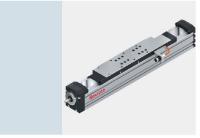# Factory Automation

Bosch Rexroth
WE MOVE. YOU WIN.

Electric Drives and Controls

Electric drives IndraDrive – unique scalable platform:

▸ Common platform for power range from 100W up to 4 MW
▸ Different types: compact converters, modular inverters/power supply, single- and double-axis inverters, distributed cabinet-free drive technology with motor-integrated and near motor drives
▸ Multi connectivity: Ethernet-based multi-protocols (SERCOS, PROFINET IO, Ethernet/IP, EtherCAT, Powerlink), ProfiBus, CANopen, DeviceNet, Analog and Parallel interfaces
▸ Intelligence: advanced firmware functions, integrated motion logic and PLC (MLD) with a wide range of libraries including ready-to-use technology functions, free programmability (IEC 61131-3), integrated safety technology, etc.

IndraDyn Motors – extensive range:

▸ Power range from 50W up to 132kW
▸ Synchronous (low and medium rotor inertia) and Asynchronous housed servo motors up to 631 Nm (including explosion-proof enclosure, forced fan and liquid cooling)
▸ High-speed (up to 22 500 rpm) and torque (up to 13 800 Nm), Linear ironcore (up to 21 500 N), ironless (up to 3 320 N) motors
▸ From standard to high precision single- and multiturn encoder systems, single cable connection technology
▸ standard planetary and high-precision planetary servo gearboxes with $\eta \geq 97$ %

IndraControl – complete and universal automation:

▸ Scalable platform for all system solutions from Bosch Rexroth: PLC, Motion controller IndraMotion MLC, CNC IndraMotion MTX
▸ Extensive range from IndraControl L25 to L85 Intel Core2Duo with cycle time from 0.25 ms, 64 axes and 20 tasks; new family IndraControl XM from XM21 (Intel ATOM E620 600 MHz, Multi-Ethernet Master/Slave, USB, Gigabit-Ethernet) to XM4X
▸ Open connectivity: RS232, Ethernet TCP-IP/UDP, PROFIBUS (Master/Slave), SERCOS, PROFINET RT, EtherNet/IP, EtherCAT
▸ I/O extension modules: IP20/IP67, local and distributed, digital/analogue I/Os, temperature, technology, communication, safety.

Industrial PC and Operator panels:

Compact and mobile operator panels, Panel PC, Embedded PC, Box PC; Display sizes from 4.3'' up to 21.5''; membrane keys, touch or multi-touch types, horizontal and vertical, robust and durable design.

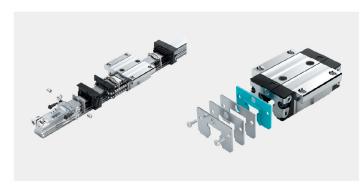## Precision motion control system MPC:

Compact multi-axis motion control system with integrated drive technology for high-tech machines in Semiconductor, Electronics, Solar and Measuring industries:

▸ High-level programming languages for motion control programs
▸ Powerful 32 kHz position control, data collection 32 ch @ 32 kHz
▸ Various motors: stepper, DC brushed, AC brushless, piezo, etc.

Frequency Converters Rexroth:

▸ V/f and SVC control (sensorless vector control), torque control, synchronous motor control
▸ Power range from 0.4 kW up to 185 kW, cold plate (0.4 – 4 kW)
▸ Power supply: 1 x AC 230 V or 3 x AC 400 V
▸ Multi-Ethernet interface (sercos, EtherCAT, Ethernet/IP, Profinet IO, Modbus TCP), CAN Open, ProfiBus, Modbus RTU, mini-USB
▸ Application specific firmware: multi-pump control, winder
▸ Multi parameter set, power loss ride through, energy saving counter, protection against pump rotating without water, etc.
▸ Extension cards (I/Os, relays, encoder, resolver), STO safe torque-off, side-by-side mounting, LED/LCD panels.

