individually or as a group

The movement of the carriers in the MCS enables a wide range of functions in the production process. Depending on the task, they can move individually or freely as a group on the section and synchronously with the process. All kinds of movements can be combined on one section. Thanks to the carrier design, the system is easy to combine with existing conventional intralogistics solutions as a way of creating highly flexible and economical solutions for transport and positioning tasks.

The drive principle of the MCS:
linear motor technology

When energised, the electric windings of the motor (stator) generate a moving magnetic field that drives the carrier (rotor of the motor) with its magnetic plate. In this process, there is a direct relationship between current intensity, magnetic field and the feed force generated.

The movement of individual carriers

The movement of each individual carrier is completely customisable on the MCS. It can move forwards and backwards under its own feed force, speeding up, slowing down or following a specific movement profile. The carrier can be precisely positioned and moved synchronously with individual process steps or the overall process.

Several carriers on the MCS will always move without colliding. The carriers are moved and positioned completely independently of each other for maximum process flexibility. Products can be transported directly on the carrier, which absorbs any perpendicular forces such as those that occur during screwing operations in assembly processes, for example.

Highlights

- Individual movement and synchronous movement in groups
- Completely jerk-free movement
- Free backward movement (reversing)
- Minimal positioning steps (≤ 1 mm)
- Freely definable motion profiles
- Product transport on the carrier
The movement of carrier groups

In the MCS, individual carriers can be combined into groups of any size with the same movement profile, acceleration and speed. The carriers can travel directly behind each other (e.g. five carriers in one filling process) or with a specific gap and force (e.g. two carriers in a packaging application).

A group of carriers can also be freely moved in the same way as individual carriers, i.e. accelerating, decelerating, stopping, reversing, precise positioning.

The group can be dynamically changed on the MCS at any time in line with the process requirements: individual carriers can be coupled or uncoupled, small groups can be merged into one large group or large groups can be separated into smaller groups.

Groups can be broken up or reassembled at any time.

Synchronisation of the carriers with other drives in the system

The SIMOTION and SIMATIC motion control systems not only control the movement of the carriers, but also other servo drives within the system, for example for the belt drive, cartoner or handling systems. This enables a significant reduction in the number of interfaces.
Transfer systems based on double belt conveyors are the industry standard in assembly technology. The example shown here is the TLM 1500 transfer system from elcom Deutschland GmbH. The MCS can be integrated precisely where it adds the most value – for more flexible process sequences, reduced changeover times and thus significantly higher productivity. Individual sections are possible as well as a branched system with multiple integrated MCS partial sections. The workpiece carriers can be empty or equipped with a specific product holder. Inward and outward transfer between the transfer system and the MCS is always seamless and without any transfer points, both with the combined and the integrated section concept.

**System overview**

Transfer systems based on double belt conveyors are the industry standard in assembly technology. The example shown here is the TLM 1500 transfer system from elcom Deutschland GmbH. The MCS can be integrated precisely where it adds the most value – for more flexible process sequences, reduced changeover times and thus significantly higher productivity. Individual sections are possible as well as a branched system with multiple integrated MCS partial sections. The workpiece carriers can be empty or equipped with a specific product holder. Inward and outward transfer between the transfer system and the MCS is always seamless and without any transfer points, both with the combined and the integrated section concept.

**Highlights**

- Maximum productivity by reducing changeover times by up to 80%
- Cost-optimised concept by using all the elcom standards, supplemented by the MCS functionality
- Optimal system layout through reduced section length
- Elimination of parallel workstations and associated mechanical system
- Cycle time-optimised multi-stop function
- Highly flexible MCS section precisely where it is needed in the process

**Guide system**

Basic profile with roller track and lateral guide for precise and low-wear guidance of the workpiece carriers on the MCS including mounting interfaces for motors and displacement encoder – for direct installation in the machine or system.
Workpiece (wp) carrier for transporting the product on the transfer system and the MCS section

The product can be transported directly by the wp carrier with highly wear-resistant base plate. The design principle allows the wp carrier to be placed on or taken off the system at any point. Additional wp carriers can thus be easily added or removed from the system at any time without the need for tools or reconfiguring the system. The integrated position magnet for position sensing and the external absolute displacement encoder make closed-loop operation possible on the MCS section.

Transition of the wp carriers between the systems

- Seamless transition between the transfer system and the MCS section
- Transition of the wp carriers, synchronised by the motion control system, between the continuous movement of the transfer system and the flexible and dynamic movement on the MCS section and vice versa
- Optional mechanical stopper at the infeed on the MCS section for stopping or queuing the carriers

Note

A special feature of the wp carrier is the almost unrestricted, product-specific adaptation, including in length (default 155 mm) and width (default 170 mm).
Integrating the MCS into a transfer systems

Section layout

Horizontal individual section – integrated

The linear MCS section is easily integrated into an end-to-end transfer line with seamless transition of the wp carriers. Short MCS sections are ideally suited to increasing the flexibility and optimising the cycle time of individual process stations. The transport section between the stations is cost-effectively realised using the transfer system.

