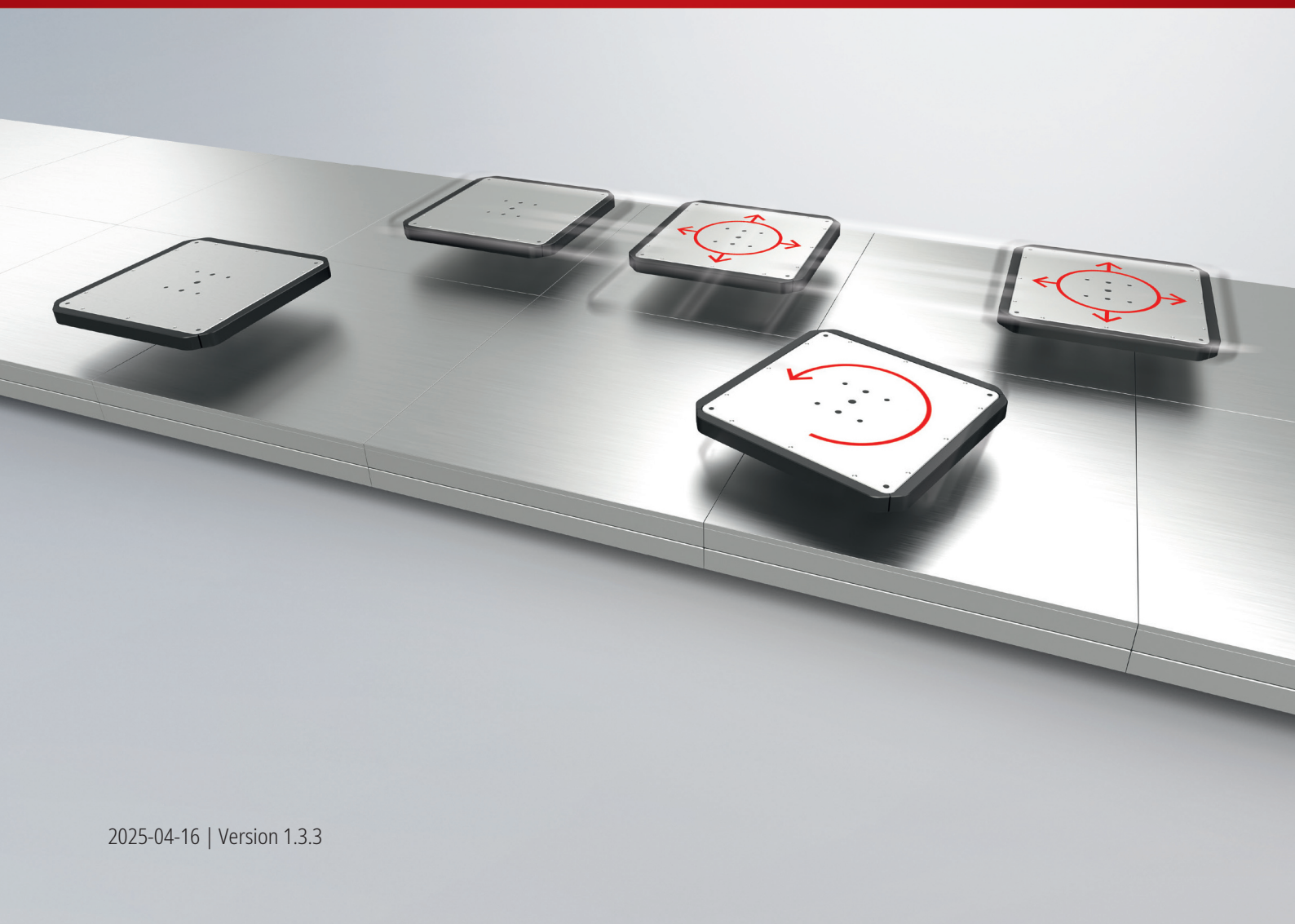


Operating Instructions | EN

XPlanar

Planar Motor System



Documentation notes	5
Disclaimer	5
Version numbers	7
Scope of the documentation	7
Staff qualification	8
Safety and instruction	10
Explanation of symbols	10
Beckhoff Services	12
For your safety	13
Safety pictograms	13
General safety instructions	14
Product overview	16
Tiles	16
Mover	19
Components	23
Product characteristics	27
DataMatrix code	28
Intended use	29
Technical data	30
Definition	30
Boundary conditions	30
Data for operation and environment	31
Tiles	32
Mover	32
XPlanar	33
Dimensional drawings	35
Scope of supply	42
Packaging	42
Transport and storage	43
Conditions	43
Long-term storage	43
Mechanical Installation – Part 1: Tiles	44
Preparation	44
Tile	45
Electrical installation	54
Cabling	54
Connection technology	54
Laying	55
Example circuit	56
Installing cables	58
Grounding the machine bed	61
Functional earth	63
System test	65
Mechanical Installation – Part 2: Mover	66
Mover	66
Mounting tools	72
Mover coupling	74
Commissioning and operation	82
Requirements	82
Commissioning	82

During operation	83
Maintenance and cleaning	84
Cleaning materials	84
Intervals	85
Maintenance work on the mover	86
Replace bumper	86
Accessories	91
ID bumper	91
Fan	92
Cover plug M8	92
Cover plug M12	92
Connector for ZC2000-0000-00xx	93
Torque wrench	93
Decommissioning	94
Disassembly	94
Disposal	95

Disclaimer

Beckhoff products are subject to continuous further development. We reserve the right to revise the operating instructions at any time and without prior announcement. No claims for the modification of products that have already been supplied may be made on the basis of the data, diagrams and descriptions in these operating instructions.

Trademarks

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Patents

The EtherCAT technology is protected by patent rights through the following registrations and patents with corresponding applications and registrations in various other countries:

- EP1590927
- EP1789857
- EP1456722
- EP2137893
- DE102015105702



EtherCAT® is a registered trademark and patented technology, licensed by Beckhoff Automation GmbH.

Limitation of liability

All components in this product as described in the operating instructions are delivered in a specific configuration of hardware and software, depending on the application regulations. Modifications and changes to the hardware or software configuration that go beyond the documented options are prohibited and nullify the liability of Beckhoff Automation GmbH & Co. KG.

The following is excluded from the liability:

- Failure to observe these operating instructions
- Improper use
- Use of untrained personnel
- Use of unauthorized spare parts

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We reserve all rights in the event of registration of patents, utility models and designs.

Version numbers



Provision of revision levels

On request, you can obtain a list of revision levels for changes in the operating instructions.

- Send your request to: info@beckhoff.com

Origin of the document

These operating instructions were originally written in German. All other languages are derived from the German original.

Product features

Only the product properties specified in the current operating instructions are valid. Further information given on the product pages of the Beckhoff homepage, in emails or in other publications is not authoritative.

Scope of the documentation

Apart from these operating instructions, the following documents are part of the overall documentation:

XPlanar	Definition
Commissioning under TwinCAT 3	Commissioning tutorial under TwinCAT 3 including user information on the TC DriveManager 2 and a description of the safety function STO (Safe Torque Off) over FSoE (Safety over EtherCAT)

Staff qualification

These operating instructions are intended for trained control and automation specialists with knowledge of the applicable and required standards and directives.

Specialists must have knowledge of drive technology and electrical equipment as well as knowledge of safe working on electrical systems and machines. This includes knowledge of proper setup and preparation of the workplace as well as securing the working environment for other persons.

The operating instructions published at the respective time of each installation and commissioning is to be used. The products must be used in compliance with all safety requirements, including all applicable laws, regulations, provisions and standards.

Instructed person

Instructed persons have a clearly defined task area and have been informed about the work to be carried out. Instructed persons are familiar with:

- the necessary protective measures and protective devices
- the intended use and risks that can arise from use other than for the intended purpose

Trained person

Trained persons meet the requirements for instructed persons. Trained persons have additionally received training from the machine builder or vendor:

- machine-specific or
- plant-specific

Trained specialists

Trained specialists have received specific technical training and have specific technical knowledge and experience. Trained specialists can:

- apply relevant standards and directives
- assess tasks that they have been assigned
- recognize possible hazards
- prepare and set up workplaces

Qualified electricians

Qualified electricians have comprehensive technical knowledge gained from a course of study, an apprenticeship or technical training. They have an understanding of control technology and automation. They are familiar with relevant standards and directives. Qualified electricians can:

- independently recognize, avoid and eliminate sources of danger
- implement specifications from the accident prevention regulations
- assess the work environment
- independently optimize and carry out their work

Safety and instruction

Read the contents that refer to the activities you have to perform with the product. Always read the chapter For your safety in the operating instructions. Observe the warnings in the chapters so that you can handle and work with the product as intended and safely.

Explanation of symbols

Various symbols are used for a clear arrangement:

- ▶ The triangle indicates instructions that you should execute.
- The bullet point indicates an enumeration.
- [...] The square brackets indicate cross-references to other text passages in the document.
- [1] The number in the square brackets refers to the position in the adjacent figure.
- [+] The plus sign in square brackets indicates ordering options and accessories.

In order to make it easier for you to find text passages, pictograms and signal words are used in warning notices:

DANGER

Failure to observe will result in serious or fatal injuries.

WARNING

Failure to observe may result in serious or fatal injuries.

CAUTION

Failure to observe may result in minor or moderate injuries.



Notes are used for important information on the product. The possible consequences of failure to observe these include:

- Malfunctions of the product
- Damage to the product
- Damage to the environment



Information

This sign indicates information, tips and notes for dealing with the product or the software.



Examples

This symbol shows examples of how to use the product or software.



QR-Codes

This symbol shows a QR code, via which you can watch videos or animations. Internet access is required in order to use it.

You can read the QR code, for example, with the camera of your smartphone or tablet. If your camera doesn't support this function you can download a free QR code reader app for your smartphone. Use the Appstore for Apple operating systems or the Google Play Store for Android operating systems.

If you cannot read the QR code on paper, make sure that the lighting is adequate and reduce the distance between the reading device and the paper. In the case of documentation on a monitor screen, use the zoom function to enlarge the QR code and reduce the distance.

Beckhoff Services

Beckhoff and its international partner companies offer comprehensive support and service.

Support

The Beckhoff Support offers technical advice on the use of individual Beckhoff products and system planning. The employees support you in the programming and commissioning of sophisticated automation systems.

Hotline: +49 5246 963-157
E-mail: xts-support@beckhoff.com
Web: www.beckhoff.de/support

Training

Training in Germany takes place in our training center at the Beckhoff headquarters in Verl, at offices or, by arrangement, at the customer's premises.

Hotline: +49 5246 963-5000
E-mail: training@beckhoff.com
Web: www.beckhoff.de/training

Service

The Beckhoff Service Center supports you with after-sales services such as on-site service, repair service or spare parts service.

Hotline: +49 5246 963-460
E-mail: service@beckhoff.com
Web: www.beckhoff.de/service

Download area

In the download area you can obtain product information, software updates, the TwinCAT automation software, documentation and much more.

Web: www.beckhoff.de/download

Headquarters

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33415 Verl
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Phone: +49 5246 963-0
E-mail: info@beckhoff.com
Web: www.beckhoff.de

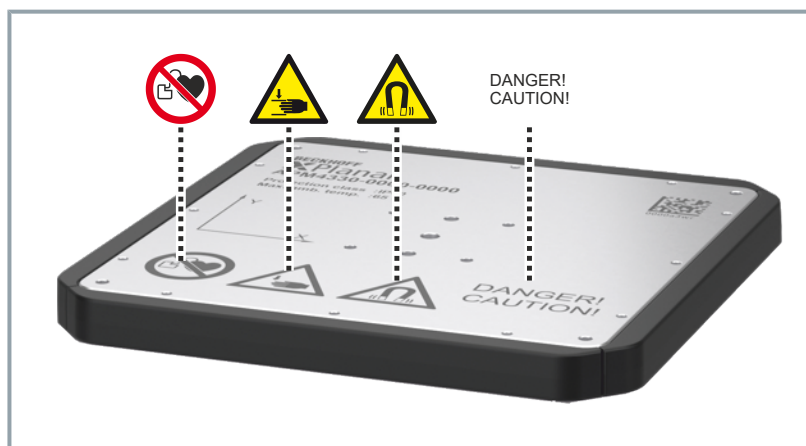
The addresses of the international Beckhoff offices can be found on the Beckhoff website: <http://www.beckhoff.de>

Read the general safety instructions in this chapter. Observe the warnings in these operating instructions for your own safety, the safety of others and the safety of the product.

When working with control and automation products, many dangers can result from careless or incorrect use. Work particularly thoroughly, not under time pressure and responsibly towards other people.

Safety pictograms

On Beckhoff products you will find attached or lasered safety pictograms, which vary depending on the product. They serve to protect people and to prevent damage to the products. Safety pictograms must not be removed and must be legible for the user.



Danger from magnetic fields

Magnetic fields at the individual XPlanar components can be dangerous for people with cardiac pacemakers or magnetically conductive implants and defibrillators, for example. Data carriers or other electronic devices in the vicinity may also be affected or destroyed.



Warning of hand injuries

The strong magnetic field of the movers can cause hand injuries if you grip and transport the mover incorrectly. For transport outside the system always use the transport securing device provided.



Magnetic fields warning

A mover contains strong permanent magnets. These magnets always generate a strong magnetic field, even in de-energized state. Avoid direct contact between movers and ferromagnetic objects. Such as assembly trolleys, tools or machine beds.

DANGER!
CAUTION!

General risk warning

Improper handling of movers may result in injury. Observe the safety instructions for handling the XPlanar unit, the safety pictograms and these operating instructions.

General safety instructions

This chapter provides you with instructions on safety when handling the product. This product is not capable of stand-alone operation and is therefore categorized as an incomplete machine. The product must be installed in a machine or plant by the machine manufacturer. Read the documentation prepared by the machine manufacturer.

Before operation

Danger from magnetic fields

Magnetic fields on individual components of the XPlanar unit pose a risk to:

- people fitted with cardiac pacemakers
- persons with magnetically conducting implants
- implanted and external defibrillators
- magnetic data storage devices, chip cards with magnetic strips and other electronic devices

Maintain a safety distance to all magnetic parts and prevent direct contact between magnetic parts and parts that are sensitive to interference.

Observe the requirements of BGV B 11 for electromagnetic fields (Germany) and applicable national regulations in other countries.

Follow the Mover handling instructions

The risks due to magnetic fields referred to above particularly relate to handling of the movers. The movers can be attracted uncontrollably by contact with magnetic objects. Read the chapter on "Mechanical installation", [Page 44] before handling the movers.

Keep the immediate environment clean

Keep your workplace and the surrounding area clean. Ensure safe working.

Shut down and secure the machine or plant

Shut down the machine or plant. Secure the machine or plant against being inadvertently started up.

Do not use damaged components

Adhere to the specifications from the technical data for storage, transport and operation. Do not use damaged components.

Check safety pictograms

Check whether the designated pictograms are on the product. Replace missing or illegible stickers.

Observe tightening torques

Mount and repeatedly check connections and components, complying with the prescribed tightening torques.

Correctly ground electrical components or modules

Avoid electric shocks due to improper grounding of electrical components or modules. Ground all conductive components according to the specifications in the chapters "Electrical Installation" and "Mechanical Installation".

Use the original packaging only

When shipping, transporting, storing and packing, use the original packaging or non-conductive materials.

During operation

Observe the GND concept

During the installation, follow the common guidelines for grounding electrical components. For grounding please refer to the chapter on Grounding the machine bed.

Do not work on live electrical parts

Ensure that the protective conductor and functional conductor are properly connected. Never loosen electrical connections when live. Disconnect all components from the mains and secure them against being switched on again.

Do not touch hot surfaces

Check the cooling of the surfaces with a thermometer. Do not touch the components during and immediately after operation. Allow the components to cool sufficiently after switching off.

Avoid overheating

Operate the components according to the technical specifications. Refer here to the chapter: "Technical data". Provide for sufficient cooling. Switch the components off immediately if the temperature is too high.

Do not touch any moving or rotating components

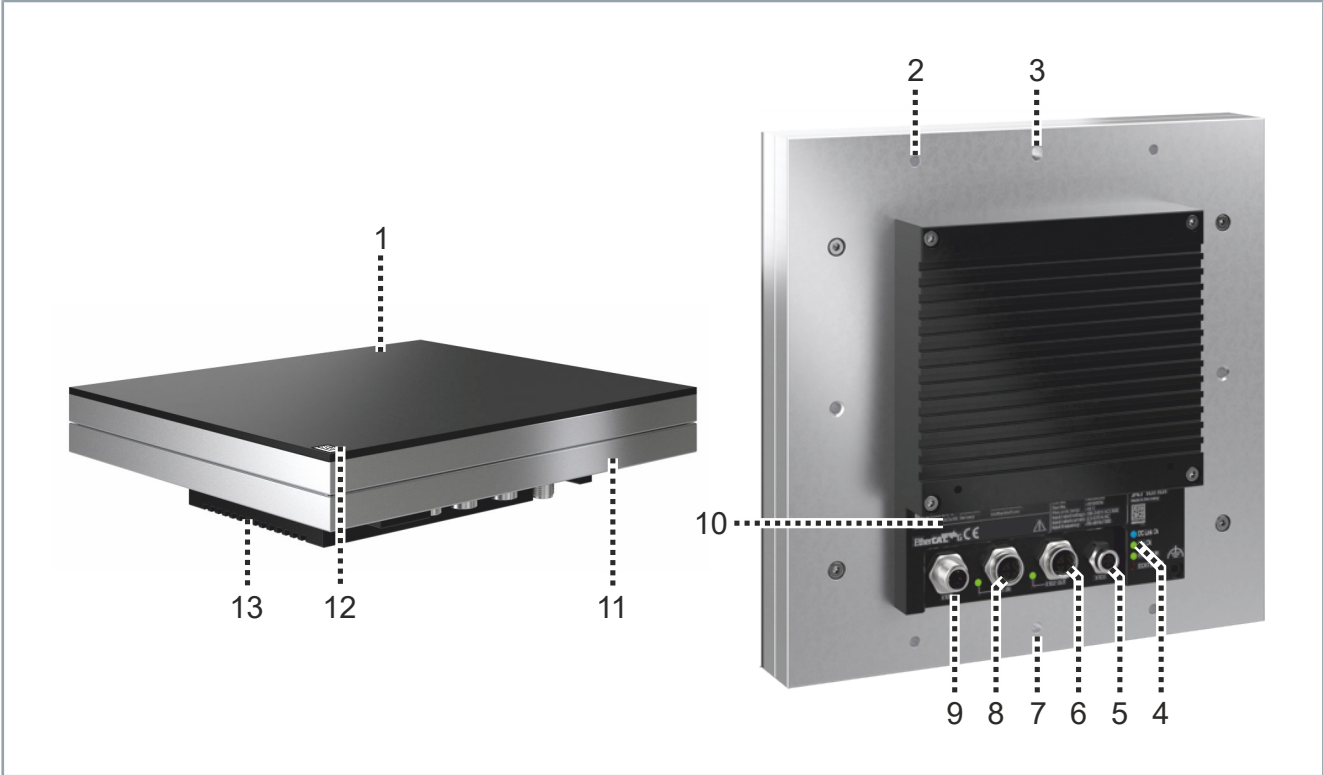
Do not touch any moving or rotating components. Fasten all parts or components on the machine or plant.

After operation

De-energize and switch off components before working on them

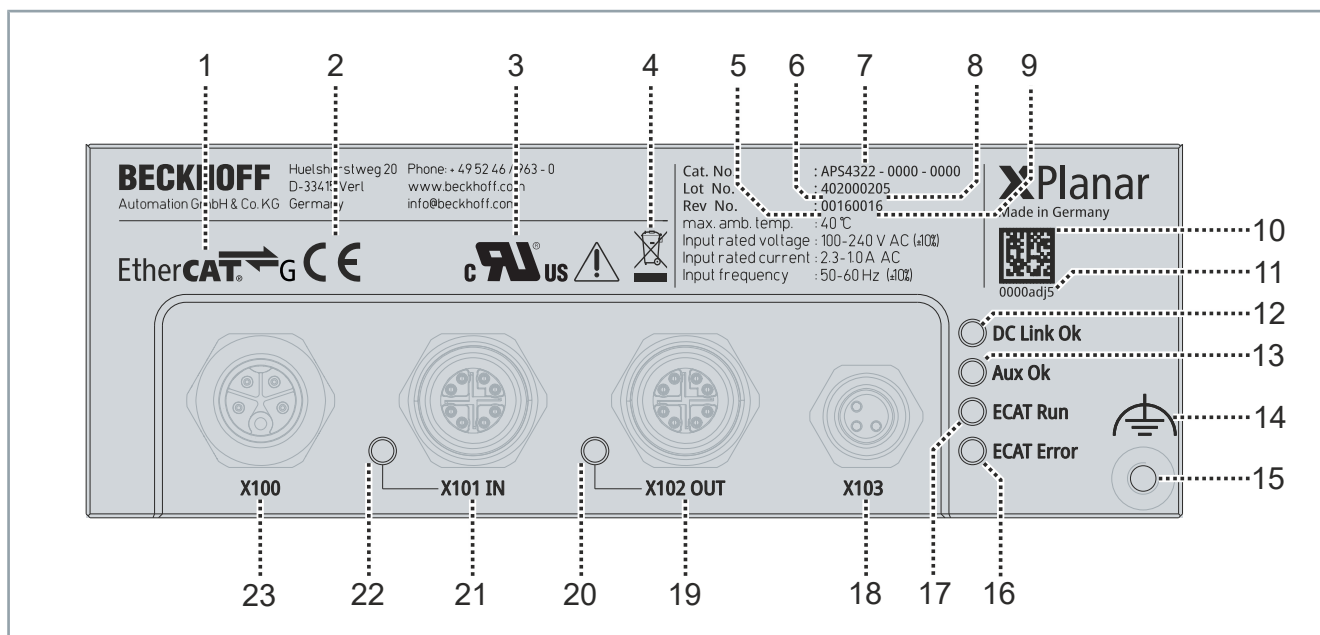
Check the functionality of all safety-relevant devices. Secure the working environment. Secure the machine or plant against being inadvertently started up. Observe the chapter: "Decommissioning".

