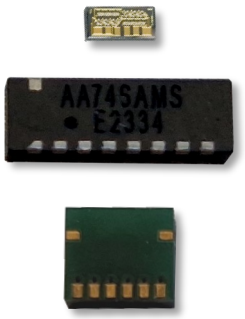
SENSITEC
MAGNETORESISTIVE SENSORS

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. The function of these signals is +sin(2α) and +cos(2α).
The bond version of AA745A 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
- Bond pads on one side
- PerfectWave technology
- Temperature range from -40 °C to +150 °C (bare die)

Advantages

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

Applications

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

Product Overview of AA745

Article description	Package	Delivery Type
AA745ABA-LB [1]	Undieced wafer	Waferbox
AA745ACA-LK [1]	Die on Wafer	Waferbox
AA745ACA-AC	Bare Die	Waffle pack (432 pcs)
AA745AKA-AC	SIL6	Waffle pack (90 pcs)
AA745AMA-AE	LGA6S	Tape on reel (2000 pcs)
AA745AMS-AE	SIL8	Tape on reel (2000 pcs)
AA745AMS-AS	SIL8-D	Tape on reel (2000 pcs)
AA745 Evalboard	Evalboard	ESD-Box

[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(α_1 = 0°, α_2 = 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_B	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 (Die)	-40	+150	°C
$T_{amb(Others)}$	Ambient temperature (Others)	-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]		-	25.0	-	kA/m

[1] The stimulating magnetic field in the sensor plane to ensure minimum error specified in note 10.

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
S	Sensitivity [2]	α_1 = 0°, α_2 = 135°	2.1	2.35	2.6	mV/deg
TC_S	Temperature coefficient of S [3]		-0.31	-0.35	-0.39	%/K
V_{off}	Offset voltage per V_{CC}	See Fig. 2	-2.0	-	+2.0	mV/V
TC_{Voff}	Temperature coefficient of V_{off} [4]	T_{amb} = (-40…+150)°C	-2.0	-	+2.0	(µV/V)/K
V_{peak}	Signal amplitude per V_{CC} [5]	See Fig. 2	12.0	13.0	14.0	mV/V
TC_{Vpeak}	Temperature coefficient of V_{peak} [6]	T_{amb} = (-40…+150)°C	-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	1.60	1.85	kΩ
TC_{RB}	Temperature coefficient of R_B [9]	T_{amb} = (-40…+150)°C	0.38	0.42	0.46	%/K
FIT	FIT-Rate		-	0.9	-	x10^9 h
MTTF	Mean time to failure	At 55 °C	-	126839	-	years

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

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

[4] $TC_{Voff} = 100 \frac{V_{off(T2)} - V_{off(T1)}}{T_2 - T_1}$ 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] $TC_{VPeak} = 100 \cdot \frac{V_{Peak(T2)} - V_{Peak(T1)}}{V_{Peak(Tamb)} \cdot (T_2 - T_1)}$ with T_1 = -40°C; T_2 = +150°C.

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

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

[9] $TC_{RB} = 100 \cdot \frac{R_{B(T2)} - R_{B(T1)}}{R_{B(Tamb)} \cdot (T_2 - T_1)}$ with T_1 = -40°C; T_2 = +150°C.

Accuracy

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

Symbol	Parameter	Conditions	min.	typ.	max.	Unit
Δα	Angular error [8]		0.0	0.1	0.17	deg
Δα	Angular error [8]	H_{ext} ≥ 40 kA/m	0.0	0.05	0.1	deg
k	Amplitude synchronism [9]		-0.5	0.0	+0.5	% of V_{peak}

[10] $\Delta X = |X_{real} - X_{measured}|$ without offset influences due deviations from ideal sinusoidal characteristics (ascertained at an ideal magnetic scale).

[11] $k=100-100\frac{V_{Peak1}}{V_{Peak2}}$

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.

