

# 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

Article Description	Package	Delivery Type
TF952APA-AE	Flip-Chip	Tape and Reel (5000 pcs)

### Quick Reference Guide

Symbol	Parameter	Min.	Typ.	Max.	Unit
$V_{CC}$	Supply voltage	-	$\pm 3.3$	$\pm 5.5$	V
$B_{Lin}$	Linear magnetic range	-20	-	+20	mT
$S_{Linmax}$	Sensitivity (in linear range)	6.0	9.0	12	mV/V/mT
$R_s$	Sensor resistance	20	50	80	k $\Omega$
$R_B$	Bridge resistance	40	100	160	k $\Omega$

### 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	$^{\circ}$ 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 TunnelMagnetoResistive (TMR) effect
- Flip-Chip assembly
- For two magnetic field directions
- Temperature range from -40  $^{\circ}$ C to +125  $^{\circ}$ C

### Advantages

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

### Applications

- Endpoint detection in cylinders
- Reference monitoring
- Magnetic switches



### Magnetic Data

Symbol	Parameter	Min.	Typ.	Max.	Unit
$B_{Lin}$	Linear magnetic flux density range (abs) <sup>1)</sup>	-20	-	+20	mT
$B_{sat}$	Saturation magnetic flux density <sup>2)</sup>	-	±30	-	mT

<sup>1)</sup> 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 (>20 mT), the sensor must be "reset" by a low (< 5 mT) or zero magnetic field.

<sup>2)</sup> At  $B_{sat}$  the sensor delivers the maximal output voltage of minimum 100 mV/V.

### Electrical Data

$T_{amb} = 25\text{ °C}$ ; unless otherwise specified.

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
$V_{CC}$	Supply voltage		-	±3.3	±5.5	V
$V_{OFF}$	Offset voltage per $V_{CC}$ <sup>3) 5)</sup>		-3.0	-	+3.0	mV/V
$TC_{VOFF}$	Temperature coefficient of offset voltage <sup>4) 5)</sup>		-5.0	-	+5.0	μV/V/K
$R_S$	Sensor resistance		20	50	80	kΩ
$R_B$	Bridge resistance		40	100	160	kΩ
$TC_{RB}$	Temperature coefficient of bridge resistance <sup>6)</sup>		-0.08	-0.1	-0.12	%/K
$S_{Linmax}$	Sensitivity (in linear max. range)		6.0	9.0	12	mV/V/mT
$S_{Lin5}$	Sensitivity ( $B = \pm 5\text{ mT}$ )		7.0	-	-	mV/V/mT
$TC_S$	Temperature coefficient of sensitivity <sup>7)</sup>		-0.13	-0.16	-0.19	%/K

<sup>3)</sup> If the field range of 20 mT is exceeded, an additional offset of up to ±3 mV/V may occur.

$$^4) \quad TC_{Voff} = \frac{V_{off(T2)} - V_{off(T1)}}{(T_2 - T_1)} \quad \text{with } T1 = 25\text{ °C}; T2 = 125\text{ °C, typ. value: } \pm 1 \mu\text{V/V/K}$$

<sup>5)</sup> Determined in signal saturation.

$$^6) \quad TC_{RB} = 100 \cdot \frac{R_{B(T2)} - R_{B(T1)}}{R_{B(T1)} \cdot (T_2 - T_1)} \quad \text{with } T1 = 25\text{ °C}; T2 = 125\text{ °C}$$

$$^7) \quad TC_S = 100 \cdot \frac{S_{T2} - S_{T1}}{S_{T1} \cdot (T_2 - T_1)} \quad \text{with } T1 = 25\text{ °C}; T2 = 125\text{ °C}$$