Linear Motion Components

Ball and Roller Rail Systems:

▶ High load capacities with limitless interchangeability, highest level of system rigidity thanks to preloaded O-configuration
▶ 14 types of runner blocks, 6 accuracy and 4 preload classes
▶ Sizes 15 / 20 / 25 / 30 / 35 / 45 / 55 / 65 and 85 /100/125
▶ Load ratings Cdyn: 3900 N to 1000 kN
▶ Steel, aluminium, corrosion-resistant steel, matte silver or black hard chrome-plated, high speed, self-alignment capabilities, etc.
▶ Guide rails: mounting from above/below, corrosion-resistant versions, cover strips, plastic and steel hole plugs, bellows etc.
▶ Maximum rail length 6000 mm one-piece, composite guide rails

Integrated Measuring System IMS

▶ Contactless inductive measuring system – scale and sensors are not corrupted by external magnetic fields
▶ IP67, resistant to contamination and vibration, no sealing air
▶ Wear and maintenance-free, not susceptible to EMV interference
▶ Repeatability: ± 0.25µm, position resolution: 0.025µm, scale accuracy: ± 3µm/m, system accuracy: ± 4µm/m.
▶ Output signals IMS-I(Incremental): 1Vpp, TTL 1µm, TTL 10µm.
▶ Interfaces IMS-A(Absolute): SSI+1Vpp, HIPERFACE®, DRIVE-CLiQ, αi(FANUC)
▶ Simplified design with guide integration, no attachments needed

Miniature Ball Rail Systems:

▶ High dynamic ratings: up to v = 5 m/s, a = 250 m/s2
▶ All steel parts of the runner block and the guide rail are made of rust and acid resistant material
▶ Interchangeability of runner block and guide rail within the accuracy class
▶ Sizes 7 / 9 / 12 / 15 / 20 and available wide sizes 9, 12, 15
▶ 4 types of runner blocks, 3 accuracy and 2 preload classes
▶ Low friction seal
▶ Clean room certificate Class 10
▶ Maximum rail length 2000 mm one-piece, composite guide rails available

Ball Screw Assembly(BSA)/ Planetary Screw (PLSA):

▶ Numerous nut types in DIN, JIS and Rexroth layout
▶ Economic Solution due to precision-rolled screw
▶ Especially smooth running due to optimized ball pickup and recirculation
▶ Single Nut w/o axial play possible, no reduction ratings (PLSA)
▶ Diameter: 6 - 80 mm, Lead: 1 - 64 mm
▶ Accuracy: T3, T5, T7, T9 acc. to ISO 3408
▶ Load ratings up to: C = 900 kN (dynamic) C0 = 3000 kN (static)
▶ Length: up to 13 000 mm (5 000 mm for PLSA)
▶ D x n value: 150 000 for all nuts

Linear Bushing and Precision Steel Shafts:

▶ Numerous types for Ø d 3 - 80 mm: self-alignment, closed/open, heavy load, rugged design, linear sets, corrosion-resistant etc.
▶ Excellent low friction, compensation of misalignments
▶ Precision shafts sizes Ø d 3-110 mm, shafts with shaft support rail, heat-treated steel/corrosion-resistant, hard chrome plated

Ball Transfer Units

▶ Conveying speed up to 2 m/s, Size 8(130N) to 120 (40 000N), different types in corrosion-resistant version available

Cam Roller Guides

▶ Dynamic(v = 10 m/s), various formats, zero-clearance adjustment

Linear Motion Systems

Compact Modules CKK/CKR:
- Extremely high rigidity due to two integrated zero-clearance ball rail systems
- Compact and low aluminum profile, various connecting elements
- Online-configurator and creation of 3D-CAD models
- Sizes: 70, 90, 110, 145, 200
- Drive: Precision Ball screw T7(CKK), Toothed belt drive (CKR)
- Length: freely configurable up to 5 500 mm (CKK), 10 000 mm (CKR)
- Travel speed: up to 2.53 m/s (CKK), 5.0 m/s (CKR)
- Repeatability: up to ± 0.005 mm (CKK), ± 0.05 mm (CKR)

Linear Modules MKK/MKR/MLR:
- Integrated zero-clearance ball rail systems (MKK/MKR), and with cam roller guide (MLR); two carriage length available
- Online-configurator and creation of 3D-CAD models
- Motor flange/coupling or timing belt side drive, gear unit
- Sizes: 40, 65, 80, 110, 145 (two rails), 165
- Drive: Precision ball screw (MKK), Toothed belt drive(MKR/MLR)
- Optionally: hard chrome plated, integrated IMS-A, T5 grade
- Length: MKK up to 5 400 mm (MKK), 12 000 mm (MKR/MLR)
- Speed: up to 2.5 m/s (MKK), 5.0 m/s (MKR), 10.0 m/s (MLR)
- Repeatability: up to ± 0.005 mm (MKK), ± 0.05 mm (MKR/MLR)

