



# MMBZ20VAL

Low capacitance unidirectional double ESD protection diode

12 April 2023

Product data sheet

## 1. General description

Unidirectional double ElectroStatic Discharge (ESD) protection diode in a common anode configuration, encapsulated in a SOT23 (TO-236AB) small Surface-Mounted Device (SMD) plastic package. The device is designed for ESD and transient overvoltage protection of up to two signal lines.

## 2. Features and benefits

- Unidirectional ESD protection of two lines
- Bidirectional ESD protection of one line
- Low diode capacitance:  $C_d \leq 80$  pF
- Rated peak pulse power:  $P_{PPM} = 40$  W
- Ultra low leakage current:  $I_{RM} = 5$  nA
- ESD protection up to 30 kV (contact discharge)
- IEC 61000-4-2; level 4 (ESD)
- IEC 61643-321

## 3. Applications

- Computers and peripherals
- Audio and video equipment
- Cellular handsets and accessories
- Portable electronics

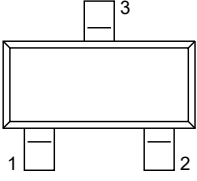
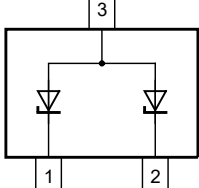
## 4. Quick reference data

Table 1. Quick reference data

| Symbol    | Parameter                | Conditions                                  | Min | Typ | Max | Unit |
|-----------|--------------------------|---|-----|-----|-----|------|
| $V_{RWM}$ | reverse standoff voltage | $T_{amb} = 25$ °C                           | -   | -   | 17  | V    |
| $C_d$     | diode capacitance        | $f = 1$ MHz; $V_R = 0$ V; $T_{amb} = 25$ °C | -   | 65  | 80  | pF   |

## 5. Pinning information

Table 2. Pinning information

| Pin | Symbol | Description       | Simplified outline  | Graphic symbol   |
|-----|--------|-------------------|---|--|
| 1   | K1     | cathode (diode 1) |  <p style="text-align: center;"><b>SOT23</b></p> |  <p style="text-align: right;"><small>006aaa154</small></p> |
| 2   | K2     | cathode (diode 2) |   |  |
| 3   | A      | common anode      |   |  |

## 6. Ordering information

Table 3. Ordering information

| Type number | Package |  |         |
|-------------|---------|--|---------|
|             | Name    | Description  | Version |
| MMBZ20VAL   | SOT23   | plastic, surface-mounted package; 3 terminals; 1.9 mm pitch; 2.9 mm x 1.3 mm x 1 mm body | SOT23   |

## 7. Marking

Table 4. Marking codes

| Type number | Marking code[1] |
|-------------|-----------------|
| MMBZ20VAL   | %H4             |

[1] % = placeholder for manufacturing site code

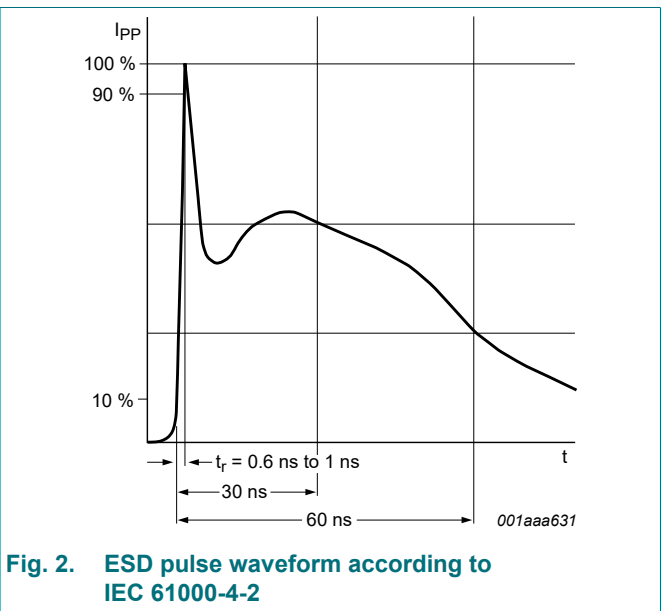
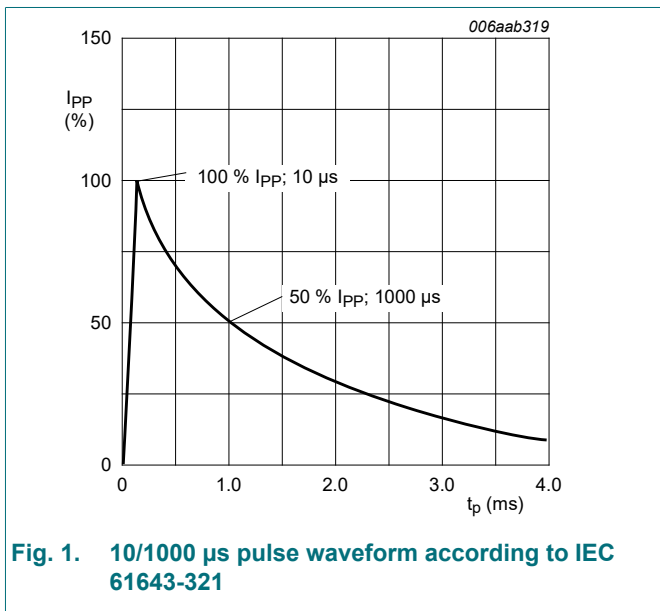
## 8. Limiting values

