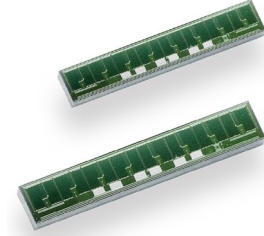


## AL796

### MagnetoResistive FixPitch Sensor (2 mm)

The AL796 is an AnisotropicMagnetoResistive (AMR) position sensor. The sensor contains two Wheatstone bridges shifted against each other. The output signals are proportional to sine and cosine of the coordinate to be measured (see Fig. 2).

The MR strips of this FixPitch sensor geometrically match to a pole length of 2 mm (equal to a magnetic period of 4 mm). Additionally, the sensor layout incorporates PerfectWave technology, i. e. the position of each block of MR strips has a special arrangement to filter higher harmonics and to increase the signal quality. The resistores in this FixPitch sensor are distributed over several poles (2), thus the errors in the magnetic measurement scale are reduced without any signal delay. The amplitude is almost constant in a wide working range between sensor and magnetic scale. The bond version of AL796 is available as bare die. For SMD processing, the sensor is available in a Si16, LGA or SIL8 package.



#### Product Overview of AL796

| Article description       | Package      | Delivery Type           |
|---------------------------|--------------|-------------------------|
| AL796ACA-AB <sup>1)</sup> | Die on Wafer | Waferbox                |
| AL796ACA-AC               | Bare Die     | Waffle pack (192 pcs)   |
| AL796AKA-AC               | SIL6         | Waffle pack (90 pcs)    |
| AL796AMA-AE               | LGA6L        | Tape on reel (2000 pcs) |
| AL796AMS-AE               | SIL8         | Tape on reel (2000 pcs) |
| AL796AMS-AS               | SIL8-D       | Tape on reel (2000 pcs) |

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

#### Quick Reference Guide

| Symbol            | Parameter                            | min. | typ. | max. | Unit |
|-------------------|--------------------------------------|------|------|------|------|
| P                 | Pitch (magnetic pole length)         | -    | 2    | -    | mm   |
| V <sub>CC</sub>   | Supply voltage                       | -    | 5.0  | -    | V    |
| V <sub>off</sub>  | Offset voltage per V <sub>CC</sub>   | -2.0 | -    | +2.0 | mV/V |
| V <sub>peak</sub> | Signal amplitude per V <sub>CC</sub> | 9.0  | 11.0 | 13.0 | mV/V |
| R <sub>B</sub>    | Bridge resistance                    | 2.2  | 3.4  | 4.6  | kΩ   |

#### Absolute Maximum Ratings

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

| Symbol                   | Parameter                    | Min. | Max. | Unit |
|--------------------------|------------------------------|------|------|------|
| V <sub>CC</sub>          | Supply voltage               | -9.0 | +9.0 | V    |
| T <sub>amb</sub>         | Ambient temperature          | -40  | +125 | °C   |
| T <sub>stg(Die)</sub>    | Storage temperature (Die)    | -65  | +150 | °C   |
| T <sub>stg(others)</sub> | Storage temperature (others) | -40  | +125 | °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 AnisotropicMagnetoResistive (AMR) effect
- Contains two Wheatstone bridges on Chip
- Sine and Cosine output
- Adapted to 2 mm poles
- PurePitch design (2 poles)
- PerfectWave technology
- Ambient temperature range from -40 °C to +125 °C

#### Advantages

- Contactless angle and position measurement
- Large air gap
- Excellent accuracy
- Minimized offset voltage
- Negligible hysteresis

#### Applications

Incremental or absolute encoder for linear or rotary movements in various industrial applications, for example:

- Motor integrated encoder
- Motorfeedback system
- Linear guide



### Magnetic Data

| Symbol           | Parameter                             | Conditions | min. | typ. | max. | Unit |
|------------------|---------------------------------------|------------|------|------|------|------|
| H <sub>ext</sub> | Magnetic field strength <sup>1)</sup> |            | 5.0  | 25.0 | -    | kA/m |

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

### Electrical Data

T<sub>amb</sub> = +25°C, H<sub>ext</sub> = 25 kA/m; V<sub>CC</sub> = 5.0 V; unless otherwise specified.

| Symbol              | Parameter                                                  | Conditions                        | min.  | typ.  | max.  | Unit     |
|---------------------|------------------------------------------------------------|-----------------------------------|-------|-------|-------|----------|
| V <sub>CC</sub>     | Supply voltage                                             |                                   | -     | 5.0   | -     | V        |
| V <sub>off</sub>    | Offset voltage per V <sub>CC</sub>                         | See Fig. 2                        | -2.0  | -     | +2.0  | mV/V     |
| TC <sub>Voff</sub>  | Temperature coefficient of V <sub>off</sub> <sup>2)</sup>  | T <sub>amb</sub> = (-40...+125)°C | -4.0  | -     | +4.0  | (μV/V)/K |
| V <sub>peak</sub>   | Signal amplitude per V <sub>CC</sub> <sup>3)</sup>         | See Fig. 2                        | 9.0   | 11.0  | 13.0  | mV/V     |
| TC <sub>Vpeak</sub> | Temperature coefficient of V <sub>peak</sub> <sup>4)</sup> | T <sub>amb</sub> = (-40...+125)°C | -0.48 | -0.42 | -0.36 | %/K      |
| R <sub>B</sub>      | Bridge resistance <sup>5)</sup>                            |                                   | 2.2   | 3.4   | 4.6   | kΩ       |
| R <sub>S</sub>      | Sensor resistance <sup>6)</sup>                            |                                   | 1.1   | 1.7   | 2.3   | kΩ       |
| TC <sub>RB</sub>    | Temperature coefficient of R <sub>B</sub> <sup>7)</sup>    | T <sub>amb</sub> = (-40...+125)°C | 0.24  | 0.28  | 0.32  | %/K      |

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

<sup>3)</sup> Maximal output voltage without offset influences. Periodicity of V<sub>peak</sub> is sin(P) and cos(P).

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

<sup>5)</sup> Bridge resistance between +V<sub>O1</sub> and -V<sub>O1</sub>, +V<sub>O2</sub> and -V<sub>O2</sub>.

