

Plug & Produce in factory automation:

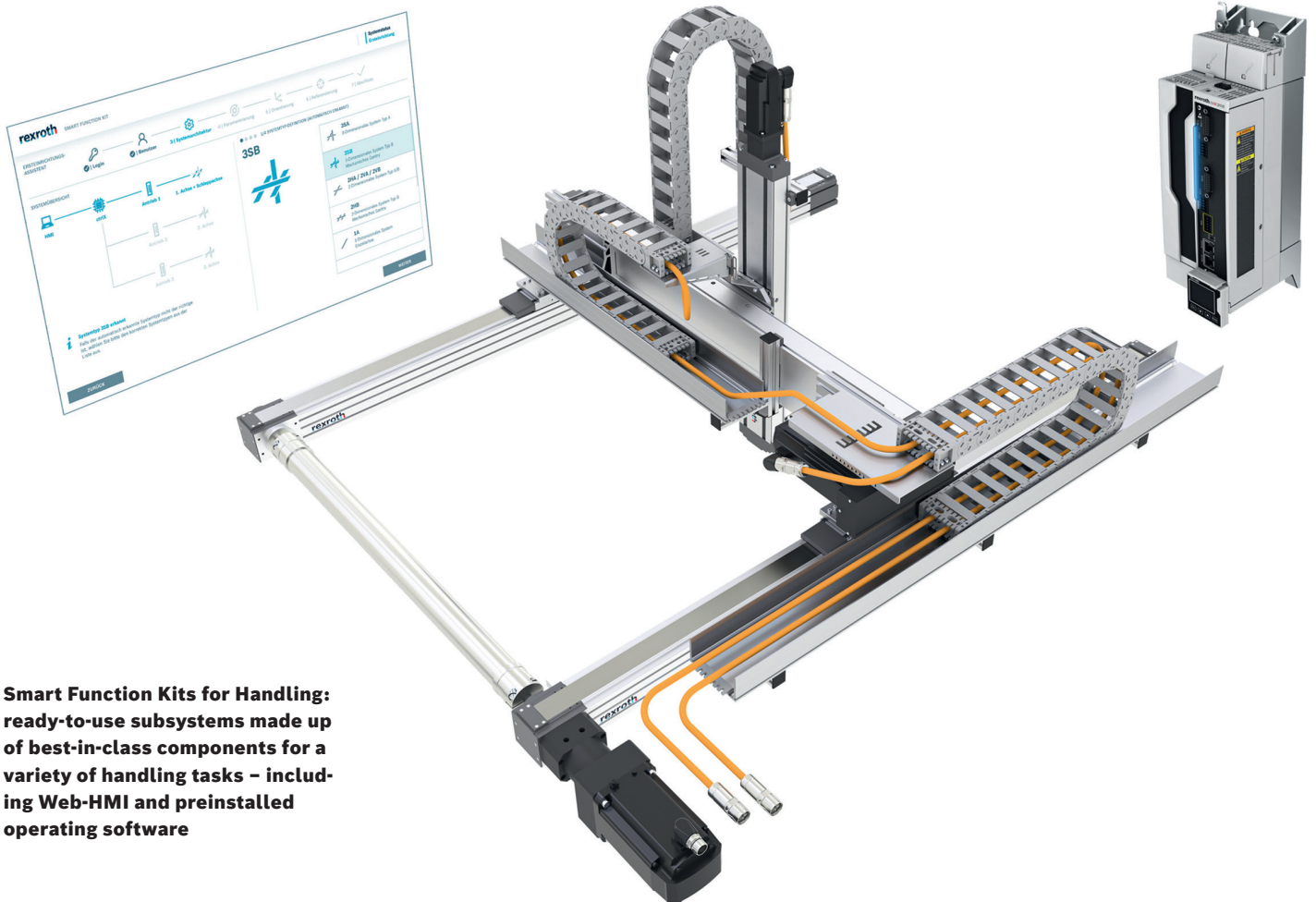
Handling tasks



Handling tasks can be performed more cost-effectively if they are accurately dimensioned and save time during engineering and commissioning. In this white paper, you can find out how mechatronic Smart Function Kits ensure the correct dimensioning and streamline the entire process chain as far as monitoring.

No one likes to give up established routines. This applies to design engineers and to programmers. And yet there are two good reasons to question how typical handling tasks should be performed. One of them relates to cost-effectiveness, the other to the time to market. With the Smart Function Kit for Handling, Bosch Rexroth pays particular attention to both aspects.





