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EBV Elektronik

Microtec Nord 2017

Bewegungs- und Positionssensierung in Roboter-Applikationen

07.09.2017

Agenda

- EBV Elektronik GmbH & Co.KG im Überblick
- Einsatzfelder von Bewegungs- und Positionssensierung
- Grundlagen
- Technologische Herausforderungen
- Innovationen
- Faktoren für die Auswahl des geeigneten Encoders

EBV Elektronik im Überblick

EBV Elektronik

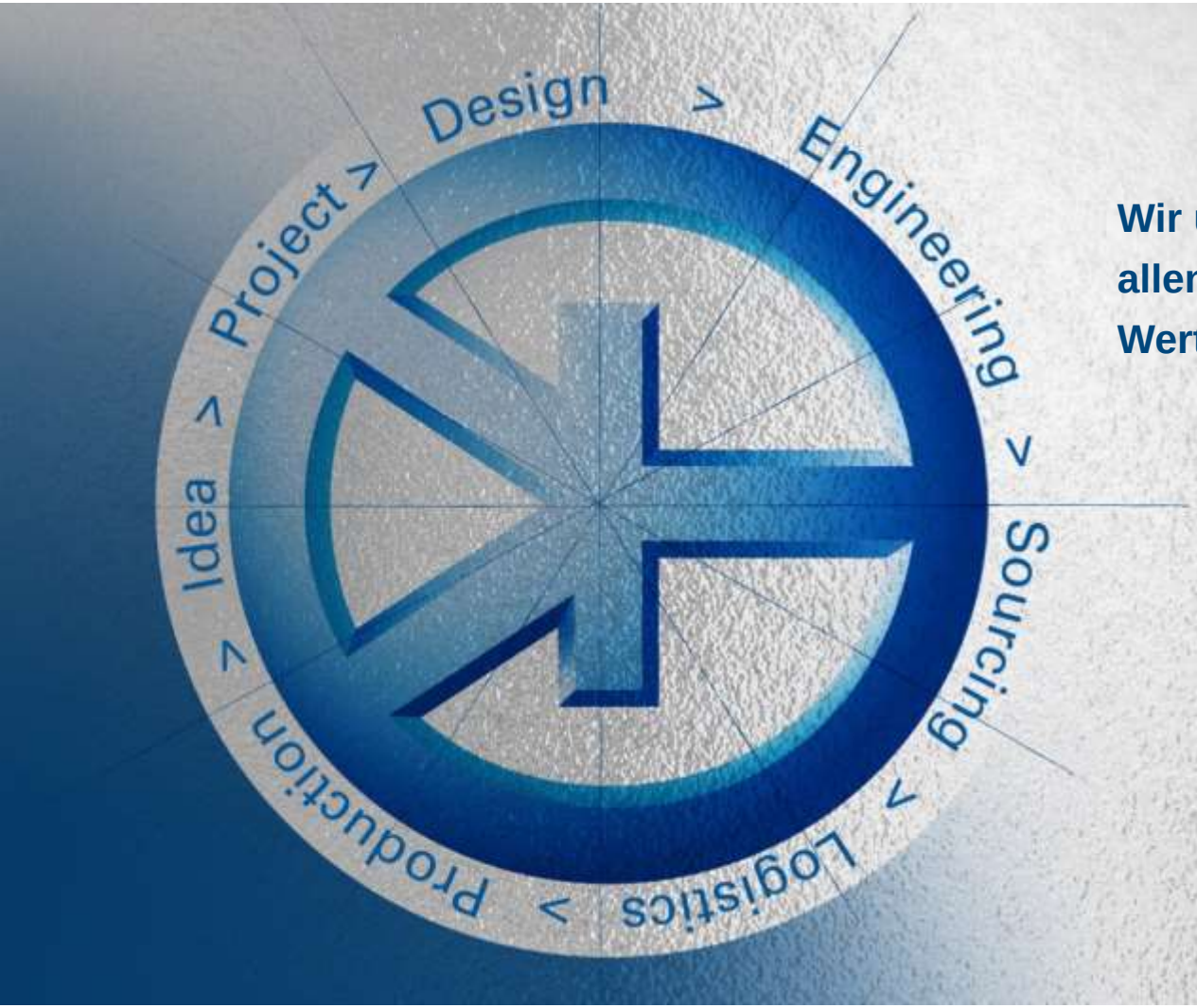
Europäische Zentrale in Poing bei München

EBV Elektronik wurde 1969 gegründet und ist einer der führenden Spezialisten in der europäischen Halbleiter-Distribution. Der Erfolg von EBV basiert auf der grundlegenden Firmenphilosophie, die auch heute noch gilt:

Optimale Prozesse, Flexibilität und Zuverlässigkeit

– mit dem Ziel der höchsten Kundenzufriedenheit.

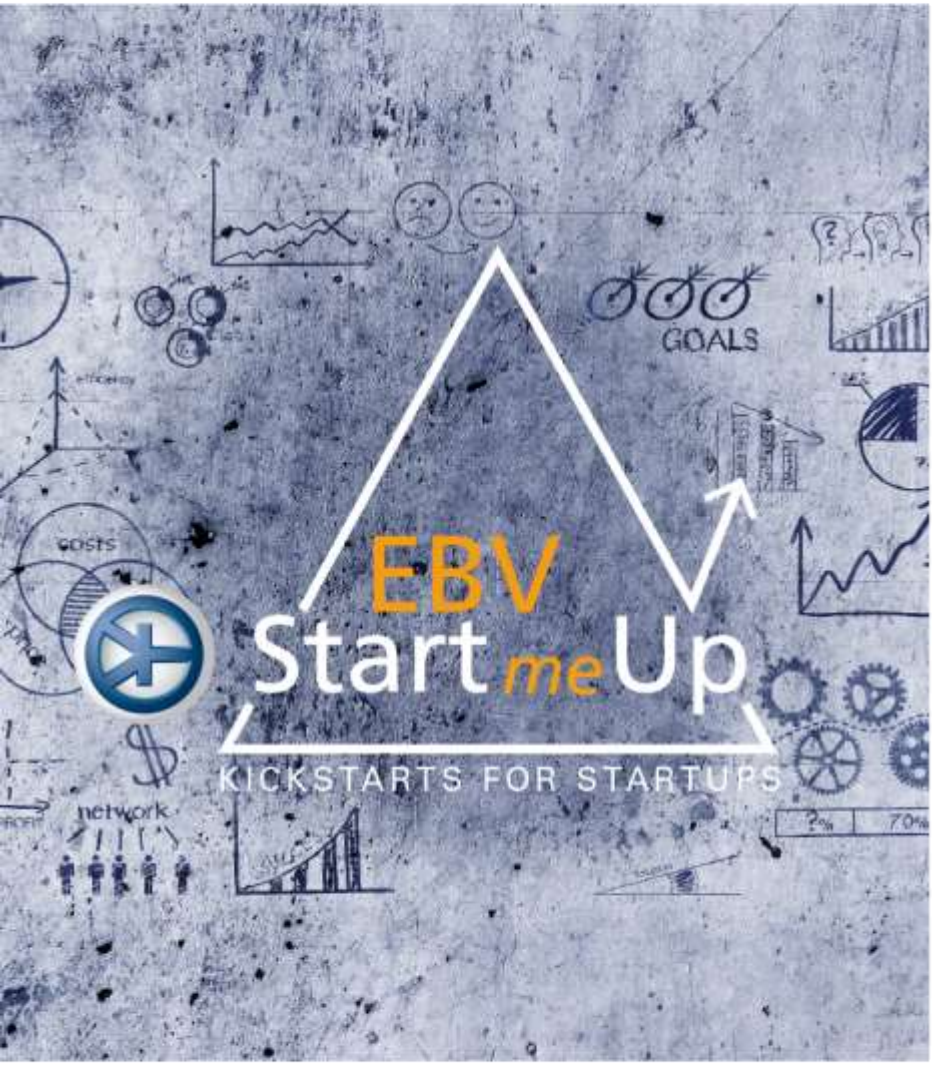
Die EBV Full-Solution-Philosophie



Wir unterstützen unsere Kunden in allen Bereichen ihrer Wertschöpfungskette:

Angefangen von umfassender Anwendungsberatung und Design-Know-how über Value-Added-Services bis hin zu kompletten Logistiklösungen.

