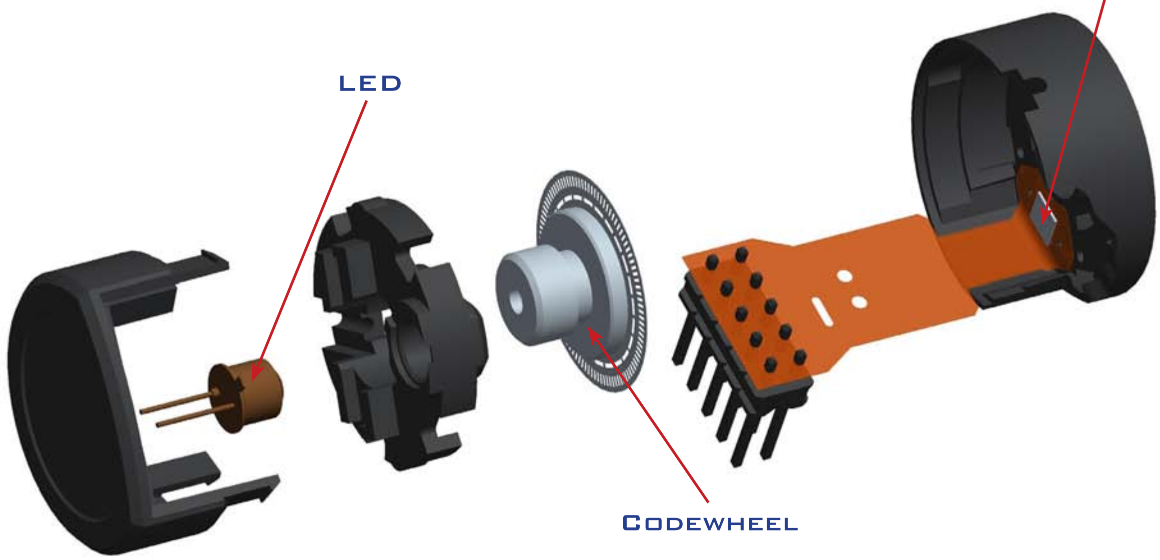
# ENCODERS


Portescap
A Danaher Motion Company

Feedback mechanisms for gauging motor position and speed are highly essential for a wide range of applications in medical, industrial automation, security and access. Portescap's encoder technologies spanning from the simplest tachogenerators to highly sophisticated MR encoders provide a bundle of solutions for positioning and speed related feedback to facilitate the needs of motion in a variety of applications.

# Why an Encoder




## Feedback & Positioning

### D.C. Tachogenerators

The combination of an ironless rotor, a high grade permanent magnet, and a commutation system made of precious metals, results in Portescap DC tachogenerators having a truly linear relationship between angular velocity and induced voltage, a very low moment of inertia and negligible friction.

### Optical Encoders

The incremental optical encoders from Portescap have three output channels. It uses a dedicated ASIC having a matrix of optoelectronic sensors which receives infrared light from an LED after its passage through a metal codewheel. The mask determining the phase angle and index position is directly integrated onto the circuit, ensuring very high precision. The differential measure of the light modulated by the codewheel generates digital output signals insensitive to temperature drift with an electrical phase shift of 90° between channels A and B. The standard version of the encoder provides CMOS compatible complementary signals for improved signal transmission and noise rejection. Besides the detection of the direction of rotation and signal transitions in channel A and B for direct control of a counter or a microprocessor, the integration of this particular circuit offers additional functions such as a stand-by mode for reduced current consumption in battery powered equipment.

### Magnetic Encoders

The integrated Portescap type D magnetic encoder consists of a multipolar magnet mounted directly on the motor shaft. As the motor shaft turns, magnetic flux variations are detected by Hall sensors which generate two TTL-CMOS compatible output signals having a 90° phase shift between both channels. The simple and robust design of this sensor makes it ideally suited to applications with severe operating conditions, such as high temperature, dust, humidity, and vibration. Integrated into Portescap motors, these units are intended for applications requiring compact and reliable high performance systems for speed and position control.

# Spotlight on MR2 encoder

Magnetoresistance effect which was first discovered in 1857 can be seen in three different configurations:-

1. R(M(T)) – Resistance changes due to indirect manipulation of magnetization through thermal changes
2. R(M) – Resistance changes due to direct manipulation of the magnetization.
3. R($\theta_{M,I}$) – Resistance changes due to the angle between the magnetization and current

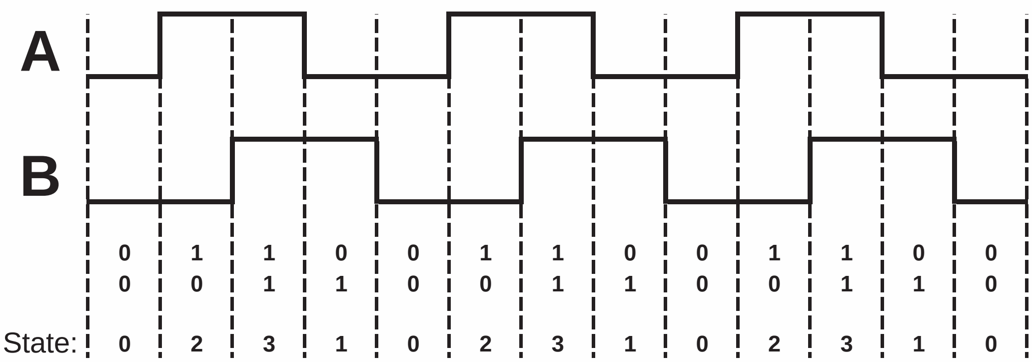
The third effect, also referred to as anisotropic magnetoresistance is exploited in Portescap's high resolution MR encoders.

