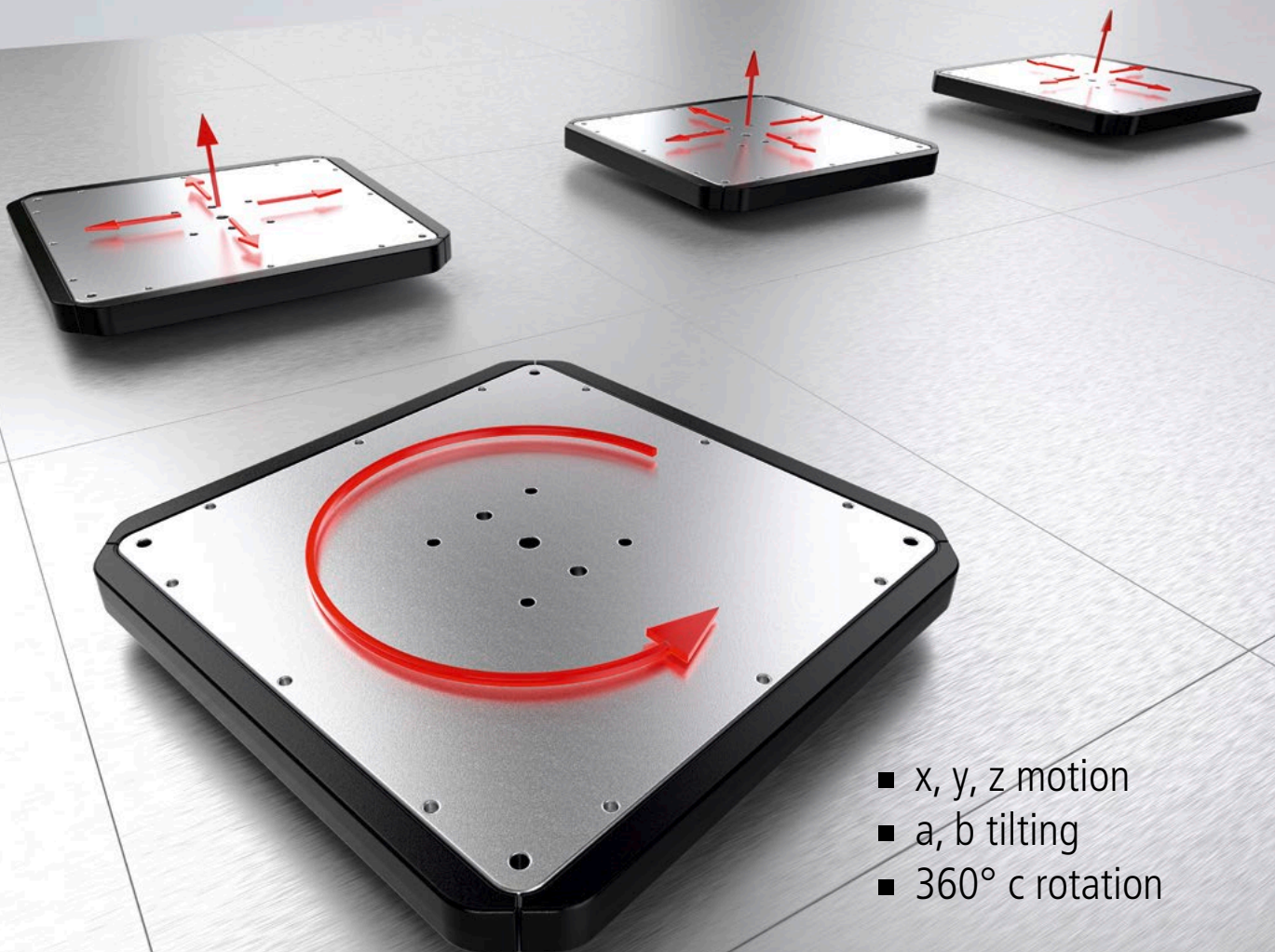**BECKHOFF** New Automation Technology

# XPlanar®: Levitating, contactless, intelligent!

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

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

The planar motor system XPlanar enables new material handling concepts through contactless 2D motion with up to 6 degrees of freedom. Levitating XPlanar movers fly across 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 makes parallel and individual product handling possible. 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 the economical lot size 1 production in the machines of the future.
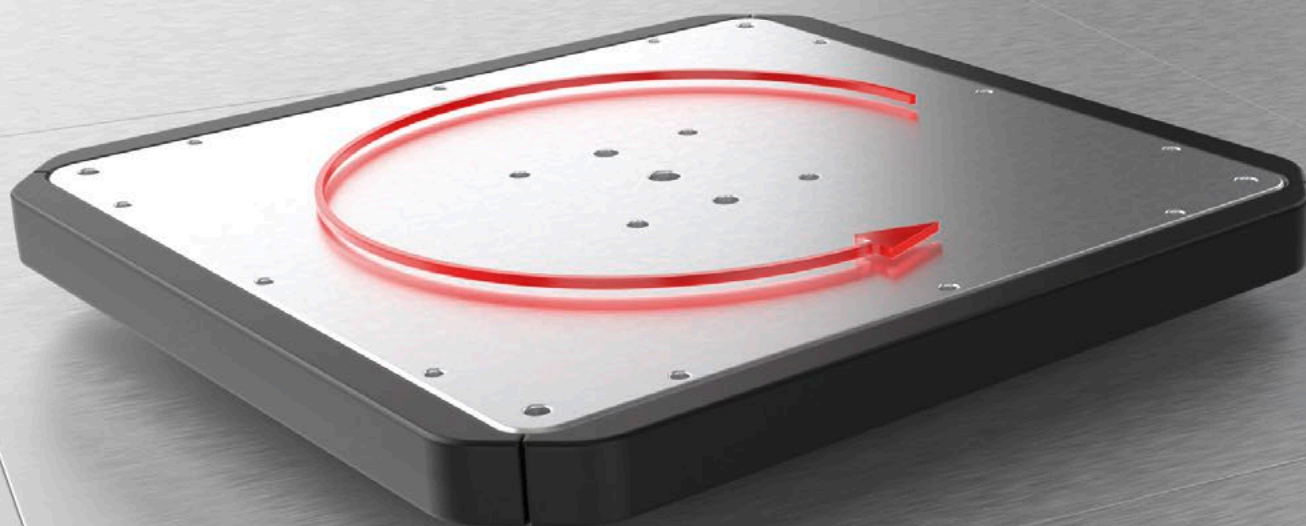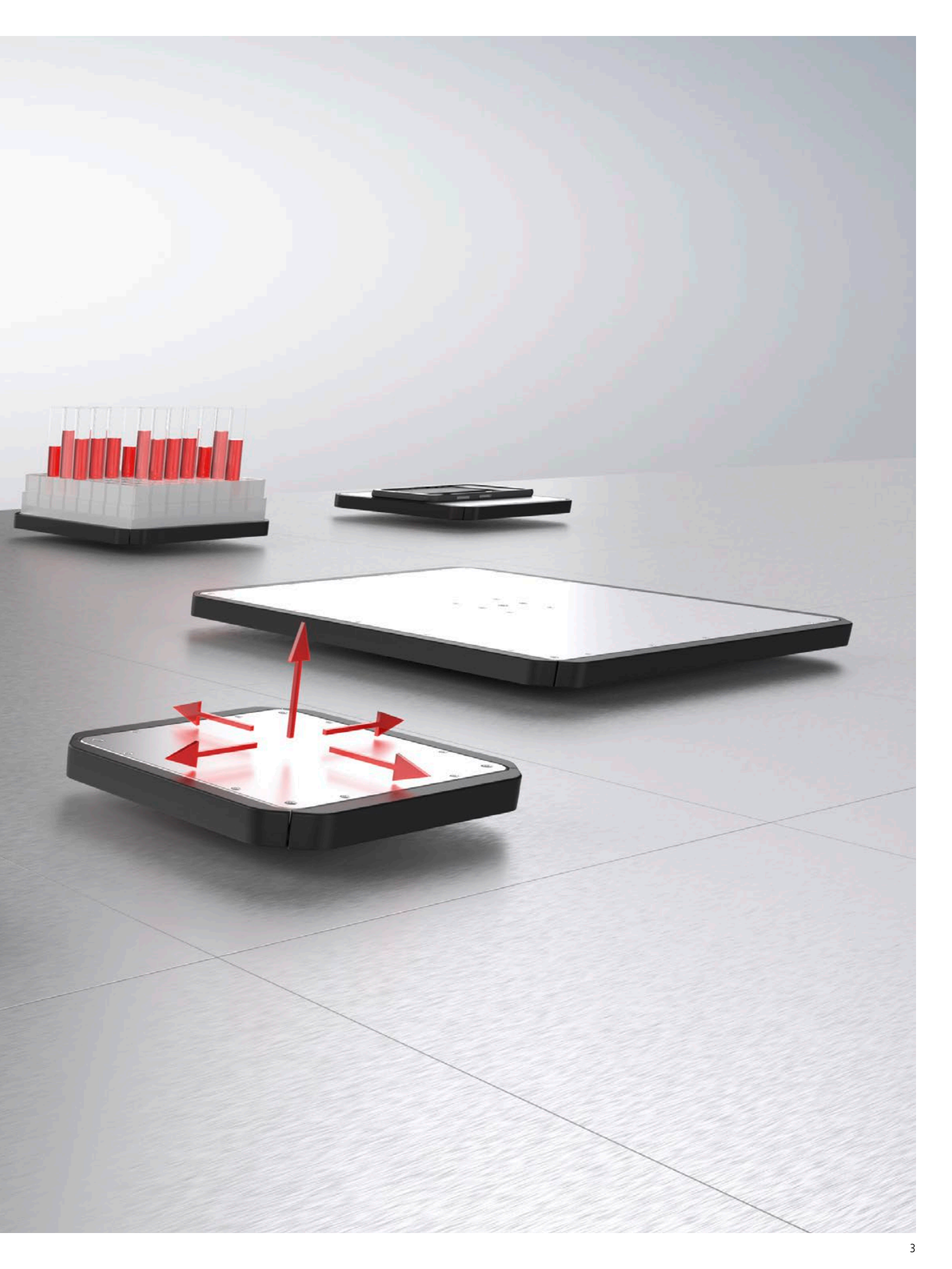
How XPlanar works: levitating movers for contactless travel

The XPlanar system is a planar motor, which – like rotary motors – consists of multiple stationary, coils (in the tiles) and mobile permanent magnets (in the movers). Contrary to rotary motors, 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. Pollutants or contaminants caused by the transported goods are not spread across the installation due to the unique levitational effect. This approach allows liquids to move without sloshing and eliminates wear and emissions caused by abrasion. The XPlanar system stands out as a revolutionary motion concept in general mechanical engineering as well as 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.