Smart Function Kits for Handling: ready-to-use subsystems made up of best-in-class components for a variety of handling tasks – including Web-HMI and preinstalled operating software

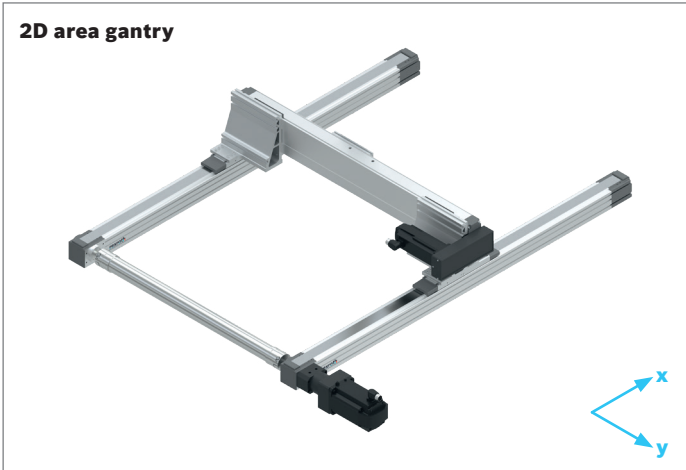
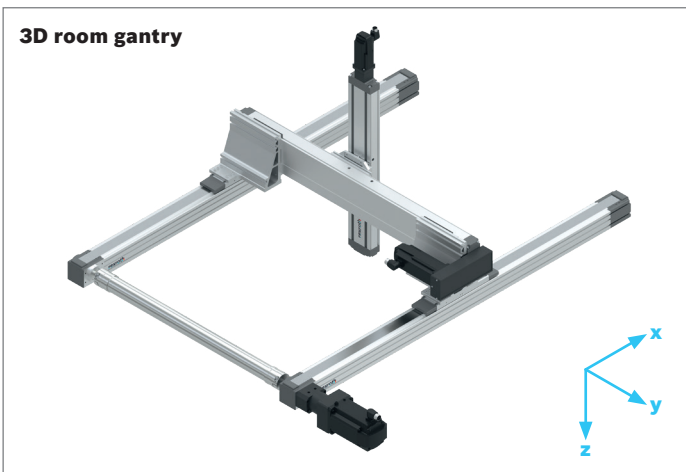
With the intelligent mechatronic kit, suitable subsystems can be designed, selected, configured and then ordered ready for installation much more quickly than before. The straightforward system selection and customization process prevent inaccurate dimensioning and overdimensioned axes. This saves money and resources. Compared to conventional Cartesian systems, the engineering outlay is significantly reduced because the entire subsystem no longer needs to be designed separately from a mechatronic point of view. Instead, a suitable reference system is selected and individually customized in just a few steps.

The design software automatically selects the required components from the kit: motors, connecting elements, power supply. This prevents dimensioning and construction errors. The previous problems during commissioning are also avoided as a wizard guides users through the process. Once the controllers have been automatically parameterized, the subsystem can be connected to a higher-level control system with the help of functional blocks.

Given their mechatronic strengths such as their space-saving design, precision and dynamics, Cartesian multi-axis systems could also be an interesting alternative to 6-axis folding-arm robots.

Selecting the axis system according to the application

In order to become established, a mechatronic solution must impress in a number of respects. It should be user-friendly and inexpensive. And it should also cater for a wide range of applications with simple processes so that various requirements as regards precision, dynamics and space are met. Looking ahead to the Factory of the Future, flexibility and end-to-end digitalization are important too. Bosch Rexroth caters for all these requirements with the Smart Function Kit for Handling – a ready-to-install mechatronic solution with preinstalled intuitive operating software which makes commissioning and process configuration considerably quicker and easier.

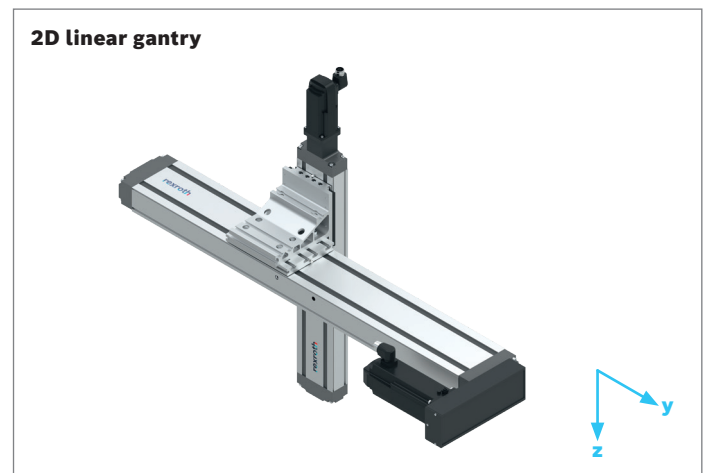


Ready-made types for a range of handling tasks

In order to speed up engineering, the LinSelect dimensioning tool provides design engineers with a clear recommendation as to which of the five predefined basic types available in 36 sizes is best suited to their application – depending on the technical features, delivery time or price.

