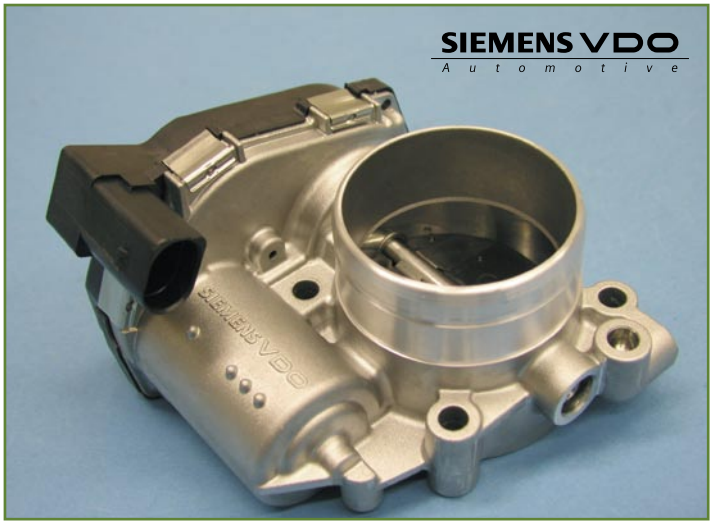
Magnetoresistive angle sensors

Covering all the angles in automotive systems

Philips Semiconductors magnetoresistive sensor technology is the superior choice for automotive measurement systems. Features such as lack of wear, long term stability and direct measurement combine to deliver highly accurate and robust sensors. With stand-alone sensors, companion signal conditioning ICs and complete single-package sensing solutions our range of cost-effective angle sensors covers all your application needs.

Semiconductors

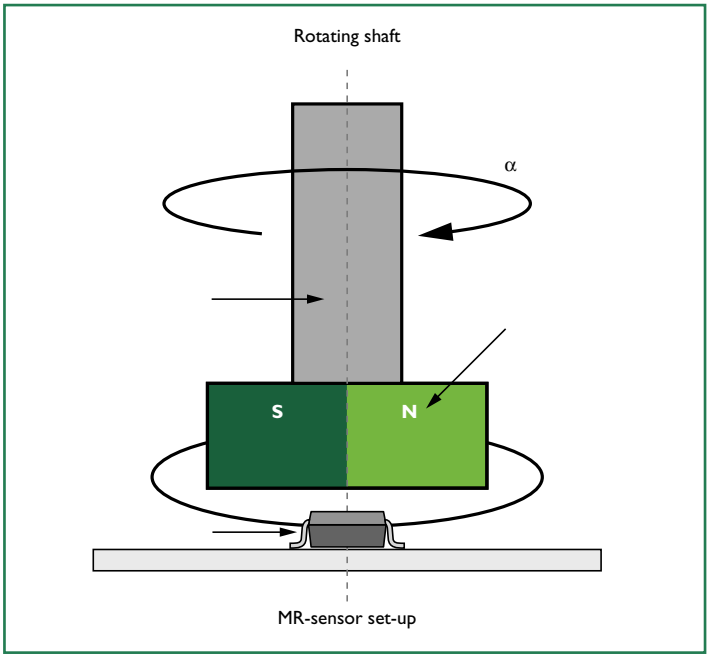


Offering many technical benefits over other technologies, Philips magnetoresistive angle sensors provide car manufacturers with a more reliable and accurate solution for automotive angle measurement – reducing the risk of mechanical breakdowns and improving overall vehicle safety. This is an increasingly important area within automotive electronics as the industry moves closer to incorporating advanced X-by-wire networks and control systems, such as FlexRay, that rely on accurate measurement data.

Magnetoresistive (MR) sensors by their nature are ideal for the severe environmental conditions presented by automotive systems. Based on the same, proven magnetoresistive technology used in automotive applications such as anti-lock braking systems, MR sensors provide direct angle measurement with long-term stability and wear-free operation.