Tiles



Item number	Explanation
1	Protective film
2	Thread for mounting on the machine bed
3	Elongated hole
4	Status LEDs
5	X103
6	X102 OUT
7	Hole for positioning with locating pins
8	X101 IN
9	X100
10	Name plate
11	Base body
12	Cover

Name plate



Item number	Explanation
1	EtherCAT marking
2	CE conformity
3	cURus approval
4	WEEE compliance
5	XML drive revision number
6	Date of manufacture - week/year
7	Product designation
8	Firmware and hardware revision
9	XML feedback revision number
10	DataMatrix code
11	BTN number
12	Status LED 7V OK
13	Status LED 10V OK
14	Functional earth marking
15	Functional earth connection
16	Status LED EtherCAT Error
17	Status LED EtherCAT Run
18	X103 Fan connection; output
19	X102 OUT EtherCAT connection 2; output
20	Status LED X102 OUT EtherCAT connection 2; output
21	X101 IN EtherCAT connection 1; input
22	Status LED X101 IN EtherCAT connection 1; input
23	X100 Power connection / input

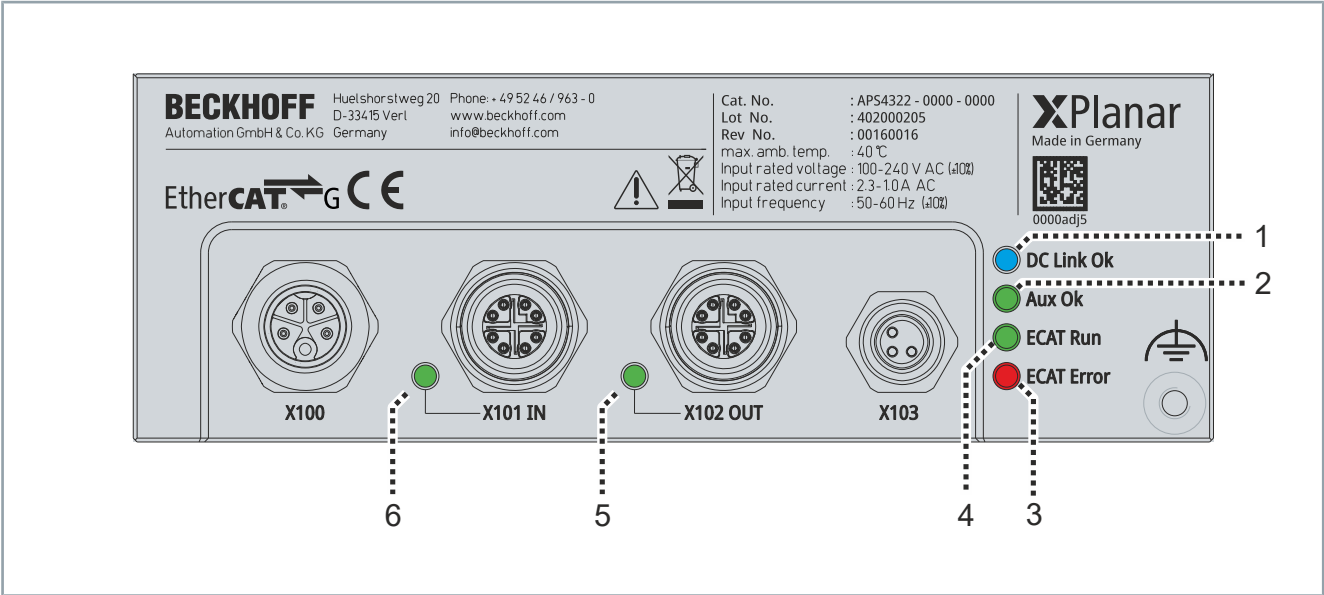
Type key

A P S 4322-0000	Explanation
A	Product area A = Drive Technology

Product overview

A P S 4322-0000	Explanation
P	Series P = Planar motor technology
S	Product type S = Stator
4	System 4 = 40 mm magnet distance
3	Quadrant size (edge length as a multiple of the magnet distance) 3 = 3 x magnet distance
2	Number of quadrants in y-direction 2 = 2 quadrants in y-direction
2	Number of quadrants in x-direction 2 = 2 quadrants in x-direction
0000	Design 0000 = Standard

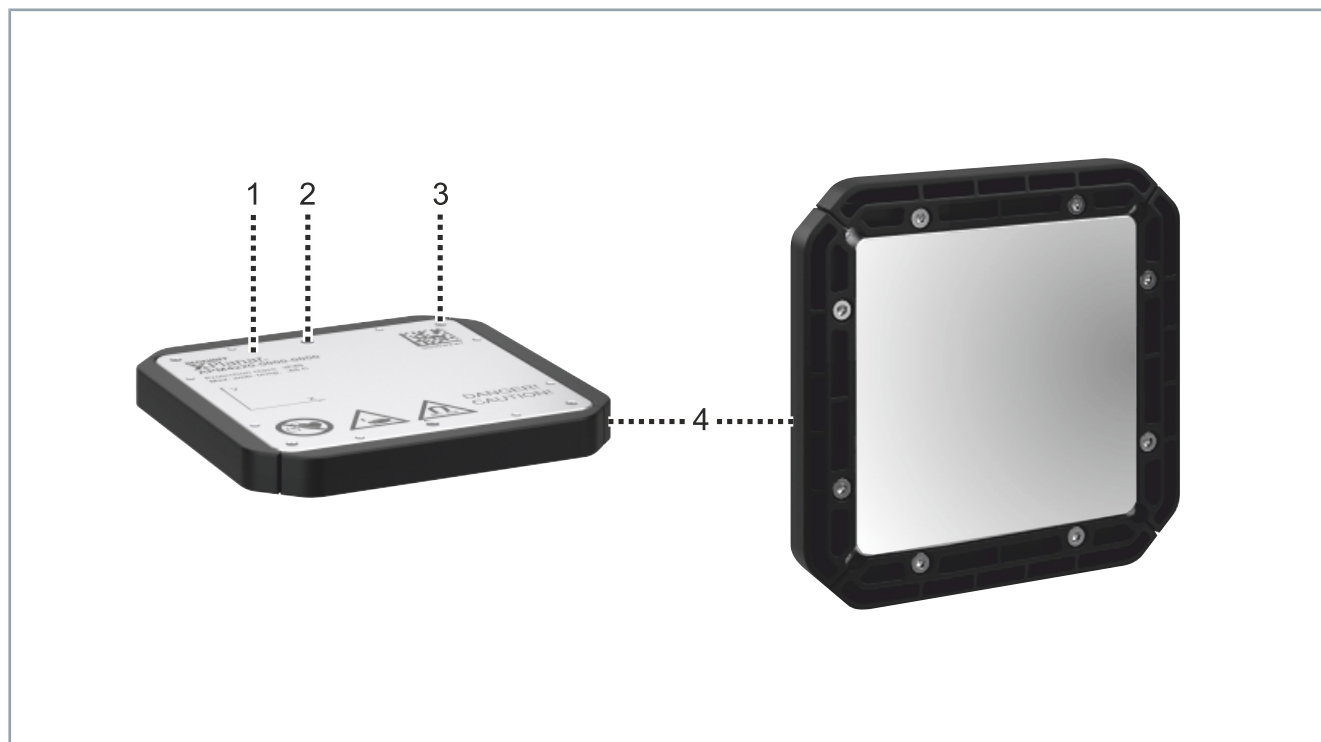
LED status indicator



Item number	Status LED	Status	Meaning
1	DC Link OK	Lights up blue	Power supply established
2	Aux Ok	Lights up green	Control voltage established
3	ECAT Run	Lights up green	EtherCat G data connection established
		off	in ConFig mode in TwinCAT
			Error in EtherCat G data connection
4	ECAT Error	Lights up red	Error in EtherCat G data connection
5	X102 OUT	Flashing green	Data cable plugged into X102 OUT
6	X101 IN	Flashing green	Data cable plugged into X101 IN

Mover

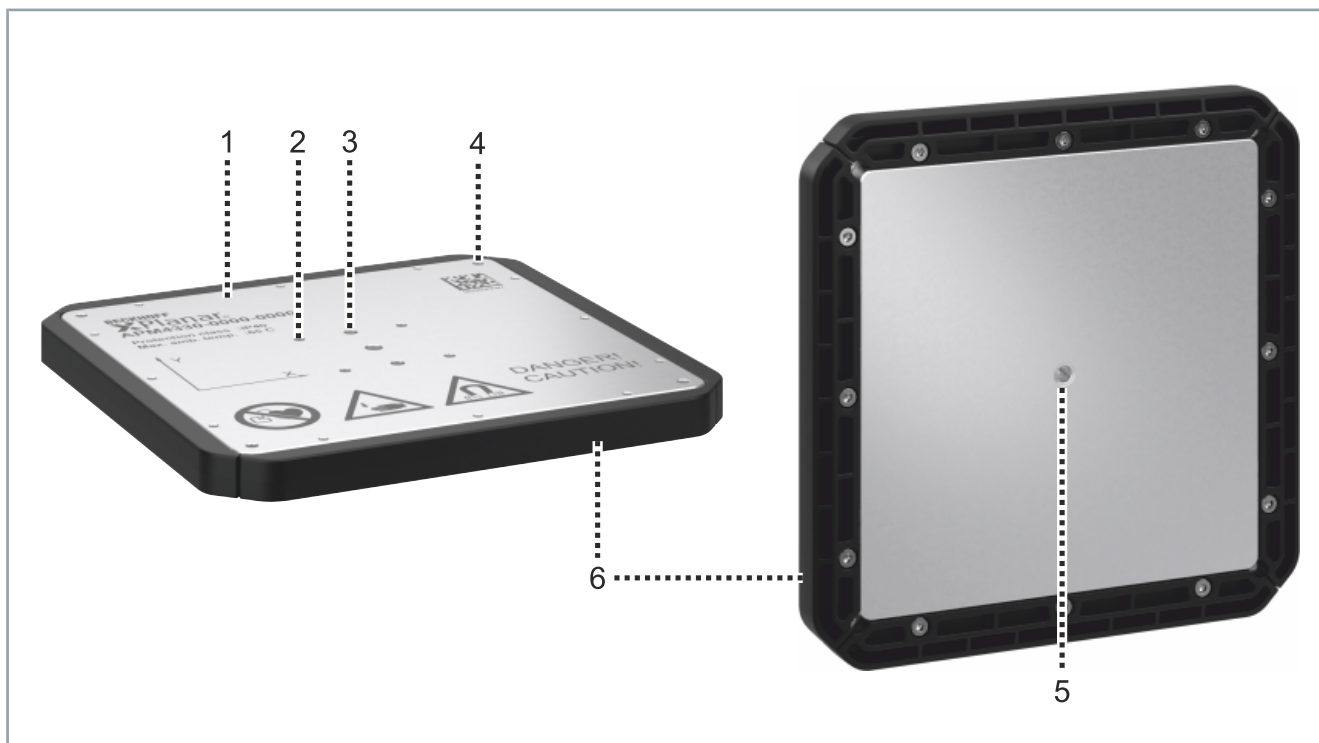
APM4220-0000



Item number	Explanation
1	Base body with magnetic section
2	Locating hole for mounting tools, 2 x
3	Thread for mounting tools, 4 x
4	Bumper

For further information on the threads and holes for mounting tools, please refer to the chapters on "Dimensional drawings", [Page 35] and "Fixing points", [Page 72].

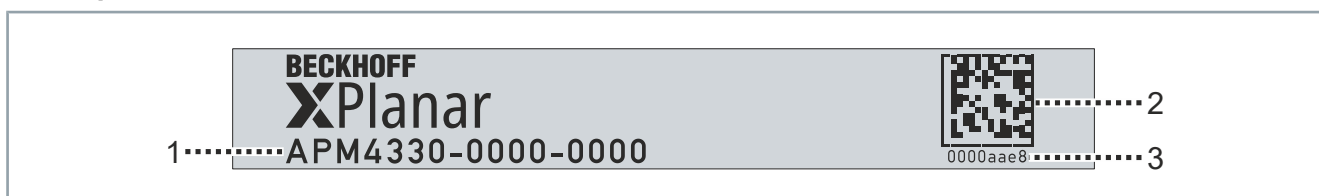
APM4330-0000 and APM4550-0000



Item number	Explanation
1	Base body with magnetic section
2	Thread for mounting tools, 4 x
3	Locating hole for mounting tools, 2 x
4	Thread for mounting tools, 4 x
5	Thread for mounting tools, 1 x
6	Bumper

For further information on the threads and holes for mounting tools, please refer to the chapters on "Dimensional drawings", [Page 35] and "Fixing points", [Page 72].

Name plate

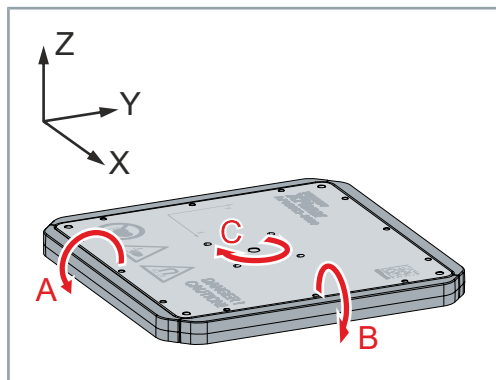


Item number	Explanation
1	Product designation
2	DataMatrix code
3	BTN number

Type key

APM4xx0-0000	Explanation
A	Product area A = Drive Technology
P	Series P = Planar motor technology
M	Product type M = Mover
4	System 4 = 40 mm magnet distance
xx0	Edge length in x and y direction (as a multiple of the magnet distance) 220 = 2 x magnet distance 330 = 3 x magnet distance 550 = 5 x magnet distance
0000	Design 0000 = Standard

Degrees of freedom



The movers have six degrees of freedom and can be moved along the following axes:

Axis	Movement
X	Procedure
Y	Procedure
Z	Raise / Lower
A	Tilting around x-axis
B	Tilting around Y-axis
C	Rotating around Z-axis

Components

A complete XPlanar system consists of:

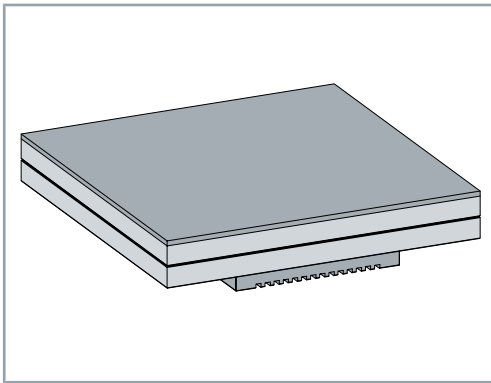
- Tiles
- Movers
- Power cables
- EtherCAT G cables

The individual components are defined via the type key and can be ordered separately or preconfigured as a complete system.

Tile

A system consists of individual tiles that are combined in a machine bed to form a stator surface. The tiles are available in the following design:

APS4322-0000

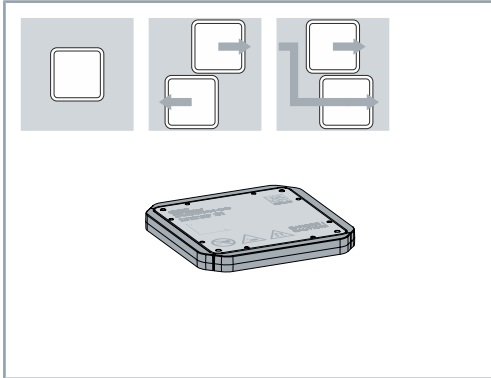


Freely scalable, application-oriented geometries can be implemented by joining 240 x 240 mm APS4322-0000 tiles.

Mover

Once placed on the tiles, the movers move highly dynamically on the top surface of the tiles. Collisions are avoided. While in motion, the movers can move up or down, tilt or rotate. The movers are available in the following versions:

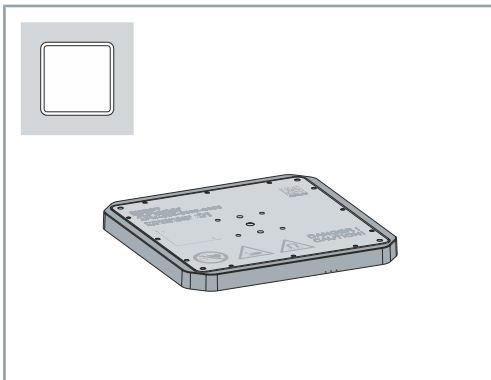
APM4220-0000



The APM4220-0000 is the smallest mover in the APM4xxx family and measures 113 x 113 mm. A large number of screw-on points enable mounting of workpiece carriers and attached parts.

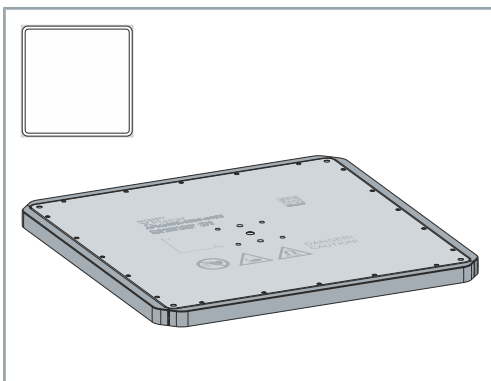
Two APM4220-0000 movers can be moved bidirectionally or overtake each other on an APS4322-0000 tile.

APM4330-0000



The next size up in the APM4xxx family is the APM4330-0000, which measures 155 x 155 mm. A large number of screw-on points enable mounting of more complex, individual workpiece carriers and attached parts.

APM4550-0000

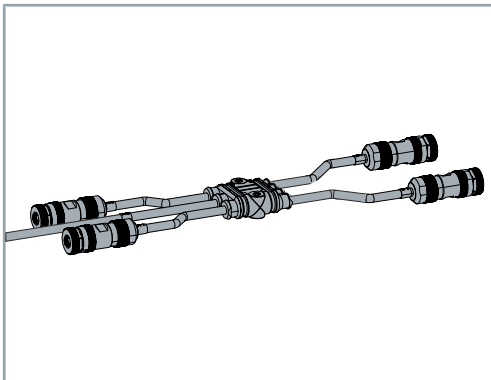


The APM4550-0000 is the largest and most powerful mover in the APM4xxx family. It measures 235 x 235 mm. A large number of screw-on points enable mounting of more complex, individual workpiece carriers and attached parts.

Power cable

Power is supplied to the tiles via star distributors or T-connectors. The star distributors are available in the following versions:

ZC2000-0000-0018

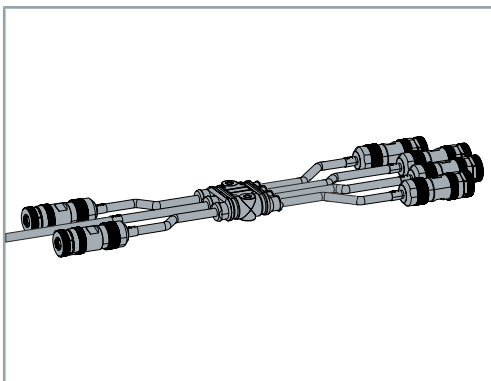


The 4-way star distributor supplies power to up to four tiles.

Connector: 4 x M12, K-coded

Cable length: 5 m supply line

ZC2000-0000-0017



The 6-way star distributor supplies power to up to six tiles.

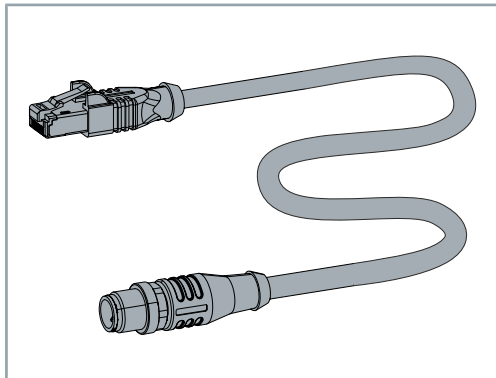
Connector: 6 x M12, K-coded

Cable length: 5 m supply line

EtherCAT G cable

Data is exchanged between the tiles and the control cabinet via EtherCAT G cables. The EtherCAT G cables are available in the following versions:

ZK1096-8191-0xxx

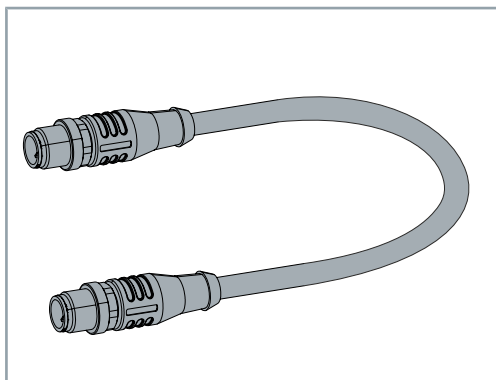


The cable is used for data exchange between tiles and the control cabinet and is available in different lengths.

Connector: RJ45 to M12, X-coded

Order number	Explanation
ZK1096-8191-0xxx	0xxx - cable length: 0005 - 0.5 m cable ... 0100 - 10 m cable

ZK1096-8181-0xxx



The cable enables data exchange between tiles and is available in different lengths. This cable can be used to establish a daisy chain connection.

Connector: M12 to M12, X-coded

Order number	Explanation
ZK1096-8181-0xxx	0xxx - cable length: 0005 - 0.5 m cable ... 0100 - 10 m cable

Product characteristics

Free-floating movers

The free-floating movers can move over arbitrarily arranged tiles without jerking or touching. The movers are kept apart by electro-magnetic forces. The movers can be positioned precisely and highly dynamically via traveling magnetic fields.

No impurities

Liquids can be moved without spilling and are not distributed in the plant.

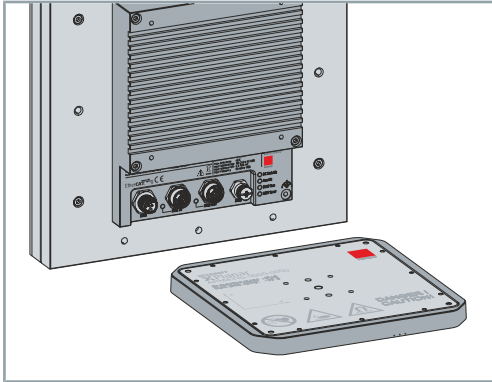
High flexibility

Depending on the need for surface area, you can use the tiles to create different variants in size and geometry. Alternatively, the tiles can be combined to create long travel paths.

Examples of solutions that can be implemented:

- Setting up a waiting zone
- Overtaking sections to avoid congestion
- Combination of outward and return movement
- Circular movements

DataMatrix code



The DataMatrix code can be found on all tiles and movers. If there is no Beckhoff Traceability Number (BTN) under the DataMatrix code, you can read it out via the DataMatrix code.

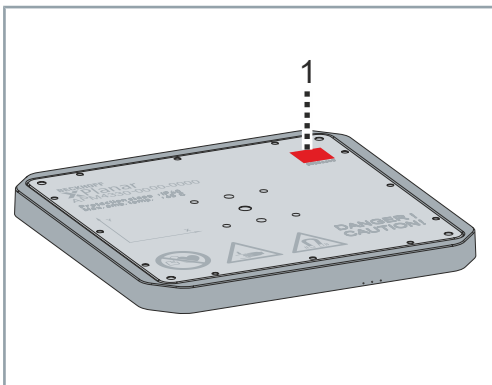
For example, you can read the DataMatrix code with the camera of your smartphone or tablet. If your camera does not support this feature, you can download a free QR code reader app or barcode reader app. Use the appropriate app distribution platform for your smartphone operating system.

Internet access is not required to use the app and to read out these DataMatrix codes.

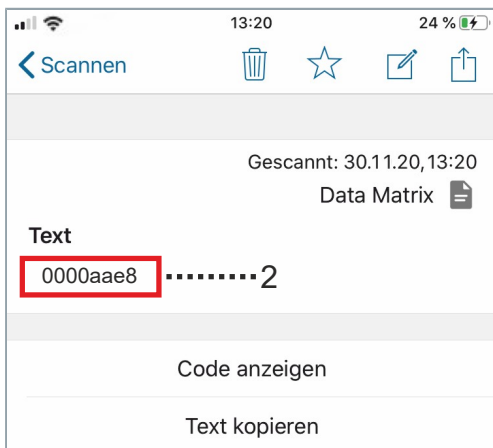


Example scan on a mover

This example shows how to read the BTN on a smartphone screen after a scan.