The Cartesian 2D and 3D multi-axis systems suggested cover most typical applications: from pick and place, positioning, palletizing and feeding to testing or assembling. The needs-based configuration begins with the spatial arrangement: a choice of three-dimensional subsystems with X, Y and Z axes as well as two-dimensional subsystems with X and Y axes (horizontal) or with Y and Z axes (vertical) is available.

Five basic axis combinations in 36 sizes offer design freedom for a range of handling tasks.



During the dimensioning process, the software queries various parameters including travel distances, cycle and non-productive times, mass and load center of gravity. This way, the required handling cycle including cable length and I/O modules can be created simply by selecting, parameterizing and individually adjusting components.

vent configuration errors. At the end of the dimensioning process, the Smart Function Kit can be automatically carried over to the online configurator in order to finalize it, download the CAD data and order it from the e-shop as a ready-to-install subsystem.

While dimensioning the system, the e-tool constantly checks whether the data entered is plausible and thus helps to pre-

Smart selection and configuration

Via the LinSelect software, the Smart Function Kit for Handling can be designed and selected intuitively and with visual guidance. After entering a few parameters, the user is given an overview of the possible variants as well as three recommendations regarding technical features, price or delivery time.

In the online configurator, the selected subsystem can be configured to the end once the data has been carried over automatically. As soon as the CAD data has been provided, the Smart Function Kit can be ordered from the Rexroth e-shop as a preconfigured complete package with preinstalled software. The fully digital tool chain saves the user time and avoids errors when entering data and configuring the system.

www.boschrexroth.com/linselect

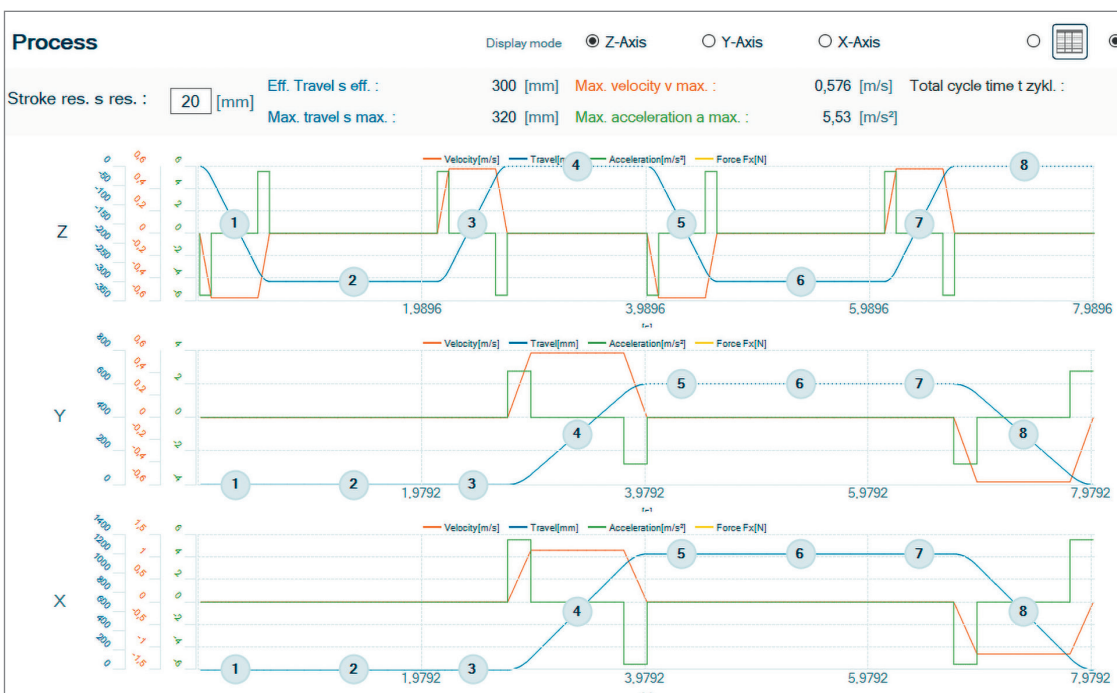


Define the process

The reference process can be adjusted very easily. Simply overwrite the desired parameter and refresh. With 'Individually', individual process steps can be adjusted, deleted or inserted.

