

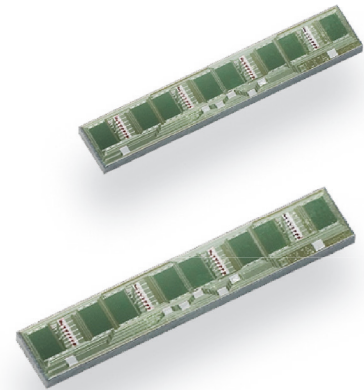
# AL780

## 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 <sup>1)</sup>	Waferbox
AL780AKA-AC	SIL6	Waffle pack (90)
AL780AMA-AE	LGA6L	Tape on reel (2500)

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

### Quick Reference Guide

Symbol	Parameter	Min.	Typ.	Max.	Unit
P	Pitch (magnetic pole length)	-	5.0	-	mm
V <sub>CC</sub>	Supply voltage (per bridge)	-	5.0	-	V
V <sub>off</sub>	Offset voltage per V <sub>CC</sub>	-1.0	-	+1.0	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	2.7	3.2	3.7	kΩ

### Absolute Maximum Ratings

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

Symbol	Parameter	Min.	Max.	Unit
V <sub>CC</sub>	Supply voltage of bridge	-9.0	+9.0	V
T <sub>amb</sub>	Ambient temperature	-40	+125	°C
T <sub>stg</sub>	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



## Magnetic Data

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
$H_{ext}$	Magnetic field strength <sup>1)</sup>		15.0	25.0	-	kA/m

<sup>1)</sup> The stimulating magnetic field in the sensor plane to ensure minimum error specified in note 9.

## 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.2	-1.0	-	+1.0	mV/V
$TC_{V_{off}}$	Temperature coefficient of $V_{off}$ <sup>2)3)</sup>	$T_{amb} = (-40...+125)\text{ °C}$	-5.0	-	5.0	( $\mu\text{V/V/K}$ )
$V_{peak}$	Signal amplitude per $V_{CC}$ <sup>4)</sup>	See Fig.2	9.0	11.0	13.0	mV/V
$TC_{V_{peak}}$	Temperature coefficient of $V_{peak}$ <sup>5)</sup>	$T_{amb} = (-40...+125)\text{ °C}$	-0.48	-0.42	-0.36	%/K
$R_B$	Bridge resistance <sup>6)</sup>		2.7	3.2	3.7	k $\Omega$
$R_S$	Sensor resistance <sup>7)</sup>		1.35	1.6	1.85	k $\Omega$
$TC_{R_B}$	Temperature coefficient of $R_B$ <sup>8)</sup>	$T_{amb} = (-40...+125)\text{ °C}$	0.22	0.26	0.30	%/K

<sup>2)</sup> For larger production volume can be restricted to target value  $\pm 2$  ( $\mu\text{V/V/K}$ ).

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

<sup>4)</sup> Maximal output voltage without offset influences. Periodicity of  $V_{peak}$  is  $\sin(P)$  and  $\cos(P)$ .

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

<sup>6)</sup> Bridge resistance between  $+V_{O1}$  and  $-V_{O1}$ ,  $+V_{O2}$  and  $-V_{O2}$ .

<sup>7)</sup> Sensor resistance between  $V_{CC}$  and GND.

$$\supset TC_{R_B} = 100 \cdot \frac{R_{B(T_2)} - R_{B(T_1)}}{R_{B(T_{amb})} \cdot (T_2 - T_1)} \text{ with } T_1 = +25\text{ °C}; T_2 = +125\text{ °C}.$$

## Accuracy

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

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
$\Delta X$	Measurement error <sup>9)</sup>		-	25.0	30.0	$\mu\text{m}$
k	Amplitude synchronism <sup>10)</sup>		-	0.1	1.0	% of $V_{peak}$

<sup>9)</sup>  $\Delta X = |x_{real} - x_{measured}|$  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.

$$\supset k = 100 - 100 \cdot \frac{V_{peak1}}{V_{peak2}}$$

## Dynamic Data

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
f	Frequency range		1 <sup>11)</sup>	-	-	MHz

<sup>11)</sup> 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 <sup>12)</sup>	See Fig. 1	-	2.0	-	mm
$T_{amb}$	Ambient temperature		-40	-	+125	°C

<sup>12)</sup> See Fig. 3 for detailed information.