► Scan the DataMatrix code [1]



► Read the BTN [2] from the screen of your end device via the camera app or the reader app

Intended use

The XPlanar may be operated exclusively for the activities foreseen and defined in this documentation, taking into account the prescribed environmental conditions.

The components are to be installed in electrical systems or machines and only put into operation as integrated components of the system or machine.

All components of the XPlanar are intended only to be programmed and commissioned with the help of the Beckhoff TwinCAT automation software.



Read the entire drive system documentation:

- This translation of the original instructions
- Translation of the original instructions for the control computer
- Complete machine documentation provided by the machine manufacturer

Improper use

Any use exceeding the permissible values specified in the Technical data is considered improper and therefore prohibited.

The XPlanar is not suitable for use in the following areas:

- in ATEX zones without a suitable housing
- in areas with aggressive environments, for example aggressive gases or chemicals

The relevant standards and directives for EMC interference emissions must be complied with in residential areas.

Definition

The following sections contain definitions of terms, boundary conditions, operating data and technical data.

Boundary conditions

All data are based on 24 °C ambient temperature and constant tile and mover temperature. The data can have a tolerance of +/- 10 %. Deviations between individual movers are possible.

Technical terms

Absolute accuracy [mm or mrad]

Specification of the difference between an expected set position and the mean value of the actual position resulting from approaching the set position from different directions (multi-directional). The absolute accuracy is valid within a tile and is defined as the difference between the set position and the actual position of the positioning system.

Standstill repeatability [mm or mrad]

Specification of how accurately the system positions when approaching a position from the two directions (bidirectionally). The standstill repeatability is to be evaluated as the average difference between the actual position and the set position and is the most important measure for the assessment of a positioning system. It defines the variance around the mean value of the actual positions for a large number of positionings.

The variance of the positions is illustrated by the Gauss distribution or normal distribution. The standstill repeatability is defined by three standard deviations (3σ) with a probability of 99.74 %.

Synchronization accuracy [mm or mrad]

Specification of the fluctuations that the system exhibits in the position during a position-controlled movement at a constant set velocity of 200 mm/s. The synchronization accuracy depends on the load on the movers and the associated inertias in all 6 spatial directions, the controller settings, the target velocity and also any mechanical misalignment between the tiles.

Data for operation and environment

Beckhoff products are designed for operation under certain environmental conditions, which vary according to the product. The following specifications must be observed for operation and environment in order to achieve the optimum service life of the products.



Operate the XPlanar only under the specified conditions

Operate the Beckhoff XPlanar only under the operating and ambient conditions specified in this chapter. This ensures a long service life and proper operation.

The service life of the system may be shortened at temperatures above 40 °C. Speak to our Applications Department in case of deviating environmental conditions and operating states of your machine or plant.

Environmental requirements	
Climate category - operation	2K3 according to EN 60721
Ambient temperature during operation [°C]	+5 to +40
Ambient temperature during transport [°C]	-25 to +65
Ambient temperature during storage [°C]	-25 to +65
Power derating	For site altitudes higher than 1000 to 2000 m above sea level and 40 °C: 1.5 % per 100 m
Installation altitude [m]	≤ 2000*
Permissible humidity in operation	15 % to 95 % relative humidity, no condensation
Degree of pollution	2 according to IEC 60664-1

* For applications at greater installation altitudes, please contact your local Beckhoff office or support@beckhoff.com

Specifications for intended use	
Ventilation	via convection
Insulation material class	F according to IEC 60085; UL1446 class F
Protection rating	IP40
Installation position	Horizontal, stator surface upwards
Vibration resistance, horizontal, stator facing upwards	Conforms to EN 60068-2-6
Shock resistance	Conforms to EN 60068-2-27
EMC requirements	Conforms to EN61000-6-2 / EN61000-6-4
Approvals	CE cURus
Overvoltage category	III according to IEC 60664-1

Tiles

Tiles	APS4322
Design	Standard
Maximum angle of rotation C axis [°]	±5
Maximum position resolution [µm; °]	1 X, Y, Z; 0.001 A, B, C
Dimensions [mm]	240 x 240 x 66

Mover

Mover	APM		
	4220	4330	4550
Velocity [m/s]	2		
Acceleration without payload [m/s ²]	10		
Maximum payload at 1 mm flight height [kg]	0.6	1.5	4.0
Surface	Aluminum housing (blasted), underside plastic film		
Dimensions L x W x H [mm]	113 x 113 x 12	155 x 155 x 12	235 x 235 x 12

XPlanar

Electrical data	XPlanar		
Auxiliary supply (control voltage)			
Input voltage [V _{DC}]	24 ±20 %		
Input current in standby [A]	0.25		
Input current with mover [A]	0.5		
Input current with mover and fan [A]	0.85		
Max. current consumption 24 V [ADC]			
without fan	0.5		
with fan	0.85		
Power supply			
Input voltage [V _{AC}]	100 to 240 ±10 %		
Input frequency [Hz _{AC}]	50 to 60 ±10 %		
Input current [A _{AC}]	1.0 to 2.3		
Inrush current peak at 230 V [A]	7.3		
Inrush current peak at 115 V [A]	3.65		
Power consumption per tile			
in standby, without mover, at 24 V [W]	6		
in standby, without mover, at mains voltage [W]	2		
Maximum, continuous [W]	240		
Maximum, short-term [W]	< 400		
Tiles per power supply	1 to 10		
Average power consumption per mover at 1 mm flight height	APM		
	4220	4330	4550
	*	35	*
	*	120	*

* For further information contact your local Beckhoff office or support@beckhoff.com.

Mechanical data			
Tiles	APS		
	4322		
Length [mm]	240		
Width [mm]	240		
Height [mm]	66		
Weight [g]	5725		
Mover	APM		
	4220	4330	4550
Length [mm]	113	155	235
Width [mm]	113	155	235
Height [mm]	12	12	12
Weight [g]	628	1237	3414
Protection rating			
Standard housing version	IP40		

Properties			
Aluminum components tile	anodized		
Aluminum components mover	blasted		
Stator surface	painted		
System size	XPlanar		
Tiles per EtherCAT G master	10		
Max. number of EtherCAT G masters	10		
System properties			
Mover	APM		
	4220	4330	4550
Maximum flight height			
without load [mm]	*	5	*
Repeatability			
XY-axis [μm]	± 15	± 10	± 10
Z-axis [μm]	± 15	± 10	± 10
A-axis [mrad °]	± 0.5 ± 0.029	± 0.5 ± 0.029	± 0.17 ± 0.01
B-axis [mrad °]	± 0.5 ± 0.029	± 0.5 ± 0.029	± 0.17 ± 0.01
C-axis [mrad °]	± 0.5 ± 0.029	± 0.5 ± 0.029	± 0.2 ± 0.012
Number of movers per CPU core	*	1 to 2	*

* For further information contact your local Beckhoff office or support@beckhoff.com.

Dimensional drawings



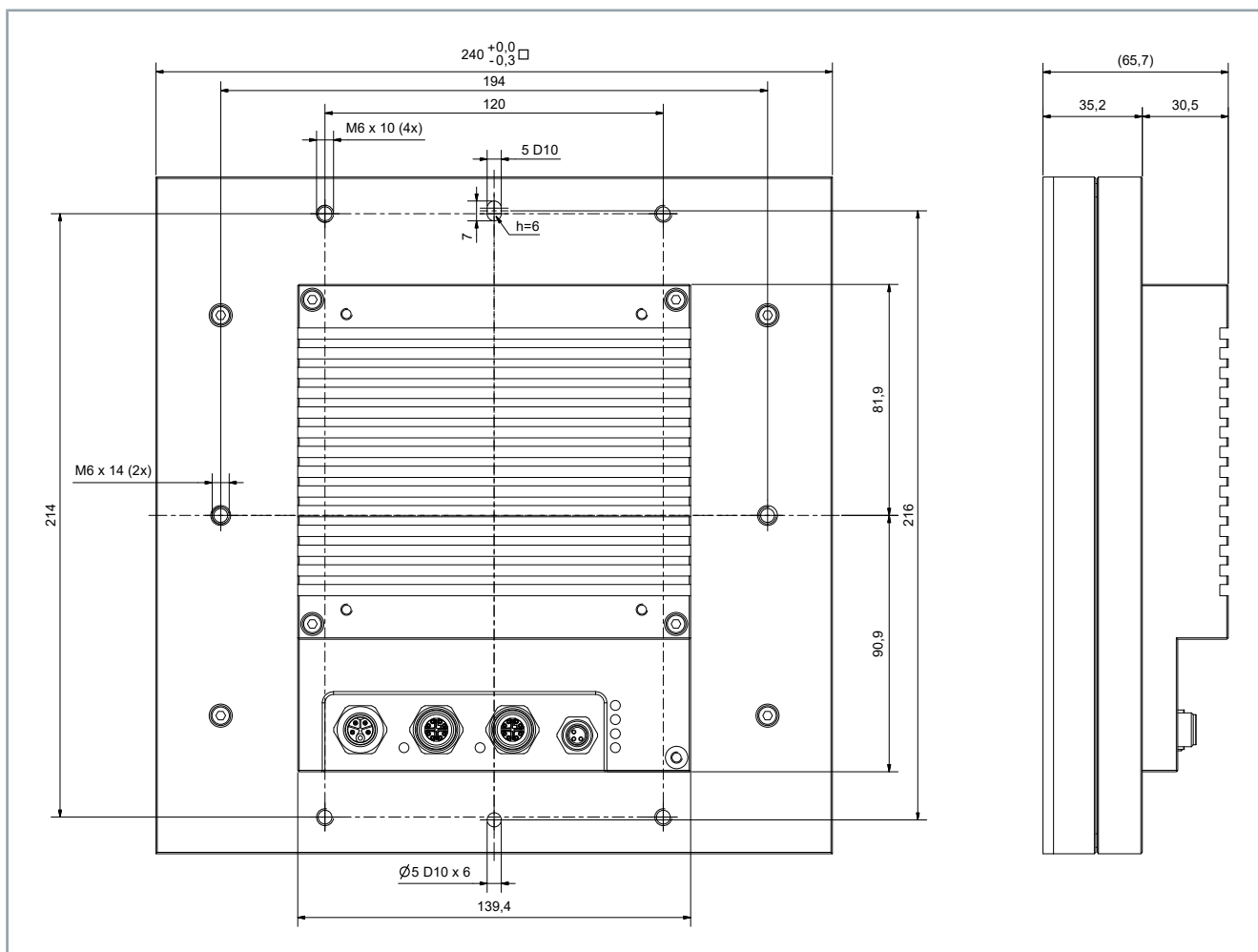
Dimensional drawings and 3D models online

You have the option to download the dimensional drawings and 3D models of the individual components from the Beckhoff website:
www.beckhoff.de/download

