maxon sensor
Technology – short and to the point

Sensors

maxon offers a series of sensors.
Their characteristics are:

Digital incremental encoder
– Relative position signal suitable for positioning tasks
– Rotation direction recognition
– Speed information from number of pulses per time unit
– Standard solution for many applications

DC tachometer
– Analog speed signal
– Rotation direction recognition
– Not suitable for positioning tasks

Resolver
– Analog rotor position signal
– Analog speed signal
– Extensive evaluation electronics required in the control system
– For special solutions in conjunction with sinusoidal commutation in EC motors

Program

– **Digital MILE encoder**
– **Digital MR encoder**
– **Digital Hall effect encoder**
– **Digital optical encoder**
– **DC Tacho**
– **Resolver**

❶ End cap
❷ Electrical connections motor and encoder
❸ Print
❹ MR sensor
❺ ASIC
❻ Magnetic multi-pole wheel
❼ Encoder housing
❽ Motor connections
❾ Motor
❿ Solid measure
⓫ Carrier of solid measure

Digital Incremental Encoder

Encoder signals
The encoders provide a simple square signal for further processing in the control system. Its impulses can be counted for exact positioning or determining speed. Channels A and B pick up phase shifted signals, which are compared with one another to determine the rotation direction.

A "home" pulse (index channel I) can be used as a reference point for precise determination of rotation angle.

The line driver produces complementary signals $\overline{A}$, $\overline{B}$, $\overline{I}$ which help to eliminate interference on long signal lines. In addition, this electronic driver installed in the encoder improves signal quality by steeper signal edges.

Magneto-resistant (MR) principle
In an MR-encoder, the multipole magnetic disc mounted on the motor shaft produces a sinusoidal voltage in the MR sensor. The typical encoder signals are created by interpolation and electronic signal refinement.

Characteristics
– Needs very little space
– No protruding parts
– High number of pulses by interpolation
– Different number of pulses can be selected
– Index channel possible
– Line driver possible

Magnetic principle with Hall sensors
On the magnetic MEnc-Encoder a small multipole permanent magnet sits on the motor shaft. The changes in magnetic flux are read by Hall sensors and fed into the electronics as channel A and B.

Characteristics
– Small design
– 2 channels A and B
– No line driver possible
– Low number of pulses

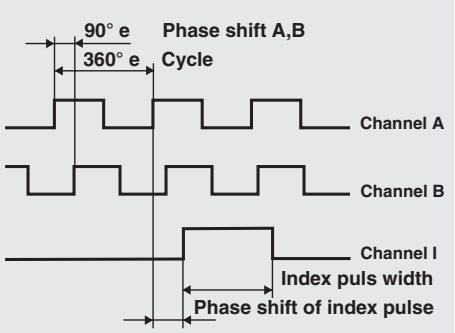
Optical principle
The opto-electronic principle (example: HEDL HEDS, Enc22) sends an LED light through a finely screened code wheel that is rigidly mounted onto the motor shaft. The receiver (photo transistor) changes light/dark signals into corresponding electrical impulses that are amplified and processed in the electronics.

Characteristics
– Needs large space with protruding part
– High number of pulses
– Index channel possible
– Line driver possible
– High accuracy

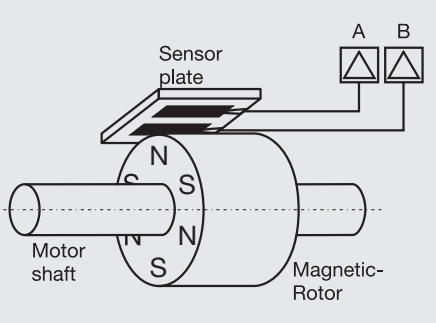
Inductive eddy current principle
In the inductive MILE encoder, a high-frequency magnetic field is brought onto a structured copper disc and the angle-dependent field displacement measured.

Characteristics
– Very robust against magnetic and electrical fields as well as contamination
– Very high speeds possible
– High precision. Interpolation errors are largely compensated for by a look-up table
– Index channel and line driver available
– Absolute interface (SSI) on request

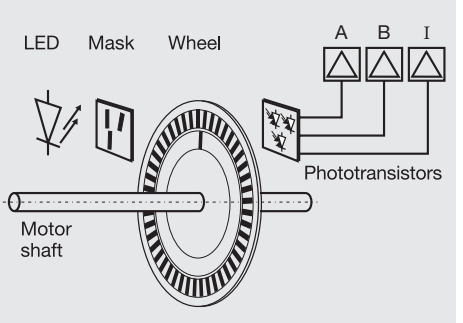
Representation of the output signal of a digital encoder

