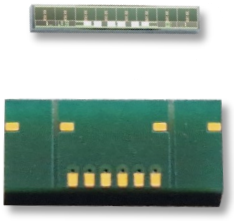
DATA SHEET

AL794

MagnetoResistive FixPitch Sensor (2.5 mm)

The AL794 is an AnisotropicMagnetoResistive (AMR) position sensor with a high resistance for low power applications. 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.
The MR strips of this FixPitch sensor geometrically match to a pole length of 2.5 mm (equal to a magnetic period of 5 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 AL794 is available as bare die. For SMD processing, the sensor is available in a Sil6 or LGA package.



Product Overview of AL794

Article description	Package	Delivery Type
AL794ACA-AB [1]	Die on Wafer	Waferbox
AL794BCA-AB [1]	Die on Wafer	Waferbox
AL794AKA-AC	SIL6	Waffle pack (90 pcs)
AL794AMA-AE	LGA6L	Tape on reel (2000 pcs)
AL794BMA-AE	LGA6L	Tape on reel (2000 pcs)
AL794 Evalboard	Evalboard	ESD-Box

[1] minimum order quantities apply.

Quick Reference Guide

Symbol	Parameter	min.	typ.	max.	Unit
P	Pitch (magnetic pole length)	-	2.5	-	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 (Version A)	52.0	62.0	72.0	kΩ
R_B	Bridge resistance (Version B)	71.0	84.0	97.0	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.

Features

- Based on the AnisotropicMagnetoResistive (AMR) effect
- Contains two high resistance wheatstone bridges on Chip
- Sine and Cosine output
- Adapted to 2.5 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

ESD

Magnetic Data

Symbol	Parameter	Conditions	min.	typ.	max.	Unit
H_{ext}	Magnetic field strength [1]		20.0	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	-5.0	-	+5.0	(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 (Version A) [5]		52.0	62.0	72.0	kΩ
R_B	Bridge resistance (Version B) [5]		71.0	84.0	97.0	kΩ
R_S	Sensor resistance (Version A) [6]		26.0	31.0	36.0	kΩ
R_S	Sensor resistance (Version B) [6]		35.5	42.0	48.5	kΩ
TC_{RB}	Temperature coefficient of R_B [7]	T_{amb} = (-40…+125)°C	0.24	0.28	0.32	%/K

[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]		-	25.0	30.0	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	-	2.5	-	mm
d	Distance [11]		-	1.0	-	mm
T_{amb}	Ambient temperature		-40	-	+125	°C

[11] See Fig. 3 for detailed information.