Tiles

All figures in millimeters

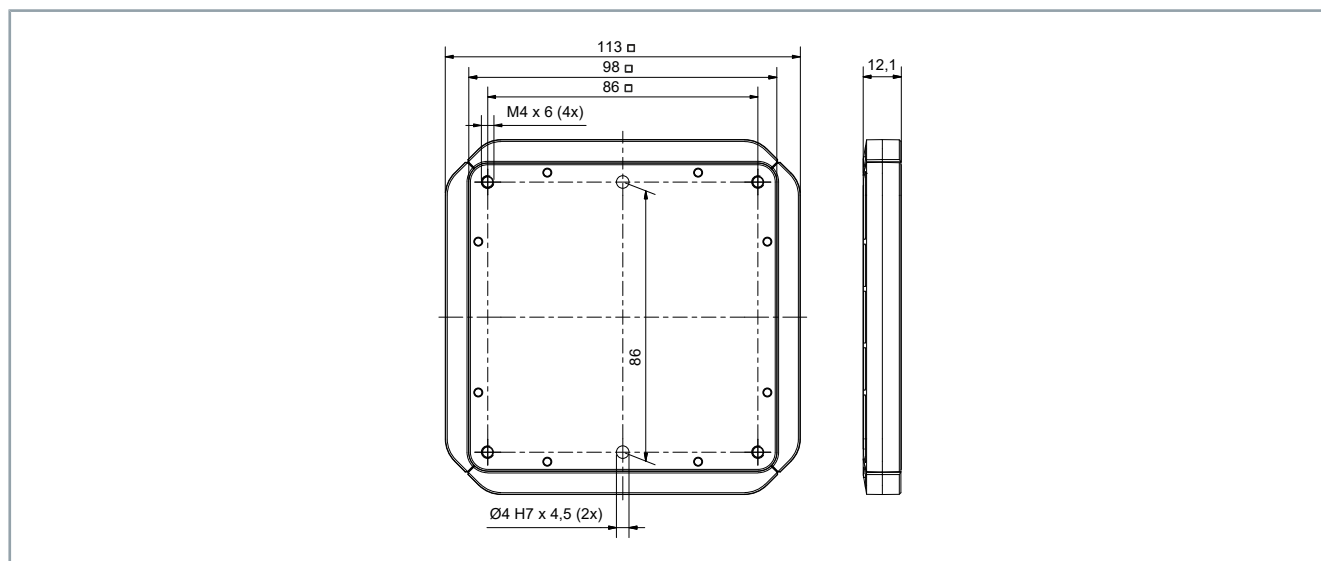
APS4322-0000



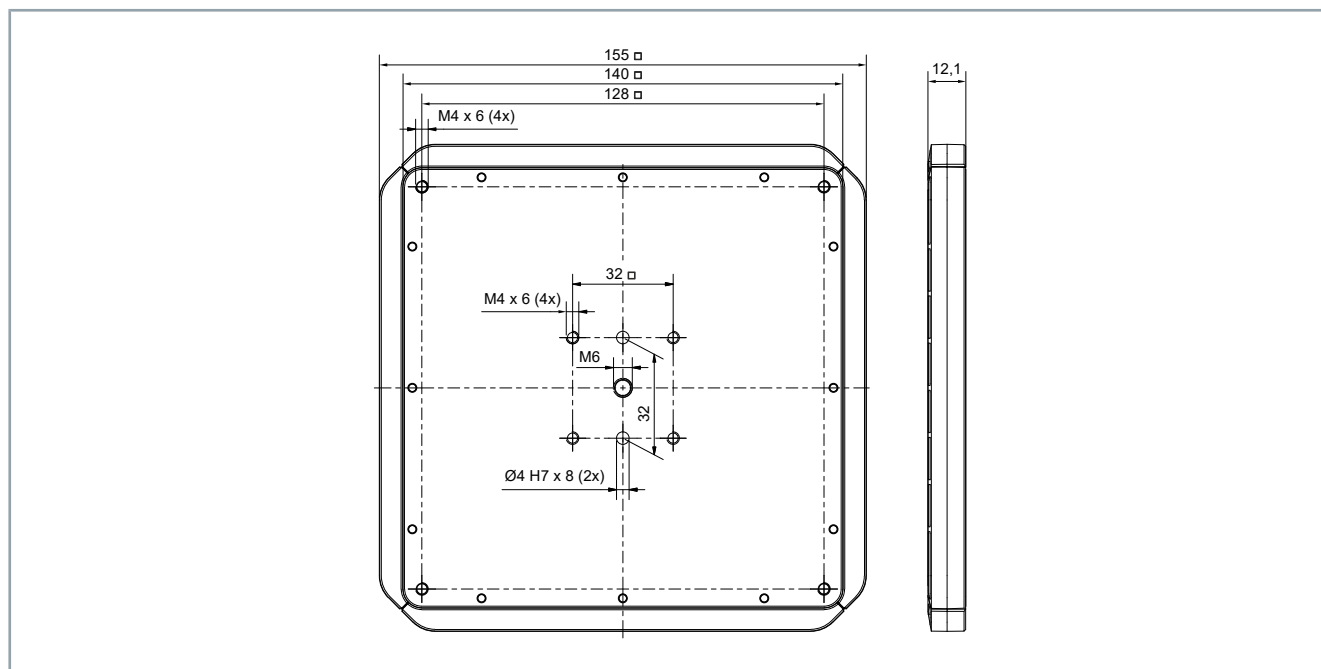
Mover

All figures in millimeters

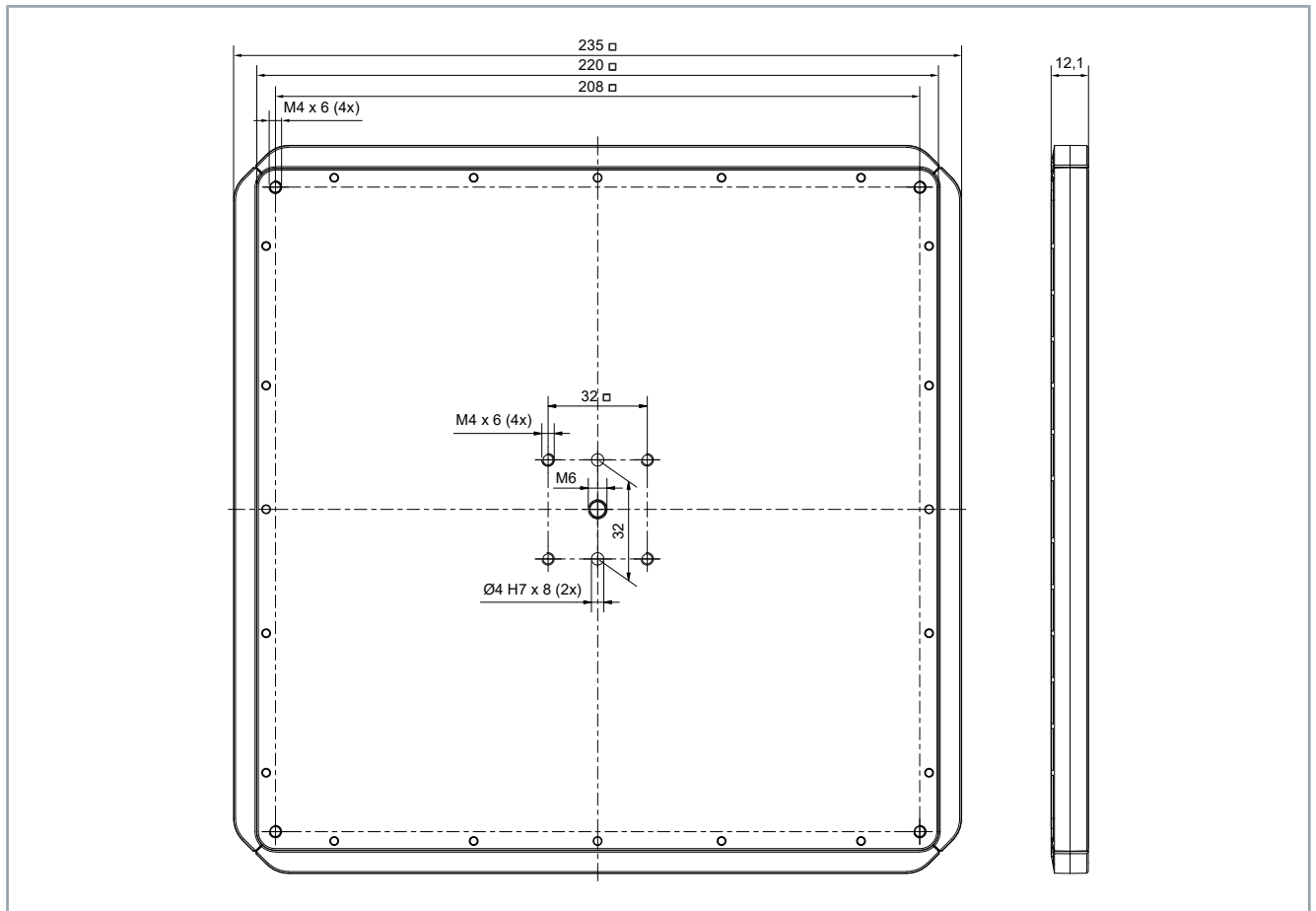
APM4220-0000

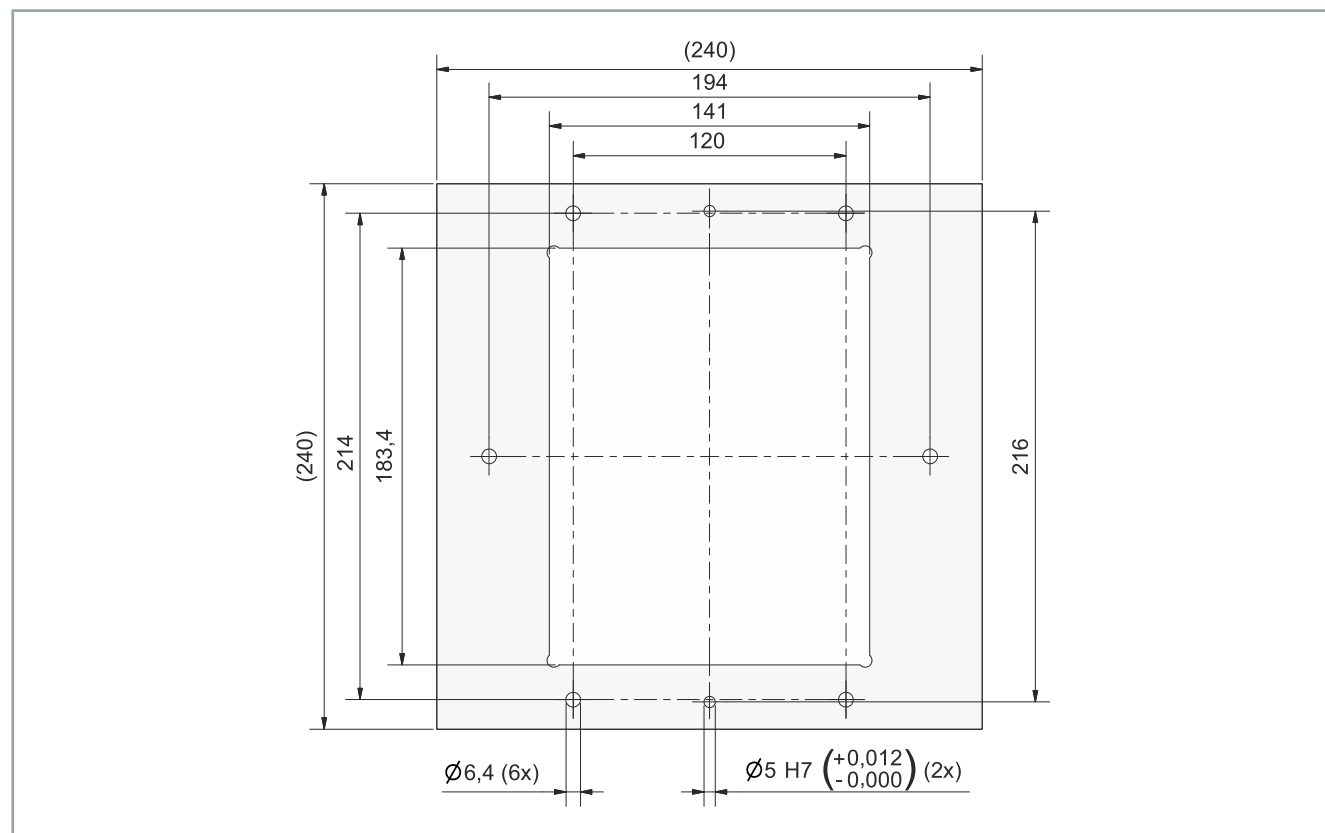


APM4330-0000

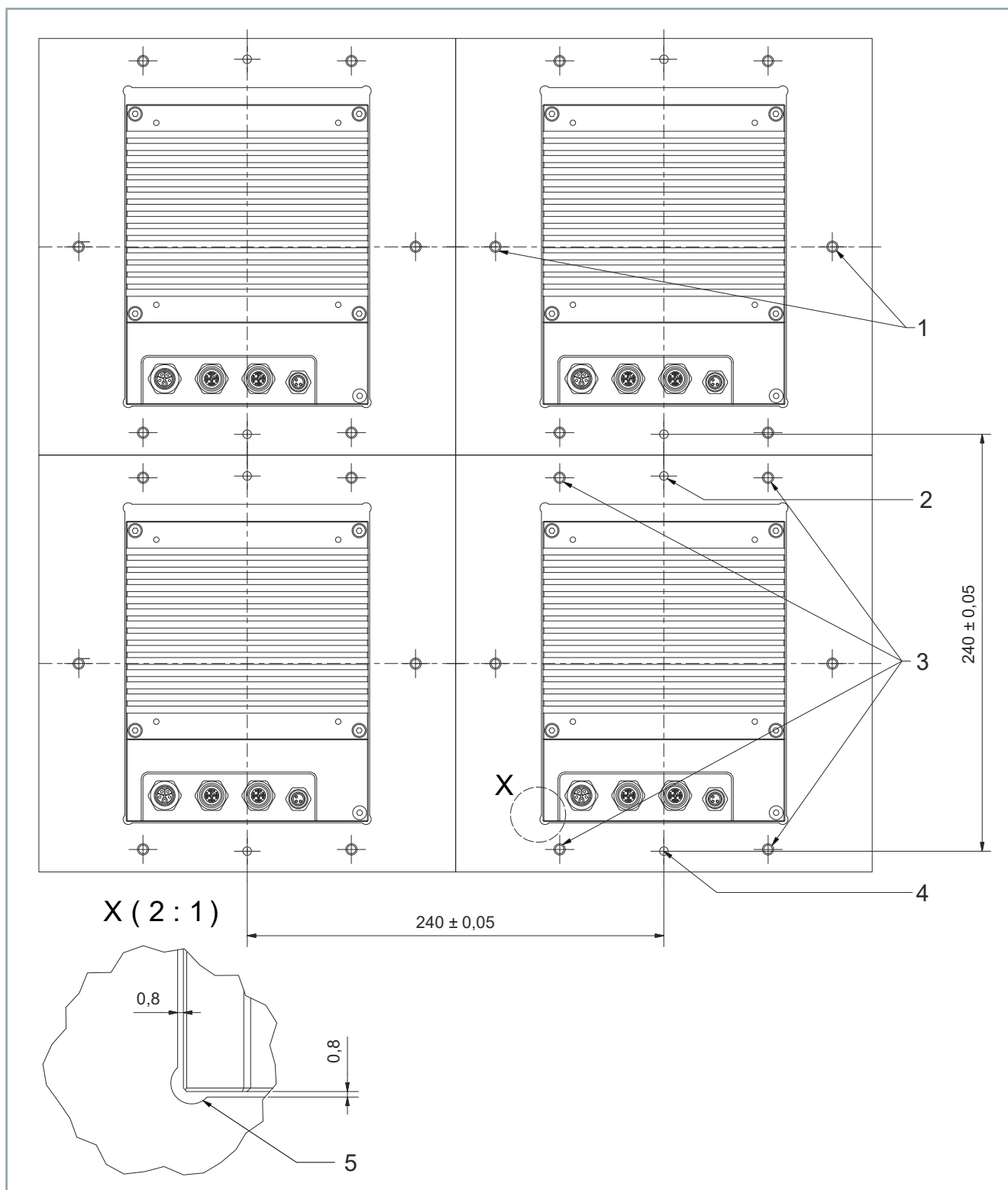


APM4550-0000

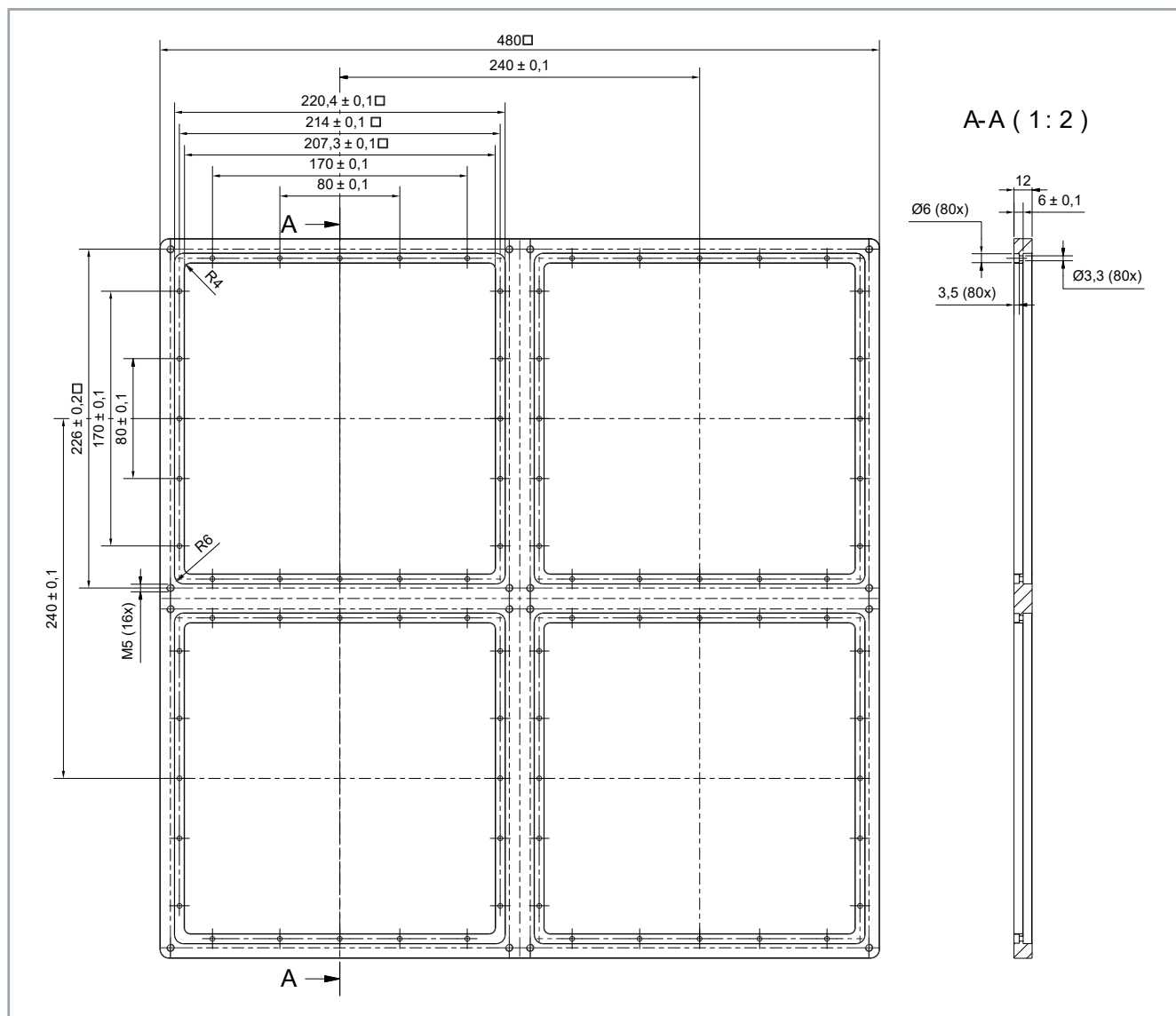




2 x 2

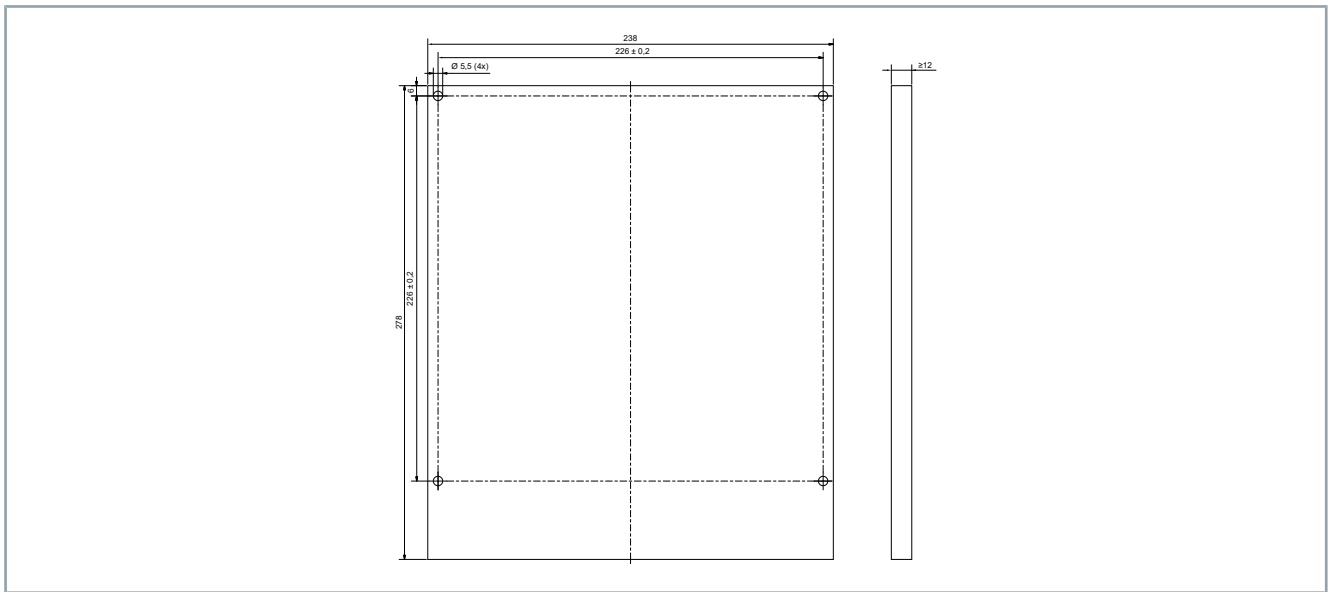


Item number	Name
1	Drilling pattern for fastening with two screws
2	Position of the elongated hole in the tile
3	Drilling pattern for fastening with four screws
4	Position of the locating hole in the tile
5	Ensure there is sufficient space at the corners



Assembly aid sample design

All figures in millimeters



**Check the scope of supply for missing or damaged parts**

Check your delivery for completeness. If any parts are missing or became damaged during transport, contact the carrier, vendor or our service department immediately.

Packaging

Instructions for handling are printed on the packaging:

Dimensions

The table below shows the dimensions of the packaging in mm:

Carton	Height	Width	Depth
Tiles	192	336	229
Mover	94	245	231

WARNING

Never transport the mover without a cover

The cover weakens the magnetic field and protects electrical components from magnetic influences.

The strong magnetic field of the movers can cause crushing injuries. Furthermore, EMC interference with electrical components may occur.



Avoid damage to the components and loss of guarantee

Observe the conditions and the following chapters on transport and storage.

Disregarding the conditions can lead to damage to the components and the voiding of the guarantee.

Conditions

Take care during transport and storage to avoid damage to individual XPlanar components. Observe the following chapters and maintain the following conditions:

- Climate category: 2K3 according to EN 60721
- Temperature: -25 °C to +65 °C, maximum fluctuation 20 K/hour
- Use of the vendor's original packaging

Long-term storage



Perform recurring inspections

Check the XPlanar state and condition every six months.

Damage to the XPlanar or failure to carry out maintenance can shorten the service life of the installed components and parts.

Prevent the formation of condensation

Keep the ambient temperature constant. Avoid solar radiation and high air humidity.

Condensation water can lead to damage during subsequent operation or to rust formation.

The XPlanar components can be stored for shorter or longer periods. Beckhoff recommends always using the original packaging for storage.



Mounting example

This chapter provides information about installing an XPlanar. The assembly is described based on a simple symmetrical system with 3 x 4 tiles as an example.



Observe the order of assembly

Assemble the XPlanar one step at a time. Insert the tiles one after the other into the machine bed. This avoids complications with positioning and mounting individual tiles at the end of the first part of the mechanical installation.

Preparation

Before you start installing the tiles, you need to provide a suitable machine bed.

Technical aids

You need the following aids for the mechanical installation:

- Suitable torque wrench
- Suitable screwdrivers
- Soft-faced hammer
- Lint-free cloth

Machine bed

The machine bed is not part of the scope of supply and must be provided by the customer.

Beckhoff recommends the following material for the milled machine bed:

- Aluminum



Dimensional drawings and 3D models online

The dimensional drawings and 3D models for the machine bed are available for download from the Beckhoff website: www.beckhoff.de/download

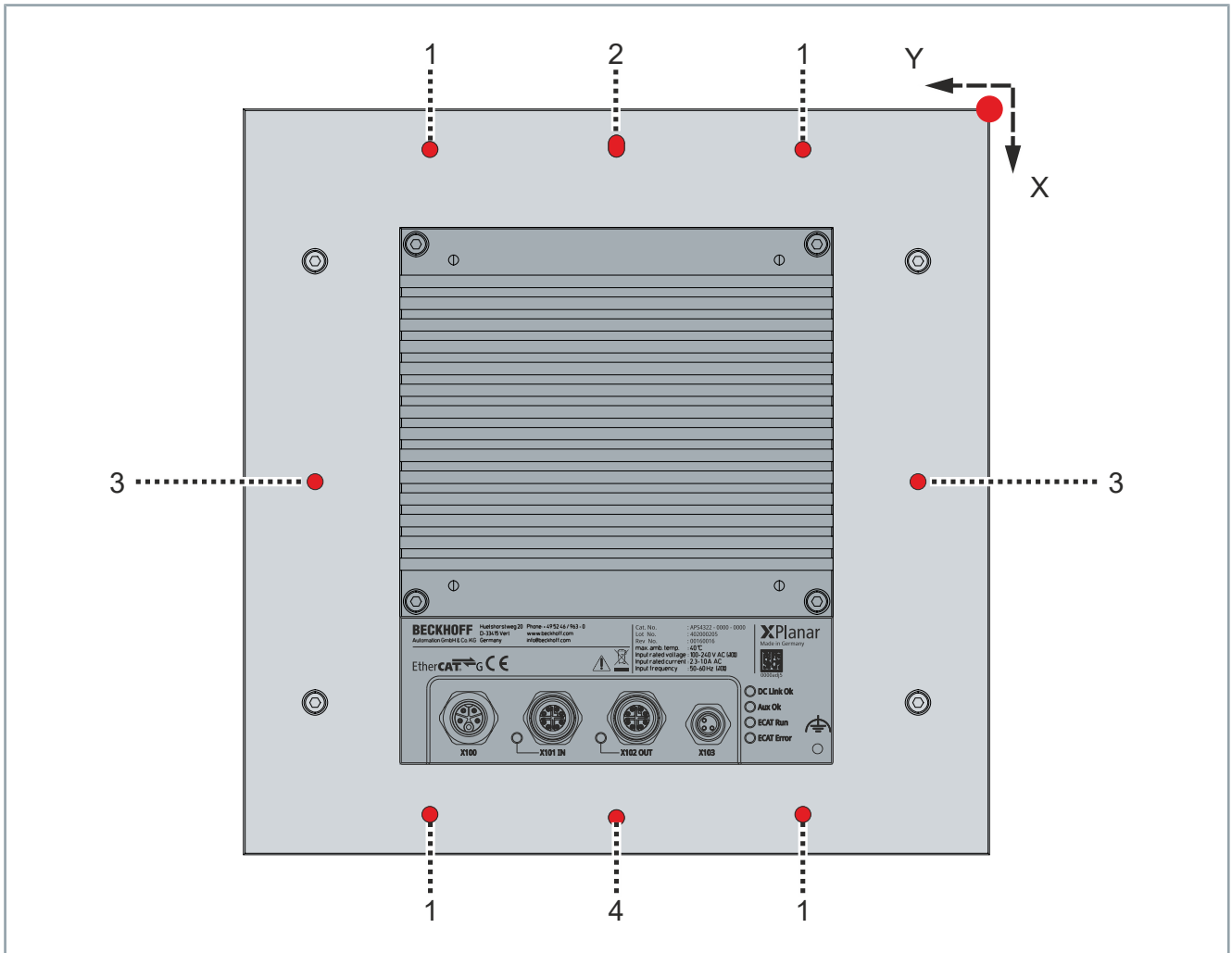
Distance

In order to facilitate assembly and maintenance work, sufficient clearance to the underside of the machine bed is required. Ensure adequate cooling of the tiles by providing adequate space below the tile, by installing a fan [+] or by using a water-cooled machine bed.

Tile

Each tile can be fixed at any position in the prefabricated machine bed. Each tile must be fixed with two locating pins and at least two screws. Depending on the position and load on the tile, four or six screws can be used for fastening.

Fixing points



Number	Name
1	Thread for mounting on the machine bed with four screws*
2	Elongated hole for locating pin
3	Thread for mounting on the machine bed with two screws*
4	Locating pin hole
●	Point of origin

* To fix the tile with six screws, use fixing points [1] and [3]

Screws and locating pins

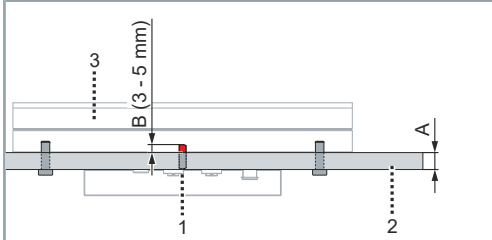


Ensure correct length of the screws and locating pins

Make sure that the screws and locating pins have the correct length in order to obtain a flat tile surface and to avoid damage to the tile.

Ensure correct tolerance of the locating pins

The D5 locating pins must have an m6 tolerance.



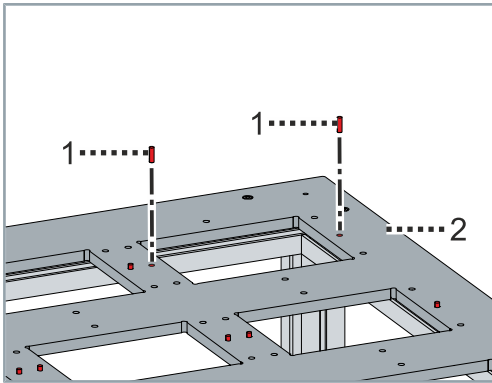
The length of the screws [1] and locating pins [2] for fixing the tiles depends on the height X of the machine bed [3].

Beckhoff recommends the following screw depths in the tile:

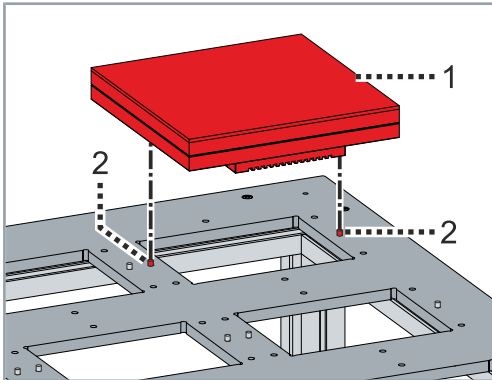
- The M6 screws [1] for fastening the tiles should protrude between 6 and 9 mm from the machine bed [3].
- The D5 locating pins [2] for fastening the tiles should protrude between 3 and 5 mm from the machine bed [3].

For further information on the maximum screw depths into the tile, please refer to the chapter on "Dimensional drawings", [Page 35].

Mounting



- Insert all locating pins [1] into the machine bed [2]



- Position the tile [1] with the locating pin hole and the elongated hole on the locating pins [2]

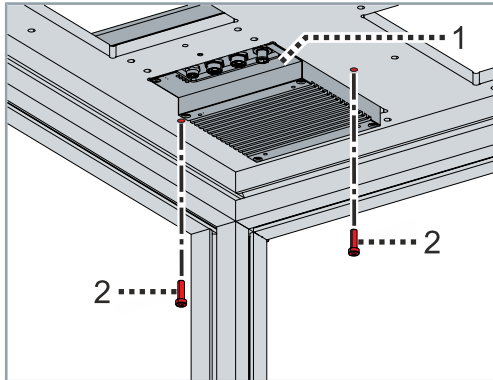


Fastening the tiles depending on position and load

Each tile must be fastened with at least two screws. Depending on the position and load on the tile, four or six screws can be used for fastening.

To fasten the tile with six screws, all six mounting holes have to be used.