Key benefits

- Contactless angle measurement up to 180°
- Measurement independent of magnetic drift caused by life time and temperature changes
- Operation independent of mechanical tolerances and shifts of the magnet caused by thermal stress
- High temperature range
- Automotive qualification
- Highly flexible solutions that measure any automotive angle effectively
- Fully stable operation over long life-cycle



Key applications

- Electronic throttle control (ETC)
- Variable valve control (VVC)
- Pedal and wiper positioning
- Active suspension
- Automatic headlight adjustment
- Electronic steering
- Seat positioning

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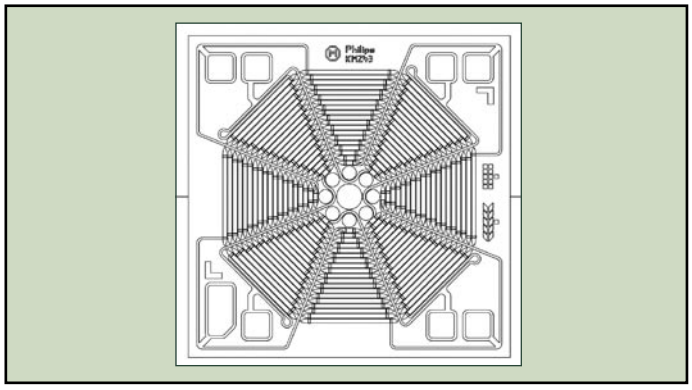
Magnetoresistive angle sensors

KMZ41 / 43 and UZZ900x

Standalone MR sensor bridges for angular measurement

Philips' KMZ41 and KMZ43 sensor bridges contain eight MR resistor networks etched into the same substrate, connected as two individual Wheatstone bridges aligned at 45°. Possessing different sensitivities, our KMZ41 and KMZ43 angle sensors are designed to work with the UZZ900x conditioning ICs. Ensuring maximum flexibility, Philips offers MR sensor bridges both as standalone devices in SO8 package and as bare die for space-critical solutions.



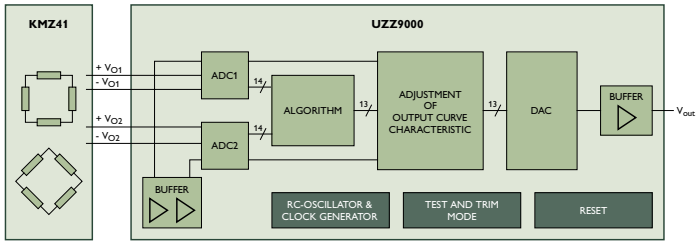
KMZ43T chip layout, showing the two separate bridges

KMZ41, KMZ43T and X3T-KMZ043 (bare die) key specifications

	KMZ41	KMZ43T X3T-KMZ043
Operating voltage	max. 9 V	max. 9 V
Angle range	180 degree	180 degree
Output signal	sin/cos	sin/cos
Sensitivity	typ. 2.8 mV/V	typ. 2.35 mV/V
Saturation field strength	100 kA/m	25 kA/m
Operating temperature range	-40 ....+150 °C	-40 ....+150 °C

Companion signal conditioning ICs for sensor bridges

Designed and developed specifically to complement Philips' KMZ family of angle sensors, the UZZ9000 series provides optimized single-chip signal conditioning solutions with either analog or 13-bit SPI interfacing. Incorporating all conditioning electronics they also offer an adjustable measurement range and zero point to maximize design flexibility.



Two Chip solution

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UZZ9000 / UZZ9001 key specifications

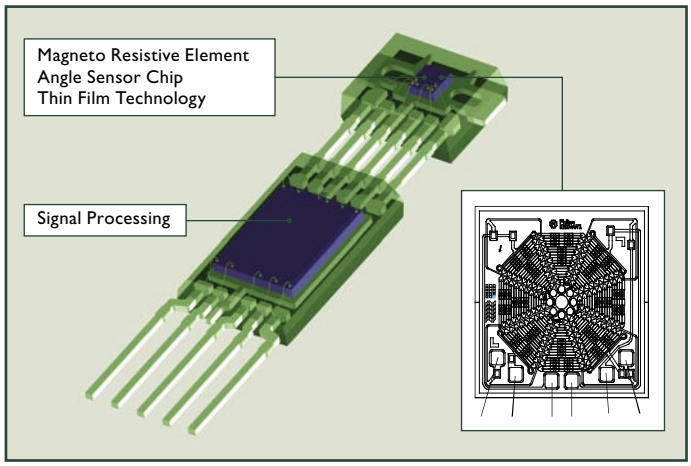
Item	UZZ9000	UZZ9001
Supply voltage	5 V +/- 10 %	5 V +/- 10 %
Maximum angle range	0° - 180°	0° - 180°
Angle range variation	0° - 30 °... 0° - 180° in steps of 10°	fixed to 0° - 180°
Zero point offset cancellation	+/- 5° in steps of 0.5°	fixed to 0.0°
Output type	ratiometric analog voltage	digital (SPI) with 13-Bit
Resolution of measurements	< 0.1°	< 0.05°
Accuracy (ideal intput signals)	< +/- 0.4°	< +/- 0.30°
Package	SO24 (SOT137-1)	SO24 (SOT137-1)
Temperature range	-40°C to +150°C	-40°C to +150°C