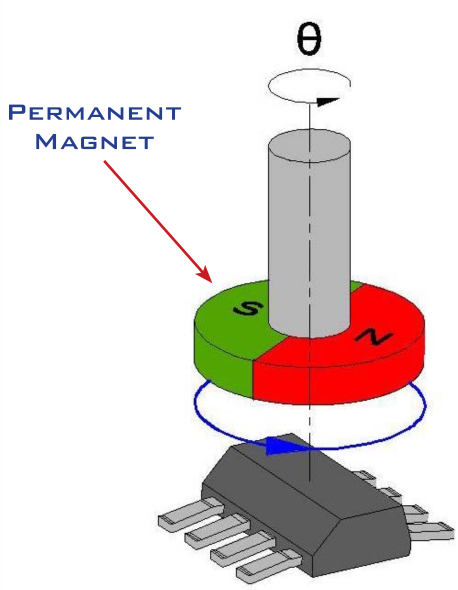
This resistance variation responds to the following equation:

$$\rho(\theta_{M,I}) = \rho_0 + \rho_\Delta \cos^2(\theta_{M,I})$$

where $\rho_0$ is the zero-field resistivity, $\rho_\Delta$ is the minimal resistivity and $\theta_{M,I}$ is the angle between the magnetic field and the current. The relation between resistivity and magnetic angle governs the design of the MR encoder and as such the encoder signals have negligible effect on variation in magnetic field strength.

Using interpolation techniques, several output lines per revolution are generated with only one period of analog signal coming out from the sensor – magnet system, in incremental magnet encoders. The pulse signal from MR encoder as shown below is proportional to speed and distance traveled by the shaft and can be used for effective feedback.

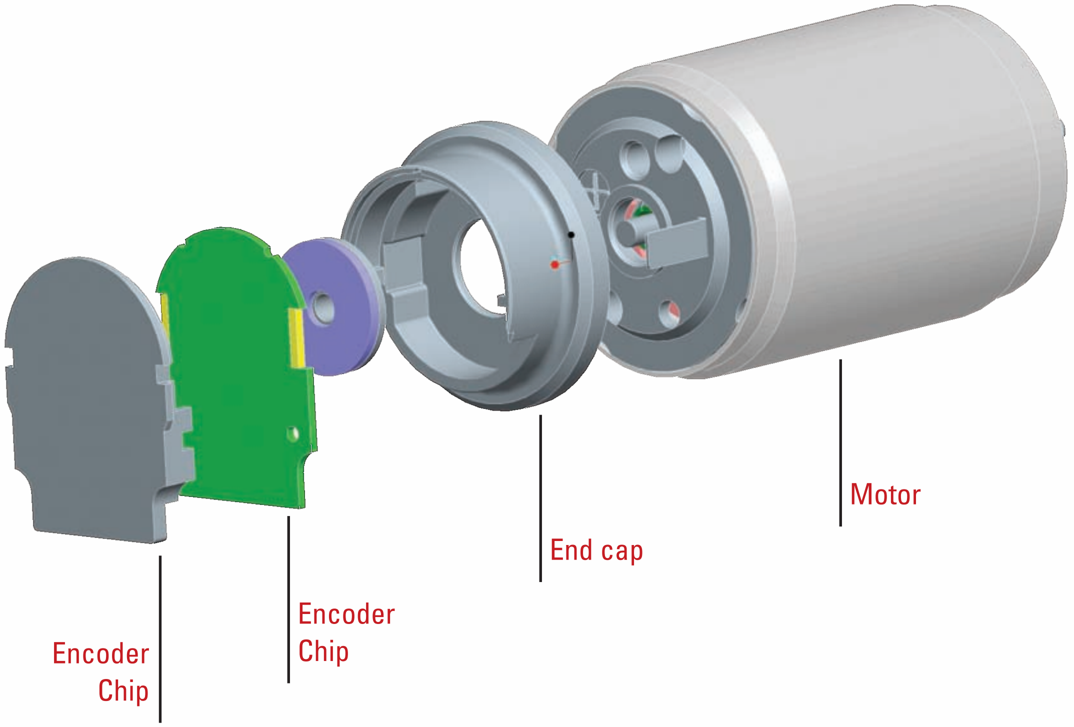



As the MR technology is not needed to have physically all the output lines (poles in case of a magnetic encoder) on the encoder disc, the MR encoder can be made very compact, even for high resolution. The magnetic field inside the encoder can be maximized by having a low number of relatively big magnetic poles. The strong field so obtained makes this encoder very resistant against any unwanted external field.

Also, with this compact design the encoder disc magnet remains very small thus sustaining the motor's high dynamic performances.

Finally, as this encoder is made around a magnetic angle sensor, it is not sensitive to vertical position changes and, hence, ball bearings in a motor are not a prerequisite to achieve high resolution.




| Concept Detail | Encoder Characteristics | Advantages for the Application |
|---|---|---|
| Interpolated lines | Physical line count on the encoder disc is much lower than encoder resolution | Ultra compact design for high resolution |
| Field angle sensor | High magnet field obtained with simple bipolar magnet<br>No sensitivity to axial movement of the encoder magnet | Very low sensitivity to unwanted external field<br>Ball bearing motor not required even for high resolution |
| Low thickness high field density magnet | Ultra low encoder inertia | High dynamic performance of the motor stays intact |