<sup>6)</sup> Sensor resistance between V<sub>CC</sub> and GND.

$$^7) TC_{RB} = 100 \cdot \frac{R_B(T_2) - R_B(T_1)}{R_B(T_{amb}) \cdot (T_2 - T_1)} \text{ with } T_1 = +25^\circ\text{C}; T_2 = +125^\circ\text{C}.$$

### Accuracy

T<sub>amb</sub> = +25°C, H<sub>ext</sub> = 25 kA/m; V<sub>CC</sub> = 5.0 V; unless otherwise specified.

| Symbol | Parameter                           | Conditions | min. | typ. | max. | Unit                   |
|--------|-------------------------------------|------------|------|------|------|------------------------|
| ΔX     | Measurement error <sup>8)</sup>     |            | -    | 5.0  | 7.0  | μm                     |
| k      | Amplitude synchronism <sup>9)</sup> |            | -    | 0.1  | 1    | % of V <sub>peak</sub> |

<sup>8)</sup> ΔX = |X<sub>real</sub> - X<sub>measured</sub>| without offset influences due deviations from ideal sinusoidal characteristics (ascertained at an ideal magnetic scale).

$$^9) k = 100 - 100 \cdot \frac{V_{peak1}}{V_{peak2}}$$

### Dynamic Data

| Symbol | Parameter       | Conditions | min.             | typ. | max. | Unit |
|--------|-----------------|------------|------------------|------|------|------|
| f      | Frequency range |            | 1 <sup>10)</sup> | -    | -    | MHz  |

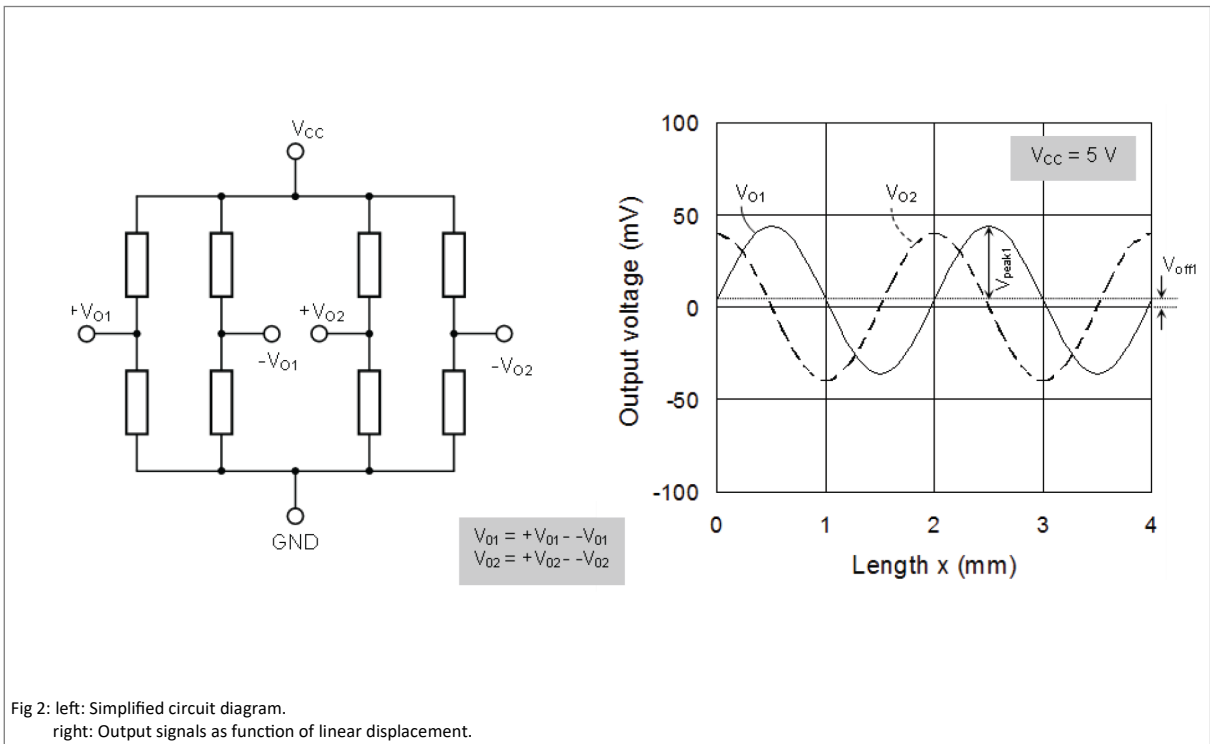
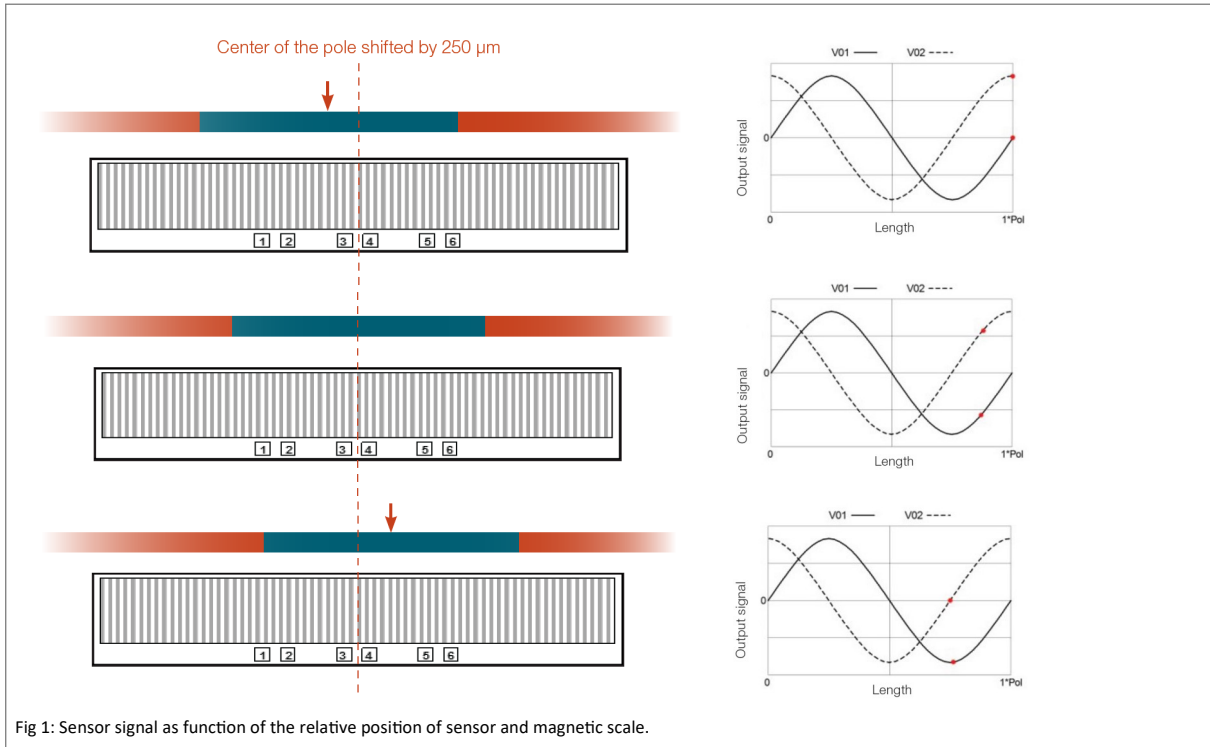
<sup>10)</sup> No significant amplitude loss in this frequency range.

