



# KMZ49

## Magnetic field sensor

Rev. 1 — 31 October 2011

Product data sheet

## 1. Product profile

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### 1.1 General description

The KMZ49 is a sensitive magnetic field sensor, employing the magnetoresistive effect of thin-film permalloy. The sensor contains two galvanic separated Wheatstone bridges, at a relative angle of  $45^\circ$  to each other.

A rotating magnetic field in the x-y plane will produce two independent sinusoidal output signals, one a function of  $+\cos(2\alpha)$  and the second a function of  $+\sin(2\alpha)$ ,  $\alpha$  being the angle between sensor and field direction (see [Figure 2](#)). The KMZ49 is suited to high precision angle measurement applications under low field conditions (saturation field strength 25 kA/m).

The sensor can be operated at any frequency between 0 Hz and 1 MHz.

### 1.2 Features and benefits

- Accurate and reliable angle measurement
- Mechanical robustness, contactless principle
- Wear-free operation
- Accuracy independent of mechanical tolerances
- Extended temperature range

### 1.3 Applications

- Steering angle and torsion
- Headlight adjustment
- Motor positioning
- Window wipers
- Fuel level
- Mirror positioning



### 1.4 Quick reference data

**Table 1. Quick reference 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                         |  | [1] -      | 5   | 9   | V                     |
| $V_M$            | peak voltage                           | see <a href="#">Figure 2</a>   | [1][2] 60  | 67  | 75  | mV                    |
| $V_{offset}$     | offset voltage                         | per supply voltage; see <a href="#">Figure 2</a>   | [1] -2     | -   | +2  | mV/V                  |
| $TC_{V(offset)}$ | offset voltage temperature coefficient | per supply voltage; $T_{amb} = -40\text{ °C}$ to $+150\text{ °C}$ ; see <a href="#">Figure 2</a> | [1][3] -2  | -   | +2  | ( $\mu\text{V/V}$ )/K |
| $R_{bridge}$     | bridge resistance                      |  | [1][4] 2.7 | 3.2 | 3.7 | $\text{k}\Omega$      |

[1] Applicable for bridge 1 and bridge 2.

[2]  $V_M = |V_{O(max)} - V_{offset}|$ . Periodicity of  $V_M$ :  $\sin(2\alpha)$  and  $\cos(2\alpha)$ , respectively.

[3]  $TC_{V(offset)} = \frac{V_{offset}(at\ 150\text{ °C}) - V_{offset}(at\ -40\text{ °C})}{150\text{ °C} - (-40\text{ °C})}$

[4] Bridge resistance between pin 4 to pin 8, pin 3 to pin 7, pin 1 to pin 5 and pin 2 to pin 6.

## 2. Pinning information

**Table 2. Pinning**

| Pin | Symbol    | Description             | Simplified outline |
|-----|-----------|-------------------------|--------------------|
| 1   | ON1       | output voltage bridge 1 |                    |
| 2   | ON2       | output voltage bridge 2 |                    |
| 3   | $V_{CC2}$ | supply voltage bridge 2 |                    |
| 4   | $V_{CC1}$ | supply voltage bridge 1 |                    |
| 5   | OP1       | output voltage bridge 1 |                    |
| 6   | OP2       | output voltage bridge 2 |                    |
| 7   | GND2      | ground 2                |                    |
| 8   | GND1      | ground 1                |                    |

## 3. Ordering information

**Table 3. Ordering information**

| Type number | Package |   |         |
|-------------|---------|---|---------|
|             | Name    | Description   | Version |
| KMZ49       | SO8     | plastic small outline package; 8 leads; body width 3.9 mm | SOT96-1 |

