DATA SHEET

TF952

MagnetoResistive Magnetic Field Sensor

The TF952 is a magnetic field sensor based on the Tunnel MagnetoResistive (TMR) effect. The sensor contains two Wheatstone bridges. This allows the simultaneous measurement of two magnetic field directions (X and Y). The sensor is ideal for measuring magnetic fields in a linear range from -20 mT up to 20 mT.
A typical application is endpoint detection of pneumatic or hydraulic cylinders. The X and Y bridge configuration allows the optional application as a simple angle sensor.
The TF952 is available as flip-chip for SMD assembly.

Product Overview of TF952

Article description	Package	Delivery Type
TF952APA-AE	Flip-Chip	Tape on reel (5000 pcs)
TF952 Evalboard	Evalboard	ESD-Box

Quick Reference Guide

Symbol	Parameter	min.	typ.	max.	Unit
V_{CC}	Supply voltage	-	±3.3	±5.5	V
B_{Lin}	Linear magnetic range	-20.0	-	+20.0	mT
S_{Linmax}	Sensitivity (in linear range)	6.0	9.0	12.0	mV/V/mT
R_S	Sensor resistance	20.0	50.0	80.0	kΩ
R_B	Bridge resistance	40.0	100.0	160.0	kΩ

Absolute Maximum Ratings

In accordance with the absolute maximum rating system (IEC60134).

Symbol	Parameter	Min.	Max.	Unit
V_{CC}	Supply voltage	-5.5	+5.5	V
T_{amb}	Ambient temperature	-40	+125	°C
ESD HBM	ESD tolerance according to HBM	-	200	V

Stresses beyond those listed under “Absolute maximum ratings” may cause permanent damage to the device.

This is a stress rating only and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

Features

- Based on the TunnelMagneto-Resistive (TMR) effect
- Flip-Chip assembly
- For two magnetic field directions
- Ambient temperature range from -40 °C to +125 °C

Advantages

- Large working distance
- High sensitivity
- Large measurement range
- Low hysteresis

Applications

- Endpoint detection in cylinders
- Reference monitoring
- Magnetic switches

ESD

Magnetic Data

Symbol	Parameter	Conditions	min.	typ.	max.	Unit
B_{lin}	Linear magnetic flux density range (abs) [1]		-20.0	-	+20.0	mT
B_{sat}	Saturation magnetic flux density [2]		-	±30.0	-	mT

[1] By exceeding the value of B_{lin} the output signal is no longer unique and goes into saturation. After the event of a high field exposure (>20mT), the sensor must be „reset“ by a low (<5mT) of zero magnetic field.

[2] At B_{sat} the sensor delivers the maximal output voltage of minimum 100 mV/V.

Electrical Data

T_{amb} = +25°C; unless otherwise specified.

Symbol	Parameter	Conditions	min.	typ.	max.	Unit
V_{CC}	Supply voltage		-	±3.3	±5.5	V
V_{off}	Offset voltage per V_{CC} [3] [5]		-3.0	-	+3.0	mV/V
TC_{Voff}	Temperature coefficient of V_{off} [4] [5]		-5.0	-	+5.0	(µV/V)/K
R_B	Bridge resistance		40.0	100.0	160.0	kΩ
R_S	Sensor resistance		20.0	50.0	80.0	kΩ
TC_{RB}	Temperature coefficient of R_B [6]		-0.08	-0.1	-0.12	%/K
S_{Linmax}	Sensitivity (in linear max. range)		6.0	9.0	12.0	mV/V/mT
S_{Lin5}	Sensitivity (M=±5mT)		7.0	-	-	mV/V/mT
TC_{RB}	Temperature coefficient of S [7]		-0.13	-0.16	-0.19	%/K
FIT	FIT-Rate	At 55 °C	-	3.3	-	x10⁹ h
MTTF	Mean time to failure	At 55 °C	-	376712	-	years

[3] In the field range of 20 mT is exceeded, an additional offset of up to ±3 mV/V may occur.

