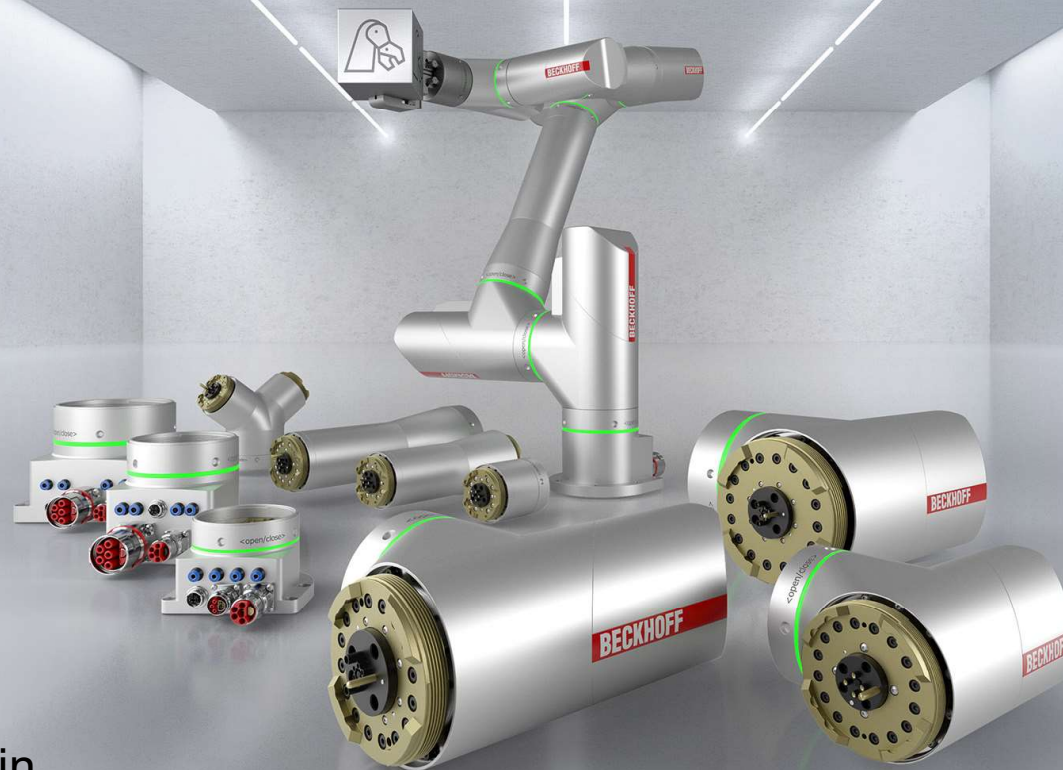


ATRO: Modular, flexible, and integrated.
The perfect robot for every application

BECKHOFF



Lluís Moreno
Sales Manager Spain

ATRO

ATRO: Tecnología de automatización para la robótica - Sistema modular para los robots industriales

BECKHOFF



Lluís Moreno
Sales Manager Spain

Robotics in machine and system engineering

BECKHOFF

- Industrial robots take over tasks in many areas that would otherwise be too dull, too dirty, or too dangerous for humans. They also help to improve accuracy and can even process reliability and cycle times.
- Alongside other important tasks such as welding, assembly, and painting, one of the main applications of industrial robots involves handling products in the plant.
- Cooperation and collaboration between robots and humans is becoming ever more important in many applications, as it
 - saves space in the plant, and
 - increases flexibility for plants with operator interaction.



ATRO: Automation Technology for Robotics

BECKHOFF

ATRO system

- offers a unique, modular, and flexible industrial robot system
- fully integrated into the Beckhoff automation system



**NUEVO
Producto**

ATRO

Facts and figures

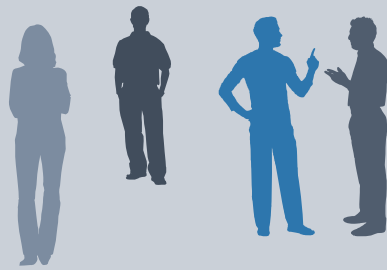
BECKHOFF

Verl, Germany



Headquarters

5,250



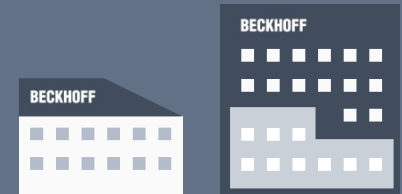
Employees worldwide

2,100



Engineers

24



Sales/business
locations in Germany

39



International
subsidiaries

> 75

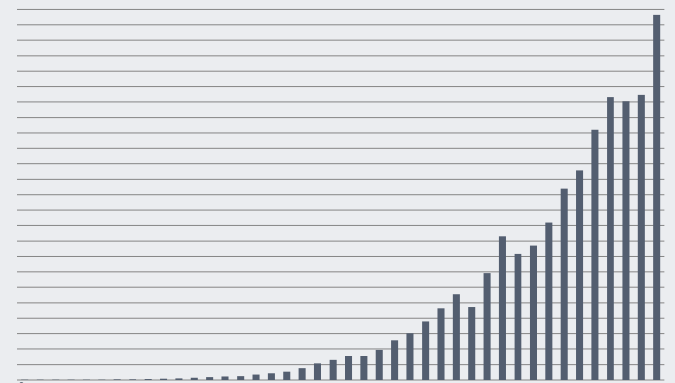


Representatives
worldwide

**€1.182
billion**

+28%

Sales
worldwide 2021

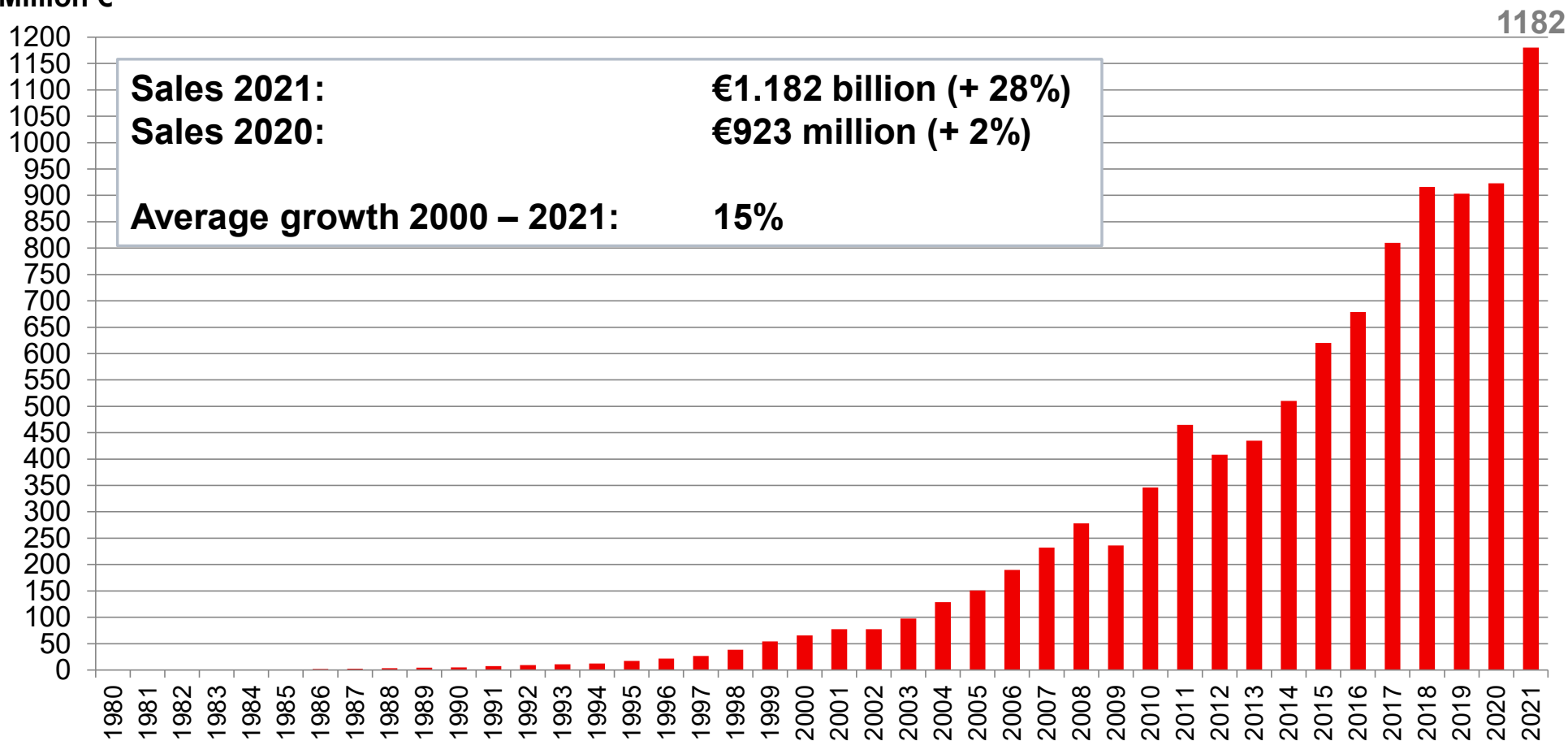


as of: 11/2022

Sales 1980 – 2021

BECKHOFF

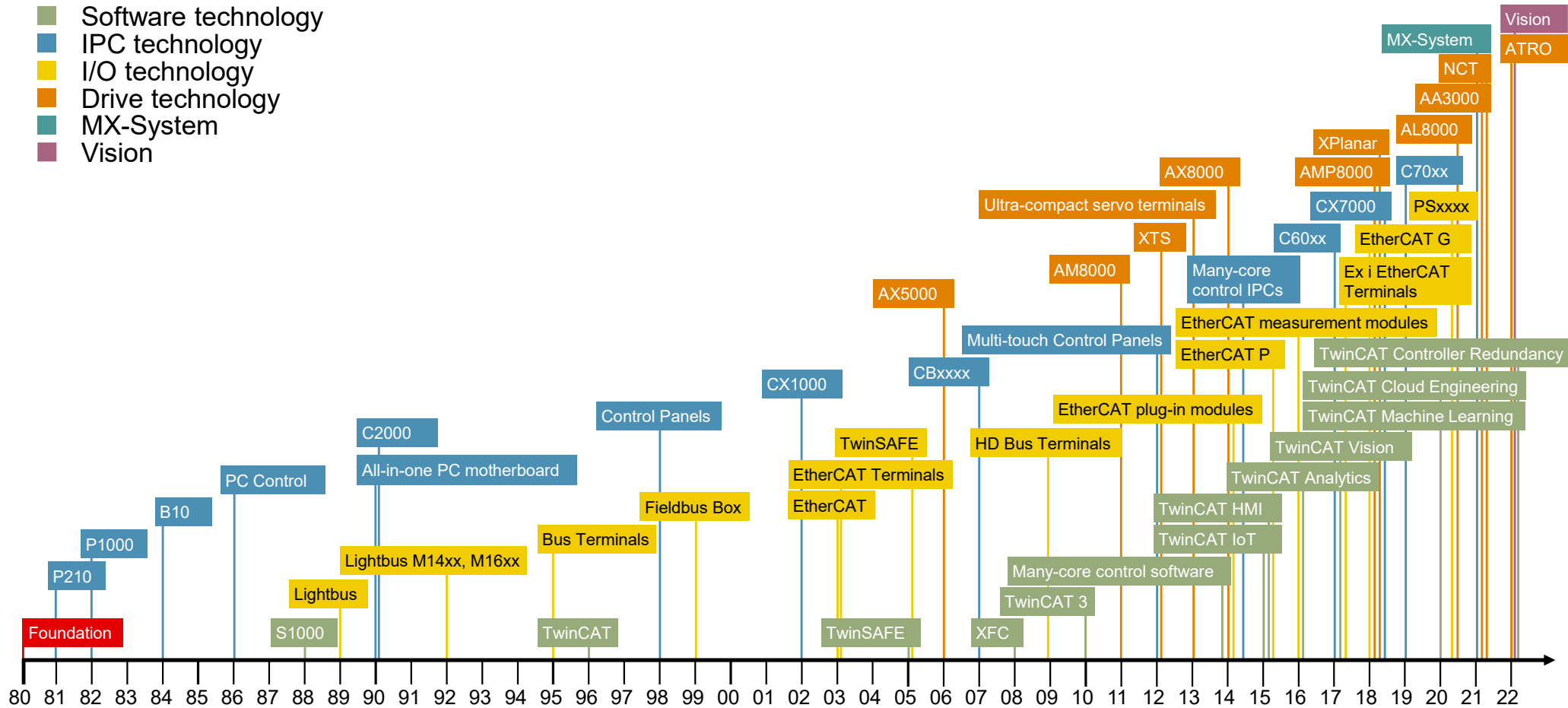
Million €



Milestones

BECKHOFF

- Software technology
- IPC technology
- I/O technology
- Drive technology
- MX-System
- Vision



