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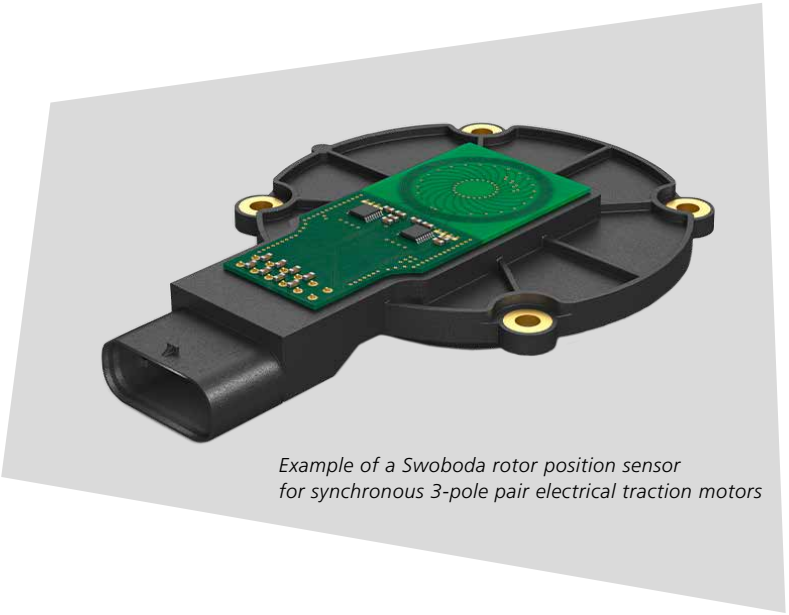
technologies

SWOBODA ROTOR POSITION SENSOR
FOR AUTOMOTIVE APPLICATIONS



Example of a Swoboda rotor position sensor for synchronous 3-pole pair electrical traction motors

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INTRODUCTION

The Swoboda Rotor Position Sensor (RPS) is based on the highly accurate and stray field robust inductive technology. The sensor detects the angle position of a target mounted on the rotor shaft and outputs this information as analog or digital signal. The sensor enables a reliable and efficient control of electrical traction machines and other motor applications.

ADVANTAGES

- Robust against mechanical misalignment
- No magnet, immune to stray fields
- High accuracy over temperature
- Operating at over 30.000 RPM
- Compact and lightweight solution

FEATURES & BENEFITS

- Inductive technology
- 360° contactless absolute angle measurements
- High speed differential analog sine/cosine, digital SENT/SPC or PWM output
- Typical statical error < 0.5 °el. (analog version)
- Typical dynamical error < 0.25 °el. (analog version)
- Propagation delay < 0.1 µs
- Operating voltage 4.75 V to 5.25 V
- Overvoltage protection ± 18 V
- Reverse polarity protection
- Operating temperature from -40 °C to +150 °C
- Current consumption < 12 mA
- Available with and without matching metal target
- Functional safety (ISO 26262): up to ASIL-C ready with redundant electronics design up to ASIL-D
- 100 % end of line testing and programming
- Full traceability, also including DMC laser marking

APPLICATION AREAS

- Electrical traction motor
- Resolver replacement
- Electric Power Steering (EPS) systems
- E-Brake booster
- Electro mechanical brake systems

Any questions about this product?
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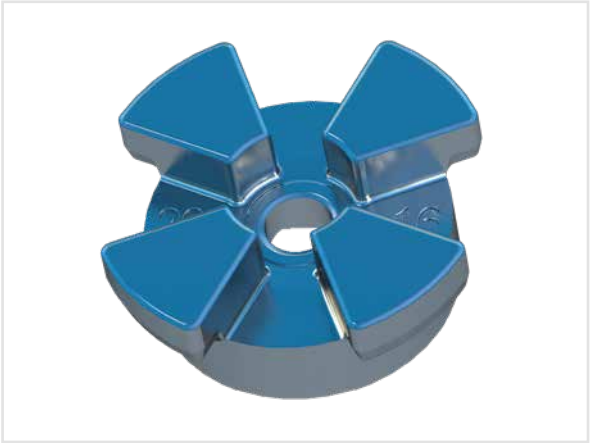
PRINCIPLE OF OPERATION

Swoboda RPS consists of two main components, the sensor and the matching target. The sensor comprises the PCB with transmitter and receiver coils and a sensor IC. It is firmly mounted to the motor housing. The matching metal target is mounted to the rotating motor shaft facing the sensor coils. During operation a magnetic field is generated inside the sensor unit by the transmitter coil, reflected by the target and sensed back by the receiver coils. The resulting backcoupling ratio depends on the angular position of the target mounted to the rotor shaft. The sensor IC measures, filters, amplifies and processes the voltages induced in the receiver coils and provides the calculated angle information. The output configuration is either a sine/cosine differential analog signal or a digital PWM/SENT/SPC signal with an absolute angle. The sensor meets the demand for enhanced ASIL levels thanks to built-in diagnostic functions. In a typical electrical traction motor application the RPS is electrically connected directly to the inverter control board.

