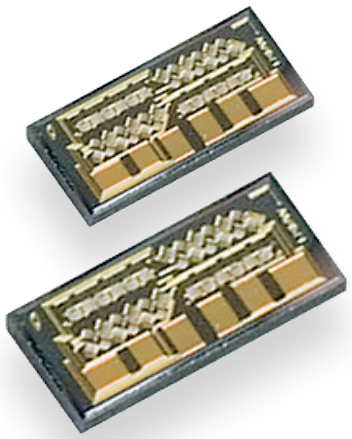
SENSITEC
MAGNETORESISTIVE SENSORS

DATA SHEET

AA745A

MagnetoResistive FreePitch Sensor



The AA745A is a position sensor based on the AnisotropicMagnetoResistive (AMR) effect. The sensor contains two Wheatstone bridges with common ground and supply pin V_{CC}. They are shifted at a relative angle of 45° to one another. Additionally, the sensor layout incorporates PerfectWave technology, i.e. the sensor stripes are designed to reduce harmonic distortions.

A rotating magnetic field in the sensor plane delivers two sinusoidal output signals with the double frequency of the angle α between sensor and magnetic field direction shown in Fig. 1. The function of these signals is +sin(2α) and +cos(2α).

The AA745A is available as wafer and in several package options.

Product Overview

Article description	Package	Delivery Type
AA745ABA-LL	Undiced wafer [1]	Waferbox
AA745ACA-LK	Die on wafer [1]	Waferbox
AA745ACA-AC	Bare die	Waffle pack (432)
AA745AKA-AC	SIL6	Waffle pack (90)
AA745AMA-AE	LGA6S	Tape on Reel (2500)

[1] Minimum order quantities apply.

Quick Reference Guide

Symbol	Parameter	Min.	Typ.	Max.	Unit
V_{CC}	Supply voltage	-	5.0	9.0	V
S	Sensitivity ($\alpha1 = 0°$; $\alpha2 = 135°$)	2.1	2.35	2.6	mV/deg
V_{off}	Offset voltage per V_{CC}	-2.0	-	+2.0	mV/V
V_{peak}	Signal amplitude per V_{CC}	12.0	13.0	14.0	mV/V
R_S	Sensor resistance	1.35	1.60	1.85	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
$T_{amb(Die)}$	Ambient temperature bare die version	-40	+150	°C
$T_{amb(others)}$	Ambient temperature others	-40	+125	°C
$T_{stg(Die)}$	Storage temperature bare die version	-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 Wheatstone bridges
- Sine and cosine output
- Bond pads on one side
- PerfectWave technology
- Temperature range from -40 °C to +150 °C (bare die only)

Advantages

- Contactless angle and position measurement
- Large air gap
- Excellent accuracy
- Position tolerant
- Minimal offset voltage
- Negligible hysteresis

Applications

- Incremental or absolute position measurement (linear and rotary motion)
- Motor commutation
- Rotational speed measurement
- Angle measurement (180° absolute on shaft end)

ESD

RoHS-Compliant www.sensitec.com

Magnetic Data

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
H_{ext}	Magnetic field strength [1]		-	25	-	kA/m

[1] The stimulating magnetic field in the sensor plane necessary to ensure the minimum error as 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
S	Sensitivity [2]	α_1 = 0°; α_2 = 135°	2.1	2.35	2.6	mV/deg
TC_S	Temperature coefficient of sensitivity [3]		-0.31	-0.35	-0.39	%/K
V_{off}	Offset voltage per V_{CC}	See Fig. 1	-2.0	-	+2.0	mV/V
TC_{Voff}	Temperature coefficient of V_{off} [4]		-2.0	-	+2.0	(µV/V)/K
V_{peak}	Signal amplitude per V_{CC} [5]	See Fig. 1	12.0	13.0	14.0	mV/V
TC_{Vpeak}	Temperature coefficient of V_{peak} [6]		-0.31	-0.35	-0.39	%/K
R_B	Bridge resistance [7]		2.7	3.2	3.7	kΩ
R_S	Sensor resistance [8]		1.35	1.6	1.85	kΩ
TC_{RB}	Temperature coefficient of R_B [9]		0.38	0.42	0.46	%/K

[2] Sensitivity changes with angle due to sinusoidal output.

[3] $TC_S = 100 \cdot \frac{S_{(T2)} - S_{(T1)}}{S_{(T1)} \cdot (T_2 - T_1)}$ with T_1 = -40 °C; T_2 = +150 °C.

[4] $TC_{Voff} = \frac{V_{off(T2)} - V_{off(T1)}}{T_2 - T_1}$ with T_1 = -40 °C; T_2 = +150 °C.

