

# Drive systems for medical technology.

Reliability when it matters most.



[www.maxonmotor.com](http://www.maxonmotor.com)

**maxon motor**

driven by precision

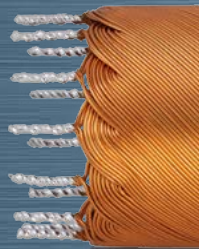
# Founded in Switzerland. Available worldwide.

## **maxon – a strong global brand.**

maxon motor, with headquarters in Sachseln/Central Switzerland, has production sites in Switzerland, Germany, Hungary and South Korea, 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.

## **Driven by precision.**

maxon motor is the worldwide leading provider of high-precision drives and systems up to 500 W. We develop and manufacture brushed and brushless DC motors with a unique ironless winding as well as motors with iron cores. The maxon modular system also includes planetary, spur and special gearheads, as well as encoders and control electronics.



# In medical technology.

## Wide range of applications.

maxon motor is a long-time partner of leading medical technology companies worldwide and covers a wide range of applications including surgical robots, insulin pumps, prostheses, respirators and much more. Depending on the application, the drive must feature high rotation speed, high dynamics or torque, and be autoclavable (sterilizable) or even implantable.

With the large selection of drive solutions from Ø4 mm to 90 mm, maxon motor can provide its customers with the optimal product for their needs. On any given day, countless motors from maxon are at work in hospitals, helping doctors perform their work and improving the quality of patients' lives. These motors provide top performance and outstanding quality.

### Sterilizability

As part of the product qualification, maxon drives are tested in autoclaves. The standard testing includes 1,000 sterilization cycles.

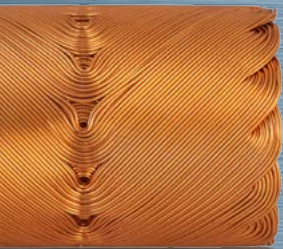


### Quality

maxon motor has been certified in accordance with the following standards: SN EN ISO 9001 for the processes, EN ISO 13485 for medical products (on request), EN 9100 for aerospace applications (on request) and SN EN ISO 14001 for environmental management systems.

## Strong together.

Whatever you need, whether it is a standard product or a custom product, we are here to help direct you to the best solution for your application. Contact us: [contact.maxonmotor.com](https://www.maxonmotor.com)



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# maxon technology.

maxon drives set the world in motion.



## 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

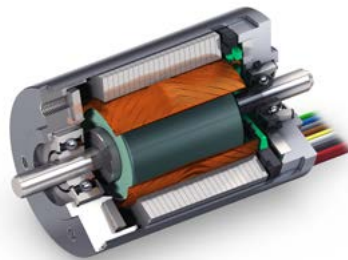
- No magnetic cogging torque
- Withstands high overload for short periods
- Low electromagnetic interference

### Product programs

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

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

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



## 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

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.