Products and system solutions

BECKHOFF

Industrial PC and Embedded PC



EtherCAT



TwinCAT



Infrastructure components



Bus Terminals



MX-System



Transport systems



Drive Technology and robot system

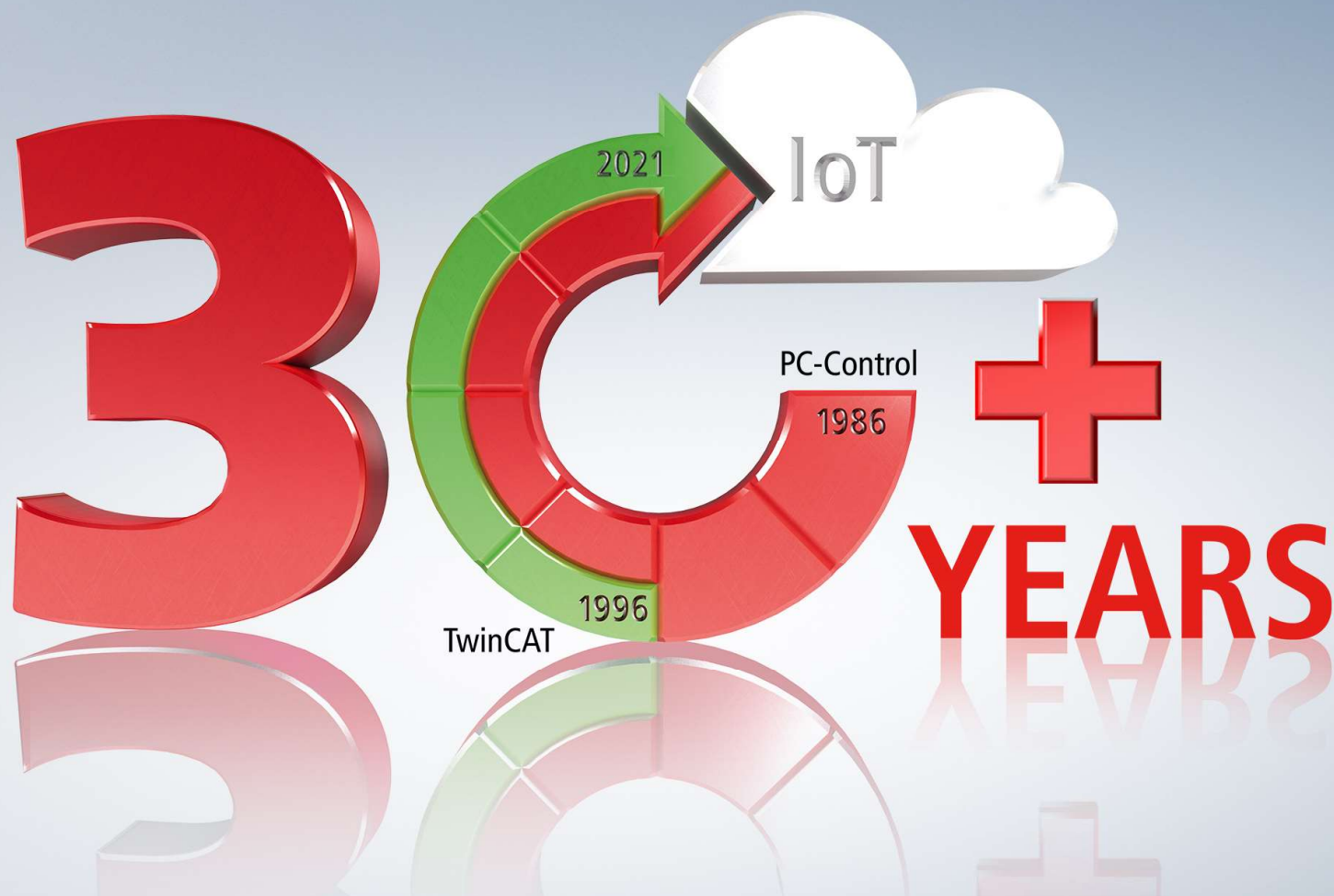


Vision



**30+ years of PC-based control –
from the idea to the world standard**

BECKHOFF

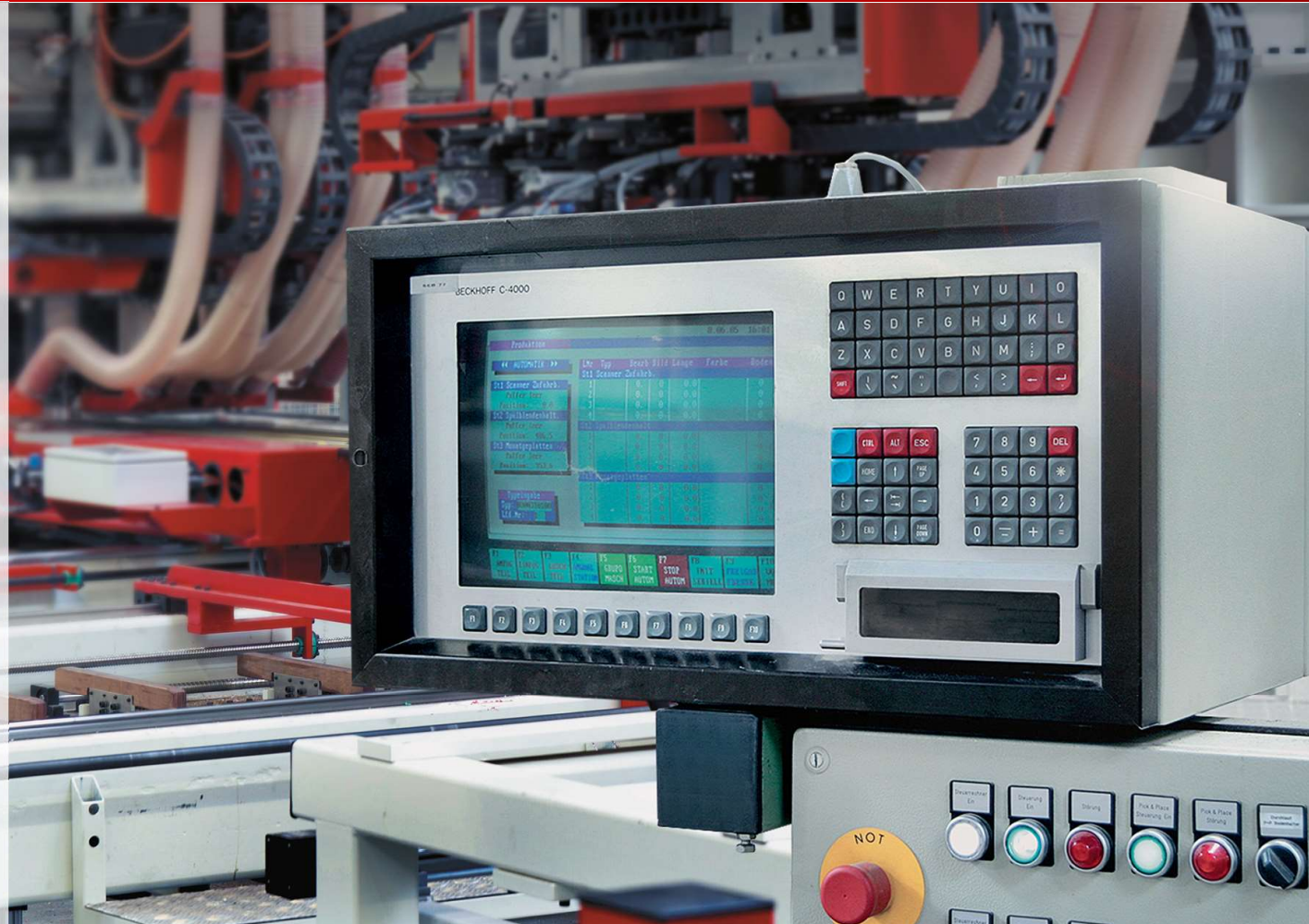


More than 30 years of expertise: built into every IPC.

BECKHOFF

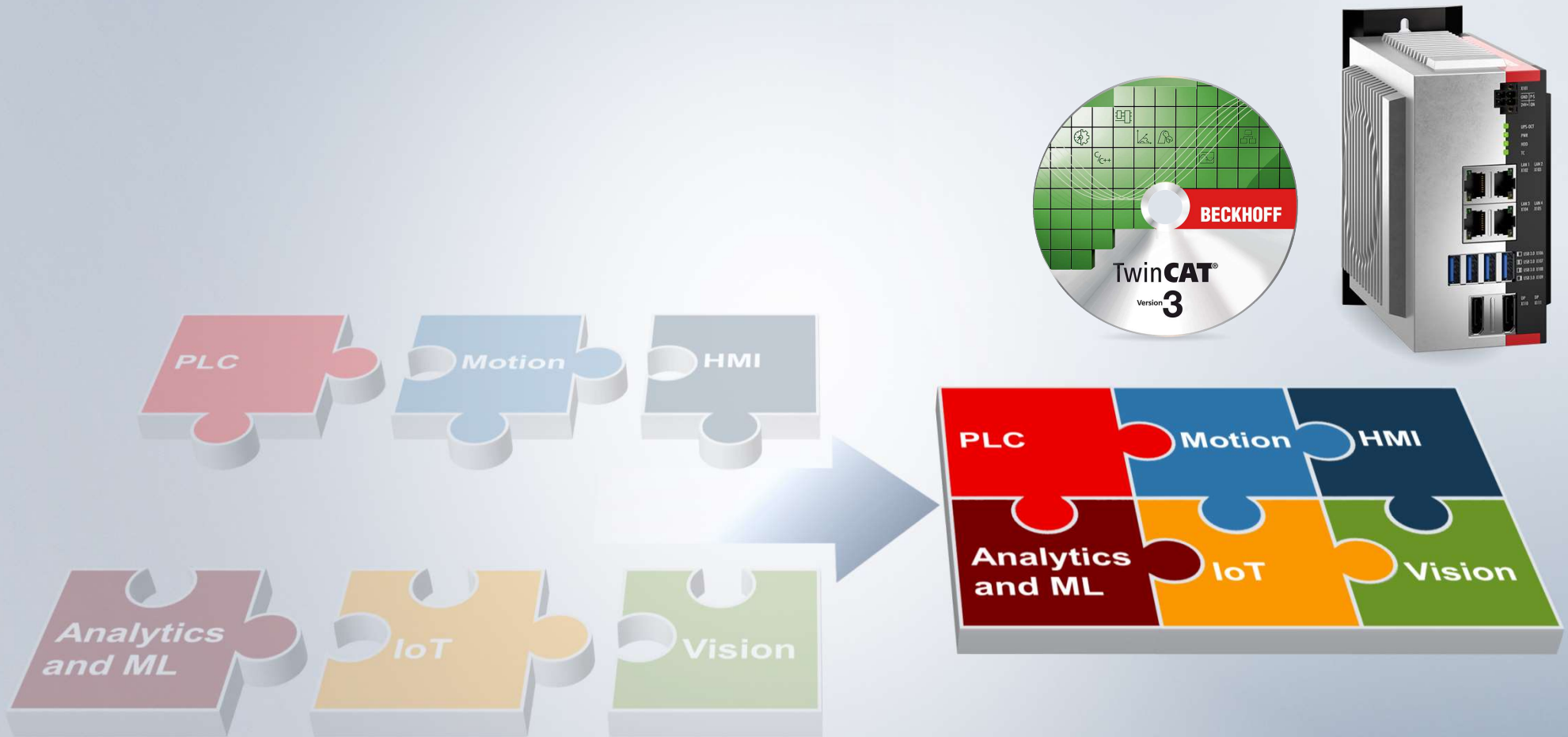
The PC-based control principle: developed by Beckhoff more than 30 years ago