XPlanar advantage: one system for transport and processing

The XPlanar system combines highly dynamic 2D product transportation with precise 6D product processing in a single system. The XPlanar movers travel at speeds of up to 2 m/s and can be positioned with a repeat positioning accuracy of up to 50 µm. And 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 the economical lot size 1 production. The 2D movement can be combined with superposed tilting, inclining and lifting for free 6D positioning. This creates innovative possibili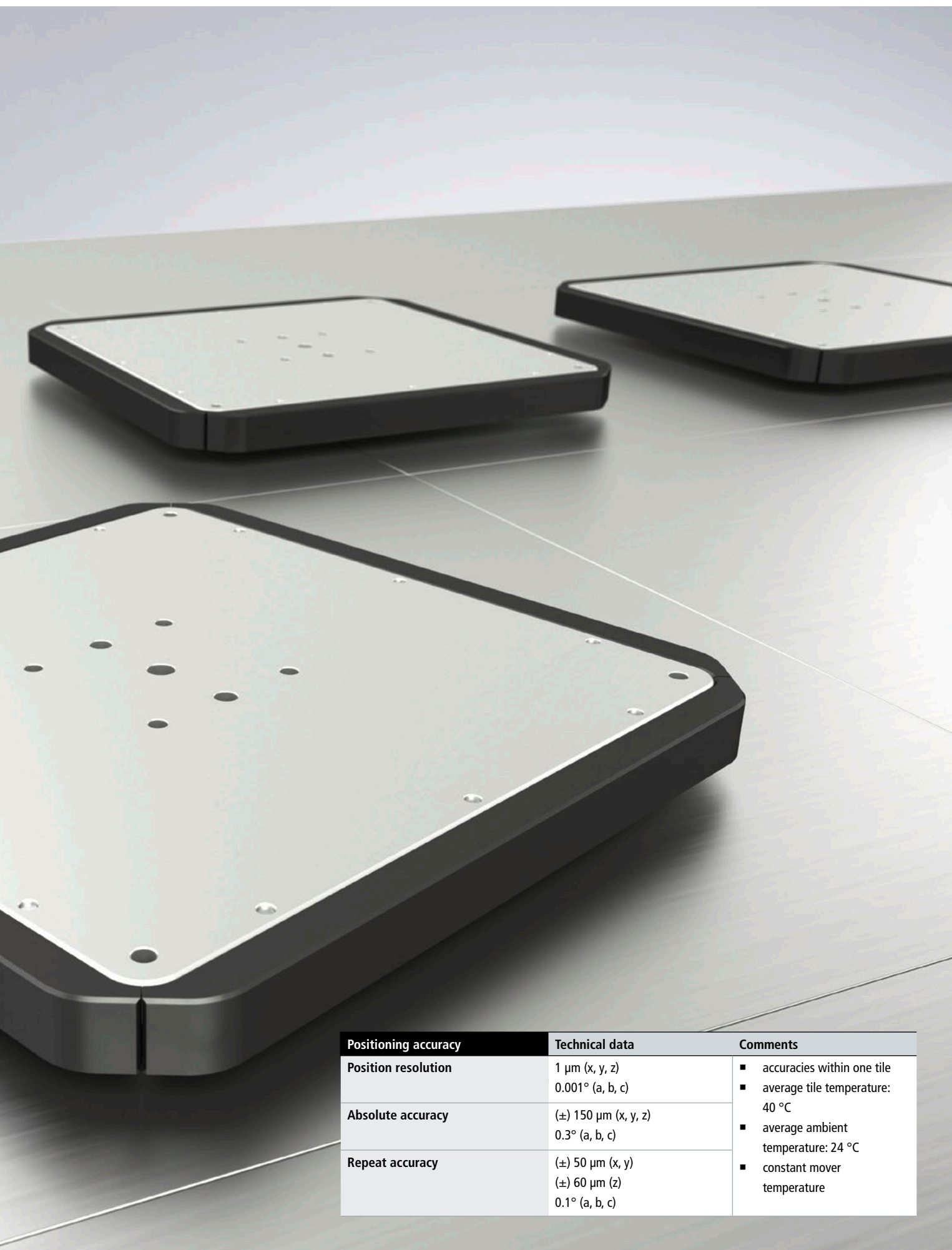ties for streamlined processing stations. In many applications XPlanar can replace XY gantries or robots to reduce the mechanical complexity of a machine considerably. Moreover, the unique 360-degree rotation functionality opens up further possibilities for the inspection, alignment or centrifugation of products.

↕	Levitating planar movers
kg	Scalable payload
360°	360-degree rotation
5°	Tilting by up to 5°
↕	Lifting by up to 5 mm
	Dynamic motion at up to 2 m/s
	6D motion
	Any installation layout
	Individual product transport

Positioning accuracy	Technical data	Comments
Position resolution	1 µm (x, y, z) 0.001° (a, b, c)	■ accuracies within one tile ■ average tile temperature: 40 °C
Absolute accuracy	(±) 150 µm (x, y, z) 0.3° (a, b, c)	■ average ambient temperature: 24 °C
Repeat accuracy	(±) 50 µm (x, y) (±) 60 µm (z) 0.1° (a, b, c)	■ constant mover temperature

XPlanar system: plug-and-play for tomorrow's machine concepts

The XPlanar system impresses with its compact system architecture. Operation requires only the tiles, movers, a Beckhoff Industrial PC with TwinCAT, and cables for power supply and EtherCAT G. The Industrial PC is connected via EtherCAT G to the first XPlanar tile. The EtherCAT G communication is then daisy-chained from tile to tile. No cross-communication between individual XPlanar tiles is needed and neither 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 simple coordination of the XPlanar system with other machine components, along with easy process optimization and fast diagnostics. New system functionalities can be easily integrated into existing systems by updating the central control system's software on the Industrial PC.

