

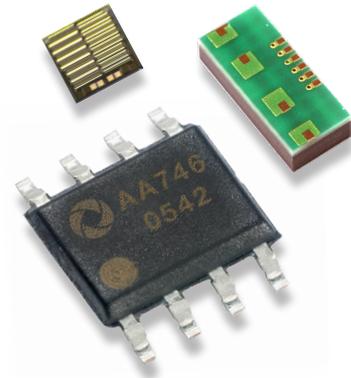
# AA746C

## MagnetoResistive FreePitch Sensor

The AA746 is an angle sensor based on the Anisotropic MagnetoResistive (AMR) effect. The sensor contains two Wheatstone bridges with common ground (GND) and supply pin ( $V_{CC}$ ). They are shifted at a relative angle of  $45^\circ$  to one another.

A rotating magnetic field in the sensor plane delivers two sinusoidal output signals with the double frequency of the angle  $\alpha$  between sensor and magnetic field direction shown in Fig. 1. The function of these signals is  $\sin(2\alpha)$  and  $\cos(2\alpha)$ .

The AA746 is optimized for a low magnetic field strength down to 5 kA/m.



### Product Overview

Article description	Package	Delivery Type
AA746CCA-AB	Die on wafer	Waferbox
AA746CMA-AE	LGA6L	Tape and Reel (2500)
AA746CHA-AE	SO8	Tape and Reel (4000)

### Quick Reference Guide

Symbol	Parameter	Min.	Typ.	Max.	Unit
$V_{CC}$	Supply voltage	-	5.0	-	V
$V_{off}$	Offset voltage per $V_{CC}$	-2.0	-	+2.0	mV/V
$V_{peak}$	Signal amplitude per $V_{CC}$	10.5	11.5	12.5	mV/V
$R_s$	Sensor resistance	0.80	0.95	1.10	k $\Omega$

### Absolute Maximum Ratings

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

Symbol	Parameter	Min.	Max.	Unit
$V_{CC}$	Supply voltage	-9.0	+9.0	V
$T_{amb}$	Ambient temperature	-40	+125	$^\circ\text{C}$

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 Anisotropic MagnetoResistive (AMR) effect
- Contains two Wheatstone bridges
- Sine and cosine output
- Temperature range from  $-40^\circ\text{C}$  to  $+125^\circ\text{C}$

### Advantages

- Non-contacting angle measurement
- Large air gap
- Excellent accuracy
- Position tolerant
- Minimal offset voltage
- Negligible hysteresis

### Applications

- Incremental or absolute position measurement (linear and rotary motion)
- Motor commutation
- Rotational speed measurement
- Angle measurement ( $180^\circ$  absolute on shaft end)



ESD



## Magnetic Data

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
$H_{ext}$	Magnetic field strength <sup>1)</sup>		5.0	-	-	kA/m

<sup>1)</sup> The stimulating magnetic field in the sensor plane necessary to ensure the minimum error as specified in note 8.

## Electrical Data

$T_{amb} = 25\text{ °C}$ ;  $H_{ext} = 25\text{ kA/m}$ ;  $V_{CC} = 5\text{ V}$ ; unless otherwise specified.

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
$V_{CC}$	Supply voltage		-	5.0	-	V
$V_{off}$	Offset voltage per $V_{CC}$	See Fig. 1	-2.0	-	+2.0	mV/V
$TC_{Voff}$	Temperature coefficient of $V_{off}$ <sup>2)</sup>	$T_{amb} = (-40...+125)\text{ °C}$	-2.0	-	+2.0	( $\mu\text{V}/\text{V}$ )/K
$V_{peak}$	Signal amplitude per $V_{CC}$ <sup>3)</sup>	See Fig. 1	10.5	11.5	12.5	mV/V
$TC_{Vpeak}$	Temperature coefficient of $V_{peak}$ <sup>4)</sup>	$T_{amb} = (-40...+125)\text{ °C}$	-0.36	-0.42	-0.48	%/K
$R_S$	Sensor resistance <sup>5)</sup>		0.80	0.95	1.10	k $\Omega$
$R_B$	Bridge resistance <sup>6)</sup>		1.6	1.9	2.2	k $\Omega$
$TC_{RB}$	Temperature coefficient of $R_B$ <sup>7)</sup>	$T_{amb} = (-40...+125)\text{ °C}$	0.22	0.26	0.30	%/K

$$^2) TC_{Voff} = \frac{V_{off(T_2)} - V_{off(T_1)}}{T_2 - T_1} \text{ with } T_1 = +25\text{ °C}; T_2 = +125\text{ °C}.$$