[4] $TC_{Voff}=100\cdot\frac{V_{off(T2)}-V_{off(T1)}}{T_2-T_1}$ with T_1 = +25°C; T_2 = +125°C, typ. Value: ±1 µV/V/K.

[5] Determined in signal saturation.

[6] $TC_{RB}=100\cdot\frac{V_{B(T2)}-V_{B(T1)}}{V_{B(T1)}\cdot(T_2-T_1)}$ with T_1 = +25°C; T_2 = +125°C.

[7] $TC_S=100\cdot\frac{S_{T2}-S_{T1}}{S_{T1}\cdot(T_2-T_1)}$ with T_1 = +25°C; T_2 = +125°C.

Accuracy

T_{amb} = +25°C; unless otherwise specified.

Symbol	Parameter	Conditions	min.	typ.	max.	Unit
ε_{Lin5}	Linearity error (B=±5mT)	See Fig. 2	-	2.0	-	% of V_{Out}
H_{C5}	Hysteresis error [8]	H_C is valid for ±5 mT field range. See Fig. 3.	-	-	0.05	mT
ε_{Linmax}	Linearity error (in max. linear range)	See Fig. 2	-	2.0	-	% of V_{Out}
H_{Cmax}	Hysteresis error [8]	H_{Cmax} marks the maximum hysteresis occurring by applying fields >±20 mT. Value is determined as H_C in the range of ±5 mT. See Fig. 3.	-	-	0.05	mT

[8] H_C is defined as half of the maximum difference between up and down of the signal trace.

Typical Performance Graphs

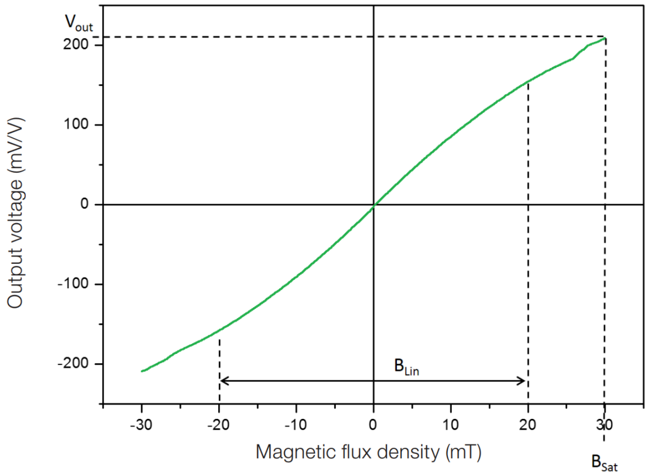


Fig 1: Typical output voltage of the TF952 depending on the magnetic flux density.

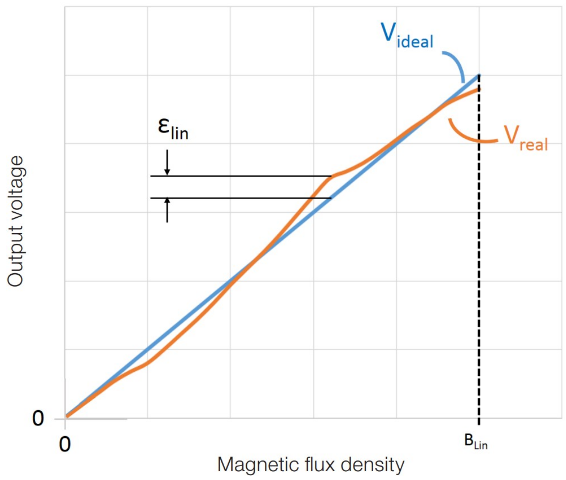


Fig 2: Definition of linearity error ε_{Lin} (schematic).