### General Data

| Symbol           | Parameter                    | Conditions | min. | typ. | max. | Unit |
|------------------|------------------------------|------------|------|------|------|------|
| P                | Pitch (magnetic pole length) | See Fig. 1 | -    | 2    | -    | mm   |
| d                | Distance <sup>11)</sup>      |            | -    | 0.7  | -    | mm   |
| T <sub>amb</sub> | Ambient temperature          |            | -40  | -    | +125 | °C   |

<sup>11)</sup> See Fig. 3 for detailed information.

Output Signal Information



Typical Performance Graphs

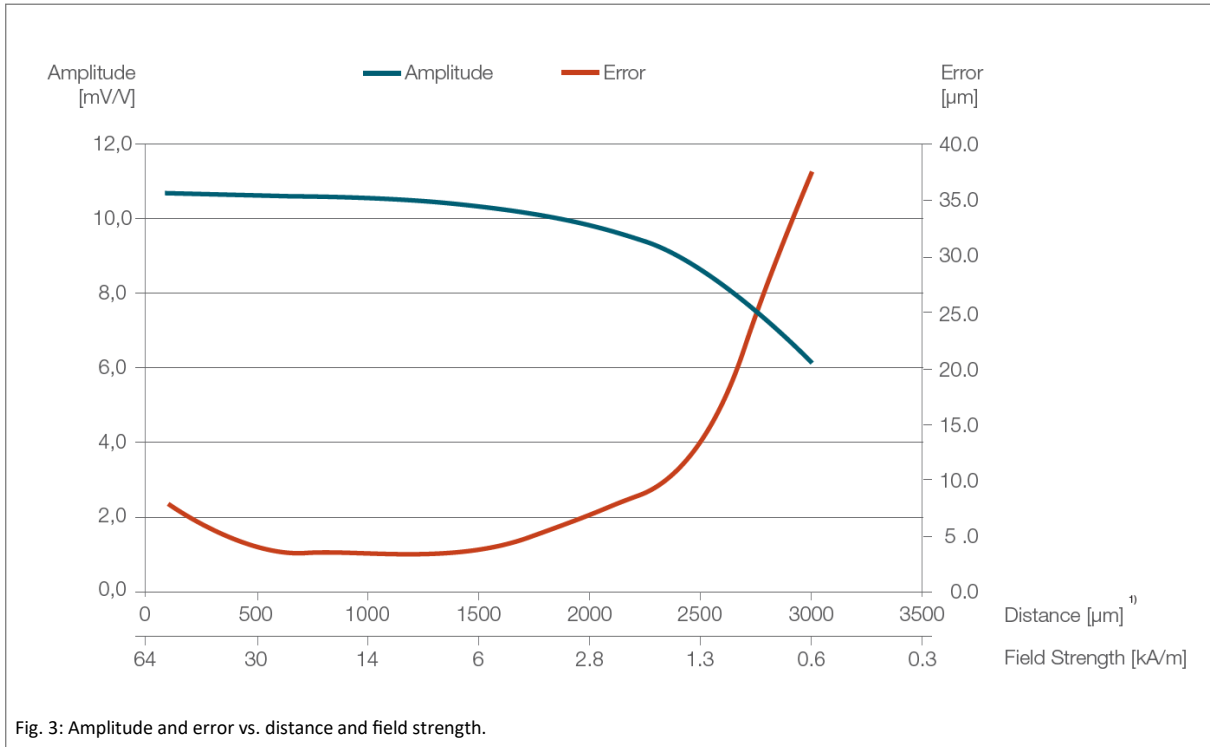


Fig. 3: Amplitude and error vs. distance and field strength.

