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KÖRBER SOLUTIONS

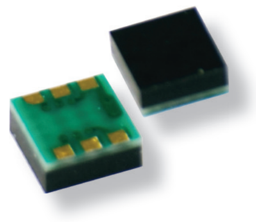
TA903

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. They are shifted at a relative angle of 90° to one another.

A rotating magnetic field in the sensor plane delivers two sinusoidal output signals depending on the angle α 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 avaliable as a bare die for chip on board processing. For SMD process the TA903 is avaliable in a LGA6B package or in a DFN8 package.



Product Overview

Article Description	Package	Delivery Type
TA903ACA-AB	Die on wafer [1]	Waferbox
TA903AMA-AE	LGA6B	Tape and Reel
TA903AIA-AE	DFN8	Tape and Reel

[1] Minimum order quantities apply.

Quick Reference Guide

Symbol	Parameter	Min.	Typ.	Max.	Unit
V_{CC}	Supply voltage	1.8	5.0	5.5	V
V_{OUT}	Output amplitude per V_{CC}	70	100	130	mV/V
V_{OFF}	Offset voltage per V_{CC}	-3.0	-	+3.0	mV/V
R_B	Bridge resistance	6.0	10.0	14.0	kΩ
R_S	Sensor resistance	3.0	5.0	7.0	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
H_{ext}	External magnetic field strength	-	180	mT
ESD HBM	ESD tolerance according to HBM (for TA903ACA-AB)	-	200	V
ESD HBM	ESD tolerance according to HBM (for TA903AMA-AE, TA903AIA-AE)	-	2000	V
T_{amb}	Operating ambient temperature	-40	+125	°C
T_{stg}	Storage temperature	-40	+125	°C
T_{reflow}	Reflow temperature [1]	-	+250	°C

[1] 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 rotatory motion)
- Motor commutation
- Rotational speed measurement
- Angle measurement (360° absolute at end of shaft)

ESD

RoHS-Compliant www.sensitec.com

Magnetic Data

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
B_{ext}	Magnetic flux density		30	-	80	mT

Electrical Data

T_{amb} = 25 °C; B_{ext} = 30 mT; V_{CC} = 5 V; unless otherwise specified

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
V_{CC}	Supply voltage		1.8	5.0	5.5	V
V_{OUT}	Output amplitude per V_{CC} [1]		70	100	130	mV/V
TC_{VOUT}	Temperature coefficient of output amplitude [2]	T_{amb} = (-40...+125)°C	-0.25	-0.10	0.00	%/K
$k_{BareDie}$	Amplitude synchronism [3] (Version: Bare die / Sil-Gel [4])		98	100	102	%
$TC_{k(BareDie)}$	Temperature coefficient of amplitude synchronism [5] (Version: Bare die / Sil-Gel [4])	T_{amb} = (-40...+125)°C	-0.01	-	+0.01	%/K
$k_{GlobTop}$	Amplitude synchronism [3] (Version: GlobTop [6])		97	100	103	%
$TC_{k(GlobTop)}$	Temperature coefficient of amplitude synchronism [5] (Version: GlobTop [6])	T_{amb} = (-40...+125)°C	-0.03	-	+0.03	%/K
V_{OFF}	Offset voltage per V_{CC}		-3.0	-	+3.0	mV/V
TC_{VOFF}	Temperature coefficient of differential offset voltage [7]	T_{amb} = (-40...+125)°C	-3.0	-	+3.0	µV/V/K
φ	Phase between sine and cosine		88	90	92	deg
R_B	Bridge resistance [8]		6.0	10.0	14.0	kΩ
R_S	Sensor resistance [9]		3.0	5.0	7.0	kΩ
TC_{RS}	Temperature coefficient of sensor resistance [10]	T_{amb} = (-40...+125)°C	-0.07	-0.05	-0.03	%/K

1) Maximal output voltage without offset influences. Periodicity of V_{OUT} is sinα and cosα

2) $TC_{VOUT} = 100 \cdot \frac{V_{OUT(T2)} - V_{OUT(T1)}}{V_{OUT(TRT)} \cdot (T_2 - T_1)}$ with T_1 = -40 °C; T_2 = +125 °C; T_{RT} = +25 °C

3) $k = 100 \cdot \frac{V_{OUT1}}{V_{OUT2}}$

4) Bare die on wafer-level or bare die encapsulated with Sil-Gel.