With two screws

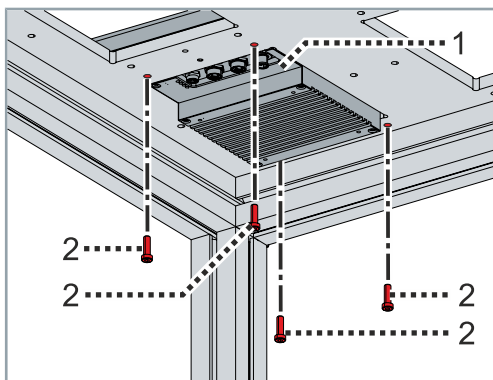


► Fasten the tile [1] with two screws [2]

► Observe tightening torques:

Component	Tightening torque [Nm]
M6 screws	7

With four screws




► Fasten the tile [1] with four screws [2]

► Observe tightening torques:

Component	Tightening torque [Nm]
M6 screws	7

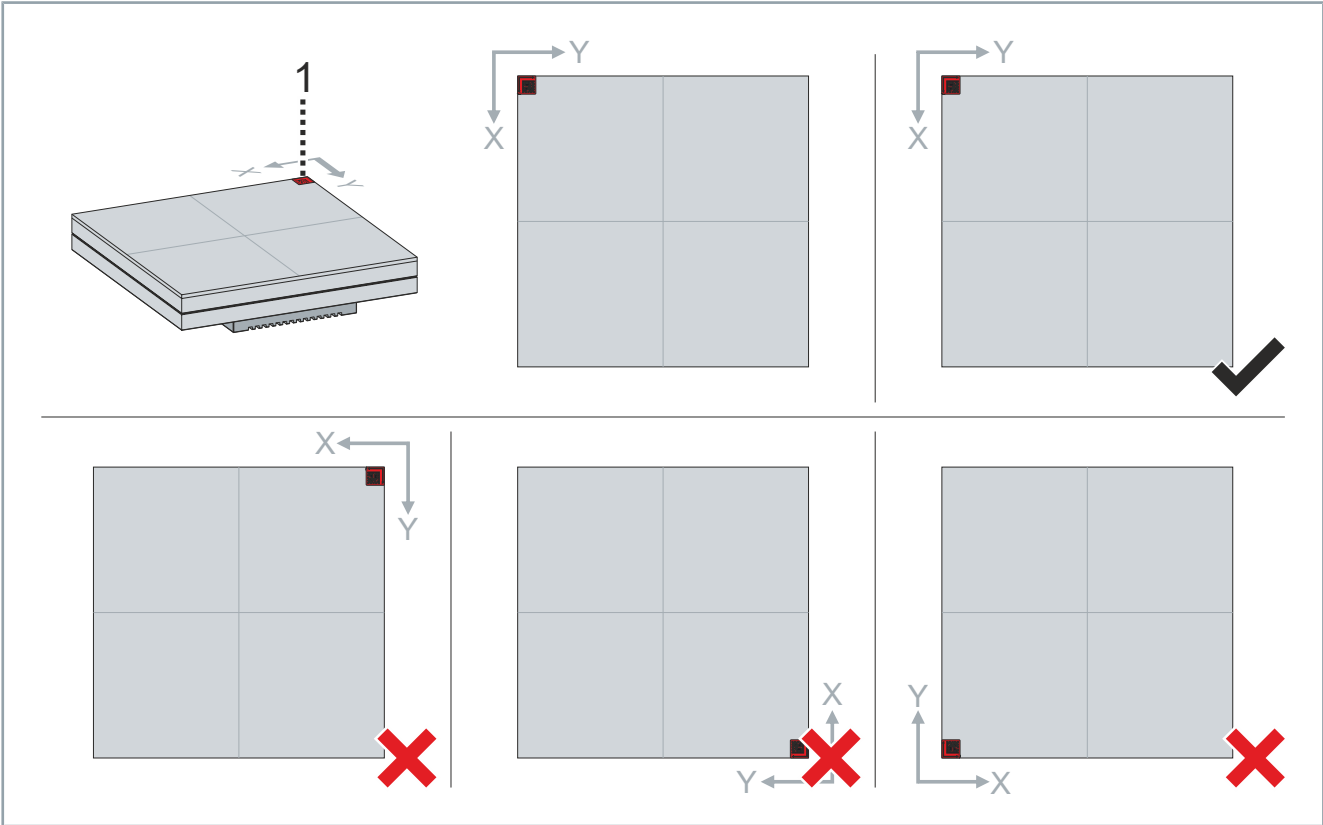
Tile orientation



Insert the tile correctly

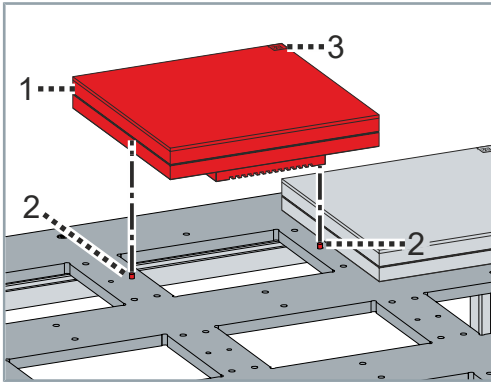
All tiles must have the same orientation in order to be able to control the movers. The point of origin is the same for each tile. Insert the tile according to the following description.

An incorrectly installed tile leads to problems with the mover control via the software.

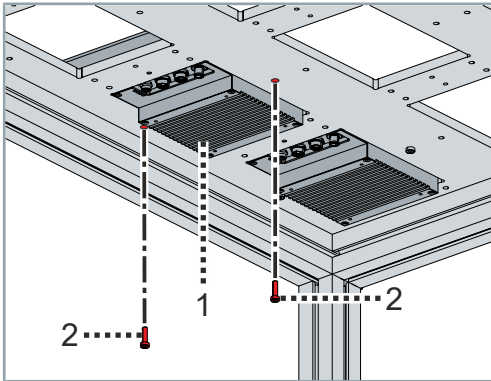


Item number	Name
1	Sticker with coordinate origin

Make sure that all tiles have the same orientation. Use the coordinate origin [1] as a guide to align tiles correctly.



- Position another tile [1] with the hole and the elongated hole on the locating pins [2]
- Note the tile orientation



- Fasten the additional tile [1] with two, four or six screws [2]
- Observe tightening torques

Component	Tightening torque [Nm]
M6 screws	7

- Mount other tiles in the same way

Mechanical protection

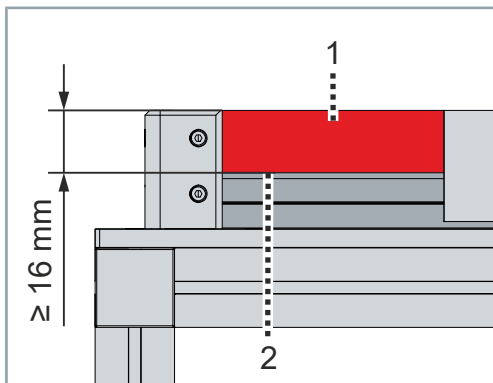
⚠ WARNING

Secure the area around the stator surface

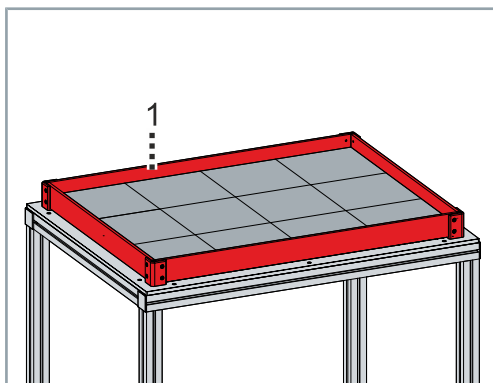
Basically, electronic devices are not fail-safe. Movers can become detached from the stator surface in an uncontrolled manner due to power failure or system control faults. Secure the stator surface with a mechanical safeguard against uncontrolled detachment of the mover.

Serious or even fatal injuries may result if this is ignored.

Beckhoff recommends mechanical protection of the stator surface after all tiles have been fastened to the machine bed.



The mechanical protection [1] must protrude at least 16 mm beyond the stator surface [2].



► Attach mechanical protection [1]

Surface

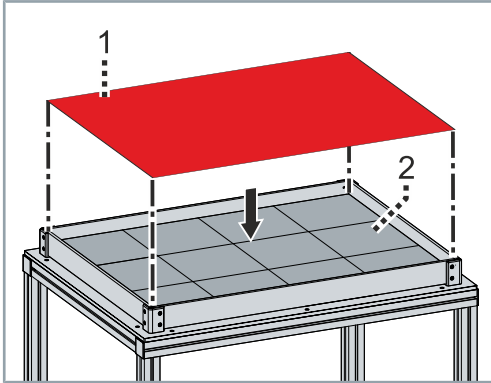


Application of an easy-to-clean surface

The application of an easy-to-clean surface supports the use of the XPlanar in the food industries and pharmaceutical applications.

The surface must not be thicker than 0.5 mm. It must be non-magnetic and have low electrical conductivity. For example, the following surface can be applied to the tiles:

- Up to 0.5 mm thick 1.4404 stainless steel sheet in accordance with *DIN EN ISO 3506-1* and *AISI 316L*



► Apply surface [1] to the stator surface [2]

Fan [+]

⚠ WARNING

Do not touch tiles without personal protective equipment

Touch hot tiles only with special thermal gloves. Avoid prolonged contact with hot components.

Hot components can cause severe burns to body parts and limbs.

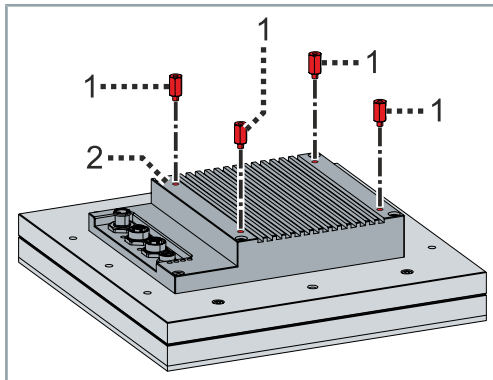


Avoid heat build-up on tiles

Observe the specifications for ambient and operating temperatures and tile loads. Ensure that there is sufficient clearance below the machine bed or that the tiles are adequately ventilated.

Insufficient cooling can cause damage to components due to heat accumulation.

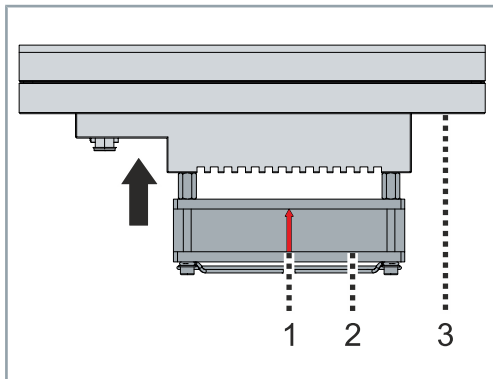
Beckhoff recommends mounting a fan [+] on tiles in situations where movers experience strong acceleration, lift or tilt, in order to dissipate heat in a targeted manner and to avoid heat accumulation.



► Screw four bolts [1] into the lower cover [2] of the tile

► Observe tightening torques:

Components	Tightening torque [Nm]
Bolt, M4 X 13.5	1.2



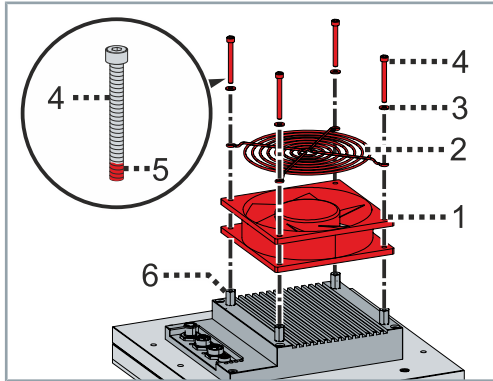
The arrow [1] on the fan [2] must point to the underside of the tile [3].



Use liquid threadlocker

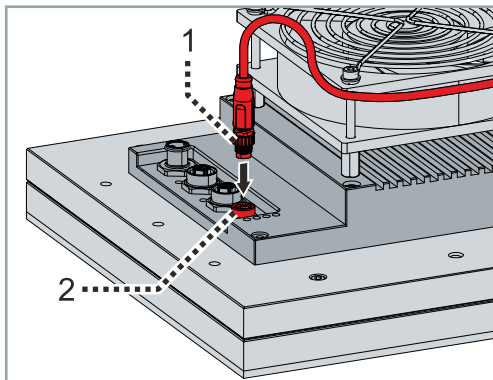
Use liquid threadlocker on the screw thread to fix the fan to the tiles.

If you do not use liquid threadlocker, the fan may come loose due to vibration during unusual operating conditions and cause damage to other components of the XPlanar.

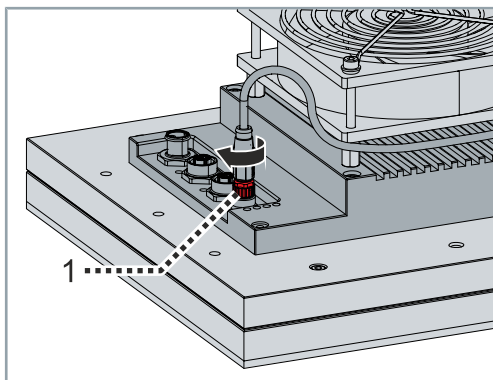


- Screw the fan [1] and guard grille [2] into the bolts [6] using four washers [3] and four screws [4] with liquid threadlocker [5]
- Observe tightening torques:

Components	Tightening torque [Nm]
Screws, M4 x 40	0.5



- Plug the connector [1] into port X103 [2] of the tile



- Tighten the locking thread [1] of the connector by turning the knurl

Water cooling

As an alternative to fan cooling, it is possible to cool the tiles using a water-cooled machine bed.

Cabling

For cabling the tiles please refer to the chapter on electrical installation. The second part of the mechanical installation involving positioning of the movers can take place once the electrical installation is complete.

Connection technology

All XPlanar tiles have interfaces for connecting the power cable and inputs and outputs for EtherCAT G lines. The end of the EtherCAT G cable ZK1096-8191-0xxx has an RJ45 connector with the TSB568A configuration. The end of the power cable is pre-assembled with ferrules. Cables are not included in the scope of supply.

Cables

Beckhoff cables have been tested with regard to the materials, shielding and connection method used. They ensure proper functioning and compliance with statutory regulations such as EMC and UL. The use of other cables may lead to unexpected interference and invalidate the warranty.



Beckhoff recommendation for correct application and assembly:

- Wiring in accordance with applicable regulations and standards
- Use the pre-assembled and shielded Beckhoff cables for power and EtherCAT connections

Laying

Slots for the following cables are integrated on the tiles:


- 5 m power cable: 3G 1.5 mm² + 2 x 0.75 mm²
 - ZC2000-0000-00xx star distributor
- EtherCAT G cable with RJ45 to M12
 - ZK1096-8191-0xxx
- EtherCAT G cable with M12 to M12
 - ZK1096-8181-0xxx

You may shorten the tube or the power cables, but not the EtherCAT cable. Route the power cable in a protected manner so that it is not exposed to external damage. Make sure that the cables lie in a position where they are protected against moving machine parts and their acceleration forces. Beckhoff recommends "fixed installation", because the cable is not suitable for drag chains. Observe the specified bending radii for a fixed or occasionally moved power cable shown in the table below:

Laying	Min. bending radius
Power cable	
Fixed	5 x cable diameter
EtherCAT G cable	
Fixed	4 x cable diameter
Occasionally moved	8 x cable diameter

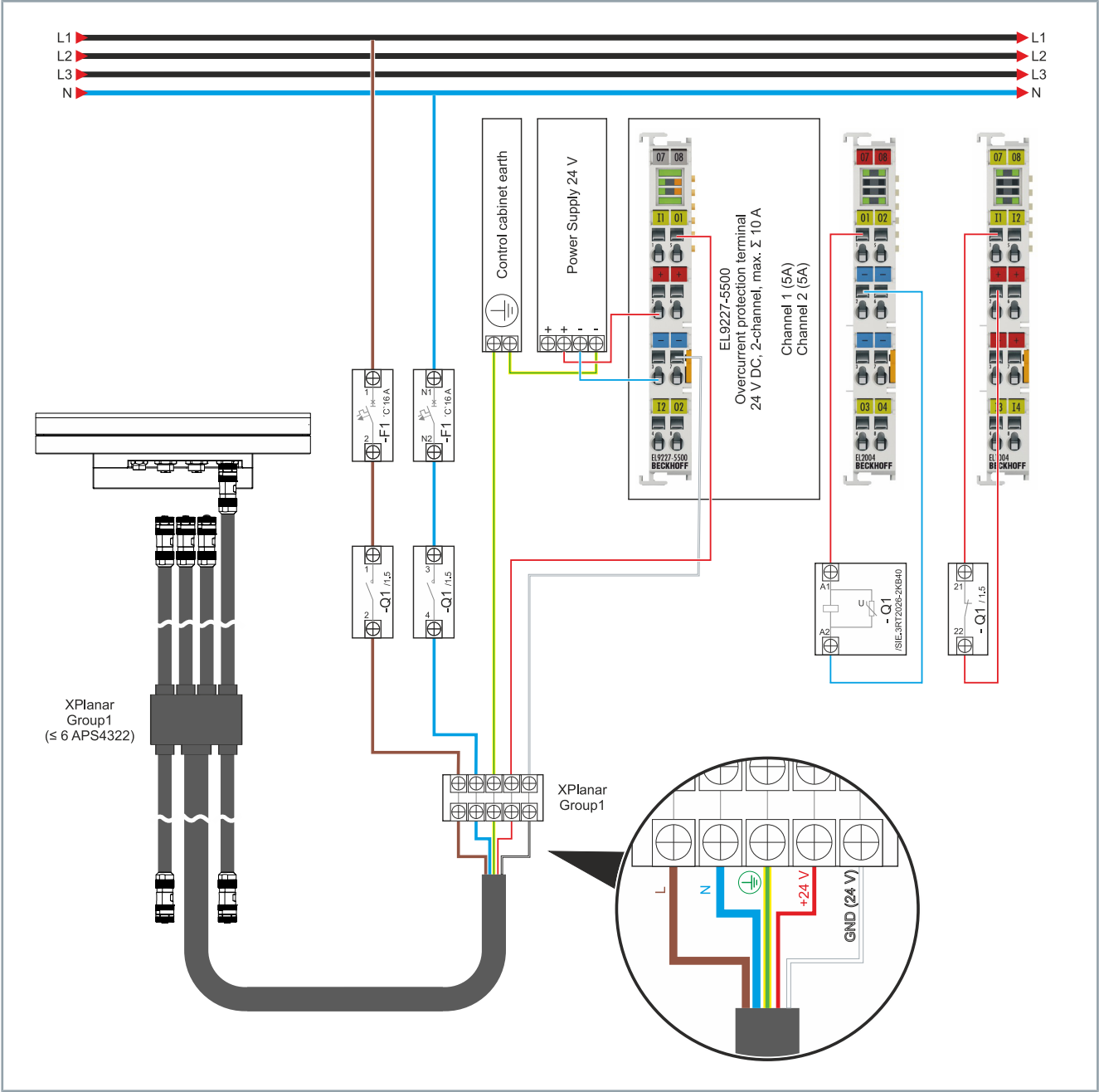
Example circuit

An example for a power supply involving connecting a star distributor with up to six tiles is provided below:



Symmetrical distribution between the phases

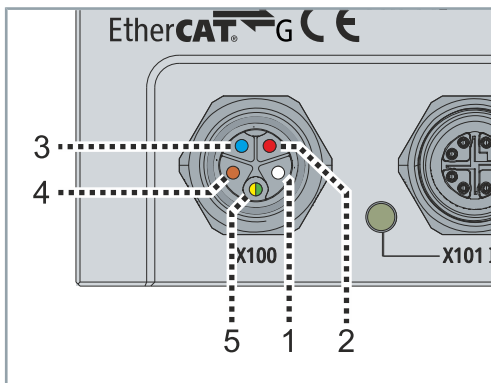
For multiphase feed networks the XPlanar tile groups must be distributed symmetrically between the existing phases. Observe the maximum possible input inrush current.



The following table shows the wire assignment for the XPlanar power cable:

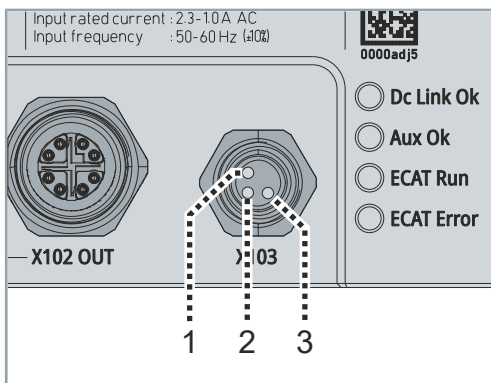
Wire color	Signal	Wire cross-section
Brown	L (100 - 240 V)	1.5 mm ²
Blue	N (100 - 240 V)	1.5 mm ²
Green/yellow PE	Protective earth	1.5 mm ²
Red	+ 24 V	0.75 mm ²
White	GND 24 V	0.75 mm ²

X100 pin assignment



Item number Pin	Identification	Signal
1	White	GND, 24 V
2	Red	+ 24 V
3	Blue	N, 100 - 240 V
4	Brown	L, 100 - 240 V
5	Green/yellow PE	Protective earth

X103 pin assignment



Item number	Identification	Signal
1	Pin 1 (A)	Power +, 5 - 12 V
2	Pin 4 (C)	Tacho, Feedback
3	Pin 3 (B)	Power -, GND, 0 V

Installing cables

First connect the power cables to the tiles. Then connect the Ether-CAT G cables. The power cable can be connected via T-distributors or star distributors.

Technical aids

The following tools are required for the electrical installation:

- Torque wrench [+]

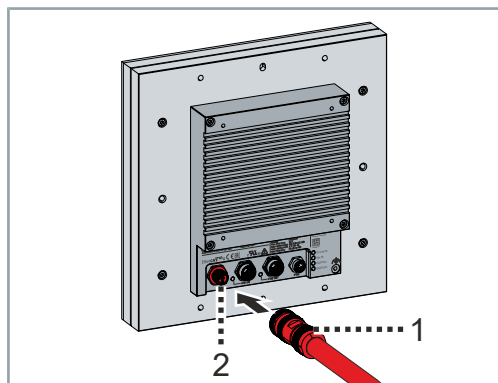
Power cable



Simplified representation

In the interest of clarity, only the tiles are shown in power cable installation description, not the machine bed.

Depending on the star distributor, up to six tiles can be connected to the power cable.



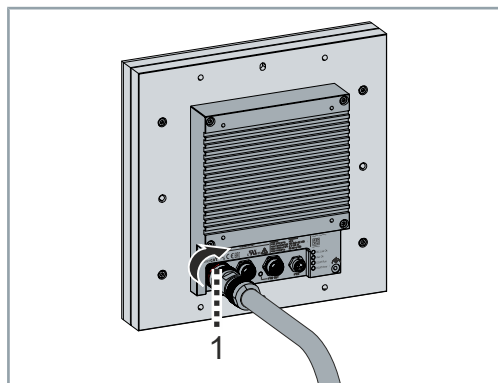
- ▶ Connect the connector of the power cable [1] to port X100 [2] of the tile



Secure the cables correctly

The cables must be secured up to the last thread with a suitable tool.

Cables that are not correctly secured can cause problems with the power supply and communication.



- ▶ Tighten the connector [1] with a torque wrench [+]
- ▶ Observe tightening torques:

Components	Tightening torque [Nm]
Power cable connector	0.6

- ▶ Connect up to five additional tiles to the star distributor and tighten the connectors
- ▶ Connect the power cables to all tiles and tighten the connectors

EtherCAT G cable

The EtherCAT G cable ZK1096-8191-0xxx is used to establish communication between the tiles and the control cabinet. The EtherCAT G cables ZK1096-8181-0xxx can be used to connect up to nine further tiles based on the daisy chain principle.



Uniform cabling

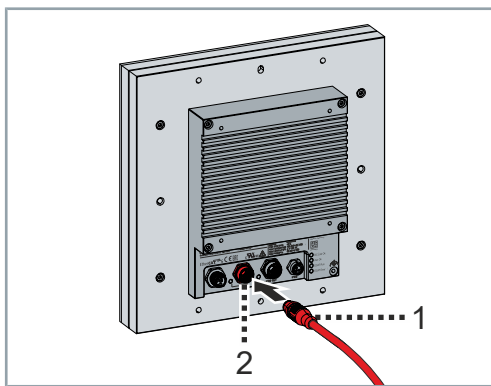
Beckhoff recommends connecting the same tiles that are interconnected via the power cable with EtherCAT G cables.



