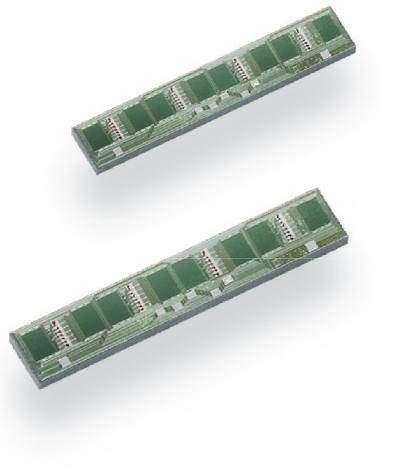
SENSITEC
MAGNETORESISTIVE SENSORS

DATA SHEET

AL780

MagnetoResistive FixPitch Sensor (5 mm)



The AL780 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 signals of the coordinate to be measured (see Fig. 4).

The MR strips of this FixPitch sensor geometrically match to a pole length of 5 mm (equal to a magnetic period of 10 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 output amplitude is almost constant in a wide working range between sensor and magnetic scale.

The bond version of AL780 is available as bare die. For SMD processing the sensor is available in a SIL6 or LGA package.

Product Overview of AL780

Article description	Package	Delivery type
AL780ACA-AC	Bare die	Waffle pack (108)
AL780ACA-AB	Die on wafer [1]	Waferbox
AL780AKA-AC	SIL6	Waffle pack (90)
AL780AMA-AE	LGA6L	Tape on reel (2500)

[1] Minimum order quantities apply.

Quick Reference Guide

Symbol	Parameter	Min.	Typ.	Max.	Unit
P	Pitch (magnetic pole length)	-	5.0	-	mm
V_{CC}	Supply voltage (per bridge)	-	5.0	-	V
V_{off}	Offset voltage per V_{CC}	-1.0	-	+1.0	mV/V
V_{peak}	Signal amplitude per V_{CC}	9.0	11.0	13.0	mV/V
R_B	Bridge resistance	2.7	3.2	3.7	kΩ

Absolute Maximum Ratings

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

Symbol	Parameter	Min.	Max.	Unit
V_{CC}	Supply voltage of bridge	-9.0	+9.0	V
T_{amb}	Ambient temperature	-40	+125	°C
T_{stg}	Storage temperature	-65	+150	°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 5 mm 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

ESD

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Magnetic Data

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
H_{ext}	Magnetic field strength [1]		15.0	25.0	-	kA/m

[1] The stimulating magnetic field in the sensor plane to ensure minimum error specified in note 9.

Electrical Data

T_{amb} = 25 °C; H_{ext} = 25 kA/m; V_{CC} = 5 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	-1.0	-	+1.0	mV/V
TC_{Voff}	Temperature coefficient of V_{off} [2] [3]	T_{amb} = (-40...+125)°C	-5.0	-	5.0	(µV/V)/K
V_{peak}	Signal amplitude per V_{CC} [4]	See Fig.2	9.0	11.0	13.0	mV/V
TC_{Vpeak}	Temperature coefficient of V_{peak} [5]	T_{amb} = (-40...+125)°C	-0.48	-0.42	-0.36	%/K
R_B	Bridge resistance [6]		2.7	3.2	3.7	kΩ
R_S	Sensor resistance [7]		1.35	1.6	1.85	kΩ
TC_{RB}	Temperature coefficient of R_B [8]	T_{amb} = (-40...+125)°C	0.22	0.26	0.30	%/K

[2] For larger production volume can be restricted to target value +/-2 (µV/V)/K.

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

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

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

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

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

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

Accuracy

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

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
ΔX	Measurement error [9]		-	25.0	30.0	µm
k	Amplitude synchronism [10]		-	0.1	1.0	% of V_{peak}

[9] $\Delta x = |x_{real} - x_{measured}|$ with a working distance of 2000 microns without affecting the sensor offsets on a typical scale (for example Tromaflex® 928). See Fig. 9 for detailed information and the influence of the air gap between sensor and scale.