5) $TC_k = 100 \cdot \frac{k_{T2} - k_{T1}}{k_{TRT} \cdot (T_2 - T_1)}$ with T_1 = -40 °C; T_2 = +125 °C; T_{RT} = +25 °C

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

7) $TC_{VOFF} = \frac{V_{OFF(T2)} - V_{OFF(T1)}}{T_2 - T_1}$ with T_1 = -40 °C; T_2 = +125 °C

8) Bridge resistance between pads $+V_{01}$ and $-V_{01}$, $+V_{02}$ and $-V_{02}$

9) Sensor resistance between pads V_{CC} and GND.

10) $TC_{RS} = 100 \cdot \frac{R_{S(T2)} - R_{S(T1)}}{R_{S(TRT)} \cdot (T_2 - T_1)}$ with T_1 = -40 °C; T_2 = +125 °C; T_{RT} = +25 °C

Accuracy

T_{amb} = (-40...+125) °C; B_{ext} = (30...80) mT; V_{CC} = 5 V; unless otherwise specified.

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

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

2) Bare die on wafer-level or bare die encapsulated with Sil-Gel.

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

4) $\Delta\alpha_{nom,\ uncomp} = |\alpha_{real} - \alpha_{measured}|$ without any signal compensation, incl. hysteresis error.