## 4. Circuit diagram

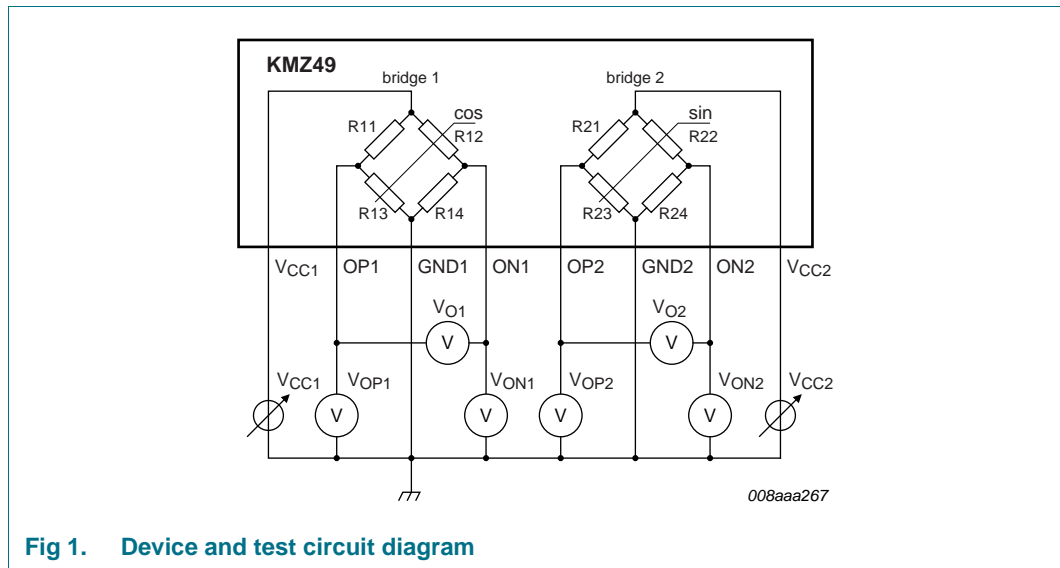


Fig 1. Device and test circuit diagram

## 5. Limiting values

Table 4. Limiting values

In accordance with the Absolute Maximum Rating System (IEC 60134).

| Symbol    | Parameter                        | Conditions | Min | Max  | Unit |
|-----------|----------------------------------|------------|-----|------|------|
| $V_{CC}$  | supply voltage                   | [1]        | -   | 9    | V    |
| $H_{ext}$ | external magnetic field strength |            | 25  | -    | kA/m |
| $T_{amb}$ | ambient temperature              |            | -40 | +150 | °C   |
| $T_{stg}$ | storage temperature              |            | -65 | +150 | °C   |

[1] Applicable for bridge 1 and bridge 2.

## 6. Thermal characteristics

Table 5. Thermal characteristics

| Symbol        | Parameter                                   | Conditions | Typ | Unit |
|---------------|---|------------|-----|------|
| $R_{th(j-a)}$ | thermal resistance from junction to ambient |            | 155 | K/W  |

## 7. Characteristics

**Table 6. Characteristics**

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

| Symbol           | Parameter                                     | Conditions   | Min         | Typ   | Max   | Unit                  |
|------------------|---|--|-------------|-------|-------|-----------------------|
| $V_{CC}$         | supply voltage                                |  | [1] -       | 5     | 9     | V                     |
| $V_M$            | peak voltage                                  | see <a href="#">Figure 2</a>   | [1][2] 60   | 67    | 75    | mV                    |
| $TC_{VM}$        | peak voltage temperature coefficient          | $T_{amb} = -40\text{ °C}$ to $+150\text{ °C}$  | [1][3] -0.3 | -0.36 | -0.42 | %/K                   |
| $R_{bridge}$     | bridge resistance                             |  | [1][4] 2.7  | 3.2   | 3.7   | k $\Omega$            |
| $TC_{R(bridge)}$ | bridge resistance temperature coefficient     | $T_{amb} = -40\text{ °C}$ to $+150\text{ °C}$  | [1][5] 0.24 | 0.26  | 0.29  | %/K                   |
| $V_{offset}$     | offset voltage                                | per supply voltage; see <a href="#">Figure 2</a>   | [1] -2      | -     | +2    | mV/V                  |
| $TC_{V(offset)}$ | offset voltage temperature coefficient        | per supply voltage; $T_{amb} = -40\text{ °C}$ to $+150\text{ °C}$ ; see <a href="#">Figure 2</a> | [1][6] -2   | -     | +2    | ( $\mu\text{V/V}$ )/K |
| $V_{o(hys)}$     | hysteresis output voltage                     | see <a href="#">Figure 3</a>   | [1][7] 0    | 0.05  | 0.18  | %FS                   |
| k                | amplitude synchronism                         |  | [8] 99.5    | 100   | 100.5 | %                     |
| $TC_k$           | amplitude synchronism temperature coefficient | $T_{amb} = -40\text{ °C}$ to $+150\text{ °C}$  | [9] -0.01   | 0     | +0.01 | %/K                   |
| $\Delta\alpha$   | angular inaccuracy                            |  | [10] 0      | 0.05  | 0.1   | deg                   |

[1] Applicable for bridge 1 and bridge 2.

