

Drive Technology for Aerospace.

Reliable, powerful and flexible.



www.maxonmotor.com

maxon motor

driven by precision

Founded in Switzerland. Available worldwide.

maxon – a strong global brand.

maxon motor, with headquarters in Sachseln/Central Switzerland, has production sites in Switzerland, Germany, Hungary, South Korea, France and the Netherlands, as well as sales subsidiaries in more than 30 countries. We produce many of the key components for our drive systems on machines and production lines that we have largely developed ourselves. This not only enables economical manufacturing of large series, but also high flexibility for handling special requirements or smaller quantities.

Driven by precision.

maxon motor develops and builds precision drive systems: brushless and brushed DC motors with maxon's unique ironless core winding. Flat motors with iron cores complete our modular product portfolio. maxon motor's modular system includes: planetary and spur gearheads, spindle drives, as well as encoders and control electronics.

Motors that are out of this world.

maxon has a matching drive for each application.

DC motors made by maxon drive the Mars rovers and have been operating on the Red Planet for more than ten years. Down here on Earth, the unique quality of our reliable, efficient and powerful drive systems ensures customer satisfaction.

For passenger planes, helicopters or spacecraft: Together with our customers, we find the right solution for each application. The name maxon is synonymous with customized precision and stands for an extensive support network that guarantees high Swiss standards anywhere in the world.

Benefits of maxon motors.

- Compact design
- High quality and reliability
- Robust design; resistant to vibrations and shocks
- Wide temperature range capabilities
- Long service life
- Flexible configuration: Rotary and linear drives
- Linear characteristics provide excellent control properties
- EN 9100 certification
- Defined configuration and change management
- Risk minimization by means of batch tracing

Strong together.

Contact us. Together we will develop a suitable solution.
contact.maxonmotor.com



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maxon technology.

Powerful performance comes in small packages. Efficiencies of over 90 %.



maxon DC motor

Ironless winding

Brushed DC motors with ironless rotor, in sizes of Ø6–65 mm, with up to 250 W power.

Main characteristics

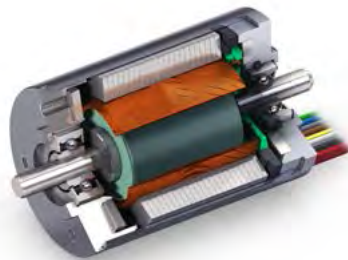
- No magnetic cogging torque
- Withstands high overload for short periods
- Low electromagnetic interference
- Easy control

Product programs

DCX and **RE** motors provide excellent performance and robust design.

A-max and **RE-max** motors combine cost-effectiveness with excellent motor performance.

DCX and **DC-max** motors can be **configured online** and are ready for shipment within 11 working days.



maxon EC motor

Ironless winding

Brushless DC motors are electronically commutated. They are available in sizes of Ø4–60 mm, with up to 480 W power.

Main characteristics

- Excellent control properties
- High overload capacity
- Very long service life
- Speeds of up to 100 000 rpm
- Autoclavable up to 1000 x

Product programs

ECX and **EC** motors provide optimum performance with high speeds.

EC-4pole motors offer high torques combined with high power density.

EC-max motors offer an excellent price/performance ratio.

ECX motors can be **configured online** and are ready for shipment within 11 working days.



maxon EC motor

Iron core winding

Brushless DC external- and internal-rotor motors are electronically commutated. They are available in sizes of Ø9.2–90 mm and torques up to 500 mNm.

Main characteristics

- Flat design
- High torques
- Very long service life
- Excellent price-performance ratios

Product programs

EC-flat motors provide very high torques and are available with integrated electronics.

EC-i motors are characterized by high torques and excellent dynamics.





maxon gear

Precision planetary and spur gearheads as well as customer-specific special gears. Compact spindle drives with steel or ceramic spindles.