## 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.

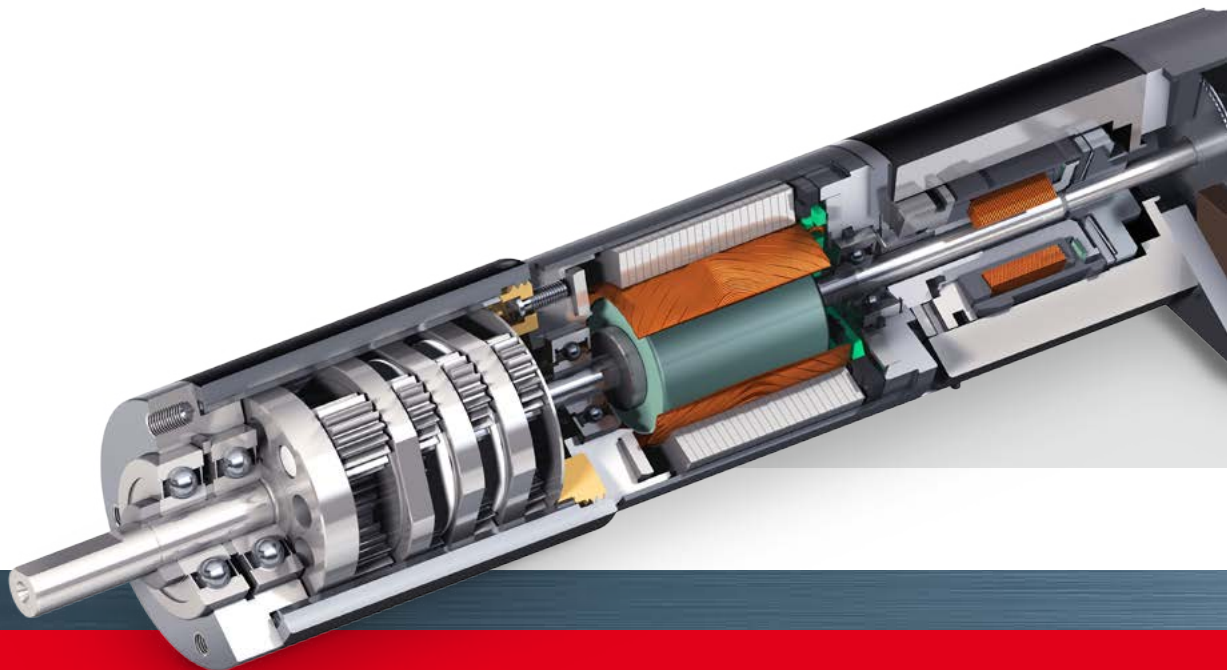
### Main characteristics

- 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

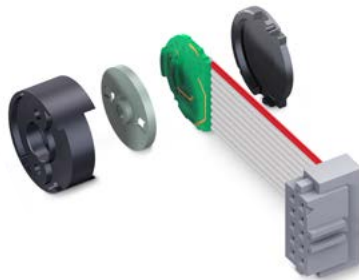
- For transmission of high torques
- High power packed into extremely small spaces
- High reduction ratio
- Can be configured online (GPX only)
- Autoclavable, with shaft seal

#### 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

### 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 tachometer, resolver



## maxon motor control

4-Q servo controllers, 1-Q EC amplifiers 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 with housing.

### Product programs

#### ESCON

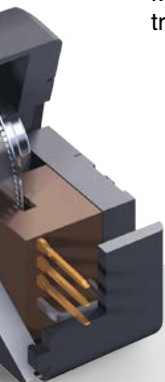
Compact, powerful servo controller. For operation with or without Hall sensors.

#### 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.

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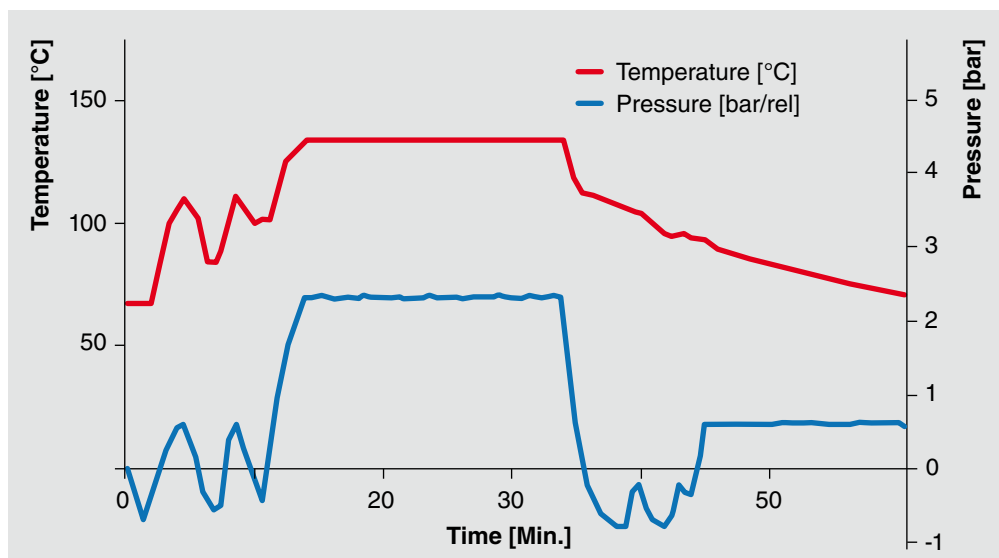
# maxon sterilization specification.

The following products have been tested in autoclaves for 1,000 sterilization cycles. The tests are performed with several vacuum phases, without additional protective measures. The drives are maintenance-free for the entire service life.

