maxon EC motor ironless winding
Technology – short and to the point

Characteristics of **maxon EC motors**
- Brushless DC motor
- Long service life
- Speeds of up to 50 000 rpm and higher are possible
- Highly efficient
- Linear motor characteristics, excellent control properties
- Ironless winding system maxon® with three phases in the stator
- Lowest electrical time constant and low inductance
- No detent
- Good heat dissipation, high overload capacity
- Rotating Neodymium permanent magnet with 1 or 2 pole pairs.
- Lowest residual unbalance

Characteristics of the **maxon *EC*-max** range
- attractive price/performance ratio
- robust steel casing
- speeds of up to 20 000 rpm
- rotor with 1 pole pair

Characteristics of the **maxon *EC*-4pole** range
- Highest power density thanks to rotor with 2 pole pairs
- Knitted winding system maxon® with optimised interconnection of the partial windings
- Speeds of up to 25 000 rpm
- High-quality magnetic return material to reduce eddy current losses
- Mechanical time constants below 3 ms

Bearings and service life

The long service life of the brushless design can only be properly exploited by using preloaded ball bearings.
- Bearings designed for tens of thousands of hours.
- Service life is affected by maximum speed, residual unbalance and bearing load.

Legend
The commutation angle is based on the length of a full commutation sequence (360°e). The length of a commutation interval is therefore 60°e.
The commutation rotor position is identical to the motor shaft position for motors with 1 pole pair.
The values of the shaft position are halved for motors with 2 pole pairs.

Program

- **EC-Program**
- ***EC*-max-Program**
- ***EC*-4pole**

- **with Hall sensors**
- **sensorless**
- **with integrated electronics**
- **sterilizable**

1. Flange
2. Housing
3. Laminated steel stack
4. Winding
5. Permanent magnet
6. Shaft
7. Balancing disks
8. Print with Hall sensors
9. Control magnet
10. Ball bearing
11. Spring (bearing preload)

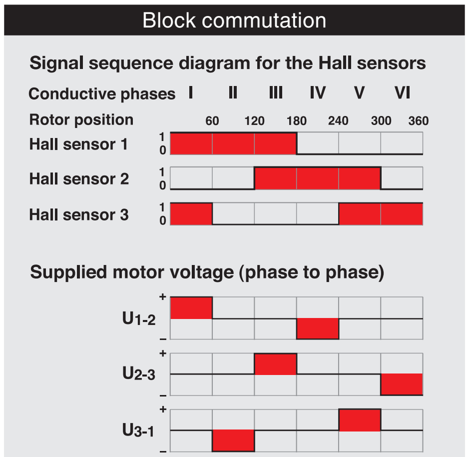
Electronical commutation

Block commutation
Rotor position is reported by three in-built Hall sensors. The Hall sensors arranged offset by 120° provide six different signal combinations per revolution. The three partial windings are now supplied in six different conducting phases in accordance with the sensor information. The current and voltage curves are block-shaped. The switching position of each electronic commutation is offset by 30° from the respective torque maximum.

Properties of block commutation
- Relatively simple and favorably priced electronics
- Torque ripple of 14 %
- Controlled motor start-up
- High starting torques and accelerations possible
- The data of the maxon EC motors are determined with block commutation.

Possible applications
- Highly dynamic servo drives
- Start/stop operation
- Positioning tasks

Block commutation



Sensorless block commutation
The rotor position is determined using the progression of the induced voltage. The electronics evaluate the zero crossing of the induced voltage (EMF) and commute the motor current after a speed dependent pause (30° after EMF zero crossing).
The amplitude of the induced voltage is dependent on the speed. When stalled or at low speed, the voltage signal is too small and the zero crossing cannot be detected precisely. This is why special algorithms are required for starting (similar to stepper motor control).
To allow EC motors to be commuted without sensors in a Δ arrangement, a virtual star point is usually created in the electronics.

Properties of sensorless commutation
- Torque ripple of 14 % (block commutation)
- No defined start-up
- Not suitable for low speeds
- Not suitable for dynamic applications

Possible applications
- Continuous operation at higher speeds
- Fans

Sensorless commutation