Product programs

GP and GPX planetary gearhead

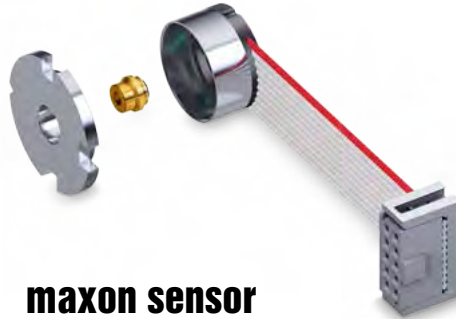
- For transmission of high torques
- High power
- High reduction ratio
- Autoclavable, with shaft seal
- Can be configured online (GPX only)

GS spur gearhead

- Economically priced
- For low torques
- High efficiency

GP S spindle drive

- Steel or ceramic spindle
- Metric spindle, ball screw and trapezoidal screw



maxon sensor

High-resolution encoders and digital encoders.

- Relative position signal, suitable for positioning tasks
- Direction detection
- Speed information from number of pulses per time unit
- Incremental & single-turn absolute encoders available
- Available with single wires

Product programs

Magnetic encoder

- Minimal space requirement
- Resistant against dirt
- Interpolated

Optical encoder

- High counts per turn
- Very high accuracy

Inductive encoder

- Robust against magnetic fields and dirt
- Integrated into EC flat motors



maxon motor control

4-Q servo controllers and position controllers for controlling quick-response brushed and brushless DC motors up to 700 W. Available as OEM module for installation on a motherboard or ready for connection with housing.

Product programs

ESCON

Compact and powerful servo controller. Commanded by an analog set value.

EPOS2 / EPOS3

Position controllers with CANopen or EtherCAT.

MAXPOS

Highly dynamic positioning controller with EtherCAT.

maxon modular system

The motors, gearheads, encoders, brakes and controllers from maxon motor are perfectly matched to each other and can be combined to meet specific requirements.



Aviation: Drives for complex flight systems.

maxon motor's quality drives can be found in complex flight systems. For example in autopilot systems for controlling flight attitude via mechanical control surfaces, in auto-throttle systems, as well as in the force feedback joystick of fly-by-wire flight control systems. To meet the requirements of the aviation industry, maxon motor has developed new production methods to electronically record the data of each individual product automatically during the manufacturing. This means even the highest certification requirements can be met.

The maxon solution

Brushless DC motors from the ECX series. ECX 19 combined with a GPX 19 planetary gearhead.
Configurable online. Production within 11 days: xdrives.maxonmotor.com

- High power packed into extremely small spaces
- Precise speed or position control
- Very high output torque
- Negligible cogging torque
- Very narrow tolerances in the motor parameters
- Modifiable to meet DO-160 ambient condition requirements

You can find additional application stories at www.maxonmotor.com
contact.maxonmotor.com





Aviation: Aircraft interiors.

maxon motor can also be found on board passenger planes. A single aircraft needs several hundred small drives. Many of these are used in the cabin, where they ensure that the passengers and crew enjoy a safe and comfortable flight. DC motors and gearheads can be found in the in-flight entertainment systems (IFE), environmental control systems (ECS) and window shade systems. They also take care of moving the seats into the correct position at the press of a button as well as adjusting the cushion hardness to meet the customer's desires. The combination of mass production, high reliability and a wide range of robust, compact catalog drives is what distinguishes maxon from its competitors.

The maxon solution

High-torque brushless EC-i 40 DC motors combined with GP 42 C planetary gearheads and brushless EC 45 flat motors.

- High torque packed into a short length
- Long service life
- Excellent price-performance ratio
- Reliable series production

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Aviation: Environmental control system (ECS) for passenger aircraft.

A modern composite passenger plane is equipped with 48 maxon DC motors, which are installed in the environmental control system (ECS). This includes drives for the cabin ventilation, for cooling the electronics and for closing and opening the air inlet on the outside of the aircraft. The drives have a long service life and are suitable for use in temperatures from -55 °C to +85 °C.

The maxon solution

maxon's customer specific project support. Specifications are analyzed and, as necessary, a range of products and services to be delivered are agreed upon. maxon provides actuators for various different drive requirements. For the customers, this reduces the complexity, as they have only a single, reliable, actuator supplier.

