

Drive technology for aerospace.  
Reliable, powerful and efficient.



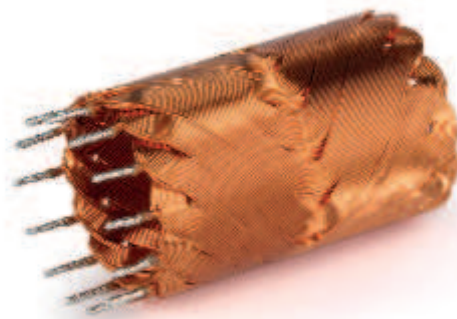
# Founded in Switzerland. Available worldwide.

## maxon – a strong global brand

maxon, with headquarters in Sachseln/Central Switzerland, has production sites in Switzerland, Germany, Hungary, South Korea, USA, France, Netherlands and China as well as sales companies in more than 30 countries. Our machines and product lines are developed in-house to guarantee cost-effective manufacturing of our products and enabling us to create custom solutions to fit your specific application needs.

## Precision Drive Systems

maxon develops and builds precision drive systems. Our brushless and brushed DC motors with ironless windings are among the best in the world. Flat motors with iron cores complete our modular product portfolio. maxon's modular system includes planetary and spur gear-heads, 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.

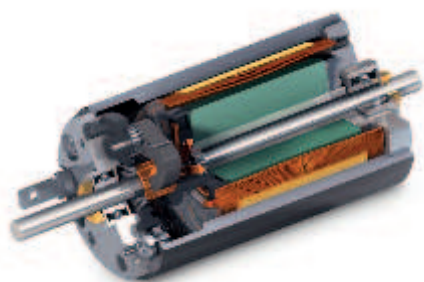
For passenger planes, helicopters or spacecraft: Together with our customers, we find the right solution for each application. The name maxon is synonymous with customized precision and stands for an extensive support network that guarantees high Swiss standards anywhere in the world.

## 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

**[aerospace.maxongroup.com](https://aerospace.maxongroup.com)**

# 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

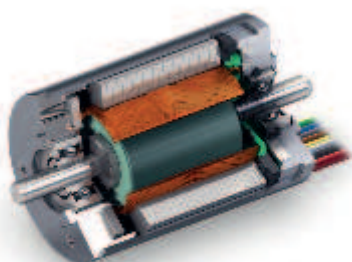
- No magnetic cogging torque
- Withstands high overload for short periods
- Low electromagnetic interference

### Product programs

DCX and RE motors provide excellent performance and robust design.

DC-max and A-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 120 000 rpm
- Autoclavable up to 2000 x

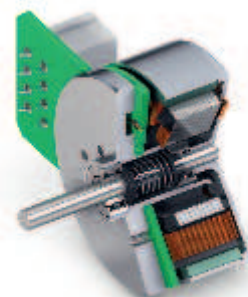
### Product programs

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, with up to 600 W power.

#### Main characteristics

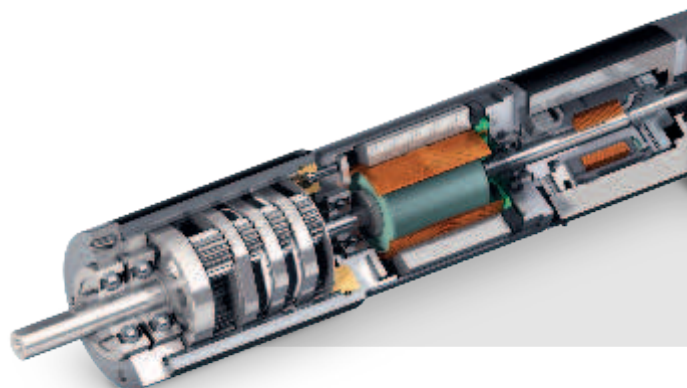
- Flat design
- High torque
- Very long service life
- Excellent price-performance ratios