Z-Travel	<input type="text" value="300"/> [mm]
Y-Travel	<input type="text" value="600"/> [mm]
X-Travel	<input type="text" value="1200"/> [mm]
Total cycle time	<input type="text" value="8"/> [s]
Sub times <small>= ext. Gripper open / close</small>	<input type="text" value="3"/> [s]
Mass load <small>= ext. Gripper + ext. attachment parts + ext. mass load</small>	<input type="text" value="5"/> [kg]
Center of gravity	
X-Position	<input type="text" value="0"/> [mm]
Y-Position	<input type="text" value="0"/> [mm]
Z-Position	<input type="text" value="-100"/> [mm]

← Back ✎ Individually

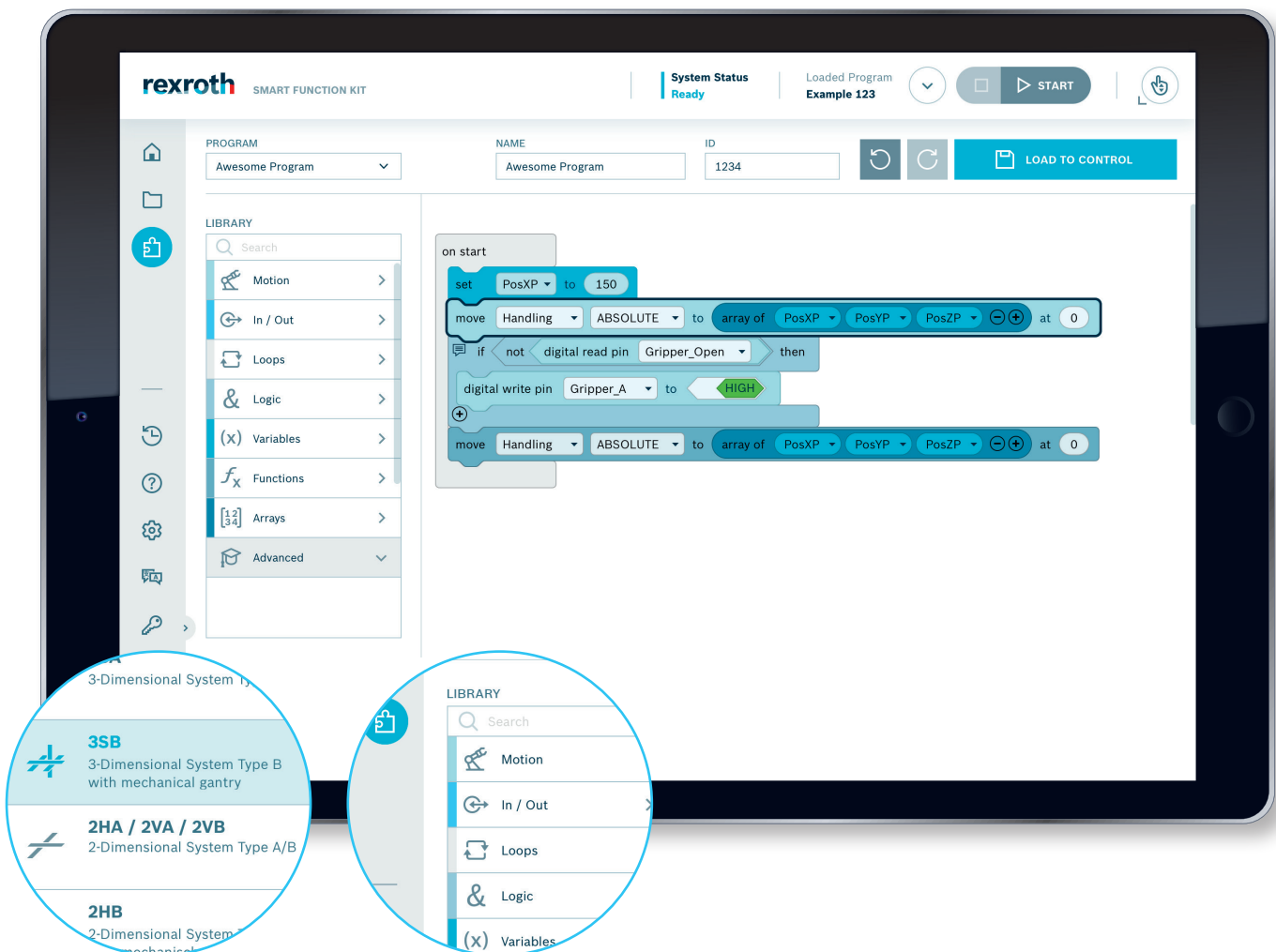


In the LinSelect selection and dimensioning tool, the handling process can be defined in six easy steps with visual guidance.

