

Technologies & Products Press Conference 2014

Superior TMR angle sensing for automotive systems

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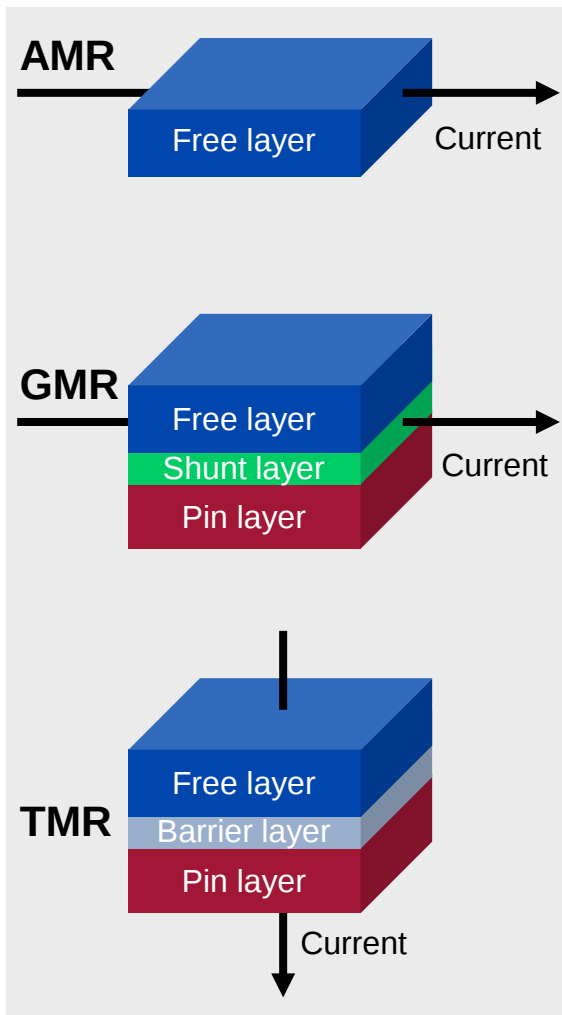
Rising requirements for automotive angle measurement



Applications	Accuracy of conventional products	Future requirements
Throttle valve	$\pm 2^\circ$ to $\pm 3^\circ$	$\pm 1^\circ$
Wipers	$\pm 1.2^\circ$ (20 to 130 mT)	$\pm 0.6^\circ$ (20 to 130 mT)
Steering (EPS motor)	$\pm 0.6^\circ$ (20 to 80 mT)	$\pm 0.3^\circ$ (20 to 80 mT) Redundancy ISO 26262

Needed: The accuracy of angle measurements in automotive applications must be doubled!