Output Signal Information

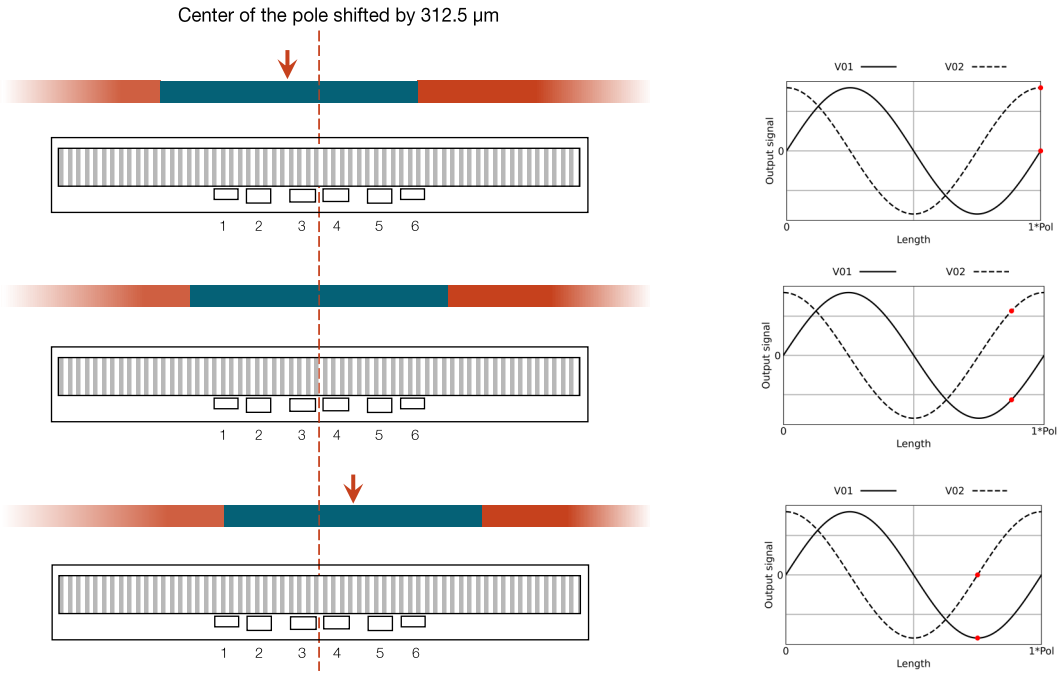


Fig 1: Sensor signal as function of the relative position of sensor and magnetic scale.

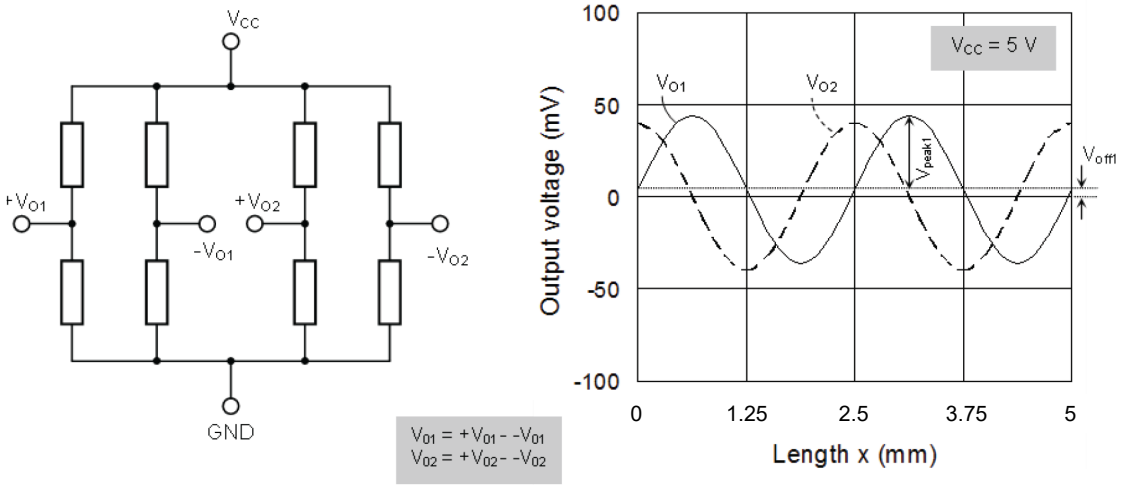


Fig 2: Left: Simplified circuit diagram.
Right: Output signals as function of linear displacement.

