

**BECKHOFF** New Automation Technology

**XPlanar**<sup>®</sup>: Levitating,  
contactless, intelligent!



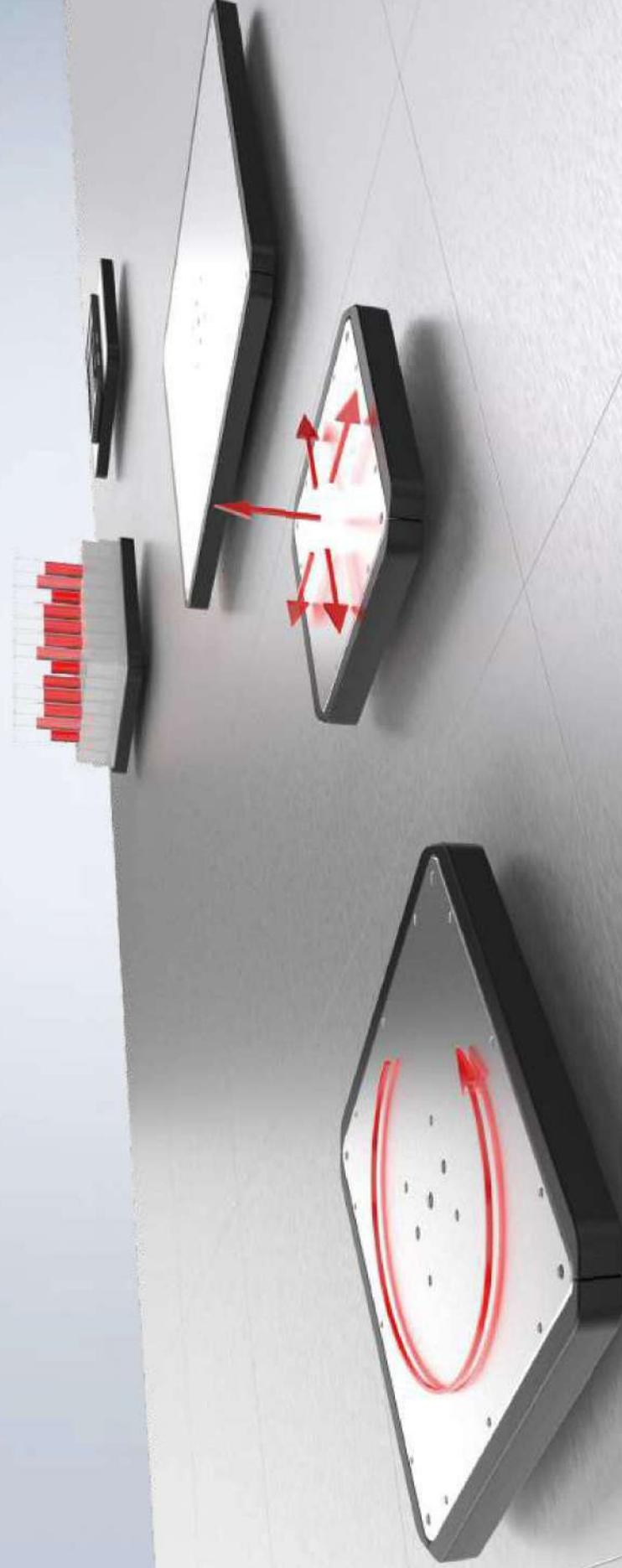
- x, y, z motion
- a, b tilting
- 360° c rotation

# XPlanar: Free 2D motion with up to six degrees of freedom

With its free 2D product movement with up to six degrees of freedom, the XPlanar planar motor system opens up a whole new world of product handling options. Levitating XPlanar movers travel on individually arranged XPlanar tiles along freely programmable tracks. 6D product processing and 2D transportation are dynamically combined in a single system while multi-mover control enables parallel and individual product handling. Mechanical wear and extensive cleaning procedures are a thing of the past with XPlanar. The system is completely integrated into standard TwinCAT software and controlled via a single central industrial PC. All proven advantages

of PC-based control technology from Beckhoff are available, making XPlanar the ideal handling system for economical lot size 1 production in the machines of the future.