Output Signal Information

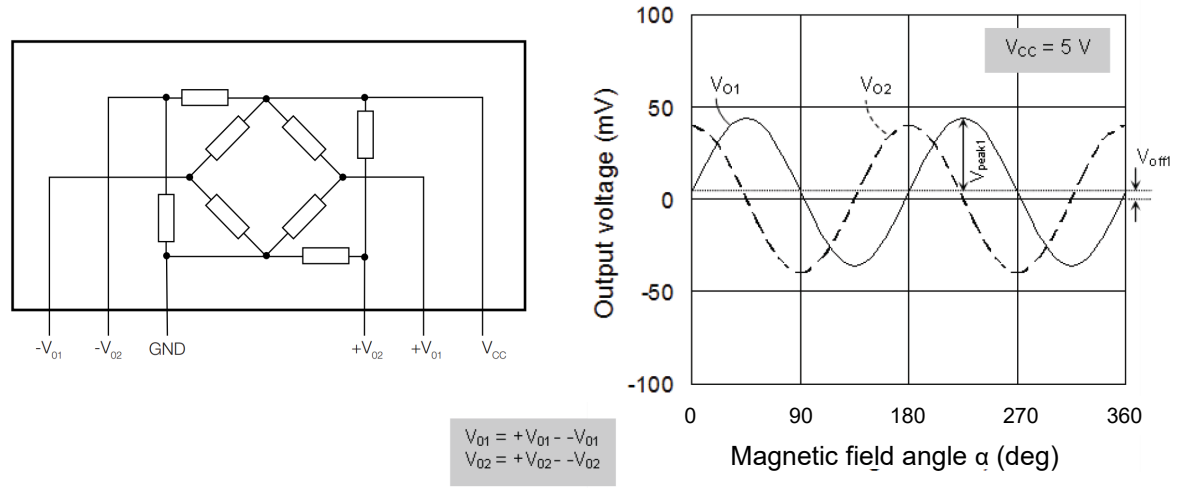


Fig 1: Left: Simplified circuit diagram.
Right: Output signals as function of linear displacement.

AA745A Bare Die

Pinout

Pad	Symbol	Parameter
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

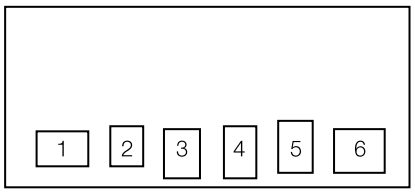


Fig. 2: Pinout of the AA745A Bare Die

Dimensions

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

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.
- Center of the active chip area (*)

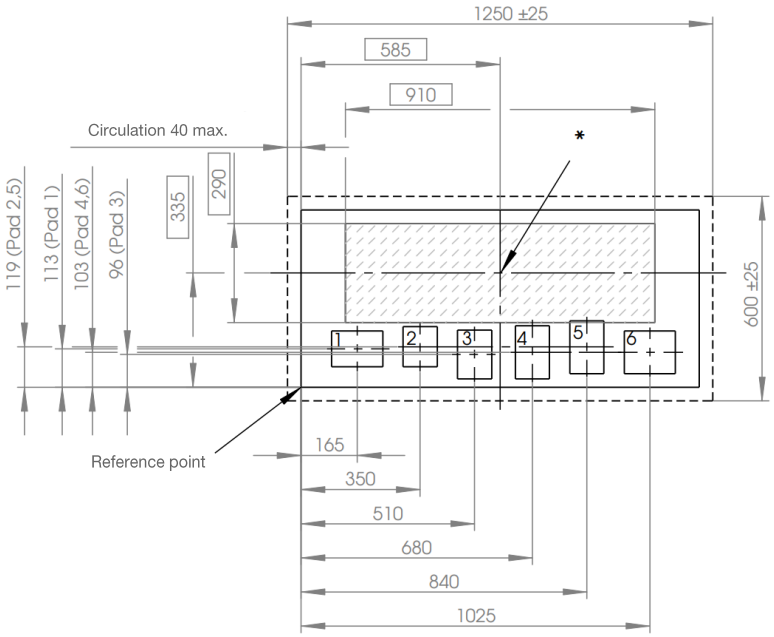


Fig. 3: Chip outline for AA745A as bare die.

Data for Packaging and Interconnection Technologies

Parameter	Value	Unit
Chip area [1)]	1.25 x 0.6	mm^2
Chip thickness	254 ± 10	µm
Pad size	See Fig. 3	-
Pad thickness	0.4	µm
Pad material	Au	-

[1)] Tolerances of chip see Fig. 3.

AA745AKA SIL6 Package

Pinout

Pad	Symbol	Parameter
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

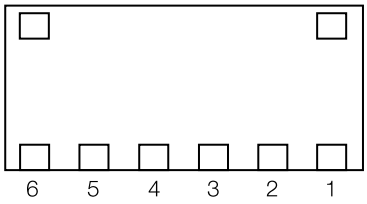
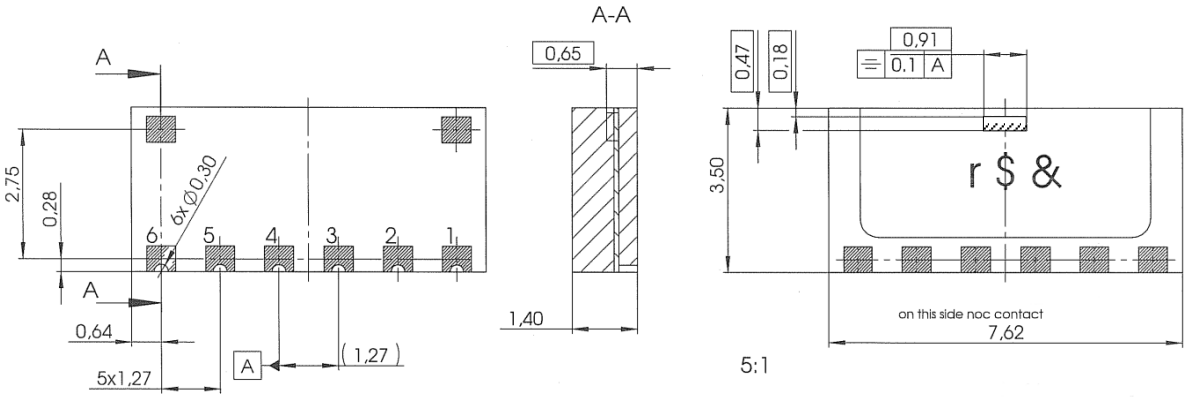