**Dimensions**

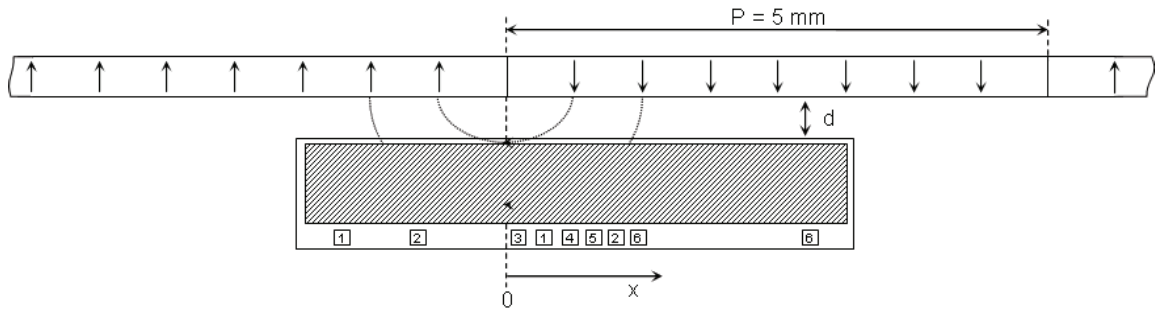
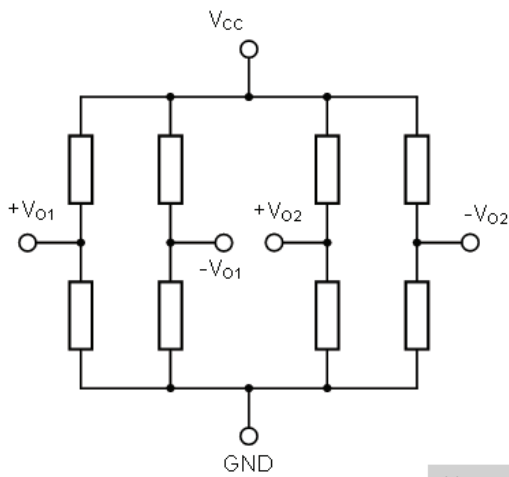


Fig. 1: Arrangement of sensor and magnetic scale. In this example the sensor moves in x-direction along the fixed scale.



$$V_{01} = +V_{01} - -V_{01}$$

$$V_{02} = +V_{02} - -V_{02}$$

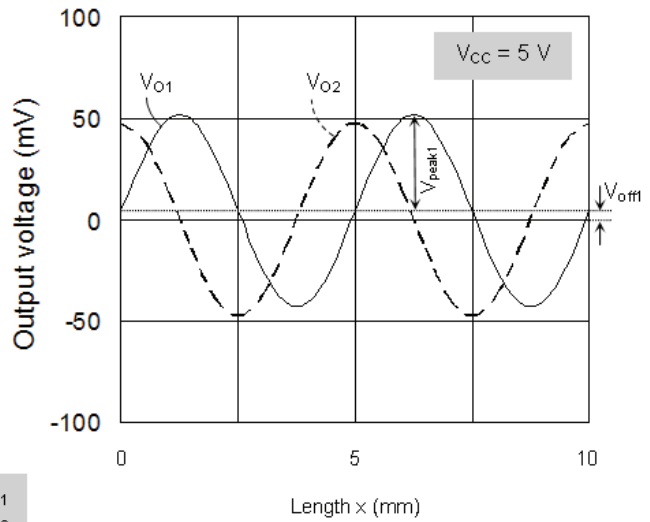


Fig. 2: *left*: Simplified circuit diagram.  
*right*: Output signals as function of linear displacements.

