

Automation solutions

for Semiconductors

from Bosch Rexroth

Expand Your Resources.

Accelerate Your Solutions.

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The semiconductor chip is the physical foundation of our digital world. Its value and use will only expand, driving levels of demand unmatched by any other modern technology. Billions of dollars are being invested by governments and manufacturers to accelerate the creation of new fabs to meet current and future demand.

Bosch Rexroth has the complete automation solutions the semiconductor industry needs now and in the future. Our unique combination of an innovative, cross-technology portfolio, deep application expertise and full lifecycle global support makes us the right partner to advance semiconductor automation performance.



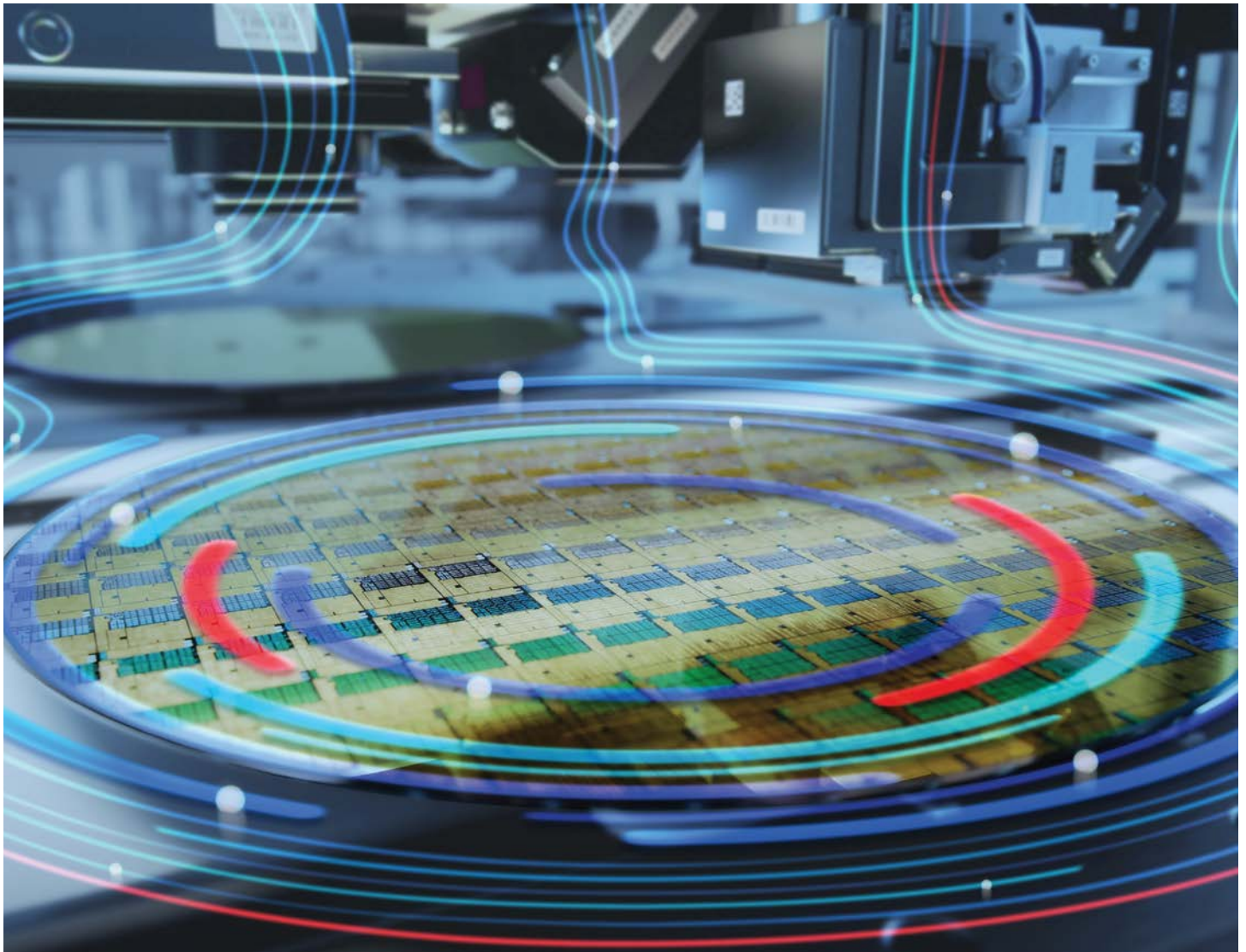


Bosch Rexroth: Advancing Semiconductor Automation

The most advanced version of a semiconductor microprocessor currently available has over 100 billion transistors in a single system-on-a-chip. Virtually no other manufacturing process demands the nanoscale accuracy, ultra-precise control and copy-exact technology that is required in creating the chips that are the foundation of our digital world.

Bosch Rexroth is the industry's best partner to address these awesome challenges. We provide the trusted technology, deep industry experience and collaborative relationships to expand manufacturing resources and deliver the critical technical performance semiconductor fabrication demands.

The semiconductor industry has a very special set of automation needs: mechatronic modules designed for smooth, vibration-free motion during wafer handling; non-contact material transport through process chambers; and nanometer-scale positioning accuracies.



Partnering with Bosch Rexroth gives tool builders and fabs the performance they need to sustain the highest levels of production quality and productivity through our unique capabilities:

PERFORMANCE-DRIVEN EXPERTISE:

We are the motion control experts, so you can focus on your complex semiconductor processes. As collaborative partners, we build productive engineer-to-engineer relationships. Our team of technology and motion control experts help apply deep semiconductor automation expertise to solve complex challenges with custom, scalable, copy-exact solutions.



INNOVATIVE PORTFOLIO:

Leading tool builders and fabricators count on our broad, cross-technology automation solutions, combining open controls, sophisticated mechatronics and advanced linear transport. Our custom, pre-engineered and tested systems and subassemblies streamline operations, delivering smooth, precise motion and nanoscale positioning accuracy.



RESPONSIVE SERVICE:

A single tool out of service can cost a fab millions in lost production. From spec to design to prototype to final implementation – and beyond – our service teams, located in industry hubs across the globe, are ready to support you.



Key Applications

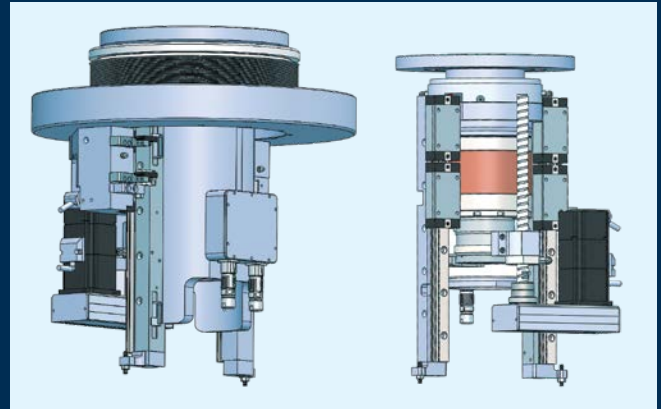
Bosch Rexroth has created multiple application solutions to satisfy the specialized requirements for precision, efficiency and critical motion control in key semiconductor fabrication applications.

WAFER LIFT ASSEMBLY



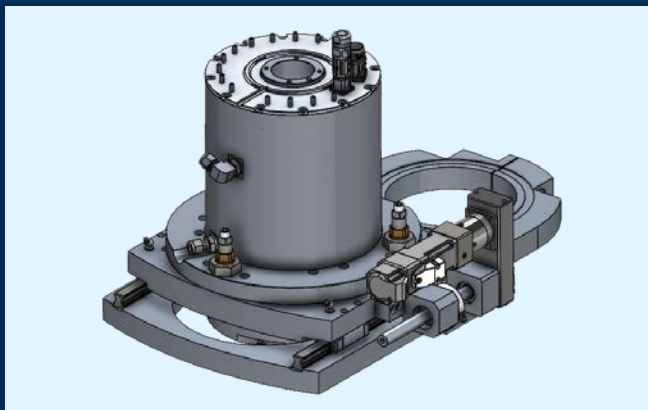
This solution is a cost-optimized subassembly design that provides much smoother motion when moving costly, delicate semiconductor wafers between two process points. It combines ball screw, ball rail and servo motor and was developed from a fully working prototype that was tested at the OEM tool builder's site for efficient integration. Tens of thousands of these lifts are part of working fabrication tools, providing highly reliable performance at more than 5 million cycles and cost reduction of ~30% compared to acquiring and integrating discrete components.

