

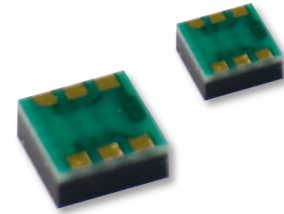
# TA903

## MagnetoResistive FreePitch Sensor

The TA903 is a position sensor based on the Tunnel MagnetoResistive (TMR) effect. The sensor contains two Wheatstone bridges with a common ground and supply pin, arranged at a relative angle of 90° to each other.

A rotating magnetic field in the sensor plane delivers two sinusoidal output signals depending on the angle  $\alpha$  between sensor and magnetic field direction as shown in Fig. 1. The function of these signals is  $+\sin \alpha$  and  $+\cos \alpha$ , i.e. the output signal in an end-of-shaft application has a periodicity of one per revolution.

The TA903 is available as a bare die for chip on board processing. For SMD process the TA903 is available in a LGA6B package or in a DFN8 package.



### Product Overview

Article description	Package	Delivery Type
TA903ACA-AB <sup>1)</sup>	Die on wafer	Waferbox
TA903AMA-AE	LGA6B	Tape and Reel
TA903AIA-AE	DFN8	Tape and Reel

<sup>1)</sup> Minimum order quantities apply.

### Quick Overview

Symbol	Parameter	min.	typ.	max.	Unit
$V_{CC}$	Supply voltage	1.8	5.0	5.5	V
$V_{Off}$	Offset voltage per $V_{CC}$	-3.0	-	+3.0	mV/V
$V_{Peak}$	Signal voltage per $V_{CC}$	70	100	130	mV/V
$R_B$	Bridge resistance	6.0	10.0	14.0	k $\Omega$
$R_S$	Sensor resistance	3.0	5.0	7.0	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
$H_{ext}$	External magnetic field strength	-	180	mT
$ESB_{HBM}$	ESD tolerance according to HBM, TA903ACA-AB	-	200	V
$ESB_{HBM}$	ESD tolerance according to HBM, TA903AMA-AE, TA903AIA-AE	-	2000	V
$T_{amb}$	Operating temperature	-40	+125	°C
$T_{stg}$	Storage temperature	-40	+125	°C
$T_{reflow}$	Reflow temperature <sup>2)</sup>	-	+250	°C

<sup>2)</sup> Maximum temperature for reflow solder process.

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 Tunnel MagnetoResistive (TMR) effect
- Contains two Wheatstone bridges
- Sine and cosine output
- Temperature range from -40 °C to +125 °C

### Advantages

- Contactless angle and position measurement
- Large air gap
- Excellent accuracy
- Position tolerant
- Minimal offset voltage
- Minimal hysteresis

### Applications

- Incremental or absolute position measurement (linear and rotary motion)
- Motor commutation
- Rotational speed measurement
- Angle measurement (360° absolute at end of shaft)



### Magnetic Data

Symbol	Parameter	Conditions	min.	typ.	max.	Unit
B <sub>ext</sub>	Magnetic flux density		30	-	80	mT

### Electrical Data

T<sub>amb</sub> = +25°C, V<sub>CC</sub> = 5.0 V; B<sub>ext</sub>=30mT; unless otherwise specified

Symbol	Parameter	Conditions	min.	typ.	max.	Unit
V <sub>CC</sub>	Supply voltage		1.8	5.0	5.5	V
V <sub>Peak</sub>	Signal voltage per V <sub>CC</sub> <sup>1)</sup>		70	100	130	mV/V
TC <sub>VPeak</sub>	Temperature coefficient of V <sub>Peak</sub> <sup>2)</sup>	T <sub>amb</sub> = (-40...+125)°C	-0.25	-0.10	0.00	%/K
k <sub>BareDie</sub>	Amplitude synchronism <sup>3)</sup> (Version: Bare die / Sil-Gel <sup>4)</sup> )		98	100	102	%
TC <sub>k(BareDie)</sub>	Temperature coefficient of k <sub>BareDie</sub> <sup>5)</sup> (Version: Bare die / Sil-Gel <sup>4)</sup> )	T <sub>amb</sub> = (-40...+125)°C	-0.01	-	+0.01	%/K
k <sub>GlobTop</sub>	Amplitude synchronism <sup>3)</sup> (Version: GlobTop <sup>6)</sup> )		97	100	103	%
TC <sub>k(GlobTop)</sub>	Temperature coefficient of k <sub>GlobTop</sub> <sup>5)</sup> (Version: GlobTop <sup>6)</sup> )	T <sub>amb</sub> = (-40...+125)°C	-0.03	-	+0.03	%/K
V <sub>Off</sub>	Offset voltage per V <sub>CC</sub>		-3.0	-	3.0	mV/V
TC <sub>Voff</sub>	Temperature coefficient of differential V <sub>off</sub> <sup>7)</sup>	T <sub>amb</sub> = (-40...+125)°C	-3.0	-	+3.0	(μV/V)/K
φ	Phase between sine and cosine		88	90	92	deg
R <sub>B</sub>	Bridge resistance <sup>8)</sup>		6.0	10.0	14.0	kΩ
R <sub>S</sub>	Sensor resistance <sup>9)</sup>		3.0	5.0	7.0	kΩ
TC <sub>RS</sub>	Temperature coefficient of R <sub>S</sub> <sup>10)</sup>	T <sub>amb</sub> = (-40...+125)°C	-0.07	-0.05	-0.03	%/K

<sup>1)</sup> Maximal signal voltage without offset influences. Periodicity of V<sub>Peak</sub> is sin(α) and cos(α).