<sup>3)</sup> Maximal output voltage without offset influences. Periodicity of  $V_{peak}$  is  $\sin(2\alpha)$  and  $\cos(2\alpha)$ .

$$^4) TC_{Vpeak} = 100 \cdot \frac{V_{peak(T_2)} - V_{peak(T_1)}}{V_{peak(T_1)} \cdot (T_2 - T_1)} \text{ with } T_1 = +25\text{ °C}; T_2 = +125\text{ °C}.$$

<sup>5)</sup> Sensor resistance between pads 1 and 2 (bare die); pads 3 and 4 (LGA6L); pads 1/2 and 3/4 (SO8).

<sup>6)</sup> Bridge resistance between pads 3 and 4; pads 5 and 6 (bare die); pads 1 and 5, pads 2 and 6 (LGA6L), pads 5 and 6, pads 7 and 8 (SO8).

$$^7) TC_{RB} = 100 \cdot \frac{R_{B(T_2)} - R_{B(T_1)}}{R_{B(T_1)} \cdot (T_2 - T_1)} \text{ with } T_1 = +25\text{ °C}; T_2 = +125\text{ °C}.$$

## Accuracy

$T_{amb} = 25\text{ °C}$ ;  $H_{ext} = 5\text{ kA/m}$ ;  $V_{CC} = 5\text{ V}$ ; unless otherwise specified.

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
$\Delta\alpha$	Angular error <sup>8)</sup>		-	$\pm 0.25$	$\pm 0.4$	deg
Hyst	Angle hysteresis <sup>9)</sup>		-	$\pm 0.20$	$\pm 0.3$	deg
k	Amplitude synchronism <sup>10)</sup>		-0.5	0	+0.5	% of $V_{peak}$

<sup>8)</sup>  $\Delta\alpha = |x_{real} - x_{measured}|$  without offset influences due to deviations from ideal sinusoidal characteristics.

<sup>9)</sup> Angular difference between clockwise and counterclockwise rotation.