Industrial PC:
scalable hardware platform

TwinCAT:
software platform for control and engineering

EtherCAT G fieldbus:
exceptional bandwidth and speeds
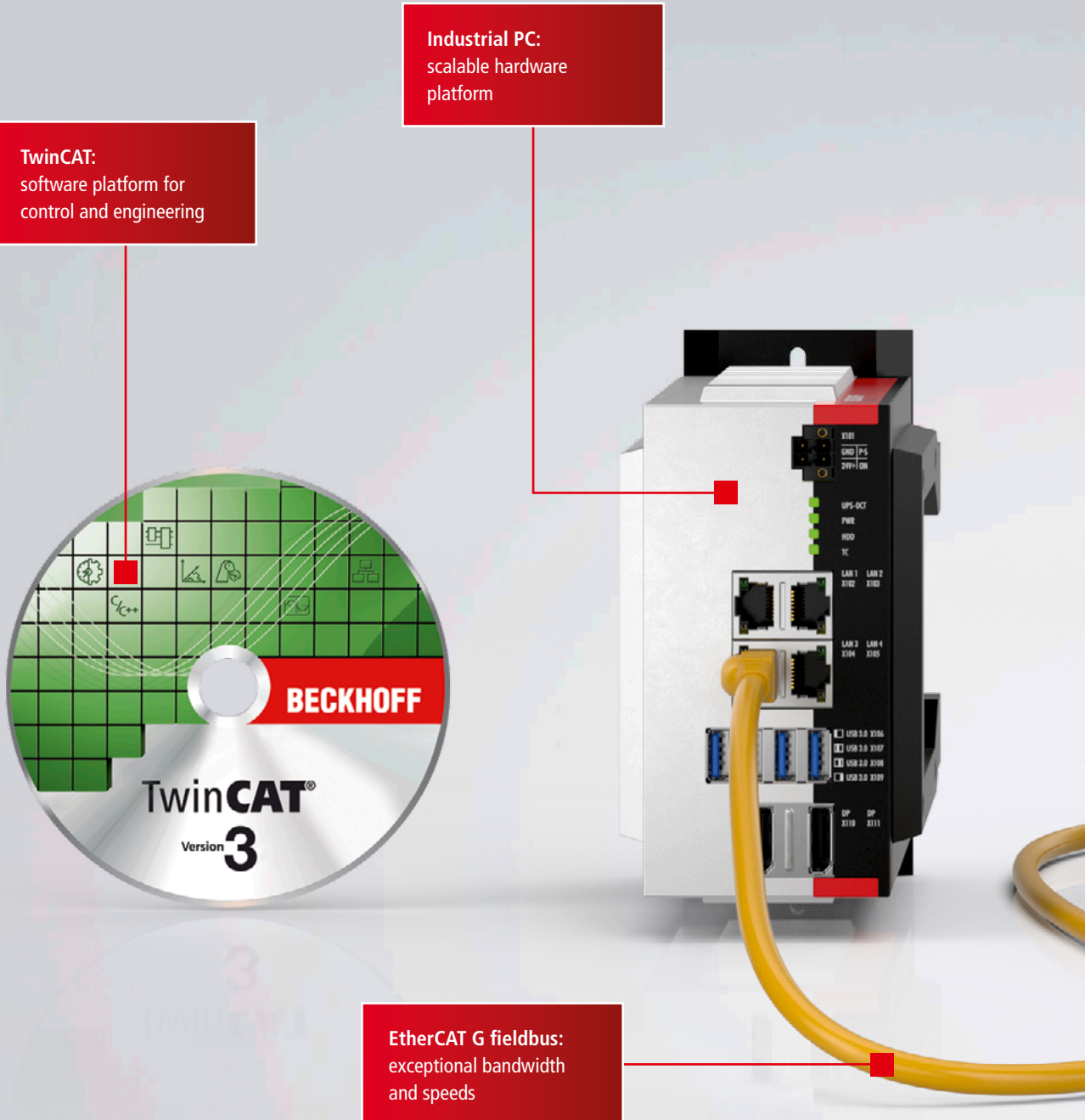
XPlanar mover:
free positioning in
three sizes

XPlanar tile:
free layout
configuration
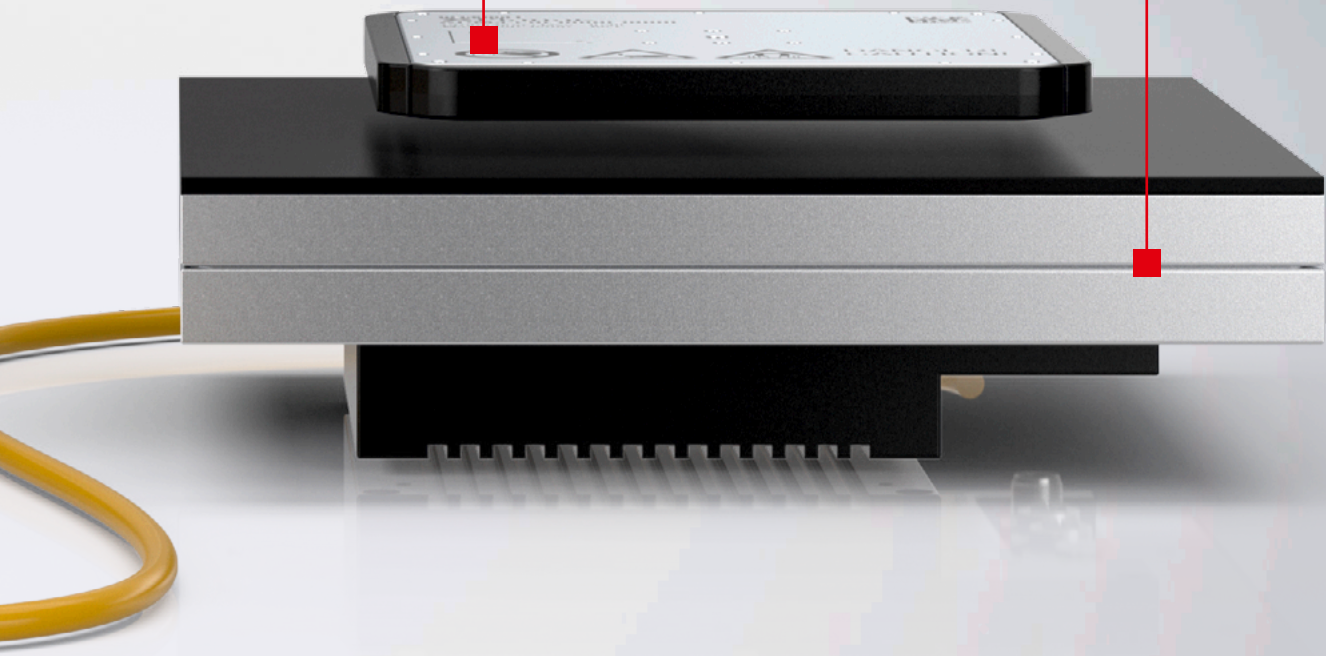
XPlanar tile: fully integrated for maximum space efficiency

The XPlanar tile is the fully integrated drive component 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 as well as the position detection, the power supply and the EtherCAT G communication. This level of integration enables a highly compact and functional design that reduces the installation effort and the total system footprint. 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.
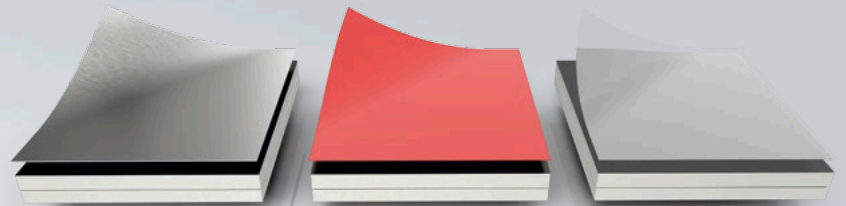
APS4322-0000-0000
XPlanar tile, 110/230 V AC or 24 V DC
240 mm x 240 mm x 67 mm
Net weight: 5.6 kg

Free choice of surfaces: Easy-to-clean glass, stainless steel in hygienic designs or plastic films allow use in cleanrooms as well as in the pharmaceutical and food industries.