WAFER SPIN MOTOR ASSEMBLY



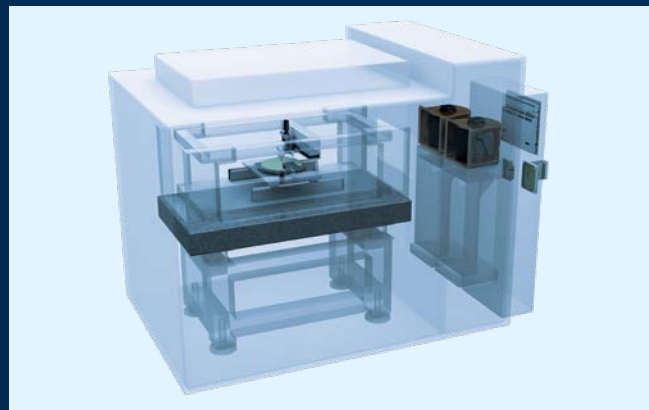
Bosch Rexroth engineered a system to reduce costs and improve the reliability of a fixture that lifts and spins a silicon wafer during processing. Key unique design challenges included large moment load, cooling, integration of load cell, accommodation of leveling and mounting features. These were solved using proprietary Bosch Rexroth sizing tools such as IndraSize and Linear Motion Design (LMD). It is an example of a complete drop-in hardware and software platform delivered as a single-source subassembly.

ADJUSTABLE MOTOR ASSEMBLIES FOR WAFER POLISHING



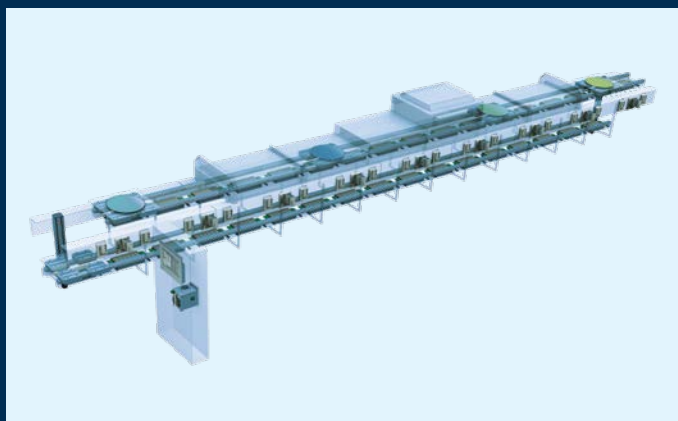
This specialized motor assembly for key semiconductor production processes integrates linear guides, a ball screw assembly, frameless servo motor (MBT) rotor and stators, small servo motor (MS2N) and compact servo drives (IndraDrive Cs). The design incorporates precision mounting and leveling features, reduced assembly time, a single bearing solution and liquid cooling for a smaller footprint. Which can also be tested as an assembly if desired.

WAFER STAGE PLATFORM



Wafer stage platforms support high-precision motion control in the nanometer range for wafer alignment, positioning and testing, as used in inspection and quality control. The ctrlX CORE motion control system guarantees high precision at nanometer resolutions. Special servo motors, ironless linear motors and torque motors enhance dynamic performance, combined with high-precision linear guides that eliminate vibration.

NONCONTACT LINEAR TRANSPORT



The linear motion system (LMS) offers a vacuum-compatible noncontact motion system to move wafers through the process chambers. Coils mounted outside the chamber provide drive power for magnetic carriers inside the chamber, without the need for feedthroughs. Suited for virtually all load factors, precision levels and motion profiles, the system offers significant flexibility, allowing individual carriers to move independently and enter on one side of the chamber and exit on the opposite side.

