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TAS Series

High-Precision TMR Angle Sensors with Analog Output

Based on the Tunnel Magneto-Resistive (TMR) effect, the TAS series comprises highly sensitive analog sensors. They are able to measure angles up to 360° with high accuracy and stability in a wide range of temperature and magnetic-field variations.

TAS214x and TAS414x are pure TMR bridge angle sensors providing SIN/COS outputs.

In combination with a microcontroller and a small piece of software, these sensors offer outstanding angular measurement performance in industrial and safety-critical automotive applications.

TMR Basic Principles

Tunnel Magneto-Resistance (TMR) sensors exploit a special form of the Magneto-Resistive (MR) effect based on quantum-mechanical processes. The MR effect appears when the change of a magnetic field applied to a conductive material leads to a change in its electrical resistance, thus transducing a magnetic stimulation into an electrical response.

In a TMR element, a stack of magnetic material is separated by an electrical insulator – the so-called tunnel barrier – into two overlapping layers (see Fig. 1–1). One of these magnetic layers (the "pinned" layer) is processed to show a well aligned in-plane magnetization that is invariant when exposed to external magnetic fields. In contrast, the magnetization of the other magnetic layer (the "free" layer) is flexible and can be modified by applying external magnetic fields. Applying a voltage between the two magnetic layers causes a current flowing (tunneling) through

the barrier layer, whereas the resistance depends on the degree of magnetization of the free layer and its orientation with respect to the pinned layer: When both free and pinned layer magnetization orientations point in the same direction, the resistance is minimal, while opposite magnetization directions evoke maximum resistance. A TMR sensor is composed of a number of individual TMR elements forming the four branches of a Wheatstone bridge, where the fixed layers of the elements within each branch are identically aligned.

Applying a rotating magnetic field in the plane of the Wheatstone bridge allows to tap periodic voltage signals from the two bridges that are phase-shifted by 90° (see Fig. 1–2). These four signals finally allow to unambiguously extract the orientation of the stimulating field, i.e., the angular position of the rotating permanent magnet.
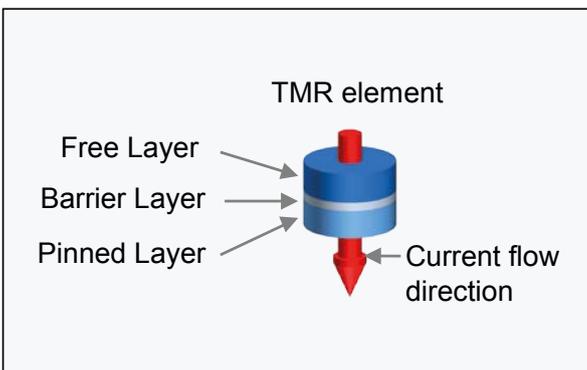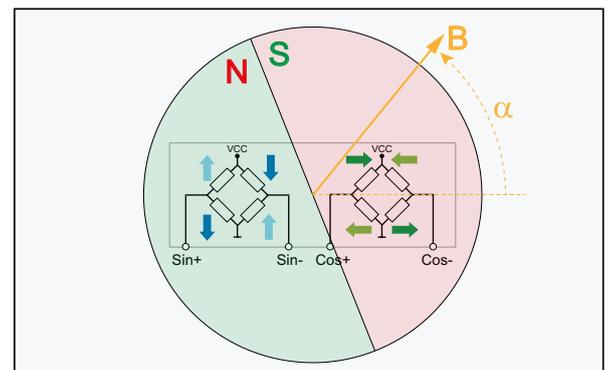

Fig. 1–1: TMR element

Fig. 1–2: Wheatstone bridge structure of TAS214x

General TMR Features

◆ High output at 1.5 Vᴘᴘ / 3.0 Vᴘᴘ @ 5 V

◆ Good angular accuracy of ±0.6 deg. (1.5 Vᴘᴘ differential output @ 5 V), ±0.8 deg. (3.0 Vᴘᴘ differential output @ 5 V)