<sup>2)</sup>  $TC_{VPeak} = 100 \cdot \frac{V_{Peak}(T_2) - V_{Peak}(T_1)}{V_{Peak}(T_{RT}) \cdot (T_2 - T_1)}$  with T<sub>1</sub> = -40°C; T<sub>2</sub> = +125°C; T<sub>RT</sub> = +25°C.

<sup>3)</sup>  $k = 100 \cdot \frac{V_{Peak1}}{V_{Peak2}}$

<sup>4)</sup> Bare die on wafer-level or bare die encapsulated with Sil-Gel.

<sup>5)</sup>  $TC_k = 100 \cdot \frac{k_{T_2} - k_{T_1}}{k_{T_{RT}} \cdot (k_{T_2} - k_{T_1})}$  with T<sub>1</sub> = -40°C; T<sub>2</sub> = +125°C; T<sub>RT</sub> = +25°C.

<sup>6)</sup> Bare die mounted on PCB and encapsulated with epoxy-based dam & fill.

<sup>7)</sup>  $TC_{Voff} = 100 \cdot \frac{V_{off}(T_2) - V_{off}(T_1)}{(T_2 - T_1)}$  with T<sub>1</sub> = -40°C; T<sub>2</sub> = +125°C.

<sup>8)</sup> Bridge resistance between +V<sub>O1</sub> and -V<sub>O1</sub>, +V<sub>O2</sub> and -V<sub>O2</sub>.

<sup>9)</sup> Sensor resistance between V<sub>CC</sub> and GND.

<sup>10)</sup>  $TC_{RS} = 100 \cdot \frac{R_S(T_2) - R_S(T_1)}{R_S(T_{RT}) \cdot (T_2 - T_1)}$  with T<sub>1</sub> = -40°C; T<sub>2</sub> = +125°C; T<sub>RT</sub> = +25°C.

### Accuracy

$T_{amb} = (-40...+125) \text{ }^\circ\text{C}$ ;  $B_{ext}=(30...80) \text{ mT}$ ;  $V_{CC} = 5.0 \text{ V}$ ; unless otherwise specified

Symbol	Parameter	Conditions	min.	typ.	max.	Unit
$\Delta\alpha_{nom, comp} (AOP)$	Angular error	Amplitude, offset and phase compensation <sup>1)</sup> Version: Bare die / Sil-Gel <sup>2)</sup>	-	0.2	0.6	deg
$\Delta\alpha_{nom, comp} (AOP)$	Angular error	Amplitude, offset and phase compensation <sup>1)</sup> Version: GlobTop <sup>3)</sup>	-	0.7	1.4	deg
$\Delta\alpha_{nom, uncomp}$	Angular error	No compensation <sup>4)</sup>	-	1.0	2.0	deg
$\alpha_{Hys(30-50)}$	Hysteresis error	(30...50) mT	-	0.03	0.10	deg
$\alpha_{Hys(50-80)}$	Hysteresis error	(50...80) mT	-	0.01	0.03	deg

<sup>1)</sup>  $\Delta\alpha_{nom, comp} (AOP) = |\alpha_{real} - \alpha_{measured}|$  with single point amplitude, offset and phase compensation due to deviations from ideal sinusoidal characteristics, incl. hysteresis error. Single point compensation := one-time compensation at room temperature (+25 °C)

<sup>2)</sup> Bare die on wafer-level or bare die encapsulated with Sil-Gel.

<sup>3)</sup> Bare die mounted on PCB and encapsulated with epoxy-based dam & fill.

<sup>4)</sup>  $\Delta\alpha_{nom, uncomp} = |\alpha_{real} - \alpha_{measured}|$  without any signal compensation, incl. Hysteresis error.