- EC 13 30 W, sterilizable
- EC 13 50 W, sterilizable
- EC 19 80 W, sterilizable
- EC 4-pole 30, 150 W, sterilizable
- GP 13 M, sterilizable
- GP 19 M, sterilizable



| Sterilization conditions       |              |
|--------------------------------|--------------|
| Sterilization with water vapor |              |
| Temperature                    | +134°C ± 4°C |
| Pressure-resistant up to       | 2.3 bar      |
| Rel. humidity                  | 100 %        |





## Robots revolutionize surgery.

What was unimaginable a few decades ago is now reality in operating rooms all over the world. Robots support surgeons during difficult prostate removal surgery or other operations on the torso. During the operation, the surgeons sit at a control console, from where they control the four-arm robot. Its instruments are laparoscopically inserted into the patient through small openings, where they can be maneuvered with more flexibility and precision than would be possible with any human hand. This helps preventing nerve damage or major bleeding during the operation. Additionally the small incisions make the healing process much faster for the patient. To accurately transmit the movements of the surgeon to the robot and have the robot execute them, several dozen maxon DC motors are needed. These have no cogging torque and are therefore ideal for use in surgical robots.

## The maxon solution

Brushed DC motors from maxon's DCX series.  
DCX 22 with graphite brushes, DCX 10 combined with a GPX 10 planetary gearhead and an ENX encoder.

- Ironless maxon winding provides smooth running
- Linear characteristic, excellent control properties
- High energy efficiency
- Minimal heat build-up
- Very quiet
- Backdrivable gearhead



### Other products to consider include:

DC motors with precious metal brushes: RE 30, 15 W and RE 40, 25 W  
Controller: EPOS2 Module 36/2.

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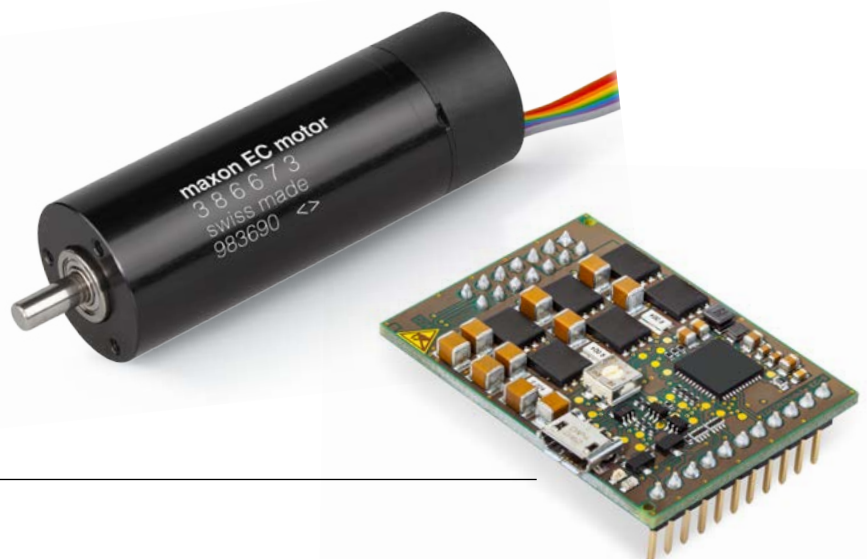
## Respiratory devices ensure adequate air flow.

Sleep disorders can leave patients very weak. As a result, devices that support breathing play an important role. They ensure better blood circulation and thus better oxygen supply to the entire organism. During the night, these quiet, pressure-resistant devices generate a positive airway pressure that continuously keeps the patient's airways open. The required miniature turbine is driven by a brushless EC 22 motor manufactured by maxon. The motor has to have a long service life and meet stringent quality requirements. It also has to be highly dynamic, as the speed has to be adapted continuously – to correspond to the breathing of the patient at any given moment.

### The maxon solution

EC 22 brushless DC motor.

- Highly dynamic behavior
- Compact design
- Very quiet
- High speeds of up to 60,000 rpm
- High efficiency
- Long service life



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#### Other products to consider include:

BLDC motors: EC 13, EC 16 and EC 19

Controllers: ESCON 36/3 EC, ESCON Module 50/4 EC-S

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





## Radiation therapy.

State-of-the-art radiation systems are in use in the fight against cancer. These adapt to the respective patient and are able to continuously adjust the alignment and dosage of the radiation, even during the treatment. The systems are equipped with several collimators, i.e. radiation generators, fastened to a rotatable frame. By means of dozens of leaves, the individual collimators can in turn be configured to only radiate the selected part of the patient where the tumor is located. A complex system of maxon motors, gearheads and controllers ensure that all leaves are correctly positioned at all times.

## The maxon solution

RE 16 brushed DC motor with GP 16 planetary gearhead,  
Enc MR (special design) and EPOS2 position controller.