[10] $k = 100 - 100 \cdot \frac{V_{peak1}}{V_{peak2}}$.

Dynamic Data

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
f	Frequency range		1 [11]	-	-	MHz

[11] No significant amplitude attenuation.

General Data

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
P	Pitch (magnetic pole length)	See Fig. 1	-	5.0	-	mm
d	Distance [12]	See Fig. 1	-	2.0	-	mm
T_{amb}	Ambient temperature		-40	-	+125	°C

[12] See Fig. 3 for detailed information.

Dimensions

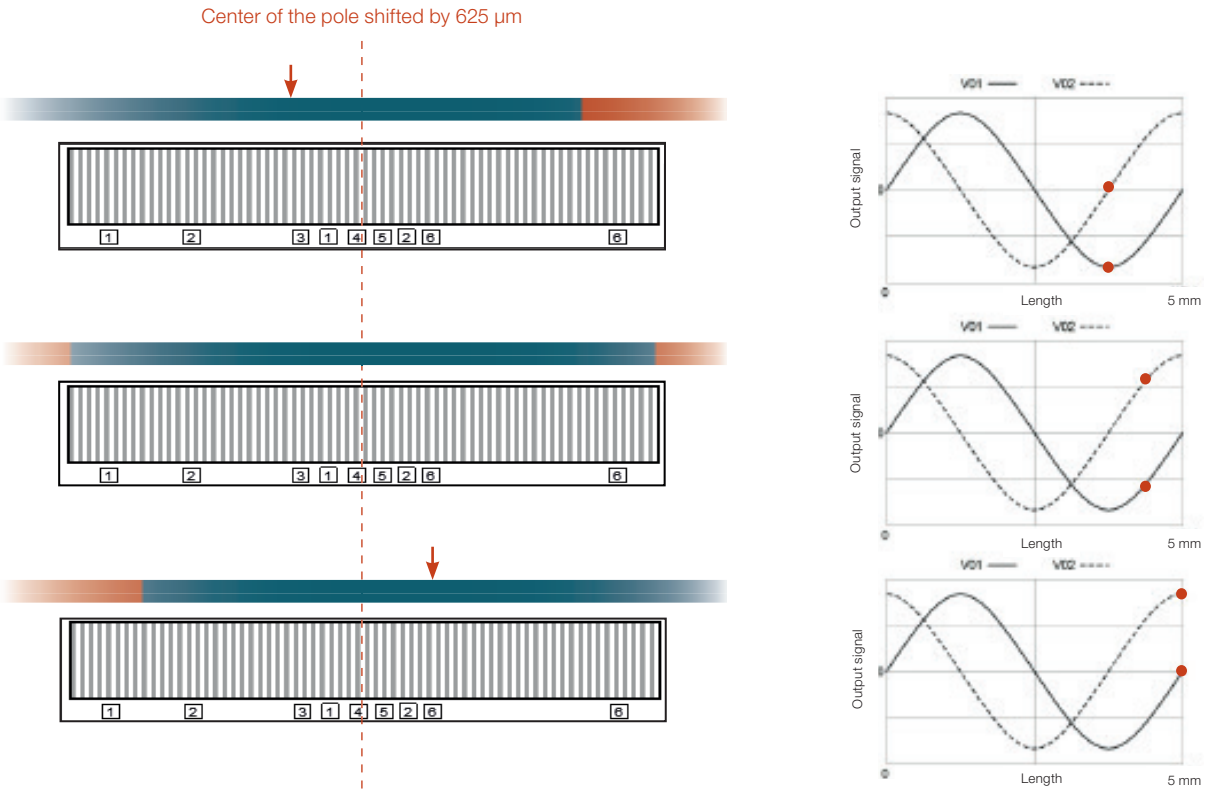


Fig. 1: Sensor signal as function of the relative position of sensor and magnetic scale.