### AL796ACA Bare Die

#### Pinout

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

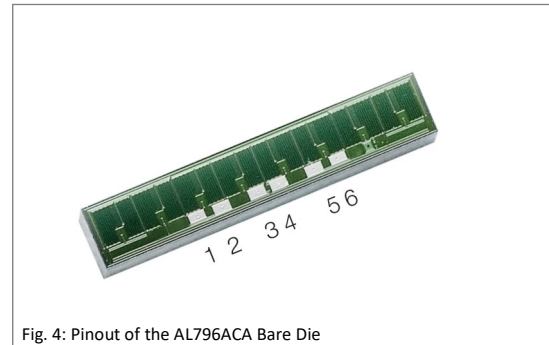


Fig. 4: Pinout of the AL796ACA Bare Die

#### Dimensions

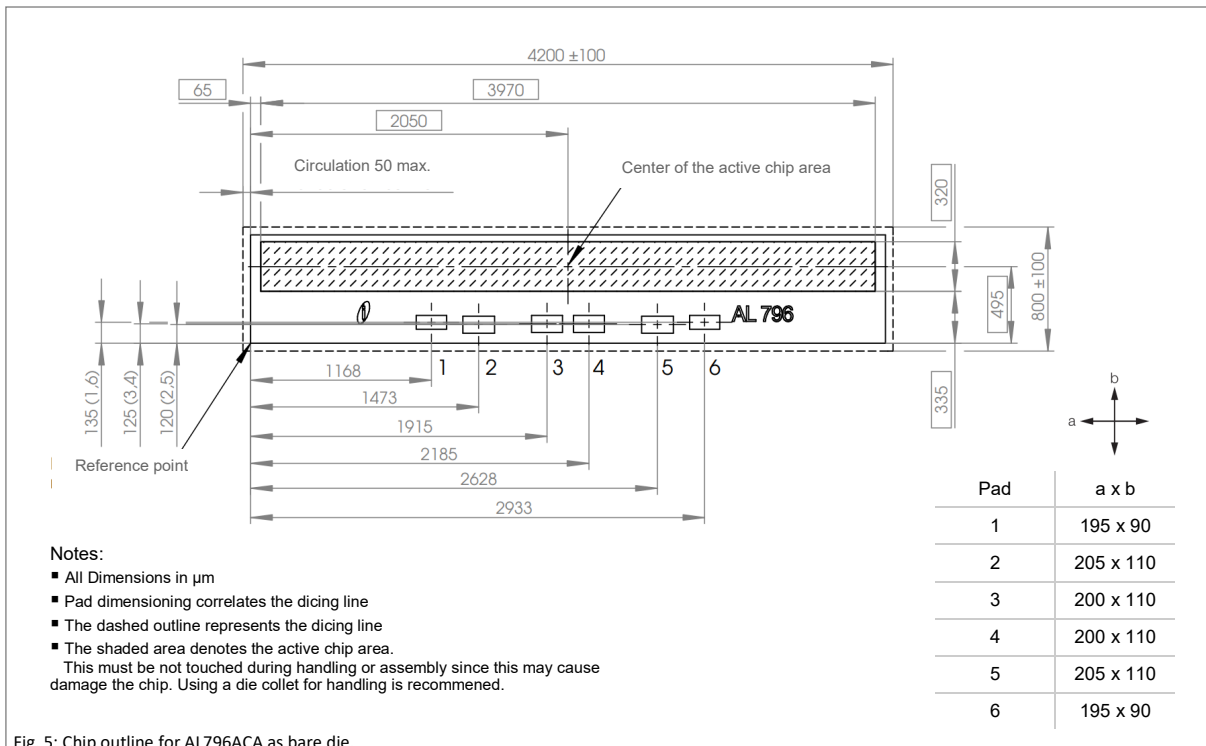


Fig. 5: Chip outline for AL796ACA as bare die.

#### Data for Packaging and Interconnection Technologies

| Parameter               | Value      | Unit            |
|-------------------------|------------|-----------------|
| Chip area <sup>1)</sup> | 4.2 x 0.8  | mm <sup>2</sup> |
| Chip thickness          | 525 ± 40   | μm              |
| Pad size                | See Fig. 5 | -               |
| Pad thickness           | 0.8        | μm              |
| Pad material            | AlCu       | -               |

<sup>1)</sup> Tolerances of chip see Fig. 5.

AL796AKA SIL6 Package

Pinout

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

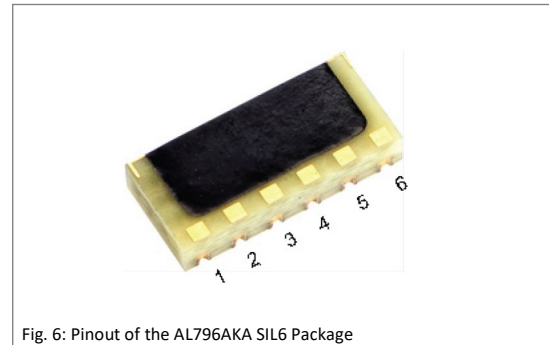


Fig. 6: Pinout of the AL796AKA SIL6 Package

Dimensions

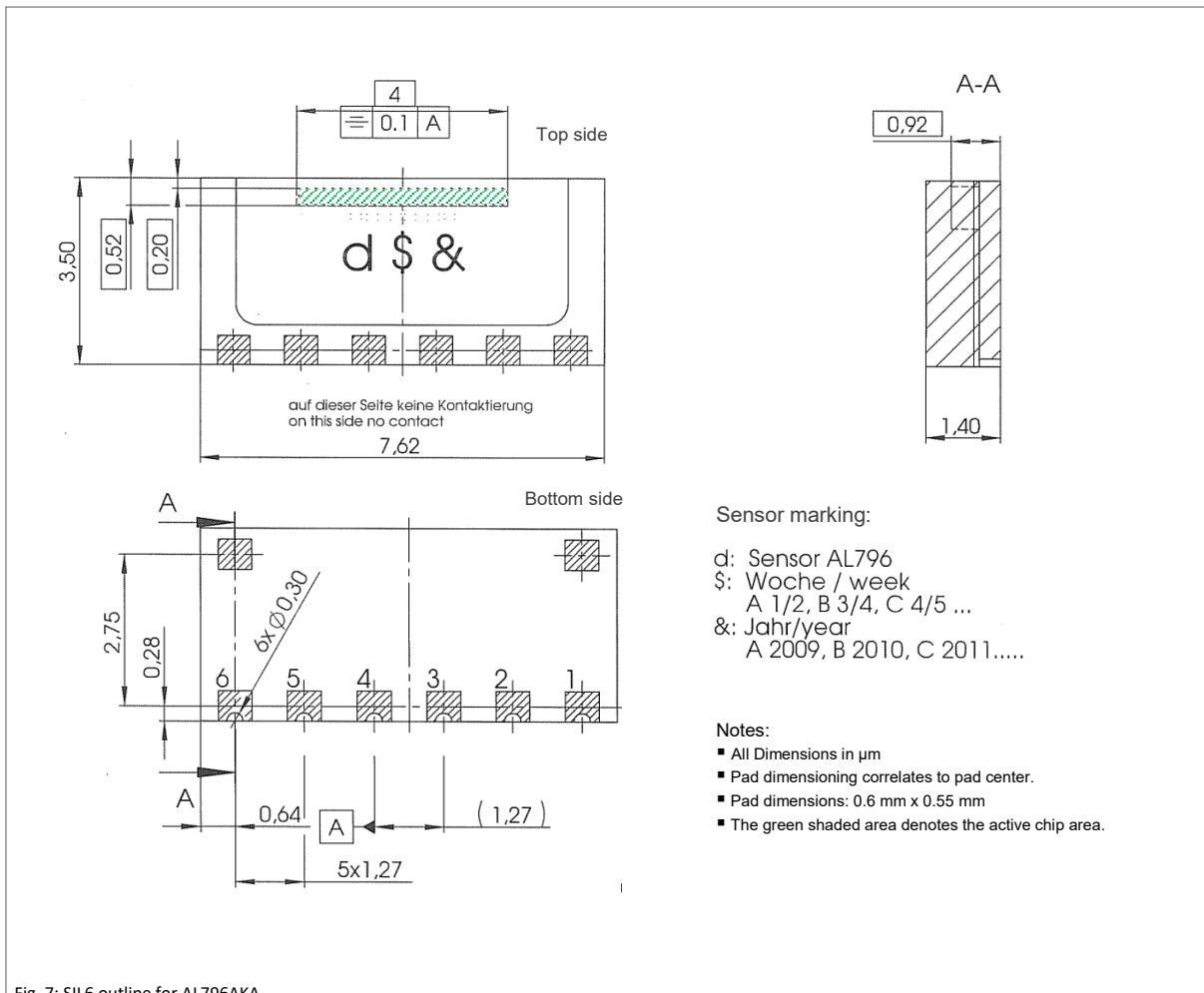


Fig. 7: SIL6 outline for AL796AKA.