- Linear MCS section of any length
- The transfer system sections can be freely designed
- Easy integration of the MCS section without any intervention in the transfer system
- The wp carriers on the MCS section are moved independently of the feed unit, i.e. accelerating or decelerating, moving faster or slower, stopping, positioning, reversing, moving synchronously with the process.

Horizontal individual section – combined

The linear MCS section is combined with the transfer system and incorporated between two sections. Longer MCS sections are ideal for realising flexible and dynamic chains of process stations. The cost-effective transfer system can be easily connected and used for the in- and out-feed of the wp carriers.

- Linear MCS section of any length
- The transfer system sections can be freely designed
- The MCS section can be easily reconfigured, if necessary without any intervention in the transfer system

Horizontal, branched transfer system – including MCS sections

Linear MCS sections can be combined with several transfer lines into one system. This creates a cost-effective, interlinked and easy-to-use transfer system for transporting the wp carriers between the systems and production modules. The highly flexible and dynamic MCS sections ensure maximum process productivity.

- The linear MCS sections can be of any length
- The transfer system sections can be freely designed
- Standard components such as deflectors or stoppers can be used

Horizontal individual section – wp carrier return transport in the machine

The linear MCS section is combined or integrated into a transport system, with the wp carriers being returned underneath the process in the machine bed. Lift for changing between both transfer sections. This enables a compact system layout with unrestricted access from all sides – ideal for freestanding machines or production modules and standardised cell concepts.

- Linear MCS section of any length
- The transfer system sections including the two lifts can be freely designed
- Easy and cost-effective return transport of the wp carriers using standardised transfer system and lift
Transfer systems based on double belt conveyors transport workpiece carriers and join assembly, processing and testing stations. The TLM 1500 system from elcom enables products to be transported horizontally. In addition, an extensive range of special modules is available for positioning the workpiece or distributing it to other or secondary transfer lines using a shunt.

- Standard transfer lines for realising simple to sophisticated section layouts and functions
- Conveyor section units of the transfer system powered by motors for continuous belt speeds
- Modules: shunts, intersections, stoppers, indexing stations, lifts, rotary sections, etc.
- Available worldwide

**Technical data**

**Achievable positioning times on the MCS section**
Guide values determined at maximum dynamic response

<table>
<thead>
<tr>
<th>Time t [s]</th>
<th>Payload [kg]*</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.1</td>
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</tr>
</tbody>
</table>

**MCS section**
- Max. payload*: 4 kg
- Max. speed: 4 m/s
- Max. acceleration: 50 m/s²
- Max. feed force: 65 N
- Repetition accuracy in travel direction: ±0.05 mm
- Max. section length: unlimited
- Width: 280 mm
- Height: 220 mm

**elcom TLM 1500**
- Max. payload (product and product holder on the carrier): 4 kg
- Max. speed: 0.5 m/s (30 m/min)
- Repetition accuracy (indexing station): ±0.03 mm

* Payload: product and product holder on the wp carrier
Integrating the MCS into a transfer systems

Section configuration and operating modes

The MCS enables an optimal machine layout with extremely efficient processes and maximum productivity. It makes cyclic processes even more flexible because the carriers can be freely placed on the MCS section; single and double cycles as well as continuous movement and cyclic operation can be combined on one line. The highly dynamic positioning on the MCS section also minimises the cycle and changeover times.

You will find sample applications on pages 6 and 7.

We will be happy to advise you. Make use of our experience – just ask us.

![Diagram of carrier movement]

**Standard variant**

**Section configuration**
- Two motor segments (1 x 102 mm, 1 x 306 mm)
- Solution for maximum economic efficiency

**Sequence**
- Wp carrier C1 at process position P, wp carrier C2 held at position W
- After processing ends at position P, wp carrier C1 moves on from motor segment M2 to the next conveyor, wp carrier C2 remains stationary
- As soon as the motor segment M2 is free, wp carrier C2 moves to process position P

<table>
<thead>
<tr>
<th>Payload (plus wp carrier weight 1.3 kg) [kg]</th>
<th>Changeover time Standard variant [s]</th>
<th>Changeover time Dynamic variant [s]</th>
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</table>

**Achievable changeover times**

The benefits to you
You reduce the overall cycle time by minimising wp carrier positioning times between the stations.
MCS for fast pallet changes in single-cycle mode

In this simple MCS section for a cyclic process, the wp carrier movement is not coupled to the traditional, continuous transport of a transfer system or rotary indexing table. The wp carriers move quickly, freely and flexibly between the stations. A highly dynamic variant enables even shorter changeover times.

By moving and positioning the two wp carriers highly dynamically and at the same time changeover times can be minimised.