[2]  $V_M = |V_{O(max)} - V_{offset}|$ . Periodicity of  $V_M$ :  $\sin(2\alpha)$  and  $\cos(2\alpha)$ , respectively.

$$[3] \quad TC_{VM} = \frac{V_M(at\ 150\text{ °C}) - V_M(at\ -40\text{ °C})}{V_M(at\ 25\text{ °C}) \times (150\text{ °C} - (-40\text{ °C}))}$$

[4] Bridge resistance between pin 4 to pin 8, pin 3 to pin 7, pin 1 to pin 5 and pin 2 to pin 6.

$$[5] \quad TC_{R(bridge)} = \frac{R_{bridge}(at\ 150\text{ °C}) - R_{bridge}(at\ -40\text{ °C})}{R_{bridge}(at\ 25\text{ °C}) \times (150\text{ °C} - (-40\text{ °C}))}$$

$$[6] \quad TC_{V(offset)} = \frac{V_{offset}(at\ 150\text{ °C}) - V_{offset}(at\ -40\text{ °C})}{150\text{ °C} - (-40\text{ °C})}$$

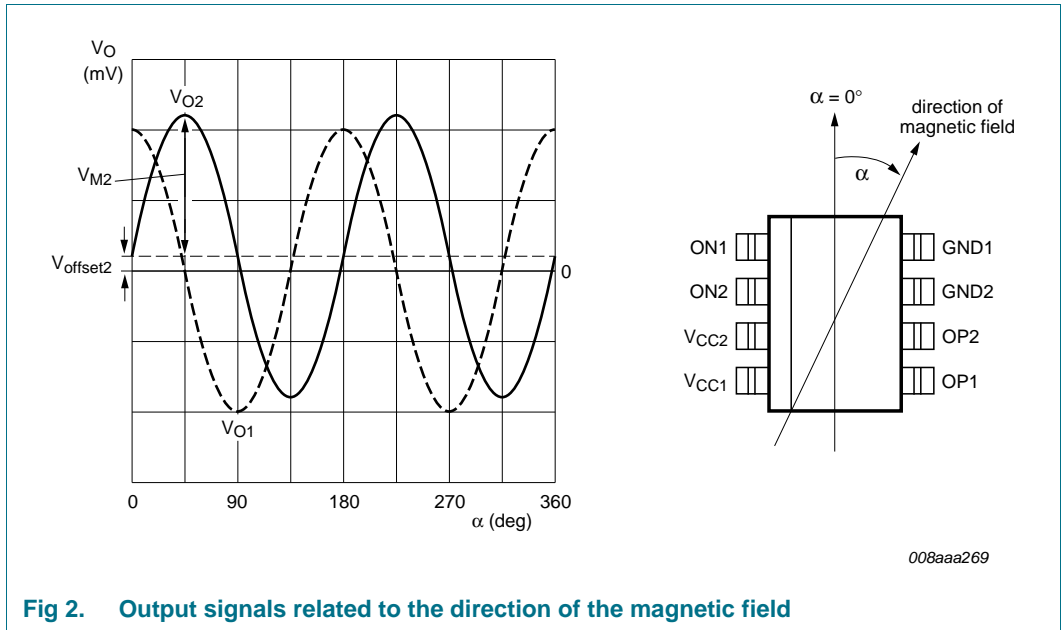
$$[7] \quad V_{o(hys)1} = \left| \frac{V_{O1}(67.5^\circ)135^\circ \rightarrow 45^\circ - V_{O1}(67.5^\circ)45^\circ \rightarrow 135^\circ}{2 \times V_{M1}} \right|$$

$$V_{o(hys)2} = \left| \frac{V_{O2}(22.5^\circ)90^\circ \rightarrow 0^\circ - V_{O2}(22.5^\circ)0^\circ \rightarrow 90^\circ}{2 \times V_{M2}} \right|$$