► [www.beckhoff.com/xplanar](http://www.beckhoff.com/xplanar)



# How XPlanar works: Levitating movers for contactless travel

The XPlanar system is a planar motor, which – like rotary motors – consists of multiple stationary energized coils (in the tiles) and mobile permanent magnets (in the movers). Contrary to rotary motors, both the coils and the permanent magnets are arranged in a horizontal plane.

The XPlanar tiles are the electrically active part of the system and generate an electromagnetic field that causes the movers to levitate above the tiles. The movers are electrically passive and highly robust. The unique floating effect means any pollutants or contaminants from the goods being transported are not spread throughout the system, there are no emissions, and there is

no wear caused by friction. The XPlanar system stands out as a revolutionary motion concept in general mechanical engineering, and in the food and pharmaceutical industries.



A planar mover equipped with permanent magnets levitates above planar tiles which generate a magnetic field and continuously detect the mover's position.

# XPlanner advantage: One system for transport and processing

The XPlanner system combines highly dynamic 2D product transportation with precise 6D product processing in a single system. The XPlanner movers travel at speeds of up to 3 m/s and can be positioned with a repeat positioning accuracy of  $\leq 5 \mu\text{m}$ . Since the movers travel completely independently, each product can take its own individual path through the system. Different products can be manufactured at the same time in a single machine, which is ideal for economical lot size 1 production. The 2D movement can be combined with superposed tilting, inclining and lifting for free 6D positioning. This generates innovative possibilities for streamlined processing stations.

In many applications, XPlanner can replace XY gantries or robots to reduce the mechanical complexity of a machine considerably. Moreover, the unique 360-degree rotation functionality opens up further possibilities for the inspection, alignment or centrifugation of products.

-  Levitating planar movers
-  Scalable payload
-  Endless 360° rotation
-  Tilting by up to 5°
-  Lifting by up to 5 mm
-  Dynamic motion at up to 3 m/s
-  6D motion
-  Any installation layout
-  Individual product transport



Positioning accuracy	Technical data	Comments:
Position resolution	1 $\mu\text{m}$ (x, y, z) 0.001° (a, b, c)	<ul style="list-style-type: none"> <li>■ Accuracies within one tile</li> <li>■ Average tile temperature: 40°C</li> <li>■ Average ambient temperature: 24°C</li> <li>■ Constant mover temperature</li> </ul>
Typical repeat accuracy APS4244 und APIM330	$\leq 5 \mu\text{m}$ (x, y, z) $\leq \pm 0.03^\circ$ (a, b, c)	

# XPlanner system: Plug-and-play for tomorrow's machine concepts

The highlight of the XPlanner system is its compact system architecture. To operate it, only the tiles, movers, a Beckhoff Industrial PC with TwinCAT, and cables for the power supply and EtherCAT G are needed. The industrial PC is connected to the first XPlanner tile via EtherCAT G. The EtherCAT G communication is then daisy-chained from tile to tile. No cross-communication between individual XPlanner tiles is needed, and nor are infrastructure components such as port multipliers or external power supplies. In line with the Beckhoff PC-based control philosophy, the system is accessed via a central industrial PC. This enables perfect coordination of the XPlanner system with other

machine components, along with easy process optimization and fast diagnostics. New system functionalities can easily be integrated into existing systems by updating the central control system's software on the industrial PC.

**TwinCAT:**  
software platform for  
control and engineering

**Industrial PC:**  
scalable hardware  
platform



**XPlanner mover:**  
free positioning,  
available in seven sizes

**XPlanner tile:**  
free layout  
configuration



**EtherCAT G fieldbus:**  
exceptional bandwidth  
and speeds



# XPlanar tile: Fully integrated for maximum space efficiency

The XPlanar tile is the fully integrated drive unit of the XPlanar system. It converts the supplied energy into precisely regulated electromagnetic fields. The fields levitate the XPlanar movers and guide them across the XPlanar tiles along freely programmable tracks. All components required to generate and regulate the magnetic fields are integrated in each XPlanar tile. This includes the coil groups and their associated power electronics along with the position detection, the power supply and EtherCAT G communication. The result is a compact, highly functional design that significantly reduces installation effort. Three tile formats of 240 mm x 240 mm,

320 mm x 320 mm, and 160 mm x 320 mm are available to choose from. Depending on the application, mover type, and desired movement, using different tile sizes can help minimize the overall footprint of the system. XPlanar tiles can also be adapted to various environmental requirements. For example, they can be covered with plastic films, glass panes or non-magnetic stainless steel to protect them from liquids, cleaning agents or mechanical impact. Accordingly, the XPlanar system is well-suited for use in demanding hygienic environments.