Electromechanical Cylinders EMC, Heavy Duty EMC-HD:
- Precision rolled Ball Screw (T7) with preload or Planetary Screw
- Compatibility with pneumatic products according to ISO 15552
- 12 sizes: 32, 40, 50, 63, 80, 100, 100XC; 085, 105, 125, 150, 180
- Protection class: IP54, IP65 or hygienic design (optional)
- Stroke: 30 – 1700 mm (variable in 1 mm intervals)
- Axial force: up to 290 kN, Dyn. Load rating: up to 470 kN
- Travel speed: up to 1,6 m/s
- Repeatability: ± 0,005 mm BSA (up to ± 0,01 mm for PLSA)
- Mounting elements, force sensor and other accessories
- Online-configurator and creation of 3D-CAD models

Function modules FMS/FMB:
- Extremely compact aluminum frame with integrated preloaded ball rail system (one or two ball rail systems)
- Travel distance: up to 1 500 mm (FMS), 3 800 mm (FMB)
- Drive: Low-backlash rolled Ball Screw (T9) or pre-tensioned belt
- Travel speed: up to 1 m/s (FMS), 3 m/s (FMB)
- Repeatability: up to ± 0.015 mm (FMS), ± 0.05 mm (FMB)
- Aluminum carriage with T-slots
- Optionally: aluminum cover plate, magnetic and optical sensors
- Online-configurator and creation of 3D-CAD models

Precision Modules PSK:
- High-precision linear modules with steel profile frames in very compact design, running tracks ground into the frame

Feed Modules VKK:
- High precision, high thrust capabilities make feed module ideal for vertical motion in Z-axes

Omega modules OBB:
- Special design for applications that require main body motion (e.g. to access workspace in machines)

Linear Motion Slides SGK, SGO, SOK, SOO:
- Economical linear axes for many applications

Assembly Technology

Interactive work instruction

Pick-to-light

Bar code scanner

Product identification HF

Visualization

Hand-tracking

Tool control unit

i4.0 CONNECTED INDUSTRY

ActiveAssist - the digital assistant for assembly tasks

The ActiveAssist assistance system is revolutionizing the manual workstation and moving the focus of Industry 4.0 towards people. Quick and easy learning of manual work steps for varied assembly tasks, precise checking and documentation of every step in real-time, integrating quality control – this dream is now a reality.

Discover more advantages of ActiveAssist:
▶ INTERACTIVE STEP-BY-STEP GUIDE, Guides employees through the assembly process with precision
▶ HAND TRACKING VIA 3D CAMERA, Reliable detection of hand movements without a distracting sensor
▶ WEB-BASED CONFIGURATOR, Intuitive learning of assembly processes, online and offline
▶ MODULAR DESIGN, Future-proof thanks to extendible functions

Key technical data:
▶ Data management: user management, order management
▶ Communication with MES-/ERP systems via XML interface
▶ Context-based provision of information
▶ Hardware solutions: e.g. depth-sensing camera, projector, pick-to-light, hand-tracking module, touchscreen, RFID, camera, tool control unit, bar code scanner
▶ Connectivity to ActiveCockpit
▶ Intelligent nutrunner integration, e.g., Nexo

ActiveCockpit – Interactive communication platform for the manufacturing industry
▶ Make decisions quickly and efficiently on the shop floor
▶ Structured and recorded team meetings, report generation
▶ All relevant data available on-site in digital form
▶ Communication and information tool for employees at all levels
▶ Register and manage Q-quality and S-safety deviations
▶ Browser-based software, can be extended via apps/widgets
▶ Connect to MES/ ERP back-end systems with i4.0 interface
▶ Scalable end devices: tablet, PC, touchscreen, from a 4.7" mobile screen to a 65" UHD touchscreen

Aluminum Profile System:
▶ Most comprehensive Modular system as the basis for a wide range of industry
▶ Over 100 different strut profile cross sections
▶ Highly durable standard profiles, largest slot retention force
▶ Innovative special profiles, profiles with closed slots
▶ Finely graduated profile size range (20, 30, 40, 45, 50, 60, 80, 90, 100 mm)
▶ 3 slot systems: 6, 8, 10 mm with groove-independent connectors
▶ Slot retention forces up to 24 000 N
▶ Patented special profiles
▶ Integrated air duct
▶ Guaranteed performance data, highest stability criteria
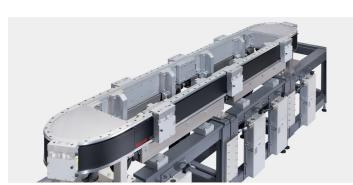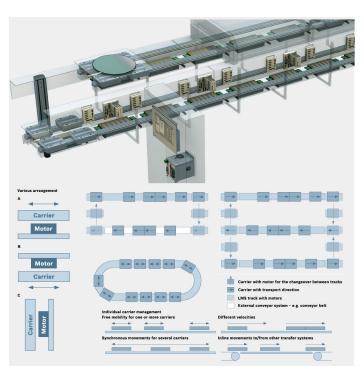▶ Customized finishes without drawings – Quick & Easy