EBV Start me Up



- Entwicklung
- Design
- Beschaffung
- Logistiklösungen
- Produktion / Wertschöpfende Services
- Marketing und Community Relations

EBV Start me Up

Kickstarts for Start-ups
and Electronic Newcomers

EBV Franchise Partner

Mensch-Elektronik-Maschine @ EBV

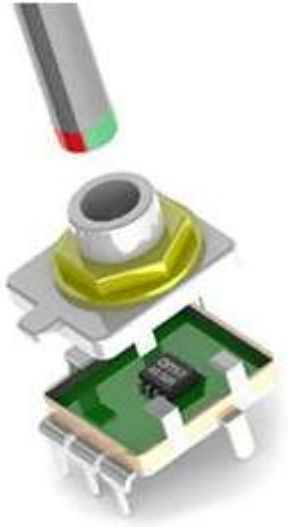
- Sensorik:
  Sprachsteuerung MEMS Microphone
  Gestensteuerung ToF, CMOS Kamera
- Prozessoren für Gateway und HMI Applikationen
- Funklösungen: NFC, ZigBee, BT, WLAN, 6LowPan, Thread, TranfserJet, GSM Module
- Netzwerk Infrastruktur: Ethernet Phys und Switches, BroadRReach, Fiber
- Security Lösungen: Authentizität, Integrität, Vertraulichkeit
- Safety Lösungen: Ansätze für unterschiedliche SIL Level.

TechTrends in Weimar am 28.09.2017

- Und natürlich Sensorik für die Bewegungs- und Positionssensierung

Einsatzfelder von Bewegungs- und Positionssensierung

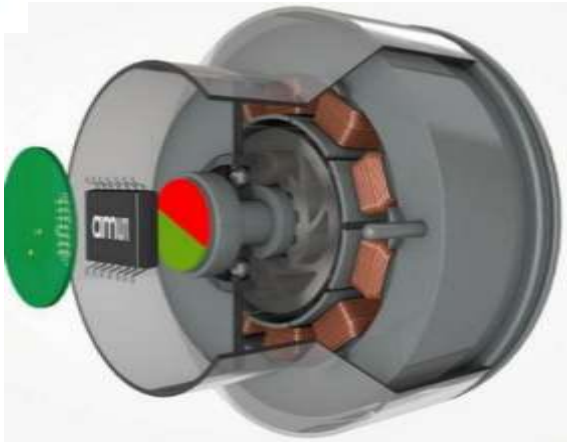
Einsatzfelder von Bewegungs- und Positionssensierung



Automotive

Industrial / Consumer

Robotics



BLDC Motor

Einsatzfelder von Bewegungs- und Positionssensierung

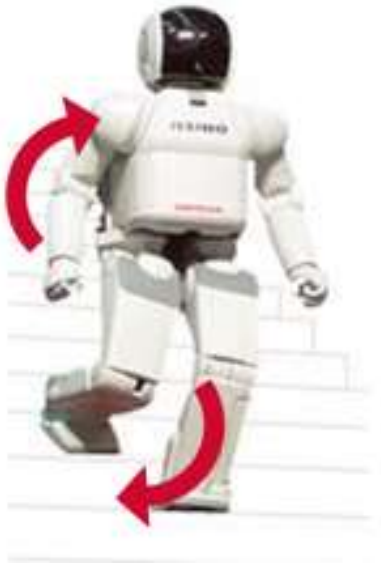
Einsatzfelder von Bewegungs- und Positionssensierung

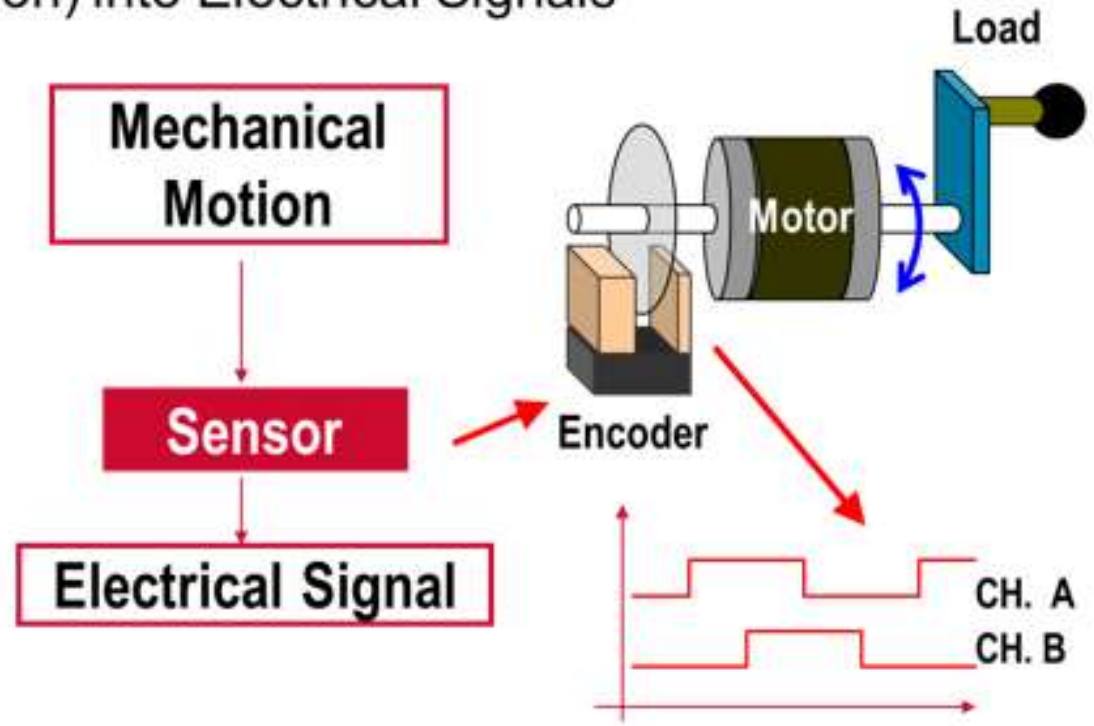
Potentiometer replacement

Grundlagen

Encoder Definition

- An Electro-Mechanical device that translates mechanical motion (such as position change, speed and direction) into Electrical Signals





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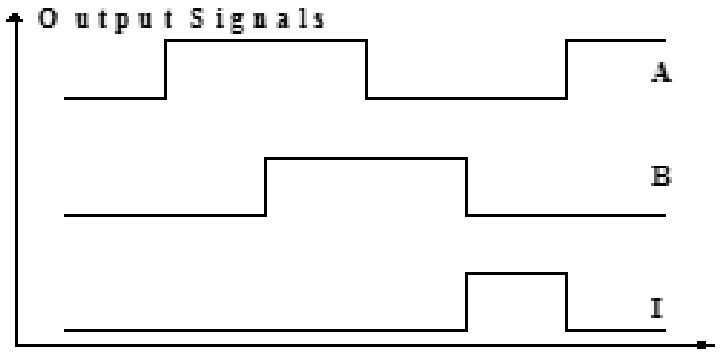
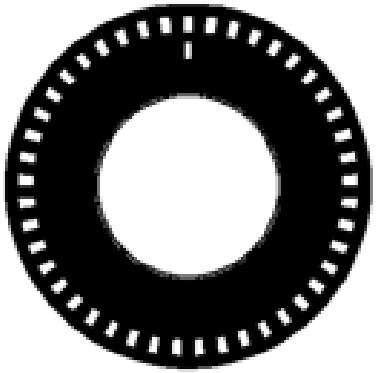
Incremental Encoders

Relative position feedback devices

- The feedback signal is always referenced to a start or home position
- Each mechanical position is not uniquely defined
- Current position sensed is only incremental from the last position
- At power up, the position of an incremental encoder is not known

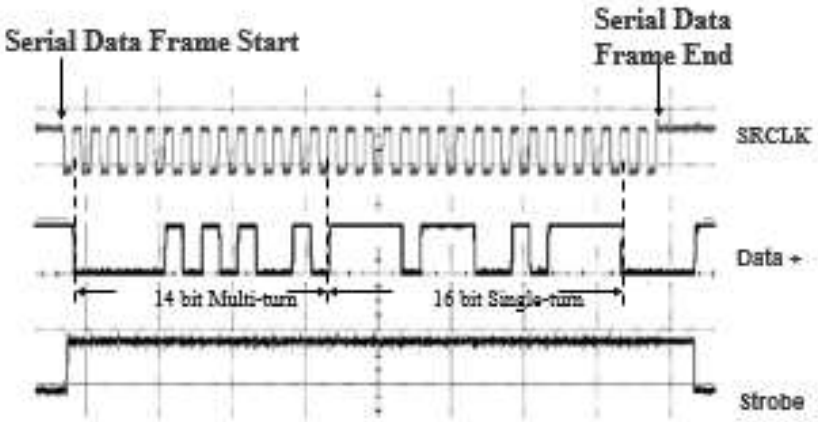


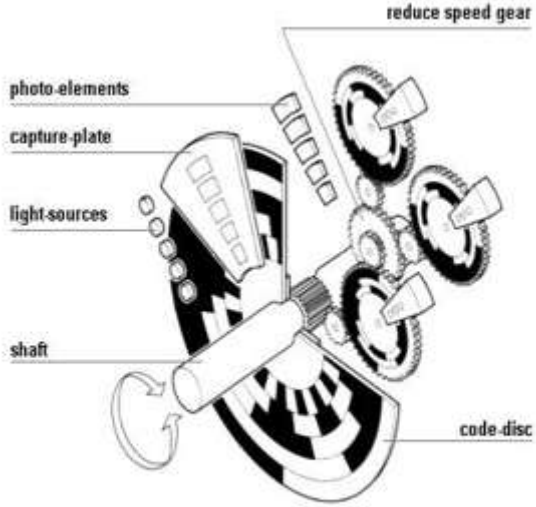


Absolute Encoders

Generates a unique code for each position

- Able to provide positional information instantly upon power up
- No code wheel movement before providing movement feedback
- Single-turn resolution in bits over 360°
- Multi-turn resolution in bits over number of revolutions