Simplified representation

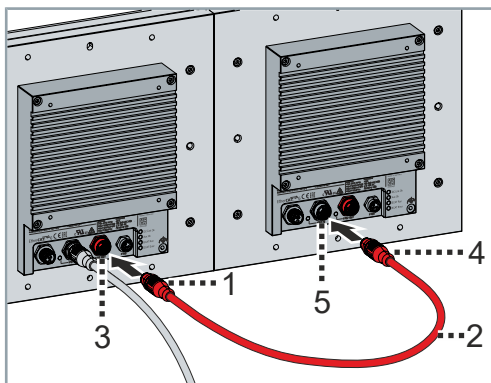
In the interest of clarity, only the tiles are shown in EtherCAT G cable installation description, not the machine bed or the power cables.

Tile to control cabinet



- ▶ Connect the M12 connector [1] of the EtherCAT G cable ZK1096-8191-0xxx to port X101 IN [2]
- ▶ Connect the RJ45 plug of the EtherCAT G cable to the control cabinet

Tile to tile



Beckhoff recommends connecting the tiles using the following cable:

- ZK1096-8181-0006

- ▶ Connect the M12 connector [1] of the EtherCAT G cable ZK1096-8181-0xxx [2] to port X102 OUT [3]
- ▶ Connect the M12 connector [4] to port X101 IN [5] of a further tile
- ▶ Add further tiles, according to the power cable wiring, to this group using EtherCAT G cables ZK1096-8181-0xxx
- ▶ Wire all further tiles, according to the power cable wiring, with EtherCAT G cables ZK1096-8181-0xxx and ZK1096-8191-0xxx

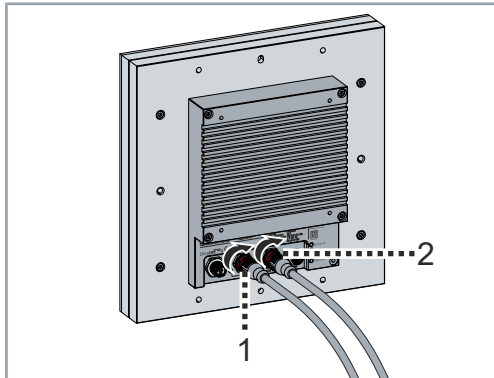
Secure connector



Secure the cables correctly

The cables must be secured up to the last thread with a suitable tool.

Cables that are not correctly secured can cause problems with the power supply and communication.



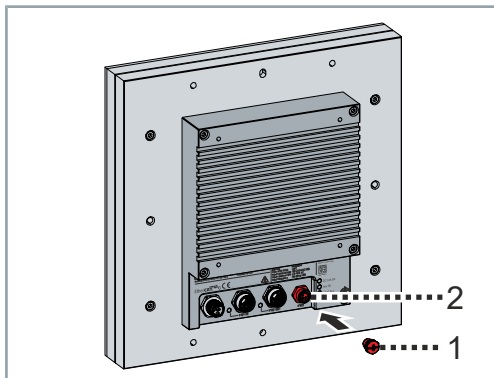
- ▶ Tighten connector [1] at connection X101 IN with torque wrench [+]
- ▶ If used: Tighten connector [2] at connection X102 OUT with torque wrench [+]
- ▶ Observe tightening torques:

Components	Tightening torque [Nm]
Connector of the EtherCAT G cable	0.6

Cover plug [+]

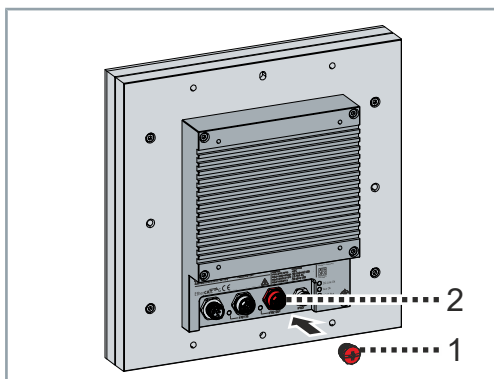
Beckhoff recommends terminating unused connections on the tiles with cover plugs [+].

Cover plug M8



- ▶ Insert cover plug M8 [1] into port X103 of the tile and lock it by turning it

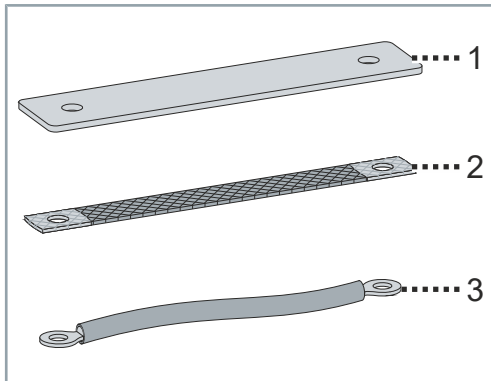
Cover plug M12



- ▶ Insert cover plug M12 [1] into port X102 OUT of the tile and lock it by turning it

Grounding the machine bed

The ground connection must be made with the largest possible cross-section, with a low impedance, over a large area and via a short connection to large conductive fastenings. Beckhoff recommends the use of wide connections with large contact surfaces, for example wide ground straps.



Suitable connectors

Suitable for grounding machine beds:

- Copper rails [1]
- Ground straps with cable lugs [2]
- Cable with cable lugs [3]

⚠ WARNING

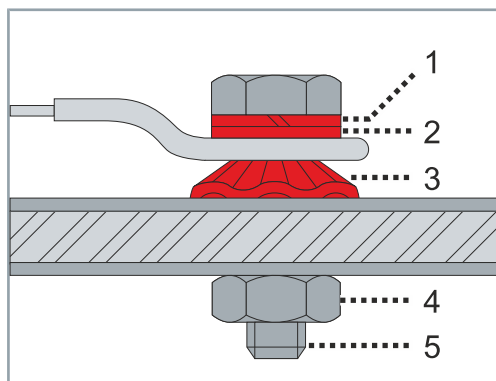
Risk of injury through electric shock

There must be an optimally conductive connection for the protective conductor at the connection point. The machine bed must be grounded in accordance with the statutory regulations.

Carefully remove paint, dirt, corrosion and all insulating components.

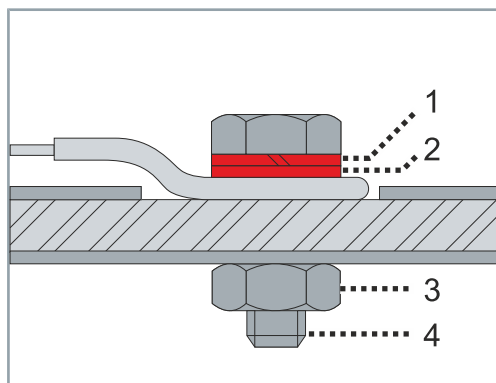
Use galvanized stud bolts and washers.

Painted surfaces



- Ground the painted surface with spring washer [1], washer [2], contact washer [3], nut [4] and bolt [5]

Unpainted surfaces



- Ground the unpainted surface with spring washer [1], washer [2], nut [3] and bolt [4]

Functional earth



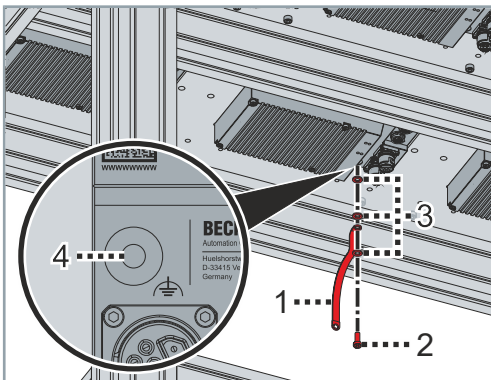
Installation with protective conductor connection

When installing electrical systems and components, the protective conductors must be connected first. They must be disconnected last when uninstalling.

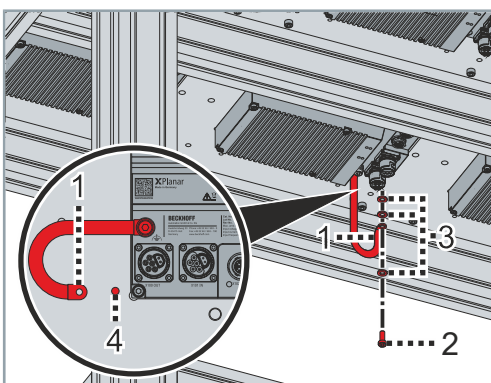
Depending on the magnitude of the leakage currents, observe the following regulations for the implementation of the protective conductor connection:

- Minimum requirement for protective conductor: KU value of 4.5
- The minimum requirement for leakage currents: $I_L < 10 \text{ mA}$; $KU = 6$ for $I_L > 10 \text{ mA}$

Value	Explanation
KU	Variable for the classification of safety-related types of failure for protection against dangerous shock current and excessive heating
KU = 4.5	Achieved in relation to interruption: With permanently connected protective conductor connection $\geq 1.5 \text{ mm}^2$ With protective conductor connections $\geq 2.5 \text{ mm}^2$ via connector for industrial plants according to IEC 60309-2
KU = 6	Achieved in relation to interruption: With permanently connected conductors $\geq 10 \text{ mm}^2$; the type of connection and routing must comply with the standards applicable to PE conductors



- Screw the cable lug of the ground strap [1] to the functional earth connection [4] of the tile using a screw [2] and washers [3]

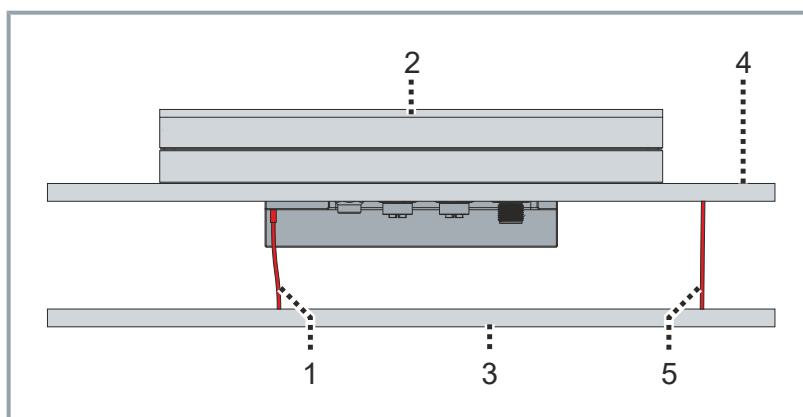


- Screw the cable lug of the ground strap [1] to the machine bed [4] using a screw [2] and washers [3]

There are two options for the functional earthing of your system:

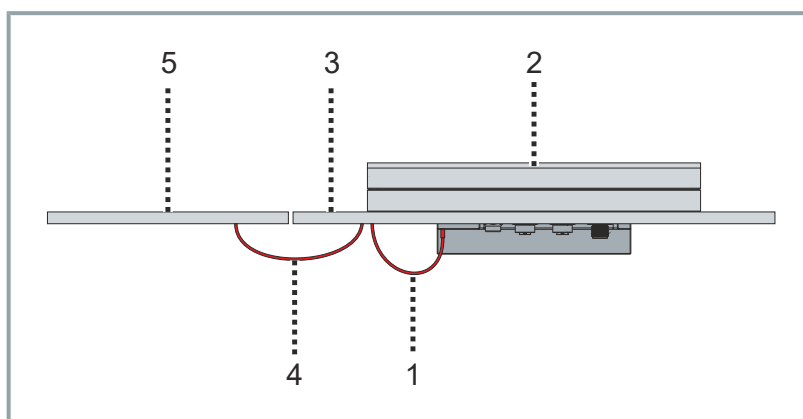
- Connection to a grounding bar
- Connection of several machine beds

Grounding bar



The functional conductor connection [1] of the tile [2] must be connected to the grounding bar [3]. In addition, the machine bed [4] must be connected to the grounding bar [3] with a functional conductor connection [5].

Machine bed



The functional conductor connection [1] of the tile [2] must be connected to the machine bed [3]. In addition, the machine bed [3] must be connected to another machine bed [5] with a functional conductor connection [4].

If required, additional machine beds can be connected with functional conductor connections.

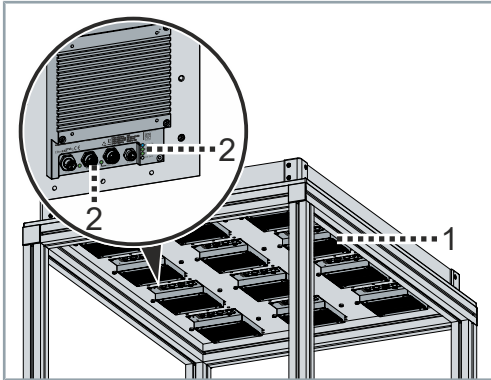
System test



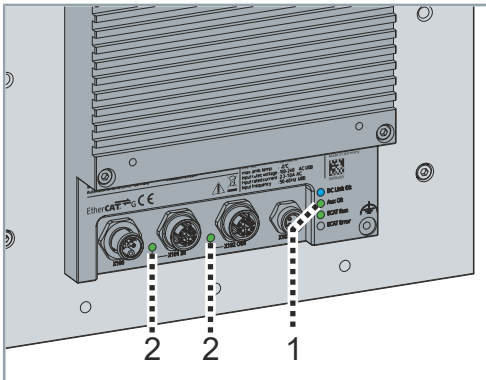
Avoid wiring faults in the control cabinet

First, only connect the 24 V supply to the tiles and check the tile function.

Accidental connection of 100 - 240 V instead of 24 V can lead to the destruction of all tiles.



- ▶ Connect the entire XPlanar system [1] to the mains supply
- ▶ First connect only 24 V
- ▶ Check the tile function
- ▶ Make sure that the LEDs [2] light up



The following LEDs [1] must light up:

- Aux Ok

The following LEDs [2] must flash if data cables have been plugged in:

- X101 IN
- X102 OUT

If the LEDs do not light up:

- ▶ Check the power supply units and fuses for voltage
- ▶ Contact the Support/Applications Department

Mover

WARNING

Do not position the mover until the electrical installation has been completed

The movers may only be positioned once part 1 of the mechanical installation and the electrical installation have been completed. Perform a tile system test before positioning the movers.
Failure to do so may result in serious injury to fingers from crushing and to eyes from splinters.

Wear safety goggles and gloves

The movers can have strong magnetic attraction to each other or other metallic objects. Splinters can form if magnets collide.
Failure to do so may result in serious injury to fingers and eyes.

Remove each mover individually from the box

If you take two movers out of the box and the distance between the movers is too small, the movers can attract each other.
If the movers attract each other and collide, serious injuries to the fingers from crushing and in the eyes from splinters can result.

Do not reach under the mover with your fingers

When carrying a mover or positioning it on the system, do not reach under the mover with your fingers.
Failure to do so can result in severe crushing and injury to fingers.

Movers contain strong permanent magnets

The permanent magnets are arranged in so-called Halbach arrays, which ensure that the magnetic field on the underside of the mover is significantly stronger than on the upper side of the mover. The field of the permanent magnets is present even when the power supply is switched off.
If the movers attract each other and collide, serious injuries to the fingers from crushing and in the eyes from splinters can result.

Unpacking

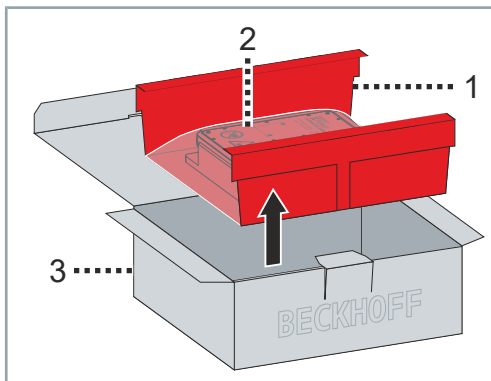
⚠ WARNING

Carry each fixing packaging containing a mover and transport securing device individually

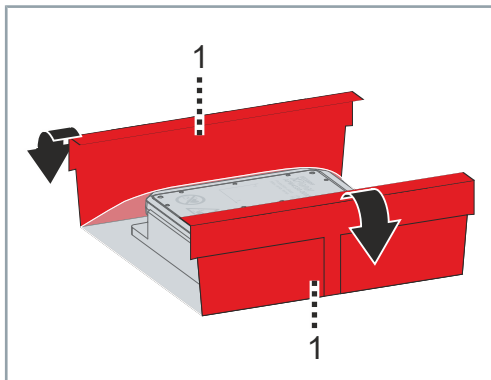
If you carry two fixing packagings with one mover each and the distance between the movers is too small, the movers may attract each other.

If the movers attract each other and collide, serious injuries to the fingers from crushing and in the eyes from splinters can result.

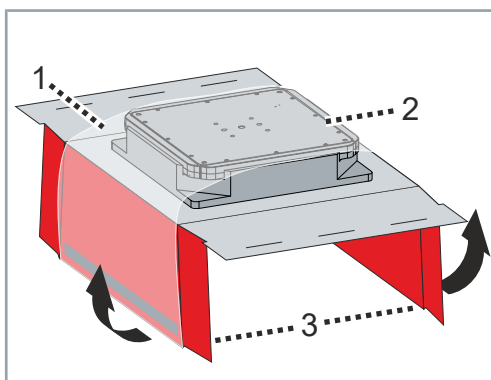
- Open carton



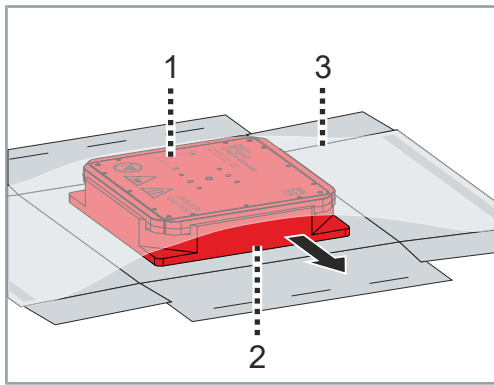
- Remove the fixing packaging [1] with mover [2] from the carton [3]



- Fold down the side parts [1] of the fixing packaging



- Release the fixing [1] of the mover [2] by folding up the fixing packaging [3]



- Remove the mover [1] with transport securing device [2] from the fixing packaging [3]

Transport

⚠ WARNING

Transport each mover with transport securing device individually

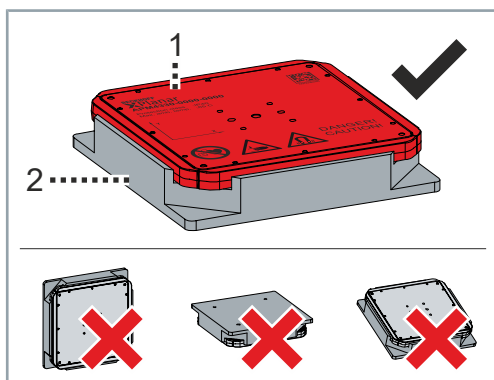
If you transport two movers and the distance between them is too small, the movers may attract each other. The transport securing device weakens the magnetic field of the mover. Transport movers only individually and in the transport securing device.

If the movers attract each other and collide, serious injuries to the fingers from crushing and in the eyes from splinters can result.

Transport the mover with the safety pictogram facing upwards

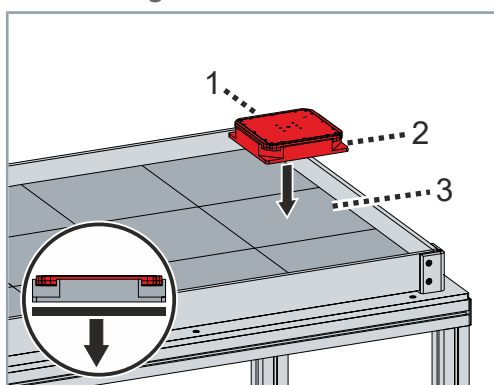
Always transport the movers with the safety pictograms facing upwards. The underside of the mover must be in the transport securing device. The transport securing device weakens the magnetic field of the mover.

Incorrectly inserted movers can attract magnetic objects or other movers, resulting in serious injuries to fingers from crushing and to eyes from splinters.



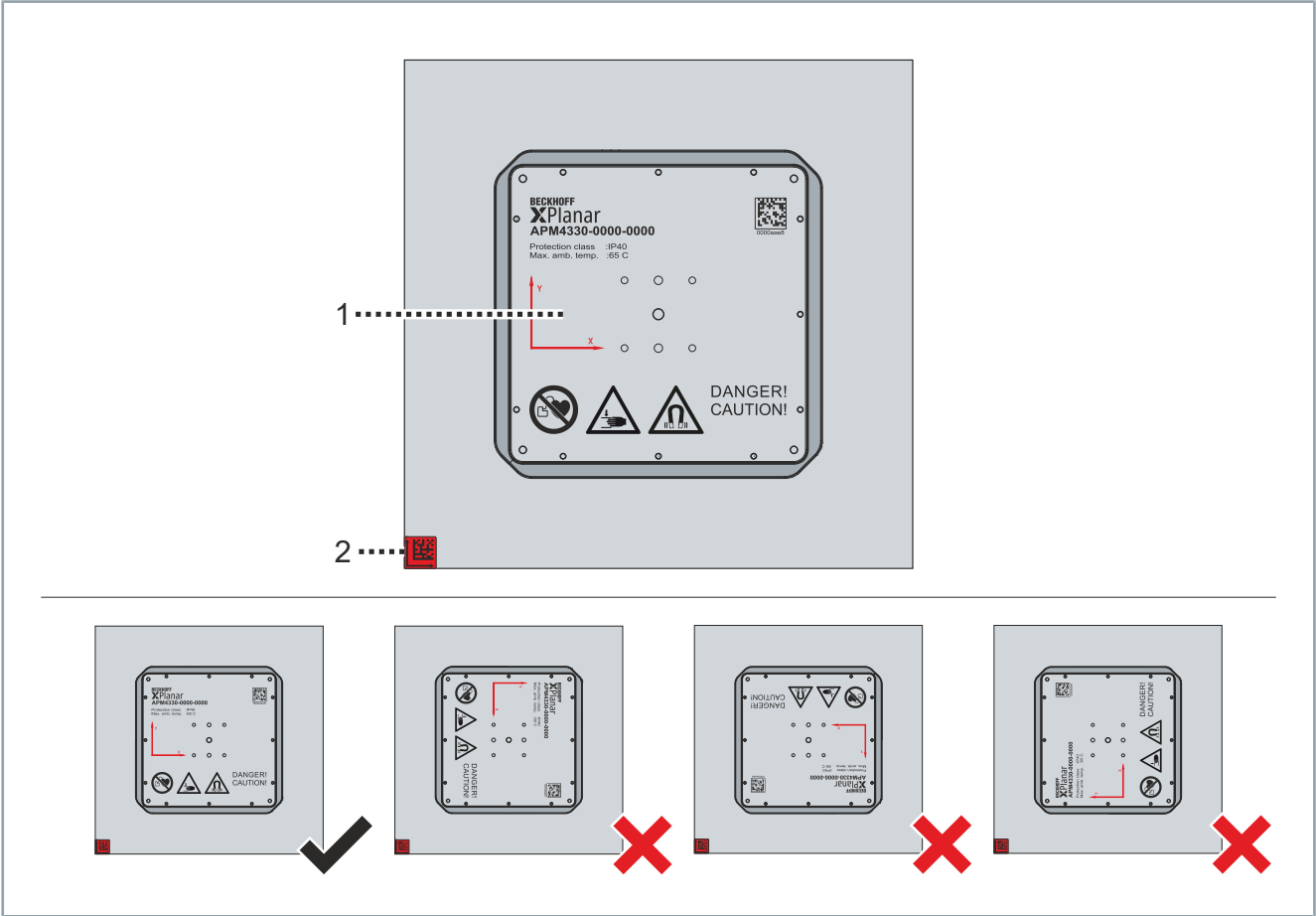
- Transport the individual mover [1] with the safety pictograms facing upwards in the transport securing device [2] straight to the workplace or system

Positioning on a tile



- Position the mover [1] with transport securing device [2] directly on the tile [3]

Mover alignment



Item number	Name
1	XY axes of the mover
2	Sticker with coordinate origin

When placing the movers, make sure that the XY axes of the mover [1] correspond to the XY axes of the tile. The coordinate origin of the tile is used for orientation. For more information see chapter "Mounting", [Page 46].