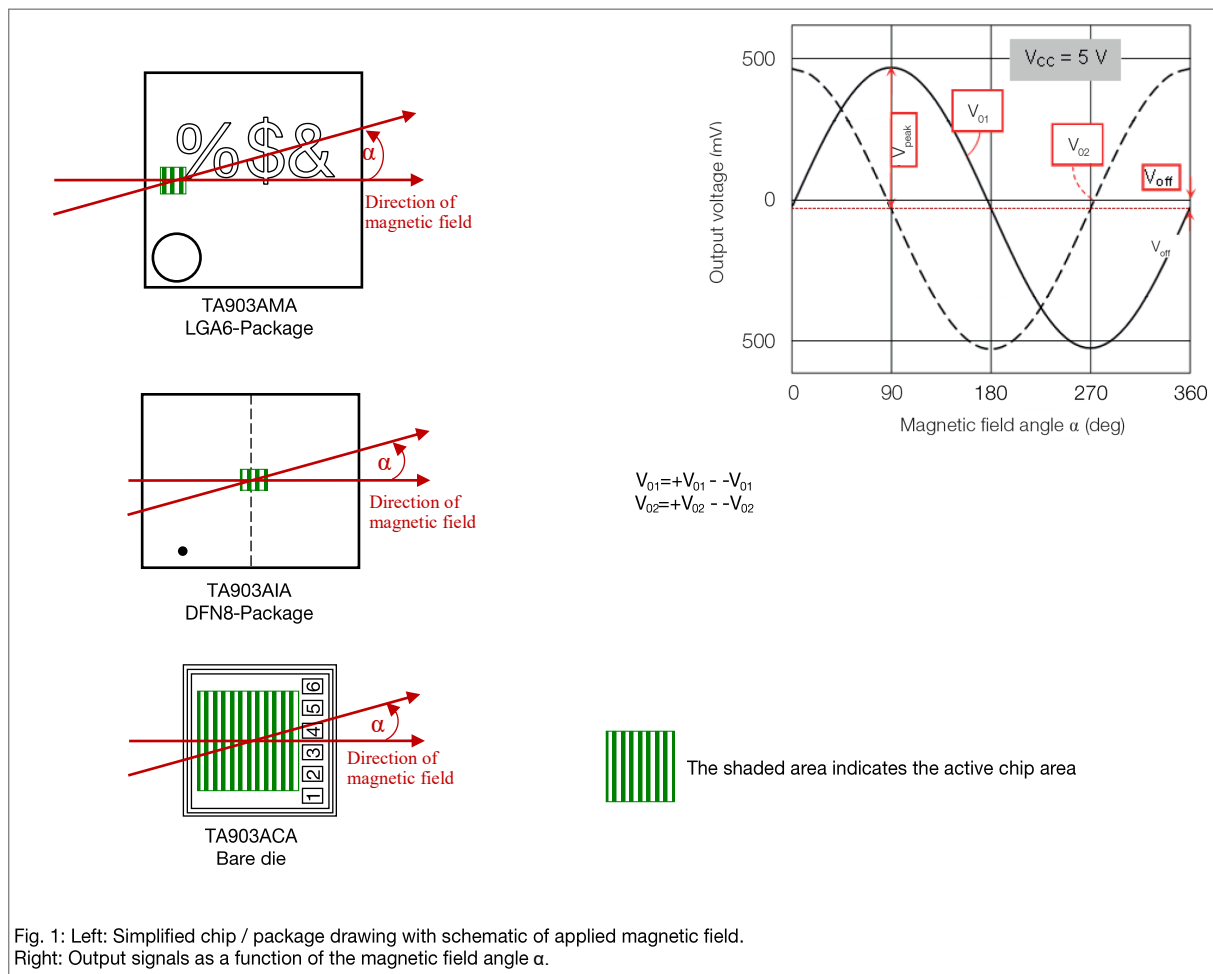


Fig. 1: Left: Simplified chip / package drawing with schematic of applied magnetic field. Right: Output signals as a function of the magnetic field angle  $\alpha$ .

Typical Performance Graphs

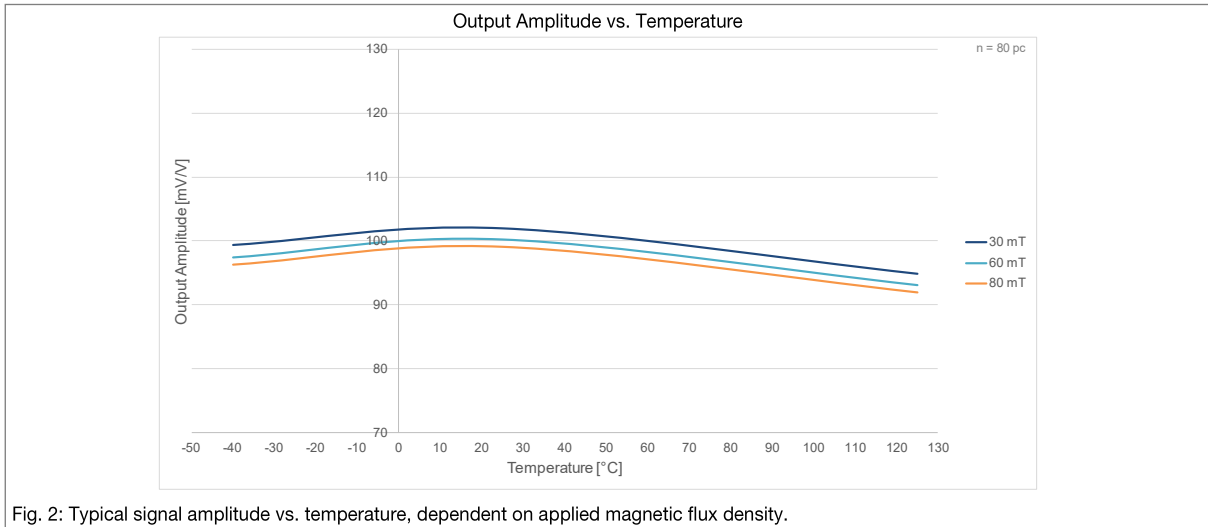


Fig. 2: Typical signal amplitude vs. temperature, dependent on applied magnetic flux density.