Multi-turn Encoder

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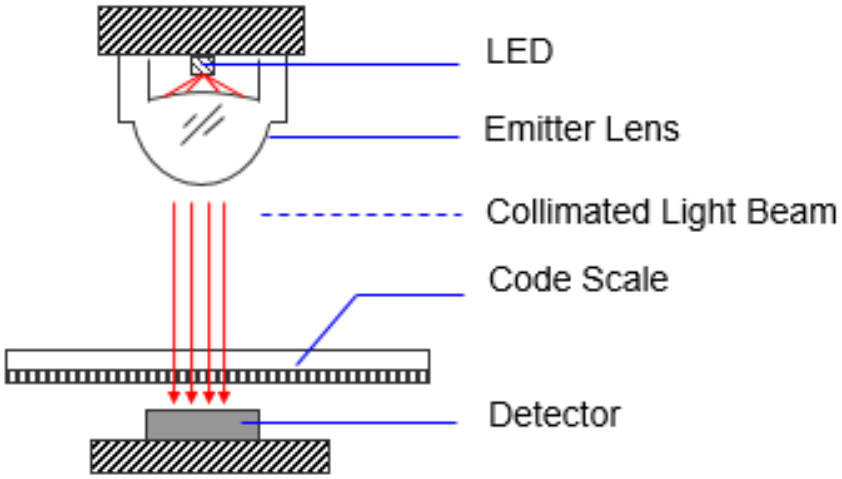
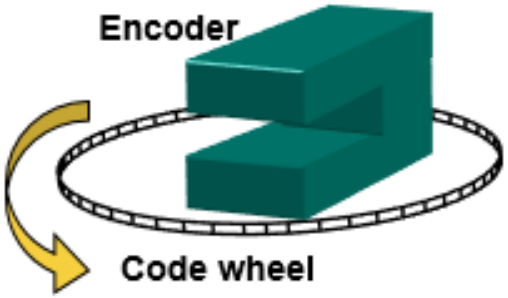
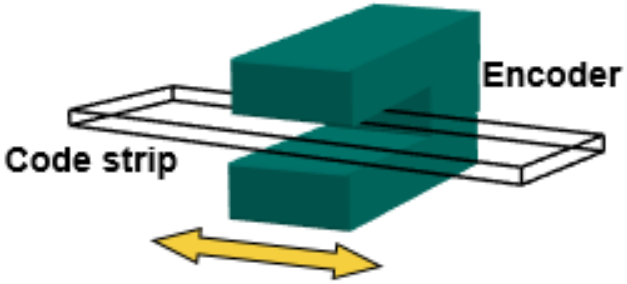
Optical Transmissive Encoder







Key Features:

- **High resolution**
- **Ease of installation**

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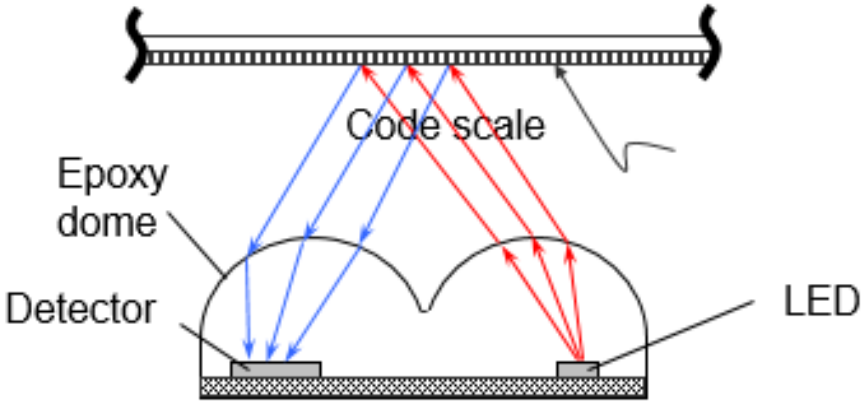
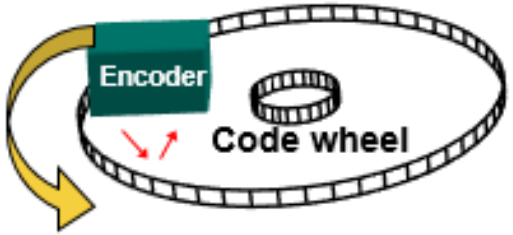
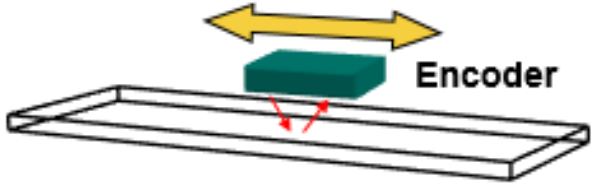
Optical Reflective Encoder







Code strip

Key Features:

- **Compact size**
- **Surface mount package**

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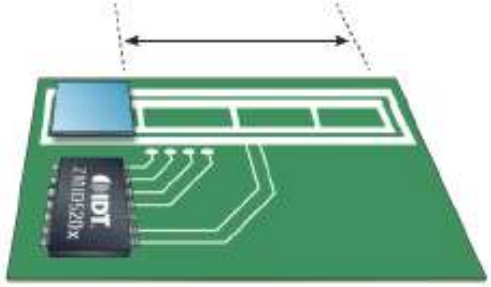
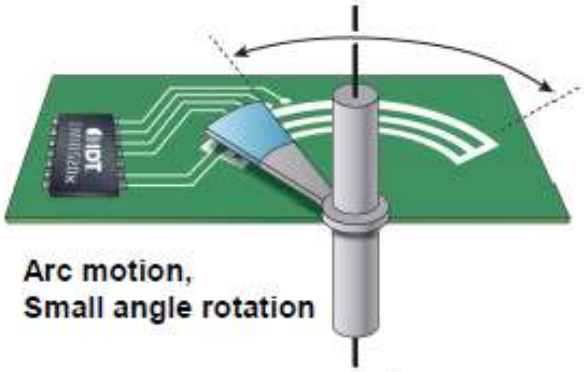
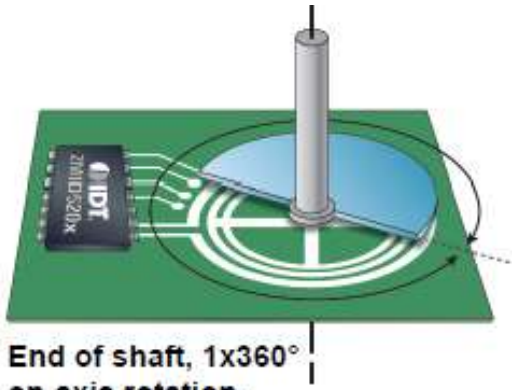
On Axis and Off Axis Sensing



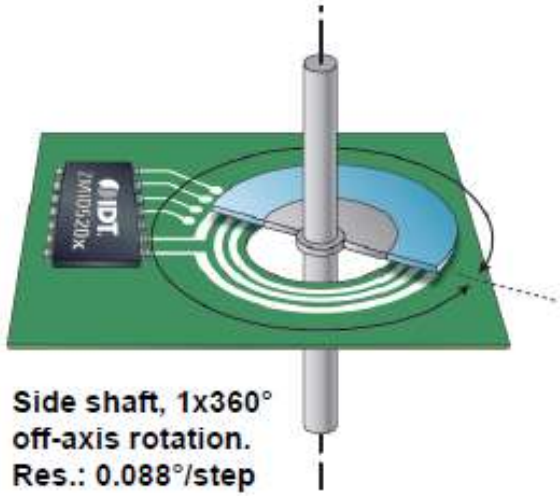
Linear motion



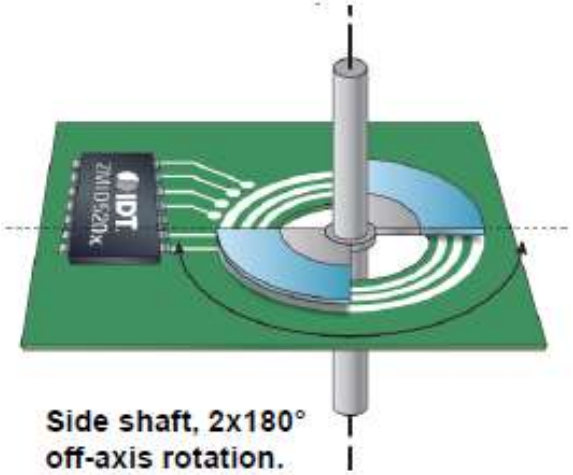
Arc motion,
Small angle rotation



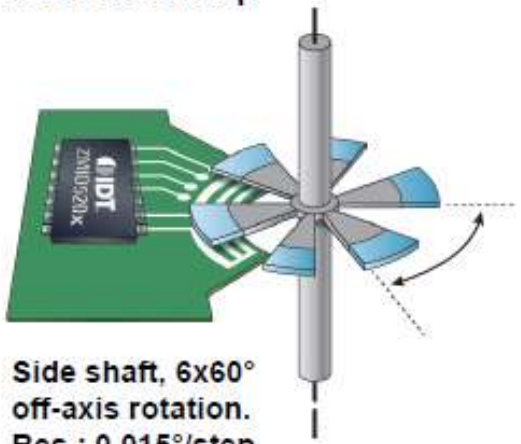
End of shaft, 1x360°
on-axis rotation.
Res.: 0.088°/step