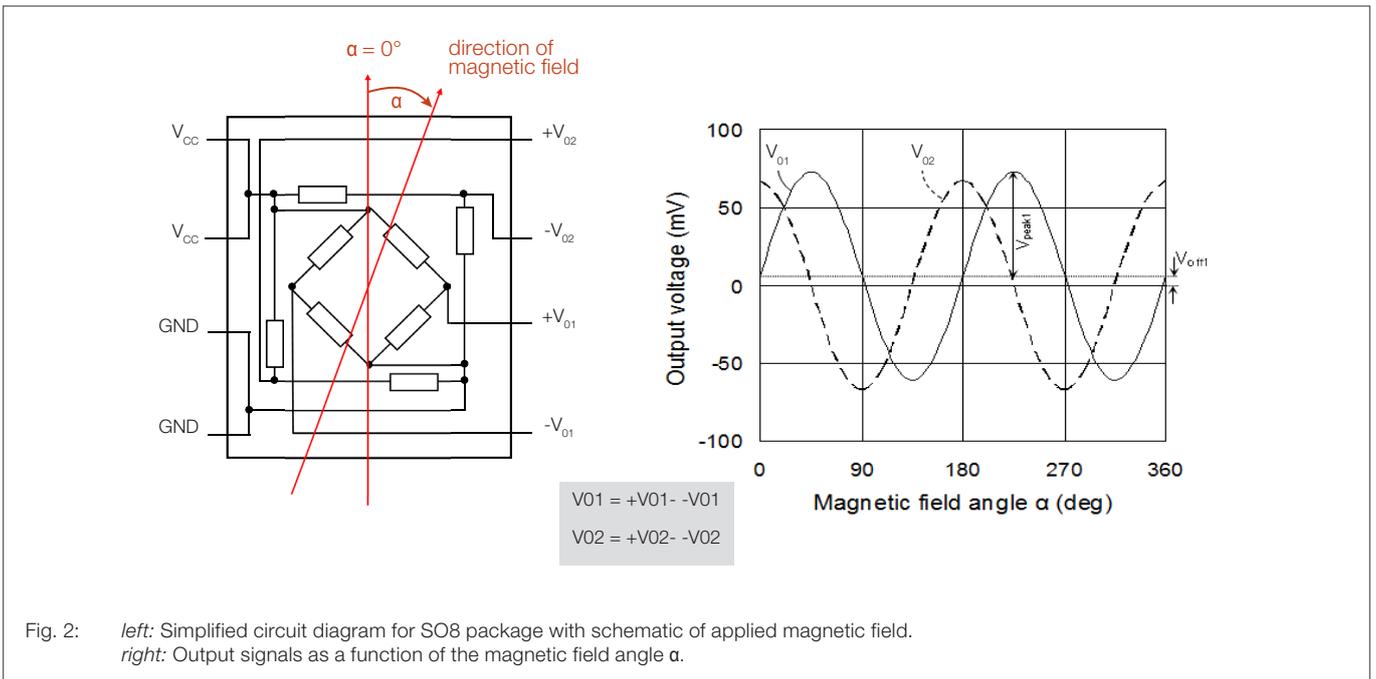
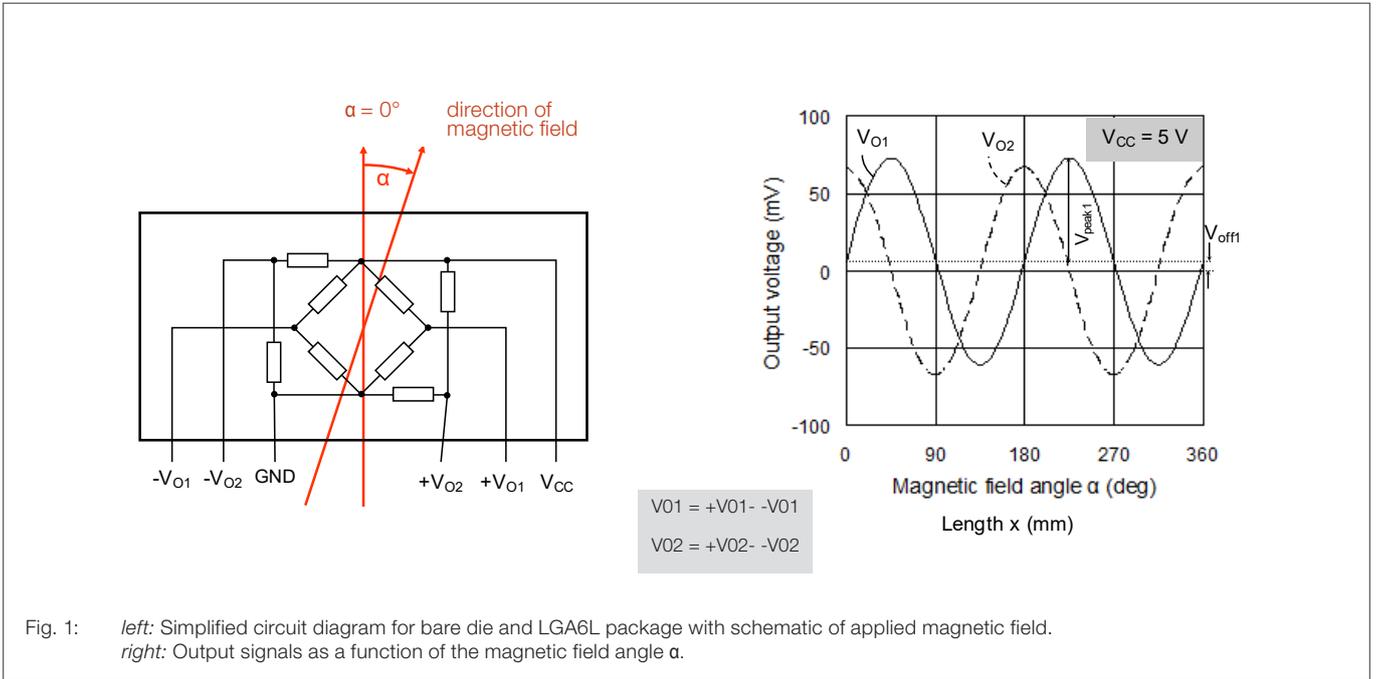
$$^10) k = 100 - 100 \cdot \frac{V_{peak1}}{V_{peak2}}.$$