Power consumption	Average	Comments
Per APM4330 mover, 2 mm flight height, unloaded, at standstill	24 W	position-dependent
Per APM4330 mover, 2 mm flight height, 1000 g load, at standstill	54 W	position-dependent
Per APM4330 mover, 2 mm flight height, 1500 g load, at standstill	77 W	position-dependent

XPlanar system: customizable and scalable layout

The XPlanar tile layout is freely definable to suit any application-specific requirements. Square, rectangular, L-shaped or ring-shaped systems can be realized with ease. A bidirectional product transport is possible on linear systems that are one or two tiles wide. The width of the linear systems depends only on the size of the operated movers. Tiles and movers can be added to the system after the initial installation to adapt the machine to new requirements. Individual tiles can be mounted on additional actuators. This installation provides additional flexibility as tiles or entire tile segments can leave the original layout in horizontal or vertical directions while the movers are levitating. The unique combination of layout customization and extension ensures an exceptional degree of future security for XPlanar based machines. At the same time, the system's footprint is minimized by optimizing the ratio of tiles and movers.

Rectengular layout:

- compact arrangement
- short transport paths
- flexible use
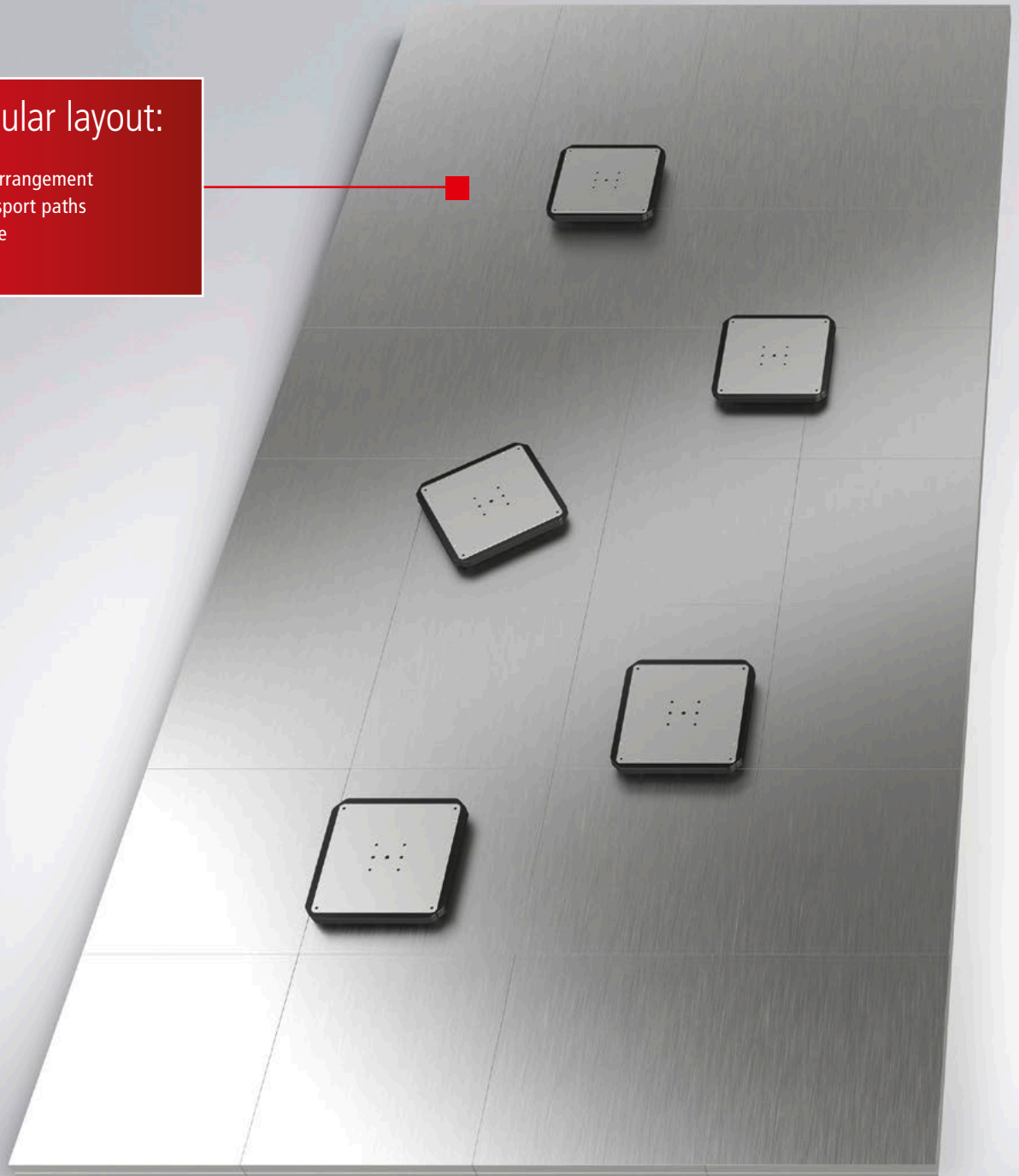
Linear layout:

- connects different systems or processing stations
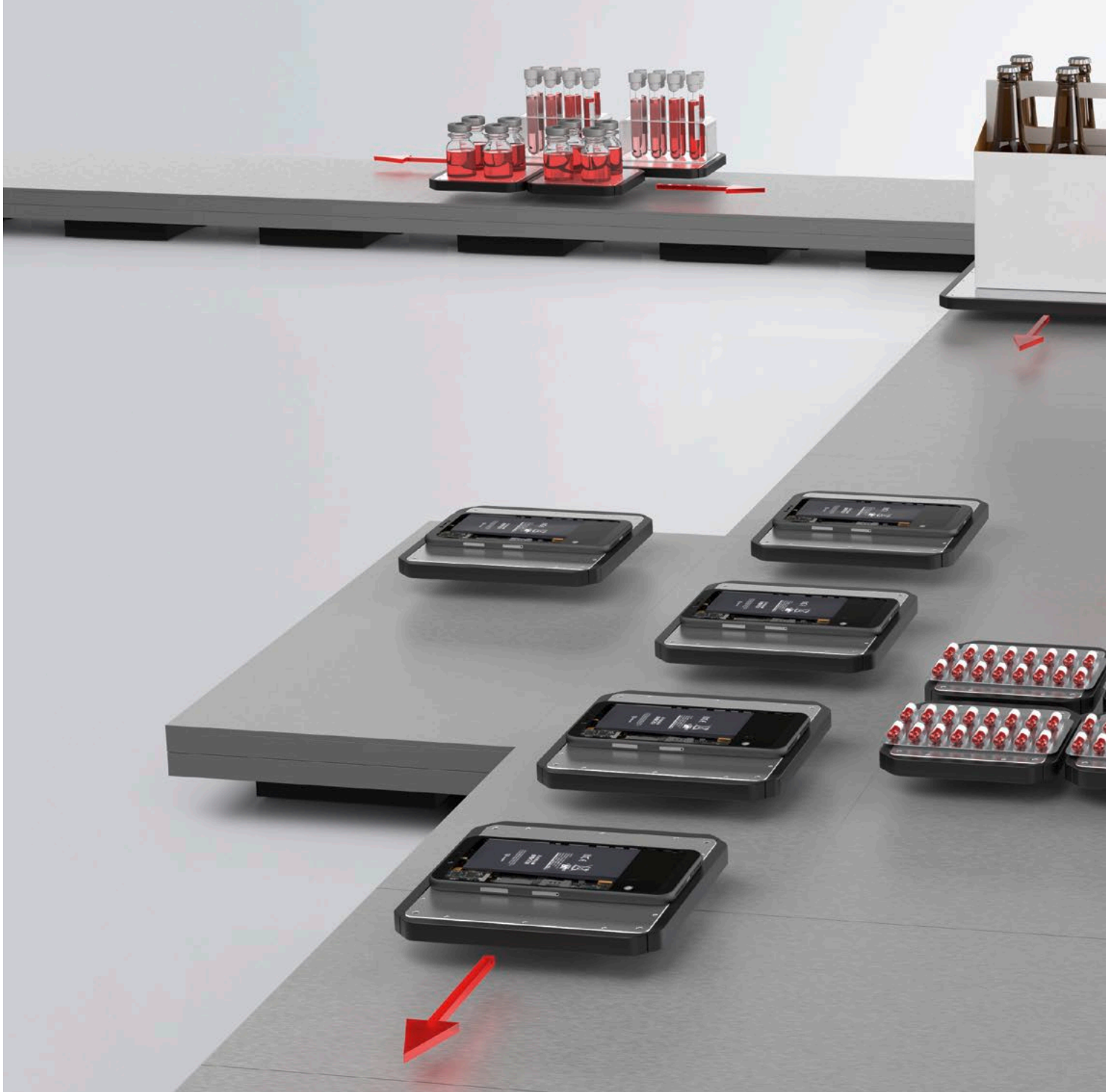- accommodates buffer zones
- easy congestion bypassing

XPlanar movers: handling of any product

The XPlanar mover is the magnetically levitating, freely movable and cable-free 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. For different product sizes and weights, various mover sizes with payloads of up to 4 kg are available. The movers can be mechanically coupled or operated as a group in order to accommodate payloads above 4 kg. In this case, the payload capacity of the entire group is the total of the in-dividual movers' payload capacities. For increased product packing density, movers with an edge length of 115 mm are available. Up to four movers of this type can move simultaneously on a single XPlanar tile. The optional mover identification enables full product traceability through the entire installation and a machine start up without refer-encing. Each mover can be identified at any time independent from its position through a unique identification number. Stainless steel movers with high protection class for hygienic applications are available as well.

0.4 kg payload

APM4220-0000-0000
XPlanar mover, anodized
aluminum housing,
115 mm x 115 mm x 12 mm

1.5 kg payload

APM4330-0000-0000
XPlanar mover, anodized
aluminum housing,
155 mm x 155 mm x 12 mm

4.2 kg payload

APM4550-0000-0000
XPlanar mover, anodized
aluminum housing,
235 mm x 235 mm x 12 mm

1.0 kg payload

APM4330-0001-0000
XPlanar mover, stainless
steel housing,
155 mm x 155 mm x 12 mm

# XPlanar software: centralized control of XPlanar applications

The TF5890 software is fully integrated into the standard TwinCAT environment and controls all functions of the XPlanar system from one central Beckhoff Industrial PC: graphical 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: the user defines 2D tracks on which the movers travel from station to station while automatically avoiding collisions. Complex and superposed 6D movements as well as 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).

Track management:

- freely definable tracks
- automatic collision avoidance
- easy station connections
- can be combined with superposed 6D movements (CAM, CNC with GCode, etc.)