Side shaft, 1x360°
off-axis rotation.
Res.: 0.088°/step



Side shaft, 2x180°
off-axis rotation.
Res.: 0.044°/step



Side shaft, 6x60°
off-axis rotation.
Res.: 0.015°/step
arc coil shape for limited space

Technologische Herausforderungen

Technologische Herausforderungen

- Multiturn Information bei Stromausfall
- Streufeldeinflüsse bei magnetischen Encodern
- Korrektur von Laufzeitverzögerungen
- Redundanz für sicherheitskritische Anwendungen
  (hier nicht weiter betrachtet)

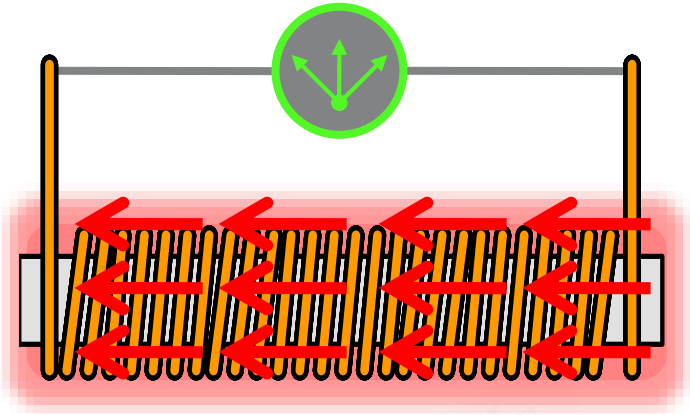
Wiegand Wire Technologie bei Multiturn Encodern

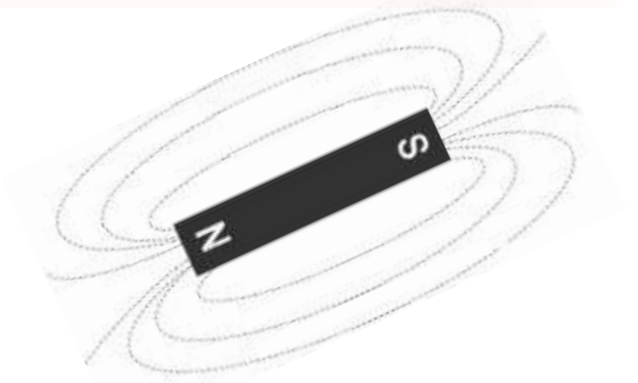
Wiegand wire is a ferromagnetic alloy made from cobalt, iron and vanadium, it is named after its discoverer John R. Wiegand.

The wire is manufactured by a series of twisting and untwisting operations, to cold-work the outside shell of the wire while retaining a soft core within the wire. Then the wire is aged. This process results in a much larger magnetic coercivity at the outside shell than the inner core and causes a magnetic hysteresis loop.

The Wiegand effect is the rapid switching of the magnetization polarity of both outer shell and inner core of the wire when an external magnet is brought near to it.

Energy from Wiegand switching effect can be harvested by using a solenoid coil over the Wiegand Wire. This makes the solution useful for position sensors.





Wire Charging

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AS38-H39E Encoder

Key Features:

- 39-bits resolution: 16-bits Multi-turn & 23-bits Single-turn
- With CRC and Alarm Status bits
- Optical, multi-turn absolute encoder with Ø38 mm,

and max height 40 mm

- 8 mm blind hollow shaft diameter
- Revolution Counter with energy harvesting technology

- Energy Harvesting Multi-Turn, do not need power supply for Multi-Turn Counter
- Outer Diameter of 38mm to fit 40mm and above motor
- Built-in Biss-C or SSI communication Protocol
- Plug and Play, Hassle Free Installation
- High Temperature Range -20 to 105 °C
- Cost Effective Solution

Application

Automatic Handlers; Robot and Robotic Engineering
Wind Turbine; Positioning Tables
Factory Automation Medical & Lab Equipment
Stepper / Servo motor

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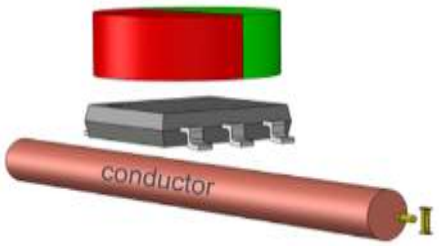
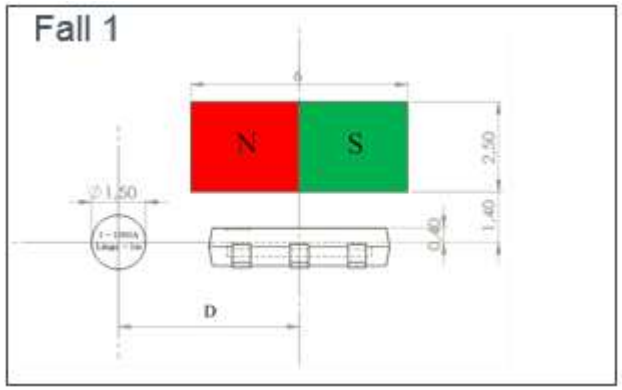
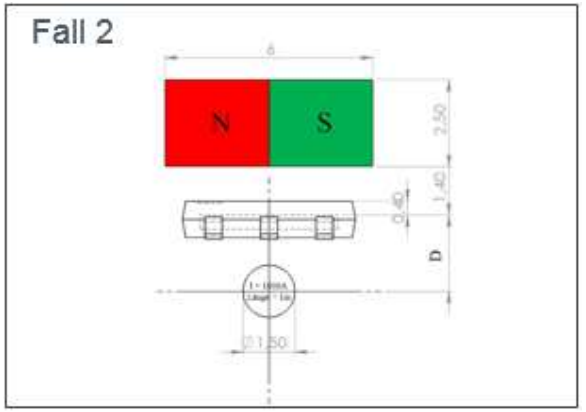
Streufeldprobleme bei magnetischen Encodern

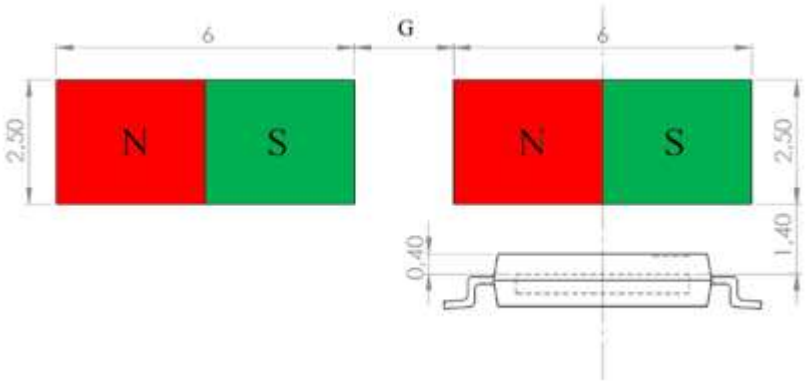






Streufelder durch:

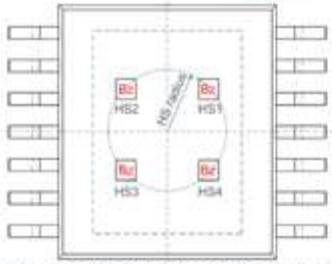
- Stromdurchflossene Leiter
- Magnetische Einflüsse