## Dynamic Data

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
$\omega$	Angular velocity of the magnetic field <sup>11)</sup>		1	-	-	MHz

<sup>11)</sup> No significant amplitude attenuation.

General Data



General Data

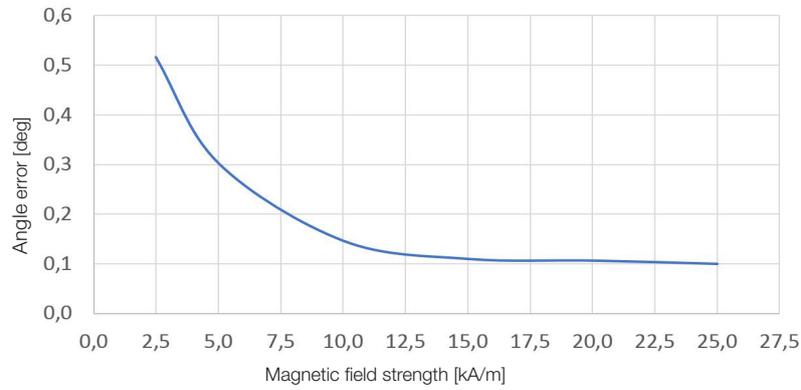


Fig. 3: Typical angle error vs. applied magnetic field strength.

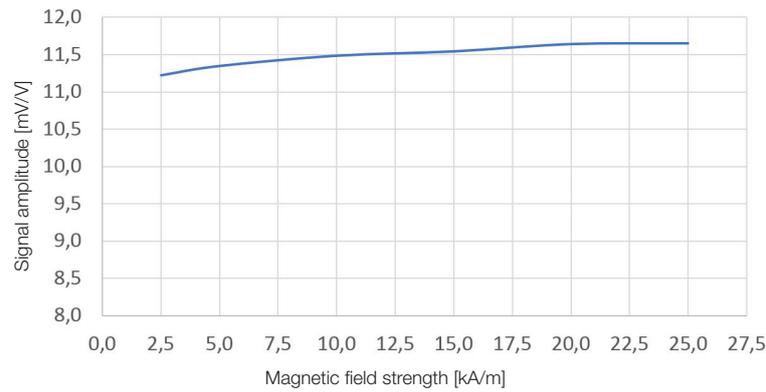


Fig. 4: Typical signal amplitude vs. applied magnetic field strength.

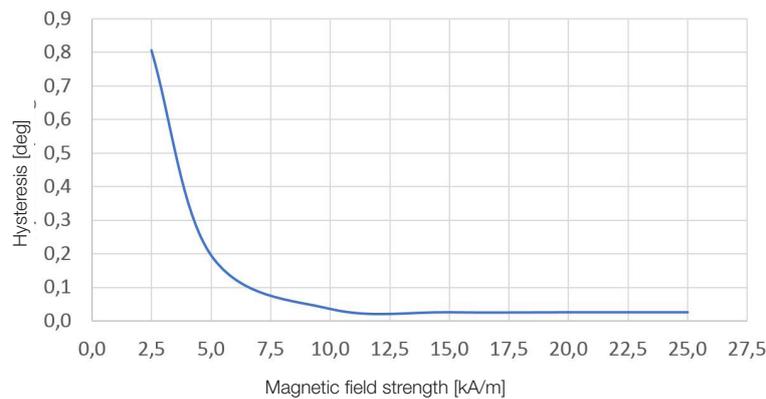


Fig. 5: Typical angle hysteresis vs. applied magnetic field strength.