Evolution of magneto resistive sensor technologies

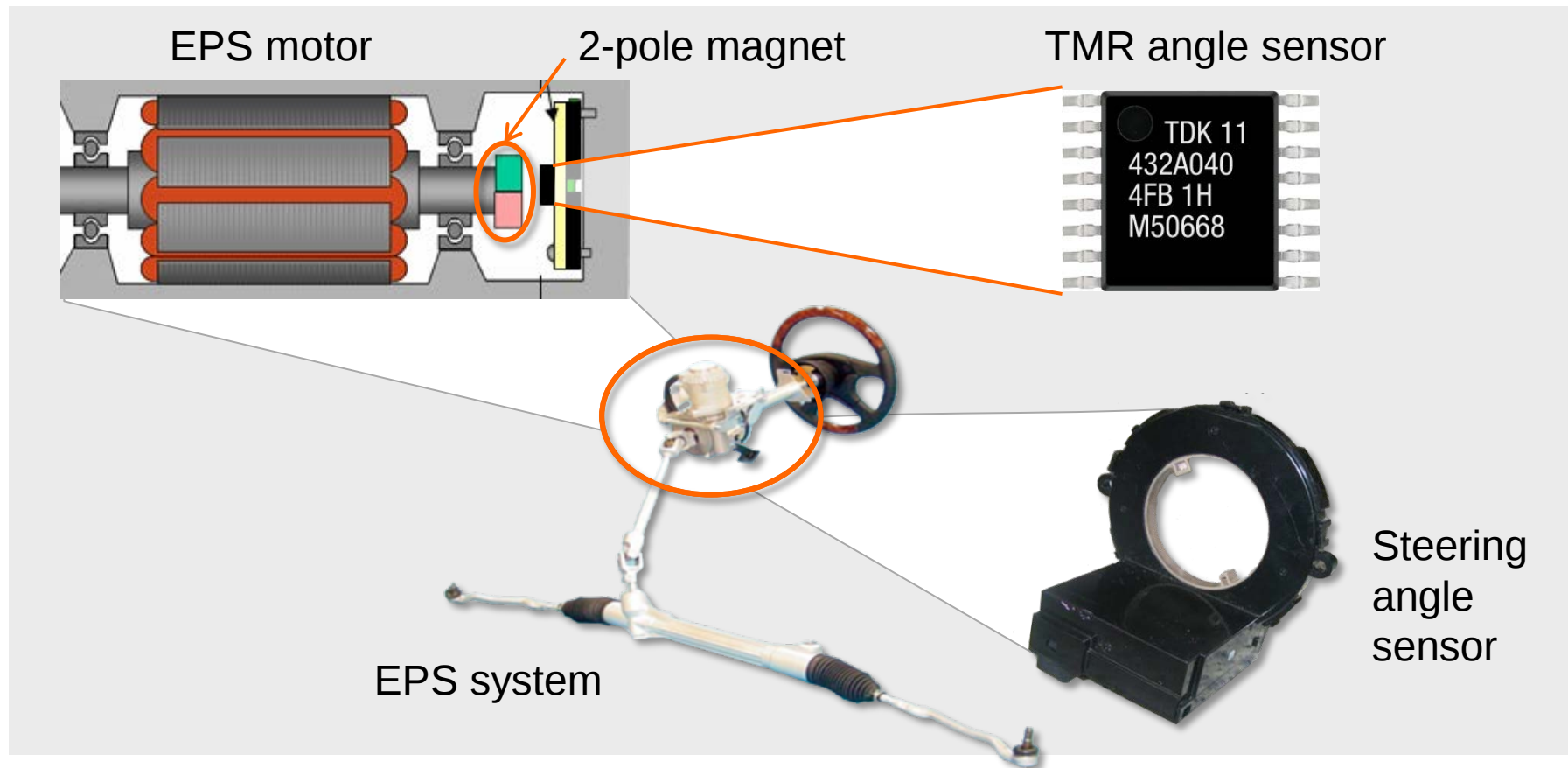


	MR ratio [%]	Output [mV]	SNR @ 10 kHz [dB]	Output shift from 25 °C to 125 °C [%]
AMR	3	90	72	-29
GMR	12	360	77	-23
TMR	100	3000	96	-13

TMR output

- more than 30 times higher than AMR
- 8 times higher than GMR
- smaller thermal coefficient factor for a broad temperature range