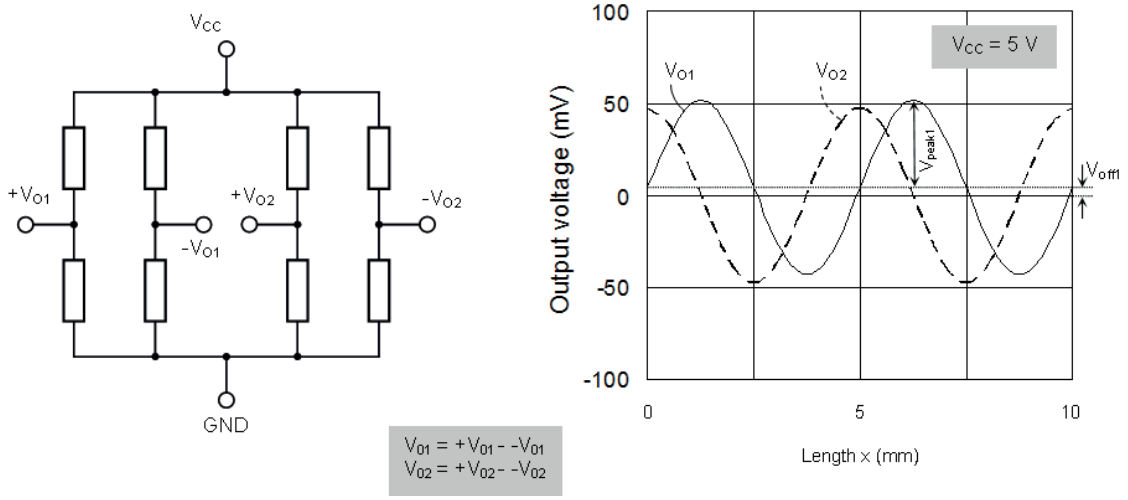


Fig. 2: *left:* Simplified circuit diagram.
right: Output signals as function of linear displacements.

Typical Performance Graphs

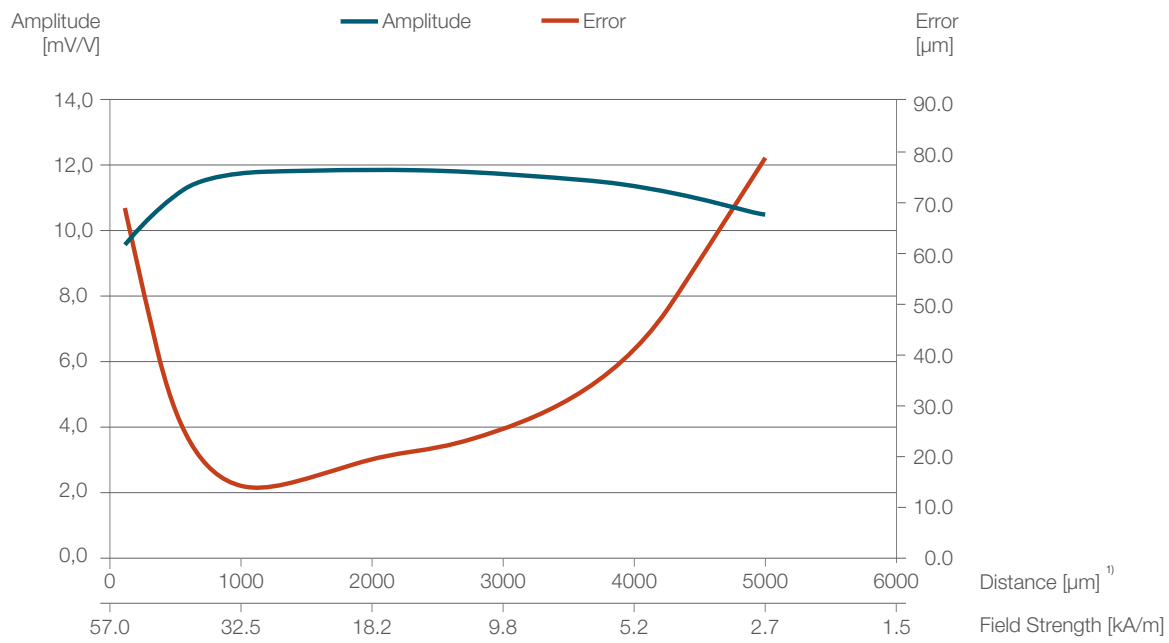


Fig. 3: Amplitude and error vs. distance and field strength.