### AA746CCA as Bare Die

#### Pinning

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

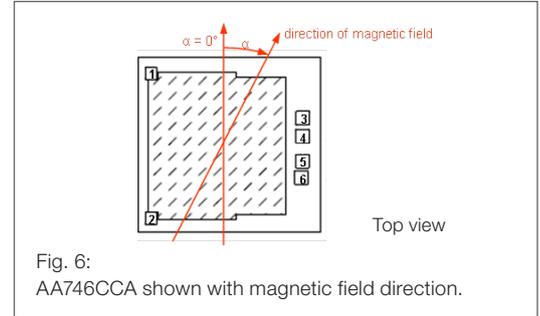


Fig. 6: AA746CCA shown with magnetic field direction.

#### Dimensions

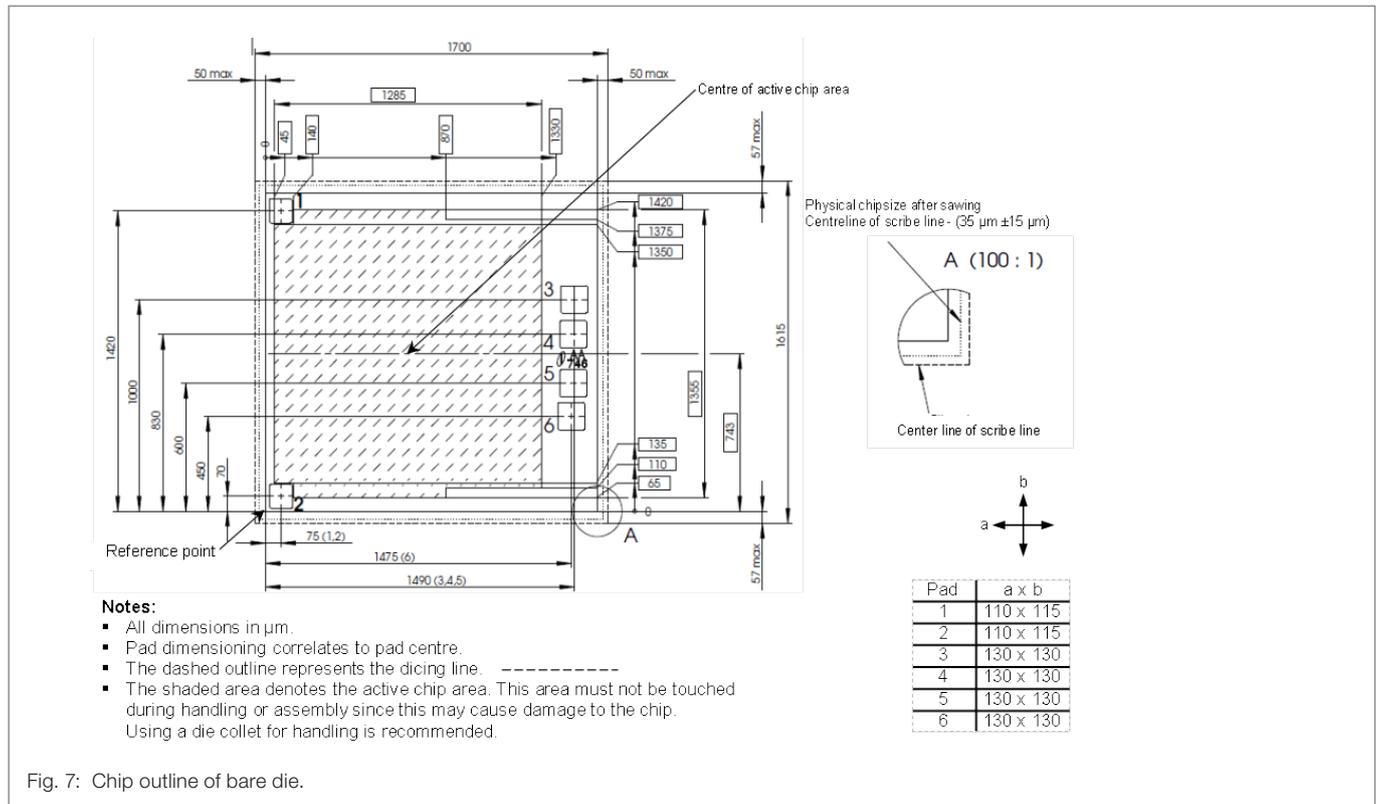


Fig. 7: Chip outline of bare die.