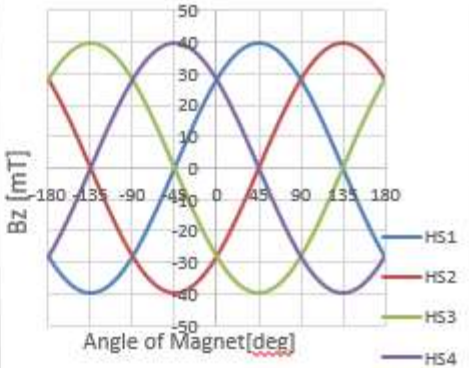
Messverfahren magnetischer Encoder

Gradient -Technology

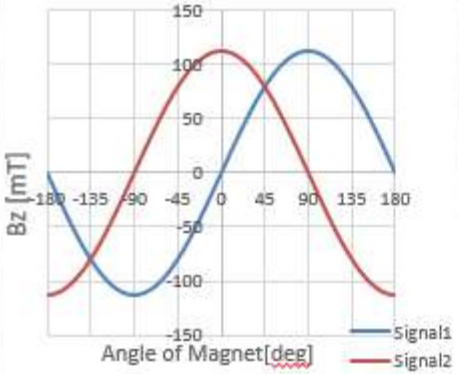
Measurement **Bz**

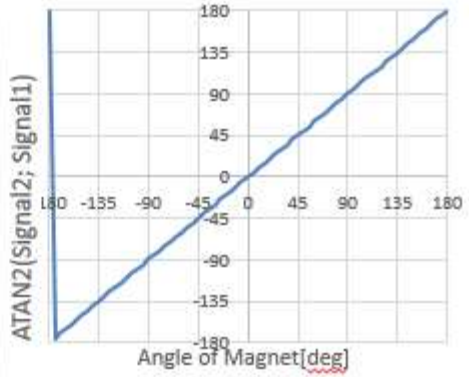


Bx and By stray fields is not measured.



$$Signal\,2 = +HS1 - HS2 - HS3 + HS4$$
$$Signal\,1 = +HS1 + HS2 - HS3 - HS4$$

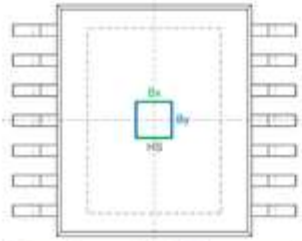




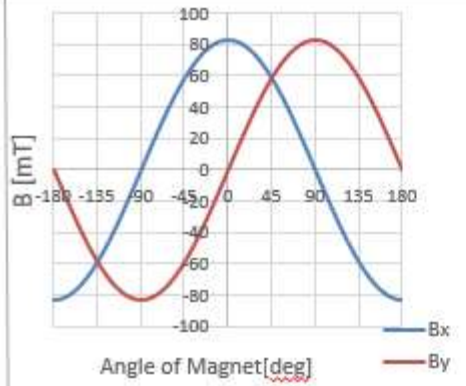
$$Calculated\ Angle = ATAN2(Signal\,2; Signal\,1)$$

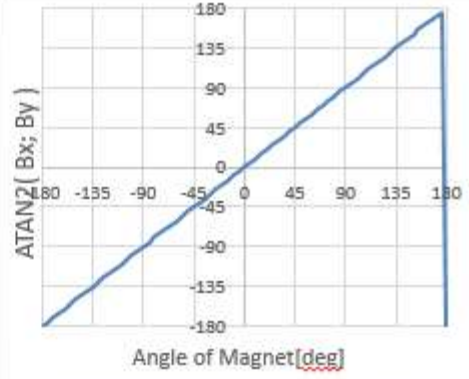
Absolut-Technology

Measurement **Bx** and **By**



Bz stray field cannot influence the sensor.



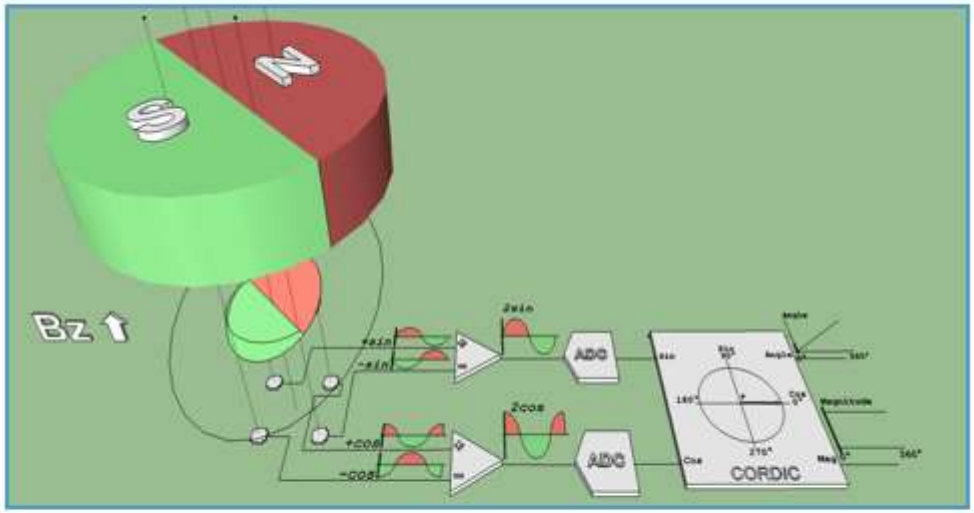


$$Calculated\ Angle = ATAN2(BX; BY)$$

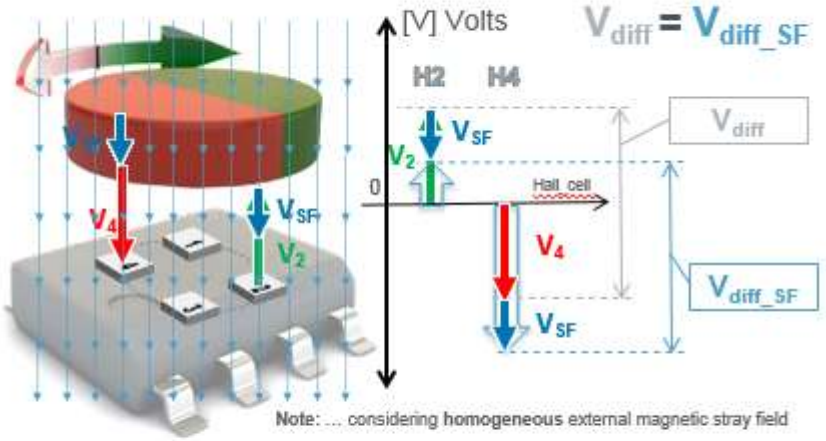
ams Sensing is life.

Kompensationsverfahren gegen Streufeldeinflüsse

Gradient -Technology

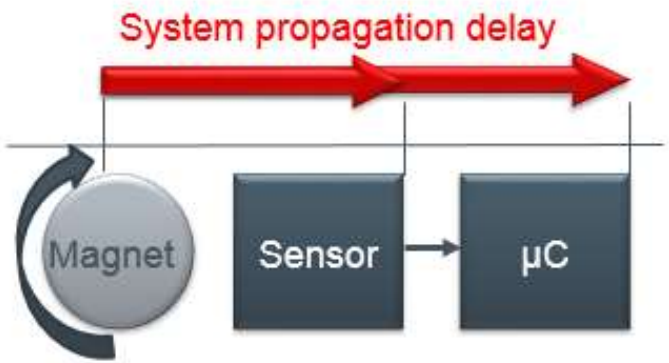


Stray Field Immunity Principle



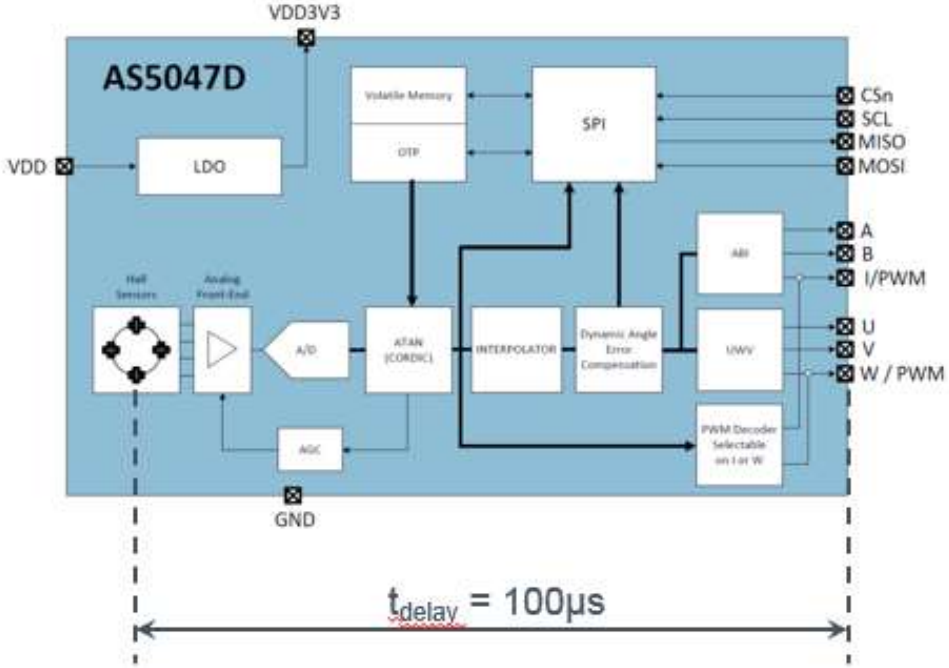
- Differential signal principle is based on a simple mathematical operation
- Most effective way to canceling external magnetic stray field

Warum Laufzeitverzögerungen ?