• Flexible positioning at the wait position and the processing station for each carrier
• Mechanically decoupling the individual stations on the MCS section

Dynamic variant

Section configuration
• Four motor segments (each 102 mm)
• Solution for maximum performance with very short changeover times

Sequence
• Wp carrier C1 at process position P_s, wp carrier C2 held at wait position W
• After processing at position P_s both wp carriers move on at the same time

Note
In closed-loop operation, only one wp carrier can be controlled per motor segment.

Short motor segments are therefore used in the dynamic variant so that the wp carriers can be positioned and moved very closely to each other. This enables extremely short changeover times.

C = Workpiece carrier
M = Motor segment
W = Wait position
P_s = Process position for single cycle
P_d = Process position for double cycle
B = Buffer position
Integrating the MCS into a transfer systems

Section configuration and operating modes

MCS for fast wp carrier changes in double-cycle mode

In this simple MCS section for double-cycle operation, the wp carrier movement is not coupled to the traditional, always uniformly cyclic transport; the wp carriers move quickly, freely and flexibly between the stations. A highly dynamic variant enables even shorter changeover times.

• Minimising the changeover times through highly dynamic movement and positioning of two wp carriers at the same time
• Flexible positioning at the wait position and the processing station for each wp carrier

Process direction

Standard variant

Section configuration
• Five motor segments (2 x 306 mm, 3 x 102 mm)
• Solution for maximum economic efficiency

Sequence
• Positions P\(_D\)\(_1\) and P\(_D\)\(_2\) are parallel process positions – wp carrier C\(_1\) at process position P\(_D\)\(_1\), wp carrier C\(_2\) at station P\(_C\)\(_2\). Wp carriers C\(_3\) and C\(_4\) are kept at wait positions W\(_1\) and W\(_2\).
• After processing ends at positions P\(_D\)\(_1\) and P\(_D\)\(_2\), wp carriers C\(_1\) and C\(_2\) move on to the next conveyor.
• As soon as the previous motor segments are free, wp carrier C\(_3\) moves to process position P\(_D\)\(_1\) and wp carrier C\(_4\) moves to process position P\(_D\)\(_2\).

<table>
<thead>
<tr>
<th>Payload (plus wp carrier weight 1.3 kg) [kg]</th>
<th>Changeover time Standard variant [s]</th>
<th>Changeover time Dynamic variant [s]</th>
</tr>
</thead>
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<tr>
<td>4</td>
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</tr>
</tbody>
</table>
Dynamic variant

Section configuration
- Six motor segments (each 102 mm)
- Solution for maximum performance with shortest changeover times and minimal installation space

Sequence
- Positions $P_{D1}$ and $P_{D2}$ are parallel process positions – wp carrier $C_1$ is kept at process position $P_{D1}$, wp carrier $C_2$ is kept at process position $P_{D2}$, wp carriers $C_3$ and $C_4$ are kept at wait positions $W_1$ and $W_2$.
- After processing ends at positions $P_{D1}$ and $P_{D2}$, wp carriers $C_1$ and $C_2$ move on to the next conveyor. At the same time, wp carrier $C_3$ moves to process position $P_{D1}$ and wp carrier $C_4$ moves to process position $P_{D2}$.

C = Workpiece carrier
M = Motor segment
W = Wait position
$P_s$ = Process position for single cycle
$P_d$ = Process position for double cycle
B = Buffer position
Integrating the MCS into plastic chain conveyors

System overview

Chain conveyors are traditionally the most common transport system in packaging and filling technology. The example shown here is the X85 plastic chain conveyor from FlexLink Systems GmbH. The MCS can be integrated precisely where it adds the most value – for more flexible process sequences, shorter changeover times (e.g. for seasonal changes) and therefore higher productivity and series production for batch sizes greater than 1. An individual section is possible as well as a branched system based on the plastic chain conveyor with multiple integrated MCS partial sections. The carriers can be empty or equipped with a specific product holder. Inward and outward transfer between the chain conveyor and the MCS is always seamless and doesn’t require any transfer actions.

Guide system

Basic profile with roller conveyor and lateral guide for precise and low-wear guidance of the carriers, including mounting interfaces for motors and displacement encoder – for direct installation in the machine or system.

X85 plastic chain conveyor from FlexLink Systems GmbH

Highlights

- Highly flexible MCS section precisely where needed by the process
- Use of the cost-effective, conventional plastic chain conveyor system
- Freely selectable section layout and number of carriers
- Seamless inward and outward transfer of the carriers without any transfer actions
- Product transport directly on the carrier with jerk-free movement
- Easy-to-clean and highly resistant materials with protection to IP65 – higher degree of protection possible on request
Sturdy standard carrier for direct transport of the product

The low-wear carrier with plastic-sheathed ball bearings enables the direct transport of the product. The magnetic plate in the carrier generates the feed forces together with the linear motors. The design principle allows the carrier to be placed on or taken off the system at any point. Carriers can be added or removed from the system at any time – without the need for tools or reconfiguration of the system. The integrated position magnet for position sensing and the external absolute displacement encoder make closed-loop operation possible.