Typical Performance Graphs

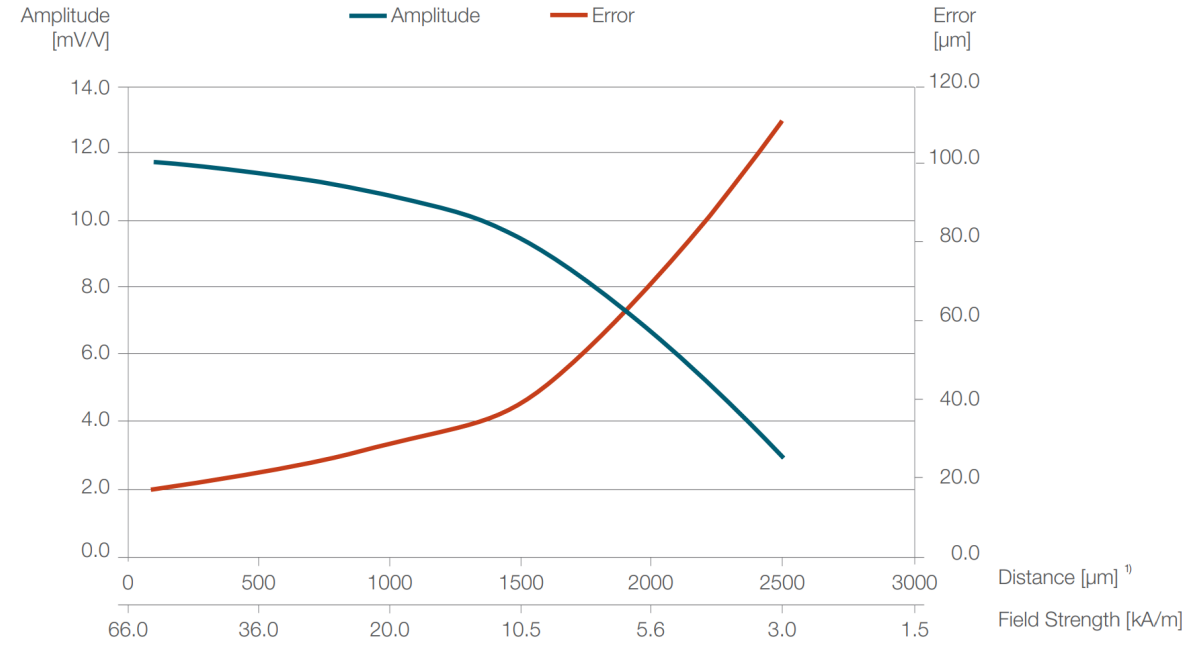


Fig. 3: Amplitude and error vs. distance and field strength.

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

AL794ACA/AL794BCA 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

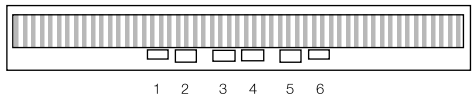
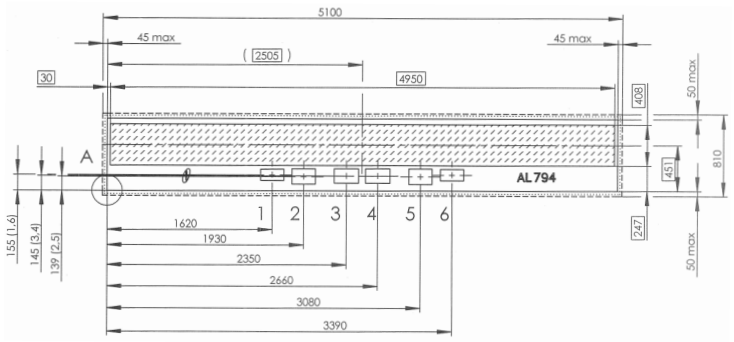


Fig. 4: Pinout of the AL794xCA Bare Die

Dimensions

Pad	a x b
1	230 x 110
2	230 x 148
3	240 x 140
4	240 x 140
5	230 x 148
6	230 x 110



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 since this may cause damage the chip. Using a die collet for handling is recommened.

Fig. 5: Chip outline for AL794xCA as bare die.

Data for Packaging and Interconnection Technologies

Parameter	Value	Unit
Chip area [1)]	5.1 x 0.81	mm^2
Chip thickness	525 ± 10	µm
Pad size	See Fig. 5	-
Pad thickness	0.8	µm
Pad material	AlCu	-