Here various different brushless DC motors are used.

- Highly robust and resistant to harsh ambient conditions
- Special materials
- Customer-specific cable and connector solutions
- Very high power density
- Long service life

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Robotics: Unmanned aerial and ground vehicles.

Unmanned vehicles, both airborne and terrestrial, need to have reliable components. The devices often face harsh conditions and have to withstand shocks and vibrations without any problems. The drives also need to be energy-efficient for long periods of operation. maxon DC motors meet all these requirements. Automated production lines help maintain the high quality standards these applications require.

The maxon solution

Heavy Duty: Robust brushless EC 32 HD DC motors with GP 32 S HD spindle drive.

- Maximum robustness due to welded connections
- High energy efficiency ensures long battery life
- High power packed into a small volume
- Precise speed or position control
- Very high output torque and linear force



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Commercial spaceflight: To the ISS and back again.

In 2012, SpaceX launched the first private cargo capsule to the international space station (ISS), with maxon motors on board. Ten brushless DC motors were installed in the Dragon cargo spacecraft, where they fulfilled mission critical functions. EC 40 drives were used to keep the two solar panels facing the sun at all times to ensure adequate power supply to the spacecraft. Additional maxon motors were used for the instrument bay hatch, which contained the navigation equipment. By the year 2015, more than 60 maxon brushless DC motors had participated in the various Dragon flights – without a single failure.