Fig. 4: Pinout of the AA745AKA SIL6 Package

Dimensions



Sensor marking:

d: Sensor AA745
$: 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. 5: SIL6 outline for AA745AKA.

AA745AMA LGA6S 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
7-8	NC	Not connected

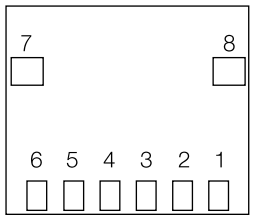
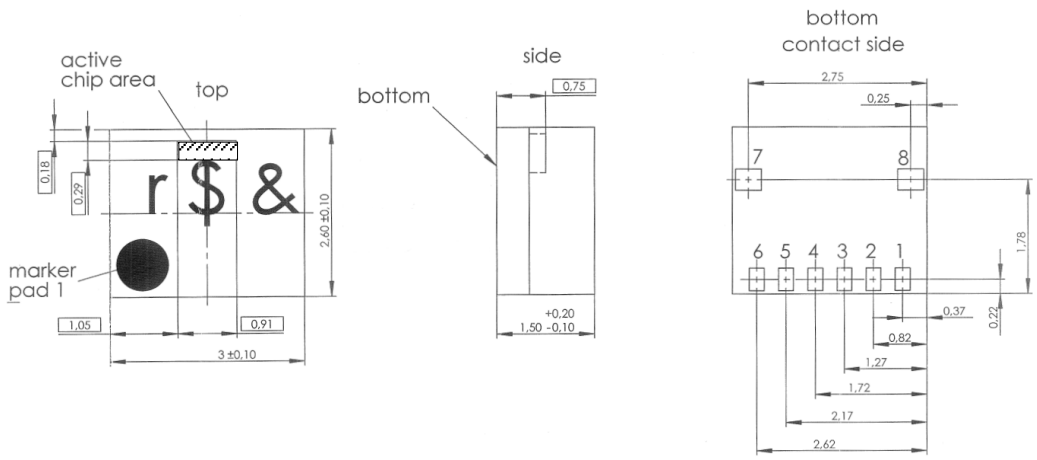


Fig. 6: Pinout of the AA745AMA LGA6S Package

Dimensions



Sensor marking:

r: Sensor AA745
$: 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 (7-8): 0.40 mm x 0.33 mm
- The green shaded area denotes the active chip area.

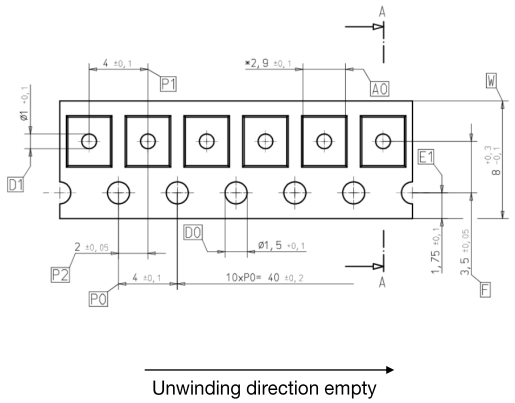
Tolerances:

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

Fig. 7: LGA6S outline for AA745AMA.