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

AL794AKA 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

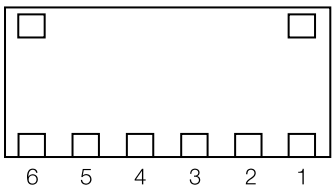
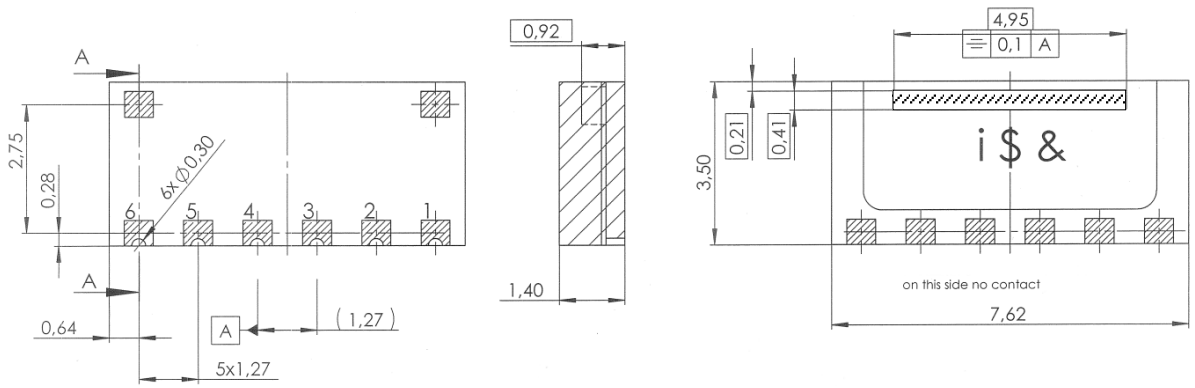


Fig. 6: Pinout of the AL794AKA SIL6 Package

Dimensions



Sensor marking:

i: Sensor AL794
$: 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 AL794AKA.

AL794AMA/AL794BMA 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

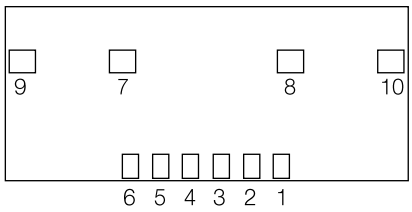
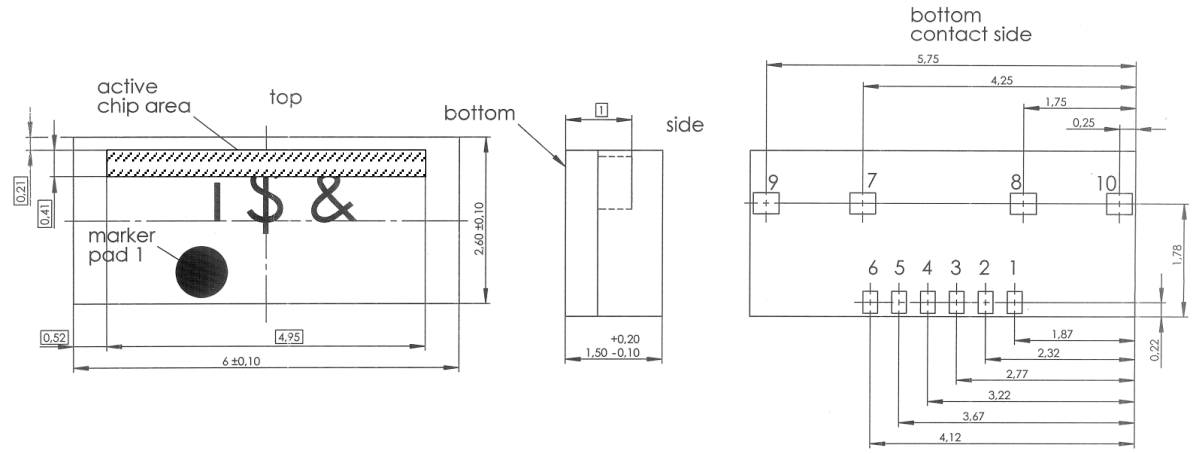


Fig. 8: Pinout of the AL794xMA LGA6L Package

Dimensions



Sensor marking:

i: Sensor AL794
$: 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.