**Table 5. Limiting values**

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

| Symbol                     | Parameter                       | Conditions  |         | Min | Max | Unit             |
|----------------------------|---------------------------------|---|---------|-----|-----|------------------|
| $P_{PPM}$                  | rated peak pulse power          | $t_p = 10/1000 \mu s$   | [1] [2] | -   | 40  | W                |
| $I_{PPM}$                  | rated peak pulse current        |   | [1] [2] | -   | 1.4 | A                |
| $P_{tot}$                  | total power dissipation         | $T_{amb} \leq 25 \text{ }^\circ\text{C}$                                      | [3]     | -   | 265 | mW               |
|                            |                                 |   | [4]     | -   | 360 | mW               |
| $T_j$                      | junction temperature            |   |         | -   | 150 | $^\circ\text{C}$ |
| $T_{amb}$                  | ambient temperature             |   |         | -55 | 150 | $^\circ\text{C}$ |
| $T_{stg}$                  | storage temperature             |   |         | -65 | 150 | $^\circ\text{C}$ |
| <b>ESD maximum ratings</b> |                                 |   |         |     |     |                  |
| $V_{ESD}$                  | electrostatic discharge voltage | IEC 61000-4-2 (contact discharge);<br>$T_{amb} = 25 \text{ }^\circ\text{C}$   | [5] [2] | -   | 30  | kV               |
|                            |                                 | IEC 61000-4-2 (air discharge);<br>$T_{amb} = 25 \text{ }^\circ\text{C}$       |         | -   | 15  | kV               |
|                            |                                 | MIL-STD-883; human body model (HBM);<br>$T_{amb} = 25 \text{ }^\circ\text{C}$ |         | -   | 8   | kV               |
|                            |                                 | machine model; $T_{amb} = 25 \text{ }^\circ\text{C}$                          | [2]     | -   | 2   | kV               |

- [1] In accordance with IEC 61643-321 (10/1000  $\mu s$  current waveform).
- [2] Measured from pin 1 or 2 to pin 3.
- [3] Device mounted on an FR4 Printed-Circuit Board (PCB), single-sided copper, tin-plated and standard footprint.
- [4] Device mounted on an FR4 PCB, single-sided copper, tin-plated, mounting pad for cathode 1  $\text{cm}^2$ .
- [5] Device stressed with ten non-repetitive ESD pulses.



## 9. Thermal characteristics

Table 6. Thermal characteristics

| Symbol         | Parameter  | Conditions  |     | Min | Typ | Max | Unit |
|----------------|--|-------------|-----|-----|-----|-----|------|
| $R_{th(j-a)}$  | thermal resistance from junction to ambient      | in free air | [1] | -   | -   | 460 | K/W  |
|                |  |             | [2] | -   | -   | 340 | K/W  |
| $R_{th(j-sp)}$ | thermal resistance from junction to solder point |             | [3] | -   | -   | 50  | K/W  |