The Value of Custom Subassemblies

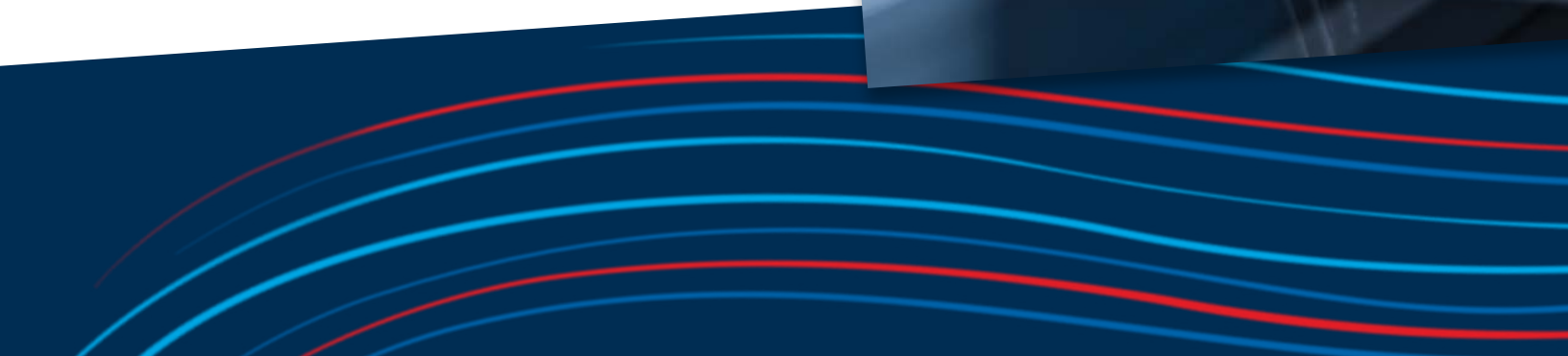
Cross-technology portfolio. Unmatched expertise. Perfectly combined.

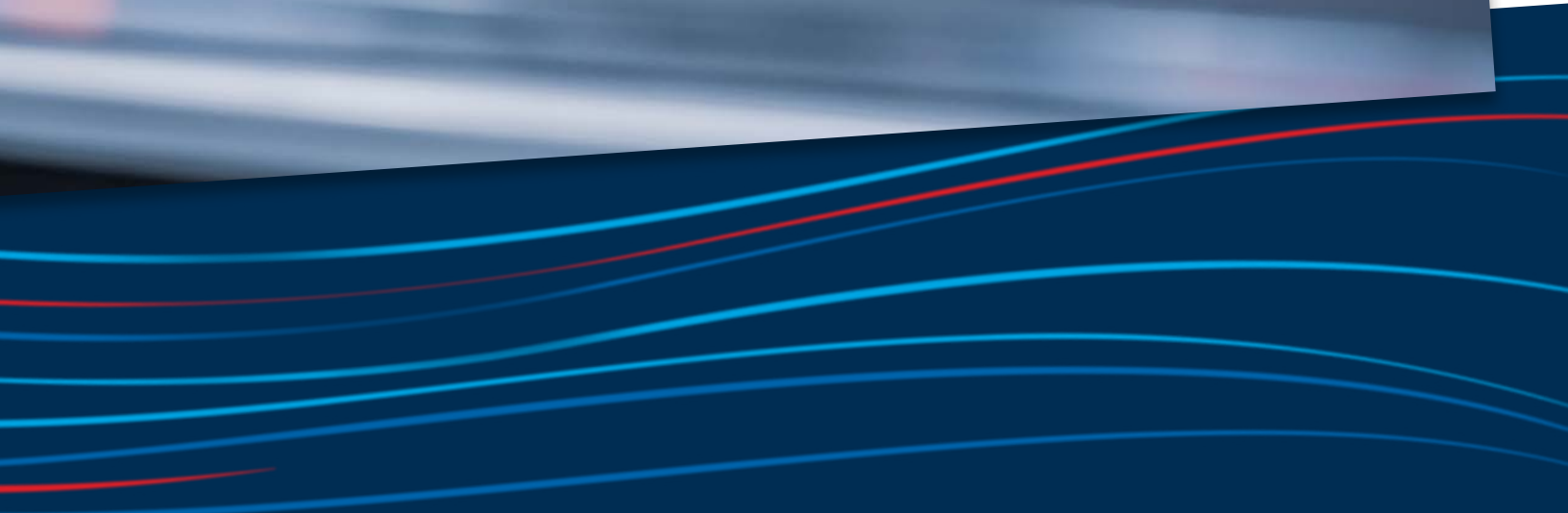
The complexities that lie at the heart of today's advanced transistor features create enormous challenges that tool builders need to focus on. Working with experts in motion control subassemblies, such as Bosch Rexroth, frees the tool designers and builders to focus on their core capabilities.