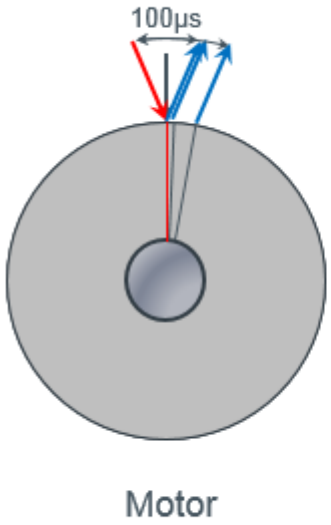


Propagation delay ≈ Angle Error

Angle Error increases at higher speed



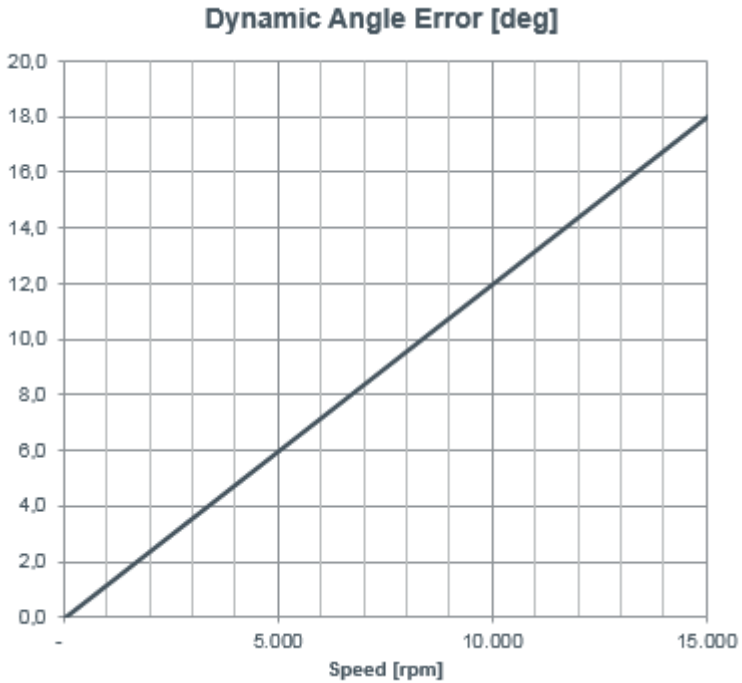
Einfluss von Laufzeitverzögerungen



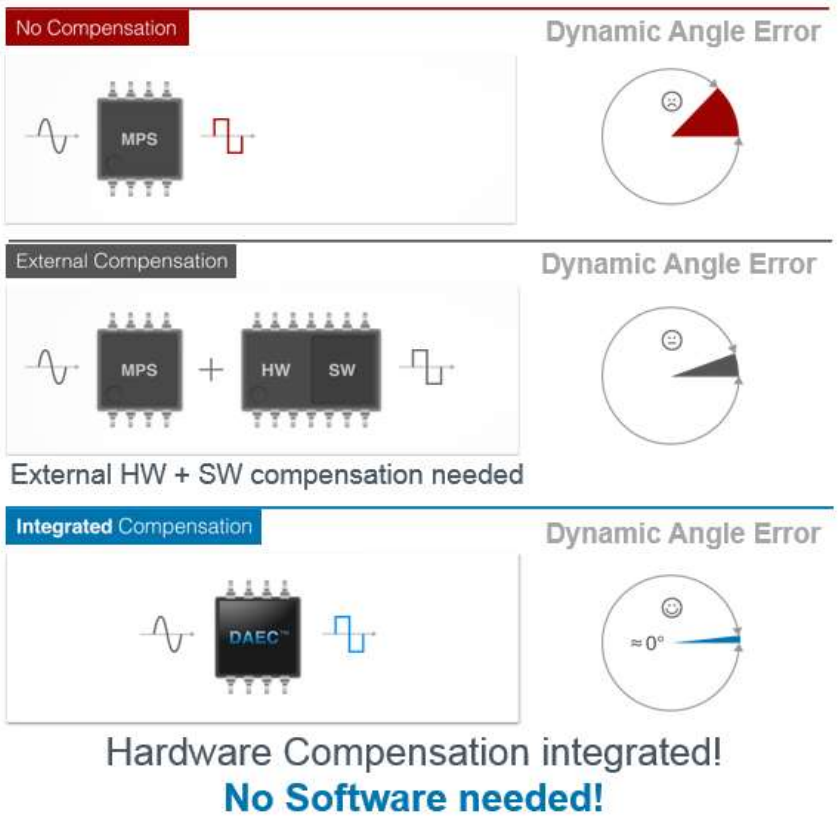
@ speed of 10 rpm ► DAE = 0.012°

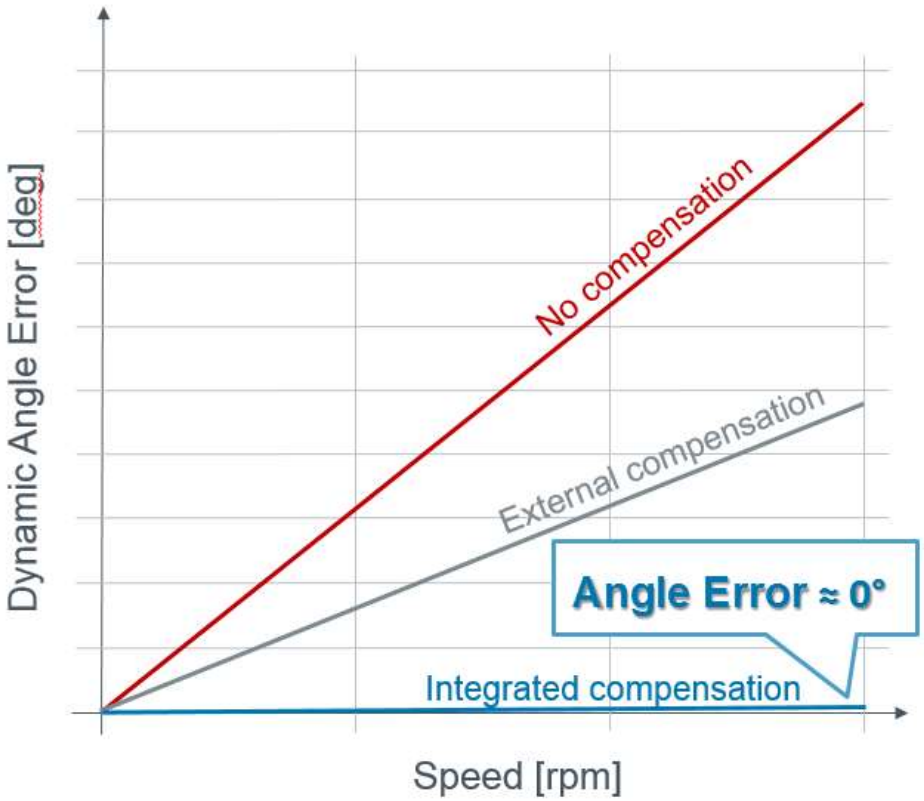
@ speed of 1000 rpm ► DAE = 1.20°

@ speed of 10000 rpm ► DAE = 12.0°



Kompensation von Laufzeitverzögerungen





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Innovationen

Induktives Verfahren

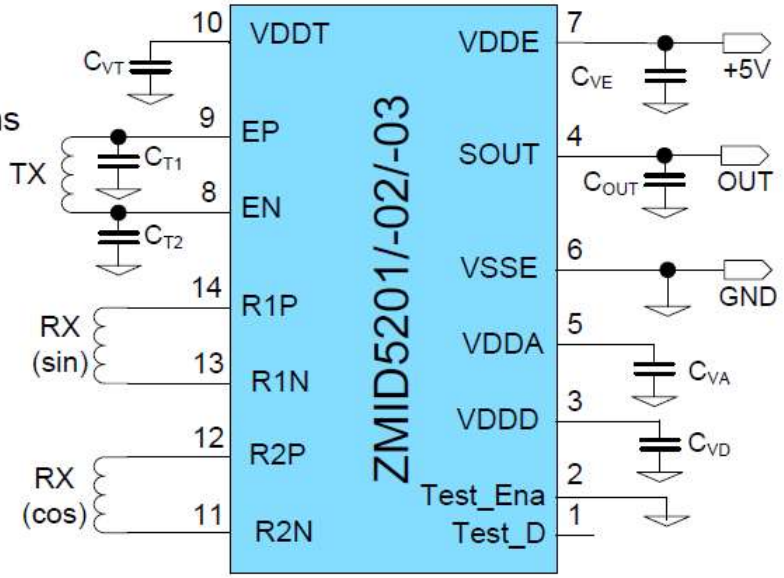
IDT

Features

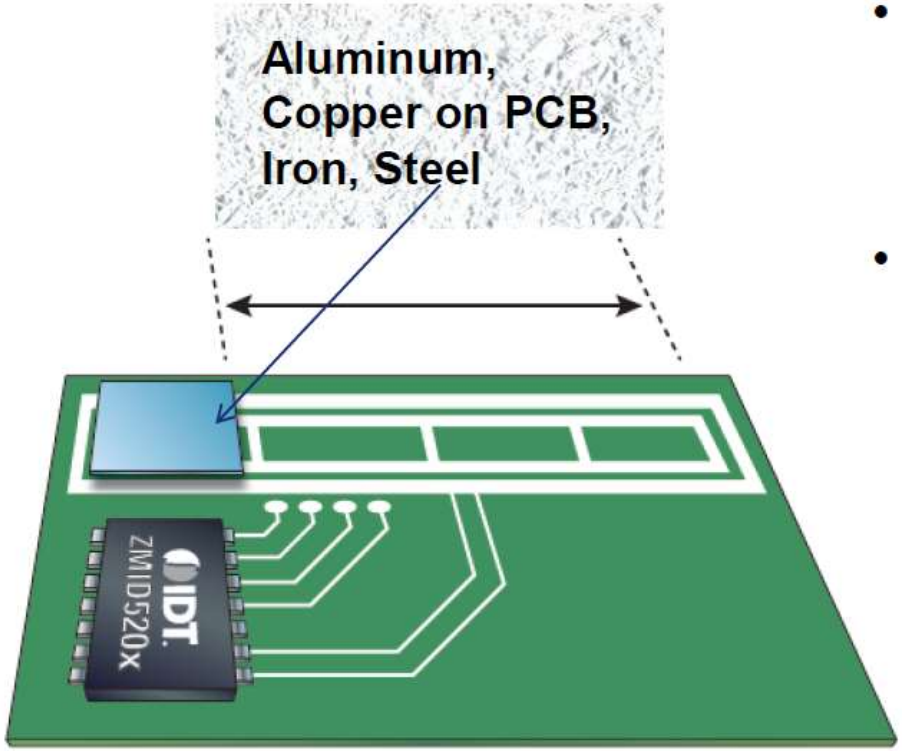
- Fully automotive qualified to AECQ-100
- 5V supply
- Overvoltage, reverse polarity, short-circuit protected
- Analog output, 1024 steps: ZMID5201
- PWM output, 1024 steps: ZMID5202
- SENT output, 4096 steps: ZMID5203
- High precision: ± 0.2% accuracy
- Suitable to be implemented in safety related systems compliant to ISO26262 up to ASIL-B