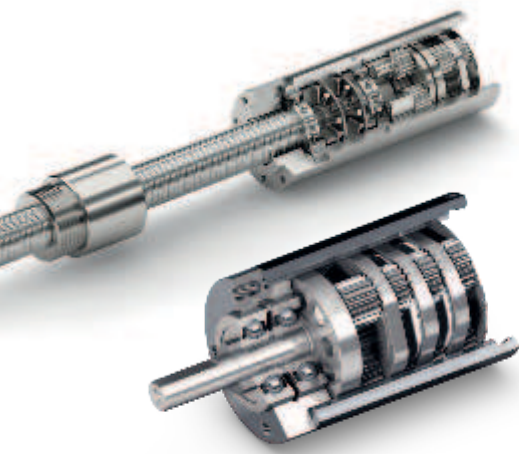
### Product programs

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

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

View the entire range of products online  
[shop.maxongroup.com](http://shop.maxongroup.com)





## maxon gear

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

### Product programs

#### **GP and GPX planetary gearhead**

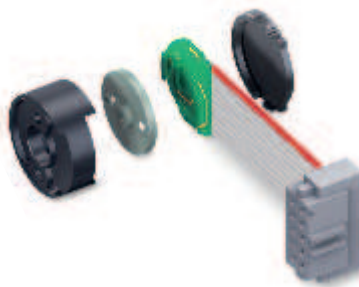
- For transmission of high torques
- High power
- High reduction ratio
- Autoclavable, with shaft seal
- Can be configured online (GPX only)

#### **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 or absolute position signal, suitable for positioning tasks
- Direction detection
- Speed information from number of pulses per time unit

### 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

#### **DC tacho, resolver**



## maxon control

4-Q servo controllers and position controllers for controlling quick-response brushed and brushless DC motors up to 1 kW continuous power. 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.

#### **EPOS4**

Position controllers with CANopen, EtherCAT, RS232 oder USB.

#### **MAXPOS**

Highly dynamic positioning controller with EtherCAT.

**Master controller available at**  
**[www.zub.ch](http://www.zub.ch)**



## maxon modular system

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



# Aviation

## Drives for complex flight systems

To meet the requirements of the aviation industry, maxon has developed new production methods.



maxon 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 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.



Brushless DC motors from the ECX SPEED series. ECX SPEED 19 combined with a GPX 19 planetary gearhead. Configurable online. Ready in 11 days: **[xdrives.maxongroup.com](http://xdrives.maxongroup.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

# Aviation

## Aircraft interior



A single aircraft needs several hundred small drives.

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

maxon 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 passenger'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.



You can find additional application stories at  
[www.maxongroup.com](http://www.maxongroup.com)

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

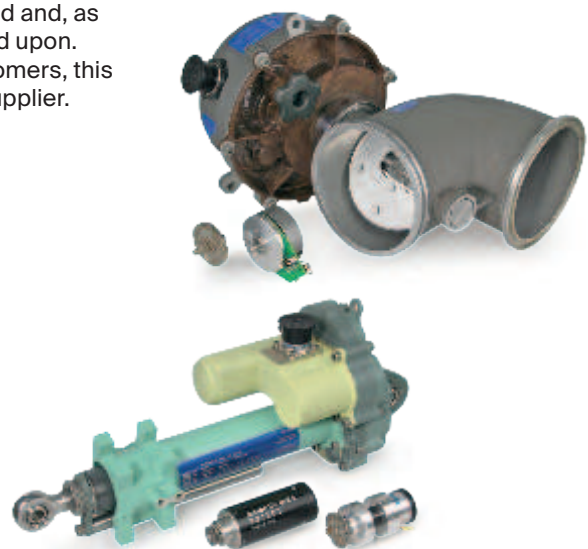


Highly robust and resistant to harsh ambient conditions.

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  $-55^{\circ}\text{C}$  to  $+85^{\circ}\text{C}$ .