Bosch Rexroth is uniquely positioned to satisfy the increasing requirements of semiconductor equipment manufacturers for outsourced design, assembly and test solutions. For decades we have invested in an industry-leading portfolio of both linear motion and motion control products, targeting the needs of some of the most cutting-edge equipment manufacturers, with a special focus on semiconductor mechatronics.

We combine our advanced automation technologies with proven mechatronic engineering expertise. This includes deep insights into the principles and design requirements for sizing, selecting and integrating the right kinds of linear motion equipment – linear guides, ball screw drives and linear modules – with extensive experience specifying and programming complete motion control systems.

To ensure that our mechatronic subassemblies satisfy all requirements, Bosch Rexroth has created a complete subassembly configuration and testing operation, with state-of-the-art production equipment and quality processes. No other subassembly supplier can source virtually all the system components from their in-house technology portfolio, then fully integrate and test them to ensure they can be quickly and easily integrated into the customer's tool.





Controls and Drives



Nanoscale accuracy and virtually vibration-free movement are critical motion control requirements for semiconductor tools. Our revolutionary ctrlX AUTOMATION platform and our expansive, compact servo drive family provide the powerful, proven motion control technology that serves as the backbone of our automation solutions.

ctrlX AUTOMATION eliminates the classic boundaries between machine controls, the IT world and the Internet of Things, moving automation two steps ahead. Bosch Rexroth is revolutionizing how the industry approaches control and drive platforms by making automation as easy to use as a smartphone by providing:

- A Linux real-time operating system
- App-based programming technology
- Full support for EtherCAT
- Web-based engineering

Key elements of the ctrlX AUTOMATION platform for semiconductor applications include:

ctrlX CORE: The high-performance ctrlX CORE control platform provides a scalable industrial control system with Linux-based multicore technology that breaks down the boundaries between embedded system platforms and drive-based technology.

ctrlX DRIVE: Compact and modular, the ctrlX DRIVE system enables rapid implementation of cost-effective servo drive and motion control solutions that grow with machine requirements. It's scalable to support both simple single-axis applications and complex multi-axis machine systems. Supporting multi-Ethernet interfaces, including EtherCAT, specific functions can be added via software apps to provide greater flexibility.

ctrlX I/O: ctrlX I/O from Bosch Rexroth opens new possibilities when it comes to connectivity and networking. The I/O portfolio is designed for horizontal and vertical integration and represents a functional extension of the ctrlX CORE control platform. As a result, users can take advantage of comprehensive communication and performance extensions, as well as I/O modules geared to future technologies, such as 5G, TSN and AI.

Elmo Motion Control™: Bosch Rexroth has expanded its semiconductor-specific controls portfolio with Elmo servo drives. These compact, space-saving drive systems allow wafers to be moved while at the same time controlling the machine axes to minimize settling time – equipping tool builders with control and size capabilities to address their most critical requirements.

Smart MechatroniX



Gantry-based handling systems for the semiconductor industry should be efficient, rigid and easy to integrate. Our Smart MechatroniX systems combine proven linear motion components with smart, easy-to-program controls to deliver multi-axis positioning with high accuracy through:

- Simplified engineering and tool integration
- Precision coordination of multiples axes
- Maximum contour control through real-time synchronization

Our Smart MechatroniX portfolio includes a wide range of tools and options for automated manufacturing. For semiconductor transport requirements, the Smart Function Kit for Handling leverages our “plug-and-produce” concept to simplify mechatronics development.