[5] Maximal output voltage without offset influences. Periodicity of V_{peak} is sin(2α) and cos(2α).

[6] $TC_{Vpeak} = 100 \cdot \frac{V_{peak(T2)} - V_{peak(T1)}}{V_{peak(T1)} \cdot (T_2 - T_1)}$ with T_1 = -40 °C; T_2 = +150 °C.

[7] Bridge resistance between $+V_{01}$ and $-V_{01}$, $+V_{02}$ and $-V_{02}$.

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

[9] $TC_{RB} = 100 \cdot \frac{R_{B(T2)} - R_{B(T1)}}{R_{B(T1)} \cdot (T_2 - T_1)}$ with T_1 = -40 °C; T_2 = +150 °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
Δα	Angular error [9]		0	0.1	0.17	deg
Δα	Angular error [9]	$H_{ext} \geq 40$ kA/m	0	0.05	0.1	deg
k	Amplitude synchronism [10]		-0.5	0	+0.5	% of V_{peak}

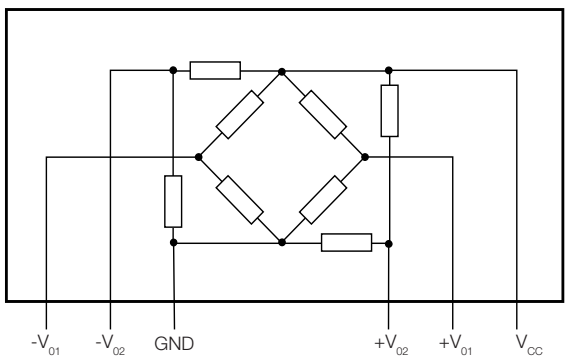
[9] $\Delta\alpha = |\alpha_{real} - \alpha_{measured}|$ without offset influences due to deviations from ideal sinusoidal characteristics.

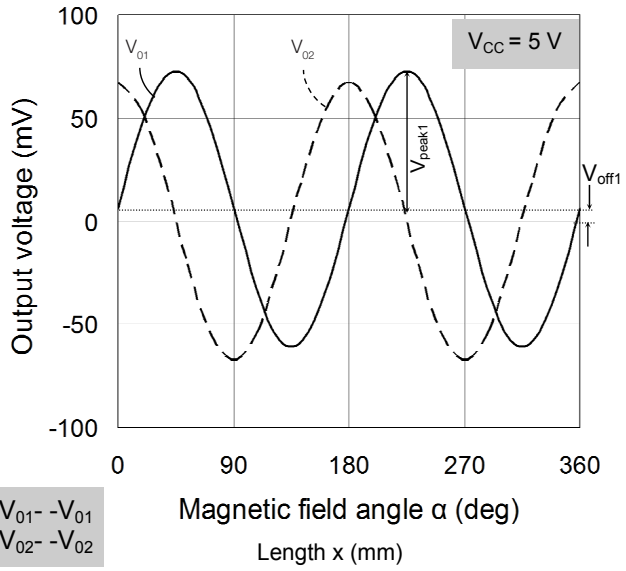
[10] $k = 100 - 100 \cdot \frac{V_{peak1}}{V_{peak2}}$

Dynamic Data

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

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





$V_{01} = +V_{01} - -V_{01}$
$V_{02} = +V_{02} - -V_{02}$

Fig. 1: *left:* Simplified circuit diagram.
right: Output signals as a function of the magnetic field angle α (see page 4/5/6).

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.

AA745A as Bare Die

Pinning

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

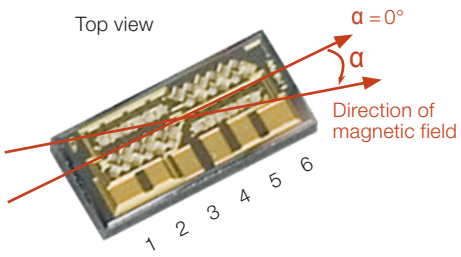
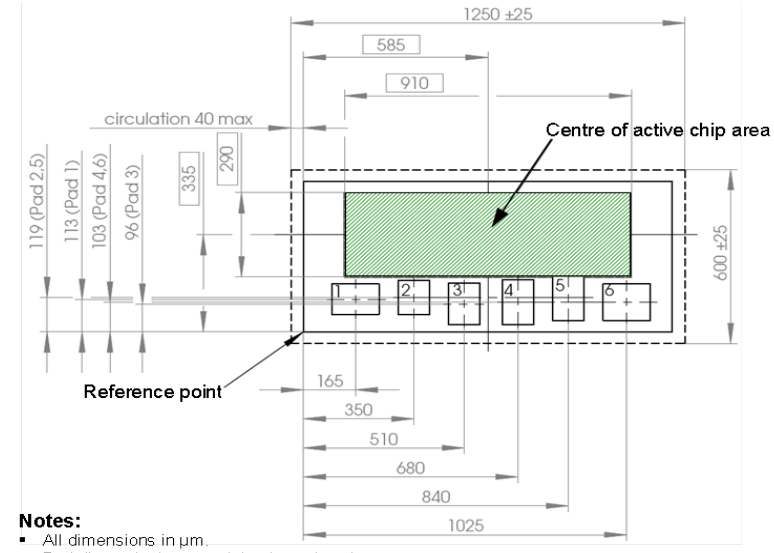
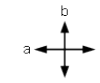