1986:
First PC-based machine controller



PC-based control General principle

BECKHOFF



System overview

BECKHOFF

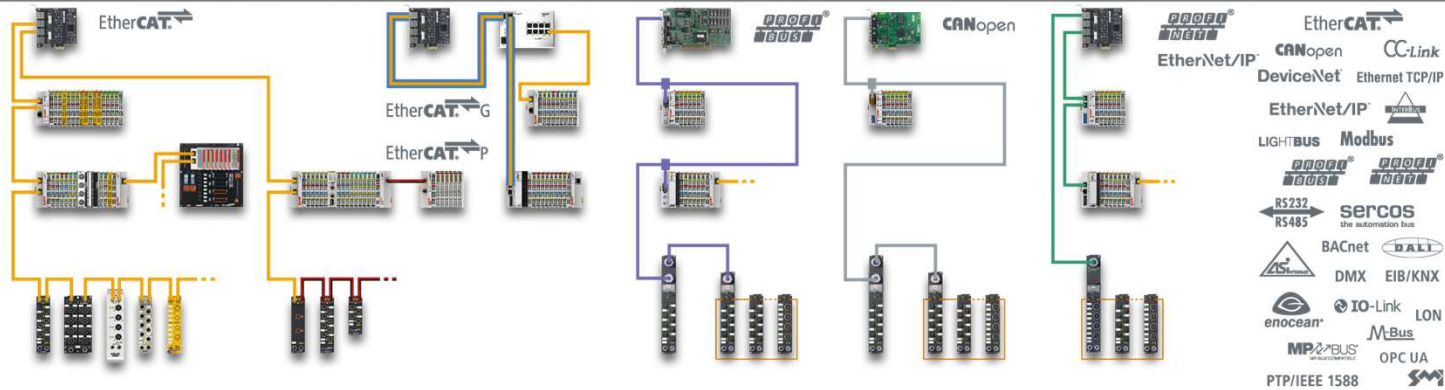
Automation



IPC



I/O



Motion



MX-System



Vision





TF5000

BECKHOFF



TF5000 CNC



TF5000 DC Link



TF5000 MC List



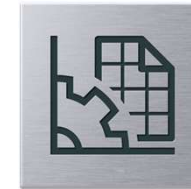
TF5000 MC
Parameterization



TF5000 Motion
Base



TF5000 Motion
Designer



TF5000 Motion
Drive



TF5000 Motor Data
File Generator



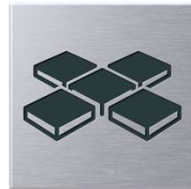
TF5000 NC I



TF5000 NC PTP



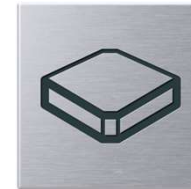
TF5000 Robotics



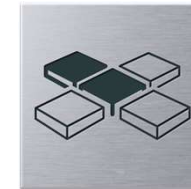
TF5000 XPlanar
Coordinate System



TF5000 XPlanar



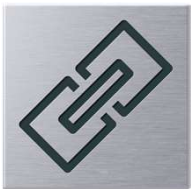
TF5000 XPlanar
Mover



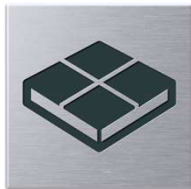
TF5000 XPlanar
Part



TF5000 XPlanar
Processing Unit



TF5000 XPlanar
Rigid Mover
Coupling



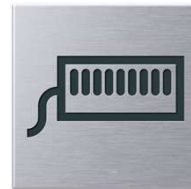
TF5000 XPlanar
Tile



TF5000 XTS



TF5000 XTS
Module



TF5000 XTS
Module Infeed



TF5000 XTS Mover



TF5000 XTS
Viewer

Una gran capacidad de potencia de cálculo ha de disponer un bus rápido, sincrónico, determinístico para controlar los Servos como E/S distribuidas

BECKHOFF

EtherCAT[®]
Technology Group

Fast Controls with slow Bus System

Super Fast Controls (such as PC-based controls)
requires a super fast bus technology!



El bus de campo Industrial con más miembros

BECKHOFF



ETG Members worldwide

As of Nov 30, 2019:

5643

A graphic illustration of a globe with a grid of latitude and longitude lines. Two yellow Ethernet cables are wrapped around the globe. One cable is at the top, with its RJ45 connector visible. Another cable is at the bottom, also with its RJ45 connector visible. The cables have the "EtherCAT" logo printed on them.

ETG members from
66 countries and 6 continents

December 2019

EtherCAT Technology Group

MULTIVAC Sepp Hagggenmüller GmbH & Co. KG, Germany

Handling modules

BECKHOFF

Automation

- TwinCAT NC PTP
- TwinCAT Kinematic Transformation

IPC

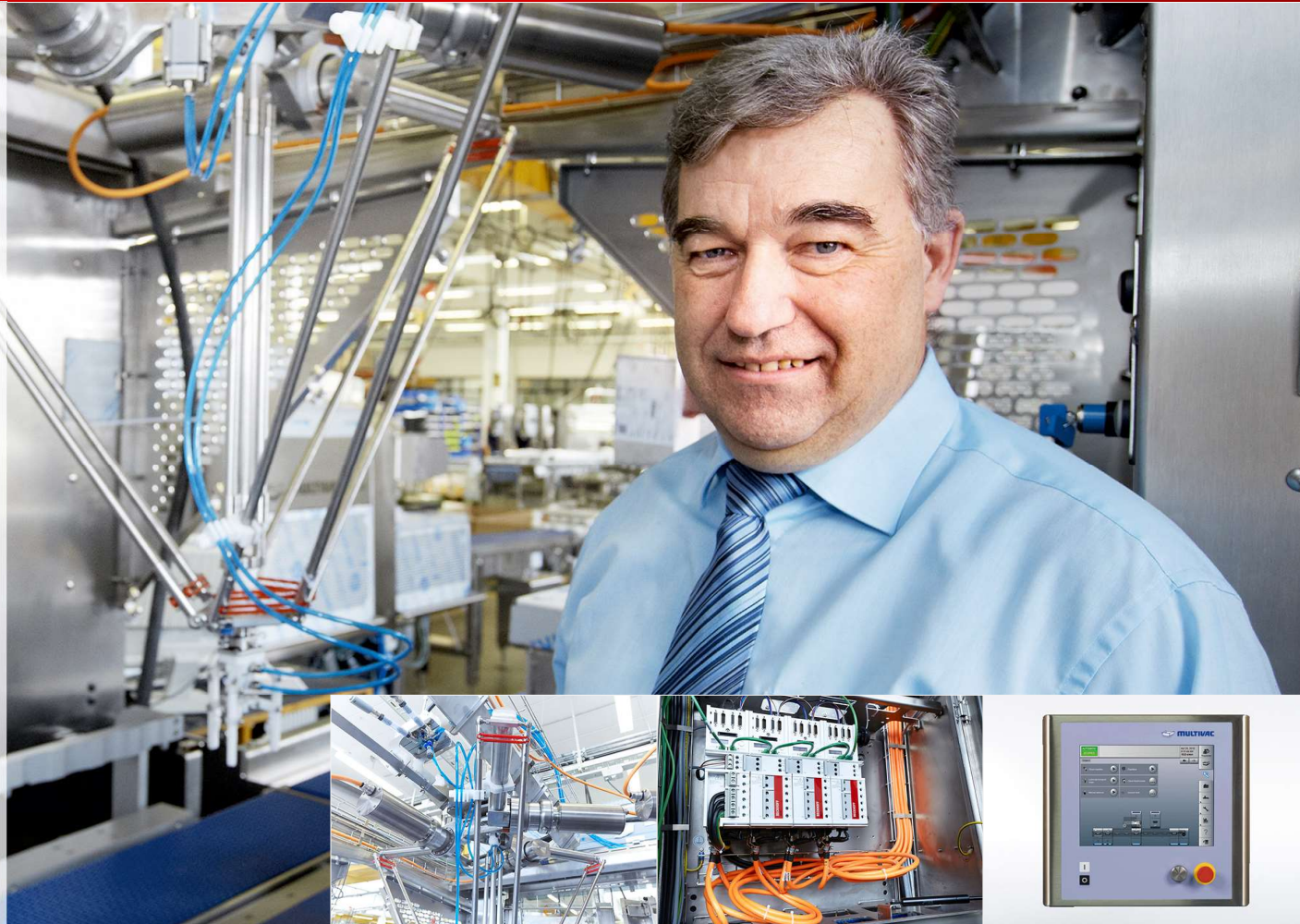
- CX1020 and CX1030 Embedded PCs
- custom-designed 12-inch CP7201 Panel PCs in stainless steel design

I/O

- EtherCAT Terminals

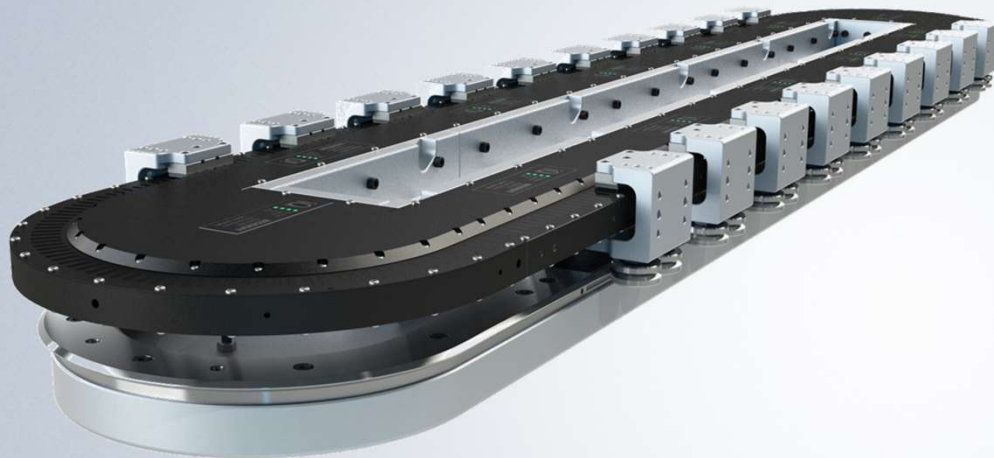
Motion

- AX5000 Servo Drives
- Stainless steel AM8800 with OCT



XTS – Sistema mecatrónico

BECKHOFF



Parallel guide rail absorbs
weight forces
high payloads

Steel rollers on steel
guide rail
high durability

Movers with different magnet
plate sets
high process forces supported

The modular XTS system enables a wide range of individual track layouts

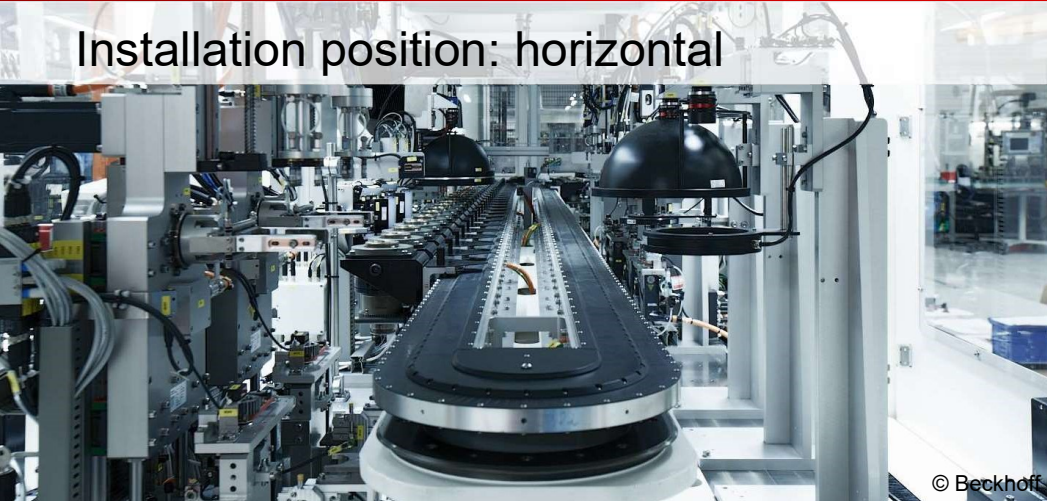
BECKHOFF



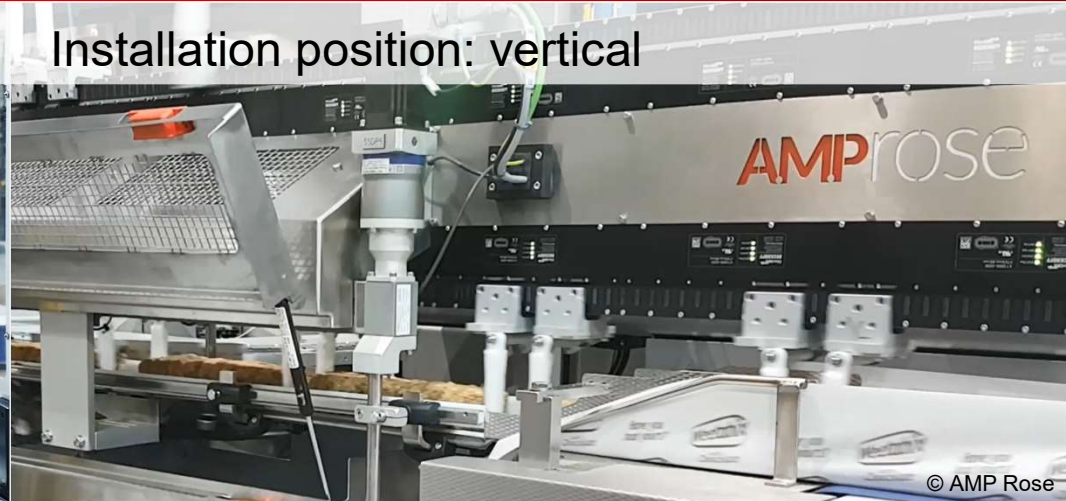
Light-weight XTS allows easy integration in any installation position