Benefits

- Ultra thin
  - Small form factor
- No magnet needed, Low BOM
  - Moving target = copper or aluminum foil
- Ratiometric measurement
  - Tolerant against misalignment of target



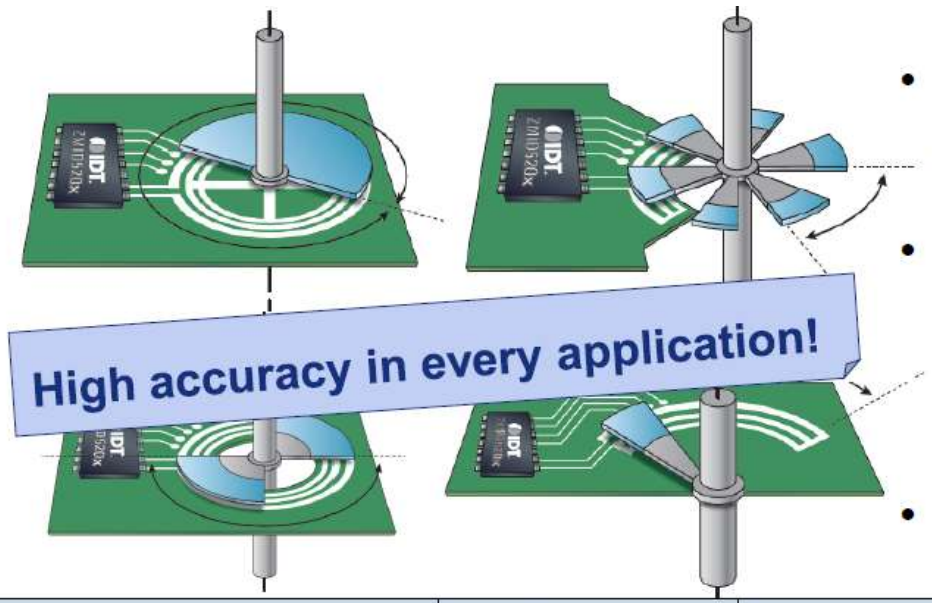
Induktives Verfahren



- Sensing target is a simple piece of copper, aluminum or other metallic material. Very low cost and low sensor height
- Competition: Hall, AMR: Low quality magnets result in low quality measurement; Non-perfect magnets lead to large errors

No magnet required!

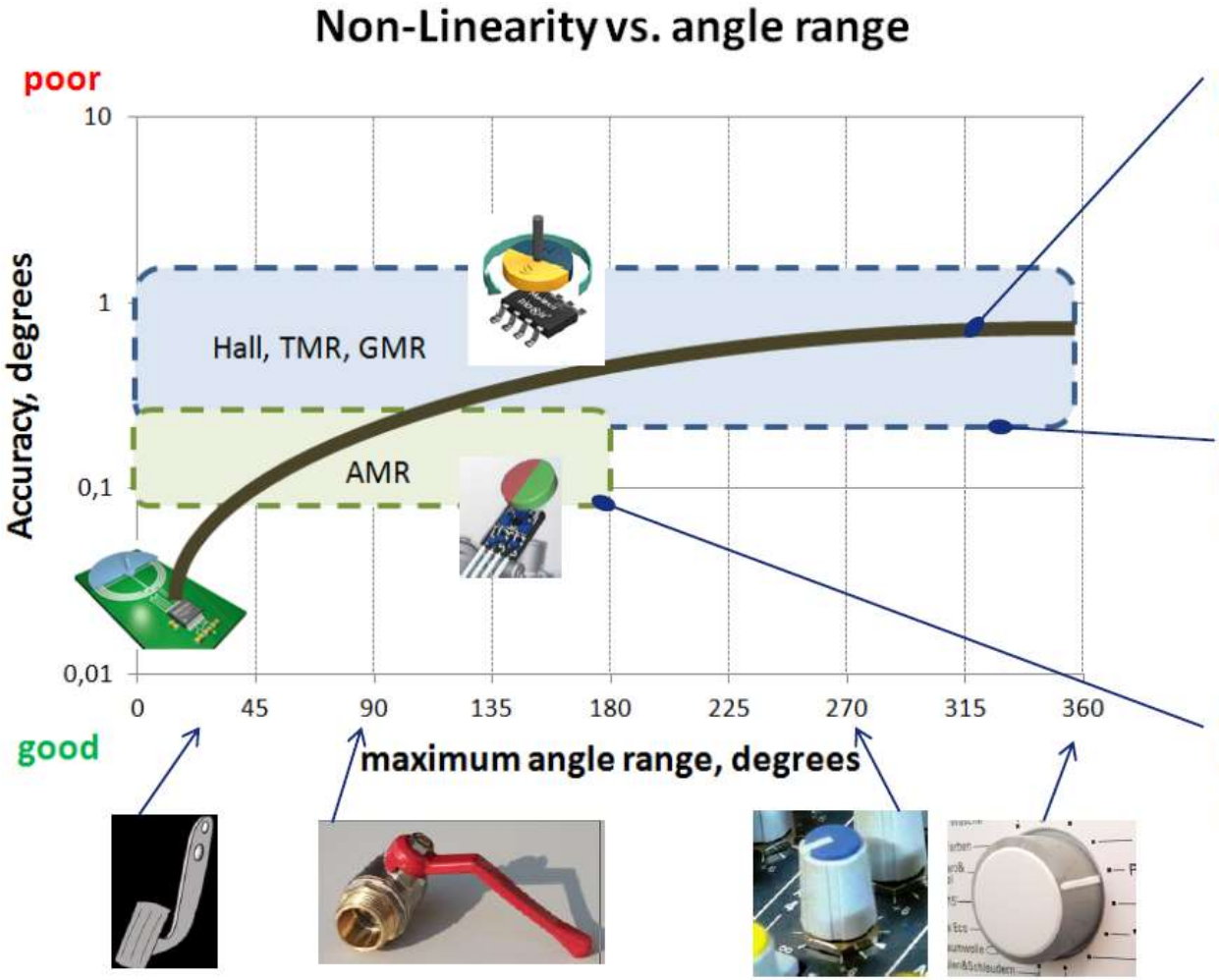
Induktives Verfahren



- Accuracy = Actual position vs. measured position: down to 0.2% full scale (FS)
- Imperfections on coil design (e.g. offsets, non-linearities) can be corrected on-chip by offset-correction and 9-point linearization in a non-volatile memory
- Resolution = number or size of steps within the angle range