Seamless inward and outward transfer of the carriers

- Easy to connect both systems without mechanical coupling at the interface
- Continuous in- and out-feed of the carriers on the plastic chain conveyor
- Mechanical stopper at the inlet on the MCS section for stopping or queuing the carriers
- The carriers are moved synchronously by the motion control system between the continuous transport of the plastic chain conveyor and the flexible and dynamic movement on the MCS section and vice versa

Certified for cleanroom applications

This technical variant of the MCS section has air quality class 6 or 4 with reduced dynamic response and is certified to ISO 14644-1 for cleanroom applications by the Fraunhofer Institute.
Integrating the MCS into plastic chain conveyors

Section layout

Horizontal individual section

The linear MCS section can be installed between two plastic chain conveyor sections. The existing transport system can thus be easily connected and used for in- and out-feed of the carriers. This makes interlinking with other system and production modules very cost-effective.

- Linear MCS section of any length
- The plastic chain conveyor sections can be freely designed
- The MCS section can be easily reconfigured without any intervention in the plastic chain conveyor

Horizontal individual section with carriers in closed vertical recirculation

A linear MCS section can be combined with a plastic chain conveyor to form a complete process of a production module. The carriers are returned cost-effectively underneath the MCS. They are moved from one side of the system to the other using the machine’s internal transport system.

- The linear MCS section can be of any length, while the plastic chain conveyor sections for return transport of the carriers is easy to design
- Secure fixation of the carrier on the chain conveyor using integrated magnetic plate

Horizontal, branched transfer system with MCS sections

Linear MCS sections can be combined with several plastic chain conveyors into one system. This means the existing transport system for transporting the carriers between the system and the production modules can be interlinked and used easily and cost-effectively. The highly flexible and dynamic MCS sections ensure maximum process productivity.

- Linear MCS sections of any length – as appropriate for the application
- The plastic chain conveyor sections and the use of standard components such as deflectors or stoppers can be freely designed
Plastic chain conveyors can be used to build automatic material flow systems for the processing, assembly and testing process of single items. FlexLink standard conveyors consist of a space-optimised plastic chain that runs on low-wear slide rails in an aluminium guide profile. This enables horizontal and space-optimised transport of the products and carriers.

- Standard conveyor modules for designing simple to complex section layouts, smooth distribution, storage and positioning of pallets
- Modules for deflectors (X-curve), curves, bridges, redirection and inward transfer of carriers
- Conveyor chain for jerk-free operation, minimal wear and low noise level
- Available worldwide

X85 plastic chain conveyor from FlexLink Systems GmbH

Technical data

Achievable positioning times on the MCS section
Guide values determined at maximum dynamic response

<table>
<thead>
<tr>
<th>Time t [s]</th>
<th>Payload [kg]</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.8</td>
<td>0.5</td>
</tr>
<tr>
<td>0.7</td>
<td>1</td>
</tr>
<tr>
<td>0.6</td>
<td>3</td>
</tr>
<tr>
<td>0.5</td>
<td>5</td>
</tr>
</tbody>
</table>

Distance g [mm]

MCS section

- Max. payload*: 5 kg
- Max. speed: 4 m/s
- Max. acceleration: 50 m/s²
- Max. feed force: 80 N
- Repetition accuracy in travel direction: ±0.1 mm
- Max. section length: unlimited
- Width: 130 mm
- Height: 200 mm

* Payload: product and product holder on the carrier
Integrating the MCS into plastic chain conveyors

**Section configuration and operating modes**

The MCS ensures optimal production processes and maximum productivity. It enables continuous movement and cyclic operation to be combined on one line. The highly dynamic positioning on the MCS section also minimises the cycle times.

You will find sample applications on pages 8 and 9.

**We will be happy to advise you. Make use of our experience – just ask us.**

**Multi-Carrier-System in single-cycle mode**

In this simple MCS section for a cyclic process, the carrier movement is not coupled to the traditional, continuous transport system. The carriers move freely, flexibly and highly dynamically between the stations.