AA745AMA LGA6S Package

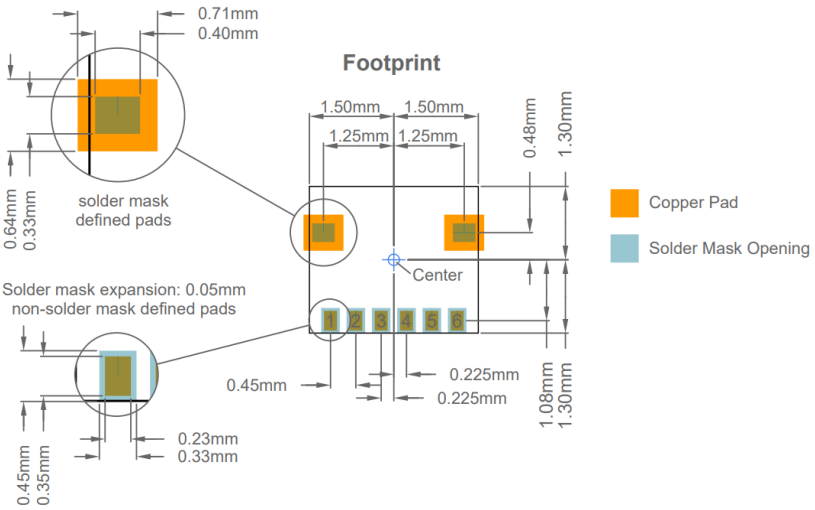
Reel layout



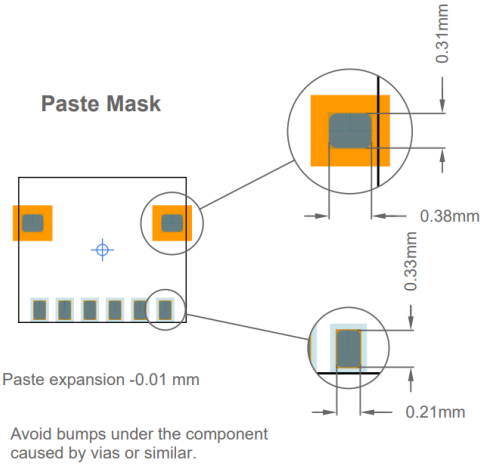
Notes:
- Type: RC 3689
- Material: PS (conductive)
- Conductivity: 10^3 - 10^6 Ω/sq
- All cavity dimensions measured at the end of radius
- All Dimensions in mm
- Surface resistivity can break
- Marking for pin 1 towards sprocket hole (IEC60286-3)
- Shelf life: 24 months after seal date (dry-packed sensors), 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. 8: LGA6S tape & reel for AA745AMA-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. 9: LGA6S land pattern and reflow recommendation.

AA745AMS-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

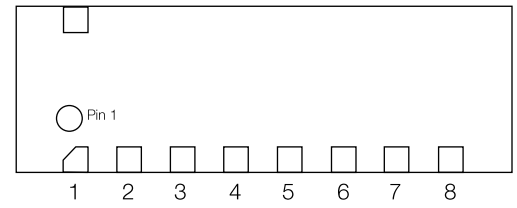


Fig. 10: Pinout of the AA745AMS-AE SIL8 Package

Dimensions

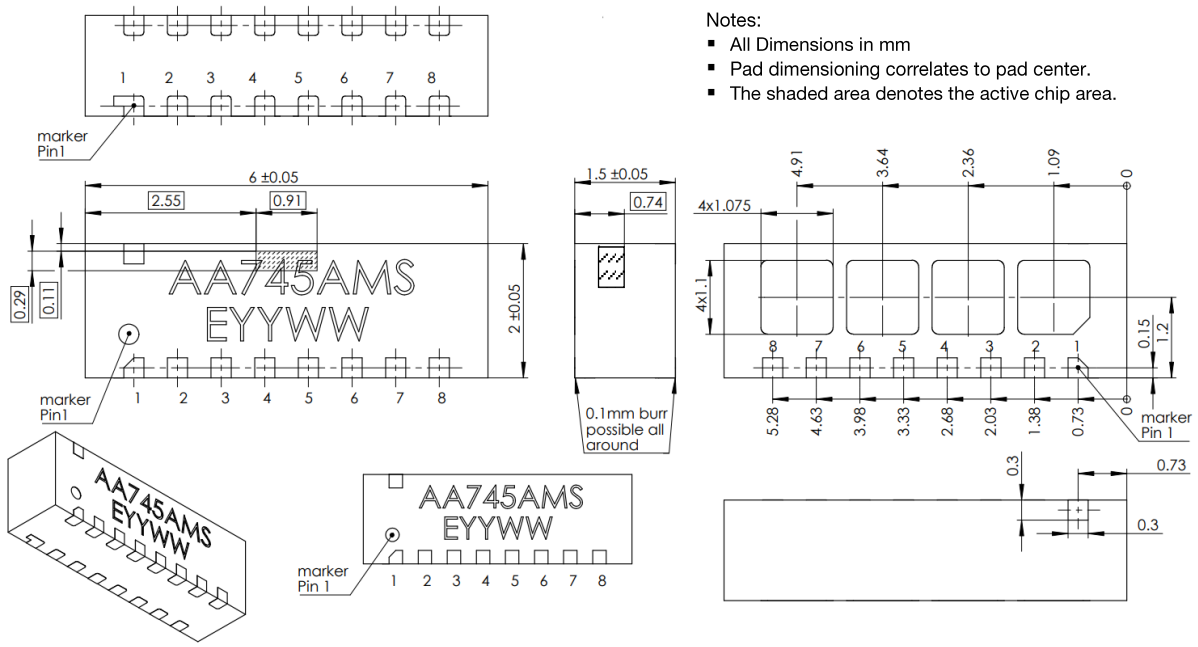


Fig. 11: SIL8 outline for AA745AMS-AE.