BECKHOFF

Installation position: horizontal



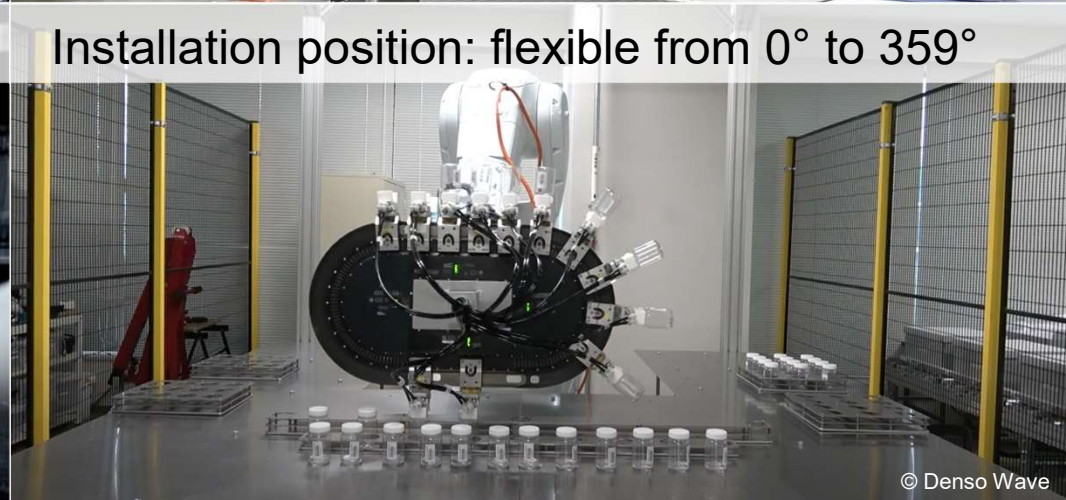
Installation position: vertical



Installation position: 45°



Installation position: flexible from 0° to 359°



Aplicación nacional XTS con PACKFEEDER y robots Delta

BECKHOFF



The bottle unscramblers of the Pickfeeder family of machines combine the eXtended Transport System (XTS) with up to four delta robots.

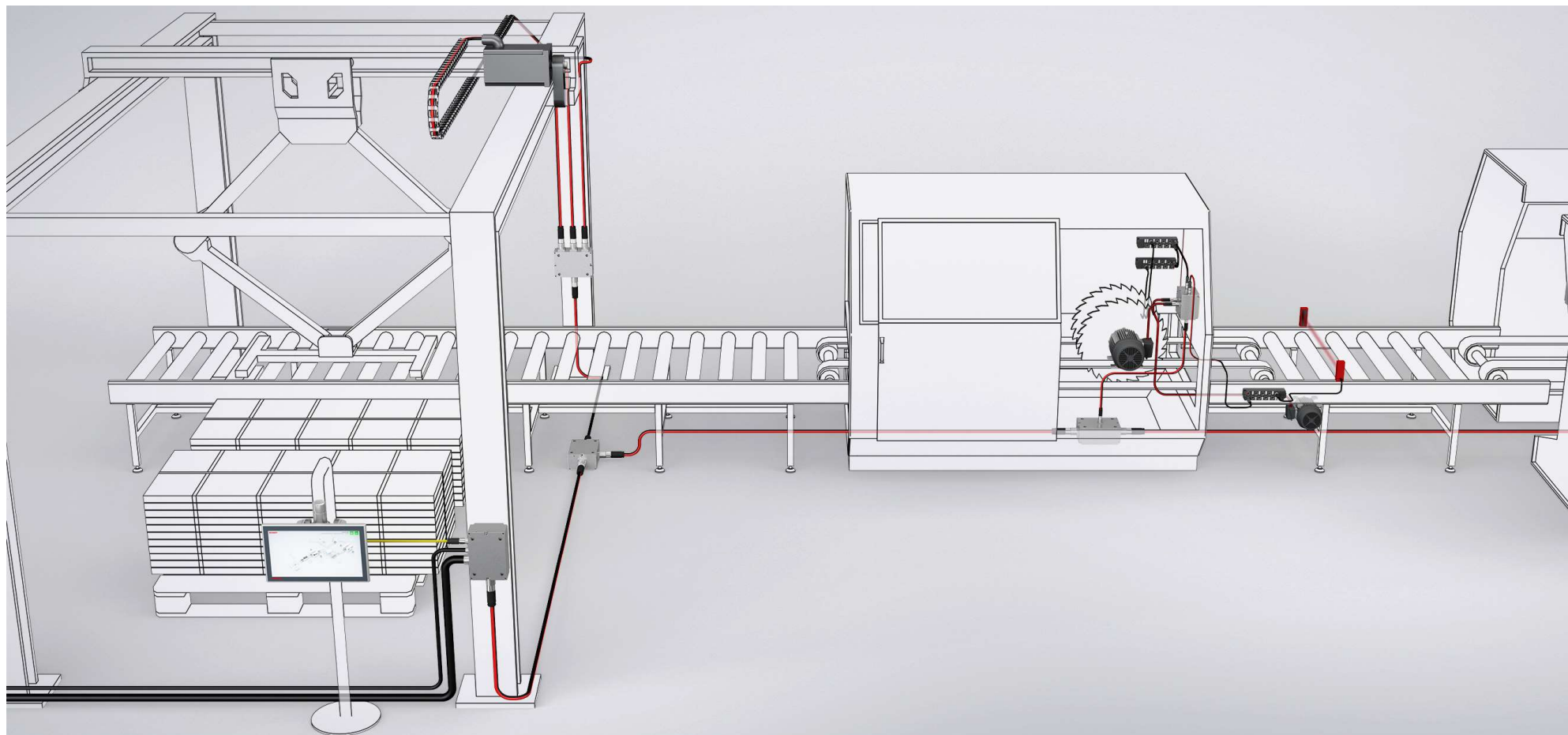
Beckhoff | The Motion Company

BECKHOFF



Servomotores AMP8000, con electronica de potencia incluida

BECKHOFF



XPLANAR Levitación de platillos, con capacidad de movimiento XY, A así como rotación

BECKHOFF

free 2D product transport with up to 6 degrees of freedom

many use cases across all industries

available and in use

deep integration into the PC control philosophy

**NUEVO
Producto**





Application

- surface treatment and cleaning with plasma
- XY positioning of one planar mover on six planar tiles
- replaces 6-axis robot and conventional linear drive technology
- reduces mechanical complexity and partly also system costs



**The Beckhoff MX-System:
New automation construction kit replaces the control cabinet**

BECKHOFF

**NUEVO
Producto**



From control cabinets to a modular automation system All components included in a compact system solution

BECKHOFF

- Metal housing (IP54), cooling
- I/O system
- Functional safety
- 24 V DC power supply
- Fuse 24 V DC
- Fuse 400 V AC
- Direct motor starter
- IPC as PLC and fieldbus master
- 600 V DC power supply
- RPM regulated drives
- Cable connection area
- Cable input area