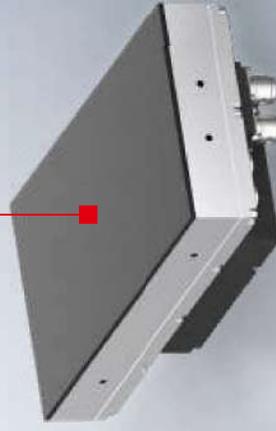
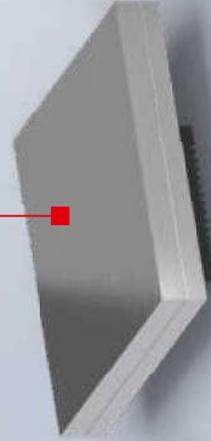


Free choice of surfaces: The choice of available surfaces includes hygienic stainless steel, plastic film, and easy-clean glass, making XPlanar tiles suitable for use in clean rooms and in the pharmaceutical and food industries.

APS4322-1x00-0000:  
240 mm x 240 mm

APS4244-1x00-0000:  
320 mm x 320 mm

APS4224-1x00-0000/  
AP-S4242-1x00-0000:  
160 mm x 320 mm



# Xplanar movers: Easy to clean, scalable payload

The Xplanar mover is the magnetically levitating, freely movable and wireless component of the Xplanar system. Due to an innovative arrangement of the integrated permanent magnets, the movers can carry their own weight and various payloads. Xplanar movers are passive without moving parts or connectors. Their smooth surface without sharp edges makes them easy to clean. Various square and rectangular movers which can carry payloads of up to 4.5 kg are available for different product sizes and weights. Depending on the mover used and the specific application, the corresponding tile is selected to keep the system footprint as small as possible. The movers can

be mechanically linked or operated as a group to accommodate payloads above 4.5 kg. In this case, the payload capacity of the entire group is the total of the individual movers' payload capacities. Movers with an edge length of 113 mm are available for very high product packing density. The optional mover identification enables full product traceability through the entire installation and a machine start up without referencing. Each mover can be identified at any time, regardless of its position, through a unique identification number. Stainless steel movers with a high protection class are also available for hygienic applications.