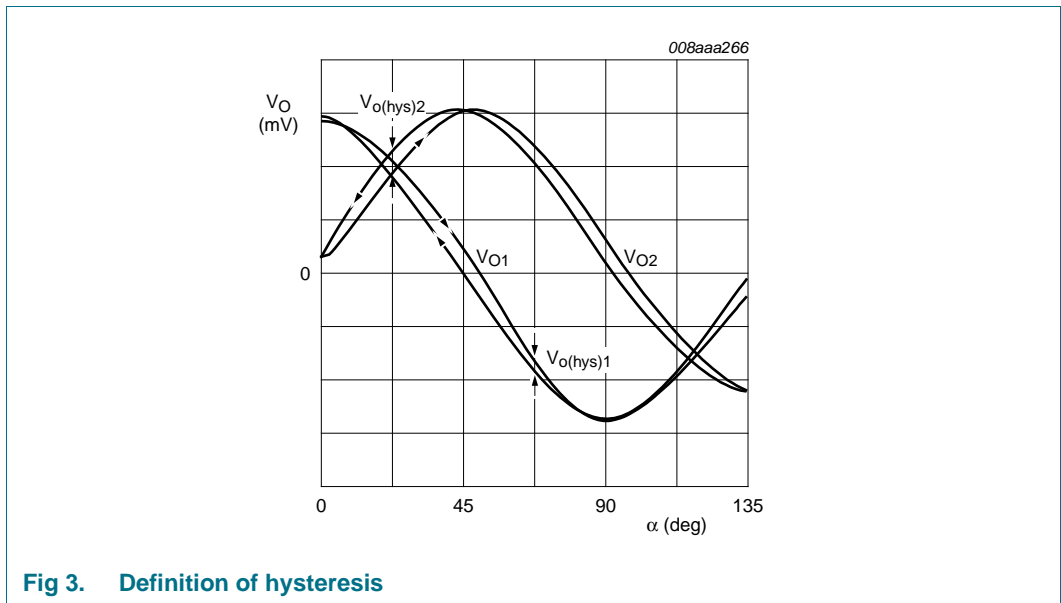
$$[8] \quad k = \frac{V_{M1}}{V_{M2}}$$

$$[9] \quad TC_k = \frac{k(at\ 150\text{ °C}) - k(at\ -40\text{ °C})}{k(at\ 25\text{ °C}) \times (150\text{ °C} - (-40\text{ °C}))}$$

[10]  $\Delta\alpha = |\alpha_{real} - \alpha_{meas}|$ ;  $V_{offset} = 0\text{ V}$ ; inaccuracy of angular measurement due to deviations from ideal sinusoidal characteristics, calculated from the third and fifth harmonics of the spectrum  $V_O$ . For definition of  $\alpha$  see [Figure 2](#).



**Fig 2. Output signals related to the direction of the magnetic field**



**Fig 3. Definition of hysteresis**

## 8. ElectroStatic Discharge (ESD)

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### 8.1 Human body model

The KMZ49 withstands 1 kV, according to the human body model at 100 pF and 1.5 k $\Omega$ . The test is according to AEC-Q101, method 001.

## 9. Test information

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### 9.1 Quality information

This product has been qualified in accordance with the Automotive Electronics Council (AEC) standard *Q101 - Stress test qualification for discrete semiconductors*, and is suitable for use in automotive applications.