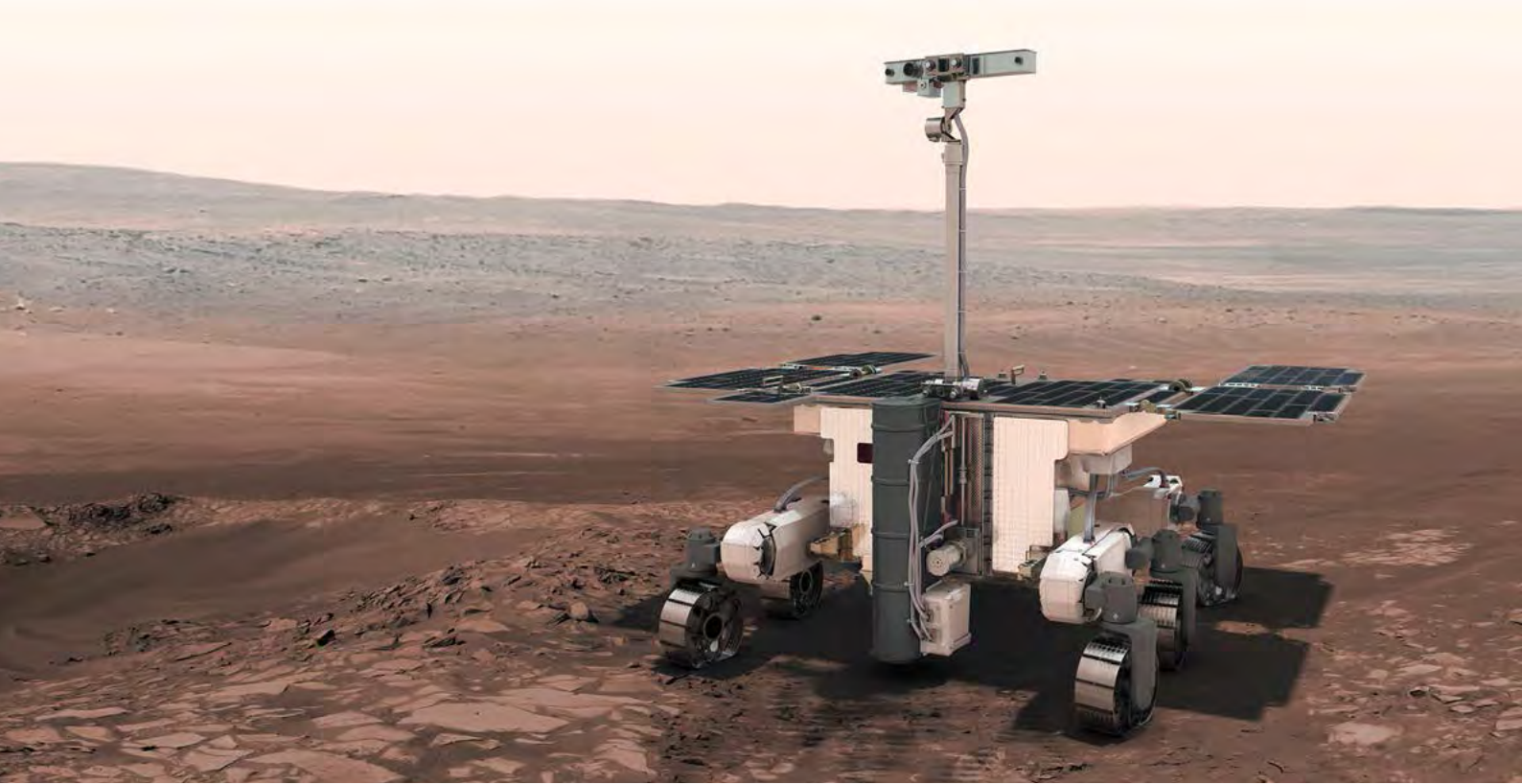
The maxon solution

EC 40 brushless DC motor.

- High power packed into an extremely compact space
- Precise speed or position control
- Very high output torque
- Extremely robust against shocks and vibrations
- Careful material choices allow use over a wide temperature range



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Research missions: Actuators for rovers, satellites and spacecraft.

There are more than 30 maxon DC motors in Opportunity, NASA's Mars rover. These are drives that were specifically optimized for use in the 8 mbar of CO₂ Martian atmosphere. After more than 11 years and 42 kilometers, the drives are still performing as required. This is why the European Space Agency (ESA) has selected maxon for their next Mars mission with the ExoMars rover. Time and again, our products can be found in satellites, on the ISS, or in space labs that investigate far-away worlds. The knowledge gained during all these missions benefits our customers down here on Earth.

The maxon solution

Brushed DC motors, planetary gearheads, and encoders from the maxon X drives series. DCX 22 with graphite brushes combined with a GPX 22 HP. Configurable online. Production within 11 days: xdrives.maxonmotor.com

- High energy efficiency ensures long battery life
- High power packed into extremely small spaces
- Precise speed or position control
- Very high output torque



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Quality assurance.

Only performance counts.

Drives manufactured by maxon motor remain reliable even under the most difficult conditions. For example, they have been operating on Mars for years. Apart from highly motivated employees, this requires a sophisticated Quality Management System (QMS).

The QMS used at maxon has been developed using many years of experience and by applying a continuous improvement system. The quality management system is actively implemented, maintained, and certified at regular intervals. Bureau Veritas has been responsible for the certification since September 18, 1991.

For the aerospace market, the following characteristics of the maxon QMS are of particular importance:

- EN 9100 aerospace certification
- Continuous computer-aided quality system (CAQ)
- High percentage of smart, automated tests
- Company-wide configuration & change management
- Company-wide standardization and approval processes for documents
- Risk minimization by means of batch traceability

EN 9100:2009 (corresponds to AS 9100).

This is an internationally accepted quality standard of the aeronautics and astronautics industries. It obliges companies and employees to reduce potential risks in aeronautics and astronautics to a minimum by structuring the design and manufacturing processes accordingly. On request, to maxon motor this standard is applied for customer-specific products, except A-max motors, RE-max motors and controllers.

The EN 9100 standard builds on the SN EN ISO 9001 standard. EN 9100 certification includes SN EN ISO 9001 certification.

EN 9100

ISO 9001

SN EN ISO 9001:2008.

SN EN ISO 9001 specifies the requirements on a quality management system (process approach) that an organization has to meet in order to provide products and services that meet customer expectations and comply with applicable regulatory requirements. Simultaneously, the management system has to be subject to continuous improvement.