◆ Low temperature drifts

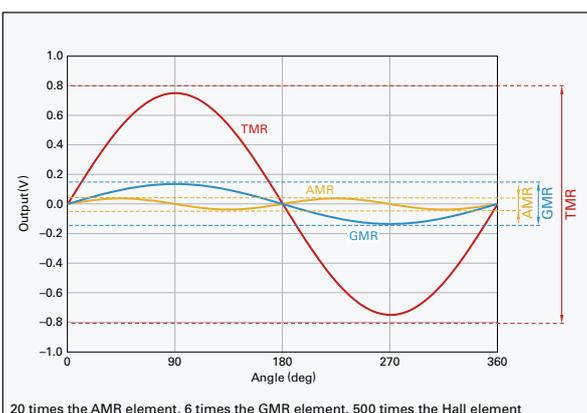◆ Low power consumption

◆ Detections can be made from 0 to 360°

20 times the AMR element, 6 times the GMR element, 500 times the Hall element

Fig. 2–1: Output wave pattern comparison TAS2141-AAAB
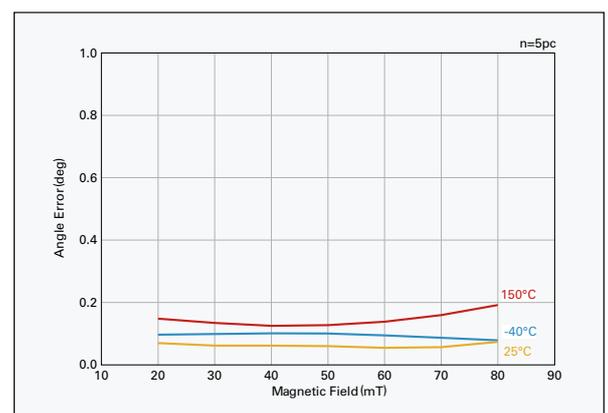(1.5 Vᴘᴘ differential output)

Fig. 2–2: Angle error graph TAS2141-AAAB
(1.5 Vᴘᴘ differential output)

TAS214x, TAS414x

**TMR-Bridge Angle Sensors with Analog Output
for Position Sensing Applications**

Application Examples

TAS214x (1 system), TAS414x (2 systems) are the optimal system solution for applications, such as:

◆ Absolute rotary angle sensor

◆ EPS motor-shaft angle sensor

◆ EPS angle sensor

◆ Throttle position sensor

◆ Resolver replacement

Fig. 3: Example of rotor position in end-of-shaft configuration

Features

◆ Specialized angle sensor for use under harsh environmental conditions.

◆ High reliability and low FIT rates allow operation in safety-critical applications

◆ Simple circuitry and low number of external components allow fast and easy development.

◆ Diagnostic capability through direct monitoring of the sensor elements.

◆ In combination with simple algorithms running in microcontrollers, the remaining very low angular drift over temperature can be compensated and allows to be operated in the complete magnetic-field range without any changes in angular precision.

Physical Characteristics

◆ Recommended supply voltage range: V_{SUP} = 3 V to 5.5 V

◆ High output 300 or 600 mV$_{PP}$/V

◆ Current consumption: 3.1 mA max. (1 system) / 6.2 mA max. (2 systems) at 5 V

◆ Wide temperature range: –40 °C to +150 °C

◆ Wide magnetic-field range:
   – 20 mT to 80 mT (standard range)
   – 80 mT to 120 mT with lower accuracy
   – higher magnetic fields with restrictions

◆ Angle accuracy: ±0.6 to 0.8 deg. (–40 °C to +150°C)

◆ Small single-mold packages available:
   – TSSOP8 for TAS214x
   – TSSOP16 and QFN16 for TAS414x

◆ AEC-Q100 qualified

Benefits

◆ Very high output voltages allow direct connection to ADCs without amplifier

◆ Direct connection to microcontrollers reduce BOM cost

◆ Very stable signals (over temperature and lifetime) – no need for re-calibration

◆ Sensor allows high diagnostic coverage and is recommended for safety critical applications

◆ Supports ASIL B by TAS214x and ASIL B(D) by TAS414x (system level ASIL D).

◆ Suitable for operation for high accurate low- or high-speed position sensing or motor control applications
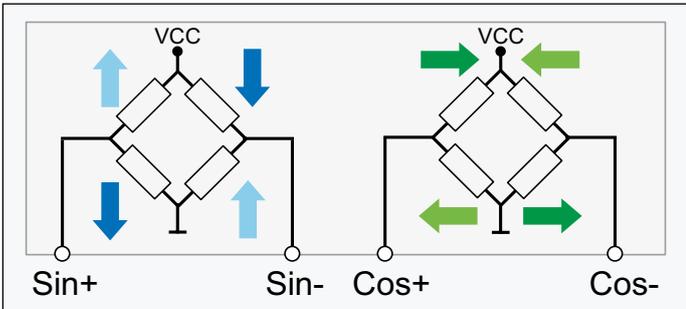
TAS214x

