



# MMBZ16VAL

High surge current unidirectional double ESD protection diodes

6 November 2017

Product data sheet

## 1. General description

Unidirectional double ElectroStatic Discharge (ESD) protection diodes 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 protection of two lines
- Reverse standoff voltage:  $V_{RWM} = 13\text{ V}$
- Average measured surge robustness:  $I_{PPM} = 14\text{ A}$  (8/20  $\mu\text{s}$ ) /  $I_{PPM} = 2.54\text{ A}$  (10/1000  $\mu\text{s}$ )
- Typical reverse leakage current:  $I_{RM} = 0.1\text{ nA}$
- AEC-Q101 qualified

## 3. Applications

- Automotive in-vehicle networks protection
- Industrial application
- Power management

## 4. Quick reference data

Table 1. Quick reference data

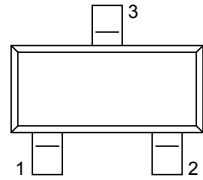
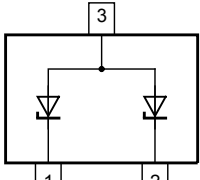
| Symbol    | Parameter                | Conditions                                                                                        |         | Min | Typ  | Max | Unit |
|-----------|--------------------------|---------------------------------------------------------------------------------------------------|---------|-----|------|-----|------|
| $V_{RWM}$ | reverse standoff voltage | $T_j = 25\text{ }^{\circ}\text{C}$                                                                |         | -   | -    | 13  | V    |
| $I_{PPM}$ | rated peak pulse current | $t_p = 10/1000\text{ }\mu\text{s}$                                                                | [1] [2] | -   | -    | 1.9 | A    |
| $V_{CL}$  | clamping voltage         | $I_{PP} = 1.7\text{ A}$ ; $t_p = 10/1000\text{ }\mu\text{s}$ ; $T_j = 25\text{ }^{\circ}\text{C}$ | [1] [2] | -   | 19.5 | 23  | V    |

[1] According to IEC 61643-321.

[2] Measured from pin 1 or 2 to pin 3.

5. Pinning information

Table 2. Pinning information

| Pin | Symbol | Description  | Simplified outline                                                                                    | Graphic symbol                                                                                   |
|-----|--------|--------------|-------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------|
| 1   | K1     | cathode      | <br>TO-236AB (SOT23) | <br>006aaa154 |
| 2   | K2     | cathode      |                                                                                                       |                                                                                                  |
| 3   | A      | common anode |                                                                                                       |                                                                                                  |

6. Ordering information

Table 3. Ordering information

| Type number | Package  |                                                                                          |         |
|-------------|----------|------------------------------------------------------------------------------------------|---------|
|             | Name     | Description                                                                              | Version |
| MMBZ16VAL   | TO-236AB | 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 <sup>[1]</sup> |
|-------------|-----------------------------|
| MMBZ16VAL   | %H7                         |