- Reduction of the overall cycle time through highly dynamic carrier movement between the stations
- Flexible positioning at the wait position and processing station
- Mechanical decoupling of the individual stations

**Sequence**

- Between the process positions PS1 ... 4 are additional free motor segments, called buffers B1 ... 4, so that the process positions are decoupled from each other
- This means, for example, that carrier C2 can move off directly after processing at process position PS2 even though carrier C1 is still at position PS1
- Carrier C2 is then buffered at motor segment M8 or at position B1

<table>
<thead>
<tr>
<th>Payload (plus carrier weight 0.8 kg) [kg]</th>
<th>Changeover time 204 mm Inter-station distance [s]</th>
<th>Changeover time 612 mm Inter-station distance [s]</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.5</td>
<td>0.13</td>
<td>0.24</td>
</tr>
<tr>
<td>1</td>
<td>0.15</td>
<td>0.26</td>
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<tr>
<td>2</td>
<td>0.19</td>
<td>0.32</td>
</tr>
<tr>
<td>3</td>
<td>0.22</td>
<td>0.37</td>
</tr>
<tr>
<td>4</td>
<td>0.24</td>
<td>0.41</td>
</tr>
</tbody>
</table>
An MCS section can contain both closed-loop and open-loop zones so that it can be optimally adapted to the process requirements. The zones can be reconfigured subsequently at any time. An open-loop zone can be transformed into a closed-loop zone by adding a displacement encoder – and vice versa.

The benefits to you
By simply combining open- and closed-loop zones you can optimise operation for the application and achieve a perfect system layout.

Multi-Carrier-System in closed- and open-loop operation

Closed-loop operation
- Used in cyclic operating mode within the process
- Moving and positioning the carrier with maximum dynamic response and precision
- The carrier position is sensed by the displacement encoder mounted laterally on the motor
- One carrier per motor segment can be moved in closed-loop control mode

Section configuration
Motor segments 102 mm in closed-loop operation for short inter-carrier distances

Sequence
- In closed-loop operation, only one carrier can be controlled per motor segment
- Simultaneous movement of the carriers results in a minimum inter-carrier distance of 153 mm on the motor segments of 102 mm
- It is possible to reduce the distance, while at the same time reducing the carrier’s actuating force

Open-loop operation
- Used in continuous operating mode and with synchronous movement of a carrier group
- Carriers move with restricted dynamic response and precision, for example for buffer sections and filling processes or to bridge large distances between stations
- MCS section is operated without lateral displacement encoder
- Several carriers can be operated with the same movement on one motor segment

Section configuration
Motor segments 306 mm in open-loop operation for high economic efficiency

Sequence
- In open-loop operation, several carriers can be moved on one motor segment
- All carriers execute the same movement in this case
- The inter-carrier distance in this case is a multiple of the motor’s so-called pole pitch (25.5 mm)
The MCS with closed recirculation of carriers

System overview

The MCS with carriers in a closed loop is ideal as a standalone transport solution for a highly dynamic machine station or in the subprocess of a linked system. It can be combined at any time with conventional intralogistics systems or set up in parallel to them. The closed MCS section enables a compact system layout and very cost-effective return transport of the carriers, including the controlled curve movement. The carriers are guided on a precision V-guide throughout the entire loop. Empty carriers that only have a pusher function as well as carriers with a specific product holder for direct product transport can be moved.

Highlights

- Highly flexible MCS section with cost-effective toothed belt return transport
- Maximum dynamic response through MCS motors in combination with outstanding precision through V-guides for carriers
- Compact design with freely definable, individual mounting position
- Product can also be accessed from below
- Jerk-free movement of the carrier throughout the entire loop

Guide system

The low-wear V-guide of the carriers with precision-ground guide surfaces guarantees a system with low friction and high precision. The carriers are guided throughout the entire loop, including during return transport via toothed belt. The guide absorbs the lateral forces and torques as well as the dynamic forces of the carriers. The guide is mounted on a base support to which the holders for the motors and the displacement encoder are fastened.
Carrier for direct transport of the product

The extremely low-wear carrier with ball bearing track rollers enables the product to be transported directly. The magnetic plate on the side of the carrier generates the feed force together with the linear motors. The integrated position magnet for position sensing and the external absolute displacement encoder make closed-loop operation possible on the MCS section. The precisely interlocking teeth create a positive engagement with the toothed belt during return transport. An RFID tag for extended carrier identification is available as an option.

1. Permanently mounted and wear-free magnetic plate
2. Integrated position magnet for sensing the position of the carrier
3. Mechanical interface for application-specific and product-specific holders and adapters
4. Carrier material: aluminium
5. Wear-free and precisely interlocking teeth for a positive engagement with the toothed belt
6. Interlocking teeth material: PTFE
7. Preloaded ball bearing rollers for backlash-free movement of the carriers on the V-guide
8. Wear-free and low-vibration movement
9. Continuously high travel speeds even with large payloads

Integrated lock in the V-guide for inserting and removing carriers without the need for tools.
MCS individual section in any mounting position

The closed MCS section with toothed belt return transport can be mounted in any position and is very compact in all three dimensions. Cost-effective and positive-locking return transport of the carriers takes place via the toothed belt.