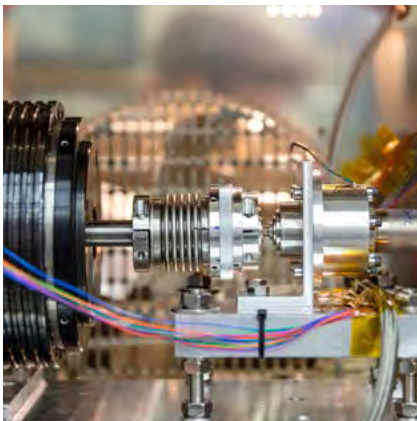
Furthermore, maxon motor has received SN EN ISO 13485 certification for medical products, and SN EN ISO 14001 certification for environmental management systems.

Product Qualification.

Reliable and efficient.

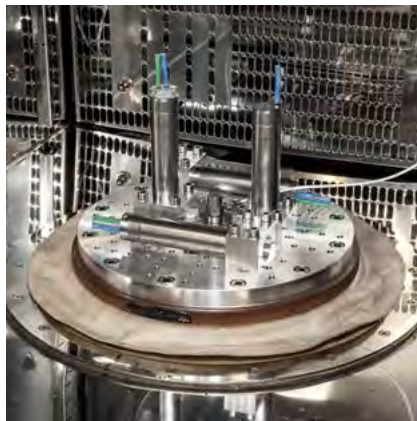
In the development phase, we push our drives to new limits. Our in-house laboratory provides us with the ability to simulate extreme conditions and perform standard maxon tests to ensure that the maxon products match our customers most demanding ambient specifications.

Below visible is an extraction of the maxon laboratory testing facilities:



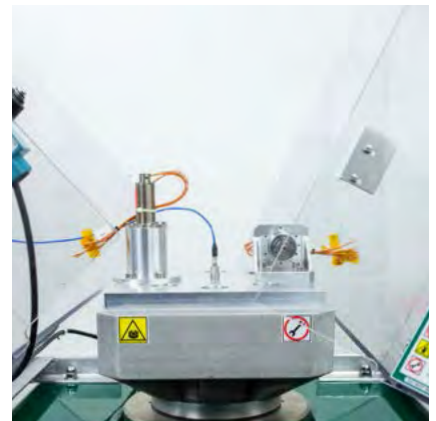
Internal full load test.

We test the motors in hydraulic oil, at extreme temperatures, and under full load during continuous operation. During this load test the winding heats up to its maximum rated temperature. Continuous monitoring provides information on the drive's performance characteristics.



Vibration and thermal stress test.

The drives are placed in a climate controlled cabinet and subjected to high vibration. Testing is carried out with the motors in operation at high temperature. The motors are required to continue functioning within their performance specification while vibrations are applied in all directions.



Shock test.

The laboratory system performs a variety of shock loads of more than 1000 g. After the shock test, the drives must be fully functional.



A global network.

Everywhere in the world, maxon motor's sales engineers collaborate with customers to develop tailor-made drive solutions.

- **maxon Manufacturing Companies**

Switzerland (headquarters), Germany, Hungary, South Korea, France and Netherlands.