Plug & produce commissioning

The preconfigured handling solution is automatically commissioned with the help of the preinstalled intuitive software. A commissioning wizard guides users step by step through the settings, including the auto parameterization of the controllers. The handling process itself can be visualized with no need for programming knowledge. The intuitive frontend provides a library of prepared function modules which can easily be sequenced using drag and drop and then parameterized.

Quick referencing of the relevant axes with visual feedback is also supported. Connection to a higher-level control system is possible via OPC UA and, in future, via various field bus protocols. PLCopen modules are provided to allow easy connection.



▲ **Process configuration requires no knowledge of programming: Via the intuitive Web-HMI, the individual steps can be selected and sequenced graphically from an expandable software library.**

▲ **Intuitive referencing of the axes with visual feedback is also possible. The controllers are parameterized automatically.**

TWO PRACTICAL EXAMPLES

The fact that the handling subsystem is supplied preassembled and ready for installation in a package and can be put into operation quickly thanks to auto parameterization reduces the engineering work enormously. The following typical pick and place scenarios show what other benefits the Smart Function Kit for Handling offers:



Situation

A coffee producer was looking for a cost-effective palletizing solution for a new production line, one which would fit seamlessly into the overall process. 12 500 g packs (18 x 99 x 144 mm) on a display should be stacked in five layers on a EUR pallet. In order to make optimum use of the space on the pallet, the pick and place system specifies that some of the displays should be rotated 90° before being stacked. Accordingly, the max. strokes (Z/Y/X) were 1000, 1200 and 400 mm.

Requirement

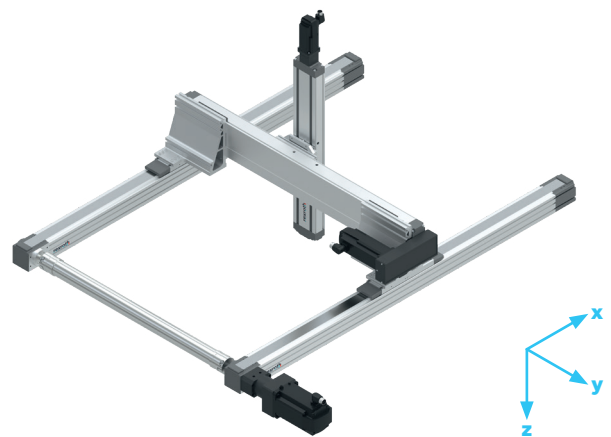
The handling solution should have a space-saving design and a minimal cycle time. It should also be flexible enough to allow different packs, sizes etc. Furthermore, the engineering and dimensioning outlay should be reduced and the solution should allow easy integration into the higher-level control system and quick commissioning.