10. Package outline

SO8: plastic small outline package; 8 leads; body width 3.9 mm

SOT96-1

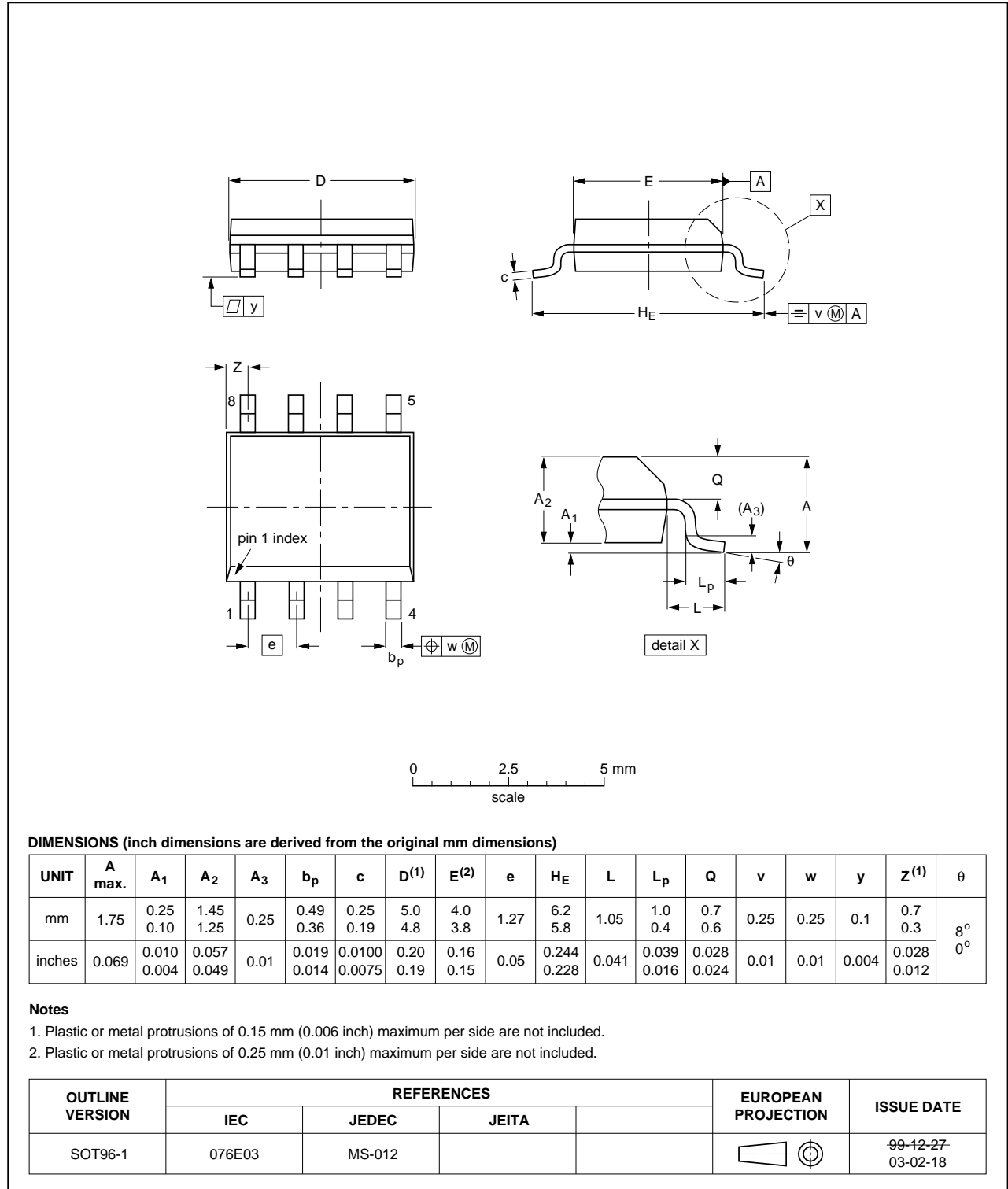


Fig 4. Package outline SOT96-1 (SO8)

## 11. Soldering of SMD packages

This text provides a very brief insight into a complex technology. A more in-depth account of soldering ICs can be found in Application Note *AN10365 "Surface mount reflow soldering description"*.

### 11.1 Introduction to soldering

Soldering is one of the most common methods through which packages are attached to Printed Circuit Boards (PCBs), to form electrical circuits. The soldered joint provides both the mechanical and the electrical connection. There is no single soldering method that is ideal for all IC packages. Wave soldering is often preferred when through-hole and Surface Mount Devices (SMDs) are mixed on one printed wiring board; however, it is not suitable for fine pitch SMDs. Reflow soldering is ideal for the small pitches and high densities that come with increased miniaturization.

### 11.2 Wave and reflow soldering

Wave soldering is a joining technology in which the joints are made by solder coming from a standing wave of liquid solder. The wave soldering process is suitable for the following:

- Through-hole components
- Leaded or leadless SMDs, which are glued to the surface of the printed circuit board

Not all SMDs can be wave soldered. Packages with solder balls, and some leadless packages which have solder lands underneath the body, cannot be wave soldered. Also, leaded SMDs with leads having a pitch smaller than ~0.6 mm cannot be wave soldered, due to an increased probability of bridging.

The reflow soldering process involves applying solder paste to a board, followed by component placement and exposure to a temperature profile. Leaded packages, packages with solder balls, and leadless packages are all reflow solderable.

Key characteristics in both wave and reflow soldering are:

- Board specifications, including the board finish, solder masks and vias
- Package footprints, including solder thieves and orientation
- The moisture sensitivity level of the packages
- Package placement
- Inspection and repair
- Lead-free soldering versus SnPb soldering

### 11.3 Wave soldering

Key characteristics in wave soldering are:

- Process issues, such as application of adhesive and flux, clinching of leads, board transport, the solder wave parameters, and the time during which components are exposed to the wave
- Solder bath specifications, including temperature and impurities



## 11.4 Reflow soldering

Key characteristics in reflow soldering are:

- Lead-free versus SnPb soldering; note that a lead-free reflow process usually leads to higher minimum peak temperatures (see [Figure 5](#)) than a SnPb process, thus reducing the process window
- Solder paste printing issues including smearing, release, and adjusting the process window for a mix of large and small components on one board
- Reflow temperature profile; this profile includes preheat, reflow (in which the board is heated to the peak temperature) and cooling down. It is imperative that the peak temperature is high enough for the solder to make reliable solder joints (a solder paste characteristic). In addition, the peak temperature must be low enough that the packages and/or boards are not damaged. The peak temperature of the package depends on package thickness and volume and is classified in accordance with [Table 7](#) and [8](#)

**Table 7. SnPb eutectic process (from J-STD-020C)**

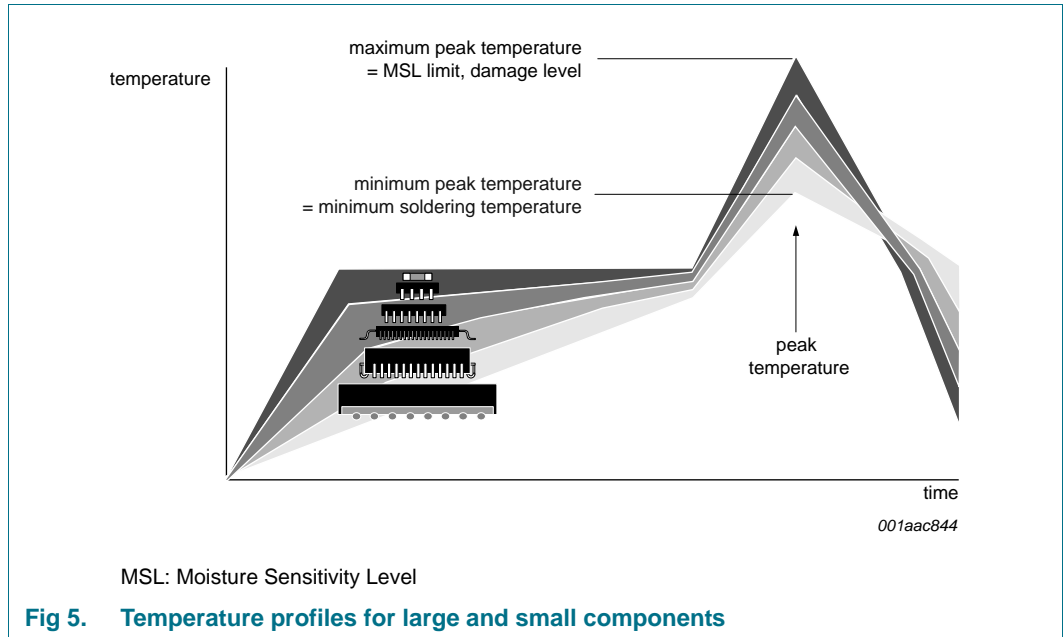
| Package thickness (mm) | Package reflow temperature (°C) |       |
|------------------------|---------------------------------|-------|
|                        | Volume (mm <sup>3</sup> )       |       |
|                        | < 350                           | ≥ 350 |
| < 2.5                  | 235                             | 220   |
| ≥ 2.5                  | 220                             | 220   |

**Table 8. Lead-free process (from J-STD-020C)**

| Package thickness (mm) | Package reflow temperature (°C) |             |        |
|------------------------|---------------------------------|-------------|--------|
|                        | Volume (mm <sup>3</sup> )       |             |        |
|                        | < 350                           | 350 to 2000 | > 2000 |
| < 1.6                  | 260                             | 260         | 260    |
| 1.6 to 2.5             | 260                             | 250         | 245    |
| > 2.5                  | 250                             | 245         | 245    |

Moisture sensitivity precautions, as indicated on the packing, must be respected at all times.

Studies have shown that small packages reach higher temperatures during reflow soldering, see [Figure 5](#).



For further information on temperature profiles, refer to Application Note AN10365 “Surface mount reflow soldering description”.

## 12. Revision history

Table 9. Revision history

| Document ID | Release date | Data sheet status  | Change notice | Supersedes |
|-------------|--------------|--------------------|---------------|------------|
| KMZ49 v.1   | 20111031     | Product data sheet | -             | -          |

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### 13.1 Data sheet status

| Document status <sup>[1][2]</sup> | Product status <sup>[3]</sup> | Definition  |
|-----------------------------------|-------------------------------|---|
| Objective [short] data sheet      | Development                   | This document contains data from the objective specification for product development. |
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