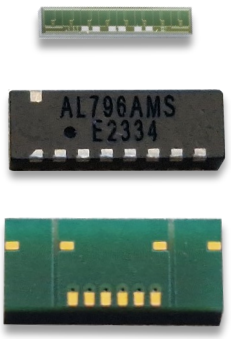
DATA SHEET

SENSITEC
MAGNETORESISTIVE SENSORS

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. 1).
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 Sil6, LGA or SIL8 package.



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, such as:

- Motor integrated encoder
- Motorfeedback system
- Linear guide

Product Overview of AL796

Article description	Package	Delivery Type
AL796ACA-AB [1]	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)

[1] minimum order quantities apply.

Quick Reference Guide

Symbol	Parameter	min.	typ.	max.	Unit
P	Pitch (magnetic pole length)	-	2.0	-	mm
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}	9.0	11.0	13.0	mV/V
R_B	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_{CC}	Supply voltage	-9.0	+9.0	V
T_{amb}	Ambient temperature	-40	+125	°C
$T_{stg(Die)}$	Storage temperature (Die)	-65	+150	°C
$T_{stg(others)}$	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.

ESD

Magnetic Data

Symbol	Parameter	Conditions	min.	typ.	max.	Unit
H_{ext}	Magnetic field strength [1]		5.0	25.0	-	kA/m

[1] The stimulating magnetic field in the sensor plane to ensure minimum error specified in note 8.

Electrical Data

T_{amb} = +25°C, H_{ext} = 25 kA/m; V_{CC} = 5.0 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. 2	-2.0	-	+2.0	mV/V
TC_{Voff}	Temperature coefficient of V_{off} [2]	T_{amb} = (-40…+125)°C	-4.0	-	+4.0	(µV/V)/K
V_{peak}	Signal amplitude per V_{CC} [3]	See Fig. 2	9.0	11.0	13.0	mV/V
TC_{Vpeak}	Temperature coefficient of V_{peak} [4]	T_{amb} = (-40…+125)°C	-0.48	-0.42	-0.36	%/K
R_B	Bridge resistance [5]		2.2	3.4	4.6	kΩ
R_S	Sensor resistance [6]		1.1	1.7	2.3	kΩ
TC_{RB}	Temperature coefficient of R_B [7]	T_{amb} = (-40…+125)°C	0.24	0.28	0.32	%/K
FIT	FIT-Rate		-	0.9	-	x10^9 h
MTTF	Mean time to failure	At 55 °C	-	126839	-	years

[2] $TC_{Voff}=100\cdot\frac{V_{off(T2)}-V_{off(T1)}}{T_2-T_1}$ with T_1 = +25°C; T_2 = +125°C.

[3] Maximal output voltage without offset influences. Periodicity of V_{peak} is sin(P) and cos(P).

[4] $TC_{VPeak}=100\cdot\frac{V_{Peak(T2)}-V_{Peak(T1)}}{V_{Peak(Tamb)}\cdot(T_2-T_1)}$ with T_1 = +25°C; T_2 = +125°C.

[5] Bridge resistance between $+V_{O1}$ and $-V_{O1}$, $+V_{O2}$ and $-V_{O2}$.

[6] Sensor resistance between V_{CC} and GND.

[7] $TC_{RB}=100\cdot\frac{R_{B(T2)}-R_{B(T1)}}{R_{B(Tamb)}\cdot(T_2-T_1)}$ with T_1 = +25°C; T_2 = +125°C.

Accuracy

T_{amb} = +25°C, H_{ext} = 25 kA/m; V_{CC} = 5.0 V; unless otherwise specified.

Symbol	Parameter	Conditions	min.	typ.	max.	Unit
ΔX	Measurement error [8]		-	5.0	7.0	µm
k	Amplitude synchronism [9]		-	0.1	1	% of V_{peak}

[8] $\Delta X = |X_{real} - X_{measured}|$ 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		1.0 [10]	-	-	MHz

[10] No significant amplitude loss in this frequency range.

General Data

Symbol	Parameter	Conditions	min.	typ.	max.	Unit
P	Pitch (mangnetic pole length)	See Fig. 1	-	2.0	-	mm
d	Distance [11]		-	0.7	-	mm
T_{amb}	Ambient temperature		-40	-	+125	°C

[11] See Fig. 3 for detailed information.