AVAILABLE PRODUCTS

Swoboda RPS are customer-specific products and optimized for the customer application. The scalability of Swoboda coil design allows the sensor to be adapted for different mounting positions (end of shaft, through shaft or side shaft) and to the number of pole pairs of the electrical machine.

ROTOR POSTION SENSOR ASSEMBLY EXAMPLE



The number of pole pairs of the target should be selected according to the number of pole pairs of the electrical machine. Geometry, material and industrialization of the target have to be carefully considered in order to achieve high accuracy angle sensing.

Figure 1:Target with 4 pole pairs, material: steel; diameter: Ø 40 mm

The sensor housing is designed according to customer specifications and building space requirements. As shown in this example, the sensor is mounted with three screws, located at the outer frame of the sensor housing. A matching cover is laser welded to the housing for sealing purposes. Optionally an external temperature sensor can be connected to the sensor housing depending on customer requirements.

Figure 2: Sensor mounted to electric traction motor housing

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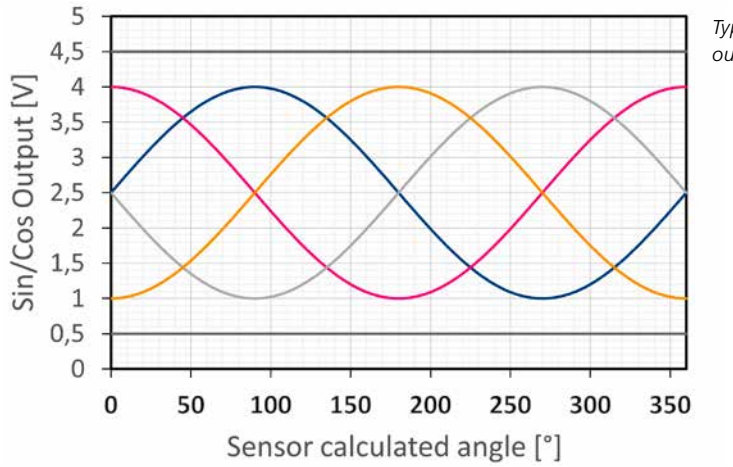
ELECTRICAL CHARACTERISTICS

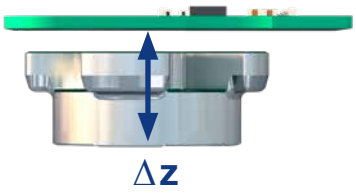
ANALOG OUTPUT SIGNALS

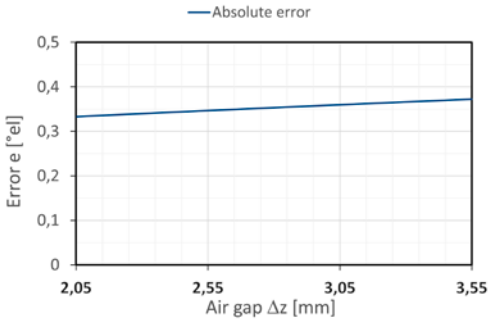


Typical analog sine and cosine differential output signals over one electrical period.

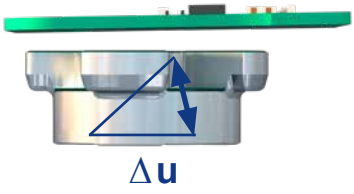
TYPICAL ELECTRICAL ANGLE ERROR OVER MECHANICAL MISALIGNMENT

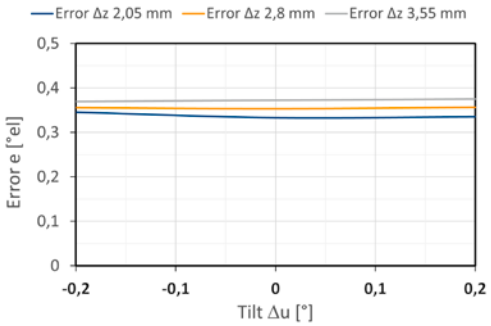
ERROR OVER AIR GAP



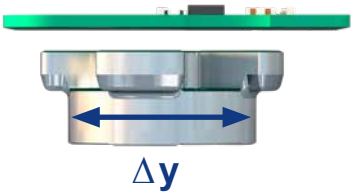


ERROR OVER AIR GAP AND TILT

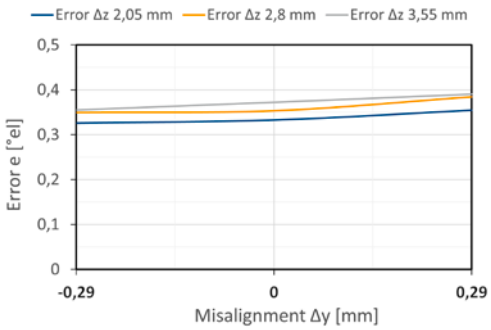




ERROR OVER AIR GAP AND PLANAR MISALIGNMENT



For Δx misaligment the error is the same



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