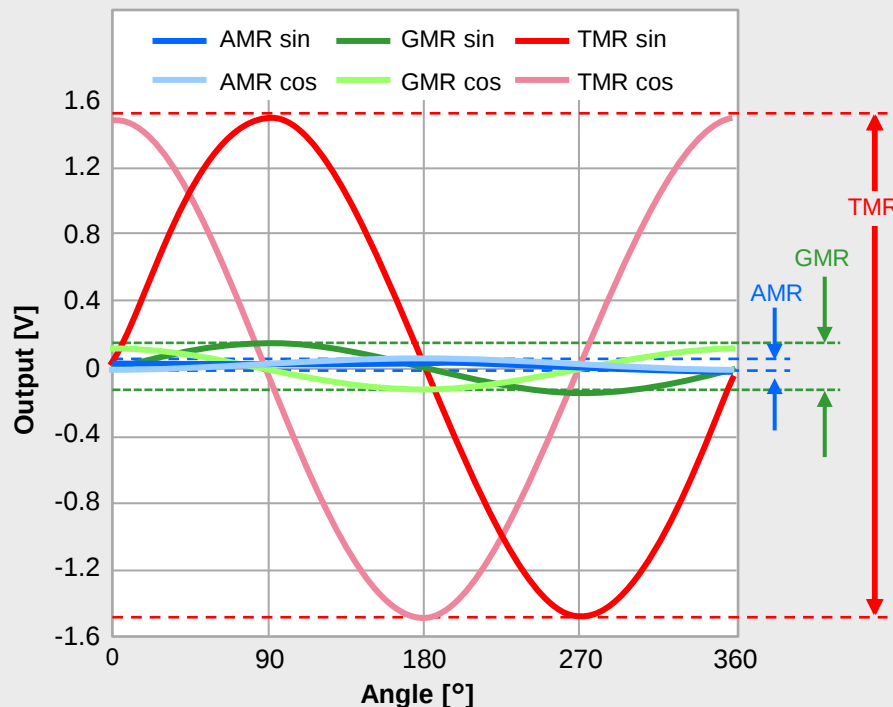
Steering – the most demanding angle sensor application



TMR sensor is positioned on the opposite side of a 2-pole magnet.

Superior performance of TDK TMR angle sensors

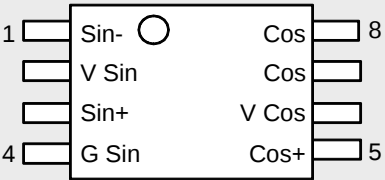
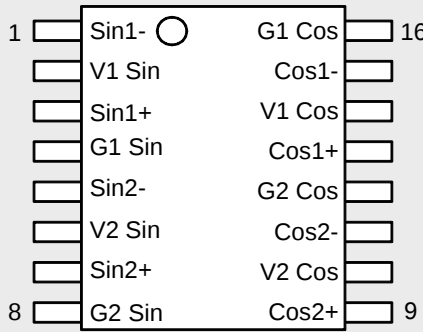
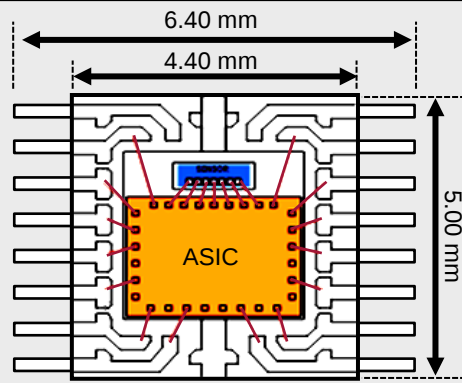
Output waveform



- **Higher output**
3.0 V_{pp} @ 5 V (30x AMR, 8x GMR)
- **Greater angle accuracy**
Angle accuracy of less than $\pm 0.6^\circ$ over a wide range of magnetic field strengths and temperatures (20 mT to 80 mT, -40 °C to 150 °C)
- **Lower power consumption**
5 mW under recommended operating conditions