- With vertical recirculation, the product can be transported directly on the carrier
- With horizontal recirculation, the product can be attached laterally
- The freely selectable mounting position means that the product can be accessed from below
- Carriers are transferred seamlessly on a servo-controlled toothed belt
- Return transport takes place through positive locking on the toothed belt
- Carriers maintain full force and precision as they move through the curves and during return transport
Multi-Carrier-System with intelligent carrier return transport

Option for carrier return transport instead of the controlled toothed belt:
• Flexible MCS on both sides between two independent, servo-controlled toothed belts for moving through the curves
• High dynamic response with best precision and full force
• Extremely compact system design with maximum flexibility during operation by arranging the process stations on both sides
• Free mounting position
• Optional also controlled curve section (on request from mid-2018)

Technical data

Achievable positioning times on the MCS section
Guide values determined at maximum dynamic response

MCS section
• Max. payload*: 2.5 kg
• Max. speed: 2 m/s
• Max. acceleration: 30 m/s²
• Max. feed force: 60 N
• Repetition accuracy in travel direction: ±0.05 mm
• Max. section length: 10 m
• Width: 350 or 420 mm (depending on mounting position)
• Height: 420 or 350 mm (depending on mounting position)

* Payload: product and product holder on the carrier
The MCS with closed recirculation of carriers

Section configuration and operating modes

The MCS ensures maximum productivity through simplified and optimised production processes. It enables continuous movement and cyclic operation to be combined on one line. Highly dynamic positioning on the MCS section also minimises the cycle times. The section layout can optionally be realised with cost-effective return transport of the carriers via a toothed belt or as a two-sided linear MCS section for even greater flexibility and dynamic response. The curve movement is carried out via a servo-controlled toothed belt – optionally also with controlled MCS section (on request from mid-2018).

You will find sample applications on pages 10 and 11.

We will be happy to advise you. Make use of our experience – just ask us.

Highly dynamic single-cycle mode

In this simple MCS section for a cyclic process, the carrier movement is not coupled to the traditional, continuous transport. The carriers move freely, flexibly and highly dynamically between the stations.

- Reduction of the overall cycle time thanks to highly dynamic carrier movement between the stations
- Flexible positioning of the carriers and free movement along the process – forwards and backwards
- Decoupling the individual stations for maximum flexibility

Sequence

- Between the process positions \( P_1 \) ... 4 are additional free motor segments, called buffers \( B_1 \) ... 4, so that the process positions are decoupled from each other
- This means, for example, that carrier \( C_2 \) can move off directly after processing at process position \( P_2 \) even though carrier \( C_1 \) is still at position \( P_1 \)
- Carrier \( C_2 \) is then buffered at motor segment \( M_8 \) or at position \( B_1 \)

<table>
<thead>
<tr>
<th>Payload (plus carrier weight 1.8 kg) [kg]</th>
<th>Changeover time</th>
<th>Changeover time</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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</tr>
<tr>
<td>2</td>
<td>0.25</td>
<td>0.43</td>
</tr>
<tr>
<td>2.5</td>
<td>0.27</td>
<td>0.44</td>
</tr>
</tbody>
</table>
Combining cyclic and continuous operation

The MCS section can be optimally adapted to the requirements of the process. Zones with cyclic and continuous movement can be individually combined. The MCS can be reconfigured at any time – within mechanical limits – at the push of a button. In this case we show the example of a two-sided MCS section (intelligent carrier return transport).

- System-related minimum inter-carrier distance during continuous operation on the linear MCS section
- Free positioning and movement of the carriers during cyclic operation on the linear MCS section
- Continuous and controlled curve movement via toothed belt – optionally on request from mid-2018 with controlled MCS section for free positioning and movement, including in the curve

**Sequence for cyclic operation**
- In the cyclic operation, the carriers stop at the stations on the straight and curved sections
- So processing takes place at the process stations or the carrier is kept at the wait position for the next process step

**Sequence for continuous operation**
- In continuous operation, the carriers move continuously on the straight and the curved sections
- The movement is synchronised, for example with an external process axis

**Section configuration**
- Motor segments 102 mm in closed-loop operation for short inter-carrier distances
- MCS sections for the forward and return travel

**The benefits to you**
By combining continuous and cyclic operation on an MCS section, the system layout is flexible and can be reconfigured at the push of a button.

![Diagram of MCS section showing cyclic and continuous operation with labels for Carrier (C), Motor segment (M), Wait position (W), Process position for single cycle (P₁), Process position for double cycle (P₂), and Buffer position (B).]
Mechatronic elements of the MCS

Tried and tested: linear motors and displacement encoder

Motors

At the heart of the MCS are the powerful, three-phase linear motors with their standardised mounting interfaces. They can be mounted in any position and offer protection to IP65 as standard. Fully encapsulated motor plates for higher degrees of protection on request. The stainless steel surface of the motors is easy to clean.

Different motor variants in a range of lengths are available for optimised machine layout and customised motor distribution. They are mounted directly on the guide strips or mounting profiles in the machine frame, so that the motors are very easy to replace, when required. There is no need to dismantle the entire section.

Mounting the motors without any transitions means the carriers move completely jerk-free.