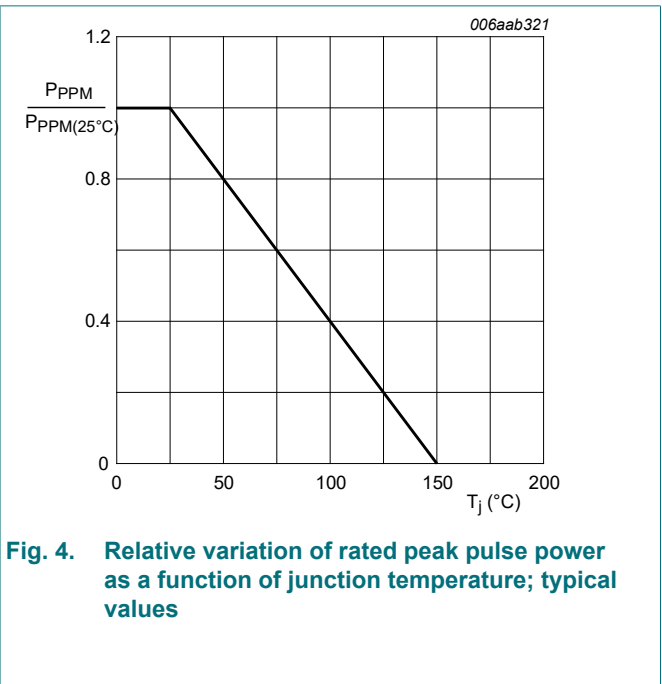
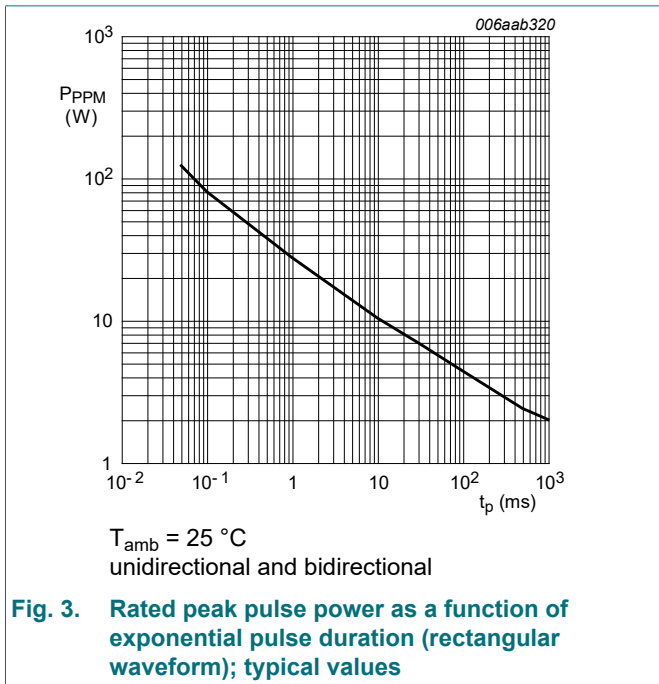
- [1] Device mounted on an FR4 Printed-Circuit Board (PCB), single-sided copper, tin-plated and standard footprint.
- [2] Device mounted on an FR4 PCB, single-sided copper, tin-plated, mounting pad for cathode 1 cm<sup>2</sup>.
- [3] Measured from pin 1 or 2 to pin 3.

## 10. Characteristics

Table 7. Characteristics

| Symbol    | Parameter                | Conditions  |         | Min | Typ | Max | Unit |
|-----------|--------------------------|---|---------|-----|-----|-----|------|
| $V_F$     | forward voltage          | $I_F = 10 \text{ mA}; T_{amb} = 25 \text{ }^\circ\text{C}$                  |         | -   | -   | 0.9 | V    |
| $V_{RWM}$ | reverse standoff voltage | $T_{amb} = 25 \text{ }^\circ\text{C}$                                       |         | -   | -   | 17  | V    |
| $V_{BR}$  | breakdown voltage        | $I_R = 1 \text{ mA}; T_{amb} = 25 \text{ }^\circ\text{C}$                   |         | 19  | 20  | 21  | V    |
| $I_{RM}$  | reverse leakage current  | $V_{RWM} = 17 \text{ V}; T_{amb} = 25 \text{ }^\circ\text{C}$               |         | -   | 0.1 | 5   | nA   |
| $C_d$     | diode capacitance        | $f = 1 \text{ MHz}; V_R = 0 \text{ V}; T_{amb} = 25 \text{ }^\circ\text{C}$ |         | -   | 65  | 80  | pF   |
| $V_{CL}$  | clamping voltage         | $I_{PPM} = 1.4 \text{ A}; T_{amb} = 25 \text{ }^\circ\text{C}$              | [1] [2] | -   | -   | 28  | V    |

- [1] In accordance with IEC 61643-321 (10/1000  $\mu\text{s}$  current waveform).
- [2] Measured from pin 1 or 2 to pin 3.