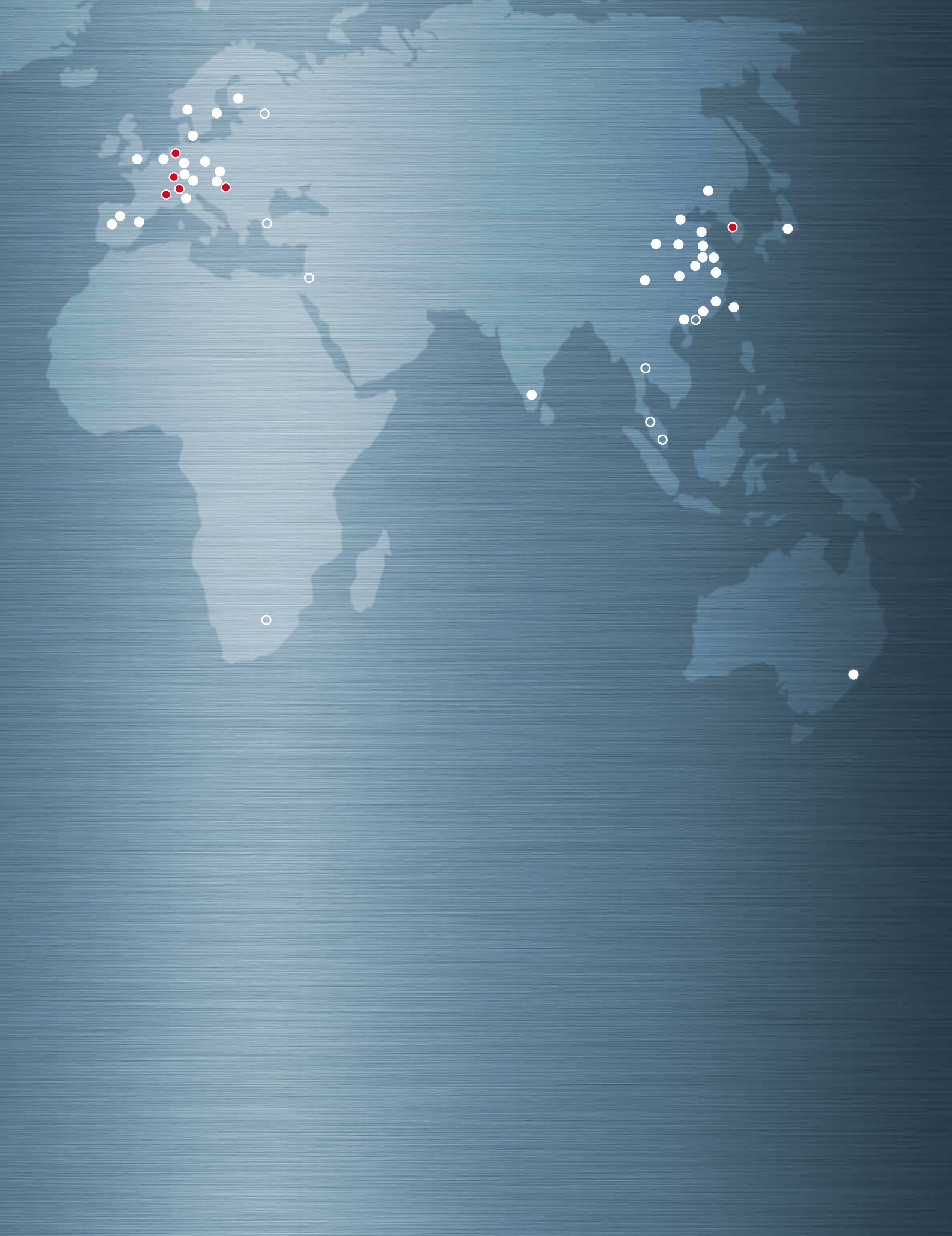
- **maxon Sales Companies**

Australia, Belgium/Luxembourg, China, Denmark, Germany, Finland, France, Great Britain, India, Italy, Japan, South Korea, the Netherlands, Norway, Austria/Hungary/Slovenia/Romania, Sweden, Switzerland, Spain, Taiwan, Czech Republic/Slovakia/Poland, USA.

- **maxon Sales Agents**

Brazil, Hong Kong, Israel, Canada, Malaysia, Russia, Singapore, South Africa, Thailand, Turkey.

For detailed contact information please visit [contact.maxonmotor.com](https://www.maxonmotor.com)



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Precise drives since 1961.

maxon motor develops and builds precision drive systems. Our DC motors with ironless windings are among the best in the world. They are used wherever the requirements are high and engineers cannot afford compromises: maxon motors drive NASA's Mars rovers. They can also be found in insulin pumps, surgical power tools, humanoid robots, and in precision industrial applications. We not only provide motors, gearheads, encoders and controllers, but also offer our know-how and many years of experience. Since 1961, maxon's engineers have been partners in the quest to create the right solution for each customer. Prototypes, custom systems, or large series. Whatever your requirements may be, we are happy to be of assistance with our global sales network, six production sites, and more than 2000 employees.



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