Output Signal Information

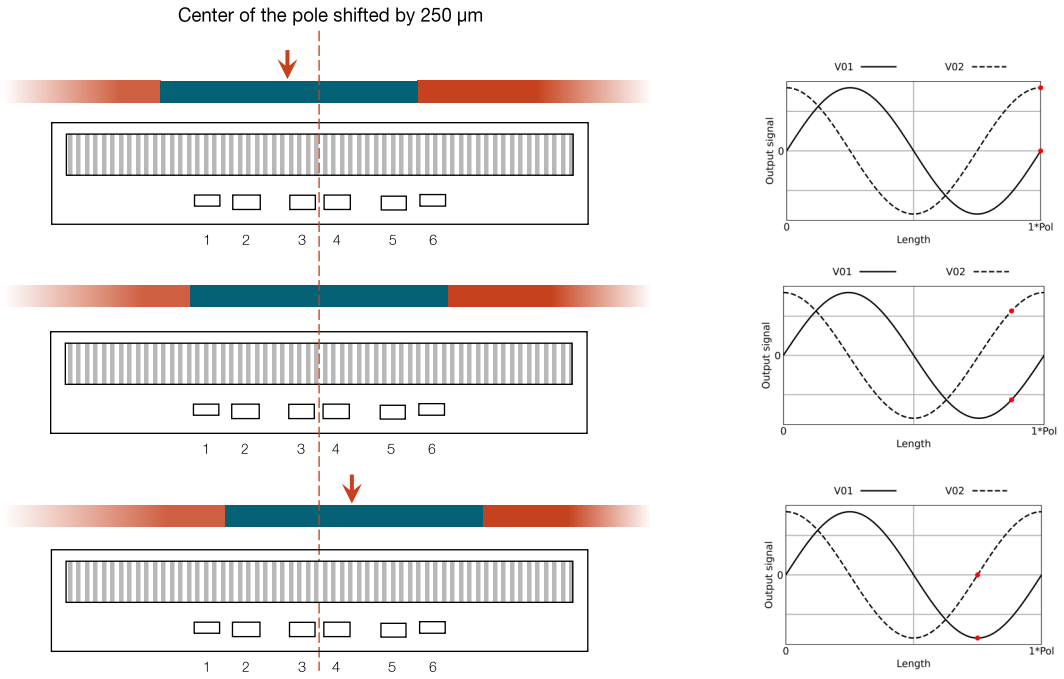


Fig 1: Sensor signal as function of the relative position of sensor and magnetic scale.

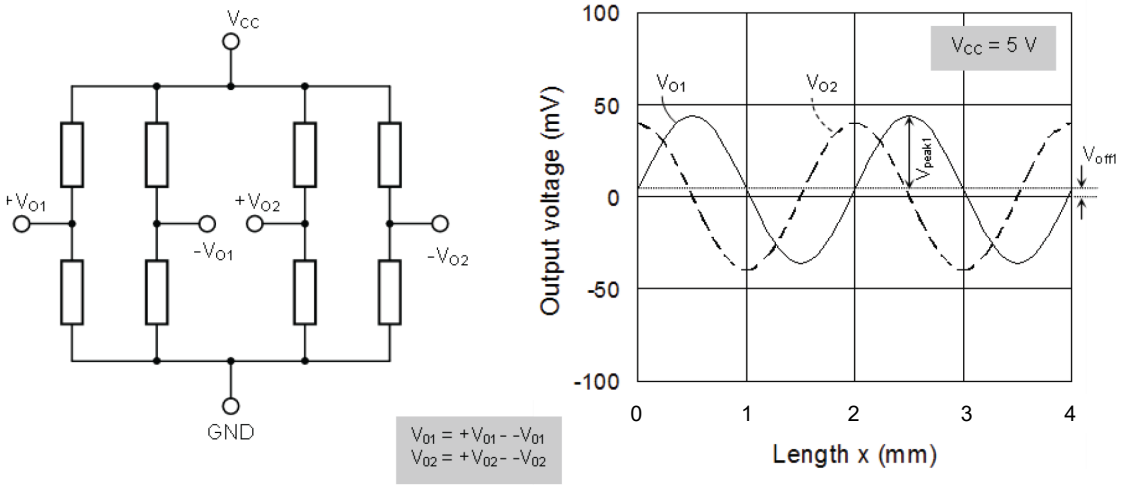


Fig 2: Left: Simplified circuit diagram.
Right: Output signals as function of linear displacement.

Typical Performance Graphs

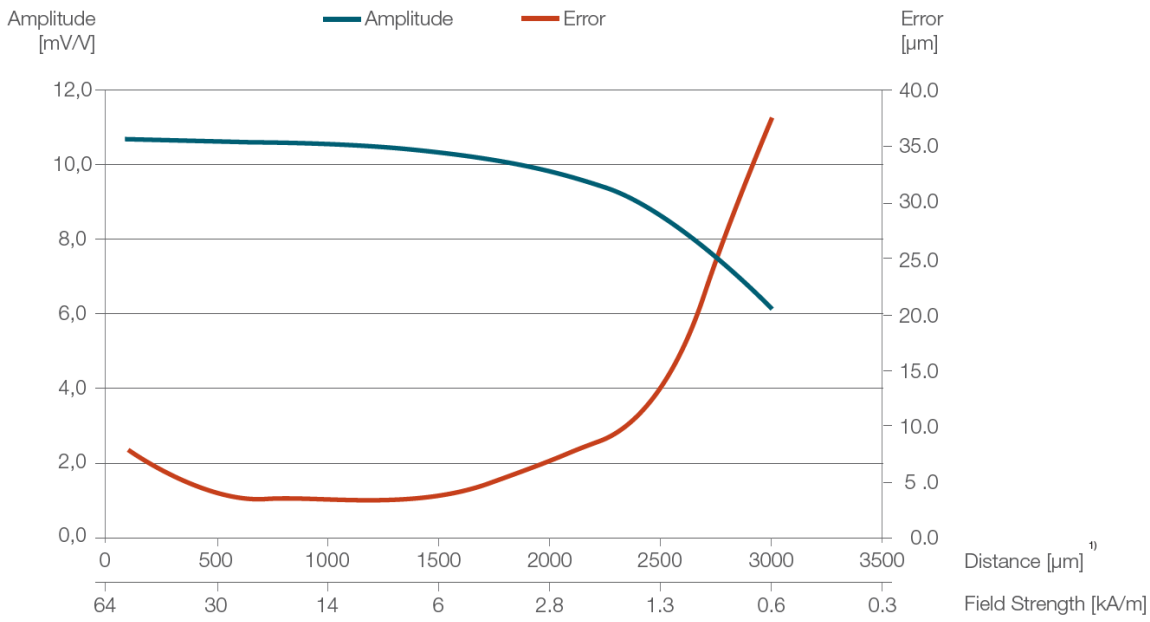


Fig. 3: Amplitude and error vs. distance and field strength.