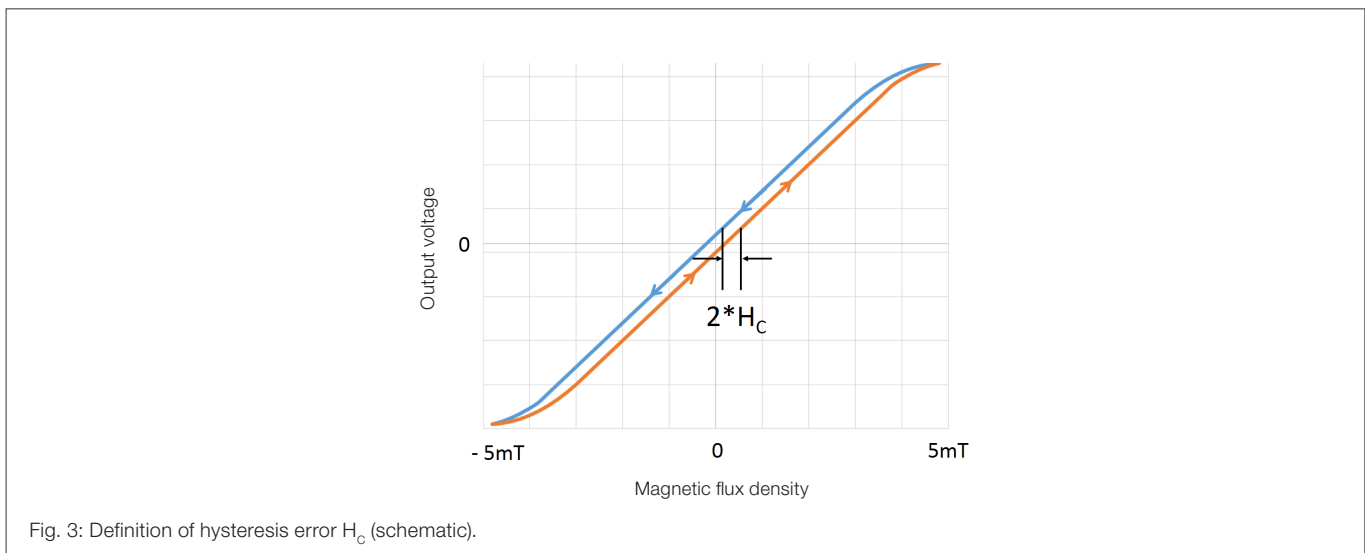
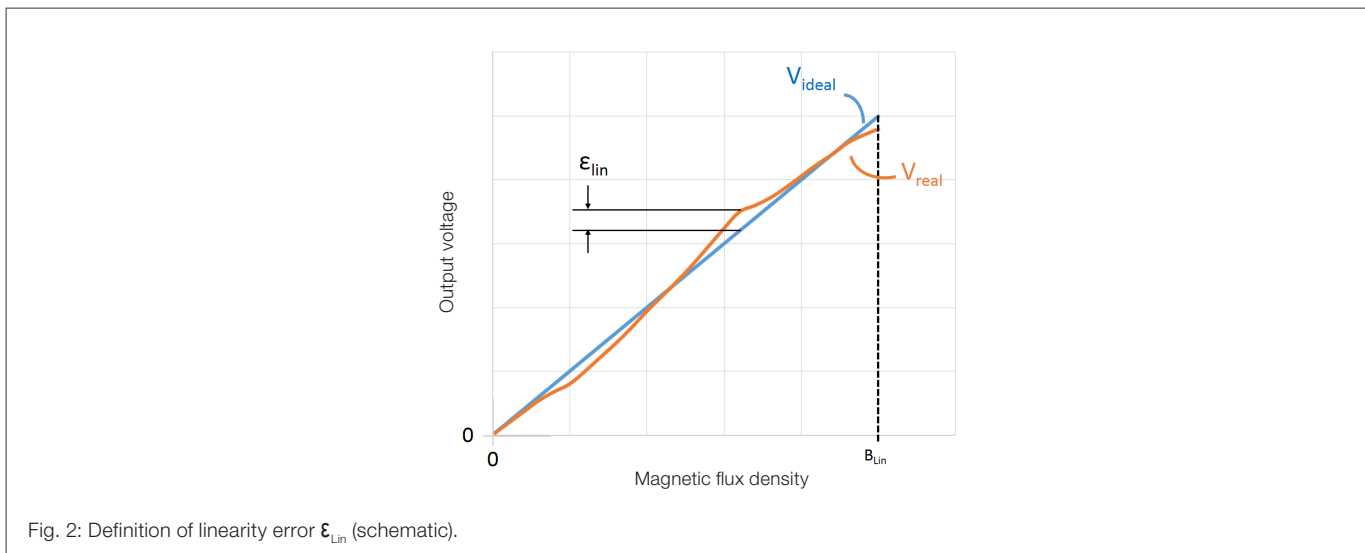
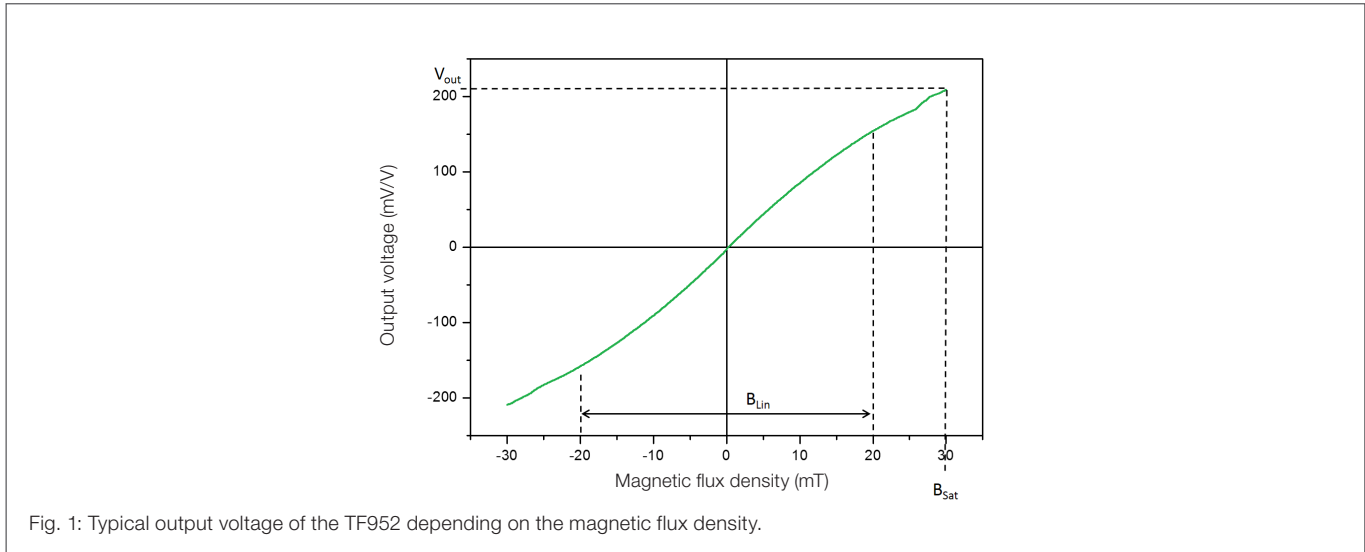
### Accuracy