Fig. 2: AA745ACA.

Dimensions



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.



Pad	a x b
1	150 x 105
2	100 x 118
3	100 x 143
4	100 x 155
5	100 x 145
6	150 x 125

Fig. 3: Chip outline of bare die.

Data for Packaging and Interconnection Technologies

Parameter	Value	Unit
Chip area	(1.25 ± 0.1) x (0.6 ± 0.1)	mm
Chip thickness	254 ± 10	µm
Pad diameter (all)	See Fig. 3	µm
Pad thickness	0.4	µm
Pad material	Au	-

AA745AKA SIL6 Package

Pinning

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

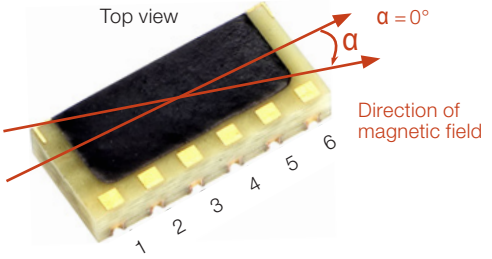


Fig. 4: AA745AKA.

Dimensions

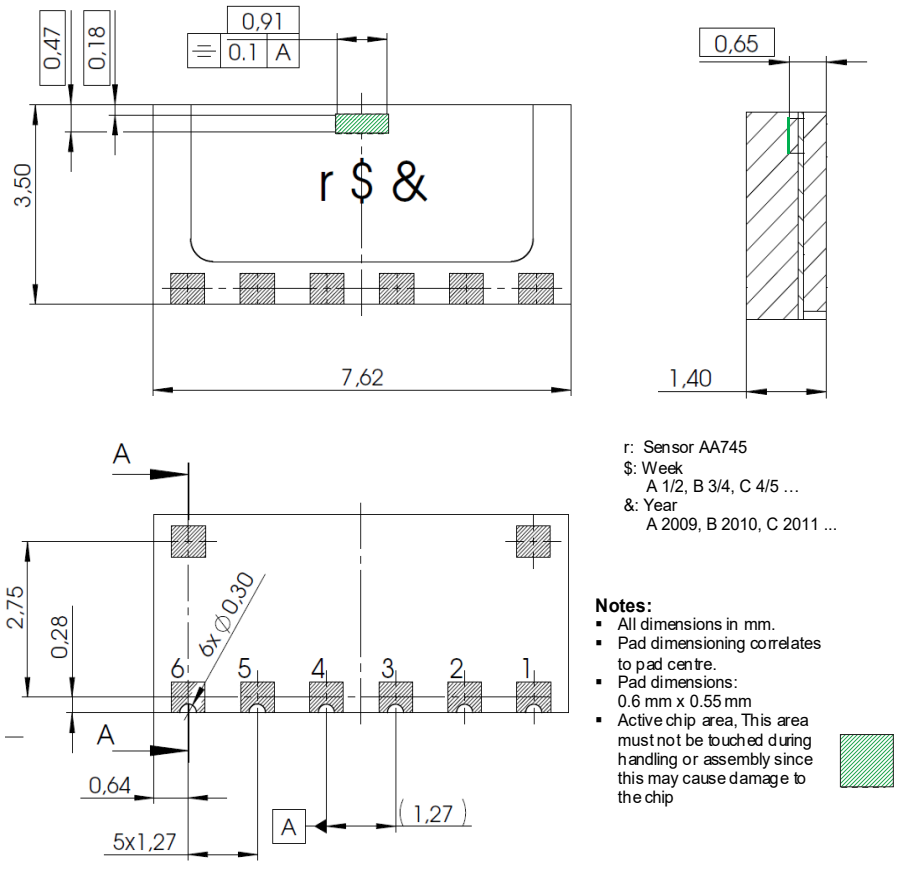


Fig. 5: SIL6 outline for AA745AKA.