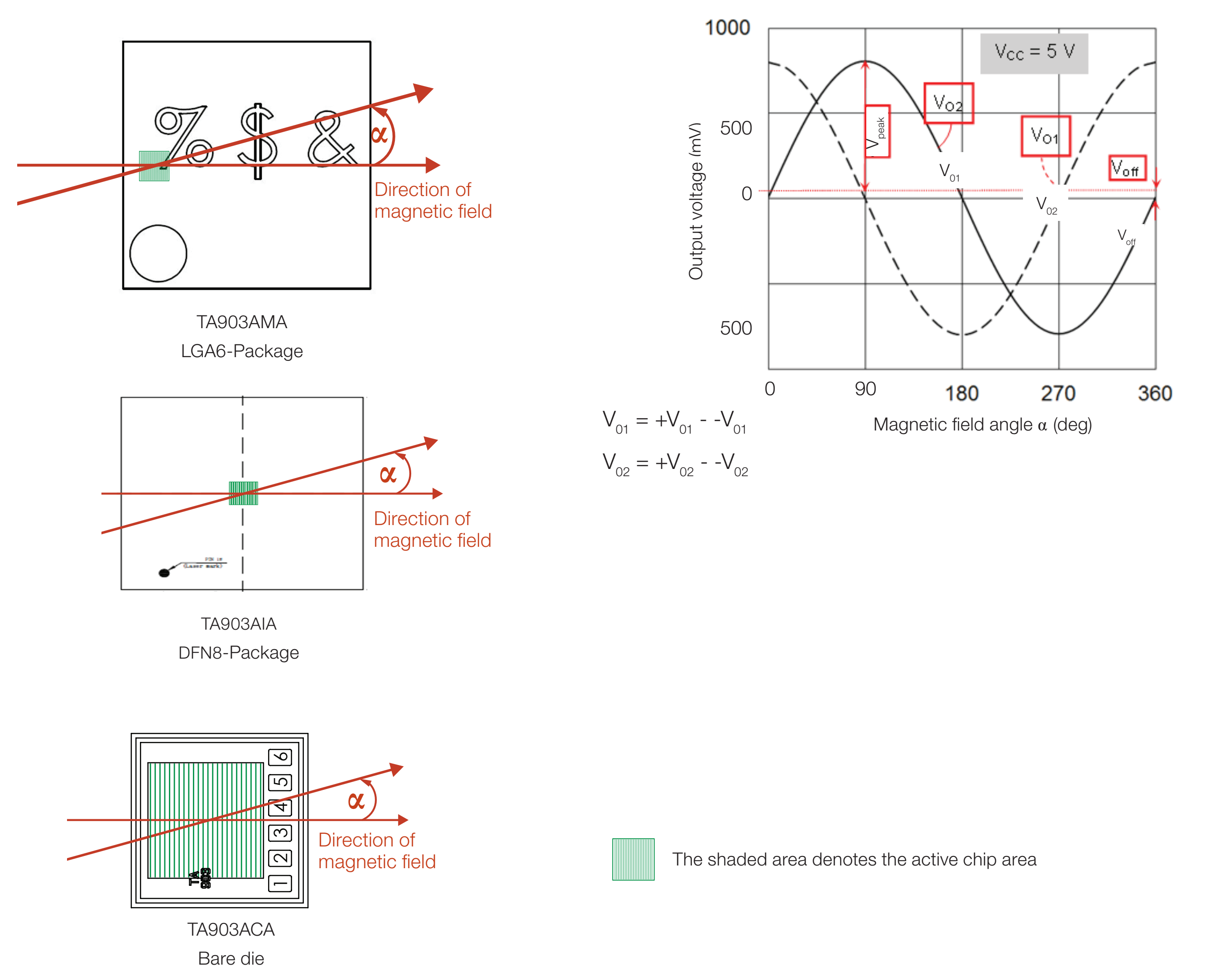


Fig. 1: Left: Simplified chip / package drawing with schematic of applied magnetic field.
Right: Output signals as a function of the magnetic field angle α.

Typical Performance Graphs

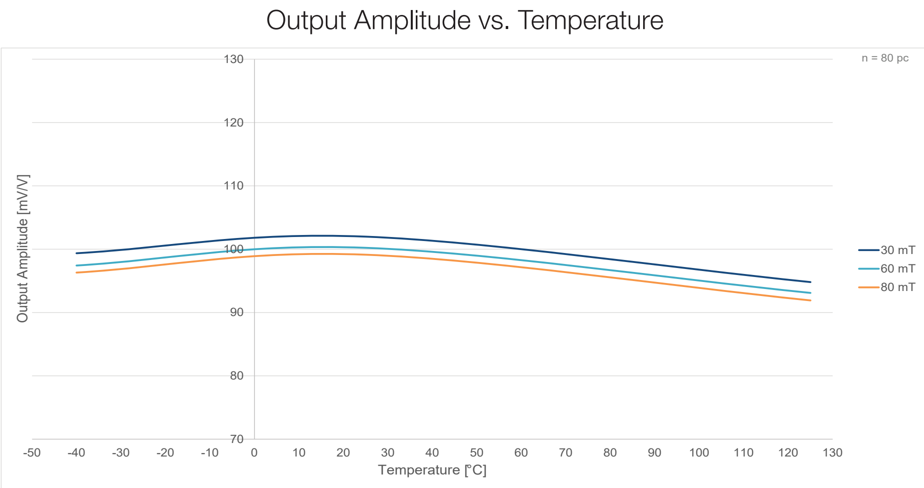


Fig. 2: Typical signal amplitude vs. temperature, dependent on applied magnetic flux density.