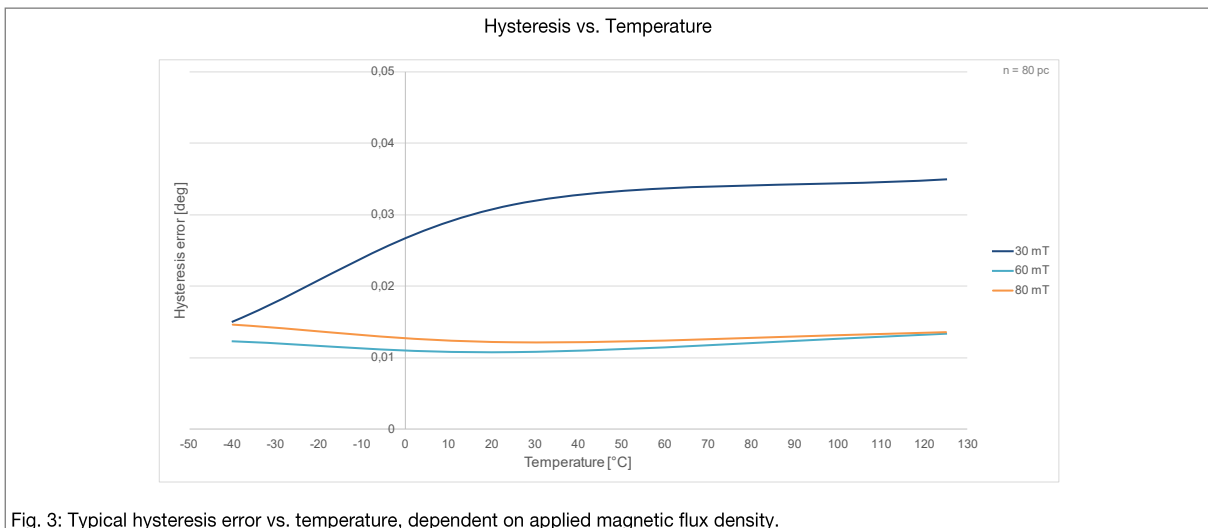


Fig. 3: Typical hysteresis error vs. temperature, dependent on applied magnetic flux density.

Typical Performance Graphs

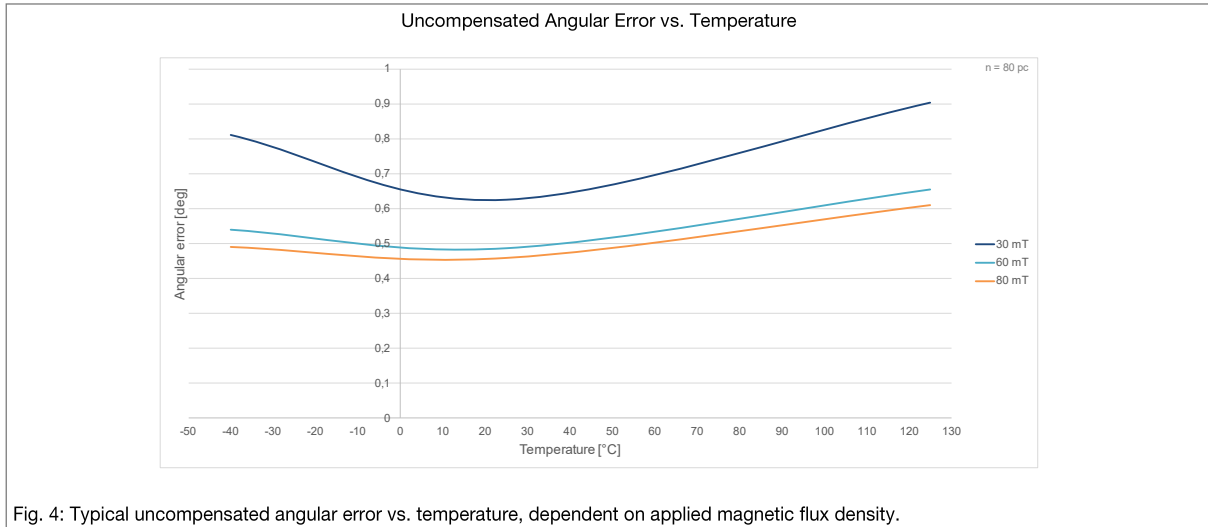


Fig. 4: Typical uncompensated angular error vs. temperature, dependent on applied magnetic flux density.