Single Die

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Internal Circuitry

Fig. 4: Internal circuitry of TAS214x

Input to A/D Converter

R1, R2, R3, R4: 470kΩ*, R5, R6, R7, R8: 1kΩ**, C1, C2, C3, C4: 1nF**
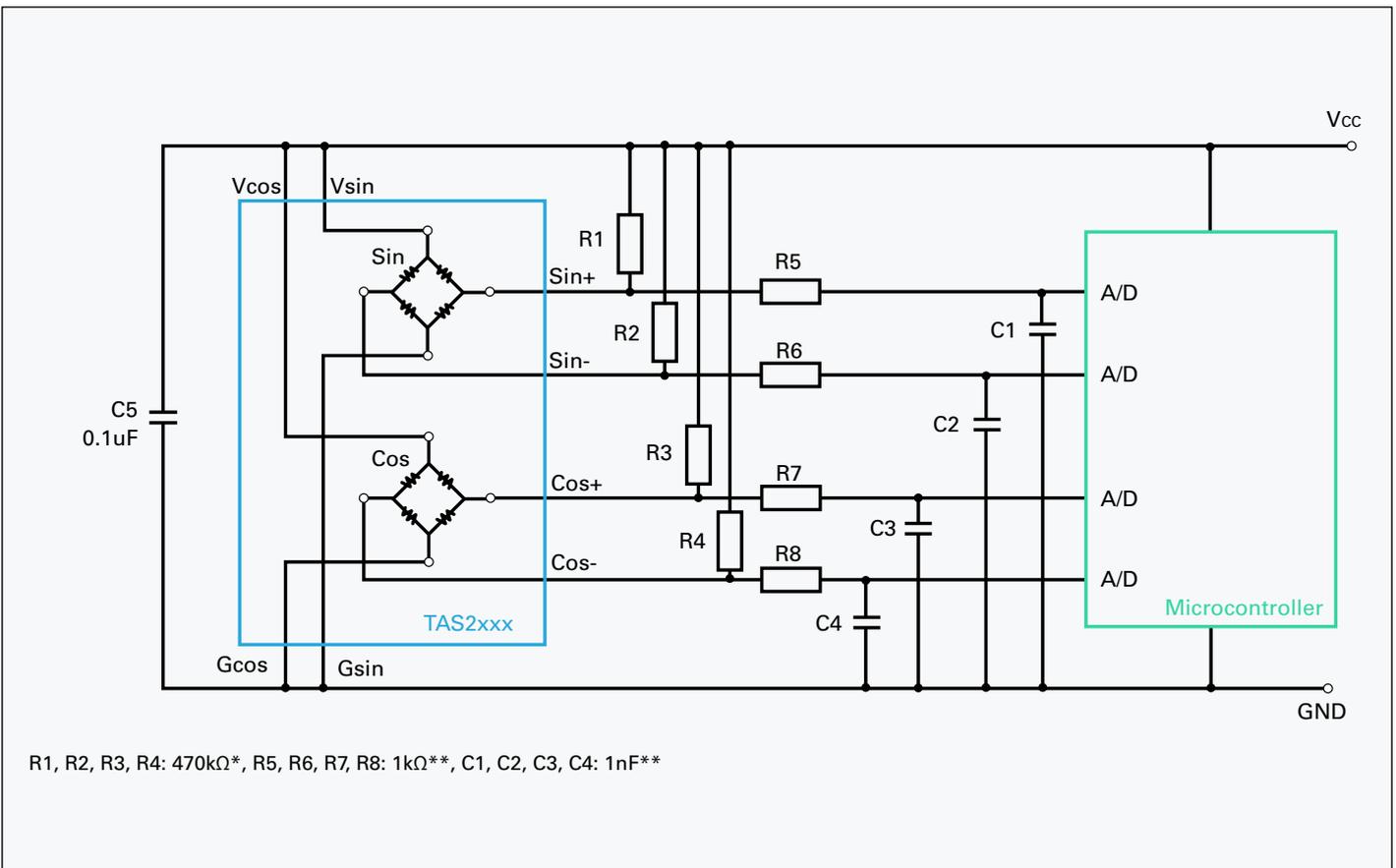
Fig. 5: Application diagram of TAS214x

