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

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 A, B, 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.

Program
- Digital MILE encoder
- Digital MR encoder
- Digital Hall effect encoder
- Digital optical encoder
- DC Tacho
- Resolver

Magneo-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

End cap
- Electrical connections motor and encoder
- Print
- MR sensor
- ASIC
- Magnetic multi-pole wheel
- Encoder housing
- Motor
- Solid measure
- Carrier of solid measure

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 quadrants.
- The higher the number of pulses, the more precise the position that can be reached. At 500 pulses (2000 quadrants) 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

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<th></th>
<th>MR</th>
<th>MILE</th>
<th>optical MILE</th>
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<tr>
<td>line driver possible</td>
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<tr>
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*on request

Schematic design of a resolver

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