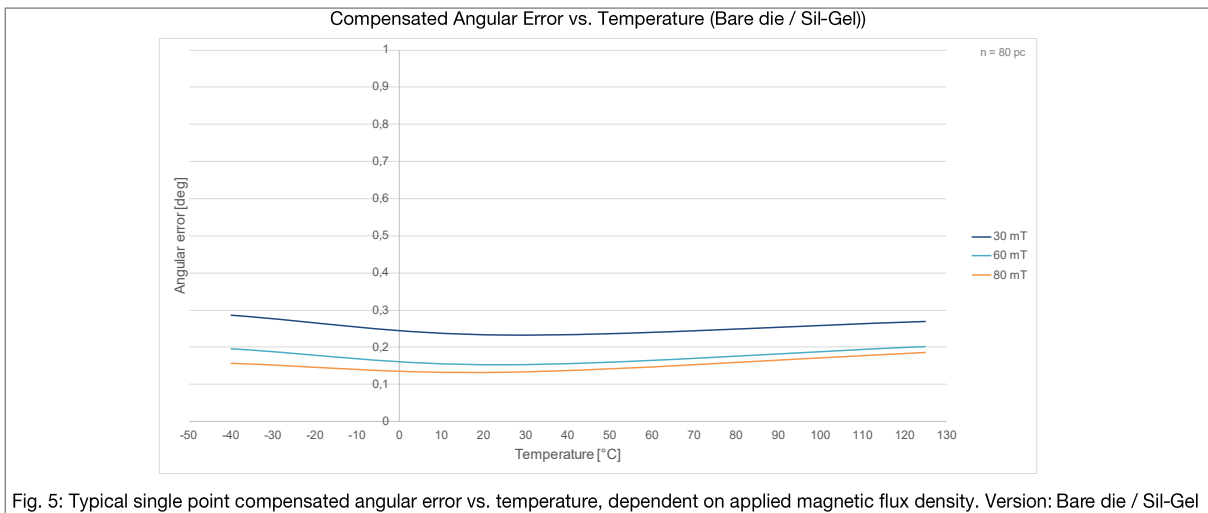


Fig. 5: Typical single point compensated angular error vs. temperature, dependent on applied magnetic flux density. Version: Bare die / Sil-Gel

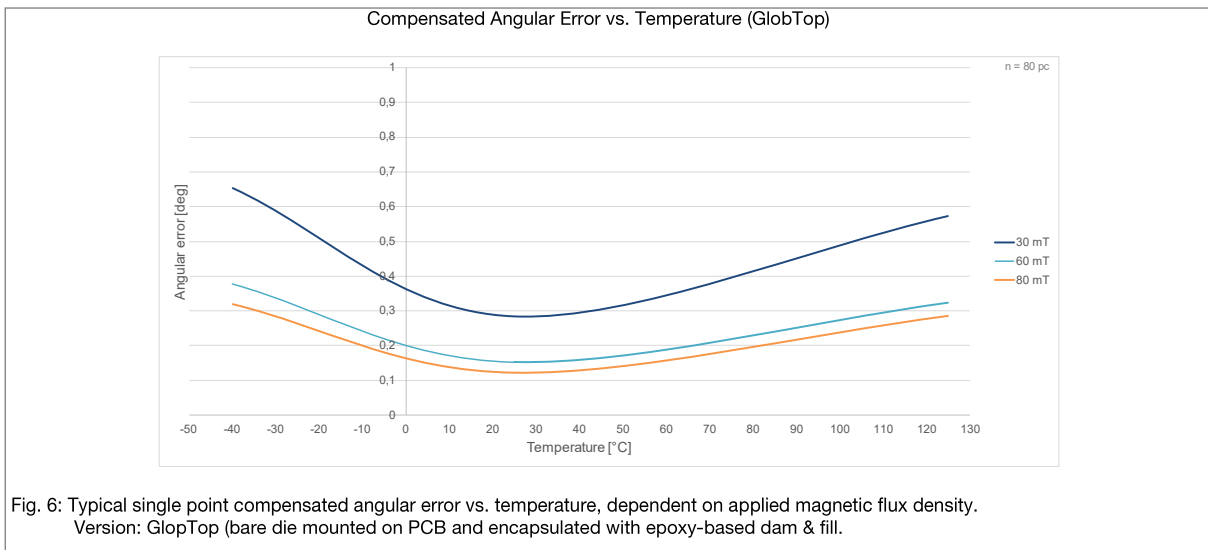


Fig. 6: Typical single point compensated angular error vs. temperature, dependent on applied magnetic flux density. Version: GlobTop (bare die mounted on PCB and encapsulated with epoxy-based dam & fill).

TA903 Bare die

Pinout

Pad	Symbol	Parameter
1	-V <sub>O1</sub>	Negative output voltage bridge 1
2	-V <sub>O2</sub>	Negative output voltage bridge 2
3	GND	Ground
4	+V <sub>O1</sub>	Positive output voltage bridge 1
5	+V <sub>O2</sub>	Positive output voltage bridge 2
6	V <sub>CC</sub>	Supply voltage