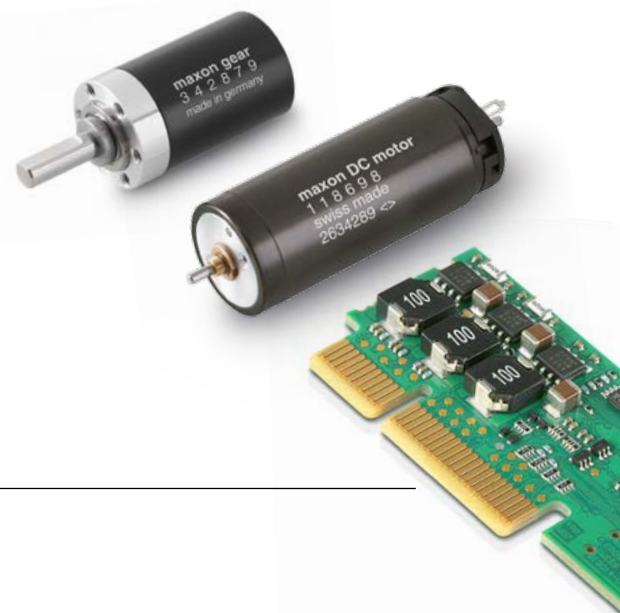
- Ironless maxon winding provides excellent control properties
- A high efficiency of more than 90 percent
- Radiation-resistant encoder
- Perfectly adapted for the interaction with the encoder and position controller
- Long service life

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### Other products to consider include:

Brushed DC motors: RE 10, RE 13

Encoder: Encoder MR



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## Precision instruments for knee operations.

Shavers are small hand-held devices used by surgeons for minimally invasive surgery on the knee or shoulder joints. They consist of a handle and a thin stainless steel pipe with an opening at its end, where a blade is attached. This enables the surgeon to remove tissue or cartilage cleanly and accurately. During the operation, shavers come into direct contact with a saline solution. This means the motors that drive them have to be corrosion-resistant and leak-tight. It's important to minimize warmth and vibrations, so that the shaver is not uncomfortable for the surgeon to hold. All of these features are provided by maxon's brushless EC motors. The motors also feature the high speed required for this application to ensure that the cut is as clean as possible.

### The maxon solution

EC 13 brushless DC motor with GP 13 M planetary gearhead.

- High speed of up to 90,000 rpm
- Can be autoclaved 1,000 times
- Sealed, corrosion-resistant
- Low heat build-up and vibration



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#### Other products to consider include:

BLDC motors: EC 16 sterilizable, EC 19 sterilizable  
Sterilizable planetary gearheads: GP 16 M, GP 19 M  
Controllers: ESCON 36/3 EC, ESCON Module 50/4 EC-S

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## Power tools - the surgeon's instruments.

During many surgical procedures in the operation room, the surgeon relies on battery-operated power tools. They are used when it is necessary to saw through bone or drill holes. This is frequently the case in trauma surgery, if hands or feet are involved or in hip joint surgery. With the EC-4pole series, maxon motor offers the perfect drive solution for this purpose. The brushless electric motor has two pole pairs, resulting in a very high power density and high torque, the ability to withstand 1,000 autoclave cycles.

### The maxon solution

EC-4pole 30 brushless DC motor.

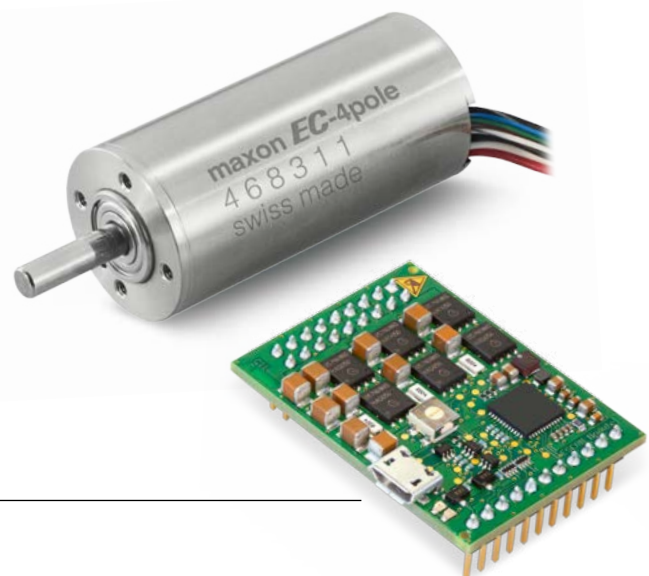
- High torque
- Ironless maxon winding provides smooth running
- Energy-efficient and thus very suitable for battery operation
- Can be autoclaved 1,000 times
- High overload capacity
- Hollow shaft Ø4 mm for Kirschner wire