1) In use with a plastic bounded hard ferrite magnetic scale (Br = 220 mT, thickness 1 mm, mounted on stainless steel),

AL796ACA Bare Die

Pinout

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

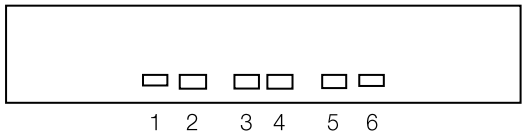
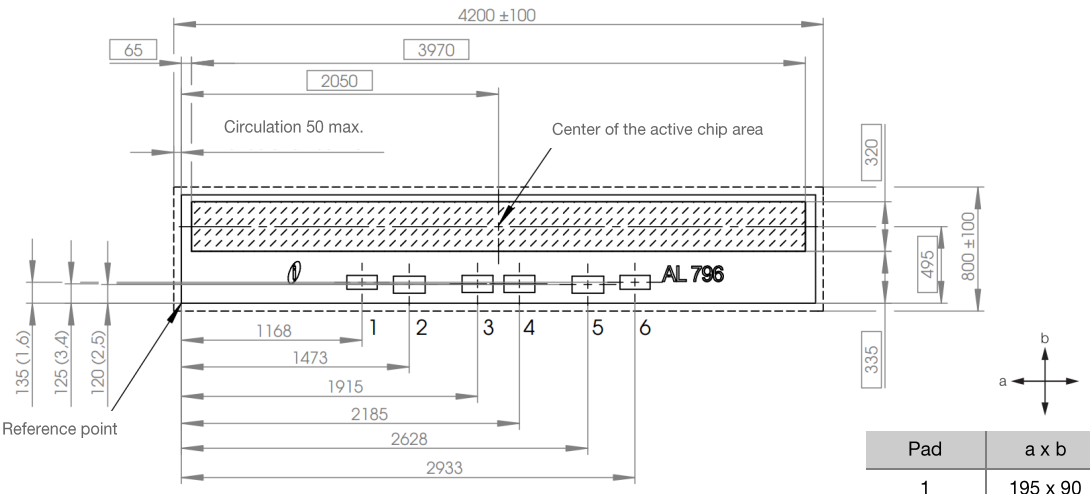


Fig. 4: Pinout of the AL796ACA Bare Die

Dimensions



Pad	a x b
1	195 x 90
2	205 x 110
3	200 x 110
4	200 x 110
5	205 x 110
6	195 x 90

Notes:
- All Dimensions in µm
- Pad dimensioning correlates the dicing line
- The dashed outline represents the dicing line
- The shaded area denotes the active chip area. This must be not touched during handling or assembly

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

Data for Packaging and Interconnection Technologies

Parameter	Value	Unit
Chip area [1)]	4.2 x 0.8	mm^2
Chip thickness	525 ± 40	µm
Pad size	See Fig. 5	-
Pad thickness	0.8	µm
Pad material	AlCu	-

[1)] Tolerances of chip see Fig. 5.

AL796AKA SIL6 Package

Pinout

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

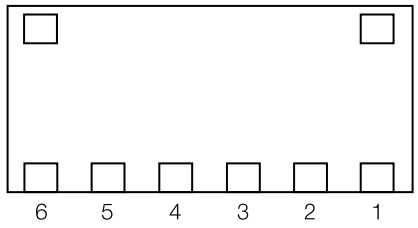
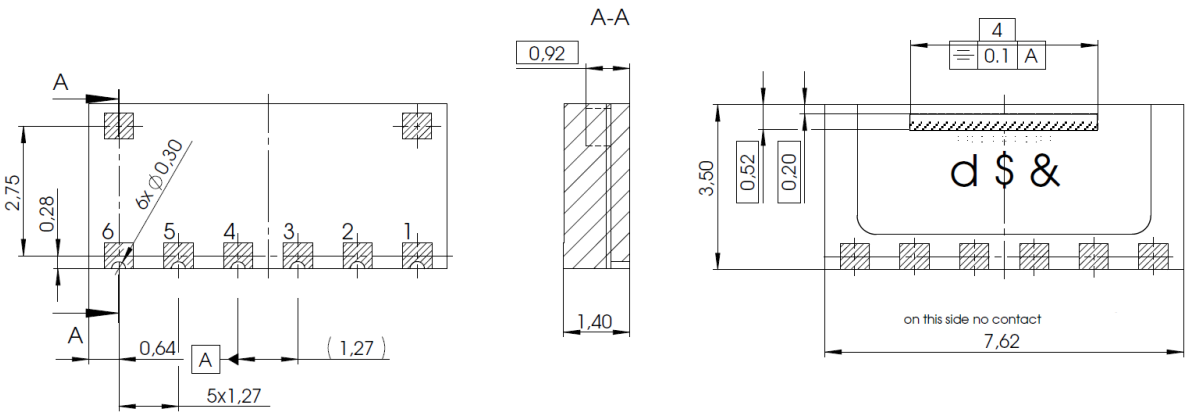


Fig. 6: Pinout of the AL796AKA SIL6 Package

Dimensions



Sensor marking:

d: Sensor AL796
$: Week (A:1/2, B: 3/4, …)
&: Year (A: 2009, B: 2010, …)

Notes:
- All Dimensions in mm
- Pad dimensioning correlates to pad center.
- Pad dimensions: 0.6 mm x 0.55 mm
- The green shaded area denotes the active chip area.

Fig. 7: SIL6 outline for AL796AKA.

AL796AMA LGA6L Package

Pinout

Pad	Symbol	Parameter
1	$+V_{O1}$	Positive output voltage bridge 1
2	$+V_{O2}$	Positive output voltage bridge 2
3	GND	Ground
4	V_{CC}	Supply voltage
5	$-V_{O1}$	Negative output voltage bridge 1
6	$-V_{O2}$	Negative output voltage bridge 2
7-10	NC	Not connected