AA745AMS-AE SIL8 Package

Reel layout

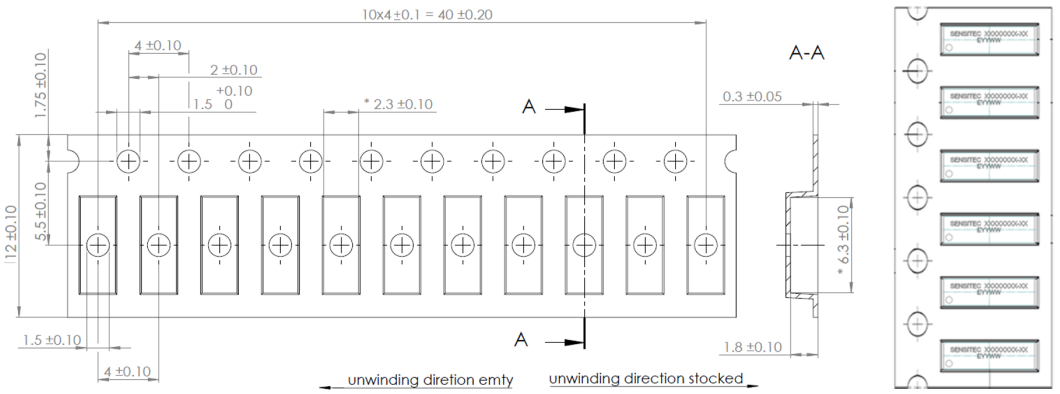
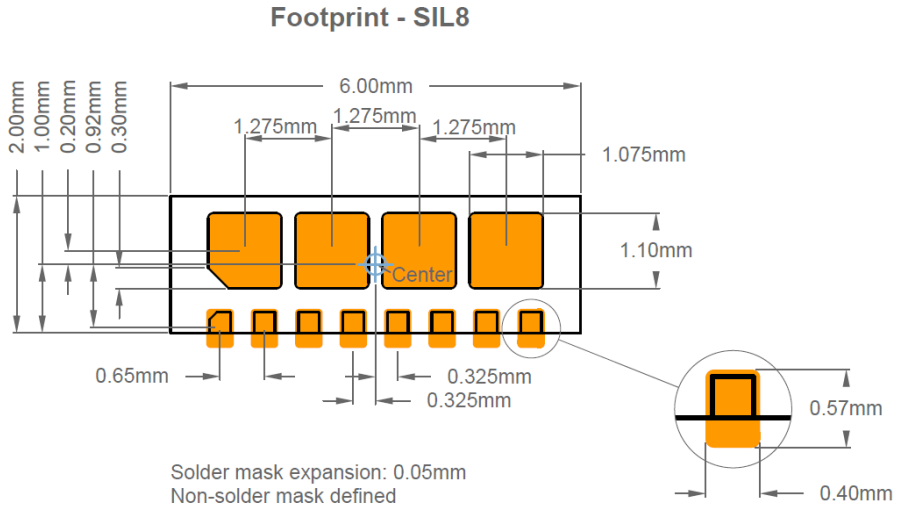
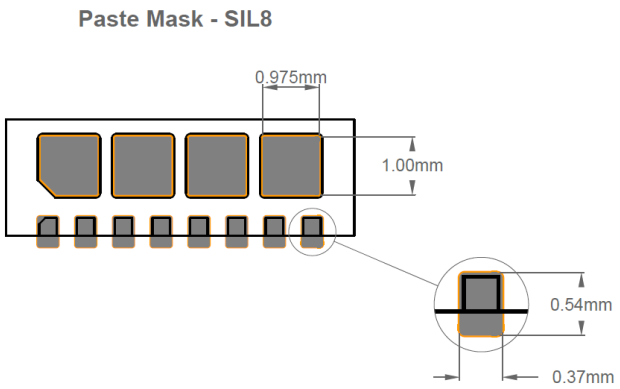


Fig. 12: SIL8 Tape&Reel for AA745AMS-AE (left). Device orientation in reel (right).

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. 13: SIL8 land pattern and reflow recommendation.