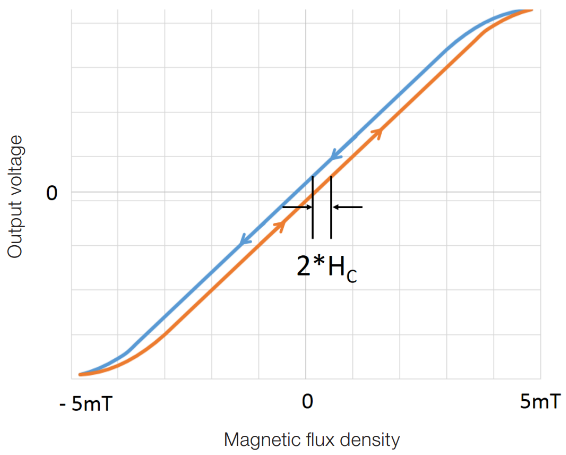


Fig 3: Definition of hysteresis error H_C (schematic).

TF952 Bare Die

Pinout

Pad	Symbol	Parameter
A1	V_{CCY}	Power supply Y
A2	$-V_{OY}$	Negativee output voltage Y
A3	$-V_{OX}$	Negativee output voltage X
B1	NC	Not connected
B3	V_{CCX}	Power supply X
C1	$+V_{OY}$	Positive output voltage Y
C2	GND	Ground
C3	$+V_{OX}$	Positive output voltage X

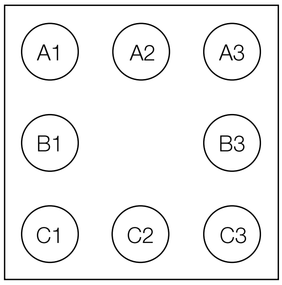
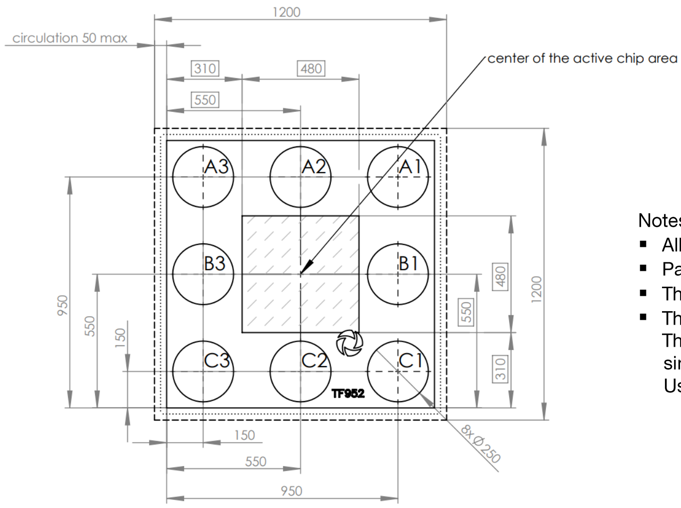
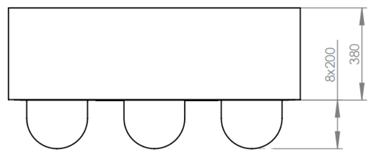


Fig. 4: Pinout of the TF952 Bare Die

Dimensions





Notes:

- All Dimensions in µm
- Pad dimensioning correlates the dicing line
- The dashed outline represents the dicing line
- The shaded area denotes the active chip area.
  This must be not touched during handling or assembly
  since this may cause damage the chip.
  Using a die collet for handling is recommened.

Fig. 5: Chip outline for TF952as bare die.

Data for Packaging and Interconnection Technologies

Parameter	Conditions	Value	Unit
Solder ball material		SnAG2.6Cu0.6	
Maximum solder temperature	6s	260	°C

Reel layout

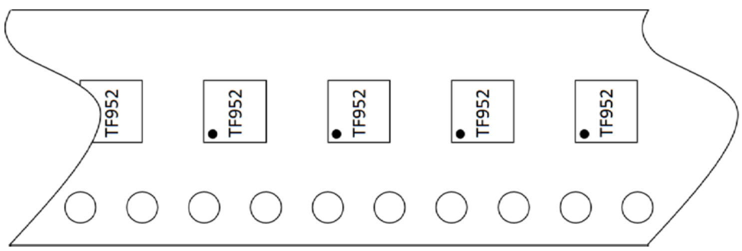


Fig. 6: Flip-chip tape & reel for TF952APA-AE.