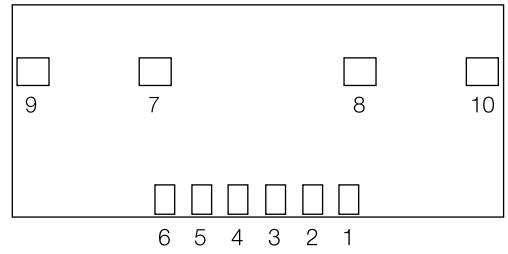
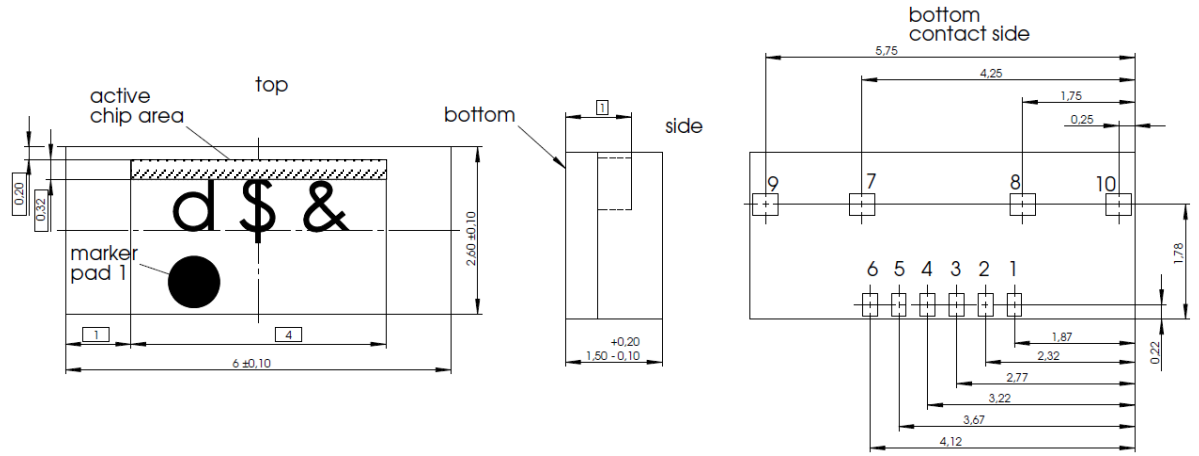


Fig. 8: Pinout of the AL796AMA LGA6L Package

Dimensions



Sensor marking:

d: Sensor AL796
$: Week (A:1/2, B: 3/4, …)
&: Year (A: 2009, B: 2010, …)

Notes:

- All Dimensions in mm
- Pad dimensioning correlates to pad center.
- Pad dimensions (1-6): 0.23 mm x 0.35 mm
- Pad dimensions (7-10): 0.40 mm x 0.33 mm
- The green shaded area denotes the active chip area.

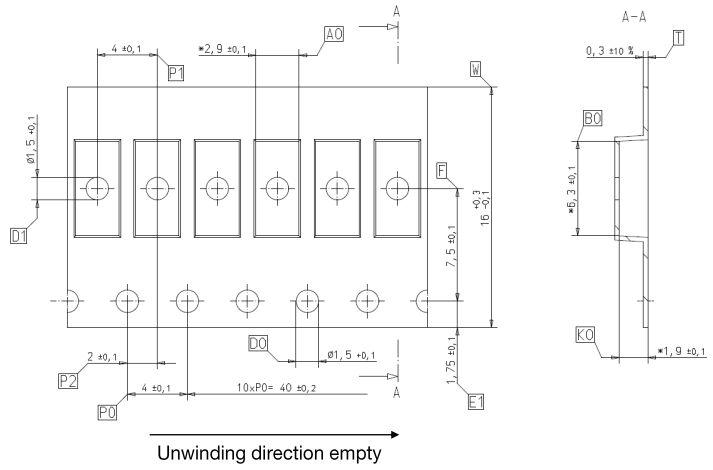
Tolerances:

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

Fig. 9: LGA6L outline for AL796AMA.