Low capacitance unidirectional double ESD protection diode

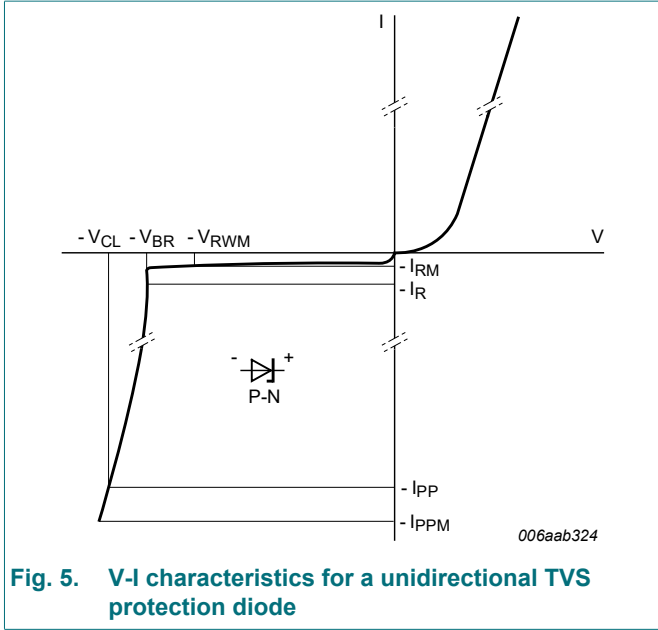


Fig. 5. V-I characteristics for a unidirectional TVS protection diode

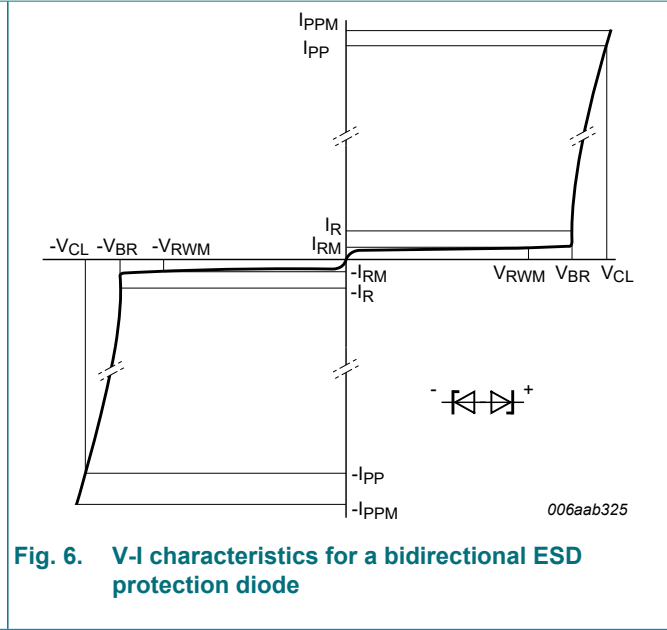
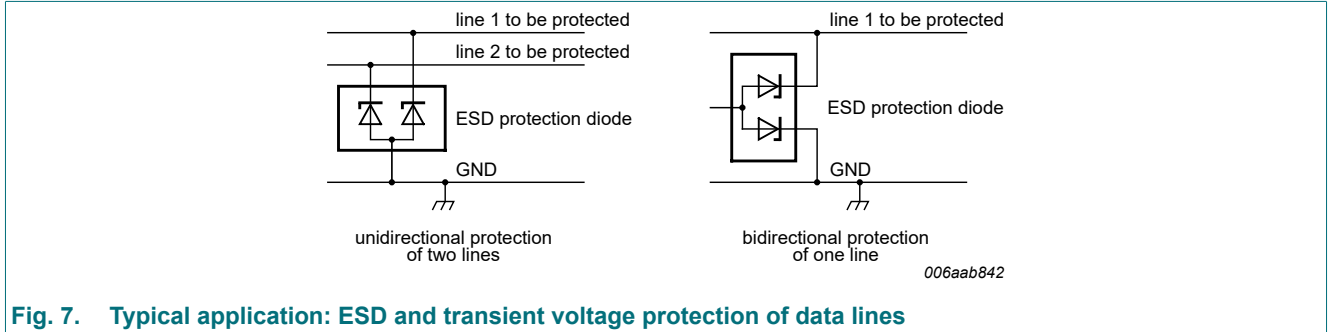


Fig. 6. V-I characteristics for a bidirectional ESD protection diode

## 11. Application information

The device is designed for the protection of up to two unidirectional data lines from the damage caused by ESD and surge pulses. The device may be used on lines where the signal polarities are either positive or negative with respect to ground.