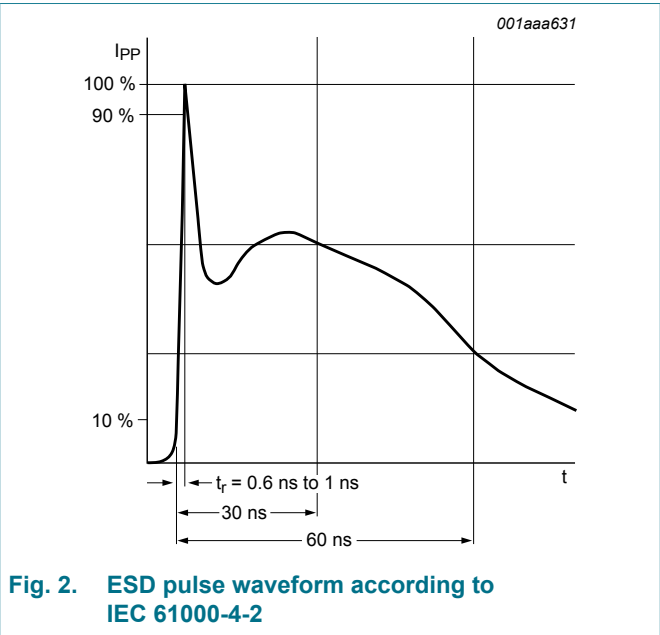
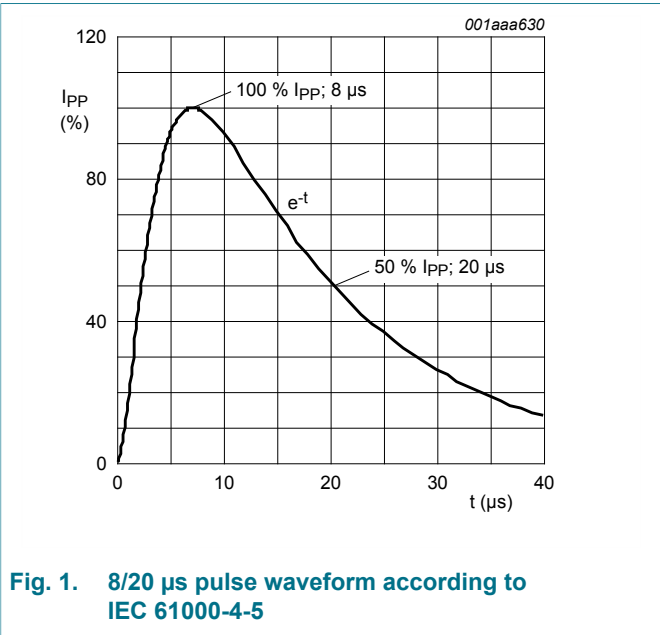
[1] % = placeholder for manufacturing site code

8. Limiting values

Table 5. Limiting values  
In accordance with the Absolute Maximum Rating System (IEC 60134)

| Symbol              | Parameter                       | Conditions                       |         | Min | Max | Unit |
|---------------------|---------------------------------|----------------------------------|---------|-----|-----|------|
| P <sub>PPM</sub>    | rated peak pulse power          | t <sub>p</sub> = 8/20 μs         | [1] [2] | -   | 300 | W    |
|                     |                                 | t <sub>p</sub> = 10/1000 μs      | [3] [2] | -   | 45  | W    |
| I <sub>PPM</sub>    | rated peak pulse current        | t <sub>p</sub> = 8/20 μs         | [1] [2] | -   | 11  | A    |
|                     |                                 | t <sub>p</sub> = 10/1000 μs      | [3] [2] | -   | 1.9 | A    |
| T <sub>j</sub>      | junction temperature            |                                  |         | -   | 150 | °C   |
| T <sub>amb</sub>    | ambient temperature             |                                  |         | -55 | 150 | °C   |
| T <sub>stg</sub>    | storage temperature             |                                  |         | -65 | 150 | °C   |
| ESD maximum ratings |                                 |                                  |         |     |     |      |
| V <sub>ESD</sub>    | electrostatic discharge voltage | IEC 61000-4-2; contact discharge | [4] [2] | -   | 30  | kV   |
|                     |                                 | IEC 61000-4-2; air discharge     | [4] [2] | -   | 30  | kV   |

- [1] According to IEC 61000-4-5.  
[2] Measured from pin 1 or 2 to pin 3.  
[3] According to IEC 61643-321.  
[4] Device stressed with ten non-repetitive ESD pulses.