TMR angle sensors for automotive applications

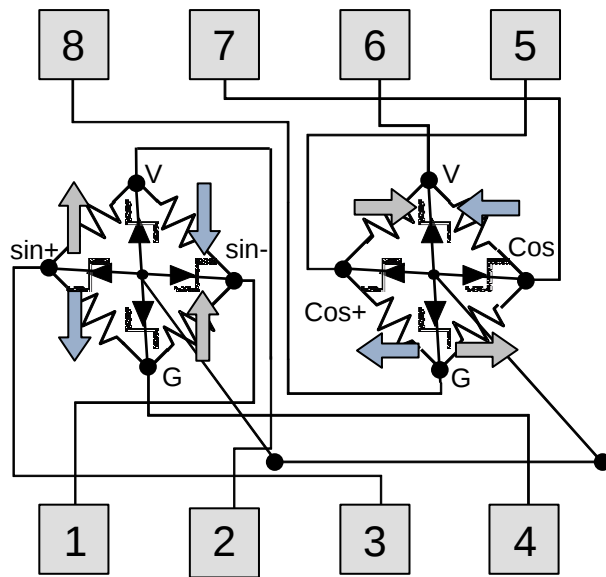


	TAS2004	TAS4501	ATAS2001
	2 directions 2 full bridges	2 x 2 directions 4 full bridges - Redundancy (ISO 26262)	2 directions 2 full bridges - plus ASIC - Redundancy (ISO 26262)
Output	Analog	Analog	Digital
Package	TSSOP8	VSOP16	SSOP16
Pin configuration			
Dimensions	3.0 x 4.4 x 1.1 mm	5.1 x 4.4 x 1.15 mm	6.4 x 5.0 x 1.15 mm

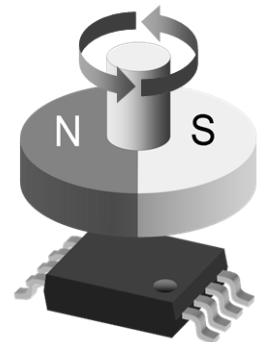
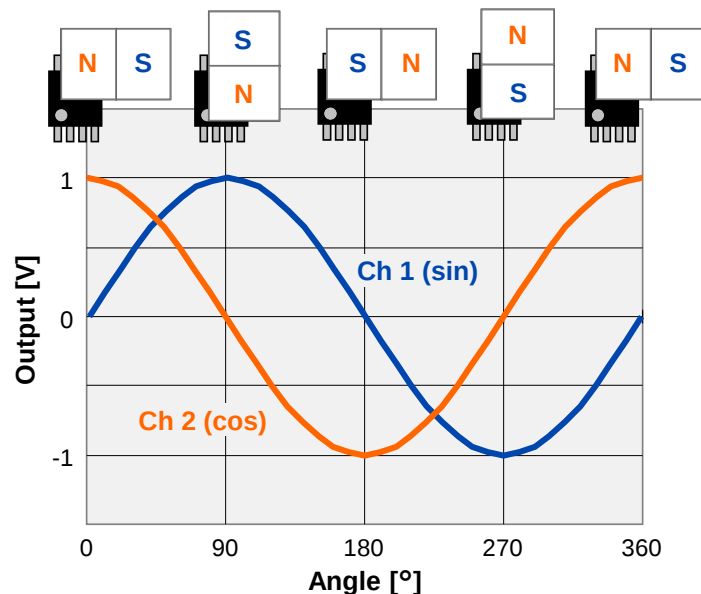
TAS2004: 2 directions, 2 full bridges, analog

- Four output waveforms (sin+, sin-, cos+, cos-) are created when the 2-pole magnet rotates
- Angle accuracy of less than $\pm 0.6^\circ$ @ 20 mT to 80 mT and -40°C to 150°C
- TSSOP8 package (3.0 mm x 4.4 mm x 1.1 mm)