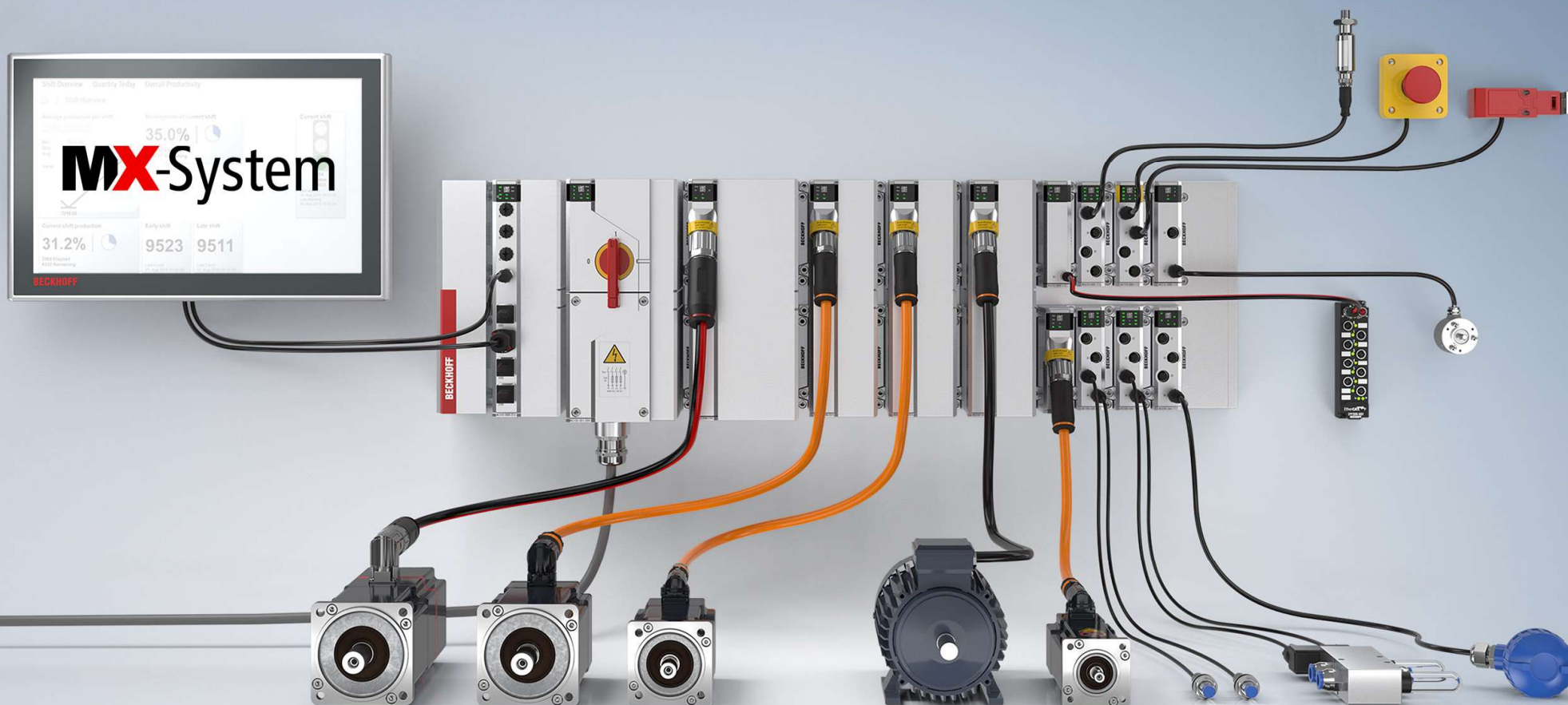


**NUEVO
Producto**

MX-System

Pluggable system solution for control cabinet-free automation

BECKHOFF



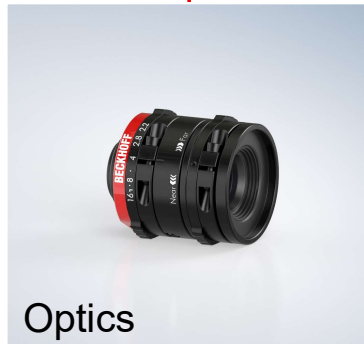
Complete vision portfolio

BECKHOFF

**NUEVO
Producto**



Cameras



Optics



Illumination



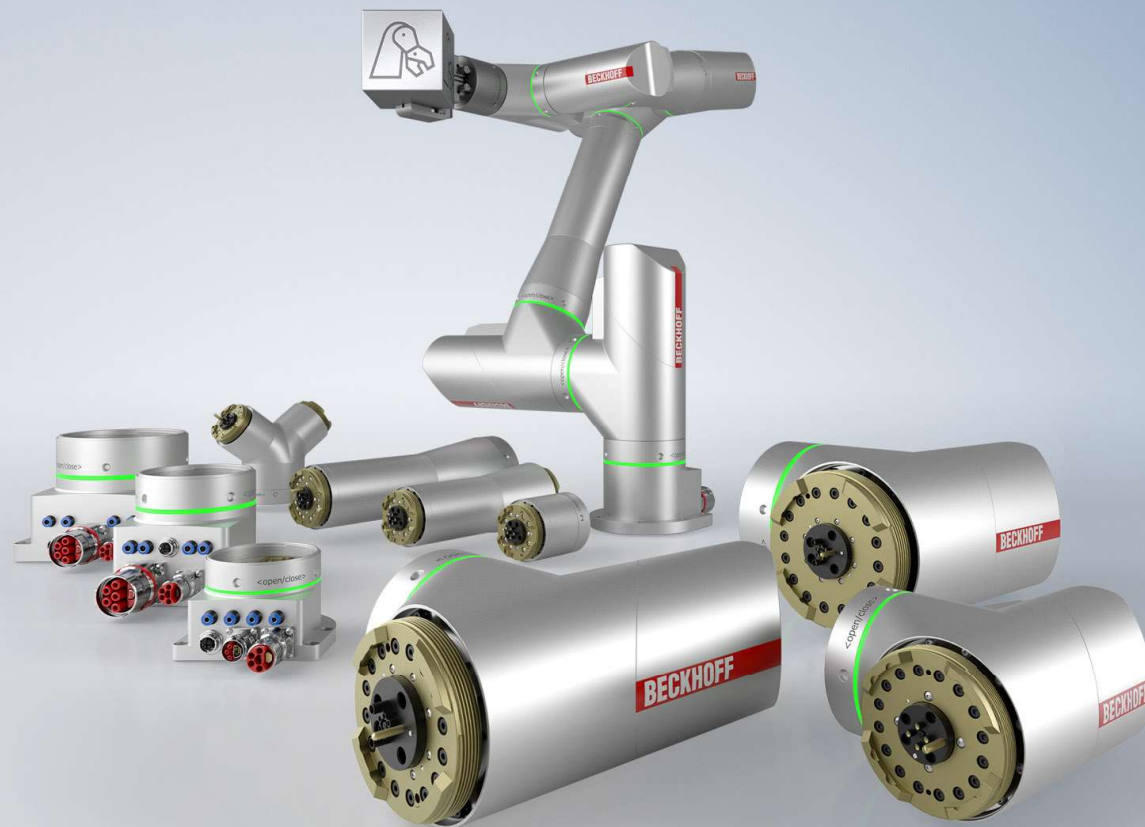
Units



TwinCAT Vision

The industrial robot system – modular und flexible

BECKHOFF



ATRO

Individual robot configurations from standardized modules

BECKHOFF

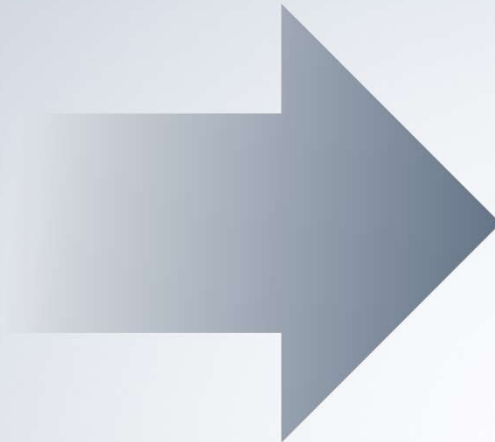
ATRO base modules



ATRO motor modules



ATRO link modules



ATRO kinematics



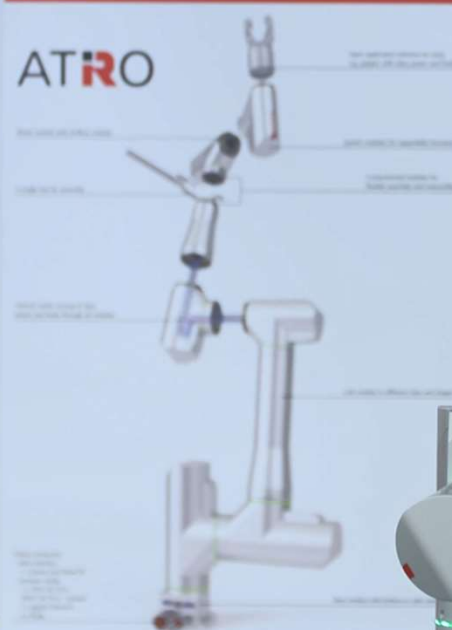
ATRO: Automation Technology for Robotics

Build your application-specific robot

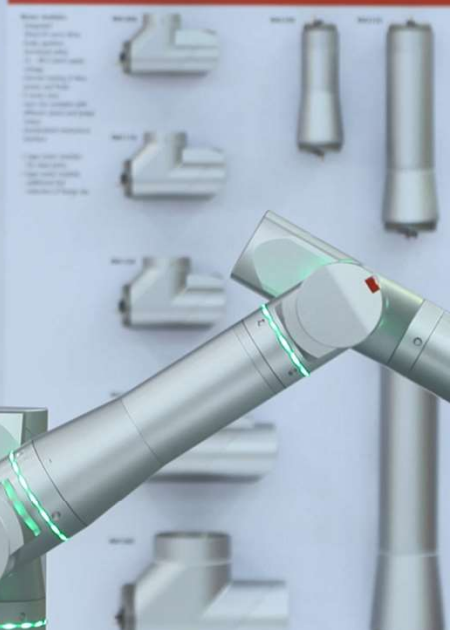


- Features**
- modular industrial robot solution for easy reconfigurable configuration
 - ready-to-use pre-installed software solution of all parts with internal routing of data, power and fluids
 - open mechanical interface
 - fully integrated into the field of automation system
 - supporting the standard control systems with safety
 - suitable for cooperative and collaborative applications

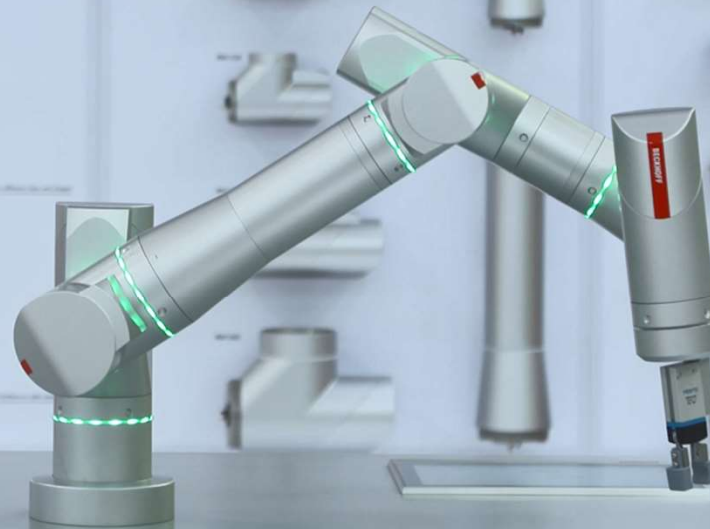
System overview



Motor modules



Link and Base modules

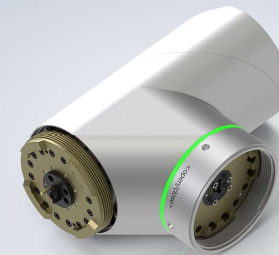


ATRO: The modular and flexible industrial robot system

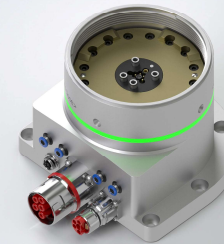
BECKHOFF

- standardized modules are turned into **individual robot configurations**
- **The combination of modules is determined on an application-specific basis.**
 - The size and number of axes vary depending on the required reach and payload, as well as on the required degree of freedom.
 - this cuts down on weight and also reduces cost
- For pick-and-place applications, 4 degrees of freedom are often sufficient
→ only 4 motor modules are required.

ATRO motor module



ATRO base module

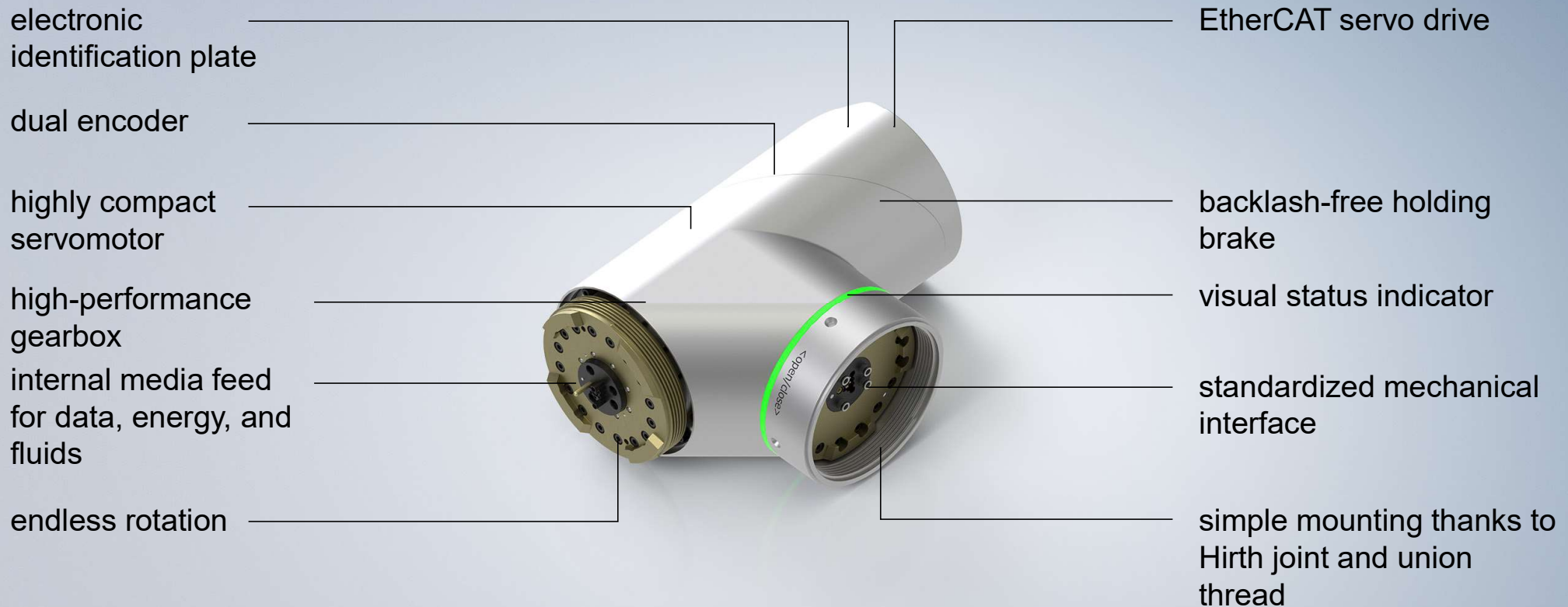


ATRO link module



The central component: The ATRO motor module

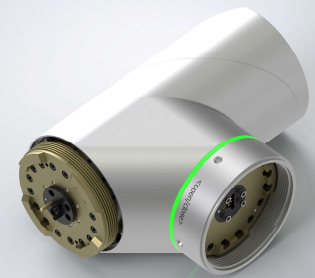
BECKHOFF



Modular industrial robot system

BECKHOFF

- **integrated servo drives in the motor modules**
 - free up space in the control cabinet and minimize wiring effort
- straightforward possibility of control cabinet-free operation
 - The control IPC can be integrated into the base.
- modular design **reduces stocking costs for** the customer
 - Different robot configurations use the same modules.
 - Existing modules can be reassembled for future applications.



ATRO interface: Standardized interface

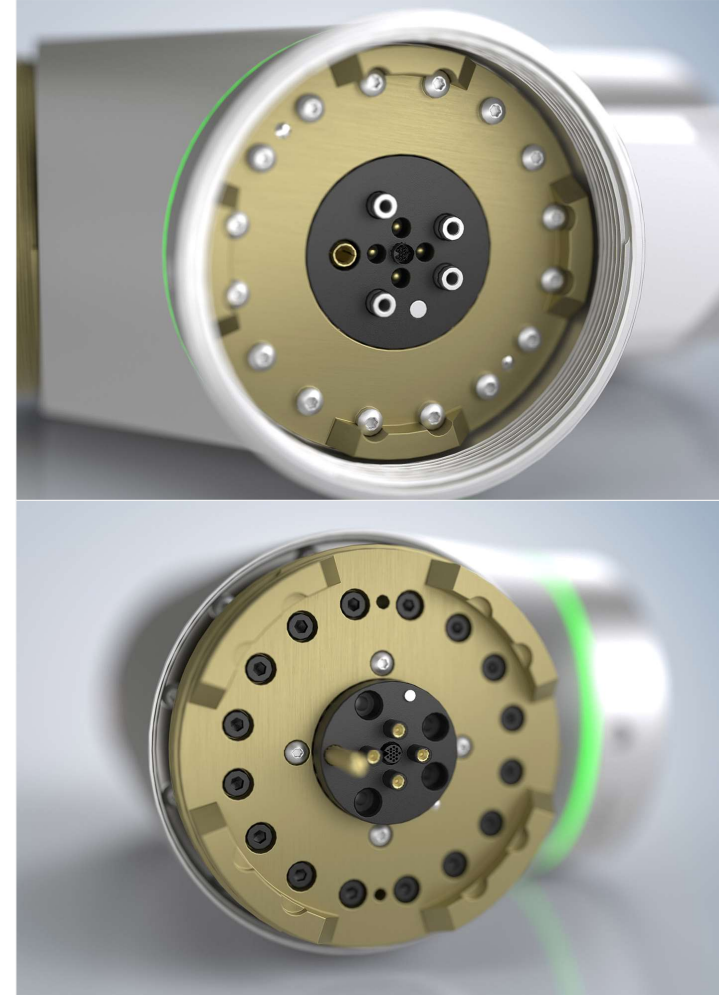
BECKHOFF

Assembly of the modules is extremely simple

- The ATRO interface is self-centering thanks to the Hirth coupling.
- The self-locking screw connection makes for a stable bond.

One tool is sufficient for the complete assembly of the kinematics.