Also make sure that you position the movers as parallel as possible to the outer edges of the tiles.

⚠ WARNING

Do not reach under the movers

When placing a mover on the tiles, do not reach under the mover with your fingers.

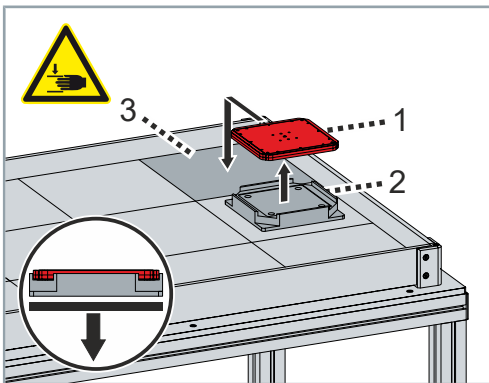
Magnetic attraction both between the mover and the tile and between two movers can result in serious injury to fingers from crushing and to eyes from splinters.



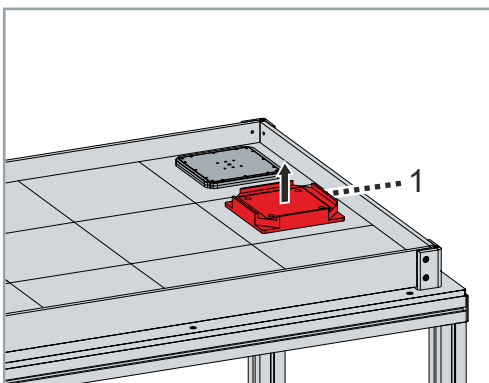
Check the underside of the mover for adhesive deposits

Check the underside of the mover for adhesive deposits and clean it if necessary.

Adhesive deposits can cause damage to the tile surface.



- ▶ Take the mover [1] out of the transport securing device [2] with a straight upward movement
- ▶ Position the mover [1] straight in the center of the adjacent tile [3]
- ▶ Make sure that your fingers are not underneath the tile [3] and that the mover [1] has sufficient distance to other movers



- ▶ Remove the transport securing device [1]
- ▶ Position the remaining movers on the tiles in the same way

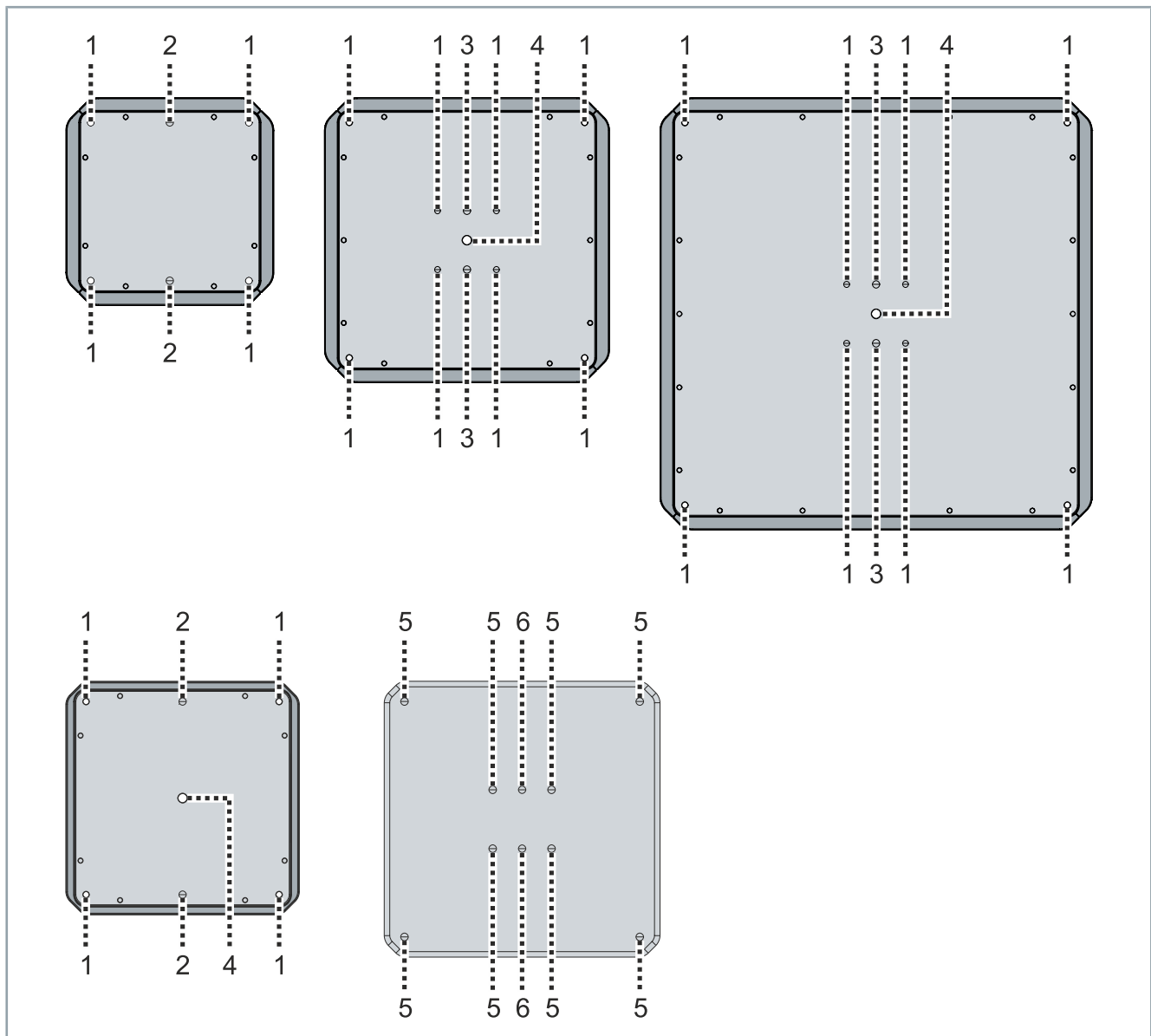
Mounting tools

Suitable tools can be mounted on the movers depending on the application requirements. Beckhoff recommends:

- Using non-magnetic material
- Holding the tool as flat as possible
- Keeping the tool weight down as far as possible
- Not to exceed the outer dimensions of the mover
- Center the weight in the middle of the mover

Fixing points

Depending on the mover version, the following attachment points are available for attaching the tool:



Item number	Name
1	Threaded hole M4 x 6
2	Locating hole dia. 4 H7 x 4.5
3	Locating hole dia. 4 H7 x 8
4	Threaded hole M6
5	Threaded hole M5 x 6
6	Locating hole dia. 4 H7 x 10

WARNING

Keep the workplace free of metallic and magnetic materials

Make sure that your workplace is free of metallic and magnetic materials before positioning the mover. Only remove the mover from the transport securing device if absolutely necessary for assembly work on the tool. The transport securing device weakens the magnetic field and protects electrical components from magnetic influences.

If movers are attracted by metallic and magnetic parts, serious injuries to the fingers from crushing and in the eyes from splinters can result.

- ▶ Carry a single mover in its transport securing device directly to the workplace
- ▶ Attach the tool to the mover
- ▶ Carry a single mover in its transport securing device directly to the system

WARNING

Label the tool with a safety pictograms

If the tool on the mover obscures the safety pictograms in your application, you must affix the safety pictograms to your tool so that they are visible.

If the safety pictograms are not visible, other persons may not be aware of possible dangers and may be seriously injured during use.

Mover coupling

Two, four or six movers can be coupled with a frame. Regardless of the mover design, the following requirements must be met for the coupling:

- 240 mm center distance between movers
- Rectangular arrangement of the movers
- Use the same mover version, e.g. only APM4550-0000

The center distance ensures an almost linear increase in payload. The total payload can be calculated by multiplying the number of movers by the maximum payload of a mover minus the frame weight:

$A \times B - C = D$	
Variable	Explanation
A	Number of movers
B	Maximum load of a mover
C	Frame weight
D	Total payload

For further information on mover coupling, please contact your local Beckhoff office or support@beckhoff.com.

Preparation

Before you start coupling movers, you must provide a suitable frame, assembly aids and screws. Frames, assembly aids and screws are not part of the scope of supply.

Frame



Dimensional drawings and 3D models online

The dimensional drawings and 3D models for the frame are available for download from the Beckhoff website:
www.beckhoff.de/download

Beckhoff recommends the following material for the frame:

- Aluminum

Assembly aids



Dimensional drawings and 3D models online

The dimensional drawings and 3D models for the assembly aids are available for download from the Beckhoff website:
www.beckhoff.de/download

The assembly aid must be made of non-magnetic material. Beckhoff recommends the following material:

- Wood, plastic or aluminum

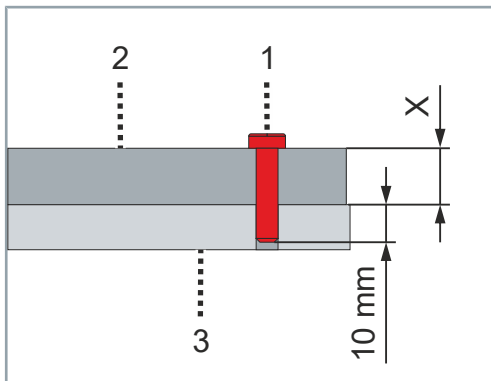
The assembly aid weakens the magnetic field of the movers, but the permanent magnetic field on the underside of the movers is still present.

Screws



Ensure that the screws have the correct length

Ensure that the screws have the correct length to avoid damage to the workplace and tiles. The screws must not protrude from the frame.



The length of the screws [1] for fastening the assembly aid [2] depends on the height X of the assembly aid. Beckhoff recommends the following screw depth in the frame [3]:

- 10 mm

The M5 screws must not protrude from the frame.

Coupling

The work required for mover coupling should be carried out by two persons. The weight and dimensions require a second person to turn and transport the mover coupling.



Mounting example

In this chapter, the mover coupling is described using a 2 x 2 frame and four APM4550-0000 movers as an example.

⚠ WARNING

Keep the workplace free of metallic and magnetic materials

Make sure that your workplace is free of metallic and magnetic materials before positioning the mover. Only remove the mover from the transport securing device if absolutely necessary for assembly work. The transport securing device weakens the magnetic field and protects electrical components from magnetic influences.

If movers are attracted by metallic and magnetic parts, serious injuries to the fingers from crushing and in the eyes from splinters can result.

Movers contain strong permanent magnets

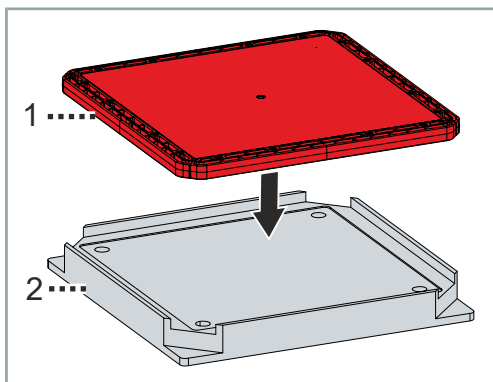
The permanent magnets are arranged in so-called Halbach arrays, which ensure that the magnetic field on the underside of the mover is significantly stronger than on the upper side of the mover. The field of the permanent magnets is present even when the power supply is switched off.

If the movers attract each other and collide, serious injuries to the fingers from crushing and in the eyes from splinters can result.

Transport the mover with the safety pictogram facing upwards

Always transport the movers with the safety pictograms facing upwards. The underside of the mover must be in the transport securing device. The transport securing device weakens the magnetic field of the mover.

Incorrectly inserted movers can attract magnetic objects or other movers, resulting in serious injuries to fingers from crushing and to eyes from splinters.

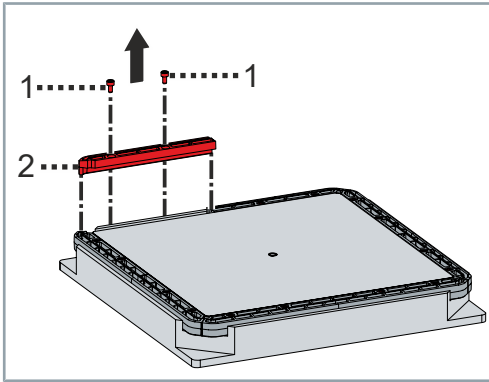


- To safely remove the bumpers, remove the mover [1] from the transport securing device [2] and turn it by 180°
- Place the mover in the transport securing device [2] with the underside facing upwards

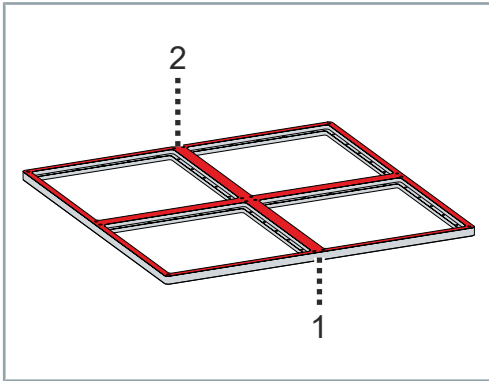


Permanent magnets can attract tools

The permanent magnets on the underside of the movers are now exposed and can attract tools used to remove the bumpers.



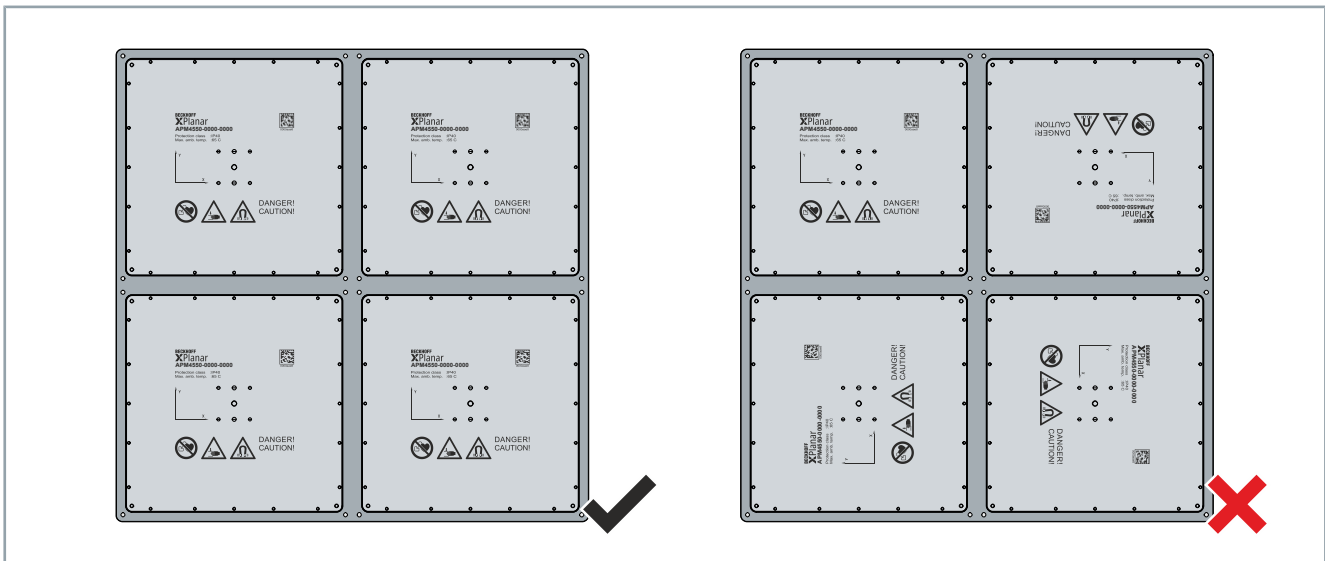
- Remove two screws [1]
- Remove a bumper [2]
- Remove other bumpers in the same way



- Place the frame [1] on the work surface with the top side [2] facing upwards

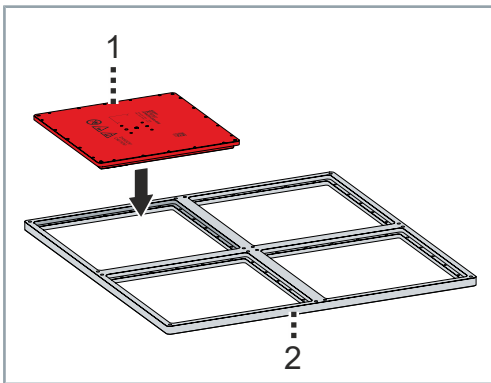
Mover alignment

All movers of the mover coupling must have the same orientation; different mover orientations are not permitted:

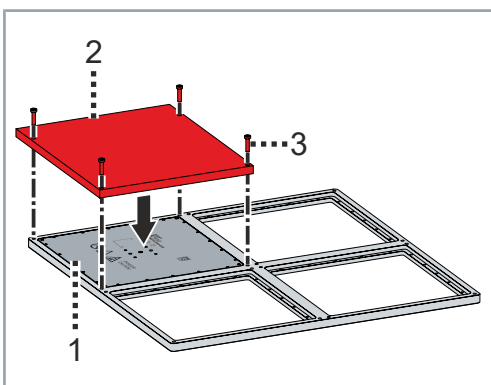


Note the orientation

Before covering the first mover with an assembly aid, note the orientation of the mover in the frame.

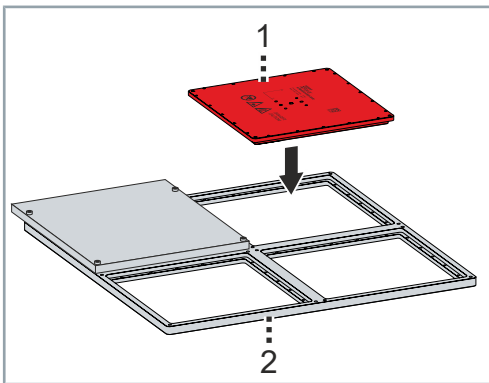


- Place the mover [1] into frame [2]

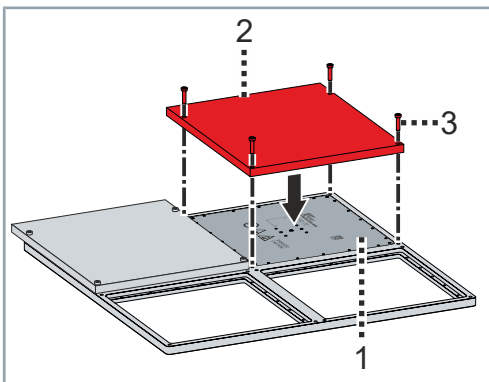


- Secure the mover [1] with the assembly aid [2] and four screws [3] to prevent it from falling out

Once the first mover has been secured with the assembly aid, you can insert the second mover. Make sure that the mover is in the correct position.



- Insert the mover [1] into the frame [2]



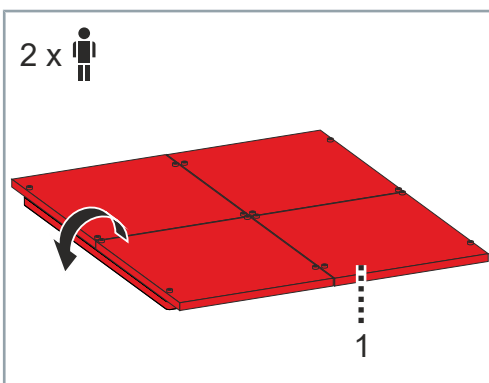
- Secure the mover [1] with the assembly aid [2] and four screws [3] to prevent it from falling out
- Insert and secure further movers in the same way

⚠ WARNING

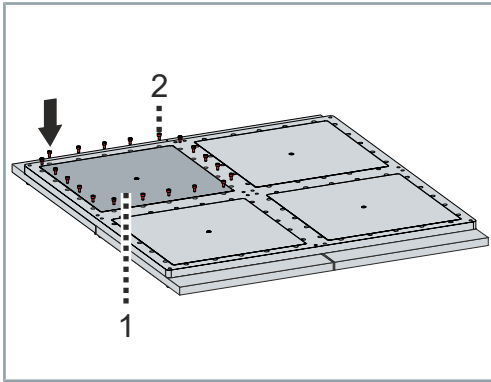
Two persons are required for turning the frame

Two persons are required for turning the frame with the attached assembly aids. The underside of the movers is permanently magnetic and can attract other movers or magnetic parts.

Failure to do so may result in serious injury to fingers from crushing or to eyes from splinters.



- Turn the frame [1] with attached assembly aids by 180°



- Fasten the mover [1] with 20 screws [2]
- Observe tightening torques:

Component	Tightening torque [Nm]
Screws, M3 x 6	1.5

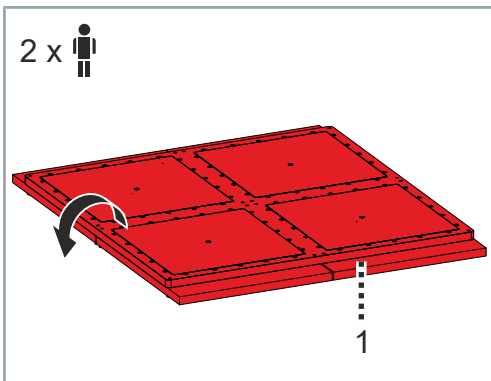
- Attach other movers in the same way

⚠ WARNING

Two persons are required for turning and carrying the frame

Two persons are required for turning and carrying the frame with the attached assembly aids. The underside of the movers is permanently magnetic and can attract other movers, mover couplings or magnetic parts. Use the assembly aids to turn and carry the mover coupling.

Failure to do so may result in serious injury to fingers from crushing or to eyes from splinters.



- Turn the frame [1] with attached movers [2] by 180°
- Carry frame to the system using the assembly aids

⚠ WARNING

Do not reach under mover coupling

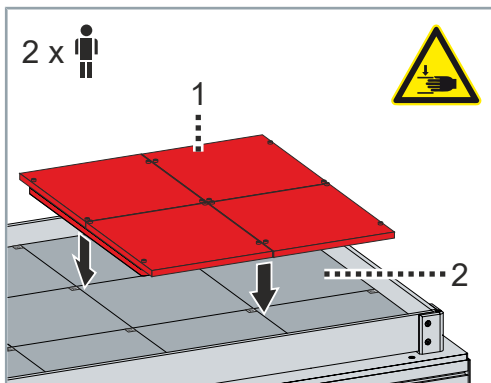
When placing a mover coupling on the stator surface, do not reach under the mover coupling with your fingers. Only hold the mover coupling by the assembly aids.