AL796AMA LGA6L Package

Pinout

| Pad  | 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 |
| 7-10 | NC               | Not connected                    |

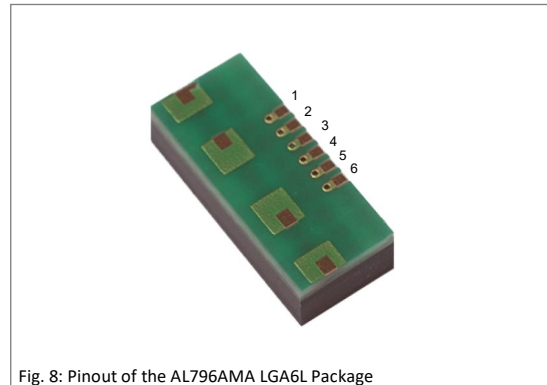


Fig. 8: Pinout of the AL796AMA LGA6L Package

Dimensions

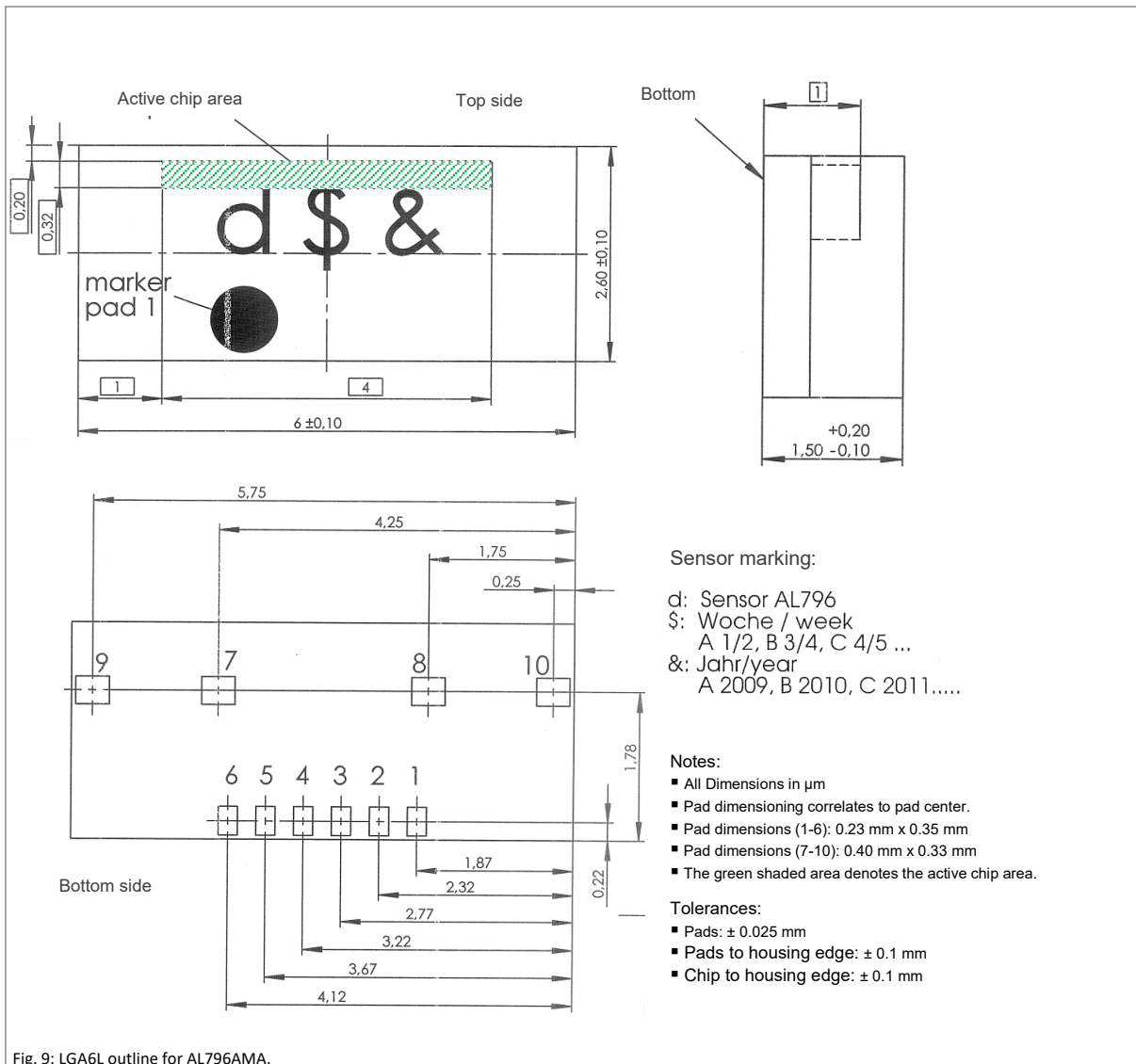


Fig. 9: LGA6L outline for AL796AMA.

**AL796AMS-AE SIL8 Package**

**Pinout**

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

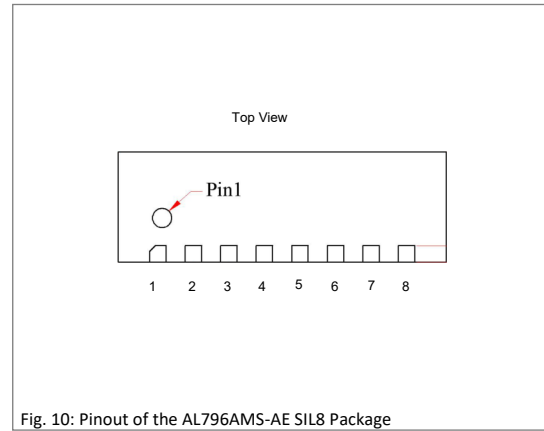


Fig. 10: Pinout of the AL796AMS-AE SIL8 Package

**Dimensions**

Notes:

- The shaded area denotes the active chip area.