**Fig. 7. Typical application: ESD and transient voltage protection of data lines**

### Circuit board layout and protection device placement

Circuit board layout is critical for the suppression of ESD, Electrical Fast Transient (EFT) and surge transients. The following guidelines are recommended:

1. Place the device as close to the input terminal or connector as possible.
2. Minimize the path length between the device and the protected line.
3. Keep parallel signal paths to a minimum.
4. Avoid running protected conductors in parallel with unprotected conductors.
5. Minimize all Printed-Circuit Board (PCB) conductive loops including power and ground loops.
6. Minimize the length of the transient return path to ground.
7. Avoid using shared transient return paths to a common ground point.
8. Use ground planes whenever possible. For multilayer PCBs, use ground vias.

## 12. Package outline

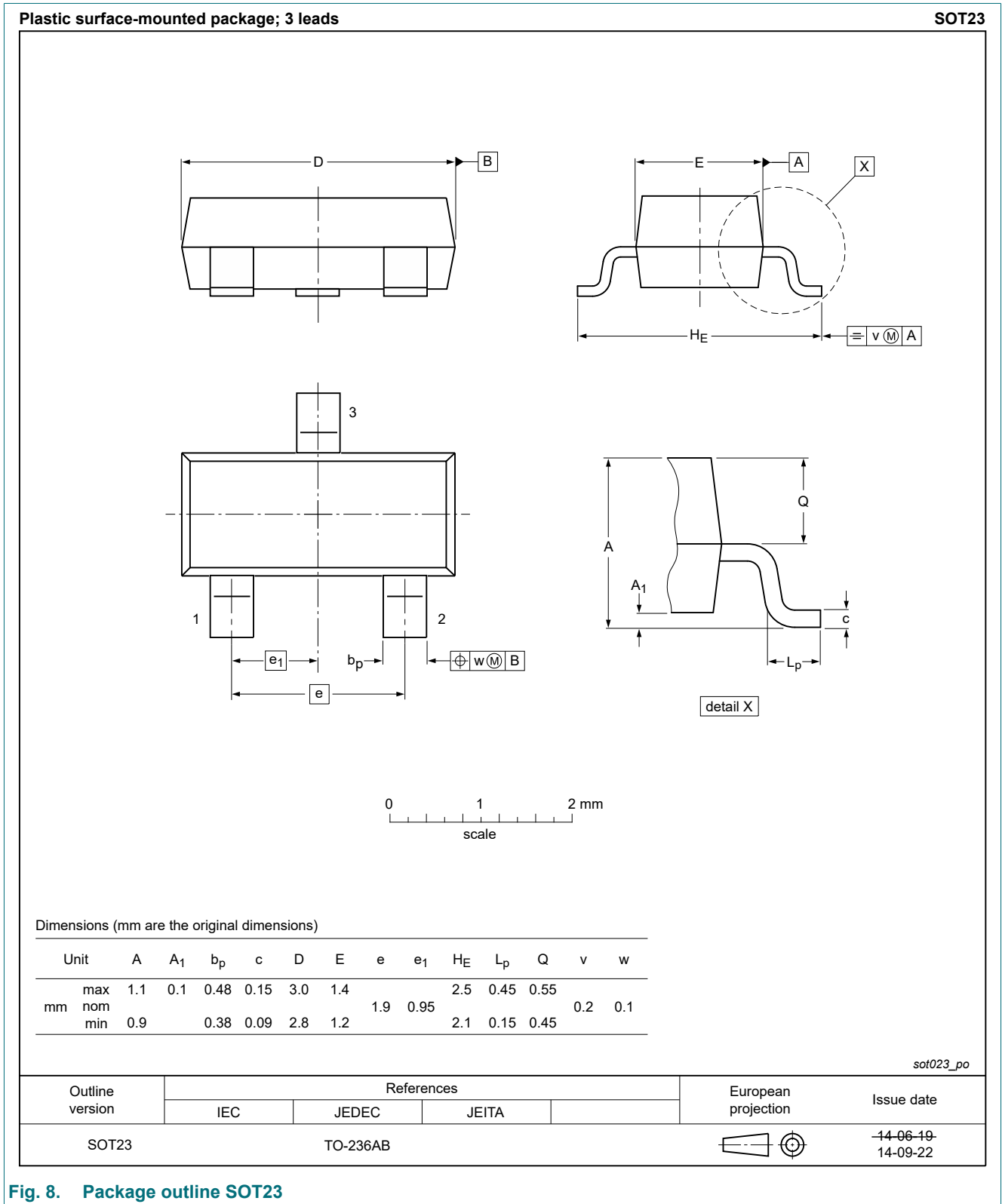


Fig. 8. Package outline SOT23

### 13. Soldering

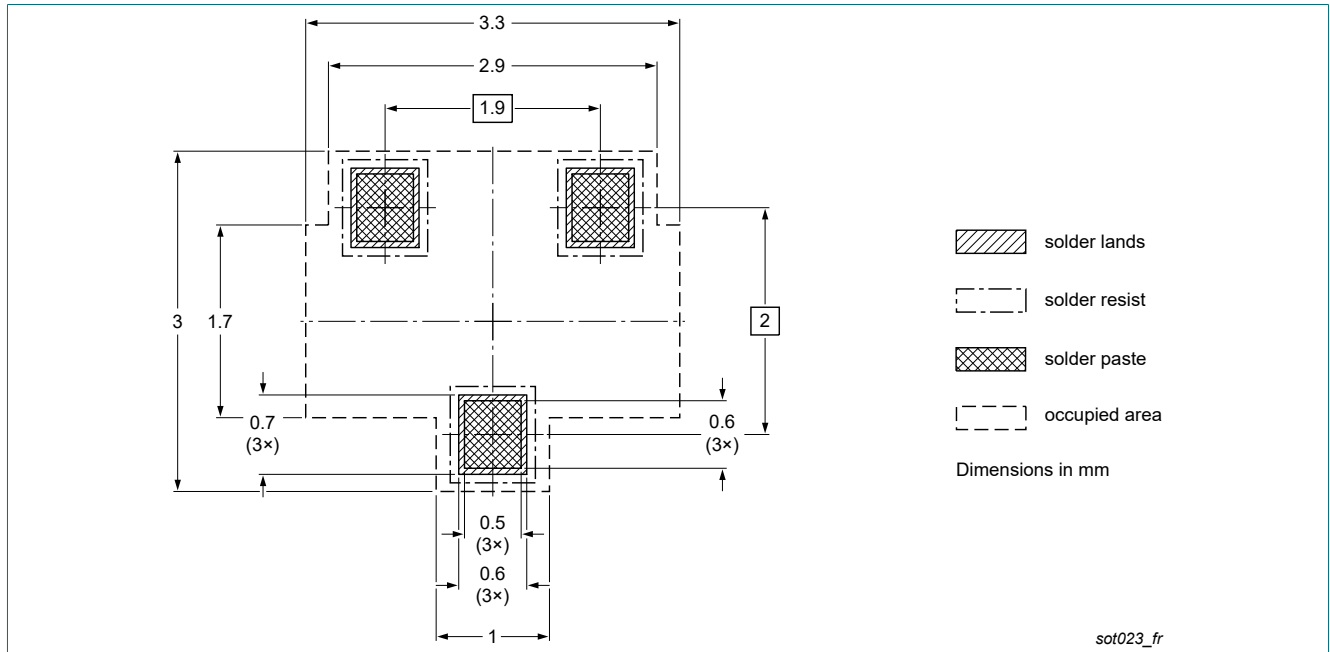


Fig. 9. Reflow soldering footprint for SOT23

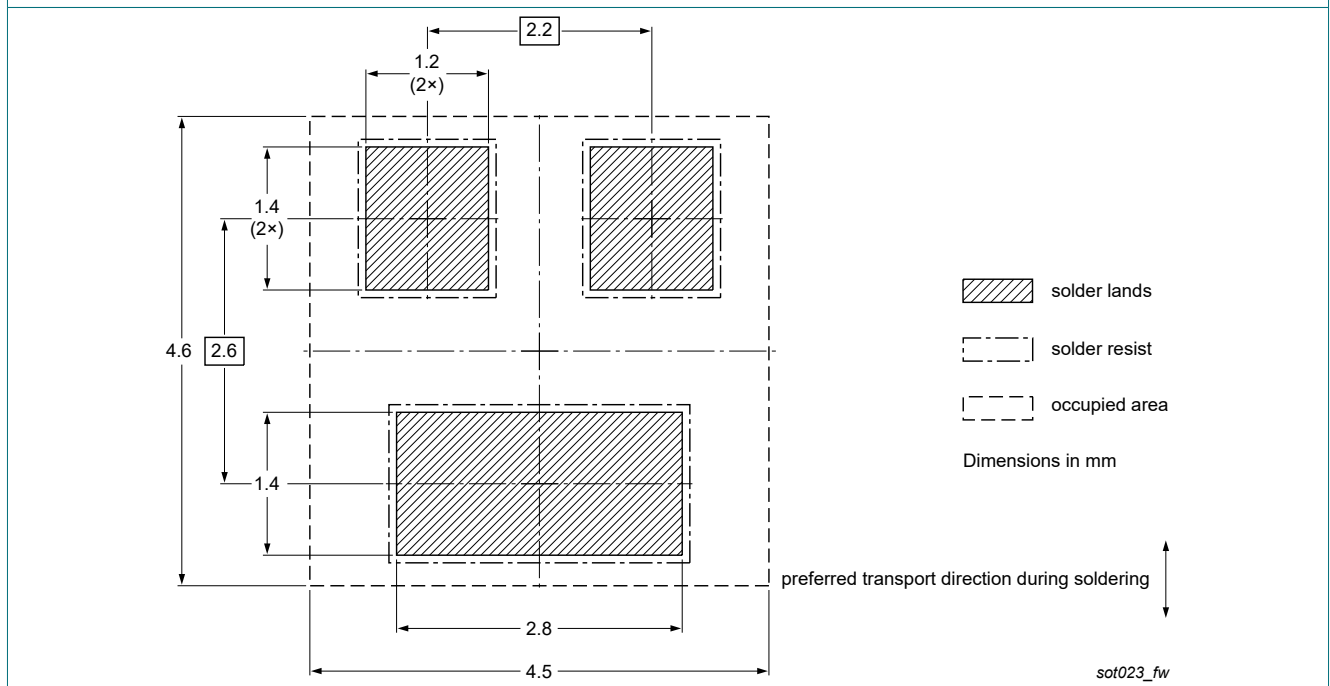


Fig. 10. Wave soldering footprint for SOT23



## 14. Revision history

**Table 8. Revision history**

| Data sheet ID  | Release date  | Data sheet status  | Change notice | Supersedes     |