The Smart MechatroniX platform is supported with advanced online selection tools such as LinSelect. These let tool builders and system integrators quickly size and select all their key linear systems, motion controls, drives, motors, cabling and more to create a complete solution, all ordered and delivered as a single product.

These systems also come with commissioning software for automated drive recognition, and they use drag-and-drop motion sequences. Pre-configured multi-axis solutions can save significant development time and costs, not only for specialized tool builders with smaller engineering staffs, but also for larger companies seeking efficiencies in costs and engineering time.

Transport Systems



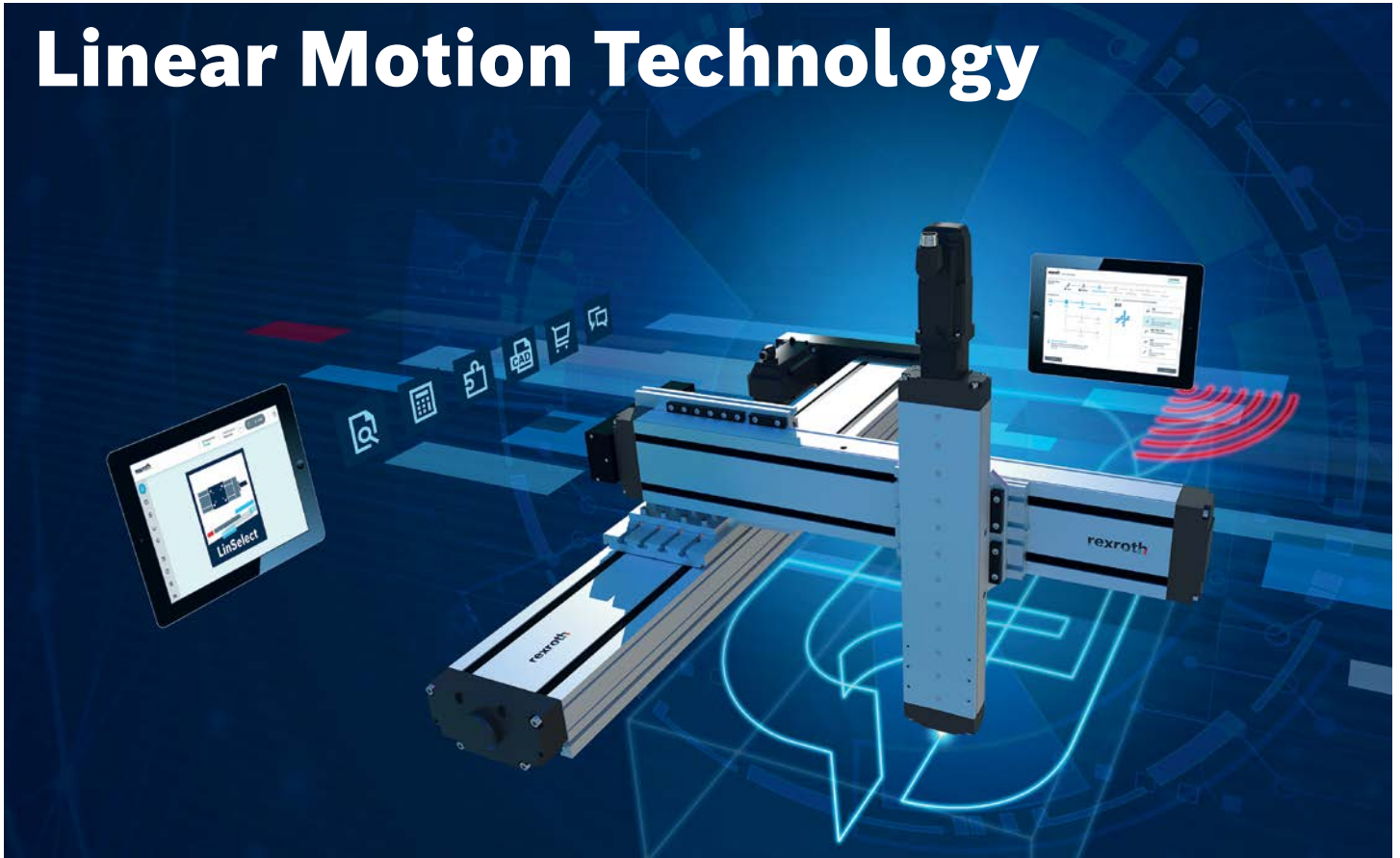
Moving wafers in process from one chamber or process tool to the next demands flawless, vibration-free transport. Bosch Rexroth can address these material transport challenges with advanced linear motor platforms such as ACTIVE Mover and the Flexible Transport System. Our total transport and conveyor offering features:

- The industry's widest range of transport technologies to make it easier to select the best platform
- Robust components and innovative technology that ensure high reliability at low maintenance costs
- Linear motor-based transport systems that support ultra-precise positioning and accelerations up to 4g
- Consistent modular design combined with our MTpro tool to speed up planning and allow easy upgrades

Our award-winning Flexible Transport System (FTS) is a linear motor-based transport system that provides a contactless and particle-free solution for positioning materials and workpieces inside or between process tools in both atmosphere and vacuum environments, and there are no cables tethered to the carriage, eliminating the need for feedthroughs.

FTS linear motion technology is suited for virtually all semiconductor processing load factors, precision levels and motion profiles. The system enables individual carriers to move independently and to enter on one side of the chamber and exit on the opposite side.

Linear Motion Technology



Engineered and manufactured to meet the highest standards for rigidity, smooth motion and long operating life, Rexroth linear motion technology sets industry standards for reliable performance in demanding applications.

Even the slightest vibration when wafers are in motion can jeopardize their quality. Through continuous improvement and innovation, we increase the performance and reliability of our linear motion products and systems. As an industry leader and innovator for over 30 years, we've constantly enhanced our portfolio to feature:

- Linear bushings and shafts
- Profiled rail systems
- Complete ball screw assemblies
- Precision linear modules, such as the PSK Gen 2

This portfolio has been engineered to deliver the critical performance characteristics required of linear components used in wafer transport assemblies. This includes high levels of mechanical stiffness, resulting in less deflection and better travel and positioning accuracy.

For semiconductor tool applications, Rexroth ball screw drives offer the optimum solution. They are ultraefficient at converting rotary motion to linear motion and provide a unique combination of high rigidity, high precision and fast travel speed, while also maintaining the necessary cleanliness.

We also provide linear components with lubricants certified for clean room applications. This ensures particle-free operation, making our components ideal for applications such as lithography and etch.

Partnering for Complete Solutions

Bosch Rexroth has successfully built strong, multi-decade relationships with leading semiconductor tool builders and fab operators, providing a range of automation solutions engineered to meet the most demanding, and constantly evolving, requirements.



We are committed to providing full lifecycle support from initial engagement through multiple generations of tool designs. At the start of system or subassembly development, our dedicated team of semiconductor experts uses this deep expertise to evaluate requirements, identify challenges and provide support, from specs to product samples to working prototypes.

We draw on Bosch Rexroth's global engineering and manufacturing resources to accelerate product development to meet tight time frames, as well as provide maintenance and technical support for the long term.

Our global Semiconductor Center of Competence, located in Pleasanton, CA, in the heart of Silicon Valley, has dedicated

semiconductor application resources and provides:

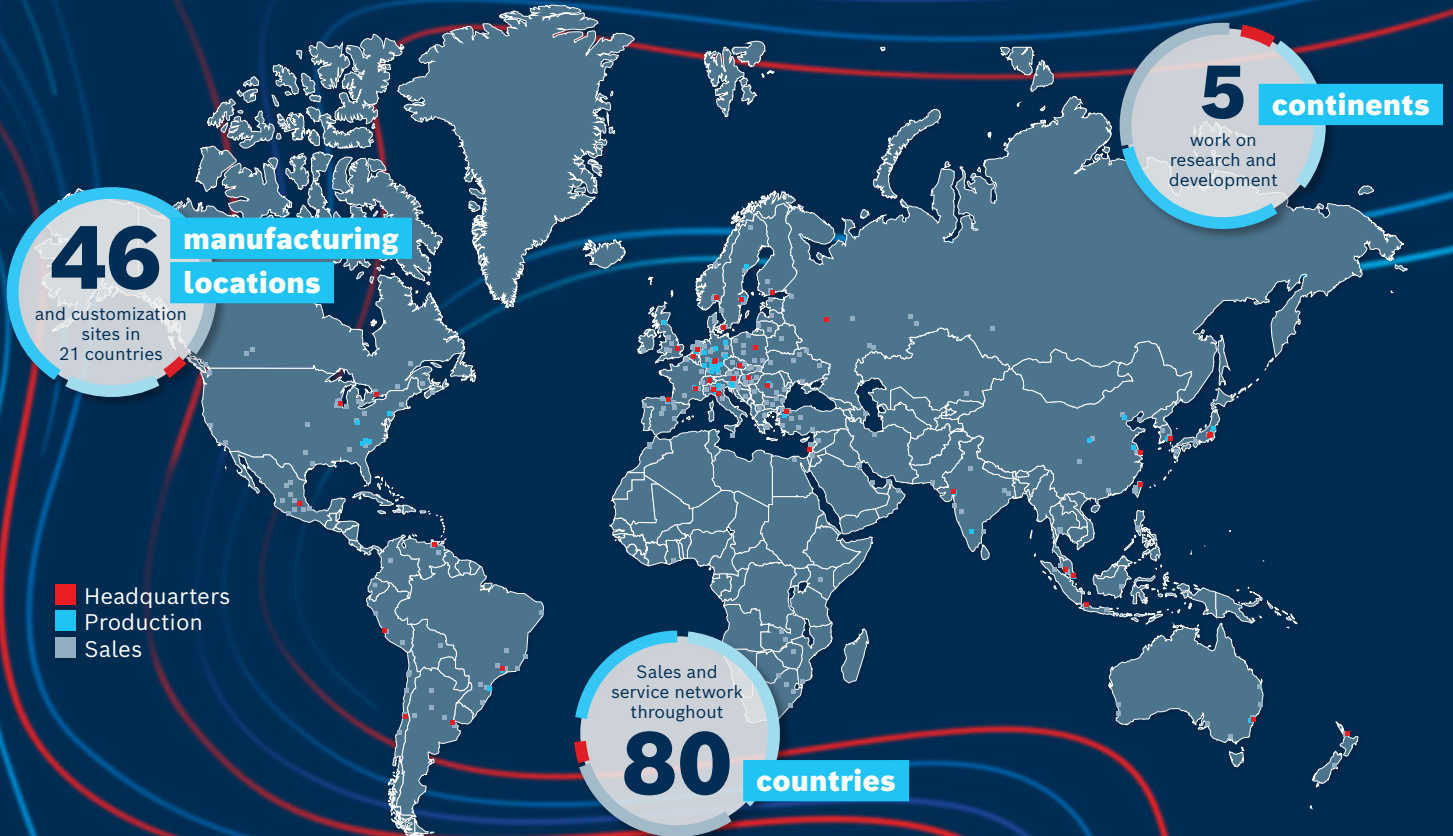
- Deep, industry-specific expertise
- Engineering resources for every stage of the project, from concept to integration
- Prototyping and proof-of-concept capabilities
- Integration and start-up support
- Development of technology roadmap for the industry

As the semiconductor industry continues to expand and innovate, Bosch Rexroth is ready to deliver the trusted performance and resources tool builders and fab operators need to stay competitive: the most complete, cross-technology automation portfolio; proven semiconductor application expertise; and full lifecycle service and support. We are ready to help move semiconductor automation forward.

Bosch Rexroth – Your Global Partner

Bosch Rexroth combines the ability to link global resources with local support – thanks to global product platforms, local added value, and the ability to coordinate projects spanning borders and to bundle the necessary resources. We are present in over 80 countries, guaranteeing competent advice and support, as well as, fast service anywhere in the world. Bosch Rexroth develops and produces locally adapted products based on global engineering teams in Europe, the Americas, and Asia.

With the services we offer, we work alongside machinery manufacturers and end users around the world and ensure the success of international projects.



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