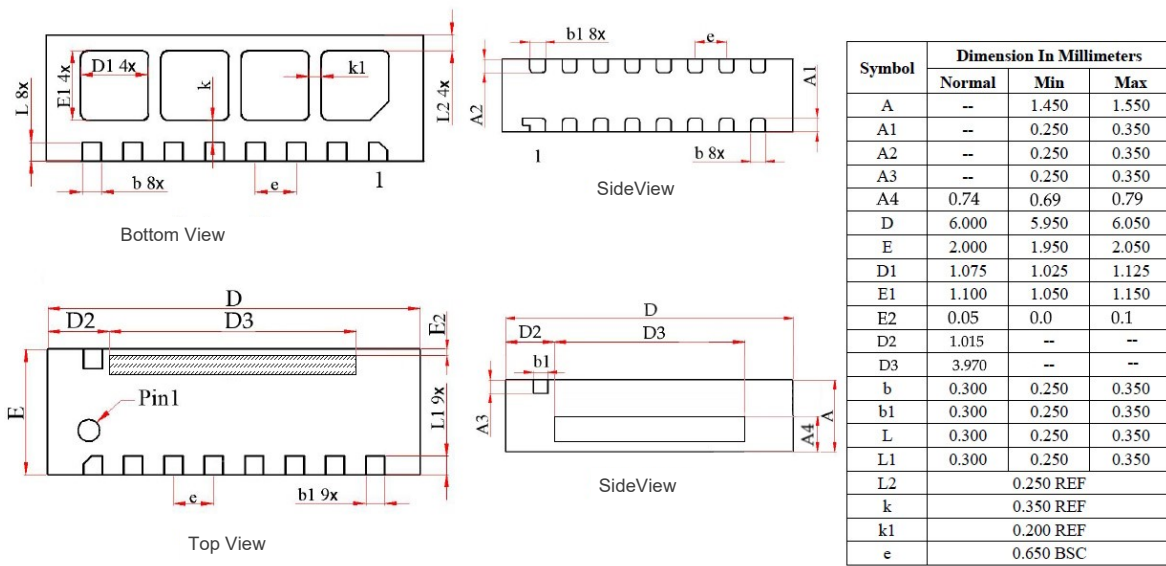


Fig. 11: SIL8 outline for AL796AMS.

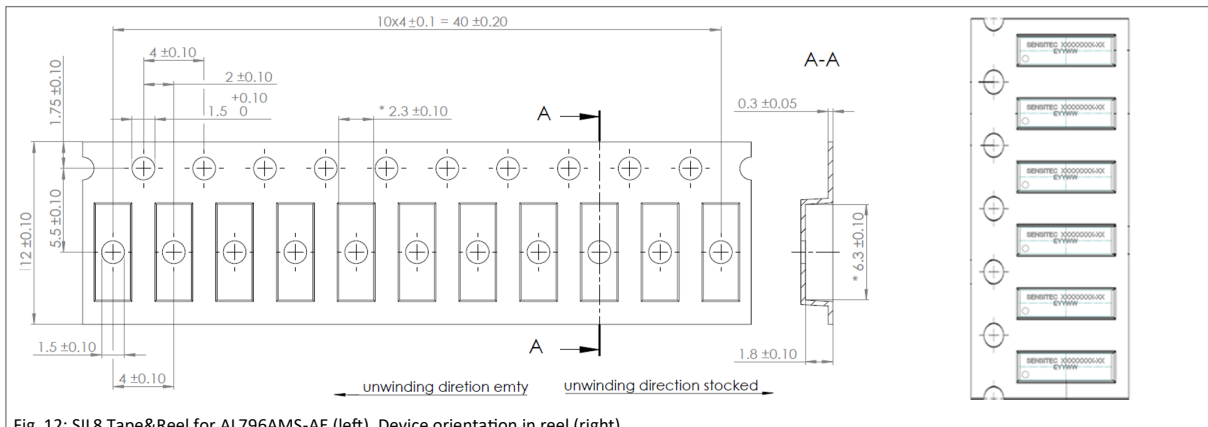


Fig. 12: SIL8 Tape&Reel for AL796AMS-AE (left). Device orientation in reel (right)