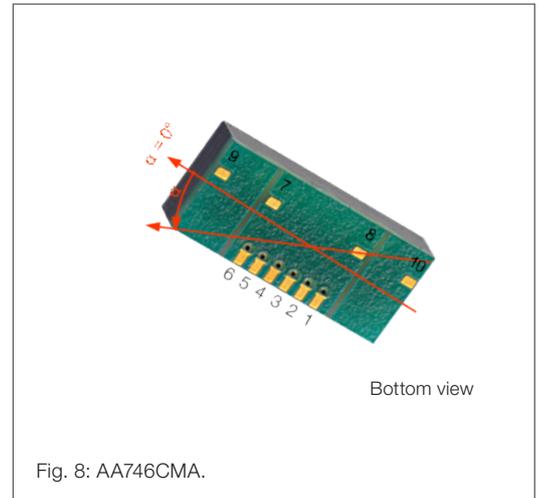
#### Data for Packaging and Interconnection Technologies

Parameter	Value	Unit
Chip area	1.7 x 1.6	mm
Chip thickness	254 $\pm$ 10	$\mu\text{m}$
Pad diameter (all)	See Fig. 7	$\mu\text{m}$
Pad thickness	0.8	$\mu\text{m}$
Pad material	AlCu	-

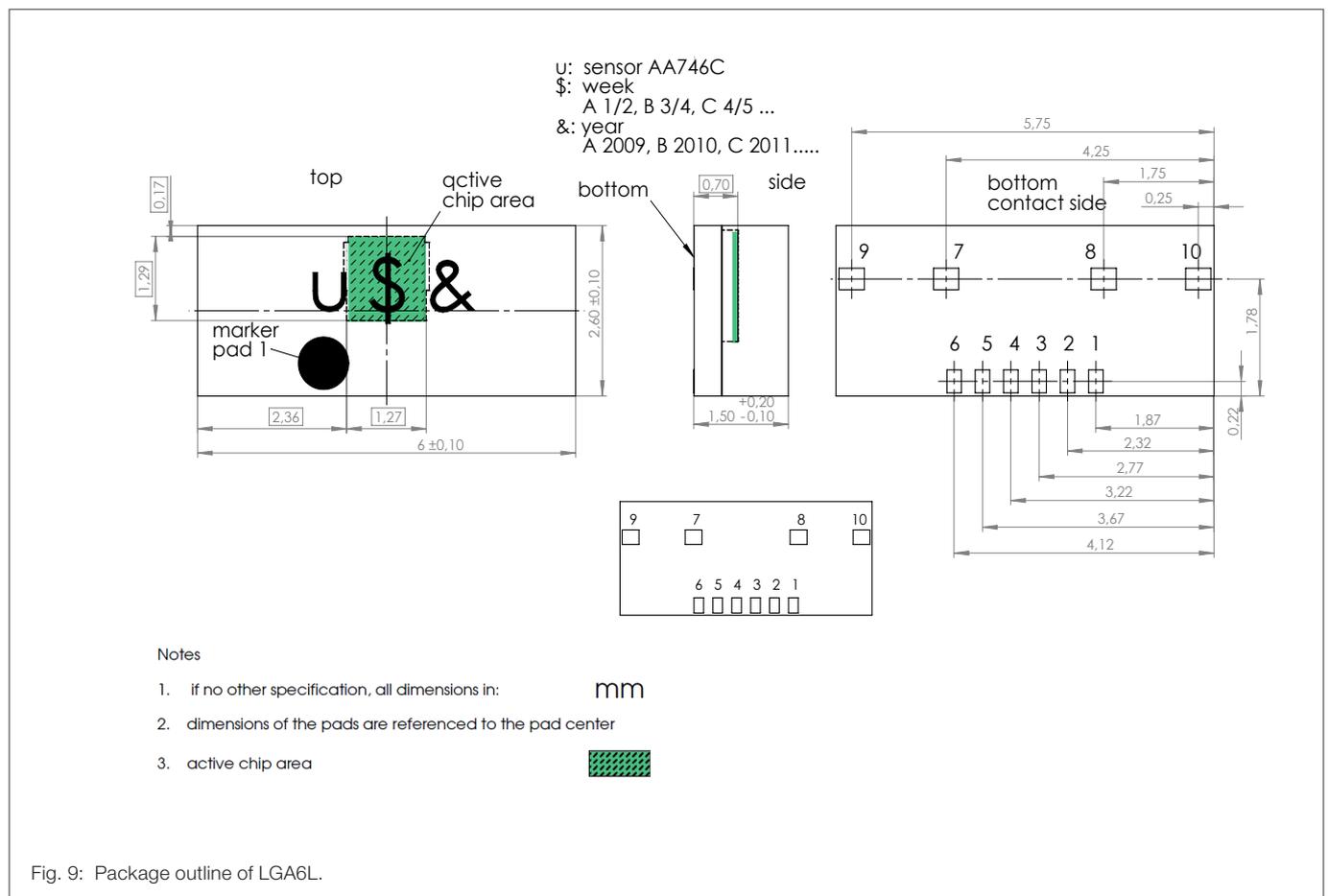
## AA746CMA in LGA6L Housing

### Pinning

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



### Dimensions



The moisture sensitivity level of the package is MSL2 according to JEDEC standard J-STD-020D. The allowable time period (floor life) after removal from a moisture barrier bag, dry storage or dry bake and before the solder reflow process is 1 year (≤30 °C / 60% RH).