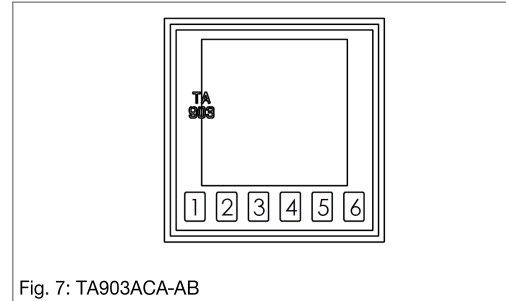


Fig. 7: TA903ACA-AB

Dimensions

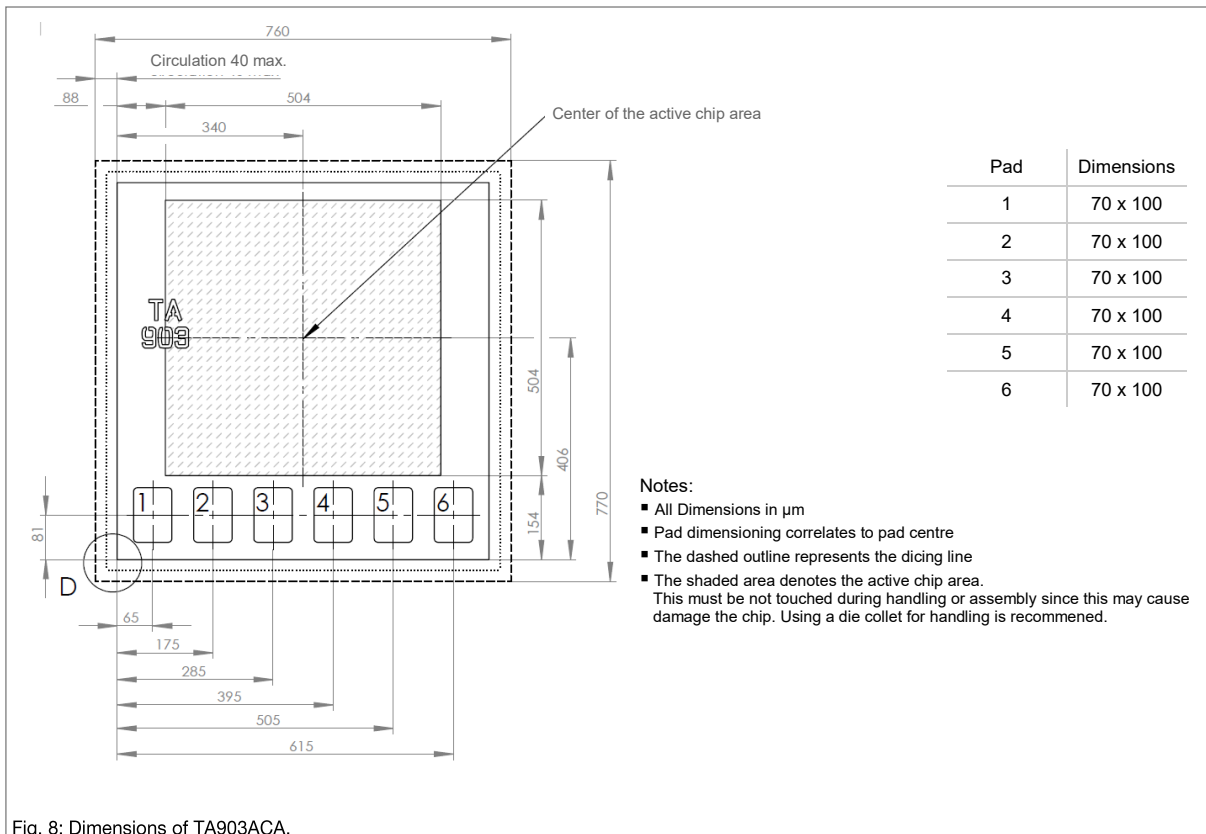


Fig. 8: Dimensions of TA903ACA.

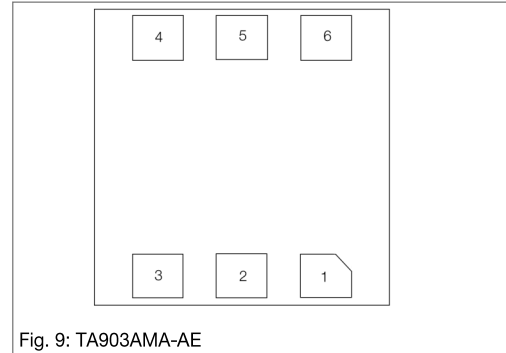
Data for Packaging and Interconnection Technologies

Parameter	Value	Unit
Chip area	$(0.76 \pm 0.1) \times (0.77 \pm 0.1)$	mm
Chip thickness	$254 \pm 10$	$\mu\text{m}$
Pad size	See Fig. 8	$\mu\text{m}$
Pad thickness	0.8	$\mu\text{m}$
Pad material	Al	-