AL796AMA LGA6L Package

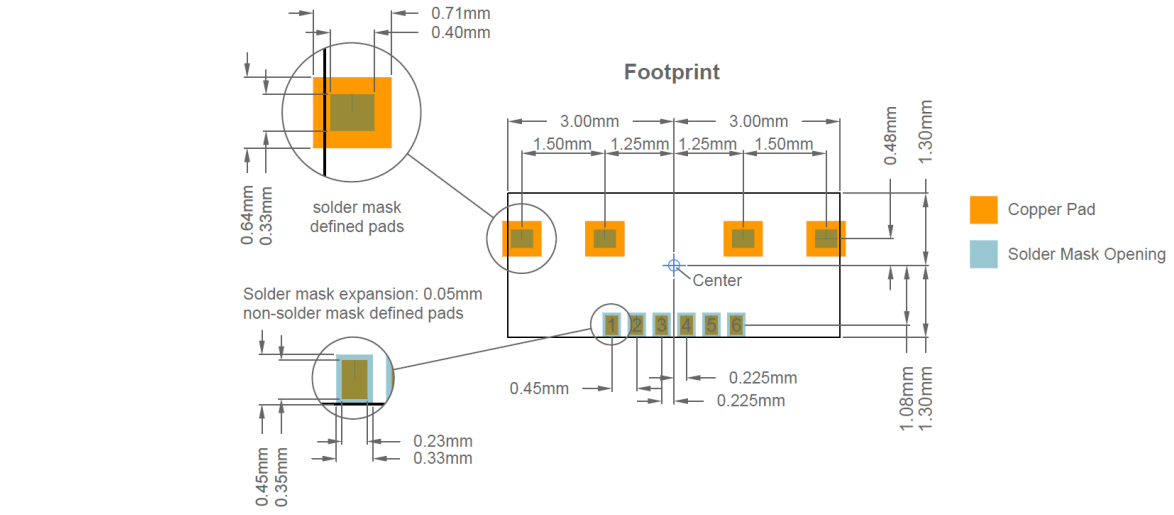
Reel layout



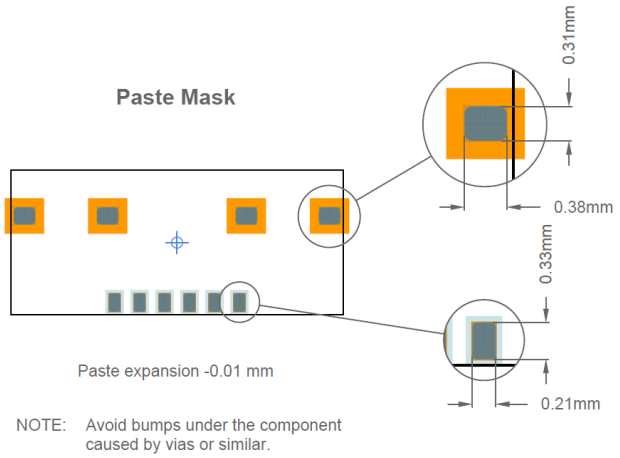
Notes:
- Type: RC 3689
- Material: PS (conductive)
- Conductivity: 10^3 - 10^6 Ω/sq
- All cavity dimensions measured at the end of radius
- All Dimensions in mm
- Surface resistivity can break
- Marking for pin 1 towards sprocket hole (IEC60286-3)
- Shelf life: 24 months after seal date (dry-packed sensors), non-condensing atmosphere, max. 40 °C, max. 90 % relative humidity
- moisture sensitivity level 2 classified (JEDEC J-STD-020)
- after dry pack opening: floor conditions und floor times as defined in JEDEC J-STD-033
- bake out times and conditions after the allowed floor time refer to JEDEC J-STD-033
- Sensors in tape & reel are not allowed to bake out at temperatures > 45 °C

Fig. 10: LGA6L tape & reel for AL796AMA-AE.

Land pattern layout



Notes:
- Solder mask of 125 µm thickness recommanded.
- Solder paste with grain size of type 5 recommanded.



NOTE: Avoid bumps under the component caused by vias or similar.

Reflow-Profile Recommendation:

Temperature	Time
40 - 170 °C	110 - 150 sec.
170 - 217 °C	100 - 140 sec.
To reach peak	240 - 310 sec.
> 217 °C	30 - 90 sec.

Fig. 11: LGA6L land pattern and reflow recommendation.

AL796AMS-AE SIL8 Package

Pinout

Pad	Symbol	Parameter
1	NC	Not connected
2	$+V_{O1}$	Positive output voltage bridge 1
3	$+V_{O2}$	Positive output voltage bridge 2
4	V_{CC}	Supply voltage
5	GND	Ground
6	$-V_{O1}$	Negative output voltage bridge 1
7	$-V_{O2}$	Negative output voltage bridge 2
8	NC	Not connected

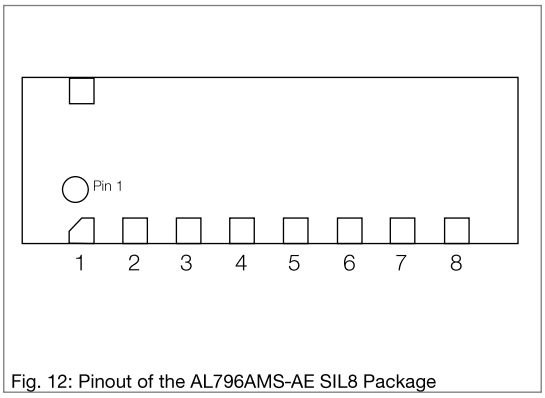


Fig. 12: Pinout of the AL796AMS-AE SIL8 Package

Dimensions

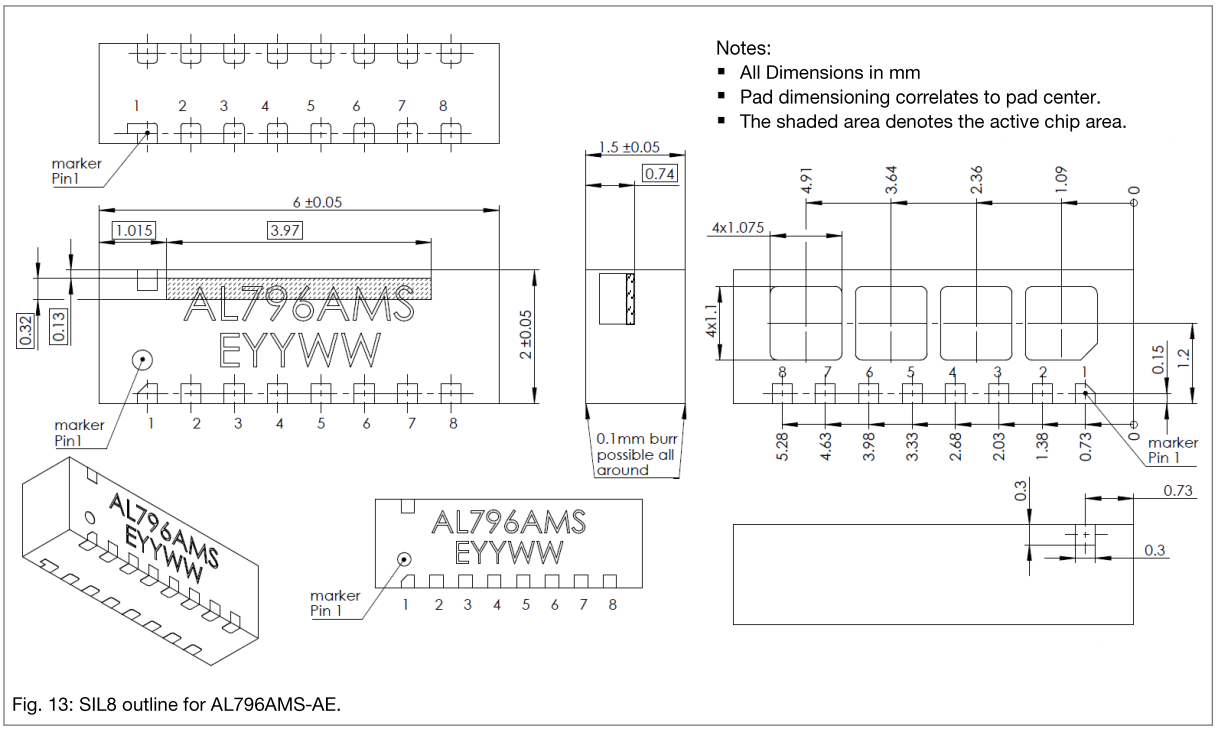


Fig. 13: SIL8 outline for AL796AMS-AE.