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#### Other products to consider include:

BLDC motors: EC 4-pole 22

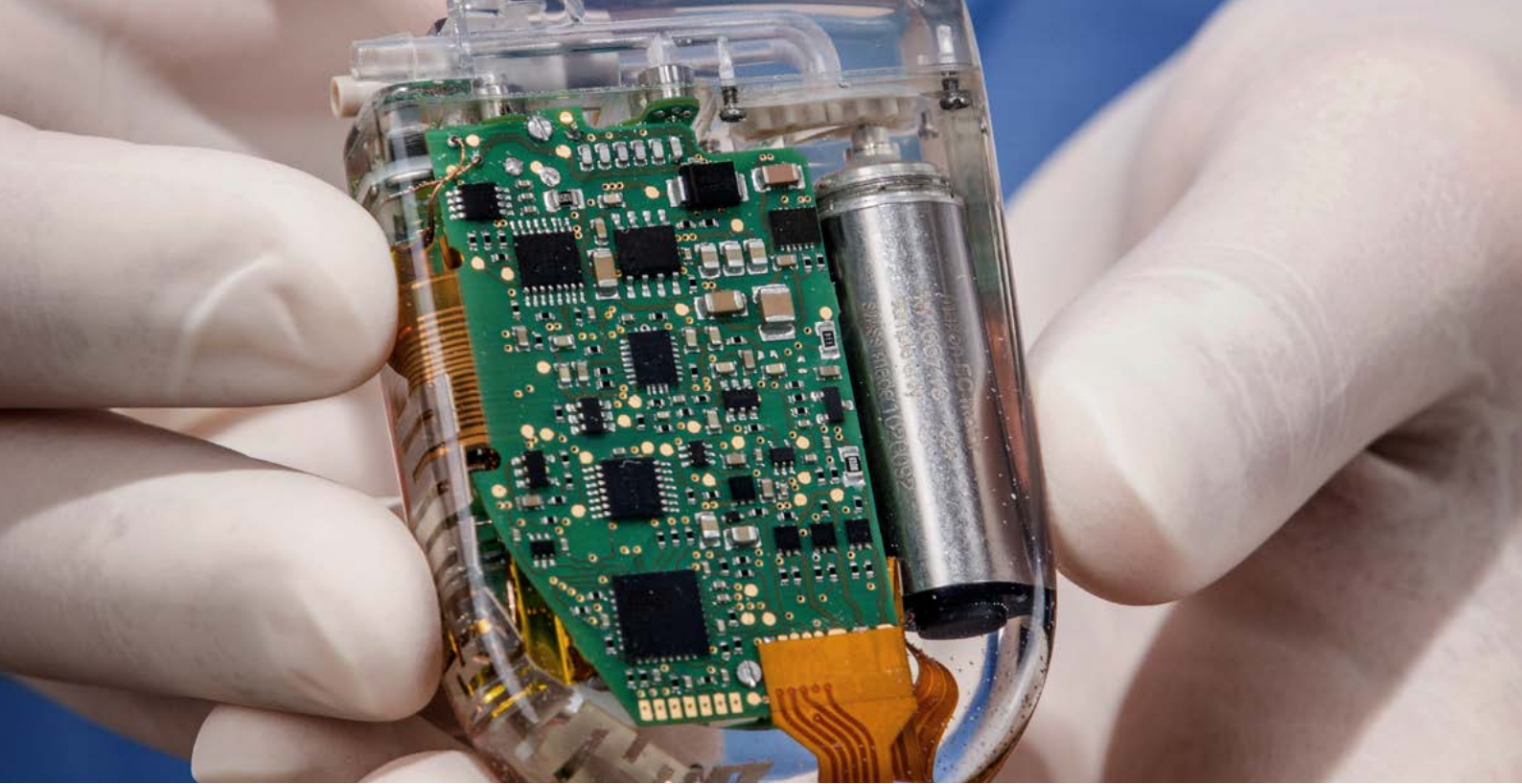
Controller: ESCON Module 50/4 EC-S



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## Implanted pumps improve quality of life.