### AA746CHA in SO8-housing

#### Pinning

Pin	Symbol	Parameter
1	$V_{CC}$	Supply voltage <sup>1)</sup>
2	$V_{CC}$	Supply voltage <sup>1)</sup>
3	GND	Ground <sup>2)</sup>
4	GND	Ground <sup>2)</sup>
5	$-V_{O1}$	Output voltage bridge 1
6	$+V_{O1}$	Output voltage bridge 1
7	$-V_{O2}$	Output voltage bridge 2
8	$+V_{O2}$	Output voltage bridge 2

<sup>1)</sup> Pin 1 and 2 are internally connected.

<sup>2)</sup> Pin 3 and 4 are internally connected.

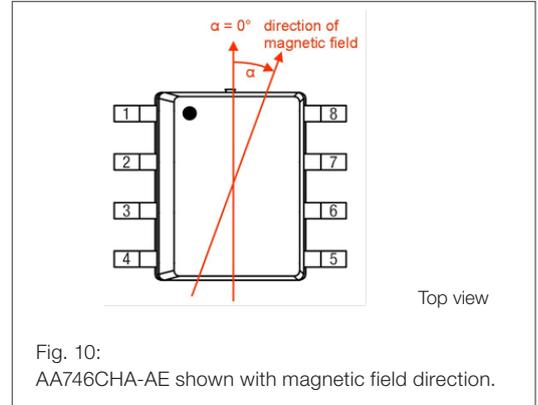


Fig. 10: AA746CHA-AE shown with magnetic field direction.