**AL796AMS-AS SIL8-D Package**

**Pinout**

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

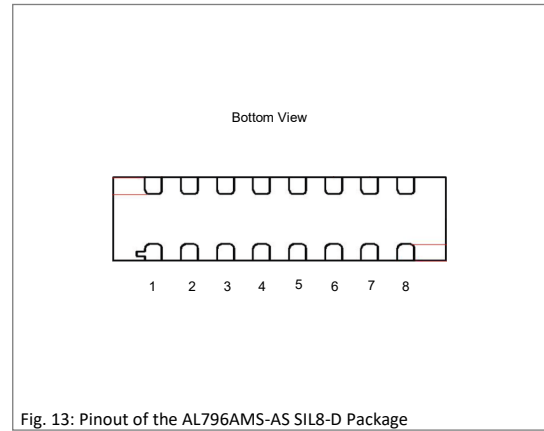


Fig. 13: Pinout of the AL796AMS-AS SIL8-D Package

**Dimensions**

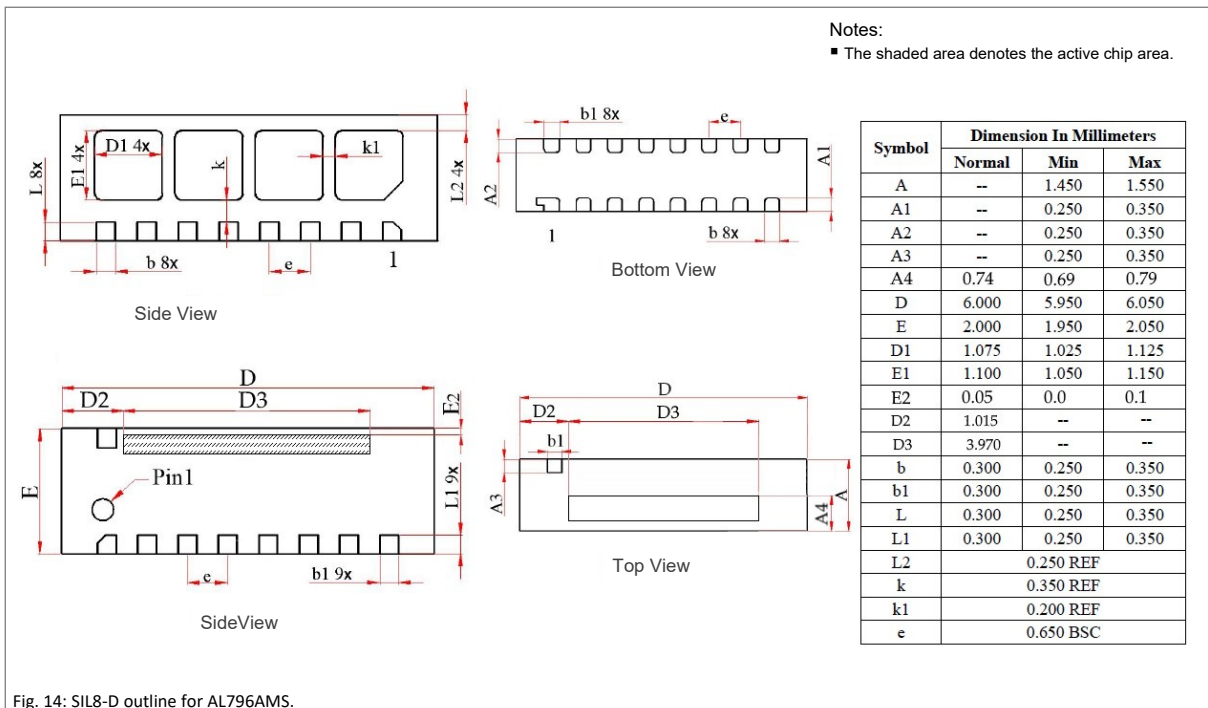


Fig. 14: SIL8-D outline for AL796AMS.

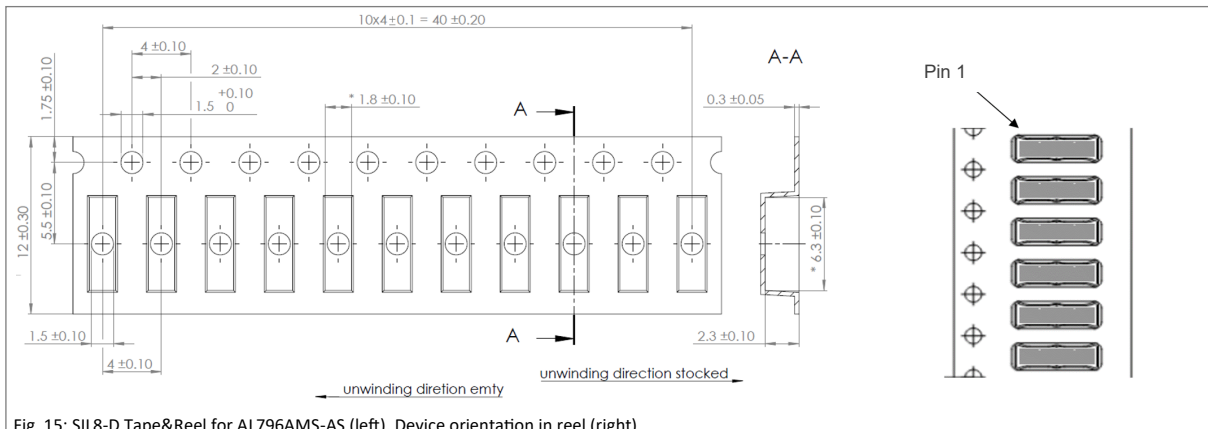


Fig. 15: SIL8-D Tape&Reel for AL796AMS-AS (left). Device orientation in reel (right)