Track 3

Tra

Track 1

Track 2

Track 4

Track 5
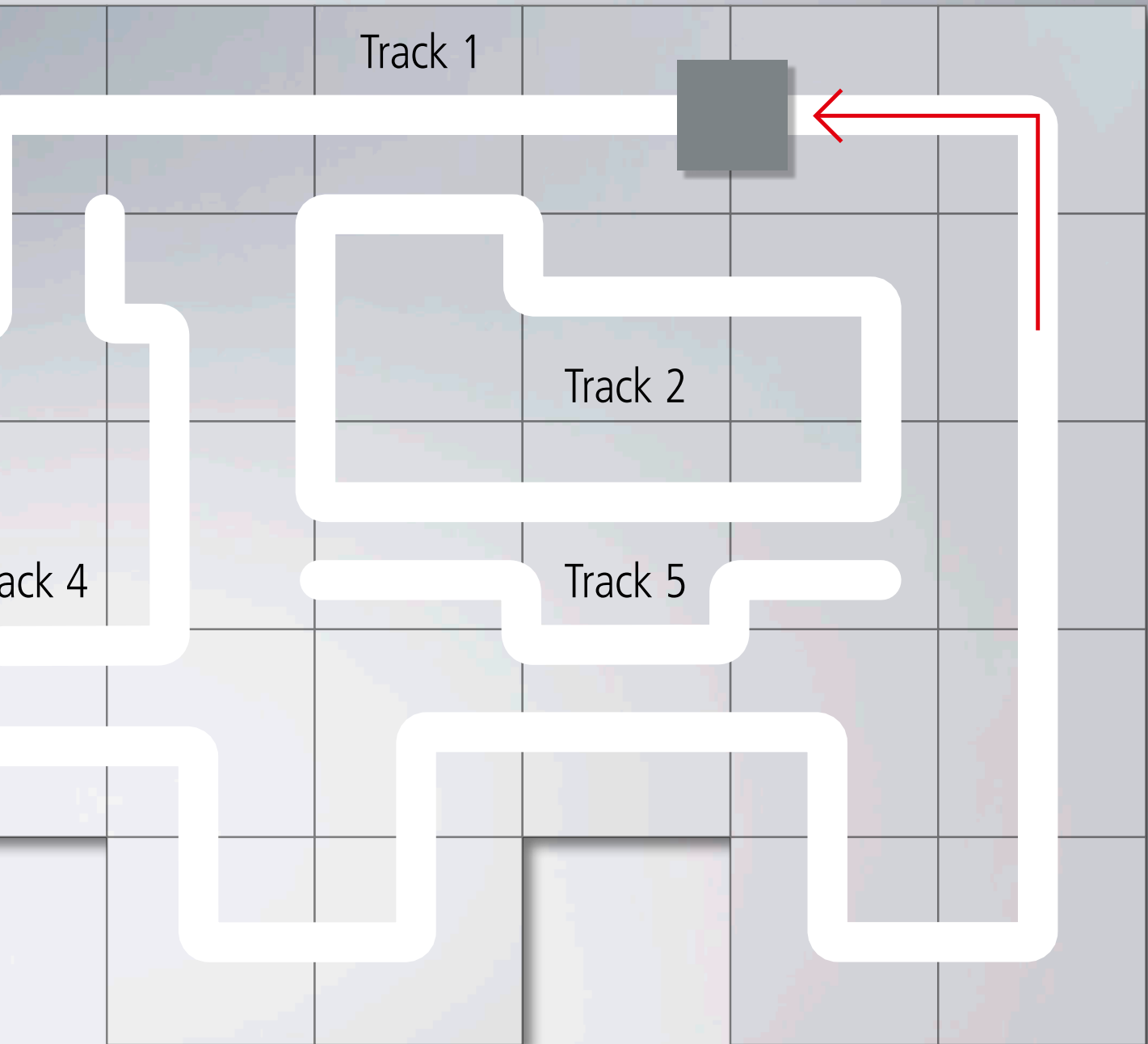
XPlanar applications: revolutionary concepts accross all industries

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 in up to 6 dimensions can be used to substitute 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 moves can be performed with defined amplitudes and frequencies in order to mix substrates. To save time, the shaking movements can be superposed 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.
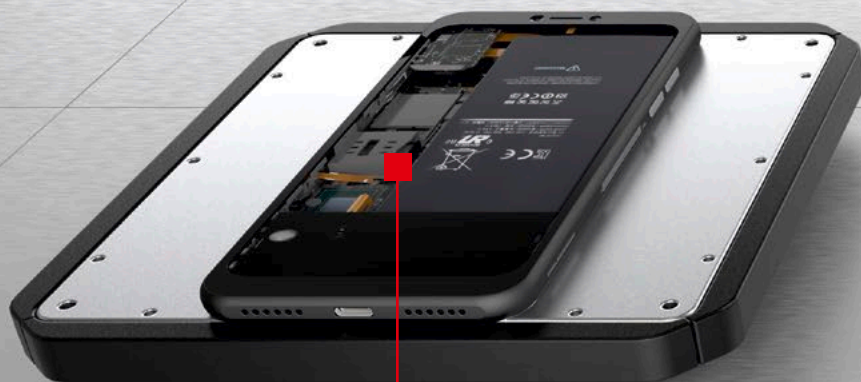
- jerk-free positioning
- high dynamics
- flexible use

- excellent cleanability
- chemically resistant surfaces
- hygienic product handling
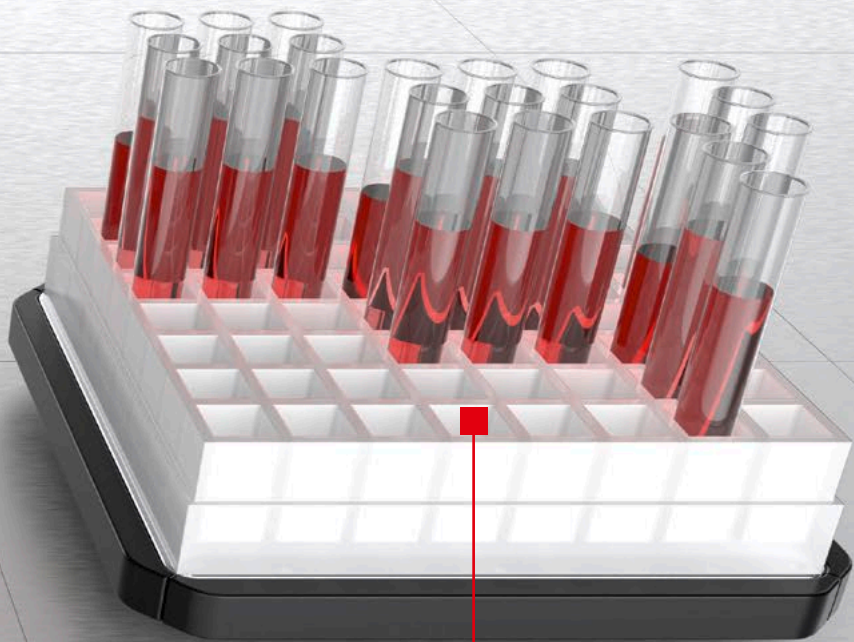
- no spillover of liquids
- no carryover of contaminants
- no abrasion/wear

XPlanar Starter Kits: quick entry into revolutionary technology

With the XPlanar Starter Kits, Beckhoff provides turnkey systems for a quick entry into the XPlanar technology. The Starter Kits are delivered pretested and fully assembled. XPlanar tiles, a robust machine bed, the XPlanar movers, a high-performance Industrial PC and a software example are included. Once they are out of the box, users can start to run their first tests immediately. The Starter Kits provide an overview of the technology's basic capabilities and an impression of the real-world application programming. They make it easy to take the first step toward your first XPlanar application.