AA745AMS-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

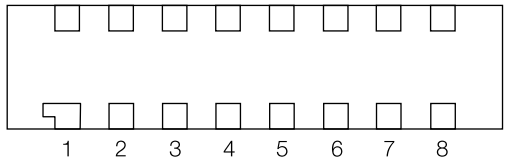


Fig. 14: Pinout of the AA745AMS-AS SIL8-D Package

Dimensions

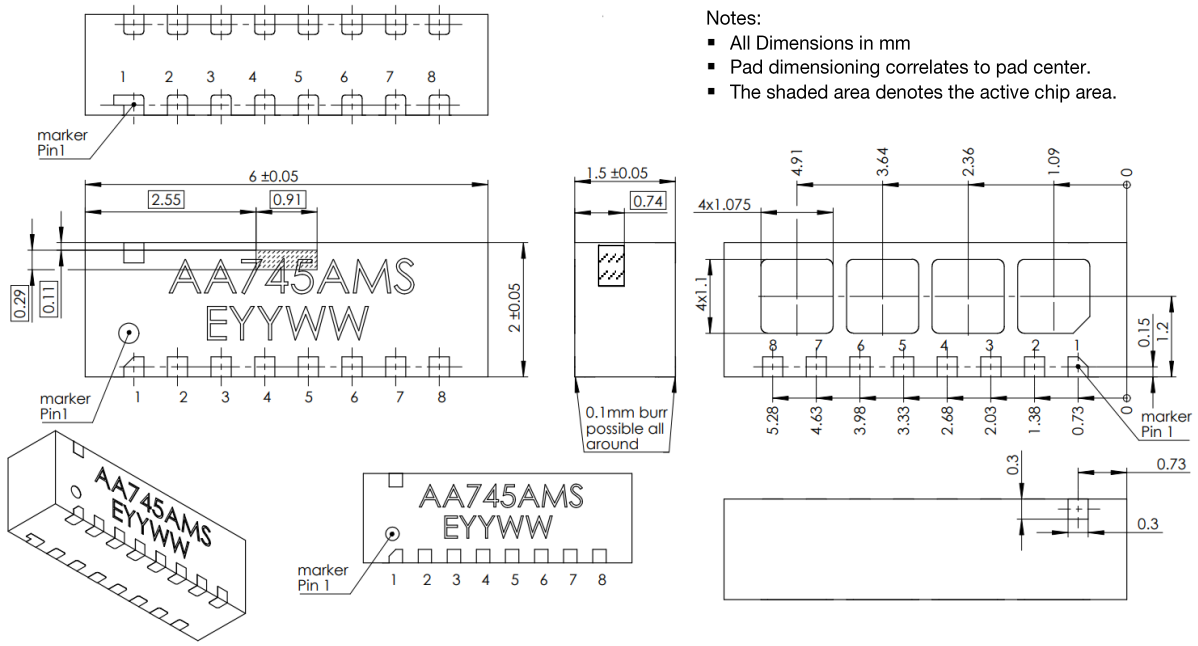


Fig. 15: SIL8-D outline for AA745AMS-AS.

AA745AMS-AS SIL8-D Package

Reel layout

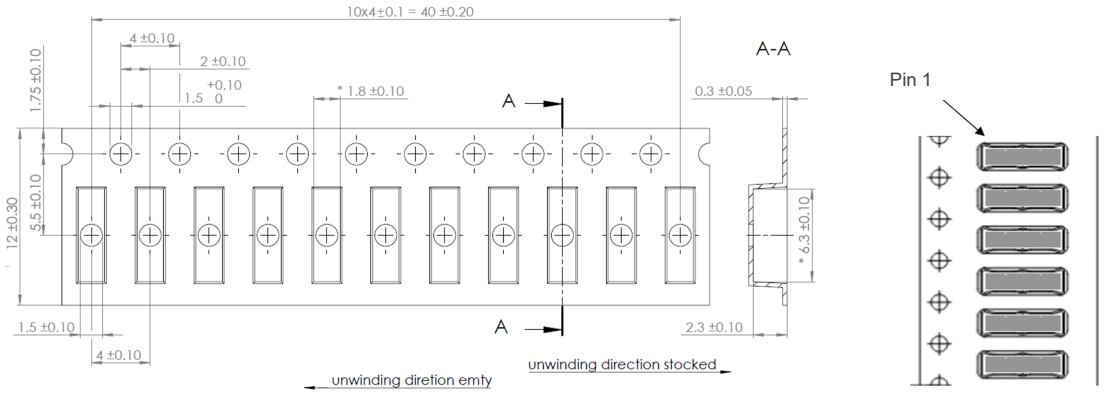
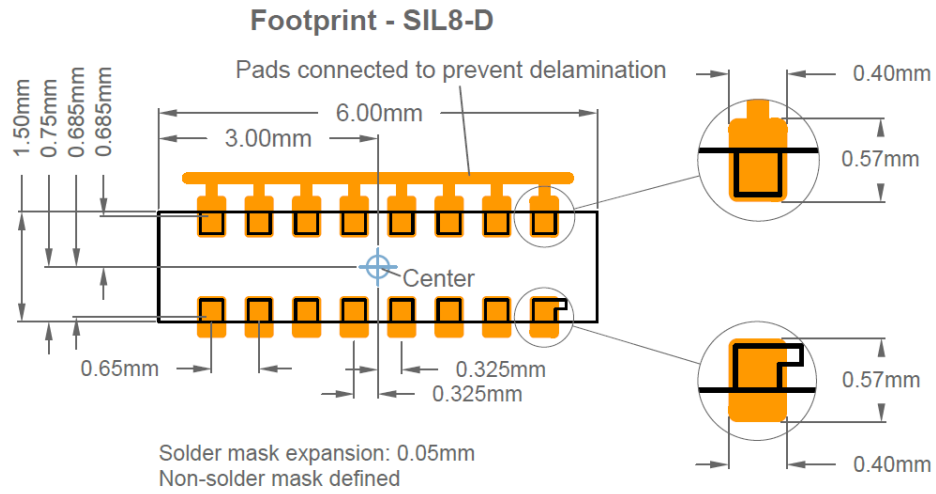
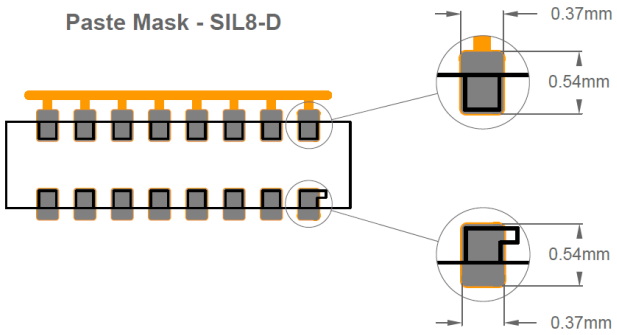