Typical Performance Graphs

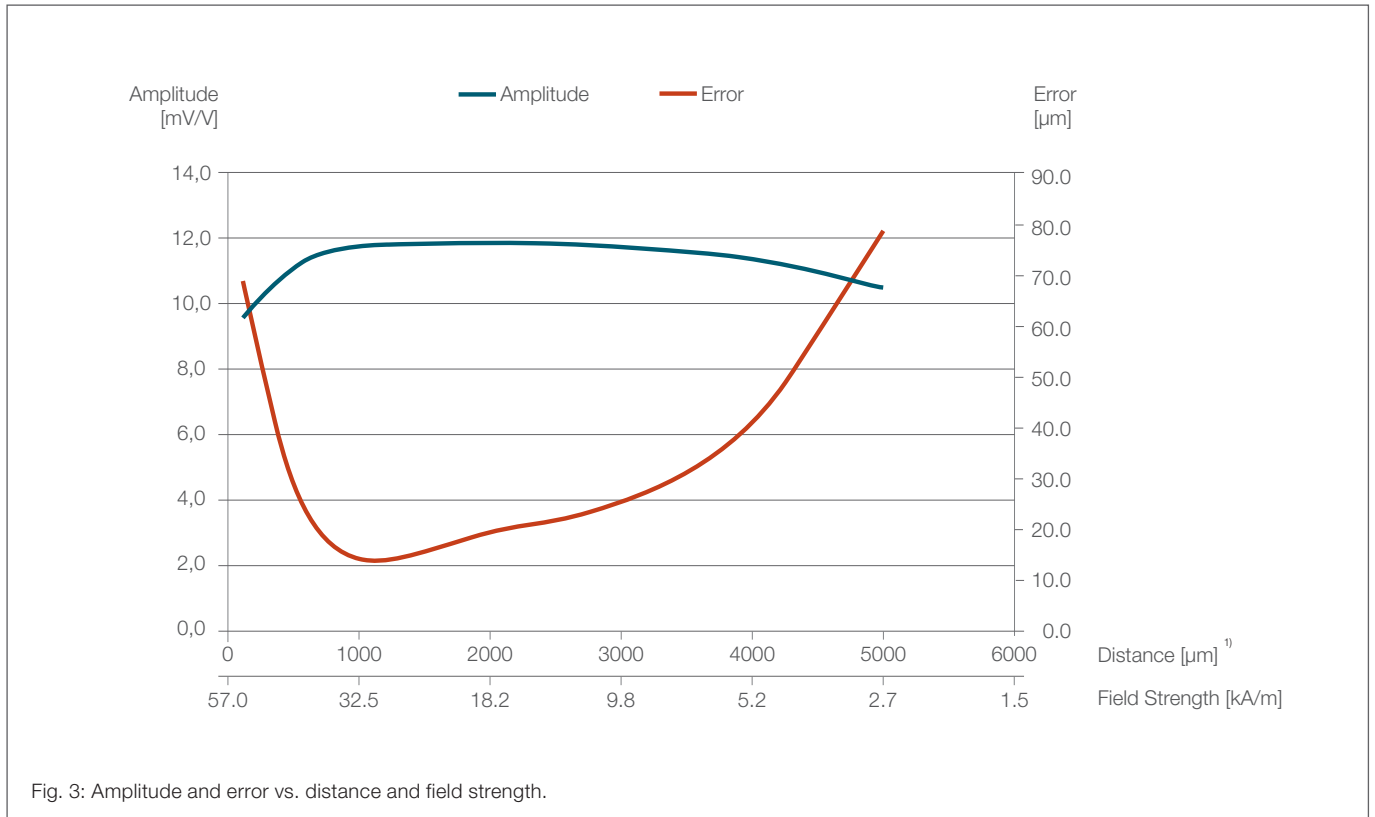


Fig. 3: Amplitude and error vs. distance and field strength.

<sup>1)</sup> 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 <sub>O2</sub>	Positive output voltage bridge 2
2	+V <sub>O1</sub>	Positiv output voltage bridge 1
3	-V <sub>O1</sub>	Negativ output voltage bridge 1
4	GND	Ground
5	V <sub>CC</sub>	Supply voltage
6	-V <sub>O2</sub>	egativ output voltage bridge 2

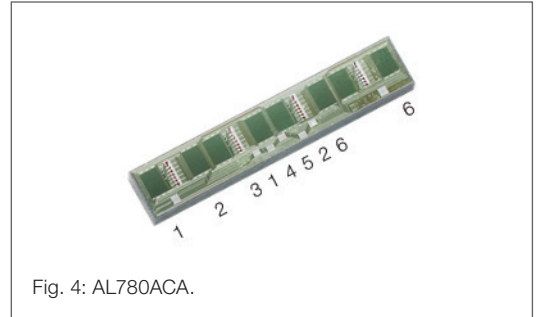


Fig. 4: AL780ACA.