Worldwide, thousands of people suffer from abdominal dropsy. With this condition, up to two liters of fluid collect in the patient's abdomen daily, as a result of cirrhosis of the liver, cancer or cardiac insufficiency. This is not only dangerous, but also constitutes a hardship for the patients. They can be helped with a new implantable pump, which routes the unwanted fluid directly from the abdomen to the bladder. A brushless EC 13 motor by maxon is used as the drive. The engineers at maxon motor have tailored the sterilizable drive specifically to the customers' needs and equipped it with Hall sensors. These help ensure reliable and stable operation, even at low speeds and high load torques. The EC motor meets the most rigorous requirements and withstands the permanent moisture and high salt concentration inside the human body.

## The maxon solution

EC 13 brushless DC motor.

- Withstands a permanently moist environment and high salt concentration
- Low consumption, which makes battery operation across several days possible
- Very quiet and emits almost no heat
- Sterilizable
- Corrosion-resistant in saline solution



**Other products to consider include:**

BLDC motors: EC 6, EC 8, EC 10

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



## A new life with high-tech prostheses.

Millions of people have lost an arm or a leg and are in need of modern prosthetics. In the past few years, these electromechanical devices have advanced greatly. Now a person with a hand prosthesis can balance plates, tie shoelaces or turn the pages of a book. Leg prostheses are now also able to actively support those who wear them, so that the wearer has the freedom of walking naturally. This is made possible by increasingly powerful and compact components – motors included. The compact yet powerful drives of maxon motor are used in many different prostheses worldwide. Customers often opt for brushless DC motors, due to the excellent control properties.

## The maxon solution

EC 10 brushless DC motor.

- High efficiency
- Long service life
- Ironless maxon winding provides smooth running
- Linear characteristic, excellent control properties
- High overload capacity



### Other products to consider include:

BLDC motors: EC-i 40, EC 45 flat  
Brushed DC motors: DCX program  
Planetary gearheads: GPX program

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## Dental implant devices.

Today, replacing teeth has become almost routine. Oral surgeons place implants made of ceramic or titanium into the bone, where the implants gradually fuse with the surrounding material. The implant then acts as a root and the dental prosthesis is mounted on top of it. To ensure that no problems occur during the operation, the surgeons need a high-quality instrument with which they can safely and efficiently bore or mill the hole into the jawbone. The respective hand-held devices have to be light and quiet and must have high torque, so that a screw can be cut at low speed. Additionally all parts of the hand-held device have to be sterilizable, to prevent infections. With the brushless EC 19 drive, maxon motor has the perfect solution for these devices.

## The maxon solution

EC 19 brushless DC motor with GP 19 M planetary gearhead.

- Can be autoclaved 1,000 times, as the electronics are potted and the rotor magnet is hermetically sealed
- Compact design with high torques and speeds of up to 40,000 rpm
- Low noise and low vibration
- The ironless winding does not have a cogging torque
- Minimal heat build-up

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### Other products to consider include:

BLDC motors: EC 16, EC 22

Planetary gearheads: GP 16 M, GP 19 M, GP 22 M

Controllers: ESCON Module 50/4 EC-S, ESCON Module 50/5

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## High-precision root canal treatment.

A tooth nerve that is inflamed or has already died causes a lot of pain for the patient. With a root canal treatment, the dentist completely removes the nerve while making all attempts to save the tooth. The dentist cleans out the root canal by using an electromechanically driven file, and then seals off the tooth. The work with the hand-held device should not be underestimated. The clamped titanium file is thin and care must be taken not to break it. To prevent this, the drive is equipped with torque control and torque limiting. maxon motors with precious metal brushes are the ideal solution, as they are easy to control and have a constant low contact resistance.

## The maxon solution

DCX 10 brushed DC motor, can be configured online and is ready for delivery in 11 working days.

- Compact and light design
- Precious metal brushes guarantee a low, constant contact resistance during the entire service life
- Easy torque control using the current
- Low start-up voltage, even after a long period in standstill
- With the patented ironless maxon winding, the high-frequency interferences are minimized



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### Other products to consider include:

Brushed DC motors: RE-max 13

BLDC motors: EC 10, EC 13

Controllers: ESCON 36/2 DC, ESCON 36/3 EC

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# maxon motor at a glance.

maxon motor is the worldwide leading provider of high-precision drives and systems up to 500 W. We develop and manufacture brushed and brushless DC motors with a unique ironless core winding as well as motors with iron cores. maxon motor's modular system includes planetary, spur and special gearheads, as well as encoders and control electronics. High-tech CIM and MIM components are manufactured in a specialized facility. maxon motor stands for top quality, innovation, competitive pricing, and a worldwide distribution network. What matters most, however, is the high quality of the customer-specific solution that we create with you and for you.



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