AA745AMA LGA6S Package

Pinning

Symbol	Parameter	Conditions
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
7-8	NC	Not connected

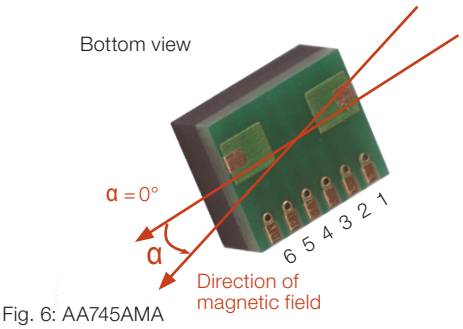
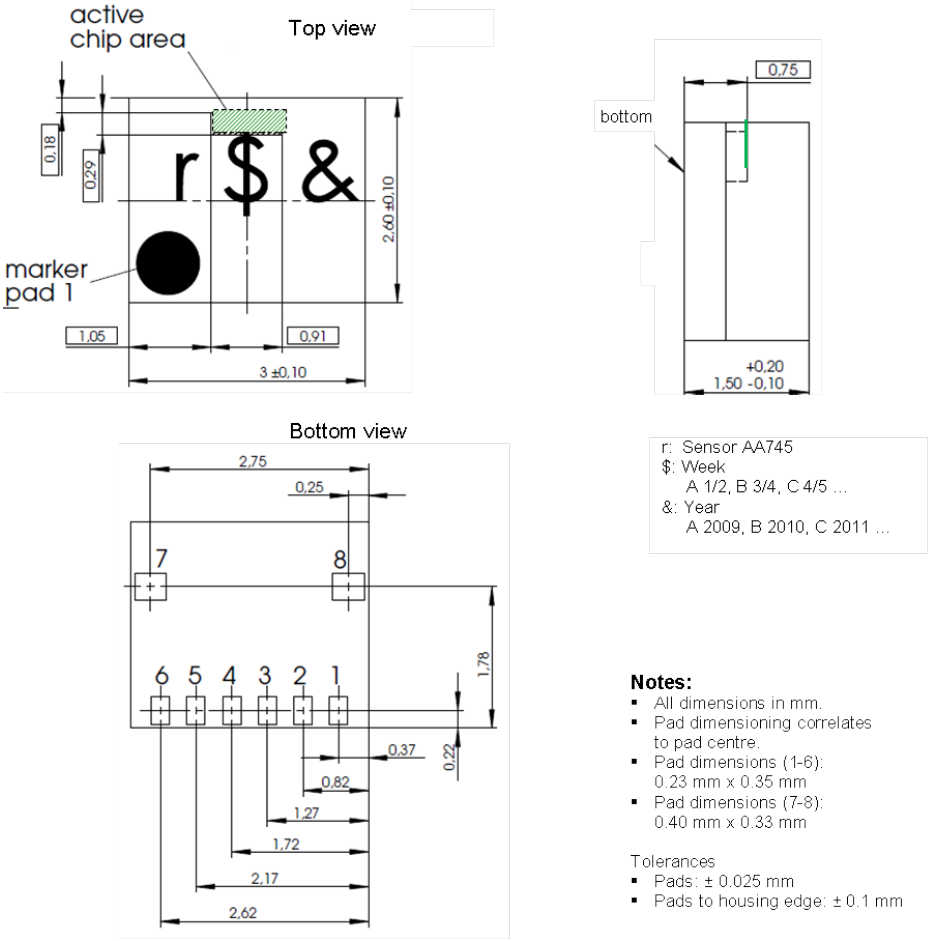


Fig. 6: AA745AMA

Dimensions



r: Sensor AA745
$: Week
A 1/2, B 3/4, C 4/5 ...
&: Year
A 2009, B 2010, C 2011 ...

Notes:
- All dimensions in mm.
- Pad dimensioning correlates to pad centre.
- Pad dimensions (1-6): 0.23 mm x 0.35 mm
- Pad dimensions (7-8): 0.40 mm x 0.33 mm

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

Fig. 7: LGA6S outline for AA745AMA.

General Information

Product Status

Article	Status
AA745ABA-LL	The product is in series production.
AA745ACA-LK	The product is in series production.
AA745ACA-AC	The product is in series production.
AA745AKA-AC	The product is in series production.
AA745AMA-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
AA745A.DSE.10	Disclaimer supplement	06/2022
AA745A.DSE.09	Change of corporate design (pp. 1-8)	01/2022
AA745A.DSE.08	Product Overview - AA745ACA-AC delivery typ (p. 1)	08/2021
AA745A.DSE.04	Change of corporate design (pp. 1-8)	01/2016
AA745A.DSE.00	Original (pp. 1-8)	11/2013

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