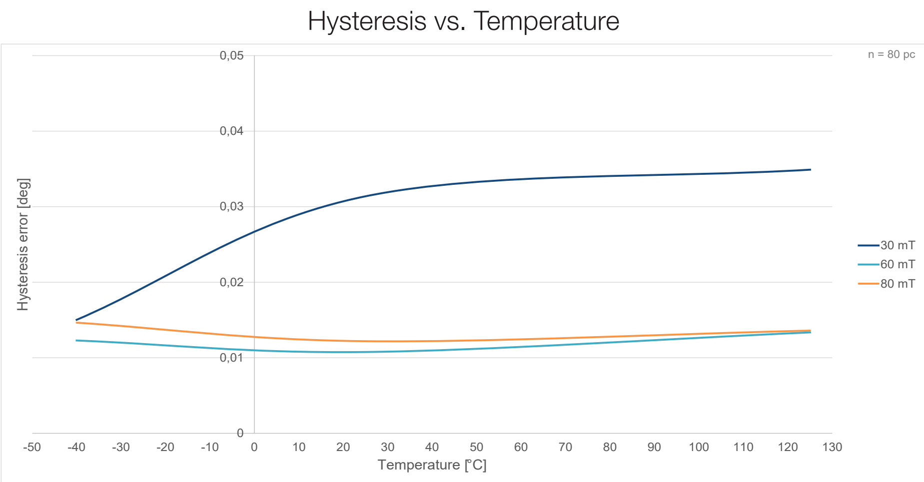


Fig. 3: Typical hysteresis error vs. temperature, dependent on applied magnetic flux density.

Typical Performance Graphs

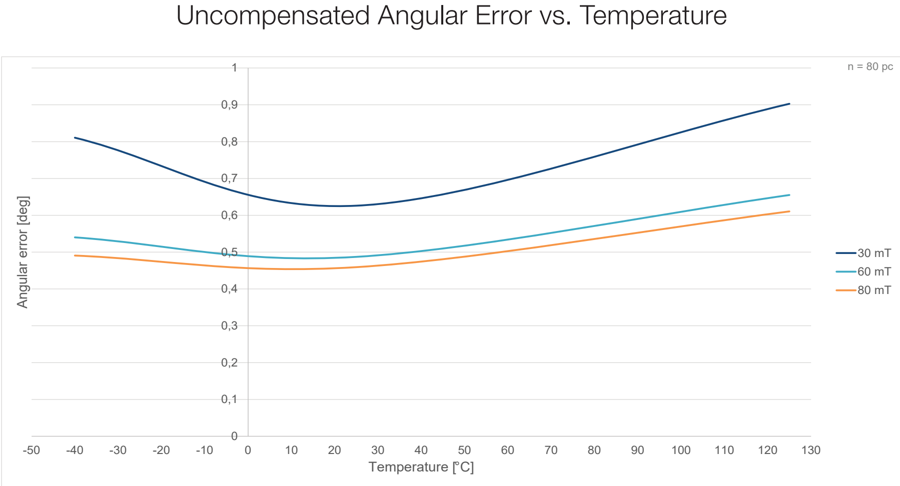


Fig. 4: Typical uncompensated angular error vs. temperature, dependent on applied magnetic flux density.

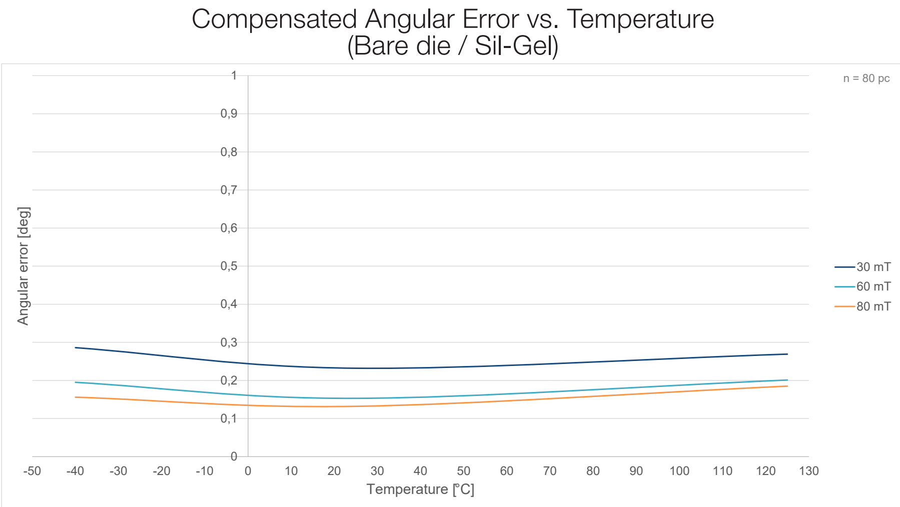


Fig. 5: Typical single point compensated angular error vs. temperature, dependent on applied magnetic flux density. Version: Bare die / Sil-Gel.