|----------------|---|--------------------|---------------|----------------|
| MMBZ20VAL v.3  | 20230412  | Product data sheet | -             | MMBZXAL_SER_2  |
| Modifications: | <ul style="list-style-type: none"><li>Family data sheet reduced to single type data sheet.</li><li>Product changed to non-automotive qualification. Please refer to <a href="https://www.nexperia.com">nexperia.com</a> for automotive (-Q) product alternative(s).</li></ul> |                    |               |                |
| MMBZXAL_SER_2  | 20091210  | Product data sheet | -             | MMBZXVAL_SER_1 |
| MMBZXVAL_SER_1 | 20080901  | Product data sheet | -             | -              |

## 15. Legal information

### Data sheet status

| Document status [1][2]         | Product status [3] | Definition  |
|--------------------------------|--------------------|---|
| Objective [short] data sheet   | Development        | This document contains data from the objective specification for product development. |
| Preliminary [short] data sheet | Qualification      | This document contains data from the preliminary specification.                       |
| Product [short] data sheet     | Production         | This document contains the product specification.                                     |

- [1] Please consult the most recently issued document before initiating or completing a design.
- [2] The term 'short data sheet' is explained in section "Definitions".
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## Contents

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|                                  |    |
|----------------------------------|----|
| 1. General description.....      | 1  |
| 2. Features and benefits.....    | 1  |
| 3. Applications.....             | 1  |
| 4. Quick reference data.....     | 1  |
| 5. Pinning information.....      | 2  |
| 6. Ordering information.....     | 2  |
| 7. Marking.....                  | 2  |
| 8. Limiting values.....          | 3  |
| 9. Thermal characteristics.....  | 4  |
| 10. Characteristics.....         | 4  |
| 11. Application information..... | 6  |
| 12. Package outline.....         | 7  |
| 13. Soldering.....               | 8  |
| 14. Revision history.....        | 9  |
| 15. Legal information.....       | 10 |

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Date of release: 12 April 2023

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