### Mechanical Data

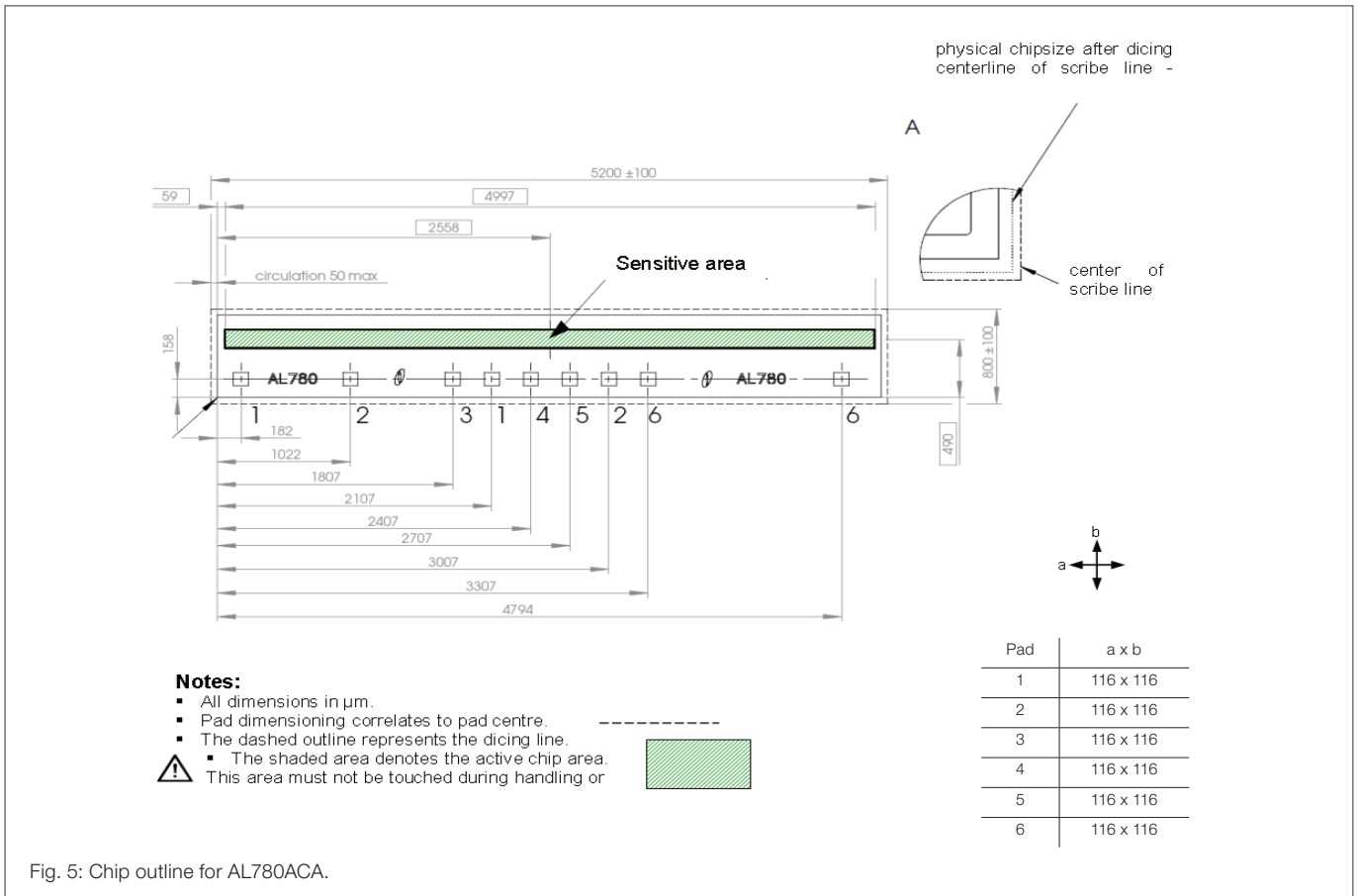


Fig. 5: Chip outline for AL780ACA.

### Data for Packaging and Interconnection Technologies

Parameter	Value	Unit
Chip area <sup>1)</sup>	5.2 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.

## AL780AKA SIL6 Package

### Pinning

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

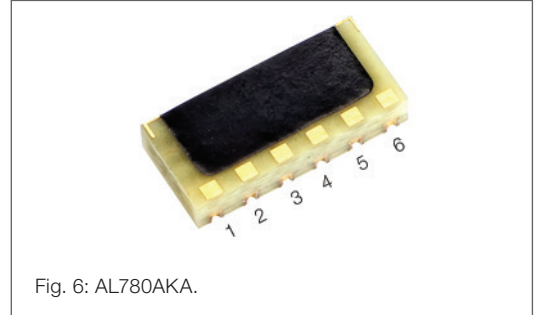


Fig. 6: AL780AKA.