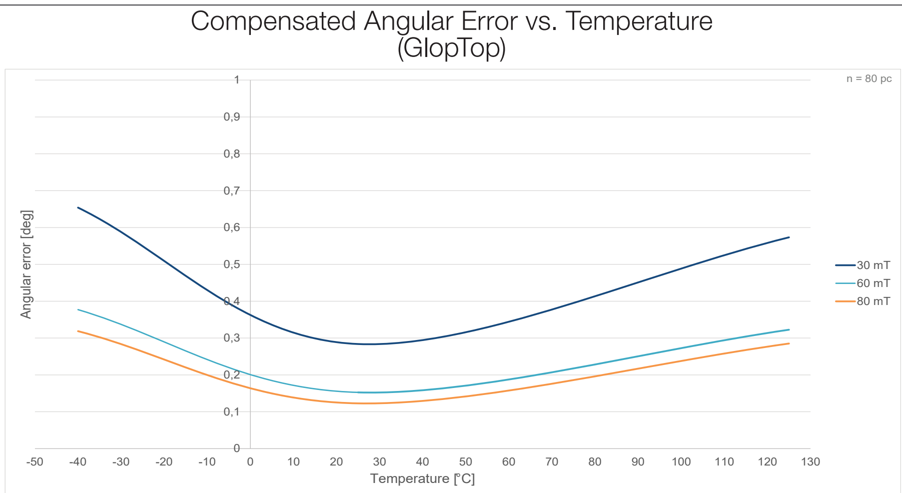


Fig. 6: Typical single point compensated angular error vs. temperature, dependent on applied magnetic flux density.
Version: GlopTop (bare die mounted on PCB and encapsulated with epoxy-based dam & fill.

TA903 Bare die

Pinning

Pad	Symbol	Parameter
1	$-V_{01}$	Negative output voltage bridge 1
2	$-V_{02}$	Negative output voltage bridge 2
3	GND	Ground
4	$+V_{02}$	Positive output voltage bridge 2
5	$+V_{01}$	Positive output voltage bridge 1
6	V_{CC}	Supply voltage

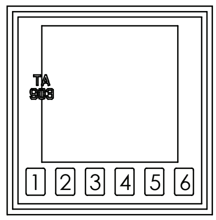
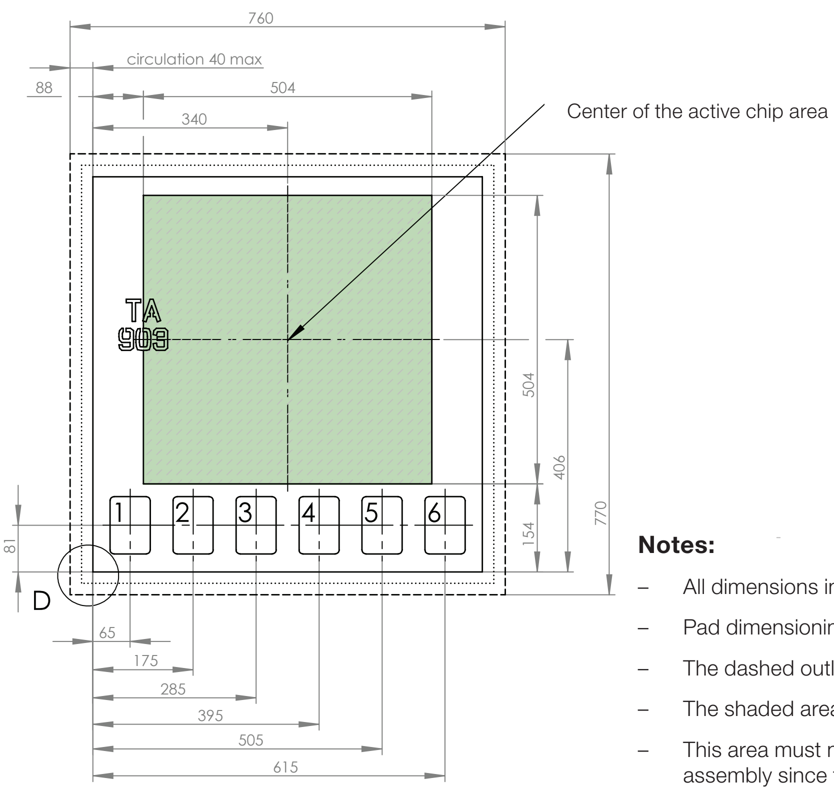