#### Dimensions

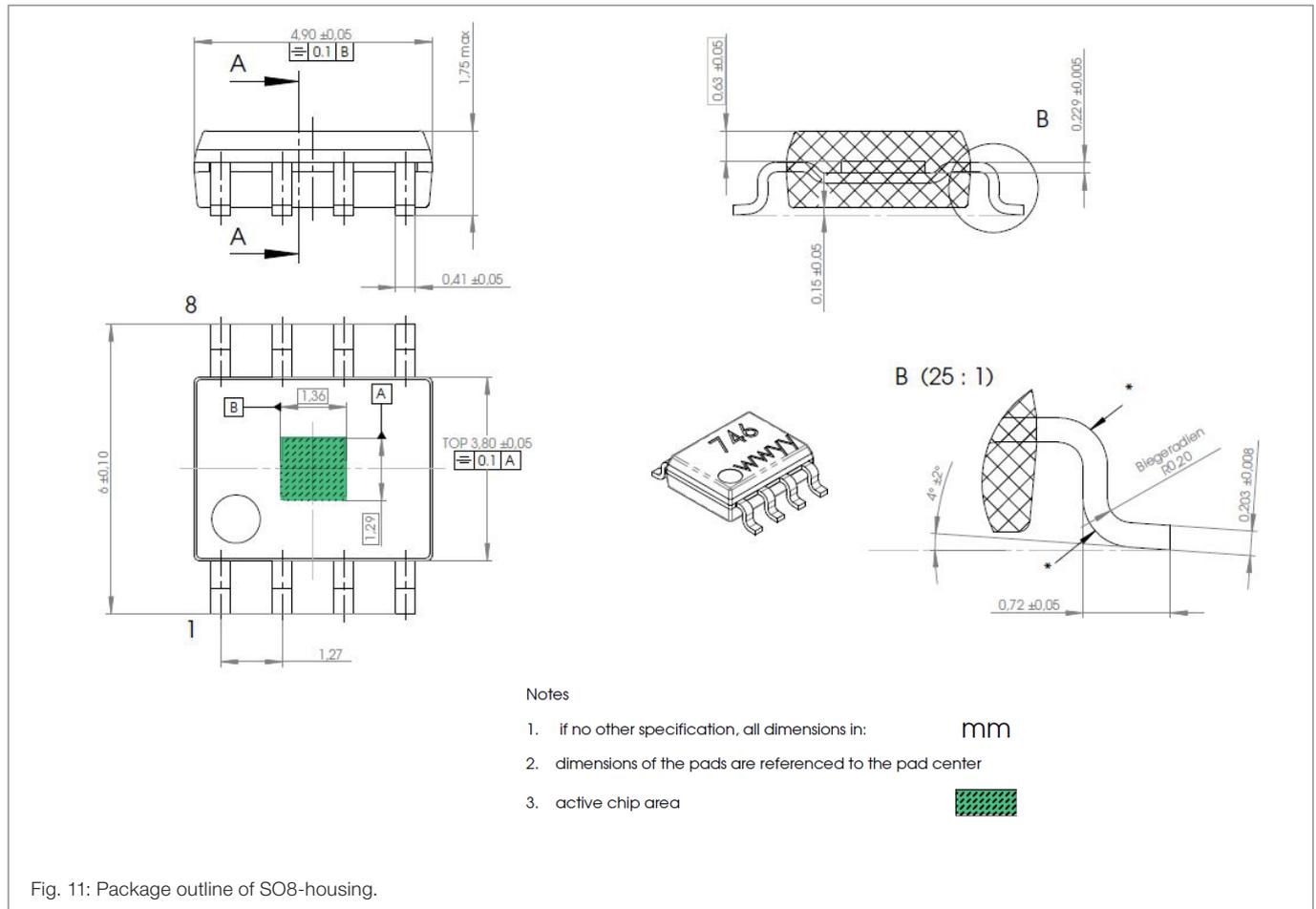


Fig. 11: Package outline of SO8-housing.

The moisture sensitivity level of the package is MSL2 according to JEDEC standard J-STD-020D. The allowable time period (floor life) after removal from a moisture barrier bag, dry storage or dry bake and before the solder reflow process is 1 year ( $\leq 30^\circ\text{C} / 60\% \text{RH}$ ).

## General Information

### Product Status

Article	Status
AA746CCA-AB	The product is in series production.
AA746CMA-AE	The product is in series production.
AA746CHA-AE	The product is in series production.
<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> .

### 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](http://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.

### Copyright © by Sensitec GmbH, Germany

All rights reserved. No part of this document may be copied or reproduced in any form or by any means without the prior written agreement of the copyright owner. The information in this document is subject to change without notice. Please observe that typical values cannot be guaranteed. Sensitec GmbH does not assume any liability for any consequence of its use.

## Changelist

Version	Description of the Change	Date
AA746C.DSE.03	Change of footnotes	07_2023
AA746C.DSE.02	Disclaimer supplement	06/2022
AA746C.DSE.01	Change of corporate design (pp. 1-8)	01/2022
AA746C.DSE.00	Original (pp. 1-9)	05/2019

### Sensitec GmbH

Schanzenfeldstr. 2 · 35578 Wetzlar · Germany  
 Tel. +49 6441 5291-0 · Fax +49 6441 5291-117  
 www.sensitec.com · sensitec@sensitec.com