AL796AMS-AE SIL8 Package

Reel layout

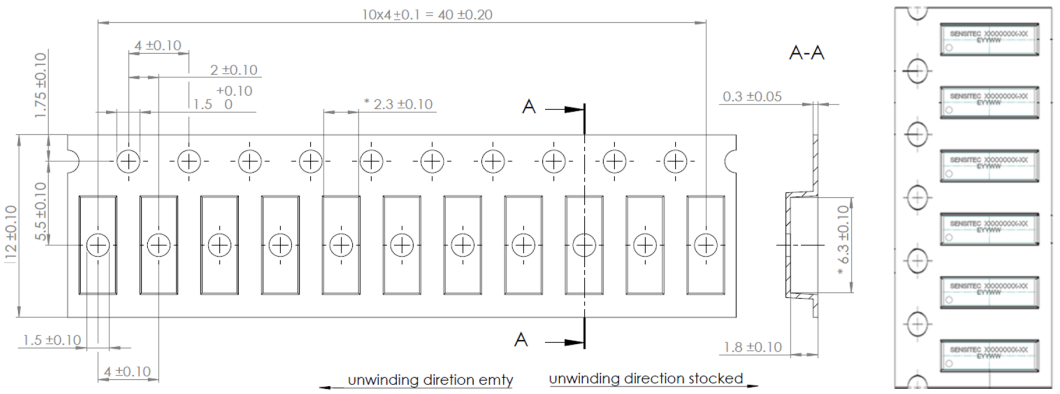
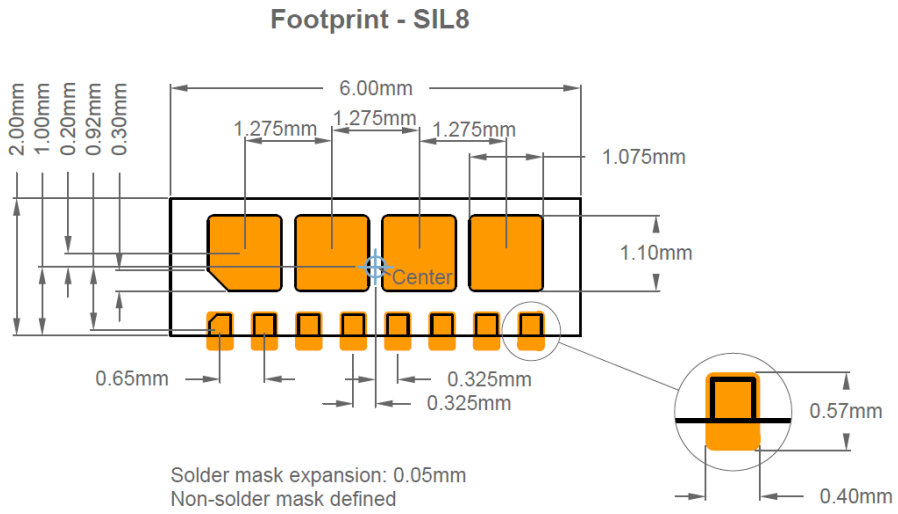
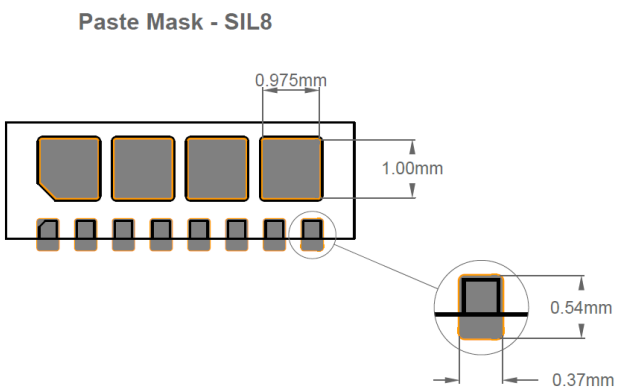


Fig. 14: SIL8 Tape&Reel for AL796AMS-AE (left). Device orientation in reel (right).

Land pattern layout



Notes:
- Solder mask of 125 µm thickness recommanded.
- Solder paste with grain size of type 5 recommanded.



Reflow-Profile Recommendation:

Temperature	Time
40 - 170 °C	110 - 150 sec.
170 - 217 °C	100 - 140 sec.
To reach peak	240 - 310 sec.
> 217 °C	30 - 90 sec.

Fig. 15: SIL8 land pattern and reflow recommendation.

AL796AMS-AS SIL8-D Package

Pinout

Pad	Symbol	Parameter
1	NC	Not connected
2	$+V_{O1}$	Positive output voltage bridge 1
3	$+V_{O2}$	Positive output voltage bridge 2
4	V_{CC}	Supply voltage
5	GND	Ground
6	$-V_{O1}$	Negative output voltage bridge 1
7	$-V_{O2}$	Negative output voltage bridge 2
8	NC	Not connected