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TAS414x

Dual Die, redundant
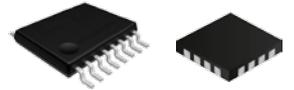
Internal Circuitry
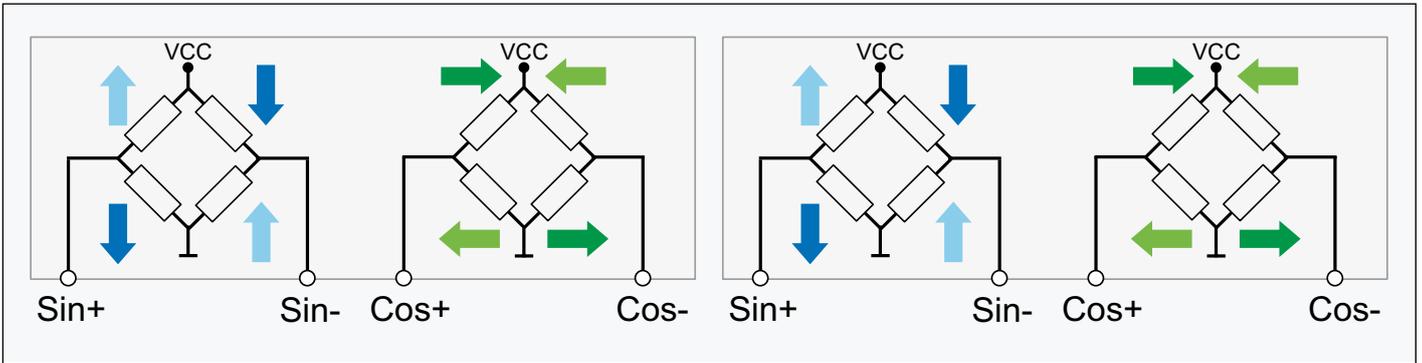
Fig. 6: Internal circuitry of TAS414x

Input to A/D Converter

R1~R8: 470kΩ*
R9-R16: 1kΩ**
C1-C8: 1nF**
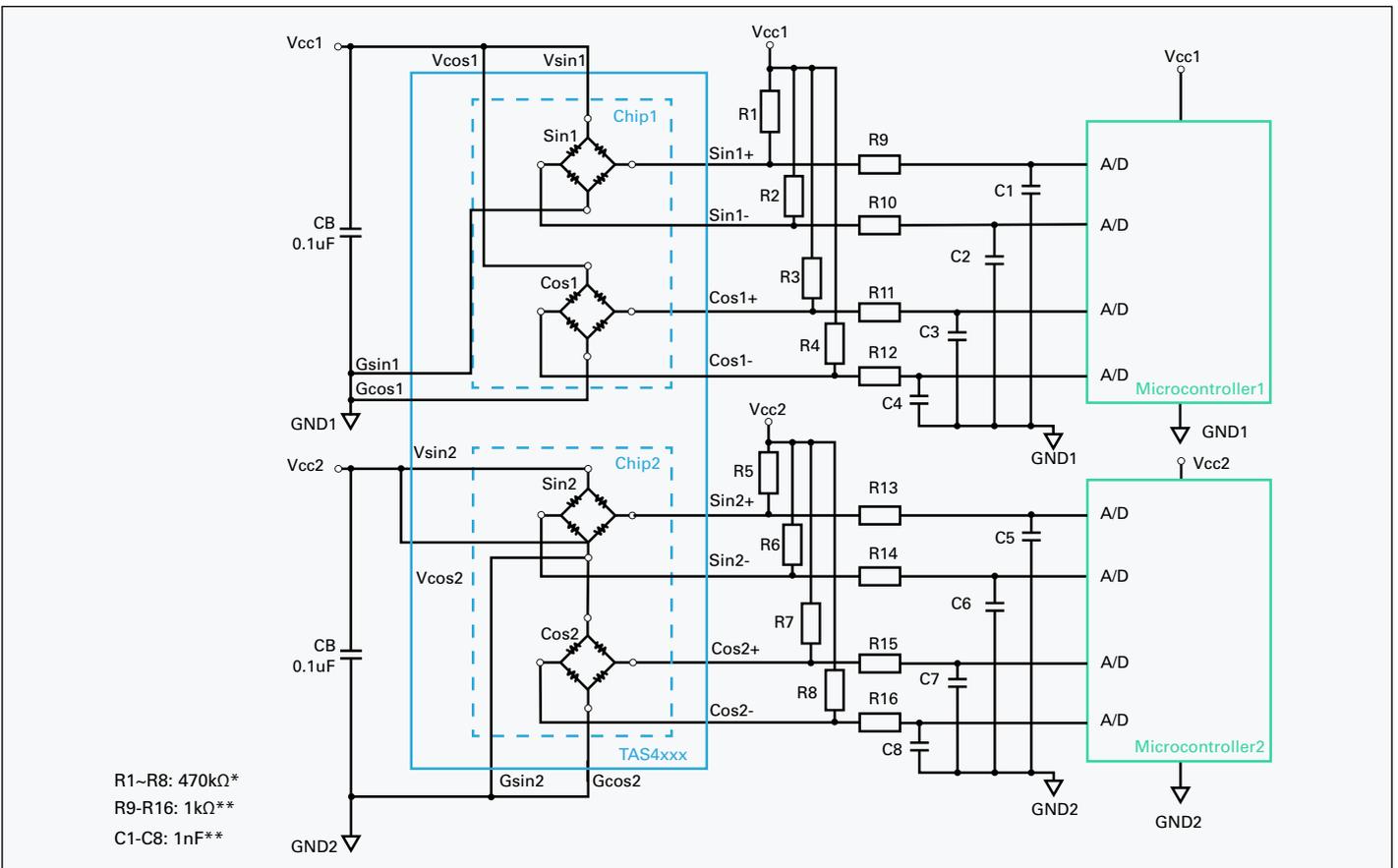
Fig. 7: Application diagram of TAS414x