Accessories
▶ Comprehensive range of accessories with more than 1300 individual parts
▶ Specific solutions as well as basic element for manual workstation and transfer systems
▶ Reliable and secure connectors with extensive accessories
▶ 25 types of connectors in more than 280 variants

Transfer Systems, Conveyors

Chain Conveyor System VarioFlow *plus*:
- Simple to project: using a modular principle and MTpro layout designer with automatic generation of parts lists
- High flexibility: universal basic units with separate drive kits allow free selection of motor mounting position on-site
- Low friction: for long conveyor sections per drive, low wear, reduced down times and low costs, longer service life
- Gliding surface does not require any time-consuming machining
- Wide product range in aluminum and stainless steel, in sizes 65, 90, 120, 160, 240, 320 mm, seven types of chains, speed up to 60 m/min

Transfer Systems:
- Wide range for different applications: TS1, TS2plus, TS2pv and TS5 for payloads up to 400 kg
- Pallet based conveyors are divided into 3 categories based on pallet size - belt, flat top chain or roller chain
- Pallets are precision machined with accurate locator bushings which allow positioners to hold pallets within ± 0.02mm for automated processes
- Identification systems to recognize and store object-related data, for optimally managed production and conveying processes
- Online Solid Models & CAD Library

ActiveMover – an innovative transfer system for short cycle time:
- Magnet coupling: low friction between linear motor and pallet
- Fully independent control and integrated collision avoidance by each pallet, Workpiece pallet width 165 mm
- Reverse, asynchronous and synchronous operation
- High repeatability of ± 0,01 mm
- Speed up to 150 m/min
- Acceleration up to 4 g for 1kg payload, 1g for 10 kg payload
- Permissible payload workpiece pallet up to 10 kg
- Robust structural base frame design

Flexible Transport System (FTS): New evolution for flexible assembly

FTS unique technical solution for transporting and positioning materials and workpieces, replaces traditional transfer where systems like rollers, chains or belt systems reach their limits for any reason.

FTS is based on standard linear motor technology which:
- Easily integrated: freely configurable track layout
- Flexible: scalable carrier size/weight (1 kg to 1,000 kg), individually controllable up to 32 carriers
- Cost-efficient: transport system can act as handling axis for easier handling
- Autonomous: perfect for i4.0 solutions, for flexible production
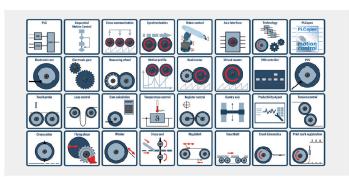- Fast and precise: high throughput, high position repeatability

Key technical data:
- Wide performance range from 60 N to 3,000 N
- Speeds from 0.02 m/s up to 5 m/s
- Position repeatability per carrier 20µm (standard), < 1 µm (with encoder option)
- Positioning accuracy for different carriers ± 300 µm (standard), ±100 µm (with teaching), up to ±10 µm (with encoder option)
- Magnetic disks standard or vacuum-compatible up to 10^{-8} mbar
- Temperature range up to 70 °C (NdFeB) or 150 °C (SmCo)
- Distance between motor and magnet plate 1-8 mm

Various arrangement

A

Carrier

Motor

B

Motor

Carrier

C

Carrier

Motor

Individual carrier management
Free mobility for one or more carriers

Synchronous movements for several carriers

Carrier with motor for the changeover between tracks
Carrier with transport direction
LMS track with motors
External conveyor system – e.g. conveyor belt

Different velocities

Inline movements to/from other transfer systems

Industry 4.0 and Didactics

Open Core Engineering – New in software engineering:

▶ **IT Automation** to connect ERP, MES or own tools with the machine control and drives(PC - Windows, Linux, Mac OS) – Visual Studio(VB/C/C++/C#/Python), NetBeans, Eclipse(Java, Lua), OPC UA, Xcode (Objective-C, Swift), MS Office Tools VBA (Excel, Word, PowerPoint), Delphi, RAD Studio, C++ Builder.

▶ **Smart Device** for a convenient machine operation and diagnosis: Visual Studio with Xamarin (C#), Google Android (Eclipse-C/C++, Java), Apple iOS(Xcode-Objective-C, Swift)

▶ **Rapid Control Prototyping** and Model Based Engineering to improve algorithm design and testing – LabVIEW(G), MATLAB, Simulink, SimulationX Dymola (Modelica) and more.