$T_{amb} = 25\text{ °C}$ ; unless otherwise specified.

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
$\epsilon_{Lin5}$	Linearity error ( $B = \pm 5\text{ mT}$ )	See Fig. 2	-	2.0		% of $V_{Out}$
$H_{CS}$	Hysteresis error <sup>8)</sup>	$H_C$ is valid for ±5 mT field range. See Fig. 3.	-	-	0.05	mT
$\epsilon_{Linmax}$	Linearity error (in max. linear range)		-	5.0	-	% of $V_{Out}$
$H_{Cmax}$	Hysteresis error <sup>8)</sup>	$H_{Cmax}$ 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.	-	-	0.30	mT

<sup>8)</sup>  $H_C$  is defined as half of the maximum difference between up and down of the signal trace.

Typical Performance Graphs



### TF952 Bare Die

#### Pinning

Pad	Symbol	Parameter
A1	$V_{CCY}$	Power supply Y
A2	$-V_{OY}$	Negative output voltage Y
A3	$-V_{OX}$	Negative 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

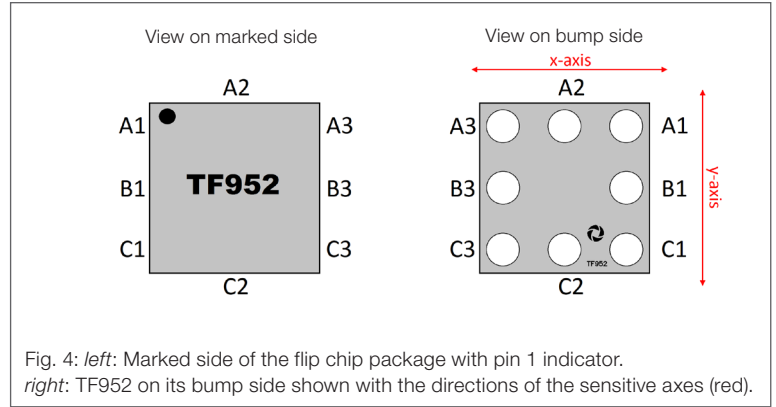


Fig. 4: *left*: Marked side of the flip chip package with pin 1 indicator. *right*: TF952 on its bump side shown with the directions of the sensitive axes (red).