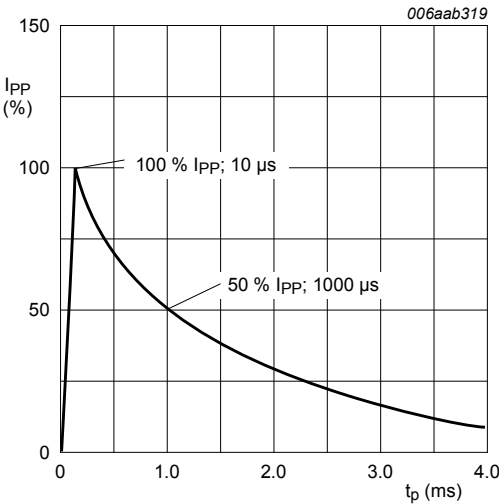


Fig. 3. 10/1000  $\mu$ s pulse waveform according to IEC 61643-321

## 9. Characteristics

Table 6. Characteristics

| Symbol    | Parameter                | Conditions                                                                                        |         | Min  | Typ  | Max  | Unit |
|-----------|--------------------------|---------------------------------------------------------------------------------------------------|---------|------|------|------|------|
| $V_{RWM}$ | reverse standoff voltage | $T_j = 25\text{ }^{\circ}\text{C}$                                                                |         | -    | -    | 13   | V    |
| $V_{BR}$  | breakdown voltage        | $I_R = 1\text{ mA}$ ; $T_j = 25\text{ }^{\circ}\text{C}$                                          | [1]     | 15.2 | 16   | 16.8 | V    |
| $I_{RM}$  | reverse leakage current  | $V_{RWM} = 13\text{ V}$ ; $T_j = 25\text{ }^{\circ}\text{C}$                                      | [1]     | -    | 0.1  | 5    | nA   |
| $C_d$     | diode capacitance        | $f = 1\text{ MHz}$ ; $V_R = 0\text{ V}$ ; $T_j = 25\text{ }^{\circ}\text{C}$                      | [1]     | -    | 76   | 95   | pF   |
| $V_{CL}$  | clamping voltage         | $I_{PP} = 11\text{ A}$ ; $t_p = 8/20\text{ }\mu\text{s}$ ; $T_j = 25\text{ }^{\circ}\text{C}$     | [2] [1] | -    | 23   | 28   | V    |
|           |                          | $I_{PP} = 1.7\text{ A}$ ; $t_p = 10/1000\text{ }\mu\text{s}$ ; $T_j = 25\text{ }^{\circ}\text{C}$ | [3] [1] | -    | 19.5 | 23   | V    |

[1] Measured from pin 1 or 2 to pin 3.

[2] According to IEC 61000-4-5.

[3] According to IEC 61643-321.

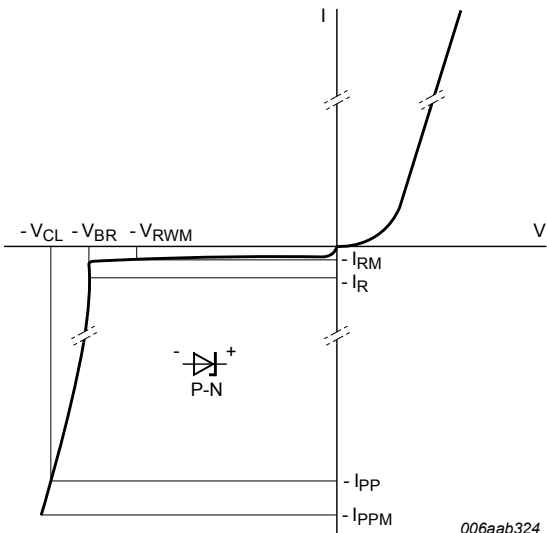


Fig. 4. V-I characteristics for a unidirectional TVS protection diode

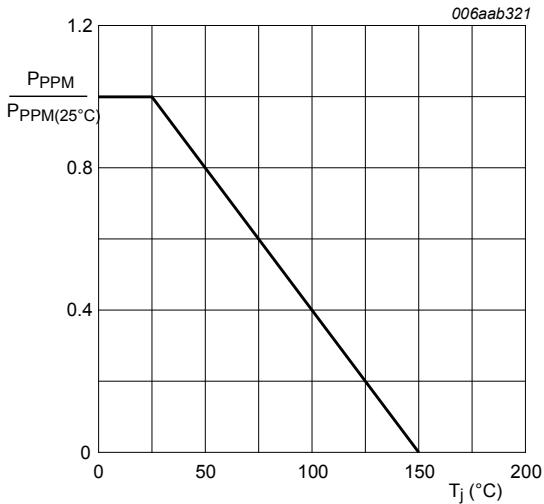


Fig. 5. Relative variation of rated peak pulse power as a function of junction temperature; typical values