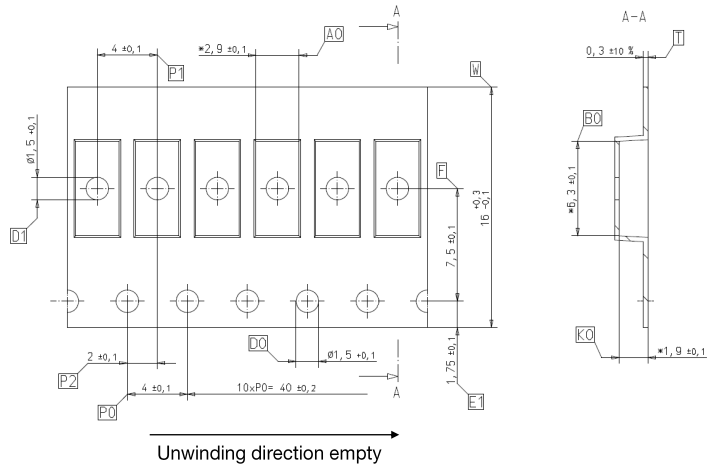
Tolerances:

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

Fig. 9: LGA6L outline for AL794xMA.

AL794AMA/AL794BMA LGA6L Package

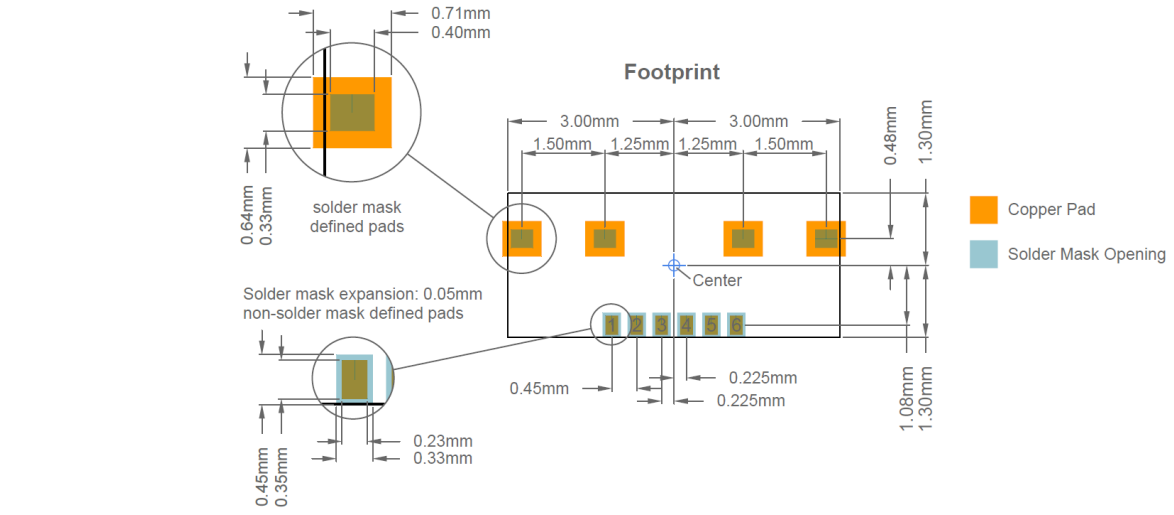
Reel layout



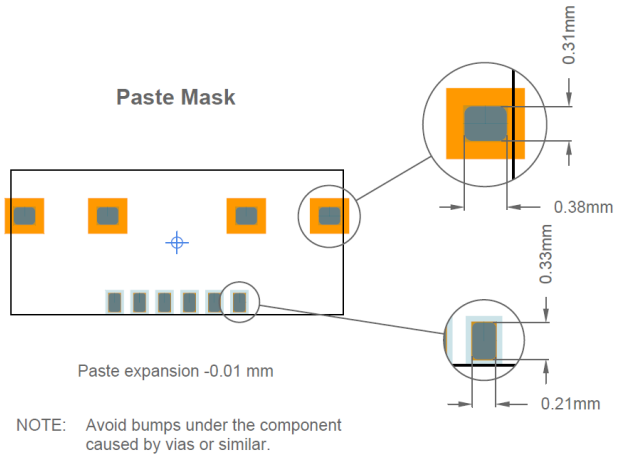
Notes:
- Type: RC 3689
- Material: PS (conductive)
- Conductivity: 10^3 - 10^6 Ω/sq
- All cavity dimensions measured at the end of radius
- All Dimensions in mm
- Surface resistivity can break
- Marking for pin 1 towards sprocket hole (IEC60286-3)
- Shelf life: 24 months after seal date (dry-packed sensors), 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 AL794AMA-AE.