#### Mechanical Data

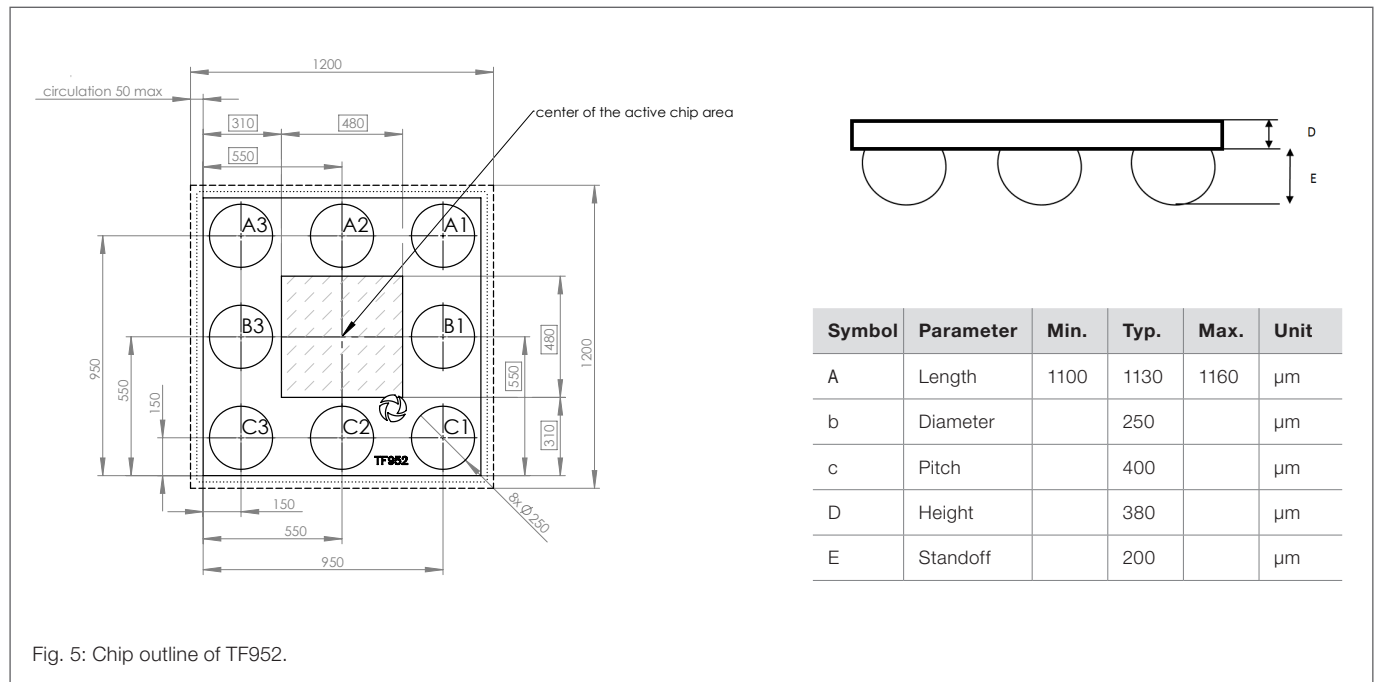


Fig. 5: Chip outline of TF952.

#### Data for Packaging and Interconnection Technologies

Parameter	Conditions	Value	Unit
Solder ball material		SnAg2.6Cu0.6	
Maximum solder temperature	6s	260	°C

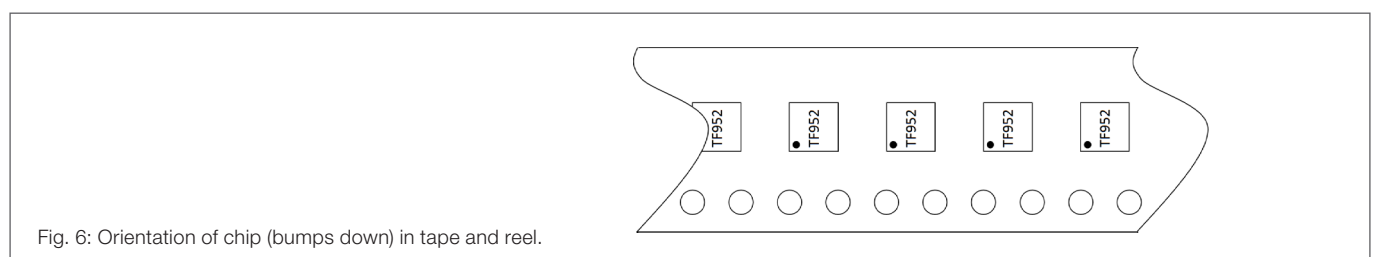


Fig. 6: Orientation of chip (bumps down) in tape and reel.

## General Information

### Product Status

Article	Status
TF952APA-AE	The product is in series production.
Note	The status of the product may have changed since this data sheet was published. The latest information is available on the internet at <a href="http://www.sensitec.com">www.sensitec.com</a> .

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## General Information

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## Changelist

Version	Description of the Change	Date
TF952.DSE.07	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.05	Change of corporate design (pp. 1-6)	01/2022
TF952.DSE.04	Mechanical Data - Fig. 5 (p. 4)	10/2021

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