Evalboard with TF952APA-AE

Pinout

Pad	Symbol	Parameter
1	$+V_{O1}$	Positive output voltage bridge 1
2	$+V_{O2}$	Positive output voltage bridge 2
3	GND	Ground
4	V_{CC}	Supply voltage
5	$-V_{O1}$	Negative output voltage bridge 1
6	$-V_{O2}$	Negative output voltage bridge 2

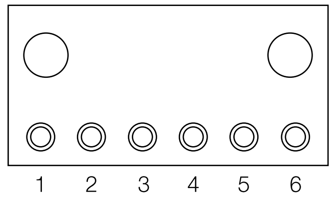
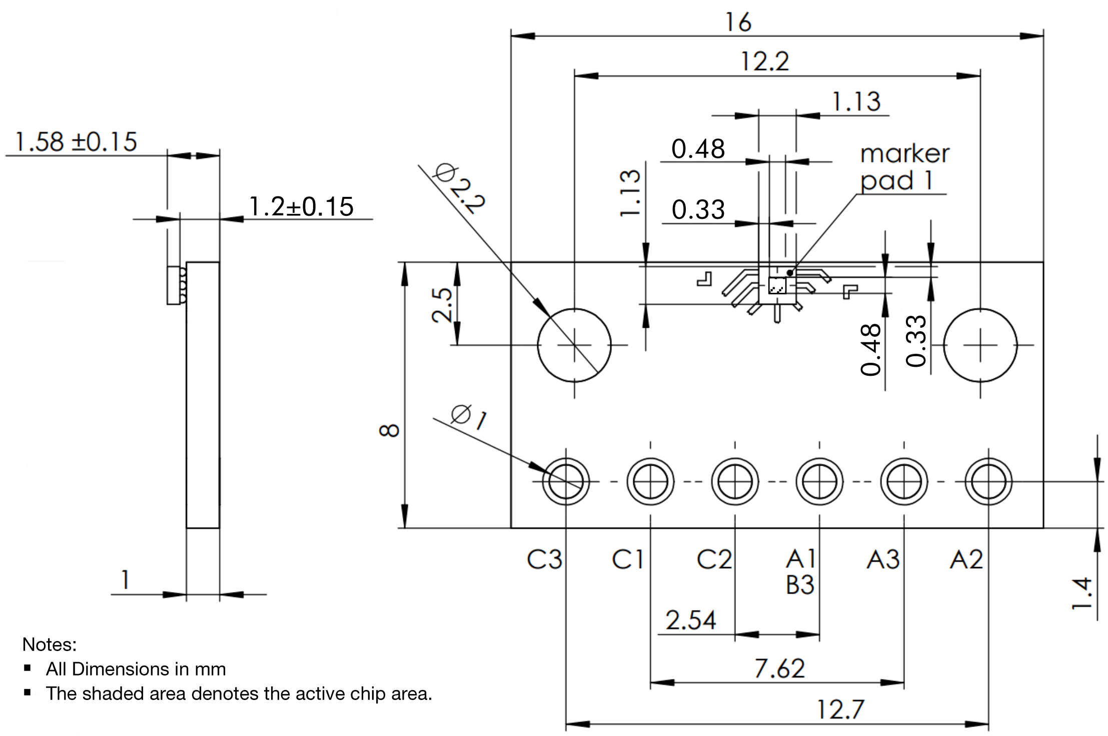


Fig. 7: Pinout of the evalboard

Dimensions



Notes:
- All Dimensions in mm
- The shaded area denotes the active chip area.

Fig. 8: Outline of evalboard with TF952APA-AE.