Example 1

PALLETIZING DISPLAYS ACCORDING TO A DEFINED SYSTEM

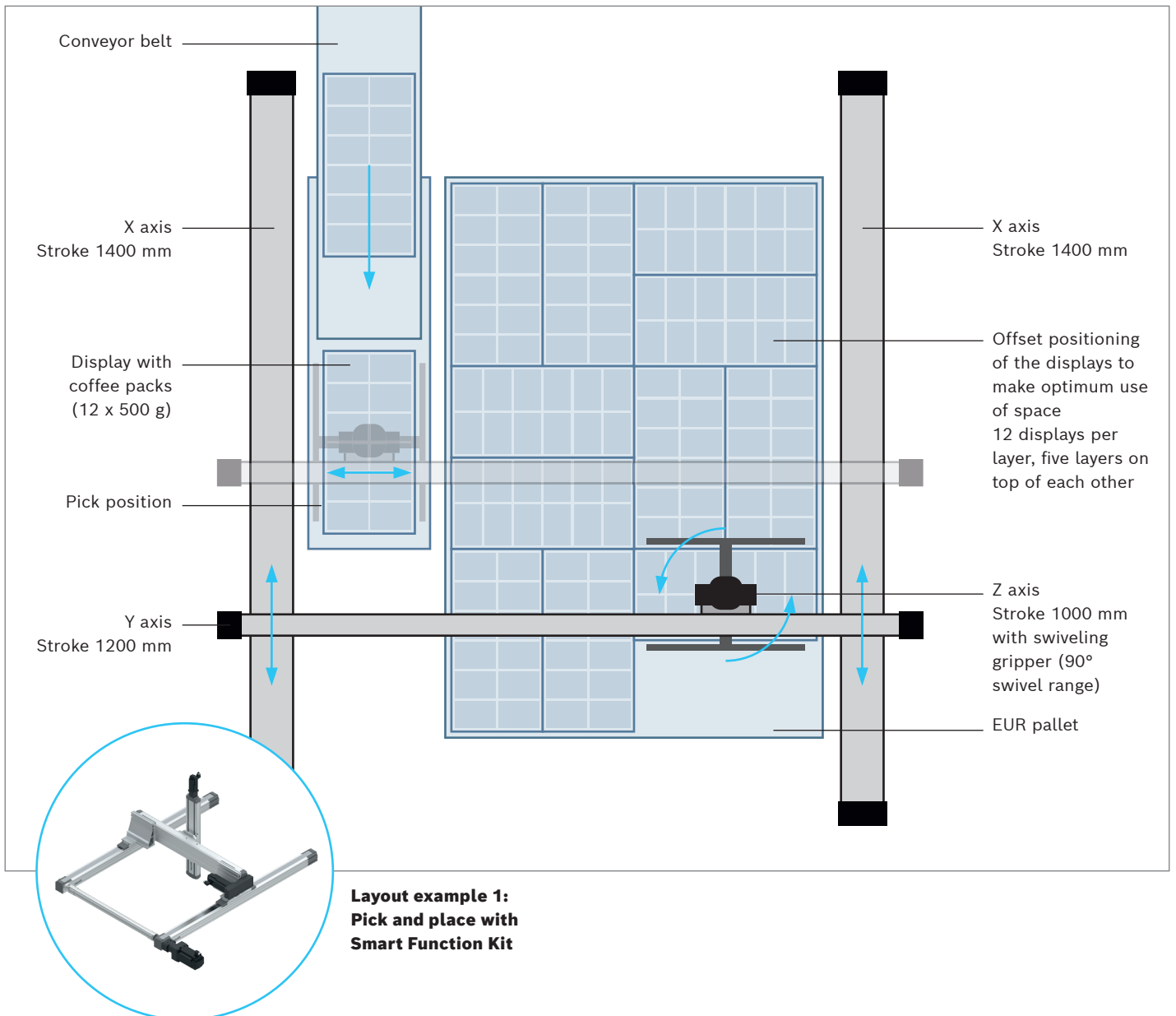
Solution

The operator opted for a Smart Function Kit for Handling, type S4H-3SB-40-2, which is positioned at the end of the production line. In the LinSelect dimensioning software, the operator selected a pick and place template with three axes. For the coffee display and gripper combination they entered a transport weight of 12 kg and strokes of 1020, 1220 and 420 mm (Z/YX).



During the selected process, the Z axis moves up and down alone. When it reaches the end position, the Y and X axes move simultaneously. A gripper with a 90° swivel range was chosen for the palletization system. The cycle varies according to position and lasts no more than 13.5 s. With the help of the commissioning wizard, the system could be commissioned on location and the following process was defined visually with the help of the function modules:

The multi-axis system positions the swiveling gripper for the pick position above the display. The Z axis moves it downwards and the display is picked up. Once the Z axis has moved right to the top again, the X and Y axes position the display where it is to be placed on the EUR pallet. The Z axis moves down, the gripper opens and places the display on the pallet. The Z axis then moves right to the top again, and the X and Y axis position themselves above the pick position once again. Depending on the alignment of the display on the EUR pallet, the gripper swivels 90° during positioning.



Result

With the Smart Function Kit for Handling, the task can be performed as required with less engineering outlay and shorter cycle times. Compared to the solution with a 6-axis folding-arm robot, less space is required in the working area because the Smart Function Kit can be positioned directly above the pallet and the conveyor belt. This also increases flexibility. After all, a folding-arm robot would have to have an extra-long cantilever in order to grip items at position 5 past the full EUR pallet. The Cartesian subsystem also offers high rigidity at a constant travel speed, especially in the outermost place positions.

The facility to select a suitable subsystem (including connection elements, motors and the power supply) quickly and in detail via LinSelect speeds up the engineering process considerably. Thanks to ready-made cables, the Smart Function Kit which is supplied in a package including pre-installed operating software can be connected up easily and commissioned with the help of a wizard. The auto parameterization of the controllers and supported referencing of the individual axes also save time. Process configuration via the Web-HMI is carried out using a tablet, and the kit is connected to the higher-level control system via OPC UA.