Fig. 7: TA903ACA-AB

Dimensions



Pad	Dimensions
1	70 x 100
2	70 x 100
3	70 x 100
4	70 x 100
5	70 x 100
6	70 x 100

Notes:

- All dimensions in µm
- Pad dimensioning correlates to pad centre
- The dashed outline represents the dicing lane
- The shaded area denotes the active chip area
- This area must not be touched during handling or assembly since this may cause damage to the chip

Fig. 8: Dimensions of TA903ACA.

Data for Packaging and Interconnection Technologies

Parameter	Value	Unit
Chip area	(0.76 ± 0.1) x (0.77 ± 0.1)	mm
Chip thickness	254 ± 10	µm
Pad diameter (all)	See Fig. 8	µm
Pad thickness	0.8	µm
Pad material	Al	-

TA903 LGA6 Package

Pinning

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

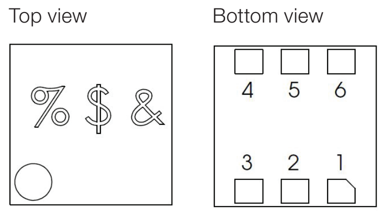
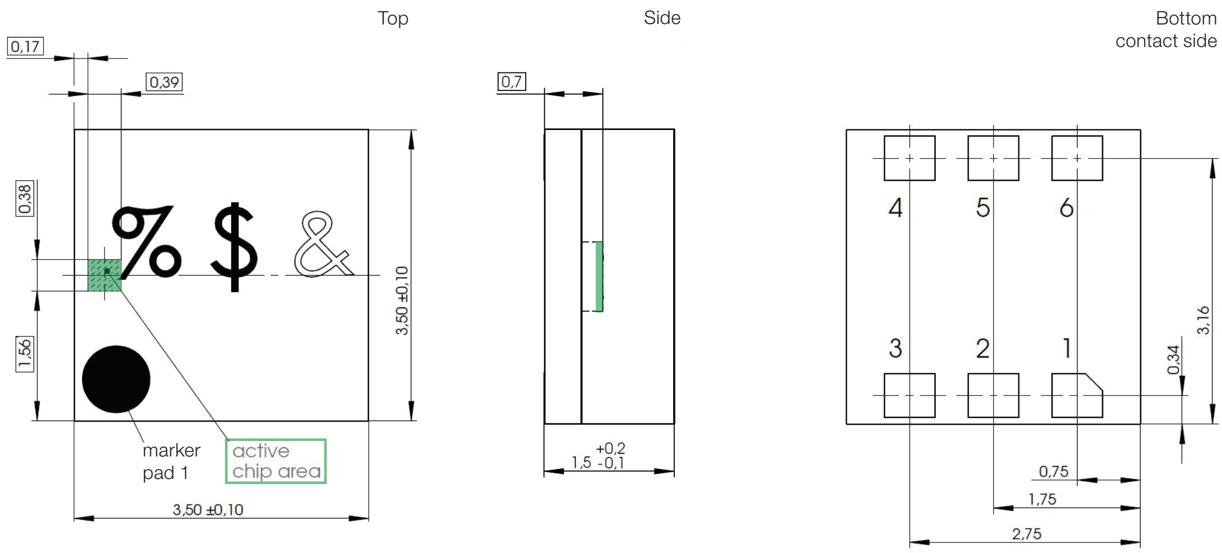


Fig. 9: TA903AMA-AE.

