maxon EC motor iron-cored winding
Technology – short and to the point

Characteristics of **maxon EC flat motors**
and **EC-i motors:**
– Brushless DC motor
– Long service life
– Flat design for when space is limited
– Comparatively high inertia
– Motor characteristics may vary from
  the strongly linear behaviour
– Hall sensor signals utilizable for simple speed
  and position control
– Winding with iron core and several teeth
  per phase in the stator
– Low detent torque
– Good heat dissipation, high overload
  capacity
– Multipole Neodymium permanent magnet
– Smaller commutation steps

Characteristics of **maxon EC flat motors:**
– Attractive price/performance ratio
– High torques due to external, multipole rotor
– Excellent heat dissipation at higher speeds
  thanks to open design

Characteristics of the **maxon EC-i** program:
– Highly dynamic due to internal,
  multipole rotor
– Mechanical time constants below 3 ms
– High torque density
– Speeds of up to 15 000 rpm

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 imbalance and bearing load

Program

– **EC flat motor**

– **with Hall sensors**
– **sensorless**
– **with integrated electronics**

Electronical commutation

Block commutation
Rotor position is reported by three built-in Hall
sensors which deliver six different signal
combinations per commutation sequence.
The three phases are powered in six differ-
ent conducting phases in line with this sensor
information. The current and voltage curves
are block-shaped. The switching position of
every electronic commutation lies symmetrically
around the respective torque maximum.

Properties of block commutation
– Relatively simple and favorably priced
  electronics
– Controlled motor start-up
– High starting torques and accelerations pos-
  sible
– The data of the maxon EC motors are
  determined with block commutation.

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

❶ Flange
❷ Housing
❸ Laminated steel stack
❹ Winding
❺ Permanent magnet
❻ Shaft
❼ Print with Hall sensors
❽ Ball bearing
❾ Spring (bearing preload)

Sensorless block commutation
The rotor position is determined using the
progression of the induced voltage. The electron-
ics 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 start-
ing (similar to stepper motor control). To allow
EC motors to be commuted without sensors in
a △ arrangement, a virtual star point is usually
created in the electronics.

Properties of sensorless commutation
– No defined start-up
– Not suitable for low speeds
– Not suitable for dynamic applications

Possible applications
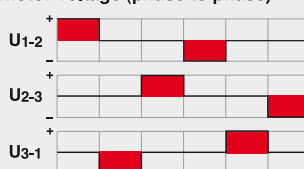– Continuous operation at higher speeds
– Fans, pumps

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 values of the shaft position can be calcu-
lated from the commutation angle divided by the
number of pole pairs.

Block commutation

Signal sequence diagram for the Hall sensors

Supplied motor voltage (phase to phase)

Sensorless commutation