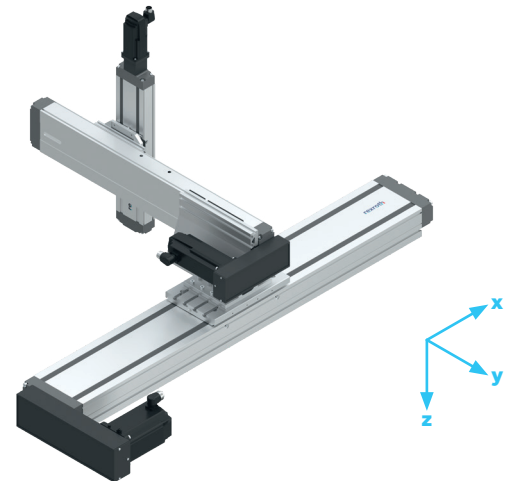


Example 2

QUICK AND PRECISE MACHINE PACKING

Solution

A Smart Function Kit for Handling (type SFH-3SA-23-2) which was dimensioned using LinSelect was placed at the end of the production line in order to place bearings in the machine. Depending on the position, the cycle time is no more than 7 s (not including laser inscription and with max. strokes). The X and Y axes travel in parallel, the Z axis travels alone.



Situation

A production company was looking for a handling solution to place roller bearings in a machine which inscribes them using a laser according to specific customer requirements. Following assembly, eight of the bearings produced in small batches are supplied on a tray. Key data:

- ▶ Roller bearings (\varnothing , h, m): max. 200 x 50 mm, max. 5 kg
- ▶ Tray: 8 places, variable diameters
- ▶ Max. stroke (Z/Y/X): 100, 600 and 1500 mm

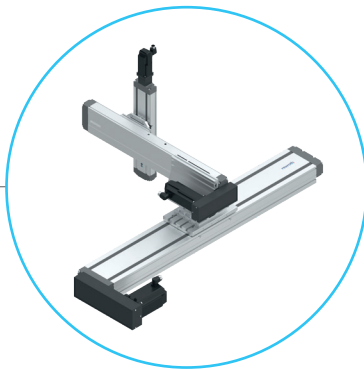
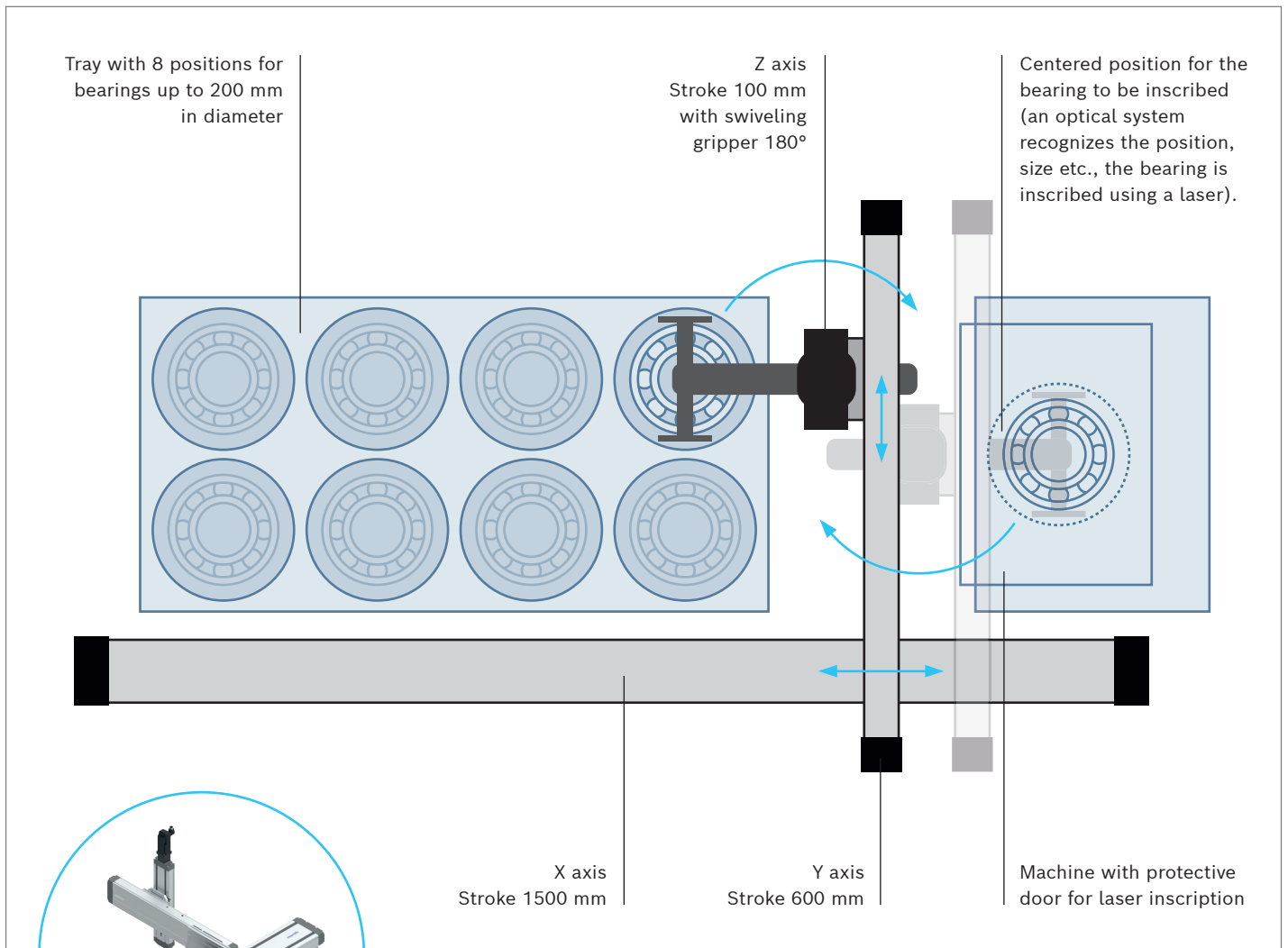
Requirement