The motor plates come in two lengths with different numbers of motor segments

Length 102 mm

- Variant 1 consists of two motor segments, each 51 mm long, together in one motor plate – for the smallest travel distance resolution and the highest component density in the MCS
- Variant 2 consists of a motor segment with a length of 102 mm – for short transport paths, medium inter-station distances and high flexibility
- Dimensions: 102 x 90 x 76 mm (L x W x H)

Length 306 mm

- Variant 1 consists of three motor segments, each 102 mm long, together in one motor plate – for greater flexibility with a simple section design
- Variant 2 consists of a motor segment with a length of 306 mm – for long transport paths and cost-efficient design
- Dimensions: 306 x 90 x 76 mm (L x W x H)

Note

Only one carrier can be operated per motor segment in closed-loop mode.

Motor cables

- Suitable motor cables come in lengths of 5 m, 10 m and 15 m
- Motor cable with reduced diameter for higher component density and smaller bending radii
- Connection technology on the motor side with protection to IP65

Certified to UL and CSA
Absolute displacement encoder

The contactless and dirt-resistant absolute displacement encoder with Hall sensor technology enables closed-loop operation for maximum dynamic response and precision of the carriers.

Technical data
- Displacement encoder resolution: 1 µm
- Degree of protection: IP65
- DRIVE CliQ interface

Note
Multi-Carrier-System without displacement encoder possible in open-loop operation.

There are two lengths suitable for the motors of the MCS
- 102 mm with one sensor cable
  - 1x for motor with a length of 102 mm with one motor segment
  - 3x for motor with a length of 306 mm with three motor segments
- 102 mm with two sensor cables
  - 1x for motor with a length of 102 mm with two motor segments
- 306 mm with one sensor cable
  - 1x for motor with a length of 306 mm with one motor segment

Dimensions:
102/306 x 11 x 51 mm (L x W x H)

Sensor cables
- Sensor cables in three lengths: 5 m, 10 m and 15 m
- Pin allocation to DRIVE CliQ standard

Magnetic plate and position magnet

Magnetic plate
- Consists of four high-energy NdFeBr magnets on a steel plate
- For integration in individual carriers
- Several magnetic plates can be combined in one carrier to multiply the feed force
- Dimensions:
  70 x 51 x 10.5 mm (L x W x H)

Position magnet
- Integrated in the carrier for position sensing by the displacement encoder
- Dimensions:
  15 x 13 x 8 mm (L x W x H)
Easy engineering and efficient implementation

Shorten your time-to-market

The key competitive advantage, especially when it comes to flexibility for batch sizes greater than 1, is the ability to respond quickly to changing requirements. Ensuring customisation and flexibility right from the start is the key to a shorter time-to-market, be that for system and process design, commissioning or for changes to any product or format.

Your application – our solution

We offer you competent consulting on site by experienced technical consultants. This includes the design process for the entire transport system, from the mechanical system to the controller. We choose the optimal solution for your application from our extensive modular system.

- Designing the entire transport system
- Selecting the standard modules or customised solutions
- Linking with other machine modules, robots or handling systems
- Carrying out application tests with our test systems (see pages 42 and 43) – at Festo or on site

Simulation for efficient design

The Mechatronics Concept Designer is a joint engineering design platform for mechanical and electrical systems and automation technology. It facilitates machine development using physics-based simulation functions – and simulates the entire machine sequence, even for high-end applications.

- Designing the MCS for different applications
- Simulation of complex or highly dynamic carrier movements
- Virtual commissioning using the system’s digital twin
With the **MCS-Creator**, graphically configuring the MCS motor section is quick and convenient thanks to the intuitive user interface and drag-and-drop function. This allows you to flexibly construct sections and select the appropriate controller for your application.

- Creating the bill of materials for the controller components
- Generating a controller and drive project that can be executed instantly
- Using predefined software modules and function templates

**Configuring the Multi-Carrier-System**

**Easy programming**

The MCS-specific software library **RailControl** features an interpreter concept for efficient application programming, for example by breaking down the MCS section into individual machine functions.

- Sequential programming of individual machine zones
- Clear, modular operating cycle, even with complex applications
- All electric axis motion functions can be used
Easy engineering and efficient implementation

Tools to make you faster

Mechatronics Concept Designer

With the Mechatronics Concept Designer the Multi-Carrier-System can be simulated and virtually commissioned for efficient design and shorter time-to-market, even with product changeovers or process changes.

This makes actual commissioning faster, more efficient and more reliable.