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

AL780ACA Bare Die

Pinning

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

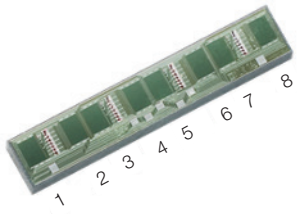
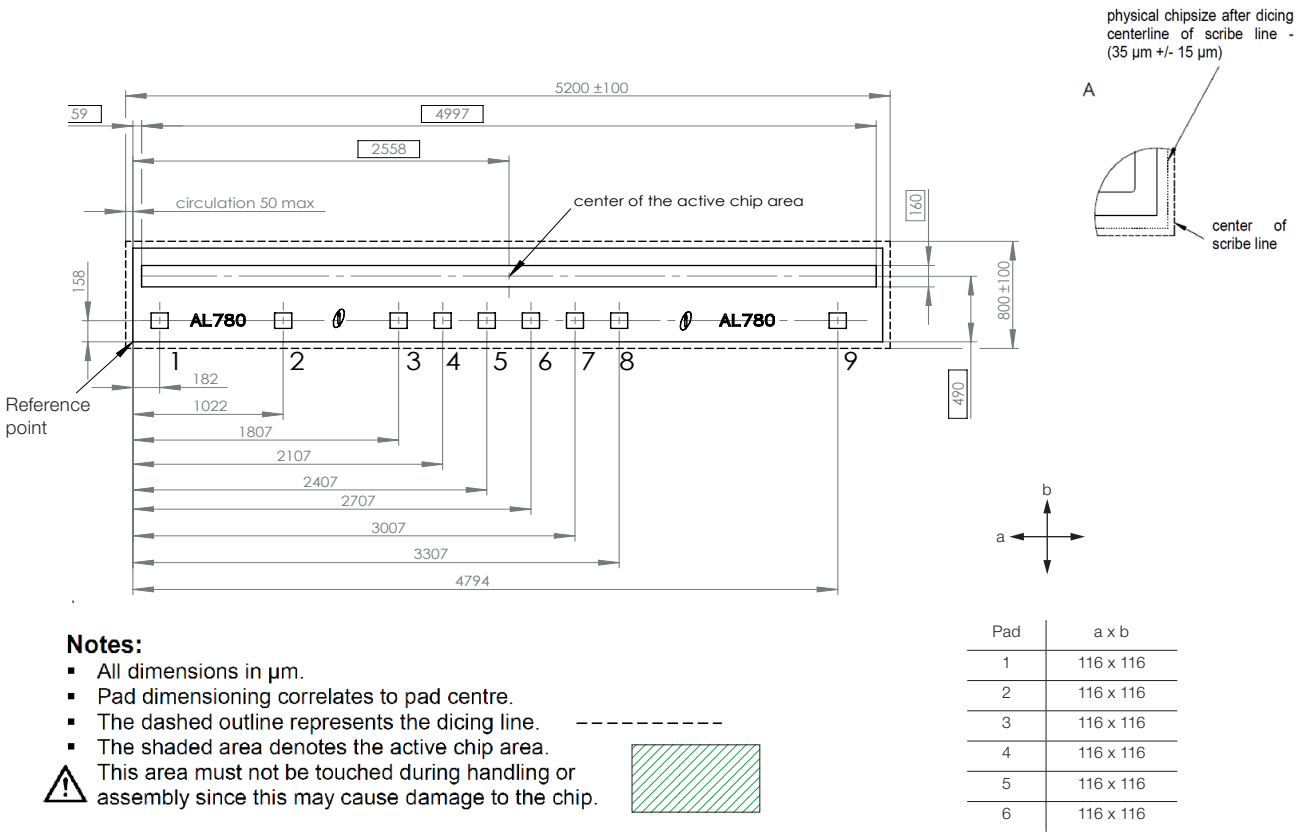


Fig. 4: AL780ACA.