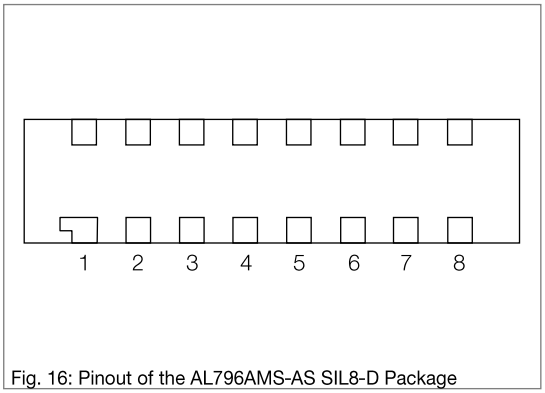


Fig. 16: Pinout of the AL796AMS-AS SIL8-D Package

Dimensions

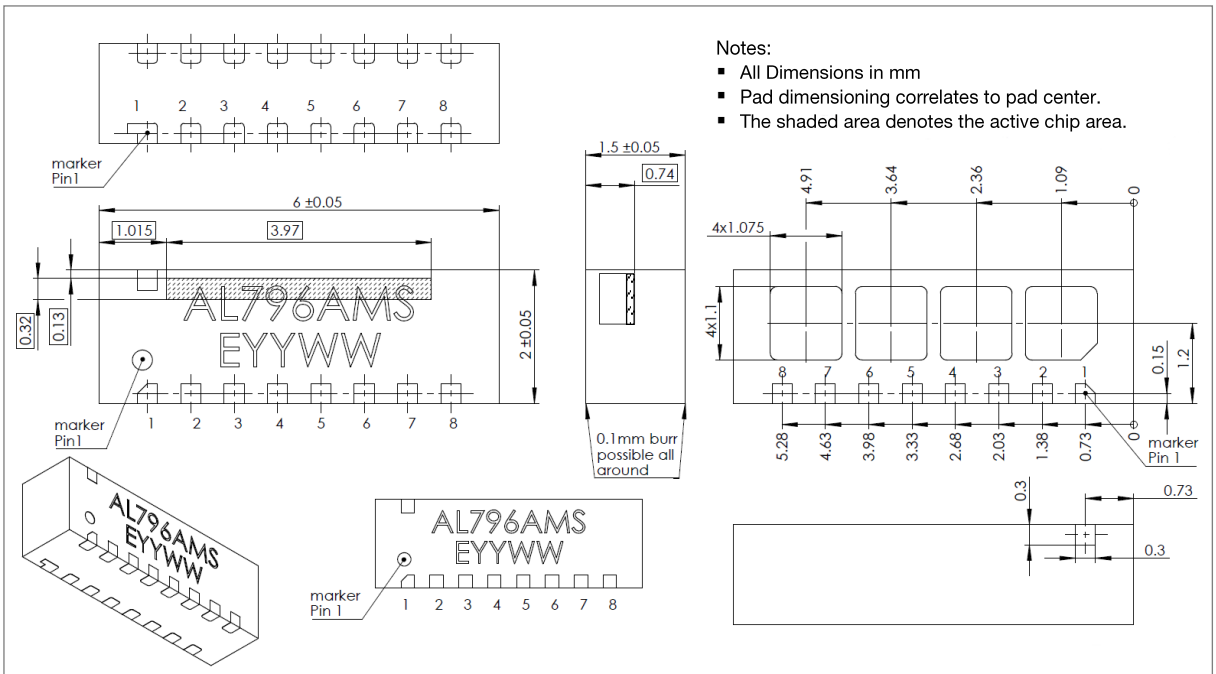


Fig. 17: SIL8-D outline for AL796AMS-AS.

AL796AMS-AS SIL8-D Package

Reel layout

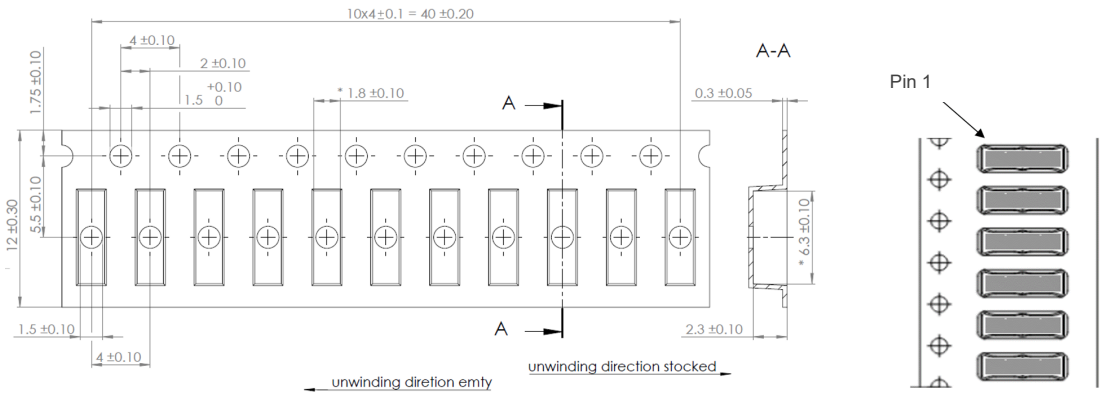
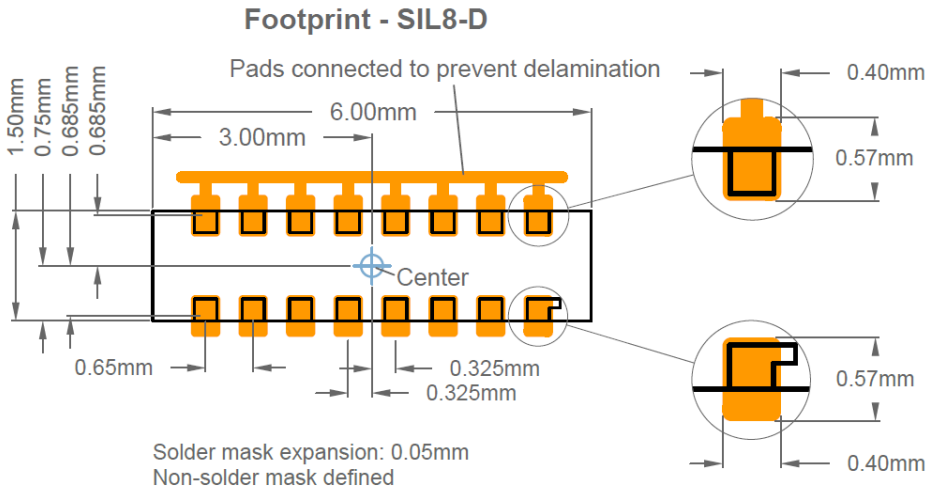
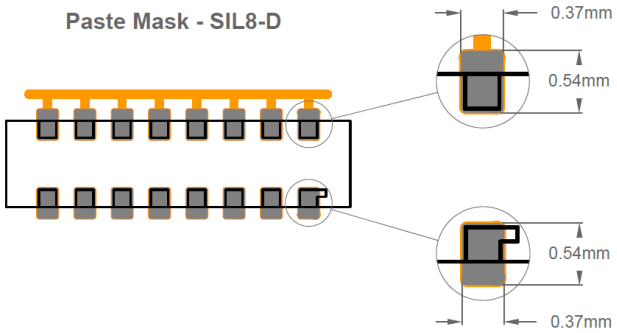