APS4322



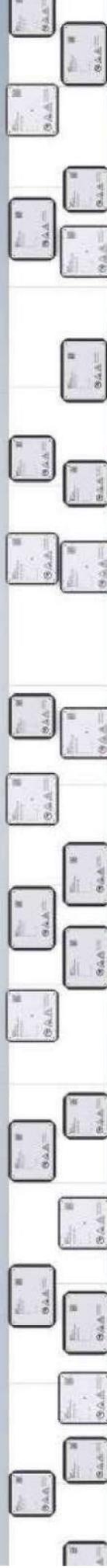
APS4244



APS4242



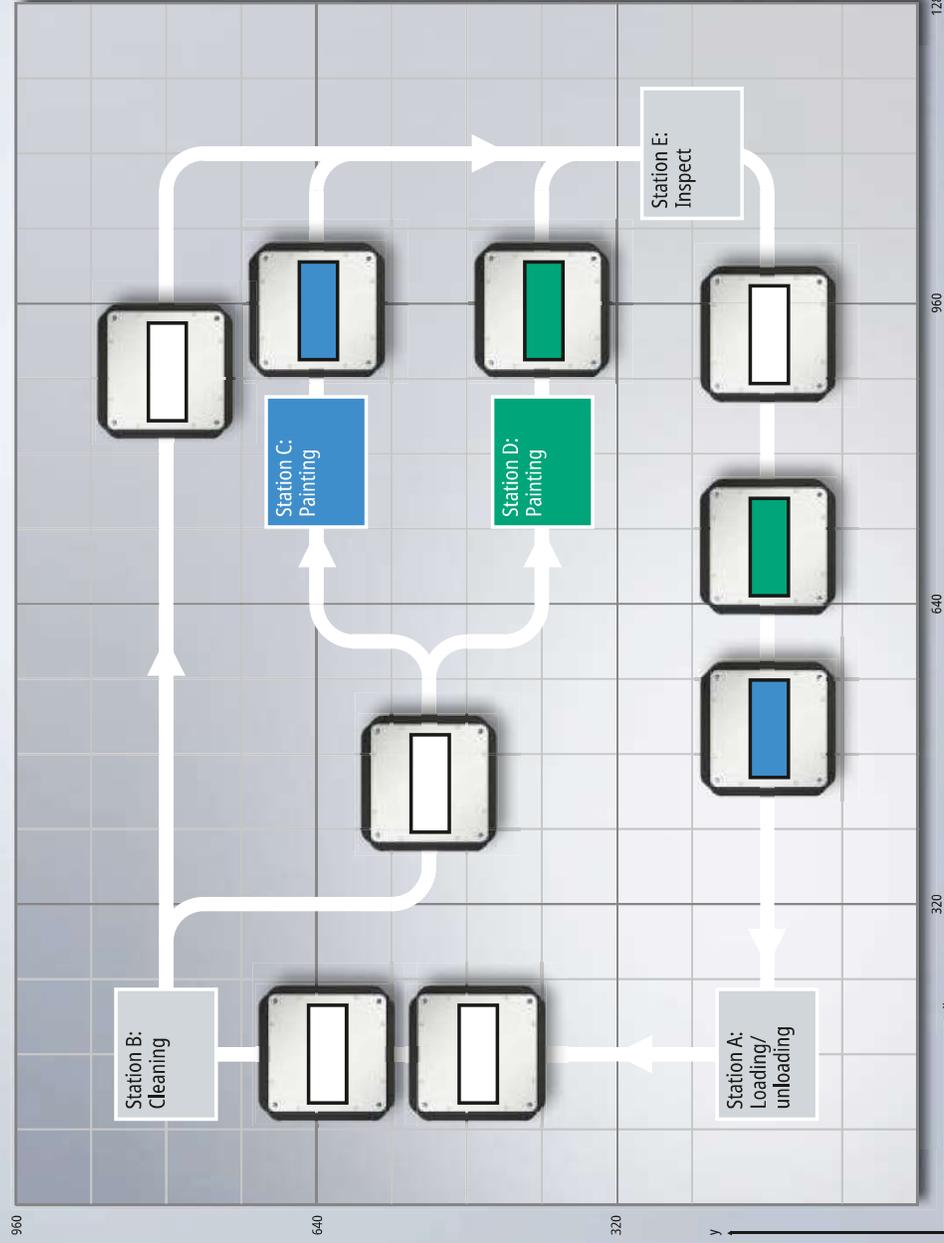
APS4322



# XPlanar software: Centralized control of XPlanar applications

The TFS990 software is fully integrated into the standard TwinCAT environment and controls all functions of the XPlanar system from one central Beckhoff Industrial PC: graphic system configuration, real-time monitoring, intelligent track planning and precise position control merge seamlessly. The setpoint generation for the movers is handled by the track management: Users can define free 2D tracks. The movers follow these tracks intelligently and automatically avoid collisions. Complex and superposed 6D movements based on CNC with GCode or CAM and free 2D movements are possible. Due to the deep integration into TwinCAT, all familiar

capabilities of the PC-based control technology from Beckhoff are available alongside the XPlanar control (TwinCAT, PLC in IEC 61131-3, motion, measurement, machine learning, vision, communication, HMI).