Circuit



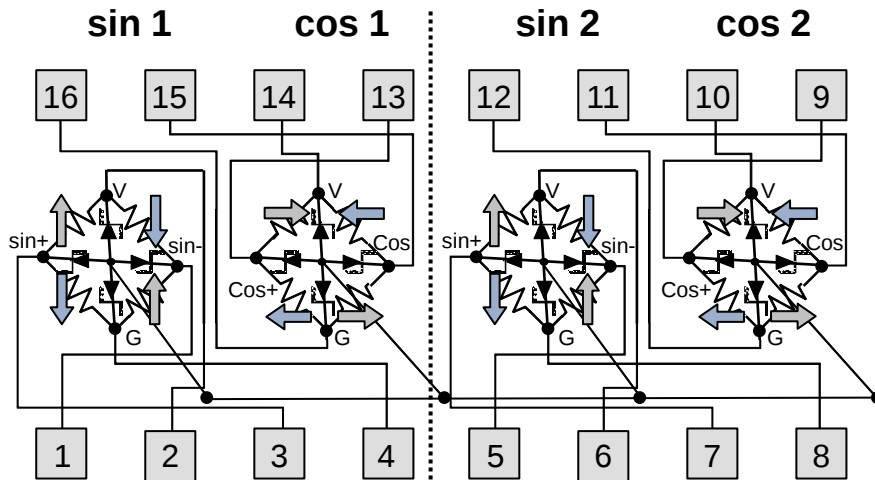
Output waveform



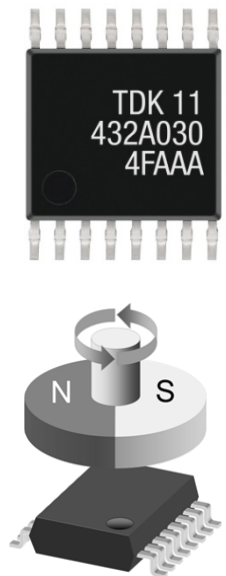
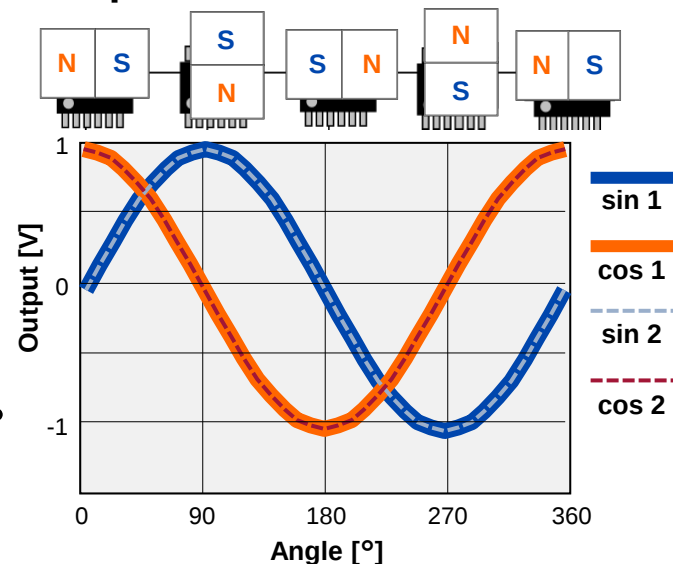
TAS4501: 2x 2 directions, 4 full bridges, analog

- 8 output waveforms (2x sin+, sin-, cos+, cos-) are created when the 2-pole magnet rotates
- Angle accuracy of less than $\pm 0.6^\circ$ @ 20 mT to 80 mT and -40 °C to 150 °C
- VSOP16 package (5.1 mm x 4.4 mm x 1.15 mm)

Circuit



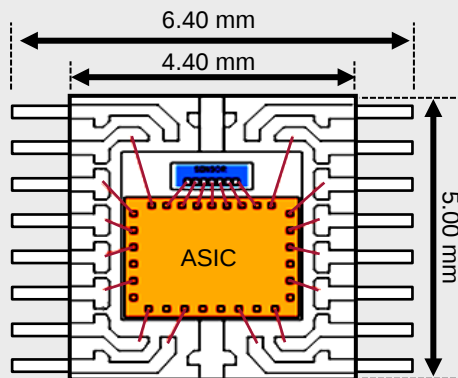
Output waveform



TAS4501 angle sensor offers redundancy in a single component.

ATAS2001 includes ASIC for digital output

High-precision digital angle sensor with signal conditioning and redundancy in a single component and support for ISO 26262



Features

- High output based on TMR technology
- Angle accuracy of $\leq \pm 0.2^\circ$ in auto-calibration mode
- High SNR
- Minimal drift over wide temperature range of -40°C to $+150^\circ\text{C}$
- Magnetic field range of 20 mT to 80 mT
- Error compensation mode
- Digital output for all standard protocols
- 14-bit A/D converter
- SSOP16 package (6.4 mm x 5.0 mm x 1.15 mm)

Error compensation significantly improves angle measurement accuracy.

Customer benefits of TDK's TMR angle sensors



- Highest measurement accuracy
- Sensor output many times higher than conventional products
- Very small temperature drift over a broad range of magnetic field strengths
- Low power consumption
- Redundancy available in a single component
- TDK supports ISO 26262 requirements

Superior performance



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