IoT Gateway – Get ready for Industry 4.0!

Combination of control hardware and software to connect new and existing machines to Industry 4.0 environments:

▶ **IoT Gateway Apps: Dashboard App**: web interface for configuration without programming, formatter, basic math. **Devices App** – connection with sensors: analog and digital, OPC UA/DA, Controls: Siemens S5/S7, Beckhoff Cx, Allen-Bradley Control-Logix. **Processing App** – forwarding of process data: MQTT, MS Azure, Oracle IoT Cloud, REST, TCP/IP, OPC UA, MySQL etc.

▶ **Hardware**: XM series – PLC built in, ideal for sensor; PC PR21 – Small and cost effective, ideal for Ethernet communications

IoT sensors and development tools

Operating conditions can be monitored with sensors that detect wear before it leads to downtime.

▶ **XDK110** Cross-Domain Development Kit – The programmable sensor device and IoT prototyping platform for any use case you can imagine. XDK combines a wide array of MEMS sensors with a microcontroller, simply connect XDK via USB, Bluetooth® or wireless network.

▶ **CISS** – The Connected Industrial Sensor Solution (CISS) is a small and robust multi-sensor device for harsh industrial environments. It is best used for machine condition monitoring and is perfectly suited for Industry 4.0 applications.

Technology functions toolkit for simplified development:

▶ Full PLC programming functionality IEC 61131-3 for online and offline engineering of controls

▶ Comprehensive function libraries for logic, motion and robot control as well as technology toolbox solutions

▶ Simplified implementation of complex processes via ready-made technology function blocks

▶ Complement of standard libraries as toolbox solutions for most different applications in factory automation

Training systems mMS 4.0 – Real-world Industry 4.0

A whole factory in miniature to understand and learn Industry 4.0:

▶ **Cyber-physical system** – adaptations of the manufacturing via smart devices, data capturing and diagnostics in real time

▶ **Connectivity** – PLC can communicate with almost any programs and other participants via the all-round Open Core interface

▶ **Cloud engineering** – Clouds collect and store process data

▶ **Interactive Communication Platform** – ActiveCockpit a digital board collects, filters and visually depicts data continuously

▶ **Smart workstations** – The operators are detected, and there is an automatic adaptation of the workplace preferences

Tightening and Welding

Tightening systems – Clever, flexible, secure

Tightening spindles and handheld nutrunners:
▶ Torque range 0.6 – 1 000 Nm
▶ Versatile and Modular construction, true redundancy possible
▶ Maintenance free for 1 million full load cycles for long service life
▶ Handheld nutrunner: Torque range 1 – 220 Nm with Ergonomic design for reduced operator fatigue, angle compensation

Compact and Modular Control systems:
▶ Reliable and easy to use single-channel controllers
▶ Touch screen or display, variant with integrated logic
▶ Space-saving and economical multi-channel controller supporting up to six tightening channels

NEXO - the most intelligent cordless nutrunner in the world:
▶ High-precision torque and rotary angle measurement system
▶ No external controller, large display for practical information
▶ Data transfer via 2.4 and 5 GHz WiFi or mini USB
▶ Torque range 1.8 – 65 Nm, max. speed 880 rpm
▶ Optionally available with barcode scanner

Bosch EXACT Production Cordless Screwdrivers/Wrenches:
▶ Torque range 0.2 – 60Nm, Exceptional runtime and lifetime
▶ High quality mechanical shut-off clutch (Cmk > 1.67 with ±10%)
▶ EXACT ION – new EC-brushless motors and Li-Ion batteries, capable of Multi-Step Tightening Processes programmed via USB
▶ Quality control with the Bluetooth EXACT cordless system

Resistance welding systems

Welding controllers:
▶ AC and Medium-frequency(1000 Hz) modular resistance welding controllers
▶ Maximum quality when welding all combinations of sheet thicknesses from steel to aluminum.
▶ Currents of up to 360 kA, air cooled/water cooled
▶ Adaptive current/voltage control algorithms for consistent weld quality and reduced expulsion
▶ Tools and user interfaces provide process monitoring and overview for weld control and quality monitoring
▶ Maximum flexibility in the I/O and network with plug-in modules such as PROFIBUS, PROFINET IO, DeviceNet and EtherNet/IP

Powerful compact medium frequency transformers:
▶ Integrated temperature monitoring of the winding package and the rectifier unit, current sensor and safety resistor
▶ Process monitoring by integrated current measuring coil
▶ Output up to 250 kVA (20 % ED)

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