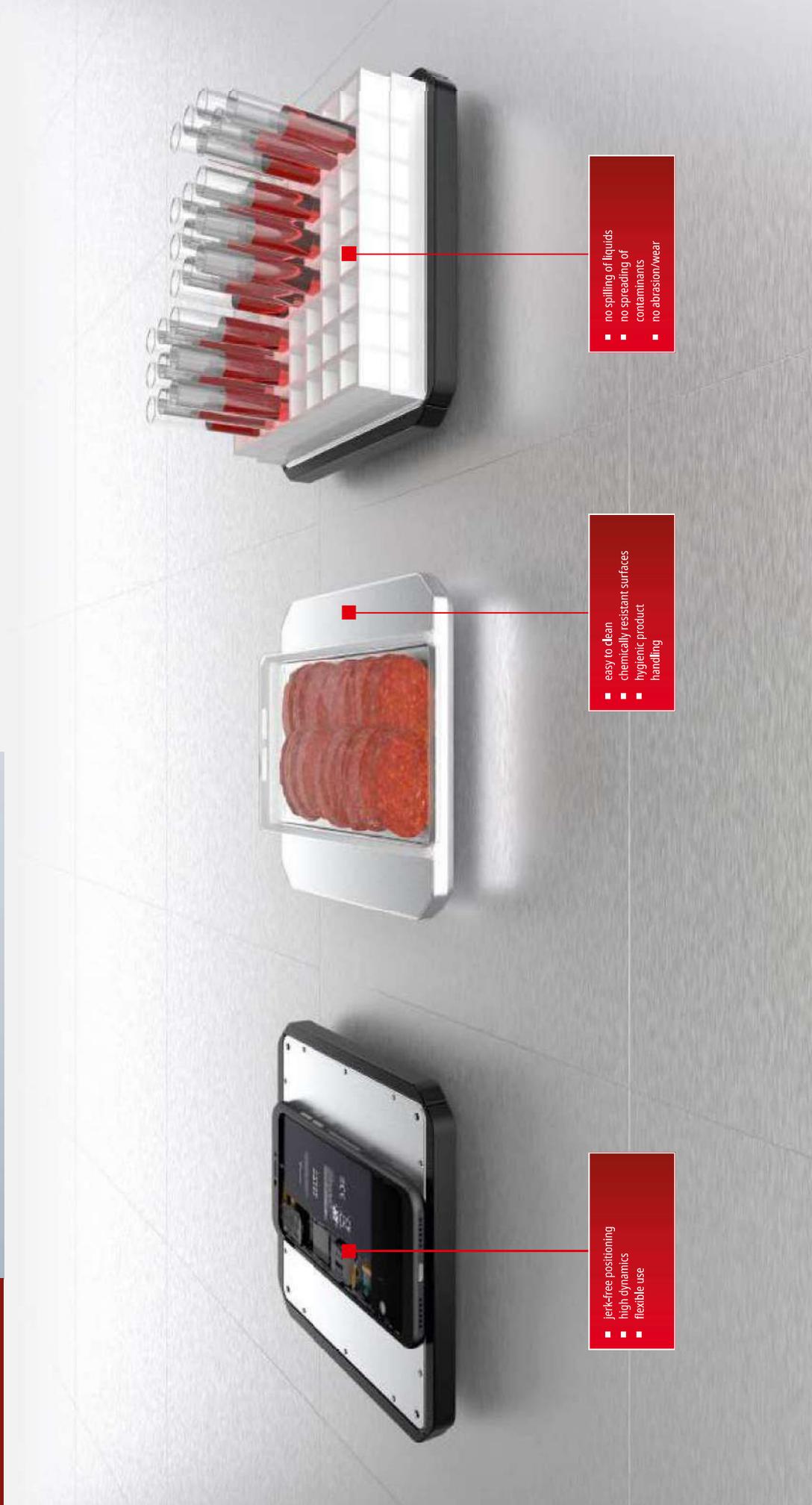


**Example application:**  
The machine can clean, paint, and inspect products, with painting being optional. Each mover is loaded with a product at Station A, then moves to Station B for cleaning. After that, the product is either not painted at all or is painted blue (Station C) or green (Station D) depending on the work order, which defines the product's path through the process. Finally, every product is inspected at Station E. If the result is 'OK', the mover is unloaded back at Station A. If it is 'not OK', the mover and product are sent through the process again. The track management system ensures collision-free, deterministic movement of the movers throughout, with predefined right-of-way rules at intersections.

# XPlanar applications: Revolutionary concepts across all industries

XPlanar enables innovative machine designs in a wide range of industries. Applications in the food industry benefit from the outstanding hygienic properties of the XPlanar tiles and movers. In electronics manufacturing, the free and highly accurate positioning capabilities of products in up to 6 dimensions can be used instead of external positioning systems. For example, adhesive dispensers or SMD placement systems can be mounted in a fixed position while the XPlanar movers carry out all positioning tasks to complete a process step. In pharmaceutical and lab environments, software-based shaking and vibration motion can be performed at defined amplitudes

and frequencies in order to mix substrates. To save time, the shaking motion can be superimposed on to the product transport from station to station. These and other system properties enable users to completely rethink existing processes. Based on the XPlanar system, engineers can design innovative machines that not only enhance cost-effective product manufacturing but also fundamentally reinvent what is possible with automation technology.