Dimensions



Notes

- All dimensions in mm
- Pad dimensioning correlates to pad centre
- Pad dimensions: 0.6 mm x 0.53 mm

Tolerances

- Pads: ± 0.025 mm
- Pads to housing edge: ± 0.1 mm

Fig. 10: LGA6 outline for TA903AMA-AE.

TA903 DFN8 Package

Pinning

Pad	Symbol	Parameter
1	+VO1	Positive output voltage bridge 1
2	GND	Ground
3	n.c.	Not connected
4	-VO1	Negative output voltage bridge 1
5	-VO2	Negative output voltage bridge 2
6	+VO2	Positive output voltage bridge 2
7	n.c.	Not connected
8	V_{cc}	Supply voltage

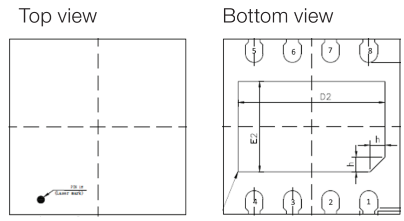
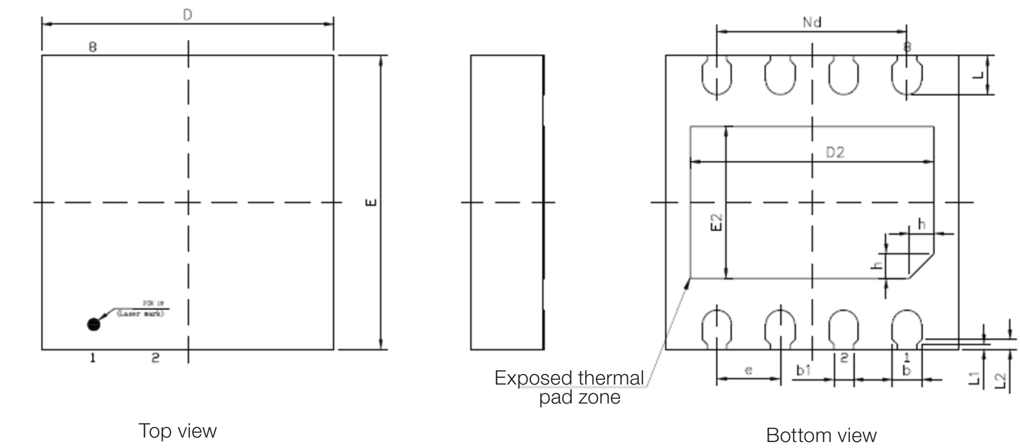
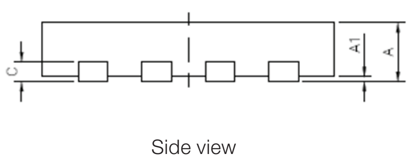


Fig. 11: TA903AIA-AE





SYMBOL	MILLIMETER		
	MIN	NOM	MAX
A	0. 70	0.75	0. 80
A1	0.00	0.02	0. 05
b	0. 25	0.30	0. 35
b1	0.20REF		
c	0. 18	0.20	0. 25
D	2. 90	3. 00	3. 10
D2	2. 40	2. 50	2. 60
e	0. 65BSC		
Nd	1. 95BSC		
E	2. 90	3. 00	3. 10
E2	1. 45	1. 55	1. 65
L	0. 30	0.40	0. 50
L1	0.05REF		
L2	0.10REF		
h	0. 20	0. 25	0. 30

Fig. 12: DFN8 outline for TA903AIA-AE.

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.
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.

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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
TA903.DSE.04	Extansion: TA903AIA-AE | Chip thickness (p. 6)	06/2021
TA903.DSE.03	Various textual changes	01/2020
TA903.DSE.02	Various textual changes	10/2019
TA903.DSE.01	Various textual changes	01/2019
TA903.DSE.00	Original (pp. 1-7)	11/2016

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