- The robot can be assembled by just one person.
 - This is especially helpful when mounting/dismounting overhead



ATRO interface: Standardized interface

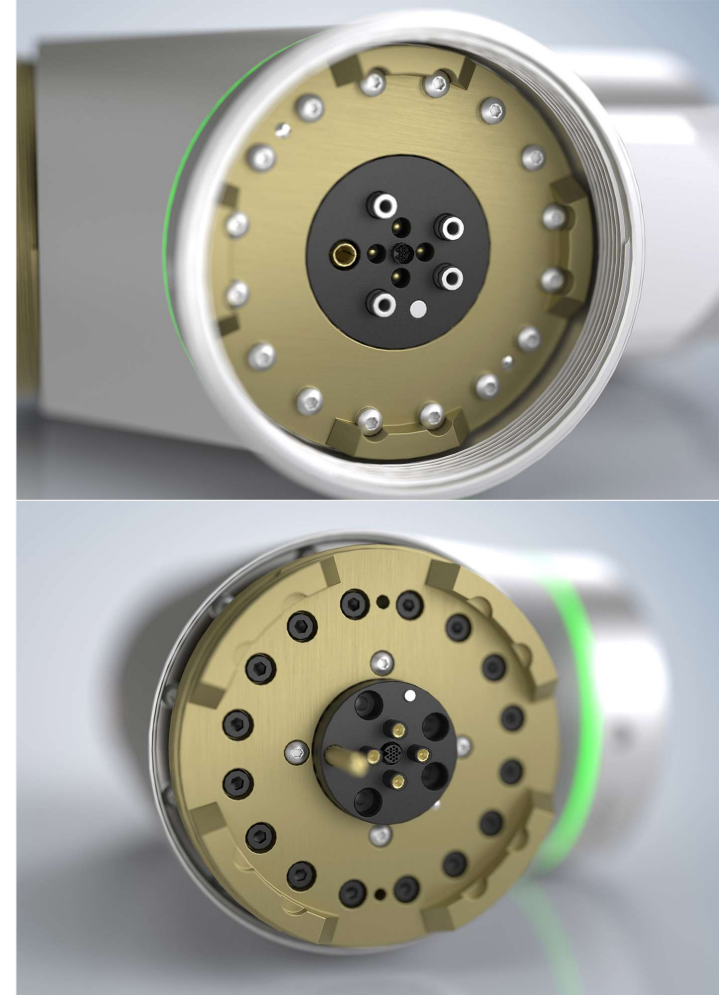
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ATRO interface on all motor, link, and base modules

- data, power and fluid interface

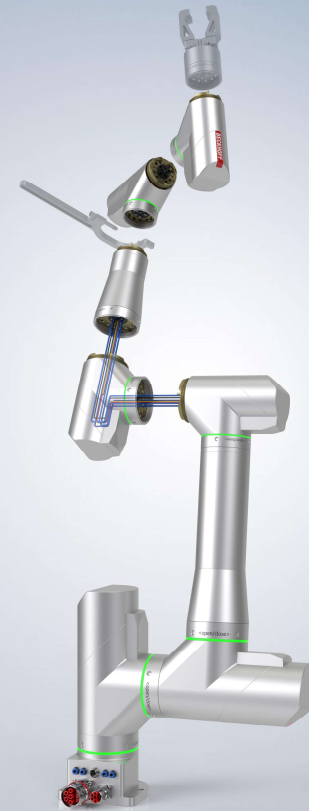
ATRO interface also serves as an interface to the tool on the end effector.

- straightforward adaptation to existing grippers
- endless rotation of the tools is maintained thanks to the internal media feed



- The assembled modules form the complete mechanical construction of the robot.
 - only the motor, link, and base modules are required
- Individual modules can be replaced for maintenance
 - this **minimizes the MTTR*** compared to a complete robot exchange.

*MTTR: Mean Time To Repair



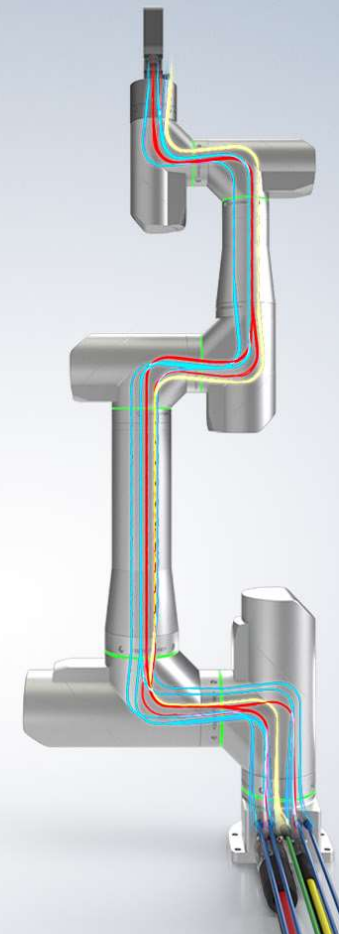


ATRO

Internal media supply

BECKHOFF

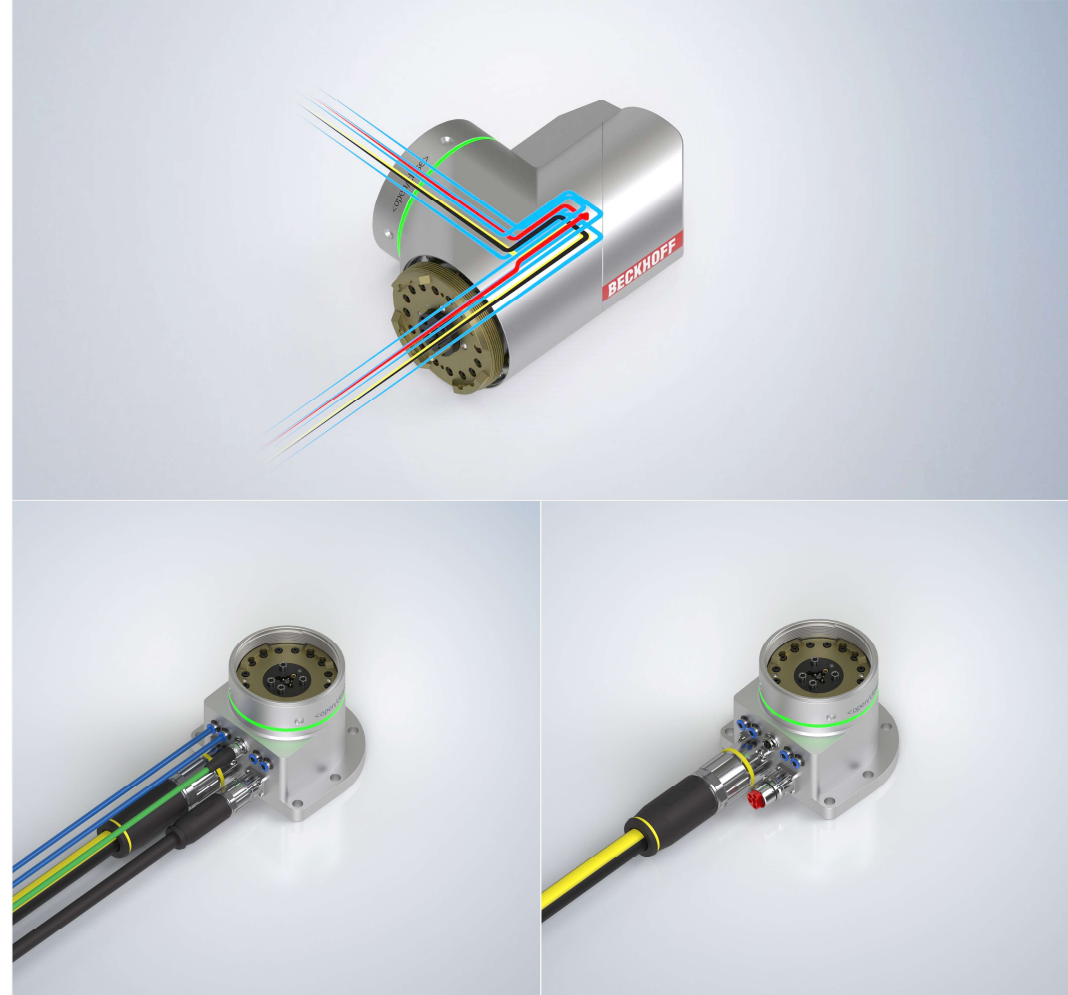
- All modules have an **integrated media supply**
 - for data, power and fluid feedthrough e.g., **compressed air, vacuum or water**
 - **from the base to the end effector**
- two media strands
 - robot supply and data interface
 - additional media channel for the customer application at the end effector



Internal media feed

BECKHOFF

- media for robot supply
 - EtherCAT communication
 - 24/48 V supply for internal electronics and motors
- independent media channel for the customer application
 - power:
 - 4-pin, e.g., 230 V and
 - 5-pin, e.g., 400 V AC, or 600 V DC (depending on module size)
 - Gigabit Ethernet communication
 - 4x fluids





ATRO

All axes are endlessly rotating

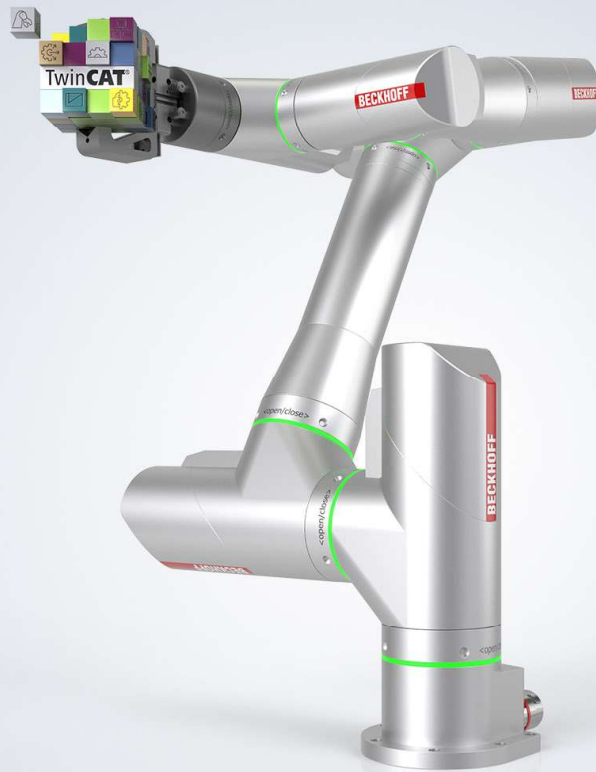
BECKHOFF

- All axes are designed for **endless rotation**.
 - This also applies to the main axes.
- The internal media feed avoids the need for an external hose and cable guide up to the gripper.
 - Interfering cables that prevent endless rotation of the entire structure are thus obsolete.
- The absence of axis limitations simplifies the programming of Cartesian movements.
 - **The shortest paths can always be taken.**



PC-based control – robot controller fully integrated into TwinCAT

BECKHOFF



ATRO

PC-based control

BECKHOFF

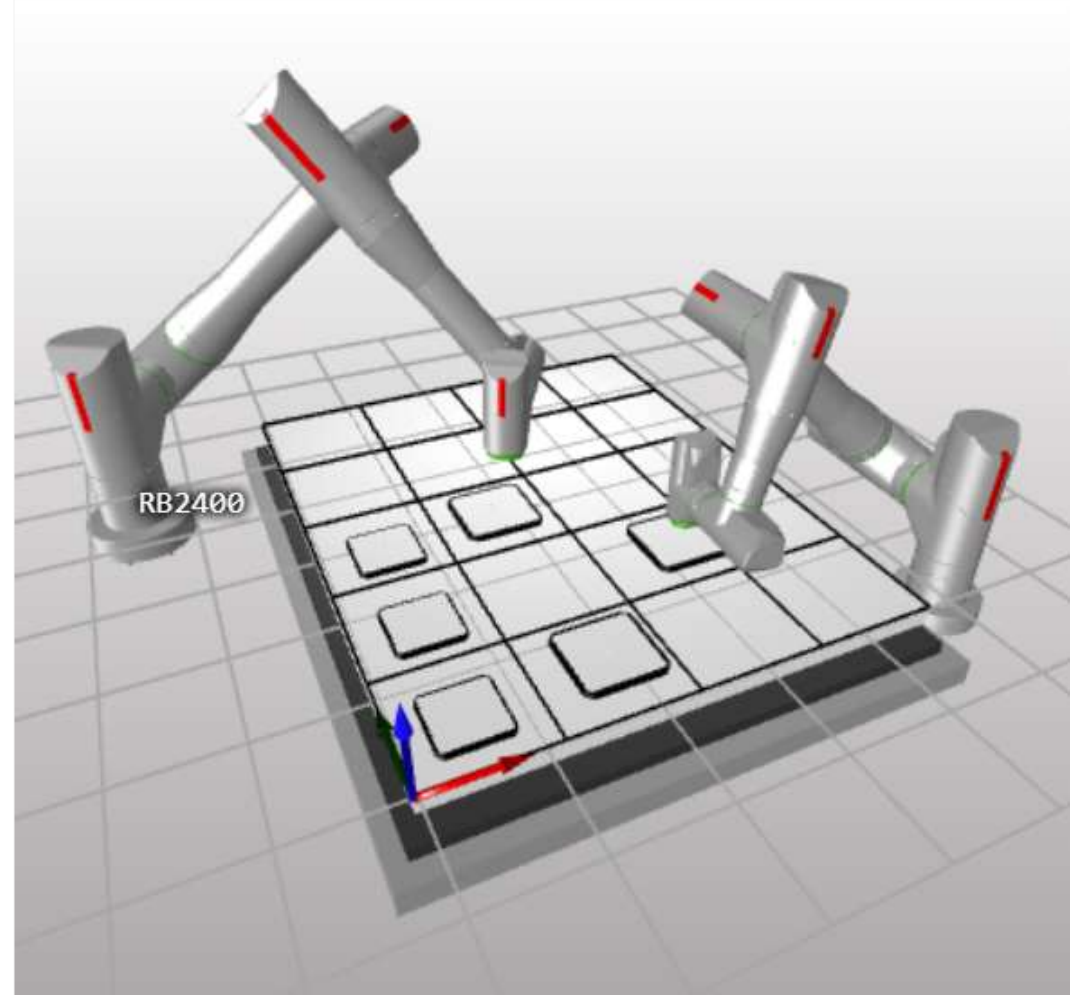
- TwinCAT transforms almost any PC-based system into a real-time control complete with multiple PLC, NC, CNC, and/or robotics runtime systems.
 - programming and configuration in a single software
- The robot control functionality is embedded in the TwinCAT automation software.
 - engineering for configuration and programming
 - runtime system for real-time control and synchronization