Failure to do so may result in serious injury to fingers from crushing or to eyes from splinters.

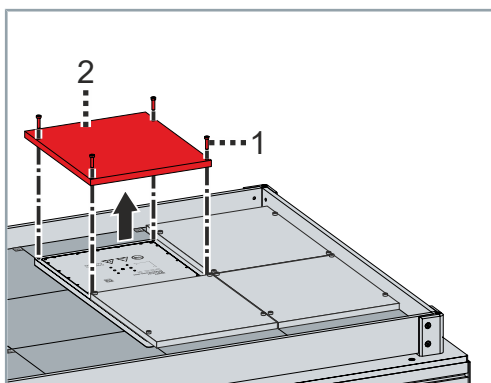


Note the alignment of the mover coupling

When placing the mover coupling, make sure that the XY axes of the movers correspond to the XY axes of the tiles, see chapter "Mover alignment", [Page 70].



- ▶ Place the mover coupling [1] straight on the stator surface [2]
- ▶ Make sure that your fingers are not underneath the mover coupling [1] and that the mover coupling has sufficient distance to other mover couplings



- ▶ Remove the four screws [1]
- ▶ Remove the assembly aid [2] from the frame
- ▶ Remove further screws and assembly aids in the same way



Exemplary commissioning

The procedure for commissioning is described as an example.

Requirements

- Components show no signs of damage
- The undersides of the movers are free from dirt and foreign objects
- Ferromagnetic objects in the vicinity of the movers are removed
- The surface of the tiles is free of dirt and foreign objects
- The surface of the tiles is correctly and evenly aligned
- The surface of the tiles is even
- Screw connections of the components are correctly tightened
- Mechanical protective equipment is correctly installed
- Electrical protective equipment is correctly installed
- Wiring and cables are installed correctly
- Machine bed is correctly grounded
- Tools and attachments are functional
- Protection against moving and live parts is correctly installed
- Current version of TwinCAT XAE, TF5890 and TF5400 software is installed on an IPC
- Control voltage is switched on
- Supply voltage is switched on

Further information on the requirements can be found in chapters "Mechanical Installation – Part 1: Tiles", [Page 44], "Mechanical Installation – Part 2: Mover", [Page 66] and "Electrical installation", [Page 54].

Commissioning

- Creating a TwinCAT project
- Choose Target System
- Add modules to the I/O devices via the Scan function
- Create XPlanar configuration using the *XPlanar Configurator*
- Activating TwinCAT

Further information can be found in the manual *TF5400 | TwinCAT 3 Advanced Motion Pack*:



Direct link to the documentation TF5400 | TwinCAT 3 Advanced Motion Pack

During operation

WARNING

Uncontrolled movers can cause serious injuries

After removing the controller enable or switching off the supply voltage, movers can move in an uncontrolled manner and cause serious injuries to fingers due to crushing and to eyes due to splinters.

- Establish a safe state of the system.
 - Make sure that all movers have come to a complete standstill.
-
- Observe information for environment and operation
 - Observe maintenance intervals
 - Switch off the system if
 - unusual noise occurs
 - smoke develops
 - an atypical temperature development occurs

⚠ WARNING

Ensure safe condition for cleaning work

Basically, electronic devices are not fail-safe. The condition is always safe when the unit is switched off and not energized. For cleaning work, bring the connected motors and the machine into a safe state.

Carrying cleaning work during operation can lead to serious or fatal injuries.



Do not immerse or spray XPlanar components

Wipe the XPlanar components with a clean, lint-free cloth.

Cleaning by immersion can lead to damage to the XPlanar components and surfaces as well as to leak-tightness problems due to impermissible solutions.

Do not apply cleaning agent to XPlanar components

For heavier soiling on the XPlanar components, isopropanol can be applied to a clean, lint-free cloth. Never apply the cleaning agent directly to the XPlanar components.

Applying cleaning agents to the XPlanar components can result in consequential damage to surfaces and electronics.

Beckhoff recommends regular maintenance in order to prevent permanent damage to the system. Contamination, dust or chips can have a negative effect on the function of the components. In the worst case, contamination can lead to failure. Therefore, clean and maintain the components at regular and necessary intervals. Observe the corresponding IP classes of the components when cleaning.

Cleaning materials

Carefully clean the components with a clean, lint-free cloth or brush.

For heavy soiling, cleaning agent can be applied to a clean, lint-free cloth. Isopropanol cleaning agent can be used for cleaning.

Intervals



Avoid excessive temperatures

Operation outside the permissible ambient conditions and operating states can lead to system failure.

Excessive mover temperatures can lead to irreversible weakening of the magnetic fields and reduce the load capacity or cause it to drop to 0 kg.

Operation outside the permissible environmental conditions and operating states shortens the intervals. The service life of consumables may be shortened depending on the mechanical dynamics due to mounted devices and movements.

We have provided you with a list of maintenance work and intervals for the associated components below. The intervals are based on the total operating time of the system and not on the operating time of individual components. The data apply to laboratory conditions and a relative humidity of 50 % at 24 °C.

Tile

Components	Interval	Maintenance
Stator surface	daily / weekly	Visual inspection of the stator surface for damage and foreign bodies
machine bed	6 months	Check the fastening of the tiles on the machine bed

Mover

Components	Interval	Maintenance
Protective film on the underside	6 months	Check the protective film for wear and damage

Replace bumper

Depending on the configuration, the bumpers of the mover are equipped with an ID function. Bumpers without ID function can be exchanged for ID bumpers at any time.



Installation example

In this chapter, the bumper replacement is described using an *APM4330-0000* mover as an example.

The *APM9000-0000-4330* bumper is exchanged for an *APM9001-0000-4330* ID bumper.

WARNING

Keep the workplace free of metallic and magnetic materials

Make sure that your workplace is free of metallic and magnetic materials before positioning the mover. Only remove the mover from the transport securing device if absolutely necessary for assembly work. The transport securing device weakens the magnetic field and protects electrical components from magnetic influences.

If movers are attracted by metallic and magnetic parts, serious injuries to the fingers from crushing and in the eyes from splinters can result.

WARNING

Movers contain strong permanent magnets

The permanent magnets contained are arranged in so-called Hallbach arrays, which ensure that the magnetic field on the underside of the mover is significantly stronger than on the top of the mover. The field of the permanent magnets is present even when the power supply is switched off.

If the movers attract each other and collide, serious injuries to the fingers from crushing and in the eyes from splinters can result.

WARNING

Transport the mover with the safety pictogram facing upwards

Always transport the movers with the safety pictograms facing upwards. The underside of the mover must be in the transport securing device. The transport securing device weakens the magnetic field of the mover.

Incorrectly inserted movers can attract magnetic objects or other movers, resulting in serious injuries to fingers from crushing and to eyes from splinters.

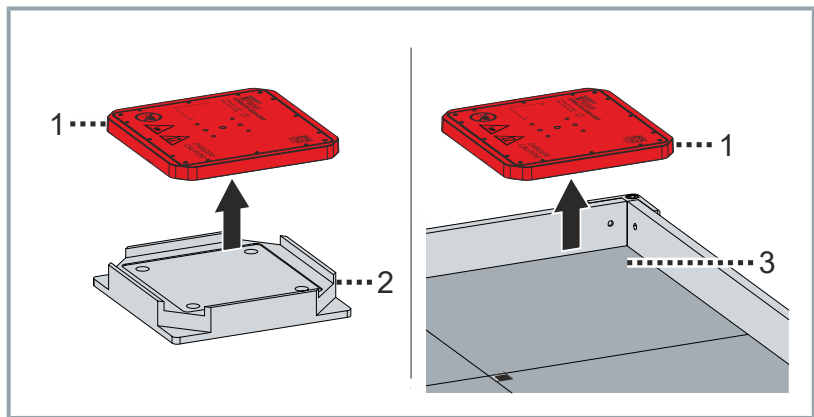
WARNING

Do not use magnetic tools

The included permanent magnets can attract used tools. Use non-magnetic tools to remove and install all bumpers.

If magnetic tools are attracted, serious injuries to the fingers from crushing and in the eyes from splinters can result.

Disassembly



- Remove the mover [1] from the transport securing device [2] and rotate it by 180°

OR

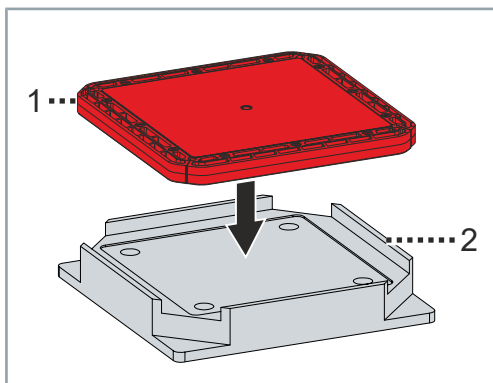
- Remove the mover [1] from the stator surface [3] and rotate it by 180°



Note the orientation

Before placing the mover in the transport securing device, note the orientation of the mover. For correct mounting of the ID bumper, the ID bumper and the mover must have the same orientation.

- Place the mover [1] in the transport securing device [2] with the underside facing upwards



Permanent magnets can attract tools

The permanent magnets on the underside of the movers are now exposed and can attract tools used to remove the bumpers.

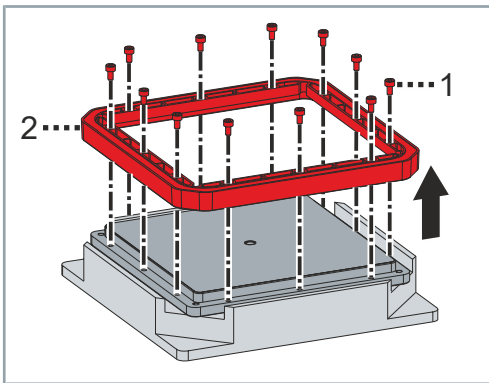


Different bumper design possible

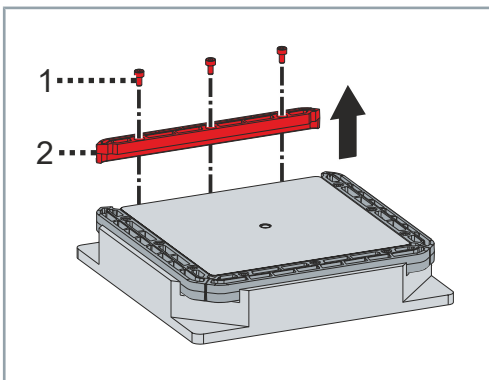
Depending on the production date of your mover, the bumper may consist of one or four parts. However, the number of screws and mounting points are identical.

Bumper 1-piece

- Remove screws [1]
- Remove a bumper [2]



Bumper 4-piece



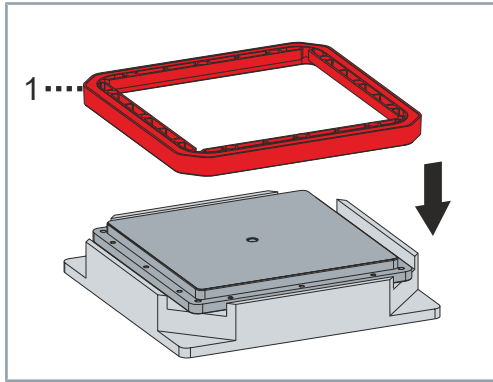
- Remove screws [1]
- Remove a bumper [2]
- Remove other bumpers in the same way

Mounting

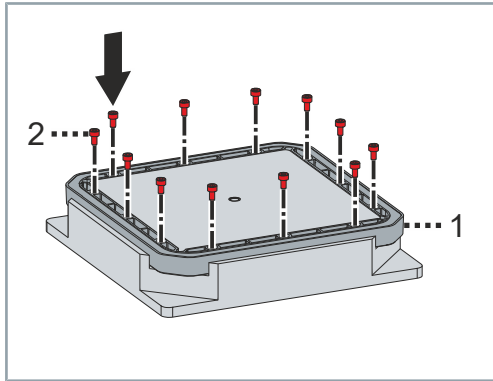


Make sure that you align the ID bumper correctly. The labels on the mover and on the ID bumper must have the same orientation. Incorrectly aligned ID bumpers can cause problems when controlling the movers.

Maintenance work on the mover

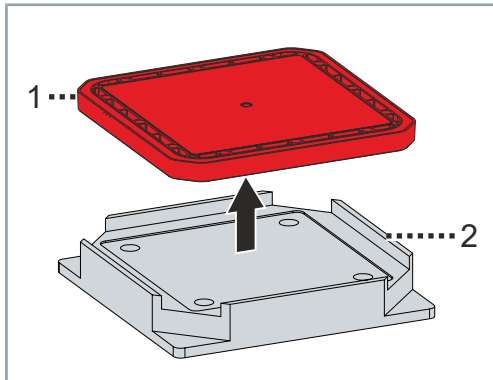


- Insert aligned ID bumper [1]

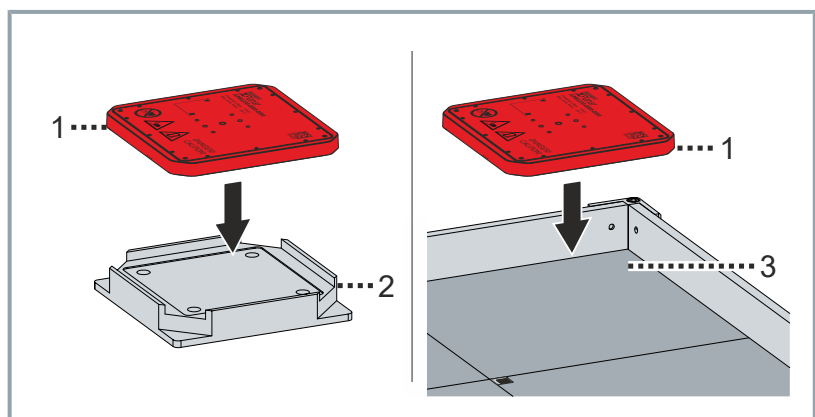


- Fasten ID bumper [1] with screws [2]
- Observe tightening torques:

Component	Tightening torque [Nm]
Screw M3 x 6	1.5



- Remove the mover [1] from the transport securing device [2] and rotate it by 180°

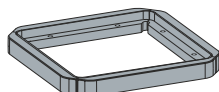


- Place the mover [1] in the transport securing device [2] with the upper side facing upwards
- OR
- Place the mover [1] straight on the stator surface [3] with the upper side facing upwards
- Make sure that the mover is correctly aligned
- Make sure that your fingers are not underneath the mover [1] and that the mover is at a sufficient distance from other movers

ID bumper

The ID bumper enables unique identification of the mover as well as reading out the individual serial number of the mover. The ID bumper is available in different versions:

1 x



8 x



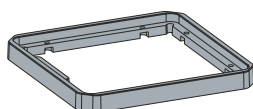
APM9001-0000-4220

This ID bumper is available for the APM4220-0000 mover.

Scope of supply:

- ID bumper
- 8 x screws M3 x 6

1 x



8 x



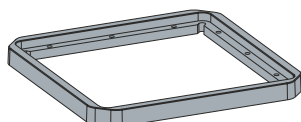
APM9001-0000-4221

This ID bumper is available for the APM4221-0000 mover.

Scope of supply:

- ID bumper
- 8 x screws M3 x 6

1 x



12 x



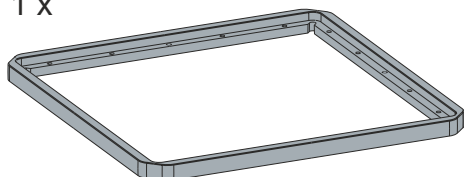
APM9001-0000-4330

This ID bumper is available for the APM4330-0000 mover.

Scope of supply:

- ID bumper
- 12 x screws M3 x 6

1 x



20 x



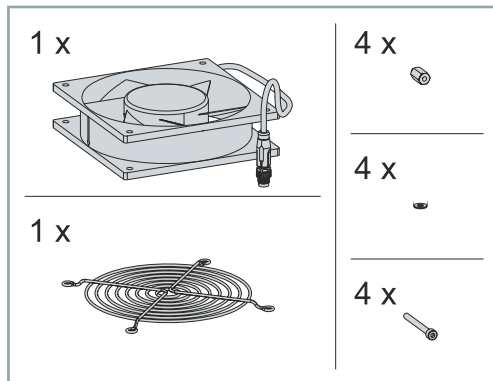
APM9001-0000-4550

This ID bumper is available for the APM4550-0000 mover.

Scope of supply:

- ID bumper
- 20 x screws M3 x 6

Fan

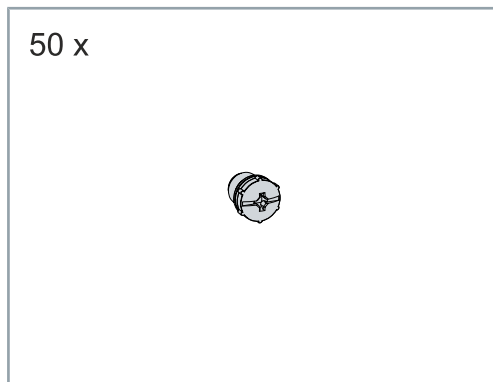


For tiles subjected to high thermal stress, a fan can be attached to the lower cover of the tile:

Scope of supply:

- Fan
- protective grid
- 4 x bolt M4 x 13.5
- 4 x washers
- 4 x screws M4 x 40

Cover plug M8



The M8 cover plugs can be used to seal unused X103 ports on the tiles:

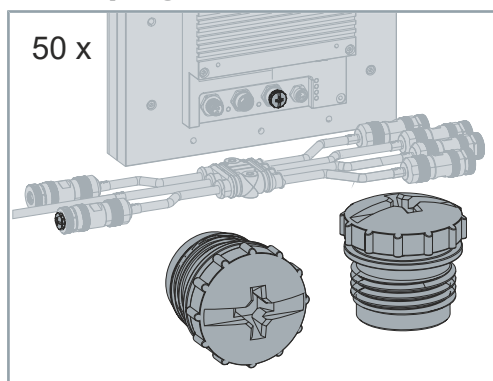
- ZS5000-0010

Scope of supply:

- 50 x cover plugs M8, IP67

- [Direct link to the data sheet](#)

Cover plug M12



The M12 cover plugs can be used to seal unused X100, X101 IN and X102 OUT ports on the tiles and on the star distributors:

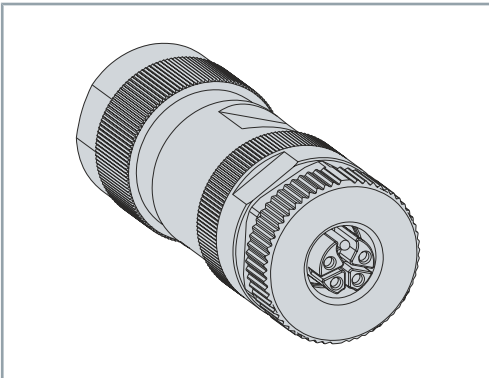
- ZS5000-0020

Scope of supply:

- 50 x cover plugs M12, IP67

- [Direct link to the data sheet](#)

Connector for ZC2000-0000-00xx

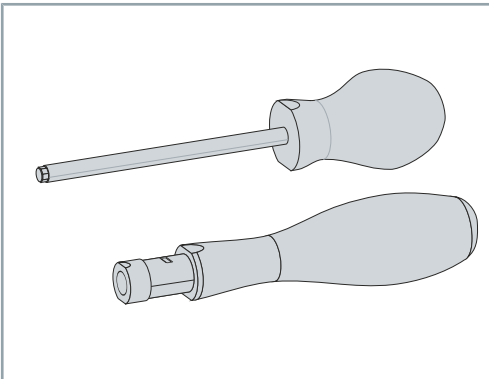


The connector is a spare part for defective connectors on the star distributors ZC2000-0000-00xx.

1 x connector, M12 K-coded

- ZS2020-2721

Torque wrench



For controlled screw-mounting of the connectors with a specified torque.

- ZB8801-0000

Scope of supply:

- Torque setting tool
- Torque wrench
- Direct link to the data sheet

Disassembly may only be carried out by qualified and trained personnel.

Further information can be found in chapter Documentation notes.

When disposing of electronic waste, make sure that you dispose of it in accordance with the regulations applicable in your country. Read and follow the instructions for proper disposal.

Disassembly

WARNING

Wear safety goggles and gloves

The movers can have strong magnetic attraction to each other or other metallic objects. Splinters can form if magnets collide.
Failure to do so may result in serious injury to fingers and eyes.

WARNING

Remove each mover individually from the box

If you take two movers out of the box and the distance between the movers is too small, the movers can attract each other.
If the movers attract each other and collide, serious injuries to the fingers from crushing and in the eyes from splinters can result.

WARNING

Do not reach under the mover with your fingers

When carrying a mover or placing it on the system, do not reach under the mover with your fingers.
Failure to do so can result in severe crushing and injury to fingers.



Do not remove components from the products

Only
Beckhoff Automation GmbH & Co. KG
is permitted to remove components.
Contact Beckhoff Service for further information.

Removing the XPlanar from the machine

- Remove cables and electrical connections
- Loosen the fastening screws of the modules
- Remove the modules from the machine one after the other
- Transport XPlanar components to the workplace or store them

Disposal

Depending on your application and the products used, ensure the professional disposal of the respective components:

Cast iron and metal

Dispose of cast and metal parts as scrap metal for recycling.

Cardboard, wood and foam polystyrene

Dispose of packaging materials made of cardboard, wood or foam polystyrene in accordance with the regulations.

Plastics and hard plastics

You can recycle parts made of plastic and hard plastic via the recycling depot or re-use them depending on the component designations and markings.

Oils and lubricants

Dispose of oils and lubricants in separate containers. Hand over the containers at the used oil collection station.

Batteries and rechargeable batteries

Batteries and rechargeable batteries may also be marked with the crossed-out trash can symbol. You must separate these components from the waste and are legally obliged to return used batteries and rechargeable batteries within the EU. Observe the relevant provisions outside the area of validity of the EU Directive 2006/66/EC.



Electronic components

Products marked with a crossed-out waste bin must not be disposed of with general waste. Electronic components and device are considered as waste electrical and electronic equipment for disposal. Observe the national regulations for the disposal of old electrical and electronic equipment.

Returning to the vendor

In accordance with the WEEE-2012/19/EU directives, you can return used devices and accessories for professional disposal. The transport costs are borne by the sender.

Send the used devices with the note "For disposal" to:

Beckhoff Automation GmbH & Co. KG
 "Service" Building
 Stahlstrasse 31
 D-33415 Verl

In addition, you have the option to contact a local certified specialist company for the disposal of used electrical and electronic appliances. Dispose of the old components in accordance with the regulations applicable in your country.

More Information:

Beckhoff Automation GmbH & Co. KG
Hülshorstweg 20
33415 Verl
Germany
Phone: +49 5246 9630
info@beckhoff.com
www.beckhoff.com