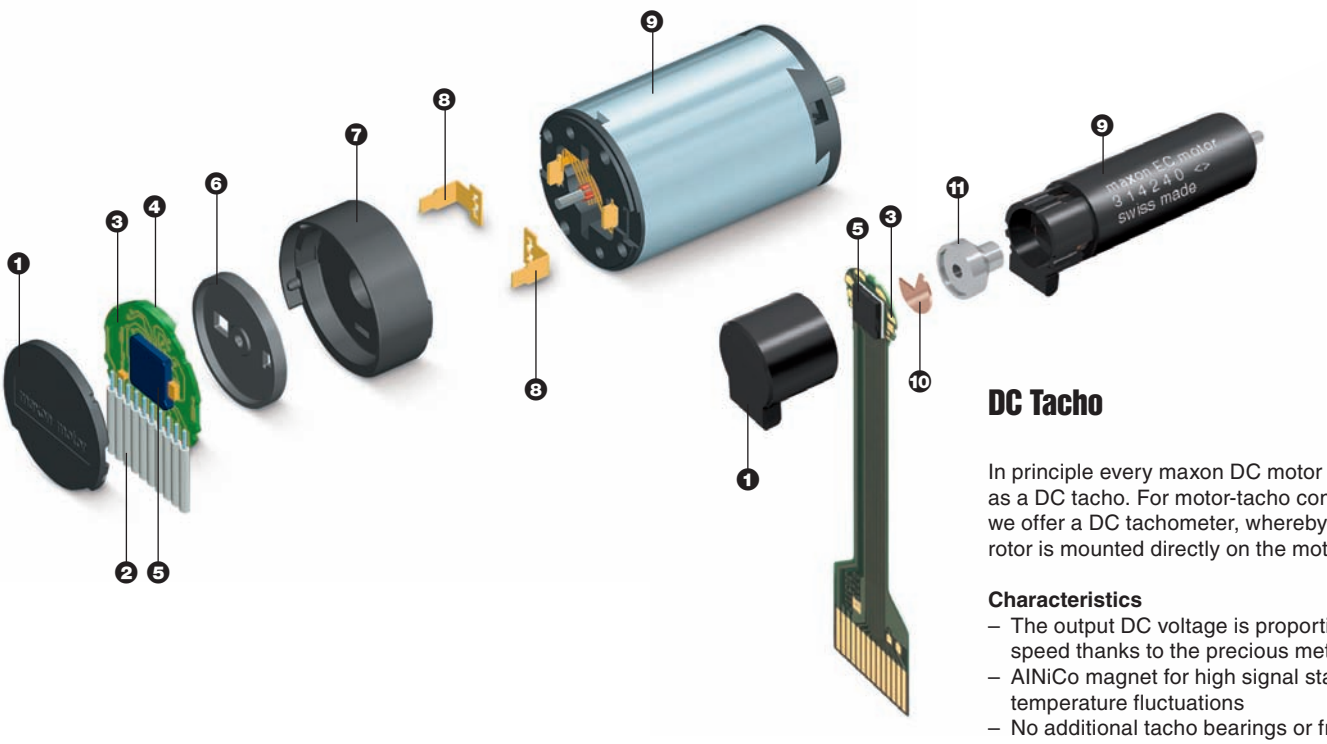


Schematic design of a magnetic encoder



Schematic design of an opto-electronic encoder





Tips on encoder selection
Principal features of the maxon incremental encoder are:
- The number of pulses per revolution (increments)
- The accuracy
- Use of an index channel
- The use of a line driver
- The maximum supported speed
- The suitability for special ambient conditions (dust, oil, magnetic fields, ionizing radiation)

Encoders and maxon controllers
- As a standard the maxon controllers are preset for encoders with 500 pulses per revolution.
- The higher the number of pulses and the higher the accuracy the better a smooth, jerk-free operation can be achieved even at low speeds.
- maxon controllers can be set for low or high speed operation and for encoders with a low or high number of pulses.
- Control electronics can restrict an encoder's maximum possible number of pulses.

The following applies especially to positioning systems:
- All maxon positioning systems evaluate the rising and falling signal edges. With regard to encoder number of pulses, this results in a four times higher positioning precision. This is what is referred to as quadcounts.
- The higher the number of pulses, the more precise the position that can be reached. At 500 pulses (2000 quadcounts) an angle resolution of 0.18° is achieved, which is usually much better than the precision of the mechanical drive components (e.g. due to gear play or elasticity of drive belts).
- Only encoders with an integrated line driver (RS422) should be used in positioning controls. This prevents electromagnetic interference signals from causing signal loss and accumulated positioning errors.
- Positioning applications often require the index channel of the encoder for precise reference point detection.

DC Tacho

In principle every maxon DC motor can be used as a DC tacho. For motor-tacho combinations, we offer a DC tachometer, whereby the tacho rotor is mounted directly on the motor shaft.

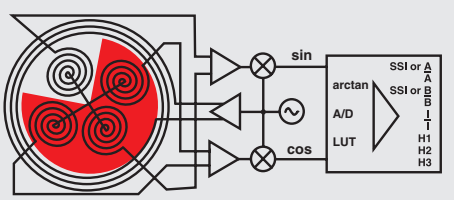
Characteristics
- The output DC voltage is proportional to the speed thanks to the precious metal brushes.
- AlNiCo magnet for high signal stability with temperature fluctuations
- No additional tacho bearings or friction
- No couplings, high mechanical resonance frequency

Resolver

The resolver is mounted on the motor's through shaft and adjusted according to the magnetic field of the motor rotor. The resolver has a rotating primary coil (rotor) and two secondary coils (stator) offset by 90°. An alternating current connected to the primary coil is transferred to the two secondary coils. The amplitudes of the secondary voltages are sin φ and cos φ, where φ is the rotation angle.

Characteristics
- Robust, for industrial use
- Long service life
- No mechanical wear
- Output signal can be transmitted over long distances without problems
- No sensitive electronics
- Special signal evaluation required
- Only one sensor for position and speed information
- EC motors with resolver are supplied without Hall sensors

Schematic design of the inductive MILE encoder



Recommendations for using the maxon encoder

	MR	MEnc	optical	MILE
line driver possible	✓		✓	✓
index channel possible	✓		✓	✓
precise position			✓	✓
very low speed			✓	
very high speed	(✓)	✓		✓
dust, dirt, oil	✓	✓		✓
ionising radiation		✓*		

*on request

Schematic design of a resolver