Simulating an individual MCS section

- Modular MCS motor section design optimally tailored to the process (motor variants)
- Validating the transport system, testing and verification of the functionality
- Simulating the carrier movements synchronised with the process
- Simulating complex or highly dynamic carrier movements
Simulating complex machines and systems

- Simulating and validating the Multi-Carrier-System with high process requirements and very complex carrier movement and of the entire machine
- Determining time-critical functions and adapting the process sequence as well as the carrier movements

Virtual commissioning

- Creating a digital twin of the system for virtual commissioning
- Modifying the program directly in the Mechatronics Concept Designer and instantly display it in the simulation to verify the functionality
- Programming and simulating changed requirements, for example new product variants or format changes, on the digital twin; all that then remains is to transfer the program to the system: plug and work
Easy engineering and efficient implementation

Tools to make you faster

MCS-Creator

The MCS-Creator offers a quick and convenient way to graphically configure and design the MCS section ready for the project to be executed. You design the section as appropriate to your application and select the right components – motors, drive systems and controller for motion control.

- Selecting the motor variants in line with the process requirements
- Creating the MCS section by dragging and dropping
- Selecting the controlled section parts (closed loop)
- Overview of system length with station markers such as wait and process position
- Selecting the right controller using a comprehensive selection aid
- Parameterising the carriers with length and weight, for example, as well as with the movement parameters
- Generating the instantly executable project directly in the software

RailControl

Programming the Multi-Carrier-System is made much easier with the integrated sector manager because it allows you to break down the MCS section into individual machine functions – supported by the interpreter concept and the MCS-specific software library.

- Modular design of the operating cycle with reduced system complexity and an overall process that is easy to control
- Carriers are represented as virtual axes
- Actuating the individual carriers using 12 standard commands for motion applications
- All the motion functions of electric axes can be used, for example positioning, gear synchronisation, curve synchronisation or path interpolation
- Safety thanks to the integrated collision monitoring of the carriers
- Integrated web server with graphical diagnostics option
Maintaining competitiveness

With a modular and versatile system

Hardware for optimal performance
The practical modular system offers many possibilities for electrical or mechanical components thanks to the scalable motion control systems as well as the various motors, carriers and guide systems.

Precisely scalable software
The scalable software tools are always precisely tailored to the application and offer a perfect solution for simple standard applications as well as advanced and high-end applications.

Whether you need ready-to-use software solutions or open software generation with highly accurate simulations, discover the myriad of possibilities for your production processes.

Source: Siemens AG
We offer you test systems to get you up and running quickly and easily. Three standard variants are available to allow you to learn all about the MCS:

- Variant with transfer system from elcom
- Variant with plastic chain conveyor from FlexLink
- Variant with closed recirculation of carriers

All test systems offer you the full range of functions, are fully assembled and ready to use straight away. In addition to the system solution with MCS section, carriers, SINAMICS S120 drive system and SIMOTION motion control system, we offer you personal training and support.

Try it out for yourself
Just try it out for yourself and see how you can optimise your system with the Multi-Carrier-System. With our systems, you can check all important parameters such as dynamic response, cycle time, movement synchronicity, process sequence or positioning accuracy under real conditions – and using your products.

**Highlights**

- Fully functioning test system
- Three variants for different transport solutions
- Fully assembled and ready to use straight away – plug and work

The Multi-Carrier-System in combination with an elcom transfer system, one of the most popular transfer systems in assembly technology.

- One MCS section combined with two transfer lines:
  - Section length: 1,224 mm
  - Configuration: 4x motor 306 mm with one motor segment
- Two MCS sections with two motors each integrated in an end-to-end transfer line:
  - Section length: 408 mm each
  - Configuration: each 1x motor 102 mm and 1x motor 306 mm with one motor segment
- Displacement encoder for closed-loop operation
- 10 carriers
- Control cabinet integrated in the frame
- Electrical energy supply: 400 V/32 A
- Dimensions: 2.6 x 1 x 1.15 m (L x W x H)
The Multi-Carrier-System in combination with a plastic chain conveyor from FlexLink, which is widely used in the packaging industry.

- MCS section length: 1,530 mm
- Configuration: 5x motor 306 mm with three motor segments
- Displacement encoder for closed-loop operation
- 10 carriers
- Control cabinet integrated in the frame
- Energy supply
  - Electrical: 400 V/32 A
  - Pneumatic: 6 bar
- Dimensions: 3.15 x 0.75 x 1.15 m (L x W x H)

Multi-Carrier-System MCS with carriers in a closed loop and return transport via servo-controlled toothed belt. Swivelling for horizontal or vertical operation, any intermediate position possible.

- Section length: 1,530 mm
- Configuration: 5x motor 306 mm with motor segments
- Displacement encoder for closed-loop operation
- 10 carriers
- Control cabinet attached to the frame
- Electrical energy supply: 400 V/32 A
- Dimensions: 2 x 1 x 1.5 m (L x W x H)
Maximum productivity is a question of ambition
Do you share this attitude? We will be glad to help you achieve this goal – through our four outstanding qualities:

- Security
- Efficiency
- Simplicity
- Competency

We are the engineers of productivity.

Discover new dimensions for your company:

> www.festo.com/whyfesto