Each roller bearing should be centered and placed in the machine. Once it has been inscribed, the bearing should be removed again and put back on the tray. Because the cycle time for pick and place should be no more than 7 s (not including inscription), communication with the laser machine is necessary. Further requirements:

- ▶ Precise gripping and positioning: 8 pick positions and 1 place position (machine)
- ▶ High rigidity thanks to changing load (weight depending on the bearing type)
- ▶ Flexibility: Different sizes depending on the bearing type
- ▶ Space-saving design
- ▶ Low engineering and dimensioning outlay
- ▶ Quick integration into the line control system
- ▶ Rapid commissioning

The following process was defined with the help of graphical programming via the Web-HMI:

The Smart Function Kit positions itself with the swiveling gripper in the pick position above the tray. The Z axis moves downwards, picks up the roller bearing and moves back up. The X and Y axes position themselves in front of the machine. Once the protective door opens, the swiveling gripper rotates 180°, moves downwards and places the roller bearing in a centered position in the machine. Once it is back at the top again, the gripper swivels 180° out of the machine and then remains in place. The protective door closes and the laser inscription begins. Once the protective door opens, the gripper once again swivels 180° into the machine and picks up the inscribed bearing. The Z axis moves upwards, the gripper swivels out of the machine while holding the work piece and positions it over the original tray position before putting it down. The Z axis moves upwards, while the X and Y axes move to the next pick position.



**Layout example 2:
Packing an inscription
machine**

Result

With the Smart Function Kit for Handling, the required multi-axis system can be chosen quickly and dimensioned in detail. Everything comes ready to install from a single source – including the drive and the power supply. The wide range of solutions with five basic types in 36 sizes allows accurate, needs-based dimensioning. Thanks to its great rigidity, the subsystem achieves high speeds constantly even in the outermost positions. Because the subsystem is designed for various bearing sizes and weights, mechanical reserves are available for future product variants.

Thanks to the wizard and auto parameterization, commissioning is possible in a fraction of the time. The kit is connected to the higher-level control system via OPC UA. No programming knowledge is required, so there is no need to use external services.

Decision-making aid for handling tasks: 6-axis folding-arm robot versus cartesian subsystem

Criterion	6-axis folding-arm robot	Smart Function Kit (Cartesian)	Explanation/Note
Degrees of freedom	++	+	With a linear robot, additional degrees of freedom are possible thanks to tactile systems
User-friendliness	++	++	Quick selection and plug and produce thanks to intuitive software with visual user guidance
Universal use	++	+	Linear robots are easily adaptable and therefore reusable
Costs per working area	-	+	Linear robots allow individual working areas (small and large)
Precision and accuracy	-	++	Linear robots: higher basic precision and accuracy – Folding-arm robots: growing inaccuracy along the 6 joint points
Rigidity	+	++	Linear robots offer maximum rigidity thanks to the Cartesian system
Dynamics	+	++	Linear robots are favorable to their lower inertia (e.g. during pick and place)
TCO/ROI	-	+	3-axis linear robots are more cost-effective than 6-axis folding-arm robots for many applications

CONCLUSION

The quicker way to the Factory of the Future

Both examples show how quickly, easily and digitally cartesian handling subsystems can be achieved with the help of a Smart Function Kit comprising ready-made mechatronic systems and intuitive software. Compared to the previous methods used when engineering multi-axis systems, overdimensioning can be avoided and needs-based solutions can be achieved cost-effectively – with minimal cycle times and low costs per working area.

Sometimes, the modularly structured, preconfigured multi-axis systems with best-in-class components are an interesting alternative to a 6-axis folding-arm robot.

In all cases, the ready-to-install subsystems can be set up easily, reduce process, project and payback times and ultimately pave the way for the Factory of the Future.

Axis combinations for virtually unlimited fields of application