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. 11: LGA6L land pattern and reflow recommendation.

Evalboard with AL794AMA-AE

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

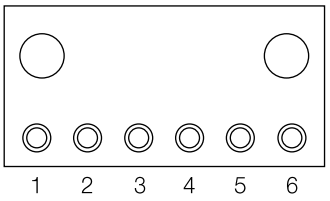


Fig. 20: Pinout of the evalboard

Dimensions

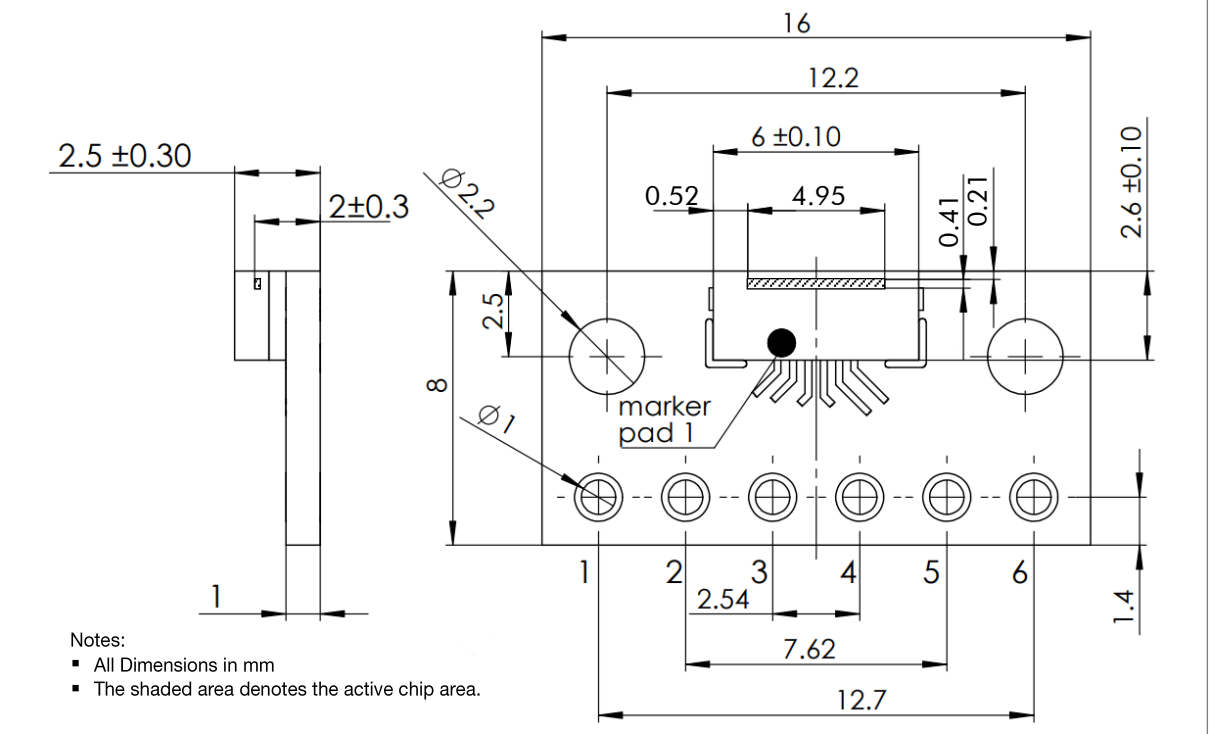
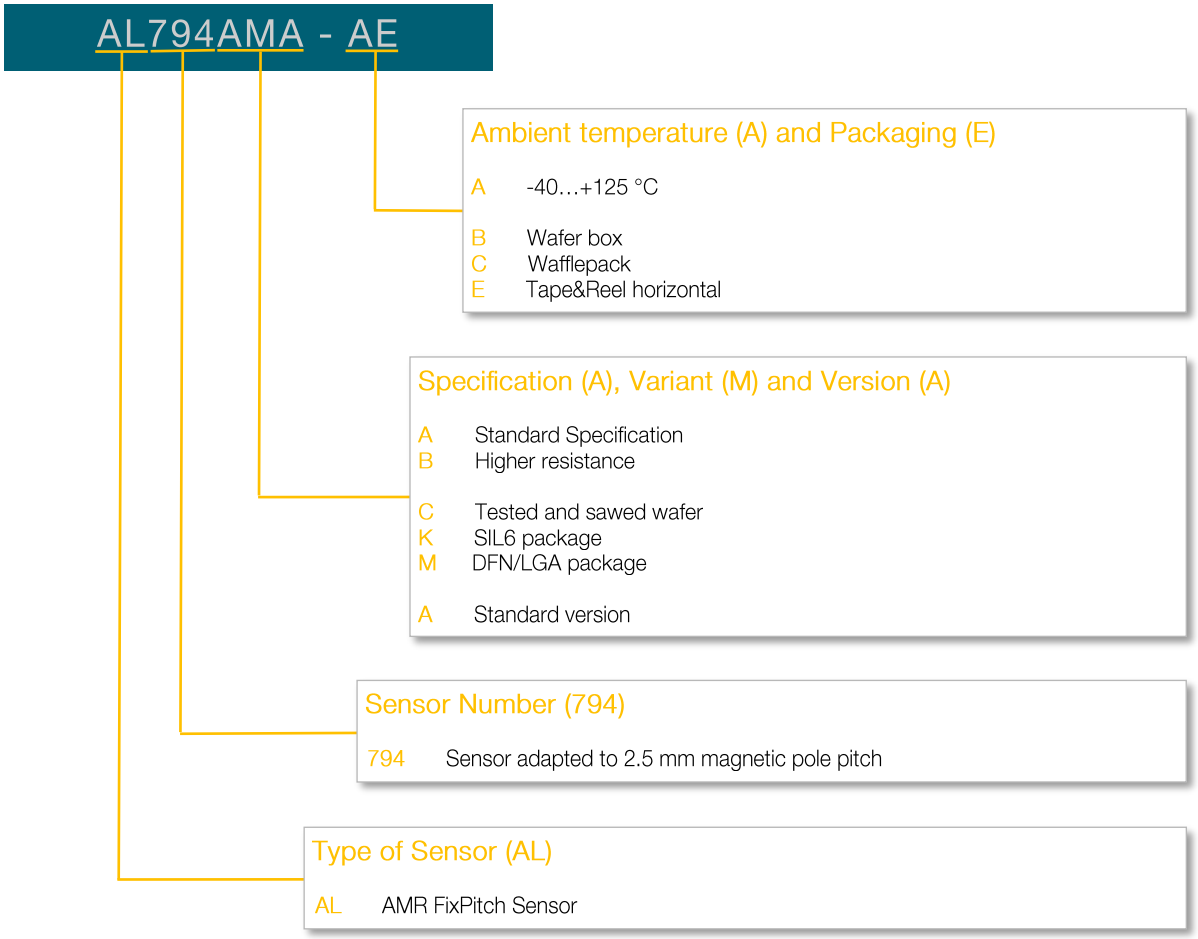


Fig. 21: Outline of evalboard with AL794AMA-AE.

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
AL794ACA-AB	The product is in series production.
AL794BCA-AB	The product is in series production.
AL794AKA-AC	The product is in series production.
AL794AMA-AE	The product is in series production.
AL794BMA-AE	The product is in series production.
AL794 Evalboard	This product is for evaluation of the AL794AMA-AE sensor.
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
AL794.DSE.10	Add evalboard information (p. 9)	12/2024
AL794.DSE.09	Disclaimer supplement	06/2022
AL794.DSE.08	Change of technical data (p. 1, 2, 5, 7, 9)	05/2022
AL794.DSE.07	Change of corporate design (pp. 1-10)	01/2022
AL794.DSE.00	Original (pp. 1-7)	10/2014

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