High-performance robot controller

BECKHOFF

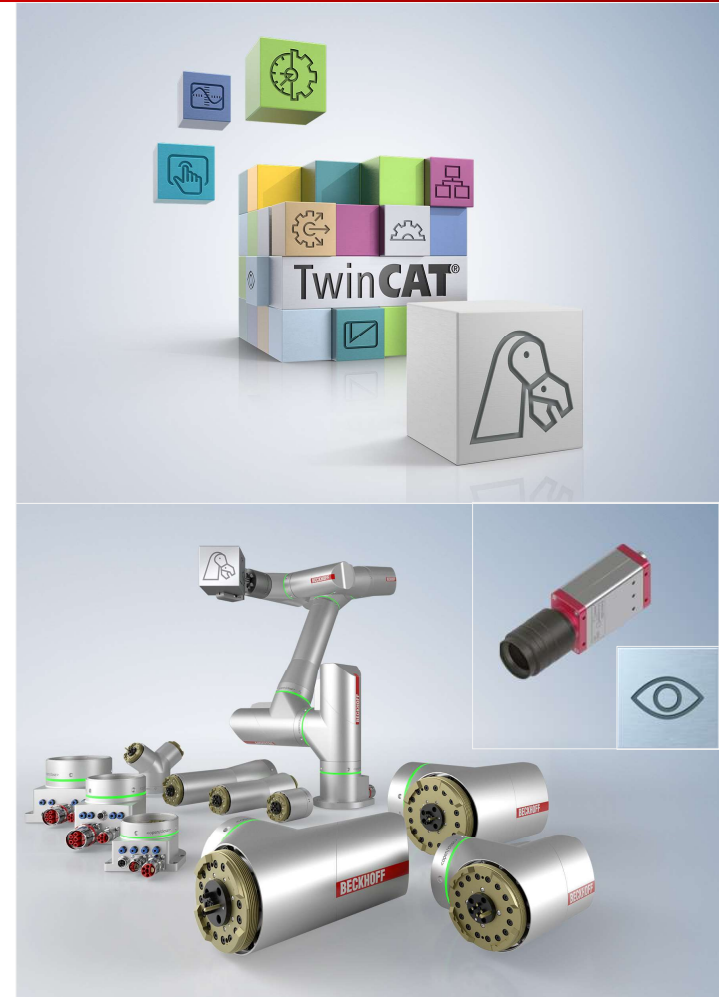
- With active support of multi-core CPUs, TwinCAT offers clear performance advantages compared to conventional robot controllers.
- integrated functionality
 - **one control IPC** for PLC, robot controller, and additional automation functions
 - this eliminates time delays for data exchange between tasks
 - the complete system is synchronized
- **Multiple robot kinematics can be operated with one control.**



Extensible through TwinCAT functions

BECKHOFF

- The robot controller can be combined with all TwinCAT function extensions.
 - The use of **TwinCAT Vision** enable sophisticated applications (e.g., automated bin picking).
 - **Machine Learning** solutions can be used to improve motion performance.
 - **Coordinated motion** between the robot, XPlanar and XTS, and other motion components works seamlessly.
 - **Analytics functions** for predictive maintenance (including operating time, load cycles, and overload) are available.



Robot programming

BECKHOFF

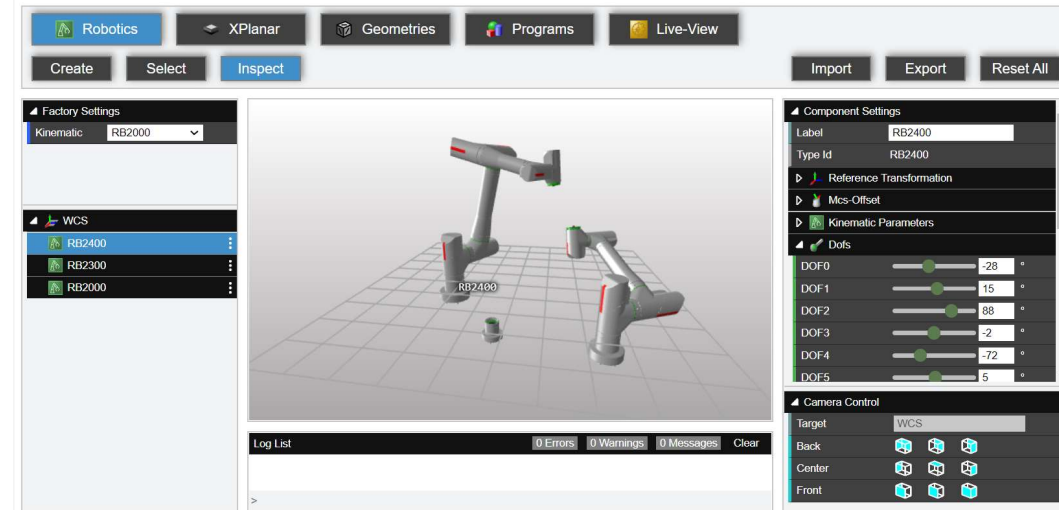
- application programming
 - **Easy Mode**
for simple applications and all users
 - **Advanced Mode**
for standard robot-based automation
 - **Technical Mode**
for TwinCAT experts to handle sophisticated tasks
- motion programming
 - positioning of the robot via **hand guiding**
 - **teaching of** positions via system module or external operating buttons



Configuration and programming

BECKHOFF

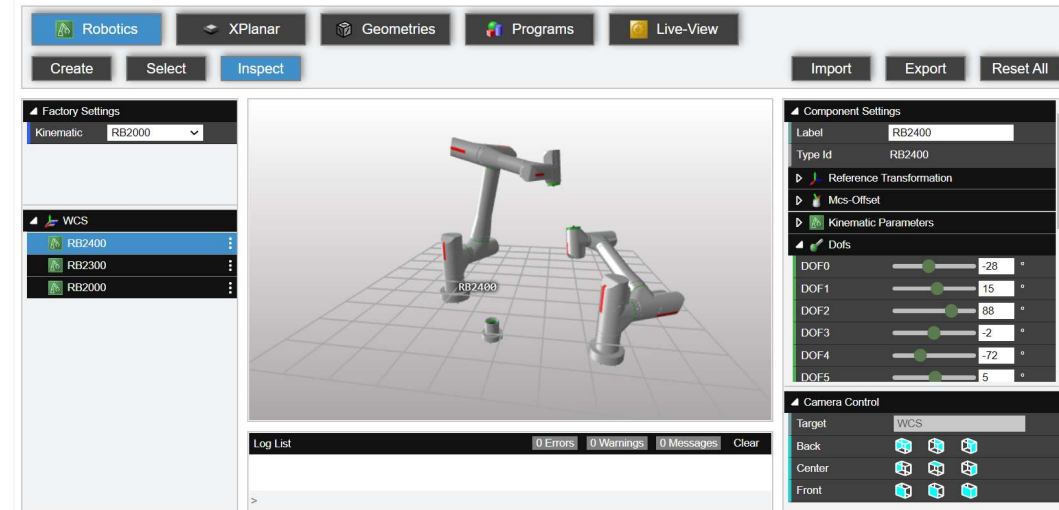
- The kinematics are configured and visualized in a **graphical 3D representation**
 - In **live view**, motion sequences can be displayed online or in a simulation environment.
 - The HTML5-based display can also be embedded in the user's interface.
- The robotics functionalities of TwinCAT are extended.



Configuration and programming

BECKHOFF

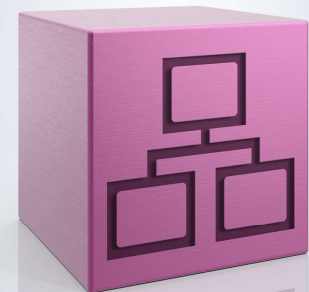
- automatic set-up and checking of the kinematics by EtherCAT bus scan
 - All ATRO modules contain an electronic identification plate that contains the dynamic properties.



PC-based control – Connectivity

BECKHOFF

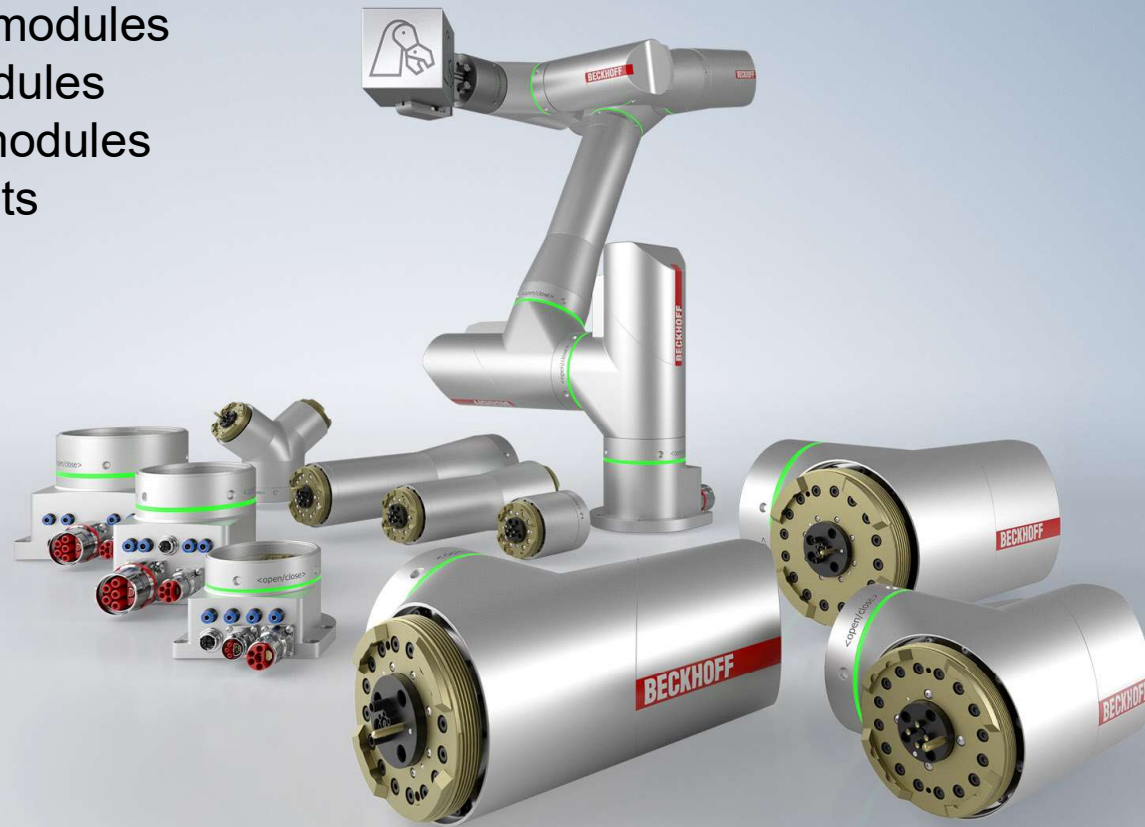
- TwinCAT connectivity solutions are also available for robotics through TwinCAT integration.
 - EtherCAT, PROFINET, EtherNet/IP, OPC UA, Modbus, etc.
- Safe sensors and actuators can also be easily integrated into the robot application.
 - All devices with Safety over EtherCAT, PROFIsafe, or safe I/O can be integrated.
- data transport from the production level right through to the production planning and ERP system or cloud