APS9000
Starter Kit for planar motor technology:
6 (2 x 3) APS4322 planar motor tiles,
2 APM4330 movers, CX2062 Embedded PC,
software, pre-installed, ready for operation
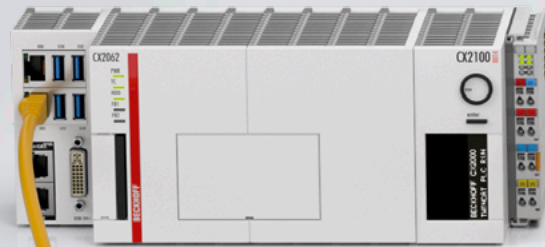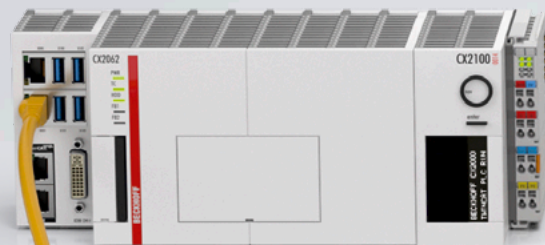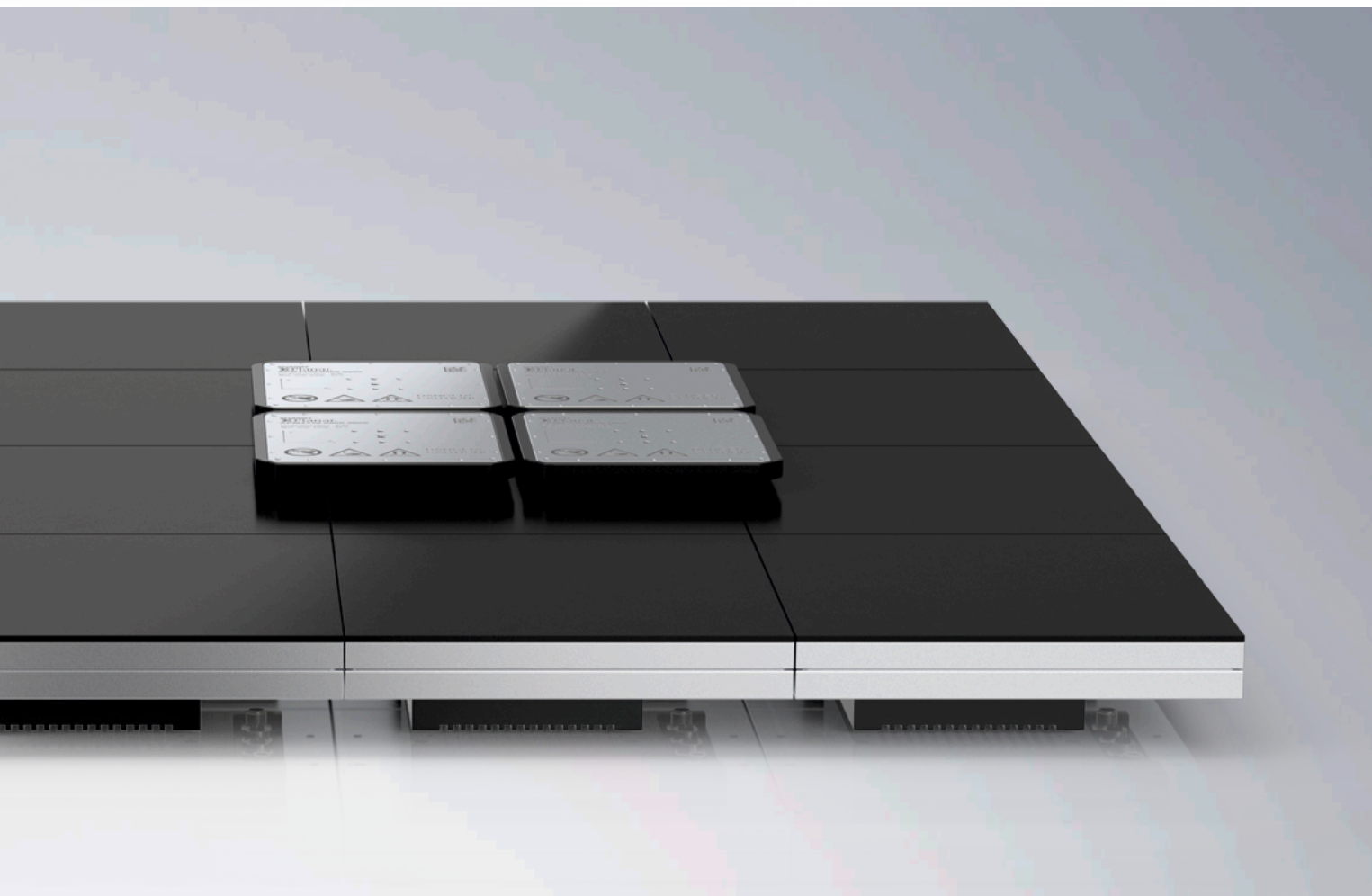
APS9001
Starter Kit for planar motor technology:
12 (4 x 3) APS4322 planar motor tiles,
4 APM4330 movers, CX2062 Embedded PC,
software, pre-installed, ready for operation

Globally available: PC-based control from Beckhoff

New Automation Technology

Beckhoff implements open automation systems using proven PC-based control technology. The product spectrum comprises these main areas: industrial PCs, I/O and fieldbus components, drive technology and automation software. Product lines are available for all areas and can be used as either individual components or as a complete system solution. The Beckhoff "New Automation Technology" philosophy stands for innovative and open control and automation solutions that are used worldwide in a diverse variety of applications ranging from CNC machine tools to intelligent building automation systems.

Globally present on all continents

Beckhoff is present in 75 countries, providing globally active customers with rapid service worldwide and technical support in their local language. Moreover, Beckhoff sees close proximity to customers as a prerequisite for an in-depth understanding of the technical challenges they face.

Beckhoff at a glance

- Headquarters: Verl, Germany
- 2020 sales: €923 million
- Employees worldwide: 4,500
- Sales offices in Germany: 22
- Subsidiaries/representative offices worldwide: 39
- Represented in over 75 countries

(As of April 2021)

Further information

Additional Beckhoff catalogs and flyers are available to download on the Internet.

▶ **www.beckhoff.com/media**

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● Subsidiary

Million €

950
900
850
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1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020

923

Sales development

DK3462-0621

Learn more about XPlanar:
▶ **www.beckhoff.com/xplanar**

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