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 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





# Aviation

## Actuators for safety-relevant functions

In the aviation industry, a wide range of applications are controlled by actuators. They have to withstand ambient conditions such as strong vibrations and extreme fluctuations in temperature. To provide even higher reliability, safety-relevant aircraft functions are equipped with dual-motor actuators. For example, one of these actuators is located at the jet engine and blocks off the fuel supply in the event of fire. This function has to be available under all circumstances and at all times. Therefore, these actuators are always equipped with two high-quality DC motors.

These actuators are always equipped with two high-quality DC motors.



Brushed DC motors from the DCX series. These drives have an efficiency of over 90 % and are equipped with powerful rare earth magnets. Configurable online. Ready in 11 days: [xdrives.maxongroup.com](https://xdrives.maxongroup.com)

- Highly dynamic
- An optimal volume/performance ratio
- Low power consumption
- Temperature resistant
- Highly resistant to corrosion

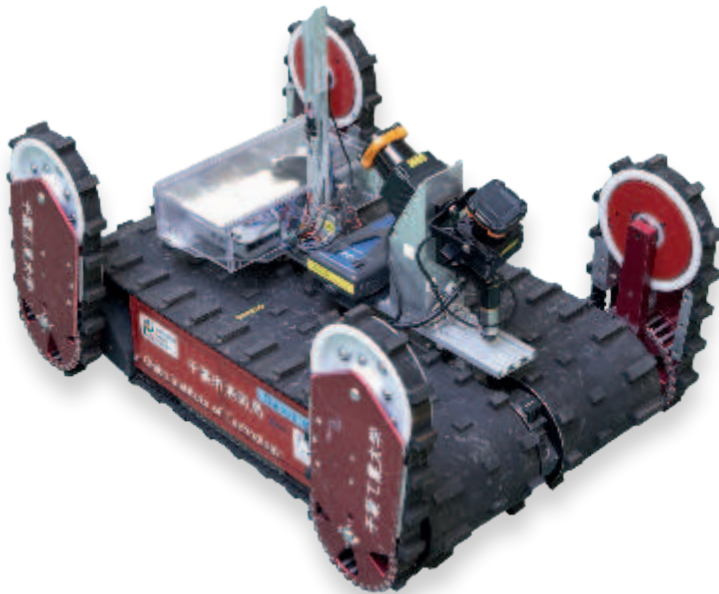


# Robotics

## Unmanned aerial and ground vehicles

High energy efficiency ensures long battery life.

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.



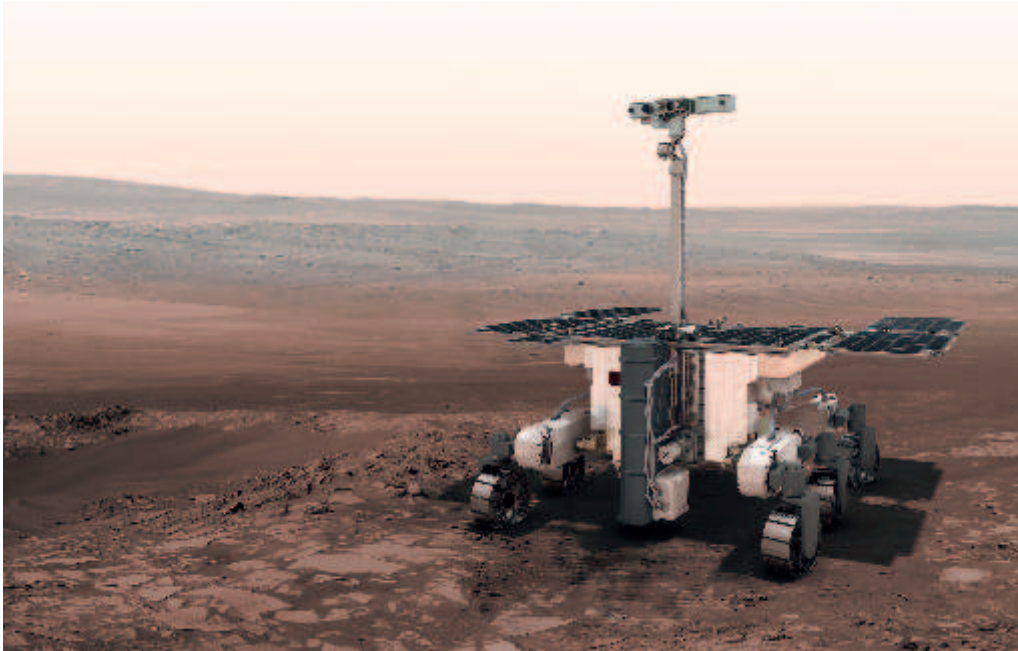
Heavy Duty: Robust brushless EC-4pole 32 HD motors with GP 32 S HD spindle drive.