- jerk-free positioning
- high dynamics
- flexible use

- easy to clean
- chemically resistant surfaces
- hygienic product handling

- no spilling of liquids
- no spreading of contaminants
- no abrasion/wear

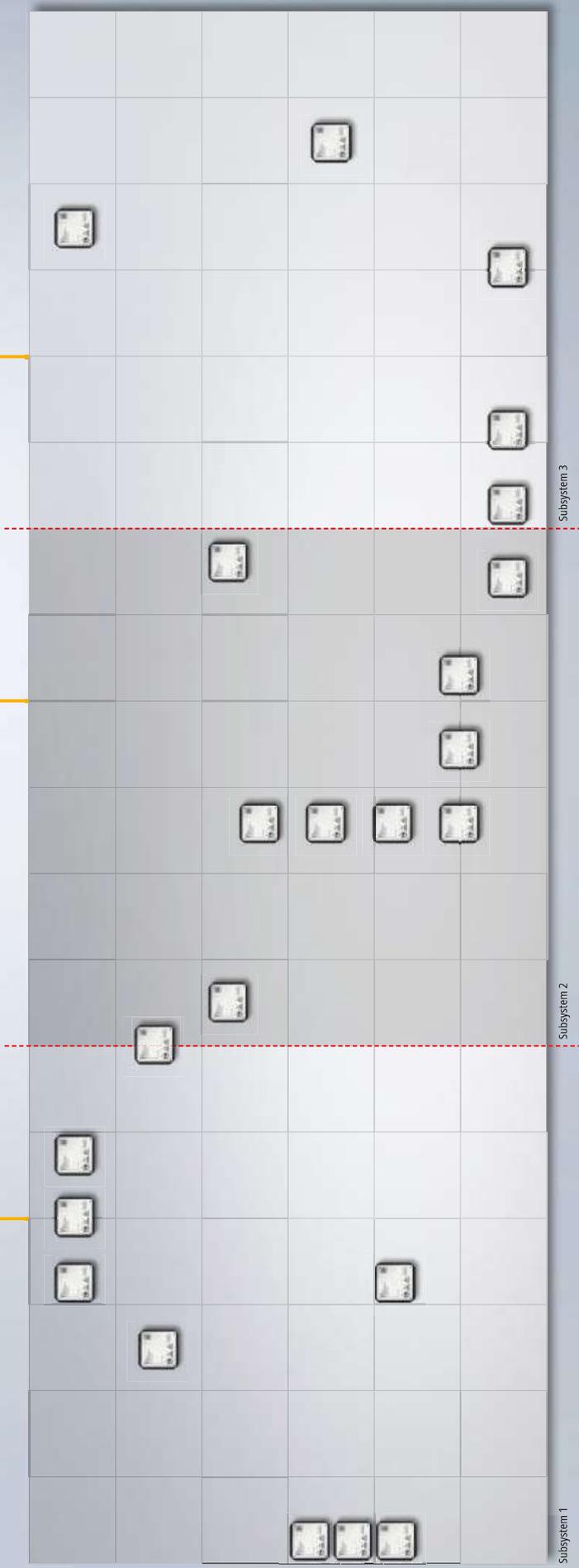
# XPlanner for large and modular systems

XPlanner multi-computing enables larger and more modular XPlanner systems to be created. To this end, the entire system is split into individual subsystems. These are each controlled by a sub IPC. The dynamic handover of a mover between two subsystems is assured by the sub-IPCs' communication with each other. Each subsystem can be commissioned independently, and they communicate with each other via defined software interfaces. XPlanner multi-computing thus makes it easy to increase the number of XPlanner movers and tiles within an overall system to a practically infinite amount. Beyond system enlargement, there are exciting possibilities for

modularizing a machine. New subsystems can easily be mechanically coupled to the existing system if required.

## Sub IPCs

- control individual subsystems
- enable smooth mover handover between subsystems through cross-communication





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