

# Technology – short and to the point

## Sensors

maxon offers a series of sensors.  
Their characteristics are:

### Digital incremental encoder

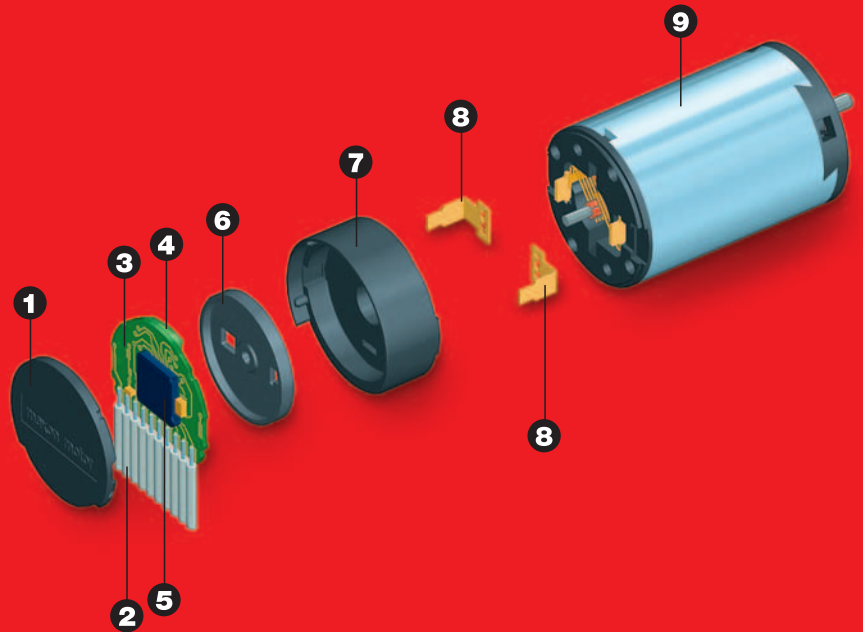
- Relative position signal suitable for positioning tasks
- Rotation direction recognition
- Speed information from number of pulses per time unit
- Standard solution for many applications

### DC tachometer

- Analog speed signal
- Rotation direction recognition
- Not suitable for positioning tasks

### Resolver

- Analog rotor position
- 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) then provides zero crossing and is used as a reference point for precise determination of rotation angle.

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

### Magneto-resistant (MR) principle

In an MR-encoder, the multipole magnetic disc mounted on the motor shaft produces a sine-wave voltage variation in the MR sensor. The typical encoder signals are created through interpolation and electronic signal refinement.

### Advantages

- Needs very little space
- No protruding parts
- High number of pulses through interpolation
- Different number of pulses can be selected
- Index channel can be selected
- Line driver can be selected

### Magnetic principle with Hall sensors

Under the magnetic principle, a small multipole permanent magnet sits on the motor shaft. The changes in magnetic flux are recorded by Hall sensors and fed into the electronics as channel A and B.

### Features

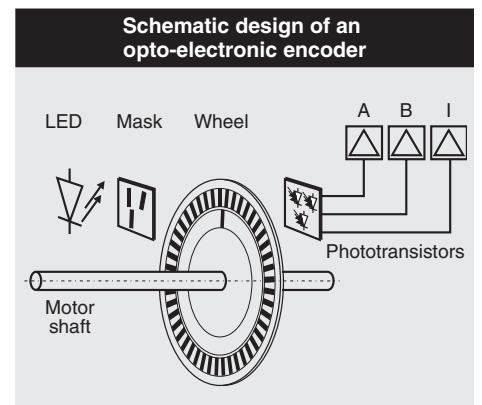
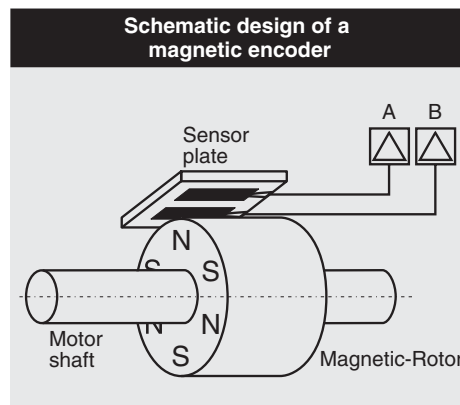
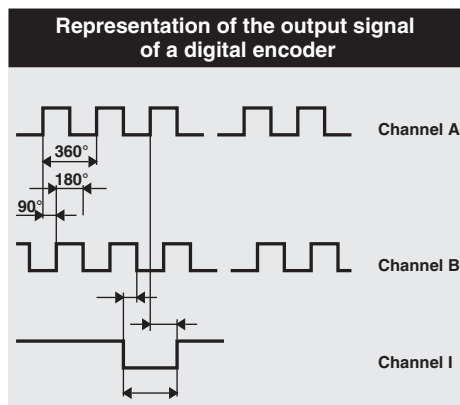
- Small design
- 2 channels A and B
- No line driver possible
- Low number of pulses

### Optical principle

The opto-electronic principle 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.

### Features

- Needs large space with protruding part
- High number of pulses
- Index channel possible
- Line driver possible



- 1 End cap
- 2 Electrical connections motor and encoder
- 3 Print
- 4 MR sensor
- 5 ASIC
- 6 Magnetic multi-pole wheel
- 7 Encoder housing
- 8 Motor connections
- 9 Motor

## Program

maxon tacho

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

maxon tacho

### Tips on encoder selection

Principal features of the maxon incremental encoder are:

- The number of pulses per revolution (increments)
- The use of an index channel
- The use of a line driver.

The maxon controllers are optimally designed for encoders with 500 increments. The size sometimes dictates that an encoder with a lower number of pulses must be selected.

The higher the number of pulses, the better a smooth, jerk-free operation can be achieved even at low speeds.

maxon controllers can be set to operate at low speed and / or for an encoder with a low number of pulses.

The frequency restrictions of the encoder and subsequent controller, limit the maximum speed up to which the encoder signals can be processed. The frequency limit of maxon encoders is typically 100 kHz, which is equivalent to a speed of 12 000 rpm with a 500 pulse encoder.

### 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  $0.18^\circ$  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.

### Advantages and Features

- 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 resonant 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  $90^\circ$ . An alternating current connected to the primary coil is transferred to the two secondary coils. The amplitudes of the secondary voltages are  $\sin \varphi$  and  $\cos \varphi$ , where  $\varphi$  is the rotation angle.

### Advantages and Features:

- 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 a resolver