Fig. 16: SIL8-D Tape&Reel for AA745AMS-AS (left). Device orientation in reel (right).

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. 17: SIL8-D land pattern and reflow recommendation.

Evalboard with AA745AMA-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

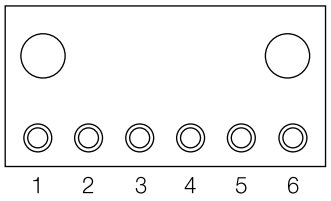
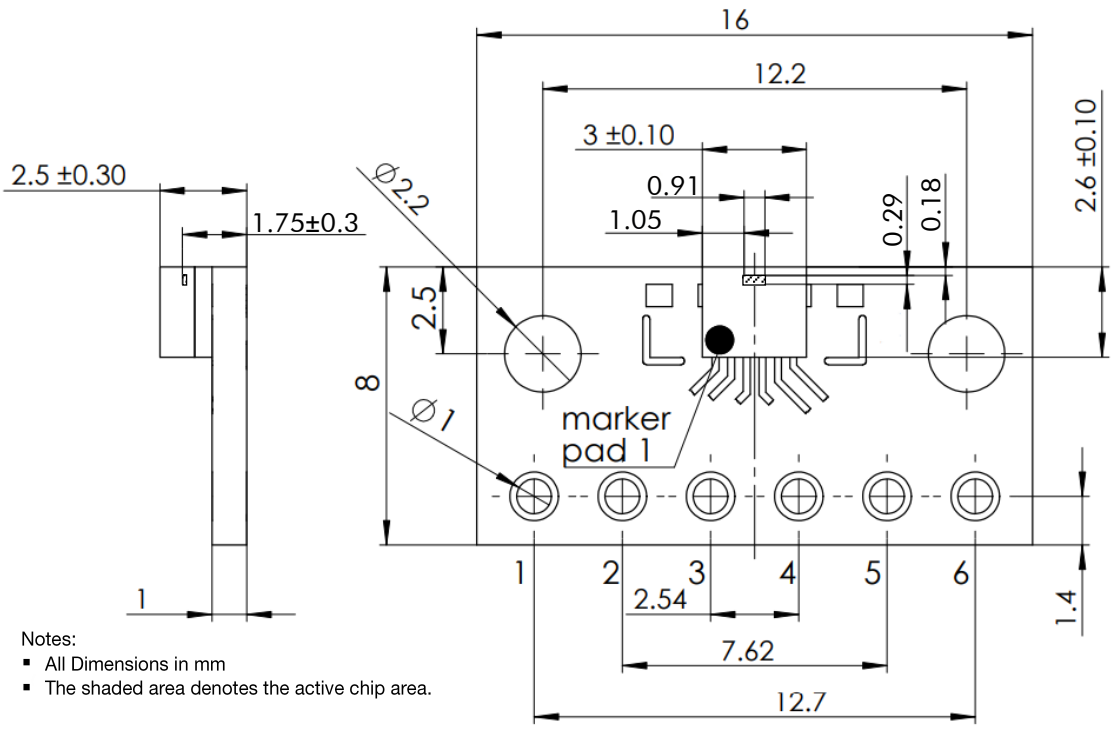