Angle Range	Resolution ZMID5201, -5202 (AngleRange/1024)	Resolution ZMID5203 (AngleRange/4096)	Accuracy @ 0.2% Full Scale (AngleRange x 0.002%)
20° (e.g. Pedal)	0,02°	0,005°	0,04 °
90° (e.g.Throttle)	0,09°	0,022°	0,18 °
180° (e.g. Robot)	0,18°	0,044°	0,36 °
270° (e.g. Potentiometer)	0,26°	0,066°	0,54 °
360° (e.g. rotary knob)	0,35°	0,088°	0,72 °

Induktives Verfahren



IDT Inductive Sensors:
Variable accuracy , depends on maximum angle range
- ~0.2% Full-scale INL (calibrated)

Hall, TMR, GMR:
Fixed accuracy ≤360° angle range
- ~0,5..2.0° INL (calibrated)

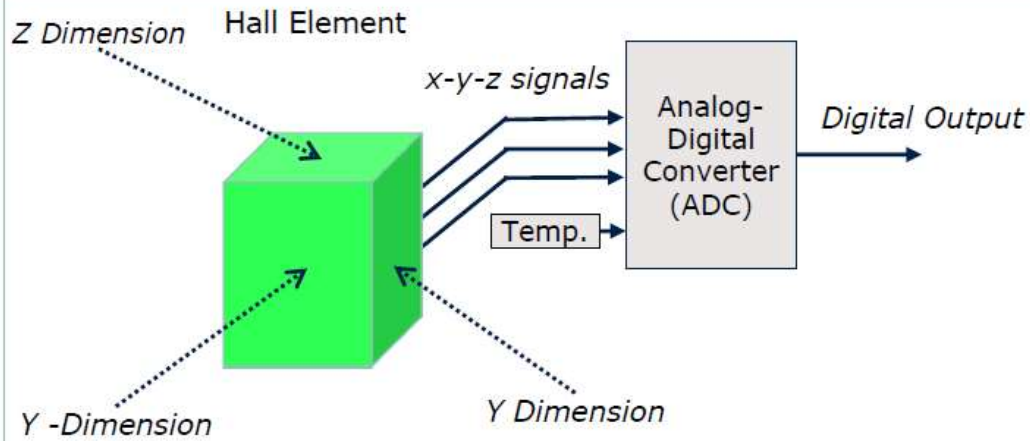
AMR:
Fixed accuracy ≤ 180° angle range
- ~0.1..0.5° INL (calibrated)

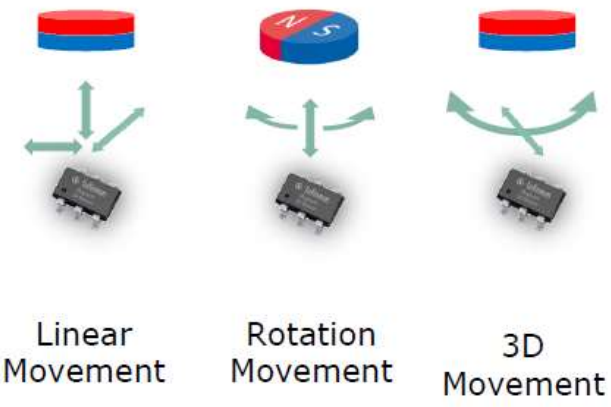
Induktives Verfahren

- **ZMID5201, ZMID5202, ZMID5203**
  - Inductive principle
  - Immune to magnetic stray fields
  - Suitable for harsh environments (dust, humidity, temperature,..)
  - Only three wires: Ground, 5V-Supply, Output
  - Three versions: Analog, PWM, SENT output
  - Scalable resolution and accuracy
  - Suitable for linear, rotational and arc motion
  - On-axis and Off-axis rotation up to 360° angle (full turn)
  - Overvoltage and reverse polarity protected
  - Automotive qualified
  - Suitable to be implemented in safety related systems compliant to ISO26262 up to ASIL-B”

3D Hall Sensor

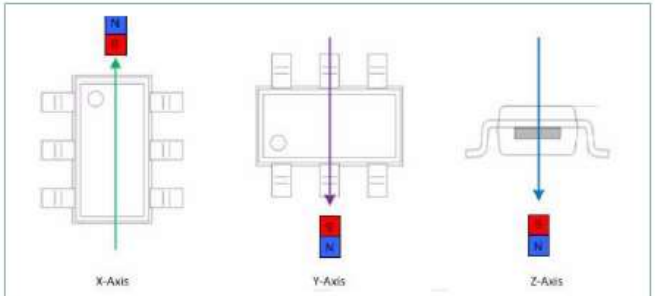
Enables for very cost efficient system designs by component reduction





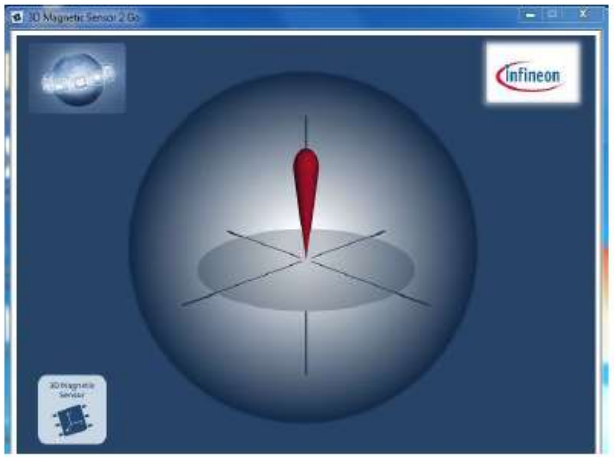
Benefit by Means of 3 Dimensions

- High Magnetic Accuracy
- Low Offset
- Low X/Y Mismatch
- High Linear Measurement Range



Best in Class - Tiny Little 3D sensor package (TSOP-6)

3D Hall Sensor



Rotation movement

3D movement

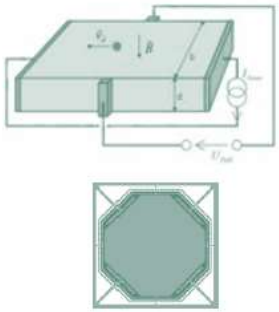
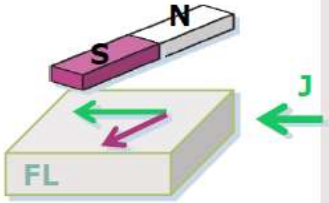
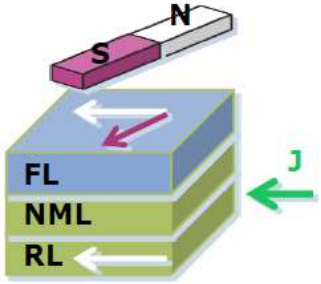
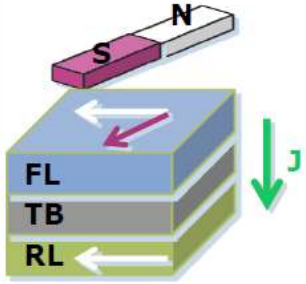
Linear movement

Faktoren für die Auswahl des geeigneten Encoders

- Einbauraum und Einbausituation
- Zu erwartende Störgrößen: Streufelder, Schmutz etc
- Auflösung, Genauigkeit, Geschwindigkeit
- Temperatur
- Interface zum Controller
- Verhalten bei Stromausfall / Backup Szenarien
- Anforderungen an funktionale Sicherheit


EBV Elektronik
Distribution is today.
Tomorrow is EBV!

Vergleich AMR, TMR, HALL

Hall	AMR	GMR	TMR
			
› Perpendicular to plane sensitivity › High field range › No magnetic hysteresis › Monolithically integrated in BiCMOS, BCD	› Inplane sensitivity › High sensitivity › High field range › Low Jitter › 180^0 angle range › Monolithically integrated in CMOS, BCD	› Inplane sensitivity › Very high sensitivity › For fields up to 90mT › Low Jitter › 360^0 angle range › Monolithically integrated in CMOS, BiCMOS, BCD	› Inplane sensitivity › Ultra high sensitivity › For fields up to 100mT › Low Jitter › 360^0 angle range › Low power