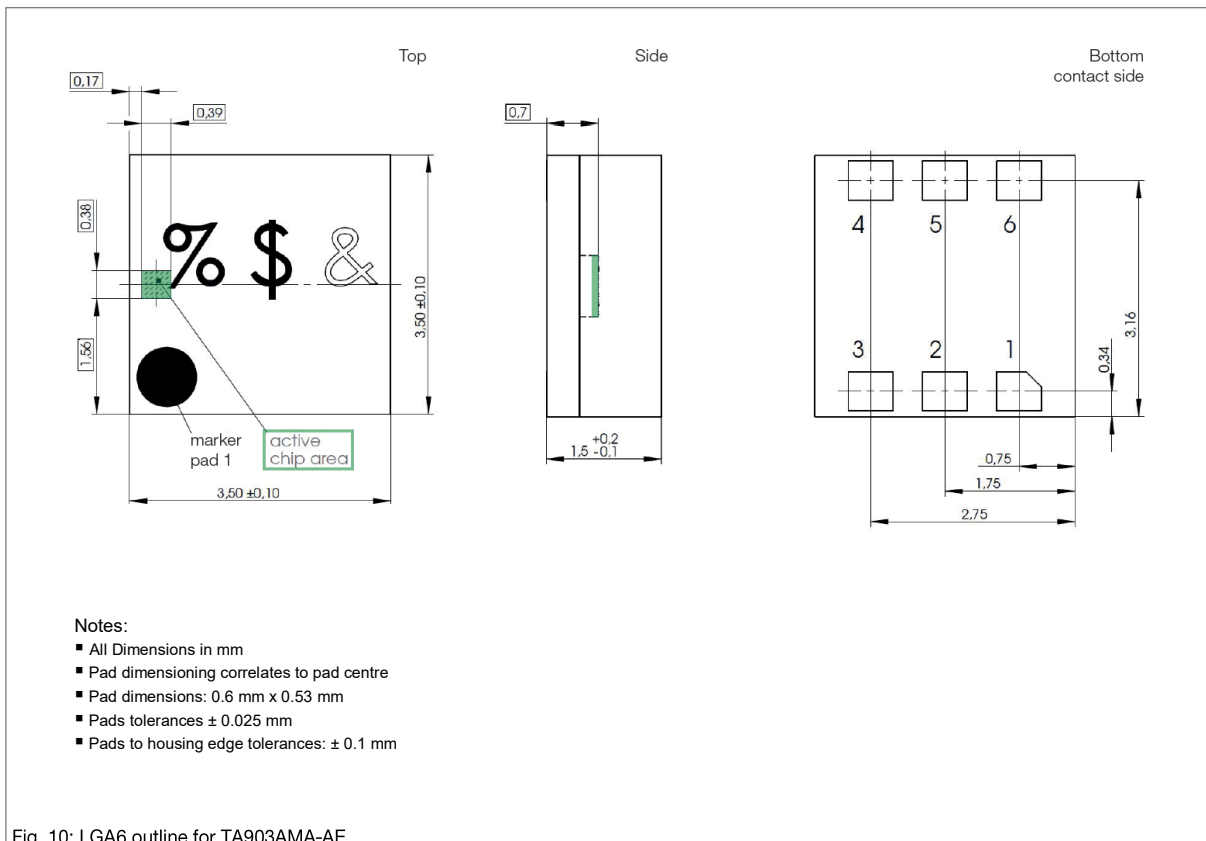
### TA903 LGA6 Package

#### Pinout

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



#### Dimensions



TA903 DFN8 Package

Pinout

Pad	Symbol	Parameter
1	+V <sub>O1</sub>	Positive output voltage bridge 1
2	GND	Ground
3	n.c.	Not connected
4	-V <sub>O1</sub>	Negative output voltage bridge 1
5	-V <sub>O2</sub>	Negative output voltage bridge 2
6	+V <sub>O2</sub>	Positive output voltage bridge 2
7	n.c.	Not connected
8	V <sub>CC</sub>	Supply voltage