Footprint SIL8/SIL8-D Package

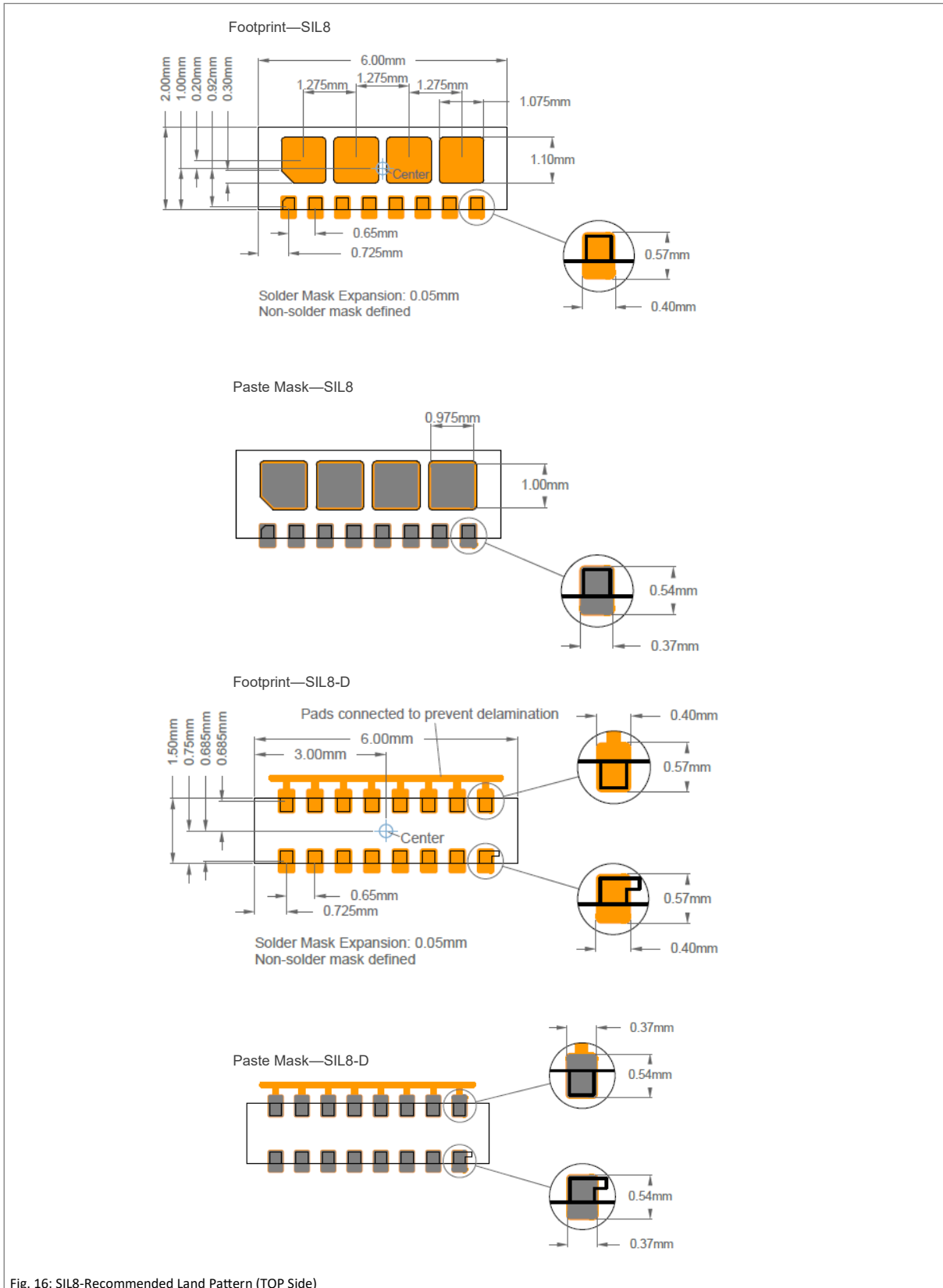
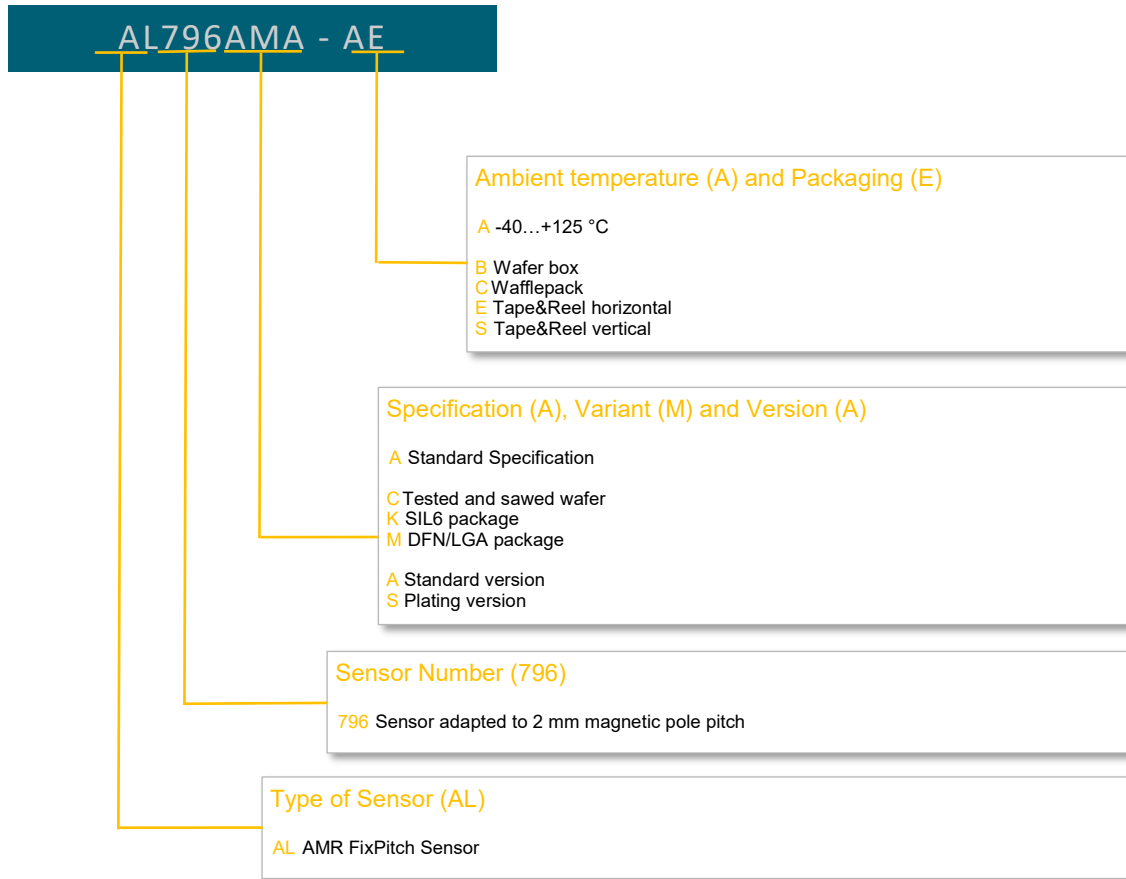





Fig. 16: SIL8-Recommended Land Pattern (TOP Side)

**Additional Information on Ordering Code**

**Special Design Features**

|                                                                                                        |                                                                                                                                                                                                                                                            |
|--------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|  <b>PerfectWave</b> | <p>Sensors with PerfectWave design provide the best signal quality, highest accuracy and optimal sensor linearity by filtering out higher harmonics in the signal. The linearity of the sensor is assured, even for weak magnetic field measurement.</p>   |
|  <b>PurePitch</b>   | <p>In PurePitch sensors the FixPitch principle is extended over several poles in order to increase accuracy still further. This arrangement reduces the influence of errors in the measurement scale and improves the immunity to interference fields.</p> |
|  <b>FixPitch</b>    | <p>FixPitch sensors are adapted to the pole length (pitch) of the measurement scale. The linearity of the sensor is optimized and the influence of interference fields is minimized.</p>                                                                   |

## General Information

### Product Status

| Article     | Status                                                                                                                                                                                          |
|-------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| AL796ACA-AB | The product is in series production.                                                                                                                                                            |
| AL796ACA-AC | The product is in series production.                                                                                                                                                            |
| AL796AKA-AC | The product is in series production.                                                                                                                                                            |
| AL796AMA-AE | The product is in series production.                                                                                                                                                            |
| AL796AMS-AE | The product is under development, qualification is on going. Deliverables have a sample status. The datasheet is preliminary.                                                                   |
| AL796AMS-AS | 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> . |

### 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    |
|--------------|-------------------------------------------------------------------------------|---------|
| AL796.DSE.16 | Change technical drawing (p. 8, p. 9)/add footprint page SIL8 package (p. 10) | 04/2024 |
| AL796.DSE.15 | Change product variant (p. 8, p. 9) / add order code page (p. 10)             | 08/2023 |
| AL796.DSE.14 | Disclaimer supplement                                                         | 06/2022 |
| AL796.DSE.13 | New product variant / Technical changes (p. 1, p. 8, p. 11) / new page (p. 9) | 03/2022 |
| AL796.DSE.12 | New page (p. 8) / various textual changes                                     | 12/2021 |
| AL796.DSE.11 | Various textual changes                                                       | 01/2020 |
| AL796.DSE.00 | Original (pp. 1-7)                                                            | 04/2012 |

### 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