Mechanical Data



Pad	a x b
1	116 x 116
2	116 x 116
3	116 x 116
4	116 x 116
5	116 x 116
6	116 x 116

Notes:

- All dimensions in µm.
- Pad dimensioning correlates to pad centre.
- The dashed outline represents the dicing line.
- 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. 5: Chip outline for AL780ACA.

Data for Packaging and Interconnection Technologies

Parameter	Value	Unit
Chip area [1]	5.2 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.

AL780AKA SIL6 Package

Pinning

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

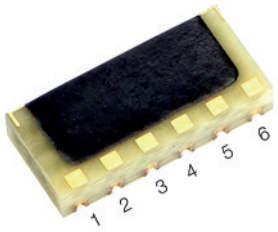
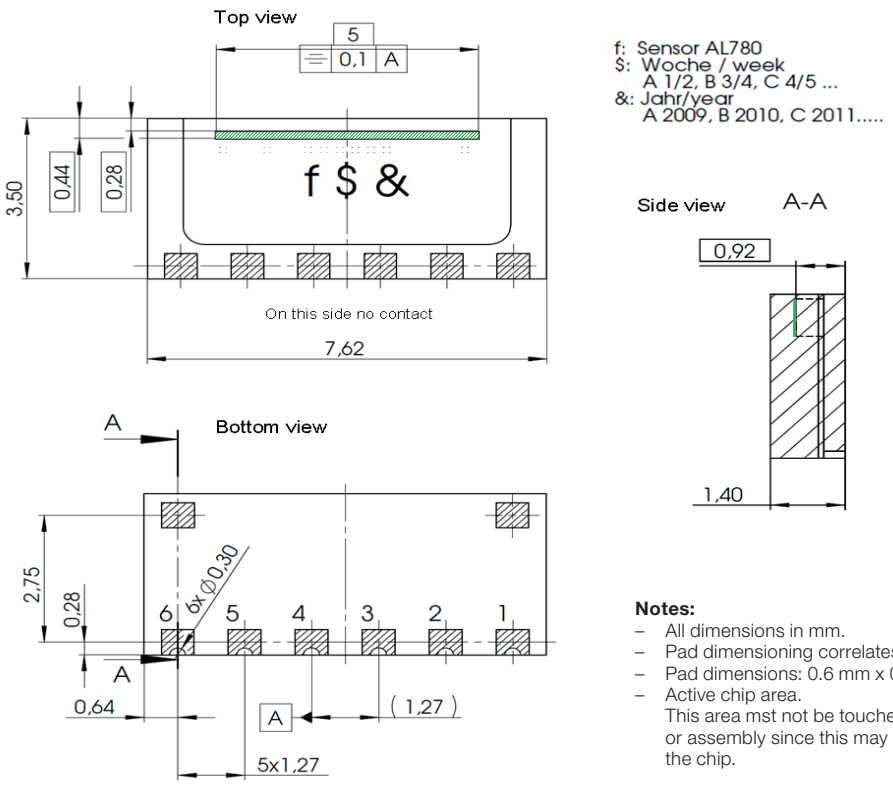


Fig. 6: AL780AKA.

Dimensions



Notes:
- All dimensions in mm.
- Pad dimensioning correlates to pad centre.
- Pad dimensions: 0.6 mm x 0.55 mm
- Active chip area.
  This area mst not be touched during nadling or assembly since this may cause damage to the chip.

Fig. 7: SIL6 outline for AL780AKA.