Product overview

BECKHOFF

- RMxxxx motor modules
- RLxxxx link modules
- RBxxxx basic modules
- RKxxxx robot kits



ATRO

RMxxxx motor modules

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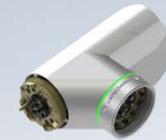
different sizes

- 14, 17, 20, 25, 32 modules

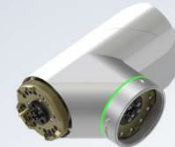
different designs

- L-motor
 - as joints for robot configurations
- I-motor
 - flange size reduction
 - additional axis for extended mobility, e.g., 7-axis kinematics

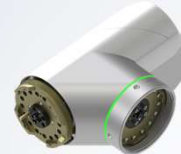
RM1000



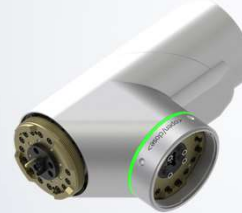
RM1110



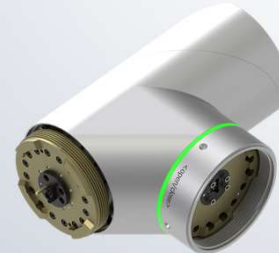
RM1220



RM1330



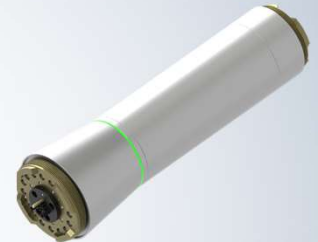
RM1440



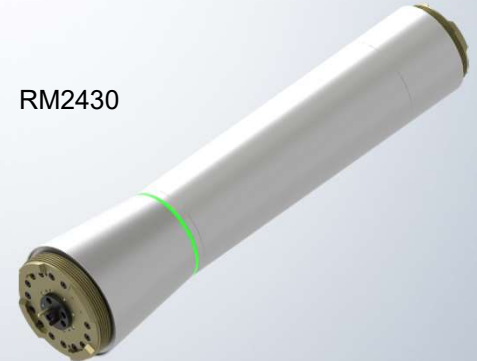
RM2200



RM2320



RM2430



RLxxxx link modules

- connection modules to create individual robot configurations
- variable shape and length
 - I-shape
 - L-shape
 - Y-shape

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RLxxxx link modules

BECKHOFF

passive connection
module

reduction of flange sizes
possible

standardized mechanical
interface



internal media feed
energy, communication,
fluids

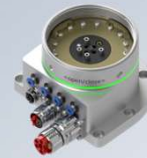
electronic identification
plate

variable shape and
length for individual
robot configurations

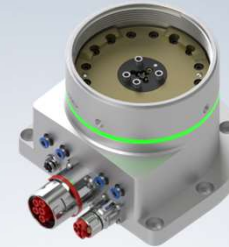
RBxxxx basic modules

BECKHOFF

- robust mounting of the robot in all orientations – on a base plate, on the wall, or on the ceiling
- connection level to the internal media supply
 - connected sideways or downwards



RB1000



RB1300



RB2000



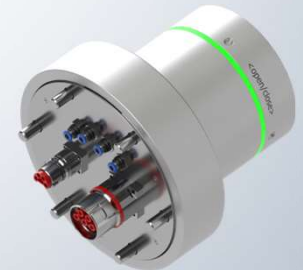
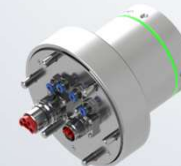
RB2200



RB2300



RB2400



passive base module

standardized
mechanical
interface

connection level

- EtherCAT and energy (internal)
- Ethernet, energy, and fluids (user)

IPC can be integrated in the base

internal media feed
communication, energy,
fluids

electronic identification plate

robust mounting on the base
plate, wall, or ceiling



RKxxxx robot kits

BECKHOFF

- defined module sets
- starter kits



3 kg, 0.6 m

RK1606-0300



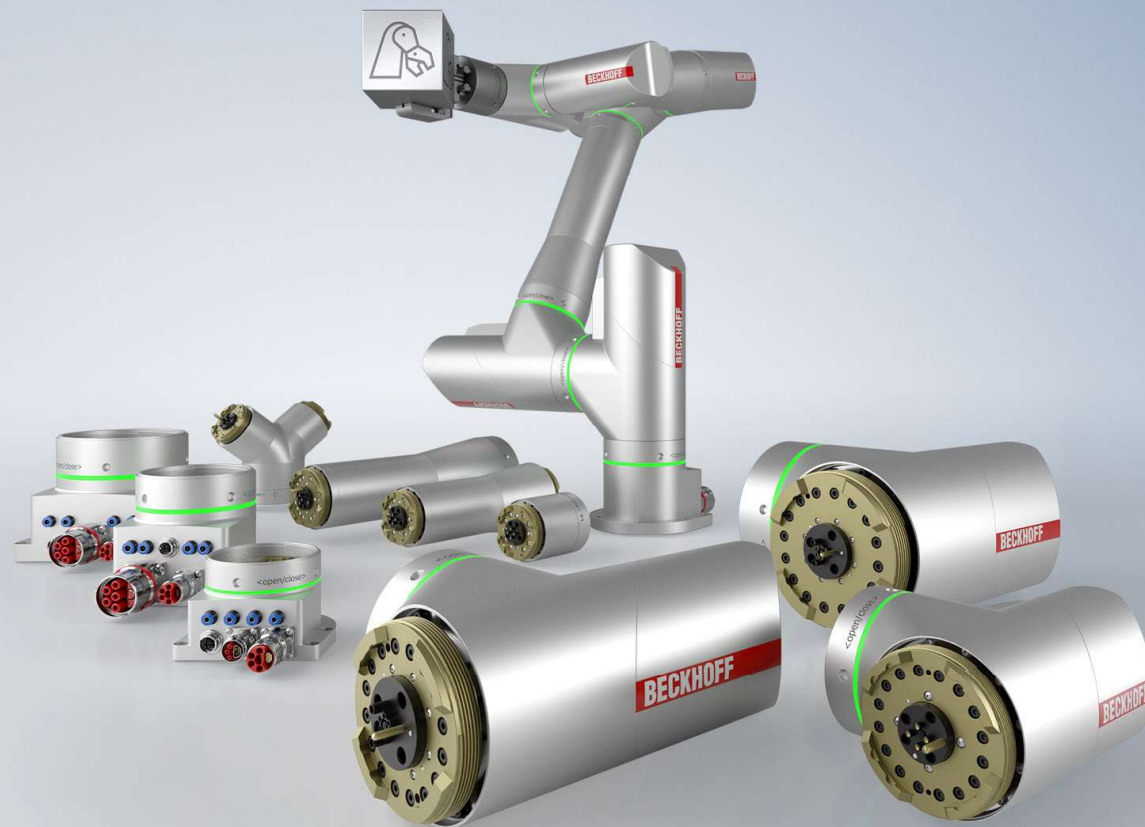
5 kg, 0.9 m

RK1609-0500



10 kg, 1.3 m

RK1613-1000



ATRO

modular industrial robot system

- motor modules with integrated servo drive
 - 24/48 V power supply
 - EtherCAT, Safety over EtherCAT
- Only the modules requested by the application are needed.
- Existing modules can be reassembled for other/future applications.
- this results in low stocking costs for spare parts
- A module exchange can be done fast (short MTTR).

internal media supply from the base to the end effector

- for feeding through data, power, and fluids (air, vacuum, water)
- All axes are designed as endlessly rotating axes.
 - better Cartesian accessibility, short paths
- no interfering contours created by external media feeds such as cables
- ATRO interface simplifies integration of robot tools (such as grippers)

integration into TwinCAT

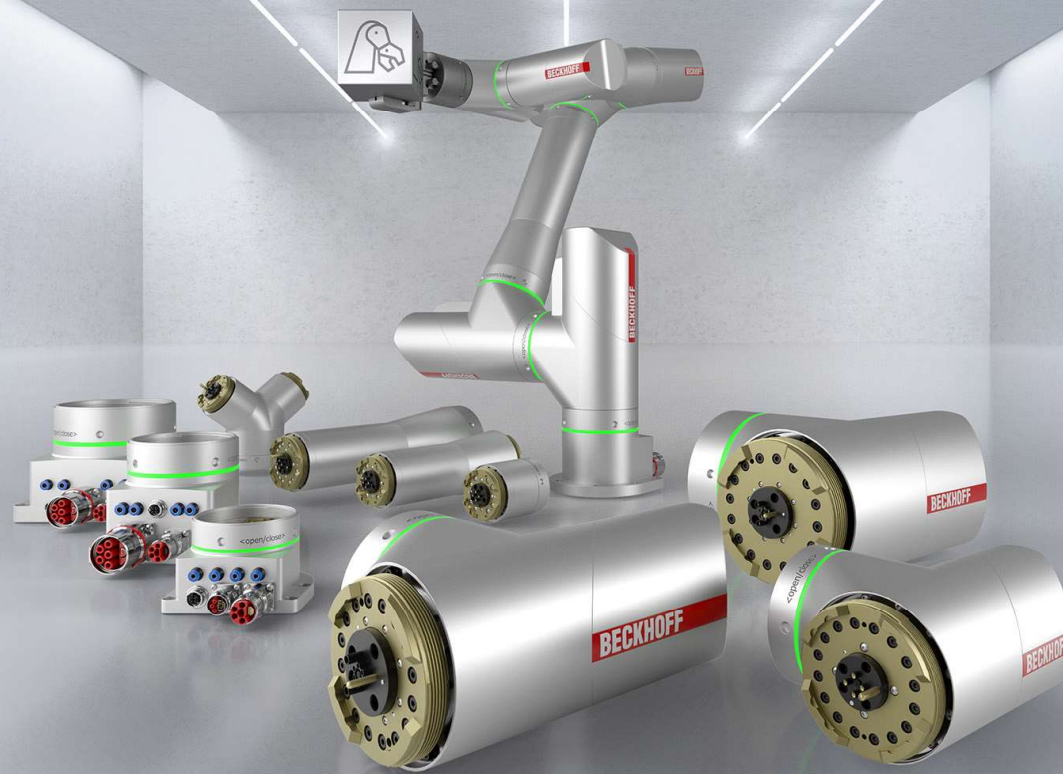
- all TwinCAT functions are available:
 - Robotics + Motion, PLC, ML, Vision, IoT, Analytics, etc.
- complete automation functionality in one control hardware
 - low HW costs
 - synchronicity of all components
 - minimal communication delays

three user modes for programming the application

- Technical Mode for TwinCAT experts
- Advanced Mode for standard robotics solutions
- Easy Mode for simple tasks and all users

ATRO: Modular, flexible, and integrated.
The perfect robot for every application

BECKHOFF



ATRO

Applications and solutions

BECKHOFF

Packaging



Window production



Robotics



Tire



Plastic



Machine tools



Woodworking



Forming



Printing



Applications and solutions

BECKHOFF

Water treatment



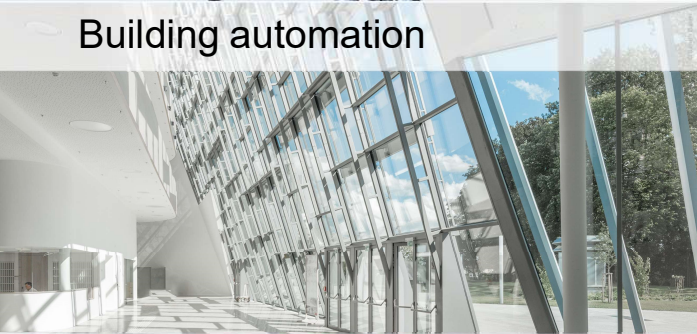
Photovoltaic



Automotive



Building automation



Process industries



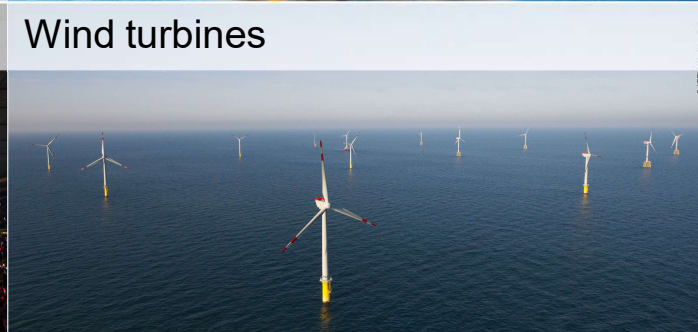
Marine industries



Entertainment industry



Wind turbines



Test facilities



Applications and solutions

BECKHOFF

Semiconductor manufacturing



Medical engineering



Energy industry



IoT and Industrie 4.0



End user



Food industry



Warehouse | distribution logistics



Textile industry



Machine building



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