Additional Information on Ordering Code

TF952APA - AE

Ambient temperature (A) and Packaging (E)

A	-40…+125 °C
E	Tape&Reel horizontal

Specification (A), Variant (P) and Version (A)

A	Standard specification
P	FlipChip
A	Standard version

Sensor Number (952)

952	Magnetic field sensor for two field directions

Type of Sensor (TF)

TF	TMR field Sensor

General Information

Product Status

Article	Status
TF952APA-AE	The product is in series production.
TF952 Evalboard	This product is for evaluation of the TF952APA-AE sensor.
Note	The status of the product may have changed since this data sheet was published. The latest information is available on the internet at www.sensitec.com.

Disclaimer

Sensitec GmbH reserves the right to make changes, without notice, in the products, including software, described or contained herein in order to improve design and/or performance. Information in this document is believed to be accurate and reliable. However, Sensitec GmbH does not give any representations or warranties, expressed or implied, as to the accuracy or completeness of such information and shall have no liability for the consequences of use of such information. Sensitec GmbH takes no responsibility for the content in this document if provided by an information source outside of Sensitec products. In no event shall Sensitec GmbH be liable for any indirect, incidental, punitive, special or consequential damages (including but not limited to lost profits, lost savings, business interruption, costs related to the removal or replacement of any products or rework charges) irrespective the legal base the claims are based on, including but not limited to tort (including negligence), warranty, breach of contract, equity or any other legal theory. Notwithstanding any damages that customer might incur for any reason whatsoever, Sensitec product aggregate and cumulative liability towards customer for the products described herein shall be limited in accordance with the General Terms and Conditions of Sale of Sensitec GmbH. Nothing in this document may be interpreted or construed as an offer to sell products that is open for acceptance or the grant, conveyance or implication of any license under any copyrights, patents or other industrial or intellectual property rights. Unless otherwise agreed upon in an individual agreement Sensitec products sold are subject to the General Terms and Conditions of Sales as published at www.sensitec.com. The use and/or application of our products in a military end use is explicitly prohibited. In the event of infringements, we reserve the right to take legal action, including but not limited to the assertion of claims for damages and/or the immediate termination of the business relationship.

General Information

Application Information

Applications that are described herein for any of these products are for illustrative purposes only.Sensitec GmbH makes no representation or warranty – whether expressed or implied – that such applications will be suitable for the specified use without further testing or modification. Customers are responsible for the design and operation of their applications and products using Sensitec products, and Sensitec GmbH accepts no liability for any assistance with applications or customer product design. It is customer's sole responsibility to determine whether the Sensitec product is suitable and fit for the customer's applications and products planned, as well as for the planned application and use of customer's third party customer(s). Customers should provide appropriate design and operating safeguards to minimize the risks associated with their applications and products. Sensitec GmbH does not accept any liability related to any default, damage, costs or problem which is based on any weakness or default in the customer's applications or products, or the application or use by customer's third party customer(s). Customer is responsible for doing all necessary testing for the customer's applications and products using Sensitec products in order to avoid a default of the applications and the products or of the application or use by customer's third party customer(s). Sensitec does not accept any liability in this respect.

Life Critical Applications

These products are not qualified for use in life support appliances, aeronautical applications or devices or systems where malfunction of these products can reasonably be expected to result in personal injury.

Changelist

Version	Description of the Change	Date
TF952.DSE.09	Add evalboard information (p. 5)	12/2024
TF952.DSE.08	Change Footer and Product Status (pp. 1-6)	02/2023
TF952.DSE.07	Disclaimer supplement	06/2022
TF952.DSE.06	Change of technical data (pp. 1-6)	05/2022
TF952.DSE.00	Original (pp. 1-6)	01/2018

Sensitec GmbH
Schanzenfeldstr. 2 • 35578 Wetzlar • Germany
Tel +49 (0) 6441 5291-0 • Fax +49 (0) 6441 5291-117
sensitec@sensitec.com • www.sensitec.com