Fig. 18: Pinout of the evalboard

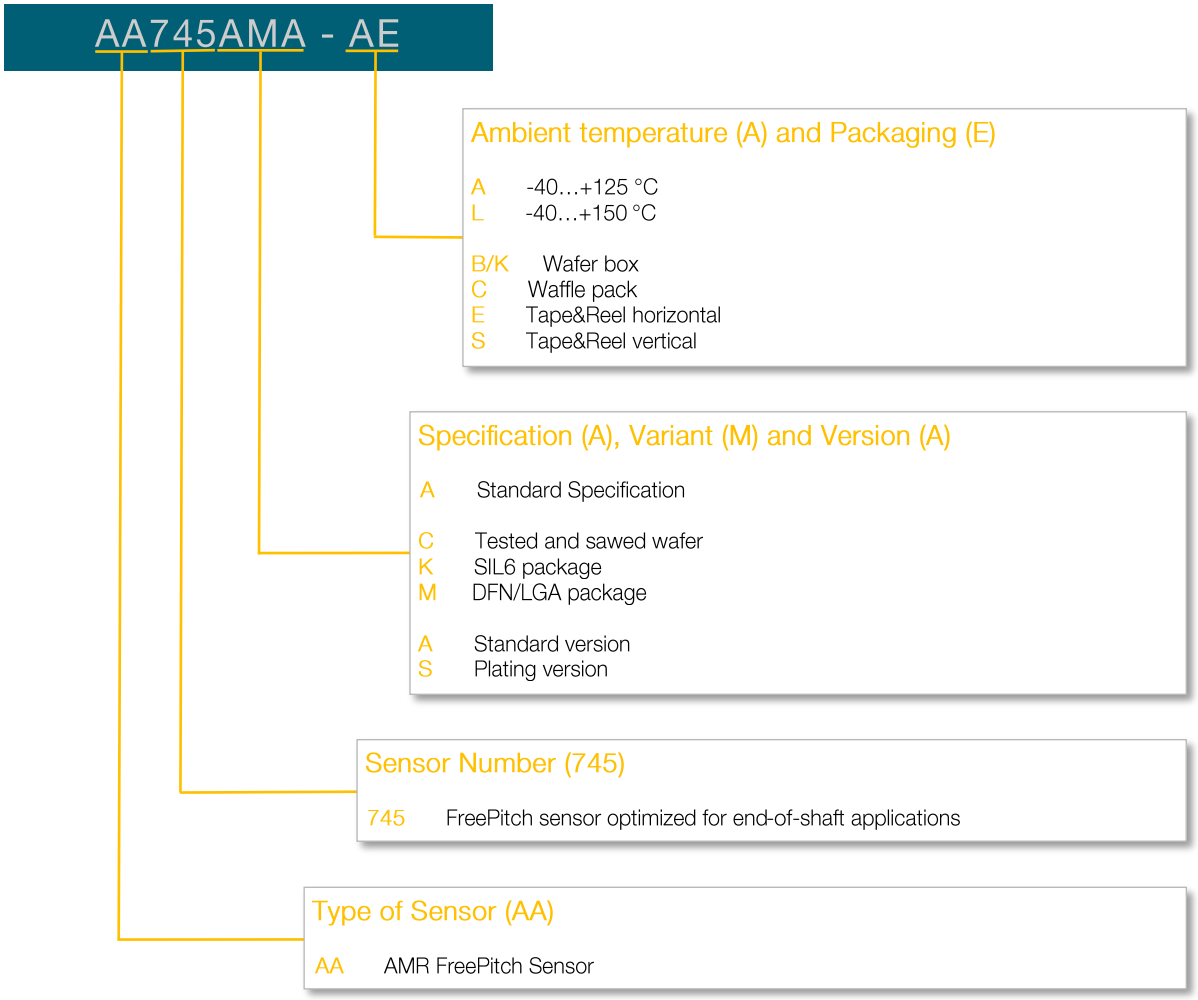
Dimensions



Notes:
- All Dimensions in mm
- The shaded area denotes the active chip area.

Fig. 19: Outline of evalboard with AA745AMA-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.

General Information

Product Status

Article	Status
AA745ABA-LB	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.
AA745AMS-AE	The product is under development, qualification is on going. Deliverables have a sample status. The datasheet is preliminary.
AA745AMS-AS	The product is under development, qualification is on going. Deliverables have a sample status. The datasheet is preliminary.
AA745 Evalboard	This product is for evaluation of the AA745AMA-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
AA745.DSE.11	Add evalboard/SIL8 information (pp. 8)	12/2024
AA745.DSE.10	Disclaimer supplement	06/2022
AA745.DSE.09	Change of corporate design (pp. 1-8)	01/2022
AA745.DSE.08	Product overview - AA745ACA-AC typ(p.1)	08/2021
AA745.DSE.04	Change of corporate design (pp. 1-8)	01/2016
AA745.DSE.00	Original (pp. 1-7)	11/2013

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