AL780AMA LGA6L Package

Pinning

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

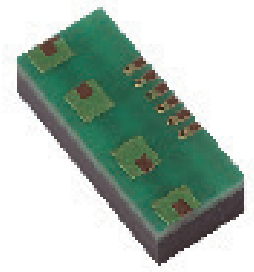


Fig. 8: AL780AMA.

Dimensions

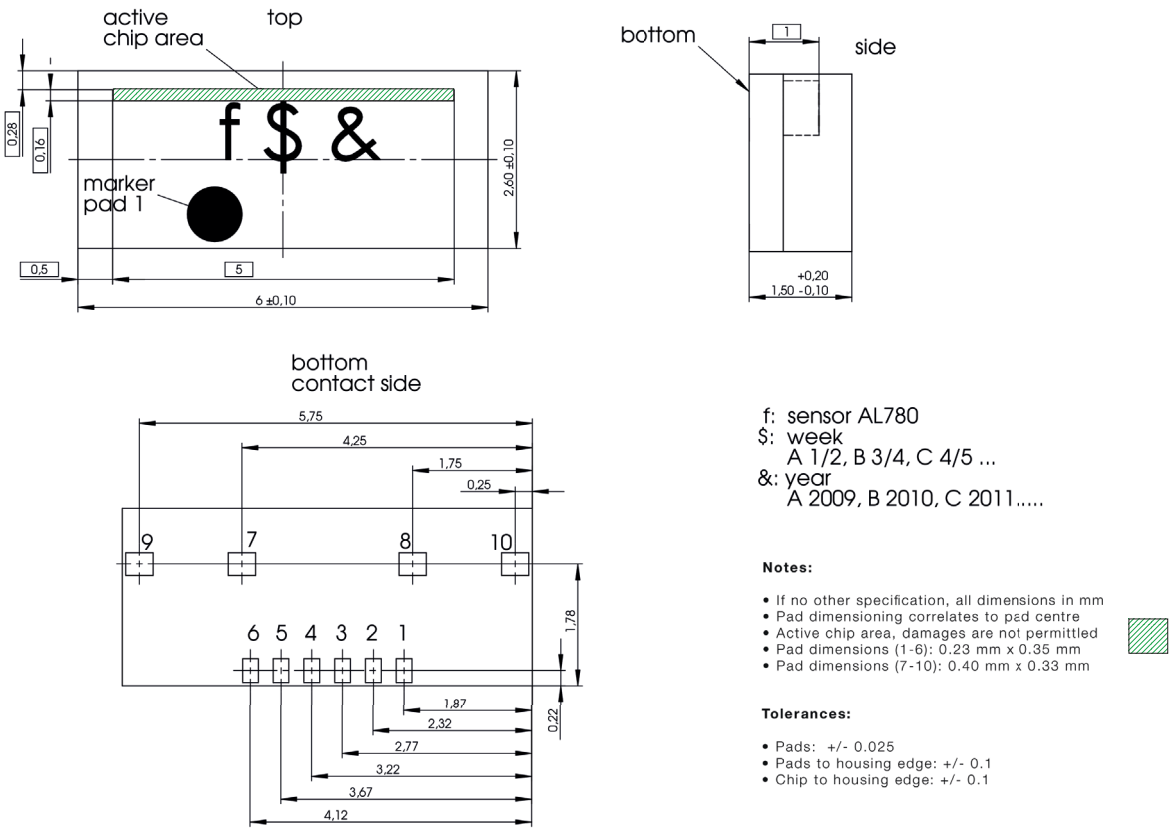


Fig. 9: LGA6L for AL780AMA.

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 measurement.

FixPitch

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.

General Information

Product Status

Article	Status
AL780ACA-AC	The product is in series production.
AL780ACA-AB	The product is in series production.
AL780AKA-AC	The product is in series production.
AL780AMA-AE	The product is in series production.
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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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
AL780.DSE.13	Change of corporate design (pp. 1-10)	01/2022
AL780.DSE.00	Original (pp. 1-10)	11/2012

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