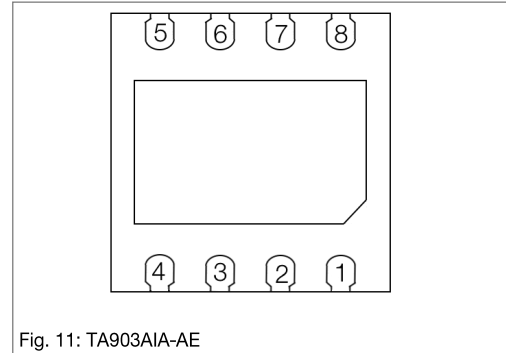


Fig. 11: TA903AIA-AE

Dimensions

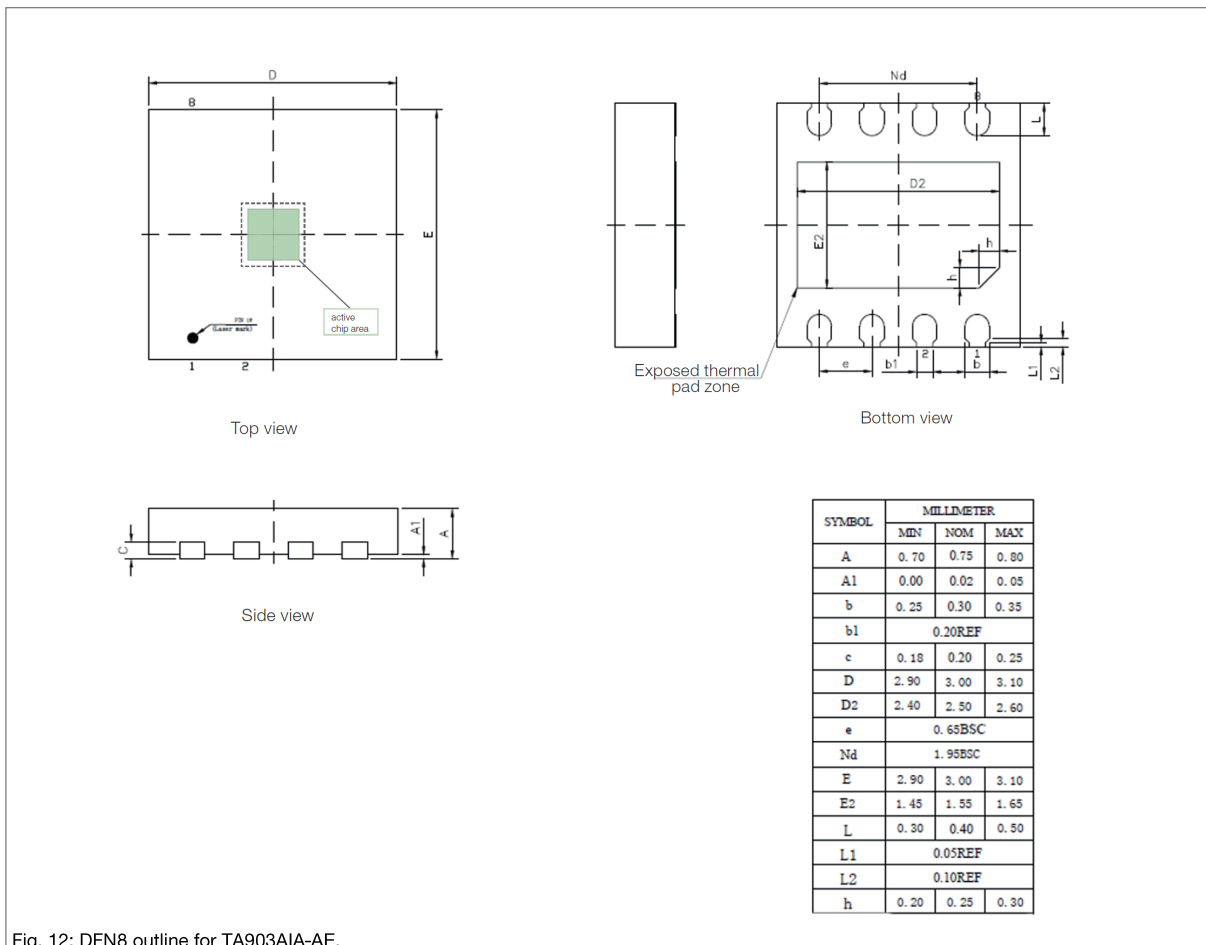
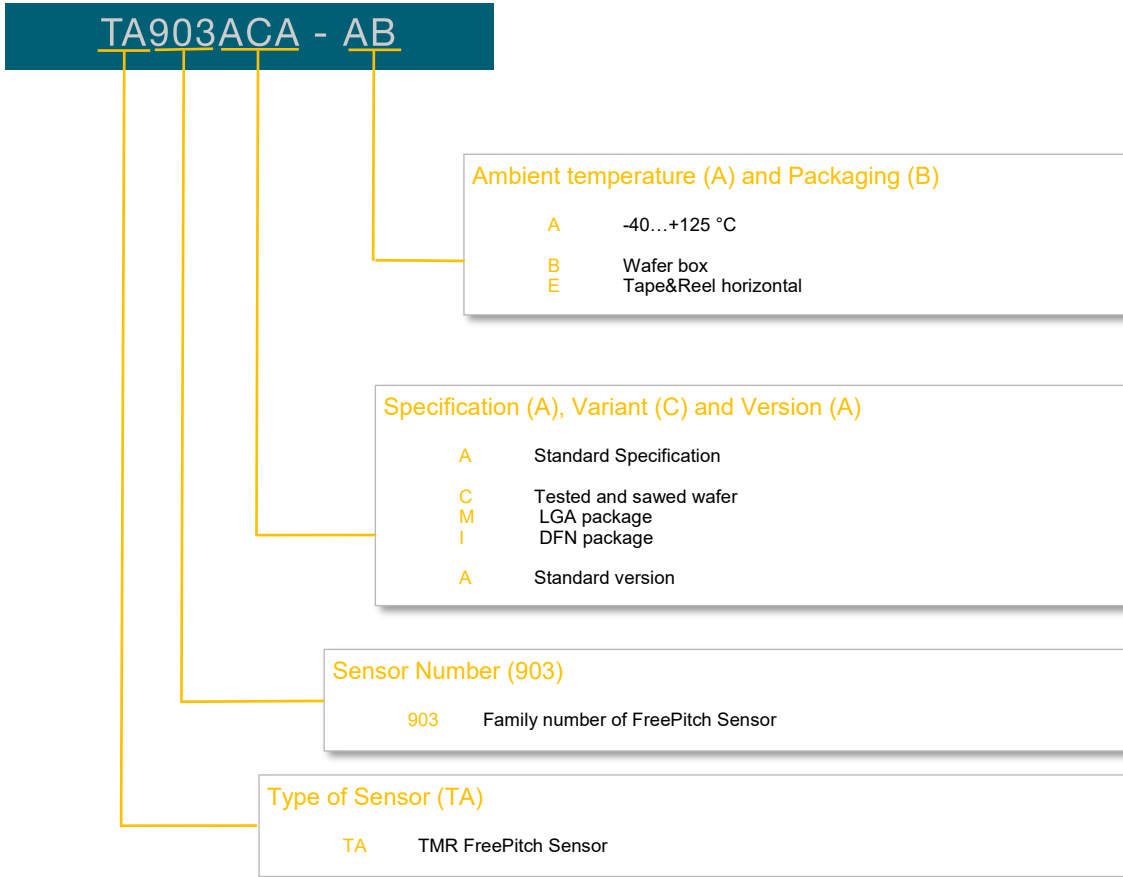


Fig. 12: DFN8 outline for TA903AIA-AE.



Additional Information on Ordering Code



## General Information

### Product Status

Article	Status
TA903ACA-AB	The product is in series production.
TA903AMA-AE	The product is under development, qualification is on going. Deliverables have a sample status. The datasheet is preliminary.
TA903AIA-AE	The product is under development, qualification is on going. Deliverables have a sample status. The datasheet is preliminary.
<b>Note</b>	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
TA903.DSE.08	Fix of incorrect y-axis labelling in Fig. 1 (p. 3), Change of corporate design (pp. 1-9)	05/2024
TA903.DSE.07	Disclaimer supplement	06/2022
TA903.DSE.06	Install Chipposition in the DFN8 drawing (p. 8)	03/2022
TA903.DSE.05	Change of corporate design (pp. 1-10)	01/2022
TA903.DSE.00	Original (pp. 1-7)	11/2016

### 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