Magnetoresistive angle sensors

KMA200

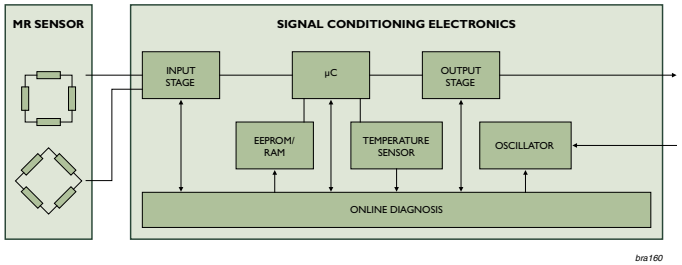
Single package angle sensor system with on-chip diagnostics

The KMA200 is a pre-aligned, ready-to-use sensor system. It consists of a magnetoresistive element containing two independent MR sensor bridges and a signal conditioning IC in a special multi-chip package. Over voltage and reversed polarity protection are both incorporated into the device, as is temperature supervision.



The KMA200 sensor system

A self-monitoring function supervises the blocks of the sensor system during normal operation, automatically detecting failures in any part of the sensor system and quickly indicats such a diagnosis error to the connected higher-level system. User programmability is achieved via an SPI with all data stored permanently in on-chip EEPROM, allowing specific adjustments of the angular range, zero point and clamping level to be set. Additionally, the device can be programmed to work either in analog or digital (SPI) output modes.



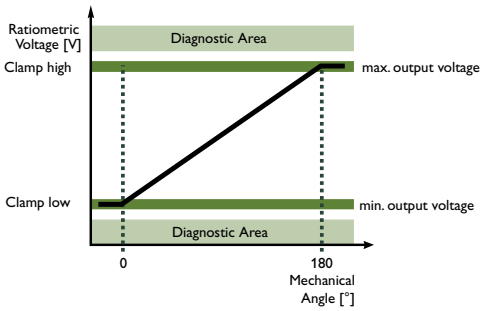
KMA200 single package solution

KMA200 key features

- Programmable angle range (max. 180°)
- 4 analog and 2 digital output modes selectable
- 5 V supply
- Ratiometric analog output
- Reverse supply voltage protection up to 16.5 V
- Over voltage protection up to 26.5 V
- Over voltage maximum 32 V (for 400 ms)
- EEPROM (user programmable)
- On-line diagnosis of all main functional blocks
- Ambient temperature range – 40 °C to + 160 °C

KMA200 key specifications

Max. deviation from ideal line	1.65 degree
at one point calibration	
Linearity error step of 1 degree	0.1 degree
Repeatability	0.1 degree
Resolution of analog output signal	0.04 degree
Temperature drift of analog output	0.64°max @ -25...+125°C
Measurement update rate	4 kHz



Analog output voltage with positive slope

The Magnetoresistive principle

MR sensors use magnetic fields to conduct measurement information between physical value and sensor. This contactless principle allows isolation of all rotating components, making the entire sensing system robust with respect to pollution and mechanical degradation. Another characteristic is that MR sensors evaluate the direction of the magnetic field and not the field strength: the field strength is not important as long as it is above a certain operational minimum.

As a result, MR-based systems using the KMZ41 or KMZ43T can tolerate variations in field strength caused by ageing, mechanical fluctuations or temperature sensitivity of the magnet.

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Portfolio overview

Type	Product	Package	Supply voltage (V)	Angle range	Output value	Output type	Operating temperatures °C
KMZ41	sensor	SO8	5.0 ... 9	180°	80 mV peak-peak	sine / cosine	-40 ... 150
KMZ43	sensor	SO8	5.0 ... 9	180°	68 mV peak-peak	sine / cosine	-40 ... 150
X3T-KMZ043	sensor	Die	5.0 ... 9	180°	68 mV peak-peak	sine / cosine	-40 ... 150
UZZ9000	signal conditioning unit	SO24	4.5 ... 5.5	180°	0.5 ... 4.5 V	analog linear	-40 ... 150
UZZ9001	signal conditioning unit	SO24	4.5 ... 5.5	180°	0.5 ... 4.5 V	digital	-40 ... 150
KMA200	sensor system	SOT637	4.5 ... 5.5	180°	0.5 ... 4.5 V	4 analog linear / 2 digital	-40 ... 160

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