### Dimensions

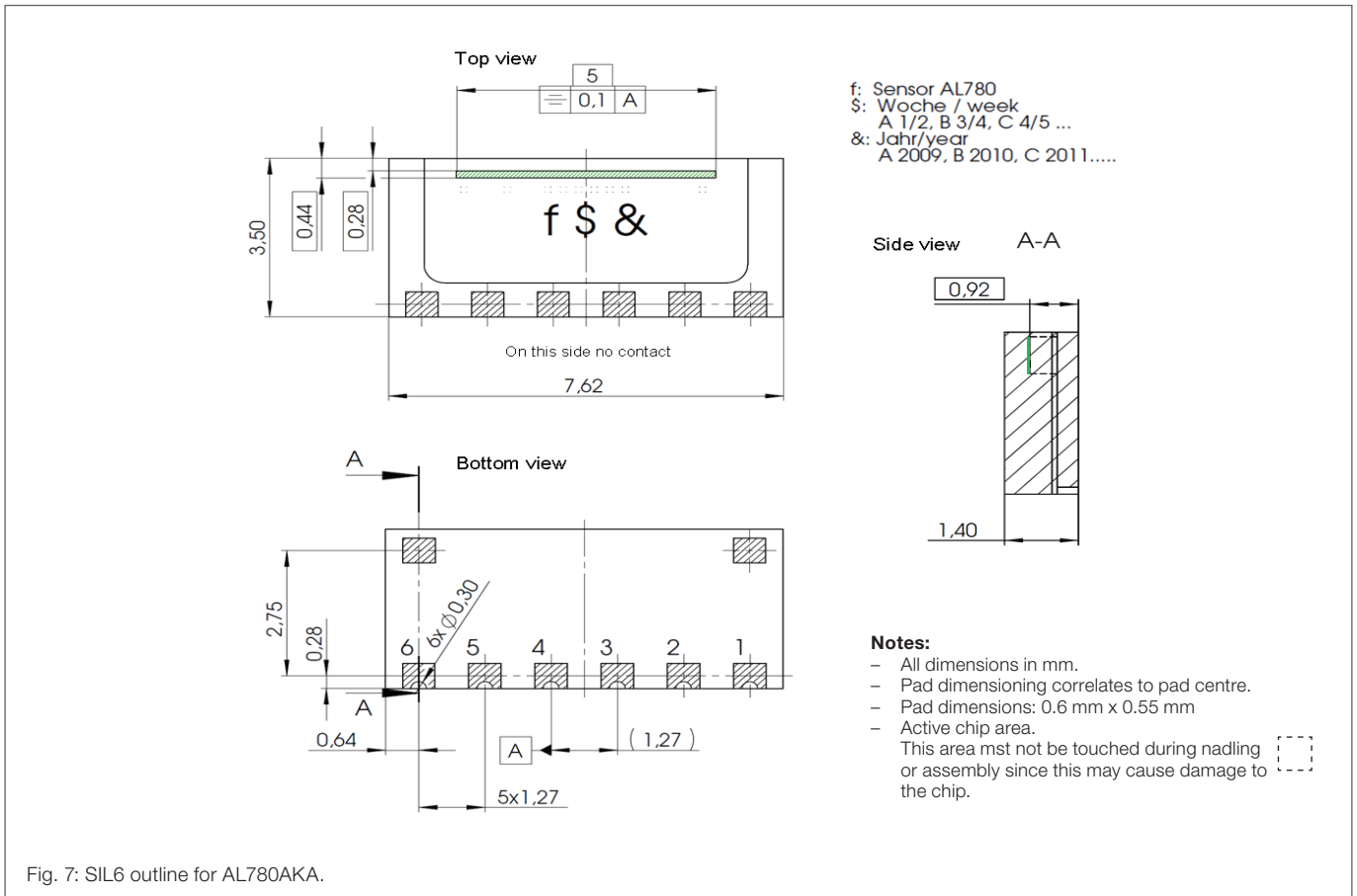


Fig. 7: SIL6 outline for AL780AKA.

**AL780AMA LGA6L Package**

**Pinning**

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

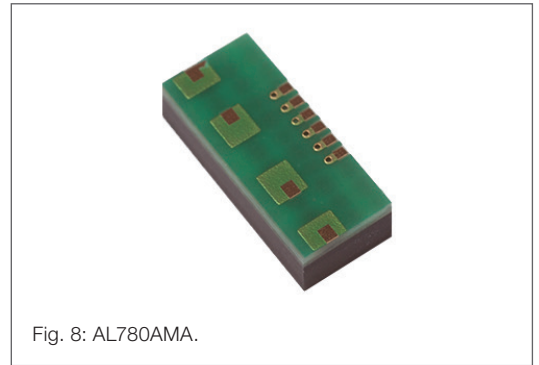


Fig. 8: AL780AMA.