- 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



# Research missions

## Actuators for rovers, satellites and spacecraft



Drives that were specifically optimized for use in the 8 mbar of CO<sub>2</sub> Martian atmosphere.

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 CO<sub>2</sub> 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.

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. Ready in 11 days: **[xdrives.maxongroup.com](http://xdrives.maxongroup.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 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

ISO 9001

### SN EN ISO 9001:2015

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

EN 9100

ISO 9001

### EN 9100: 2018 (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 this standard is applied for customer-specific products, except A-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.

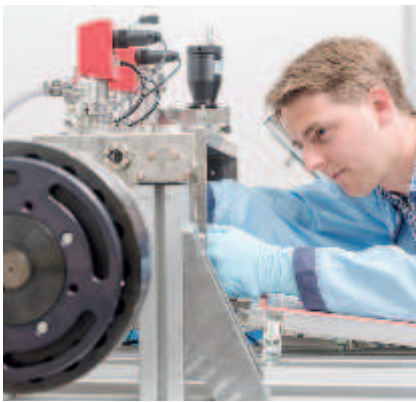


# Product qualification

## Reliable and efficient

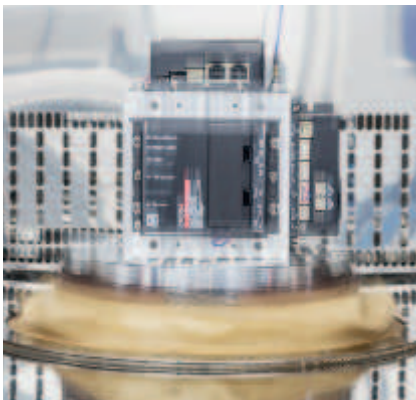
In the development phase, we push our drives to new limits. Our in-house laboratory provides us with the ability to simulate extreme conditions and perform standard maxon tests to ensure that the maxon products match our customers most demanding ambient specifications.

Below are a few images of the maxon laboratory testing facility.