TAS series

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Part Number Construction

T	A	S	2	1	4	1	–	A	A	A	B
(1)	(2)	(3)	(4)	(5)	(6)	(7)		(8)	(9)	(10)	(11)
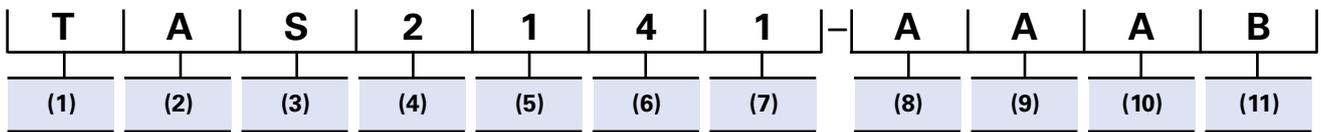
(1) Sensor technology

T	TMR

(2) Typical application

A	Angle

(3) Sensor type

S	Sensor only

(4) Bridge/System

2	2
4	4

(5) Bridge type

1	Full bridge

(6) Sensing axis

4	XY

(7) Internal code

0	0
1	1
2	2
3	3

(8) Sensor package

A	TSSOP8
B	TSSOP16
H	QFN16

(9) Grade

A	Automotive

(10) Specials

A	None

(11) Product internal code

A	1
B	2

Product Lineup

Product Name	Differential Output @5 V	Sensor technology	Typical application	Sensor type	Bridge/ System	Bridge type	Sensor axes	Internal code	Sensor package	Grade	Specials	Product Internal code
TAS2141-AAAB	1.5 V_{PP}	TMR	Angle	Sensor only	2	Full bridge	XY	1	TSSOP8	Automotive	none	1
TAS2143-AAAA	3.0 V_{PP}				2			3	TSSOP8			
TAS4140-BAAB	1.5 V_{PP} (Support redundant system)				4			0	TSSOP16			
TAS4142-BAAC	3.0 V_{PP} (Support redundant system)				4			2	TSSOP16			
TAS4142-HAAA	3.0 V_{PP} (Support redundant system)				4			2	QFN16			

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Dimension, Packaging Information

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TSSOP8, TSSOP16, QFN16

Fig. 8: TSSOP8 package

Fig. 9: TSSOP16 package

Fig. 10: QFN16 package

MUL: 3000 pcs/reel (TAS214x/TAS414x)

Fig. 11: Reel specifications (TSSOP8, TSSOP16, and QFN16 package)

Fig. 12: Carrier tape specifications (TSSOP8)

Fig. 13: Carrier tape specifications (TSSOP16)

Fig. 14: Carrier tape specifications (QFN16)

Please be sure to request delivery specifications that provide further details on the features and specifications of the products for proper and safe use.
Please note that the contents may change without any prior notice due to reasons such as upgrading.