**Dimensions**

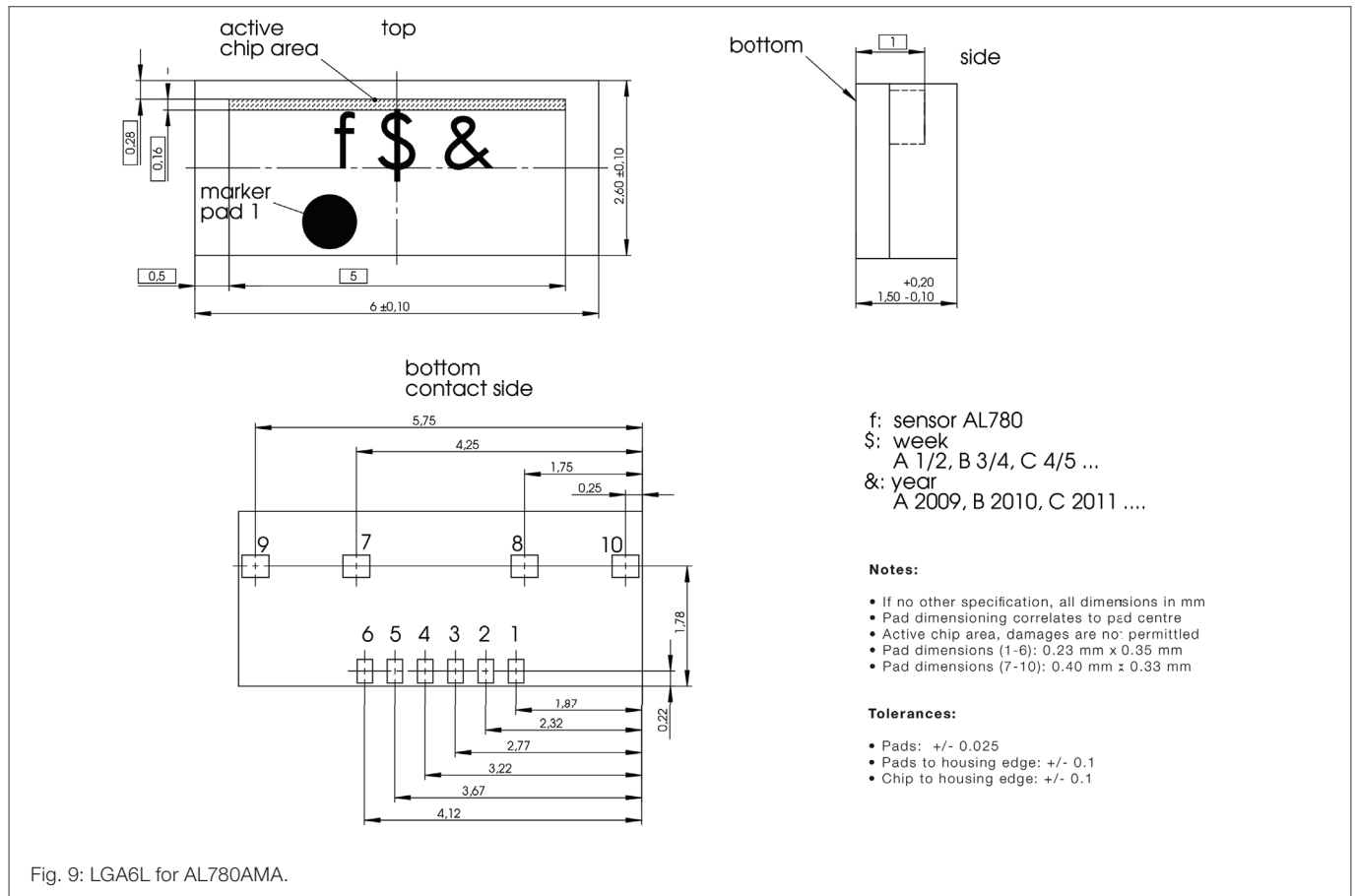


Fig. 9: LGA6L for AL780AMA.

### 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.
<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> .

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