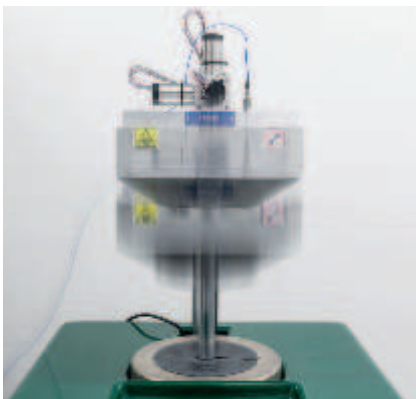
### Internal full load test

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

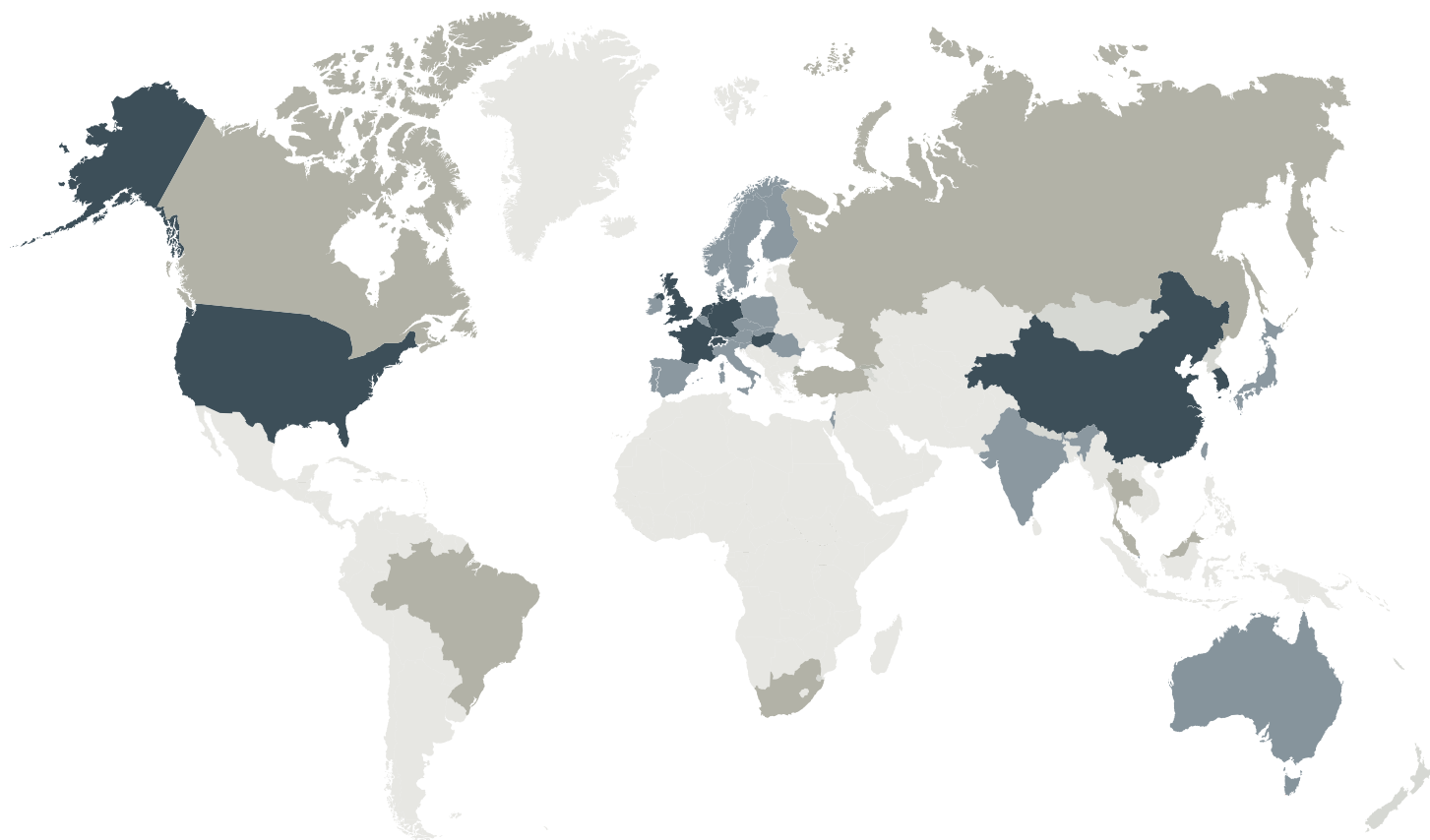
The drives are placed in a climate controlled cabinet and subjected to high vibration. Testing is carried out with the motors in operation at high temperature. The motors are required to continue functioning within their performance specification while vibrations are applied in all directions.



### 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



## maxon Manufacturing Companies

Switzerland (Headquarters)	South Korea	USA
Germany	France	China
Hungary	the Netherlands	Great Britain

## maxon Sales Companies

Australia	Hungary	Singapore
Austria	India	Slovakia
Benelux	Ireland	Slovenia
China	Israel	South Korea
Czechia	Italy	Spain
Denmark	Japan	Sweden
Finland	Norway	Switzerland
France	Poland	Taiwan
Germany	Portugal	USA
Great Britain	Romania	

## maxon Sales Agents

Brasil	Malaysia	Thailand
Canada	Russia	Turkey
Hong Kong	South Africa	

For detailed contact information please visit  
[contact.maxongroup.com](http://contact.maxongroup.com)