Fig. 18: SIL8-D Tape&Reel for AL796AMS-AS (left). Device orientation in reel (right).

Land pattern layout



Notes:
- Solder mask of 125 µm thickness recommanded.
- Solder paste with grain size of type 5 recommanded.

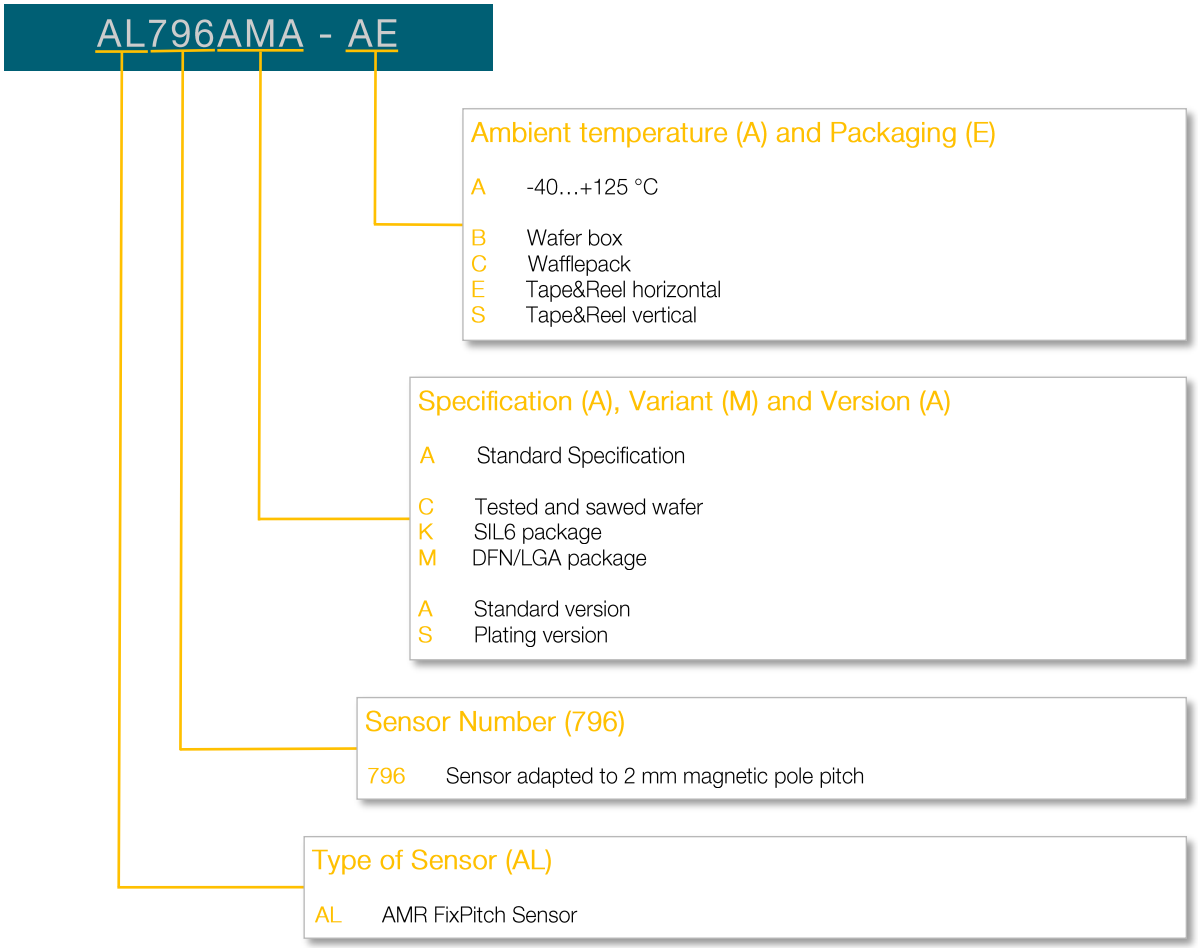


Reflow-Profile Recommendation:

Temperature	Time
40 - 170 °C	110 - 150 sec.
170 - 217 °C	100 - 140 sec.
To reach peak	240 - 310 sec.
> 217 °C	30 - 90 sec.

Fig. 19: SIL8-D land pattern and reflow recommendation.

Additional Information on Ordering Code



Special Design Features

PerfectWave

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 measurment.

PurePitch

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 measurment scale and improves the immunity to interference fields.

FixPitch

FixPitch sensors are adapted to the pole length (pitch) of the measurment scale. The linearity of the sensor is optimized and the influence of interference fields is minimized.

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.
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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General Information

Application Information

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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.

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Changelist

Version	Description of the Change	Date
AL796.DSE.17	Layout improvements (pp. 1-15), Change technical drawing (p. 9, p. 11)	05/2024
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.00	Original (pp. 1-7)	04/2012

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