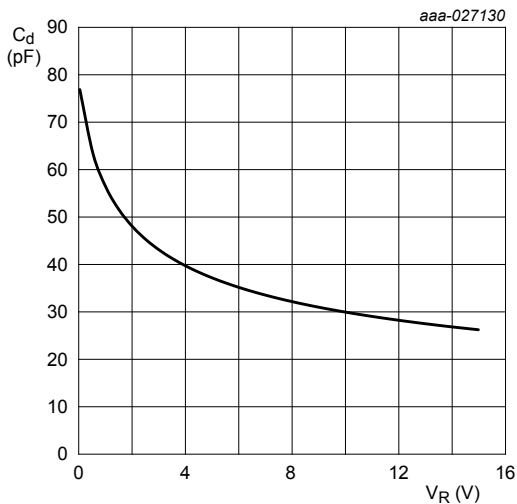


Fig. 6. Diode capacitance as a function of reverse voltage; typical values

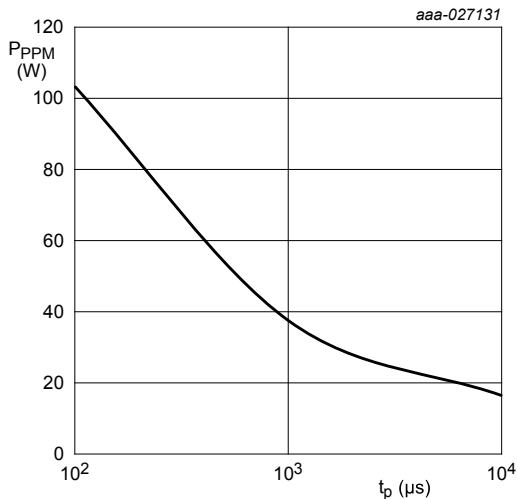
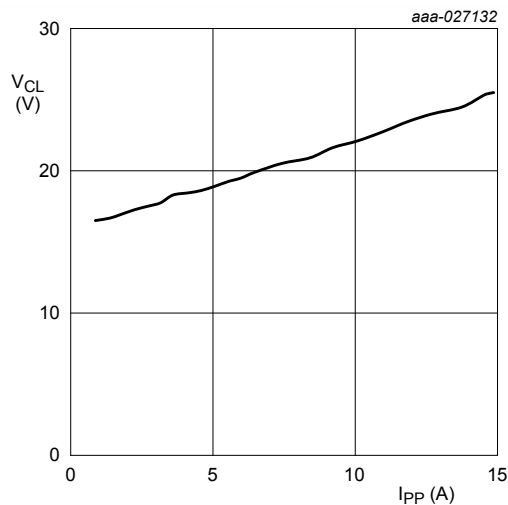
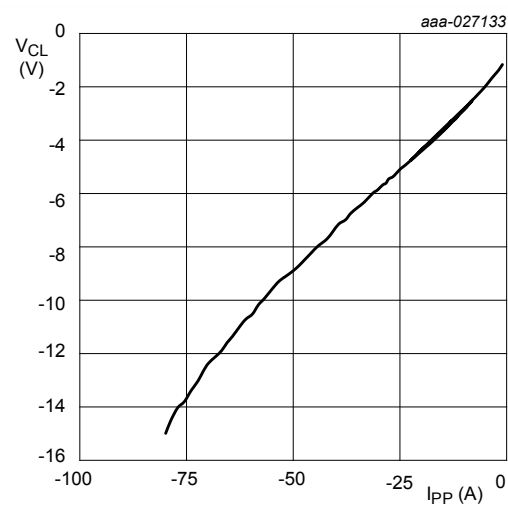


Fig. 7. Rated peak pulse power as a function of a pulse duration; typical values



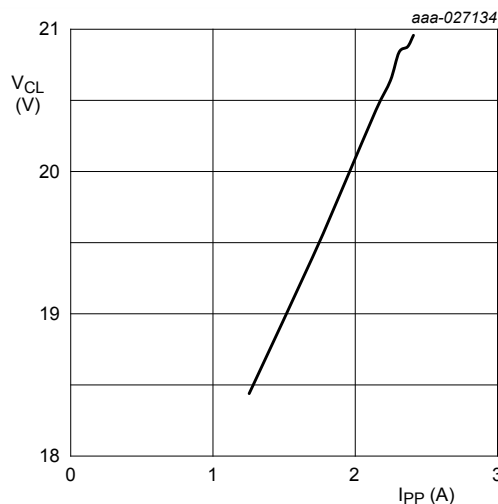
$t_p = 8/20 \mu s$ ; according to IEC 61000-4-5

Fig. 8. Positive clamping voltage (8/20  $\mu s$  pulse); typical values



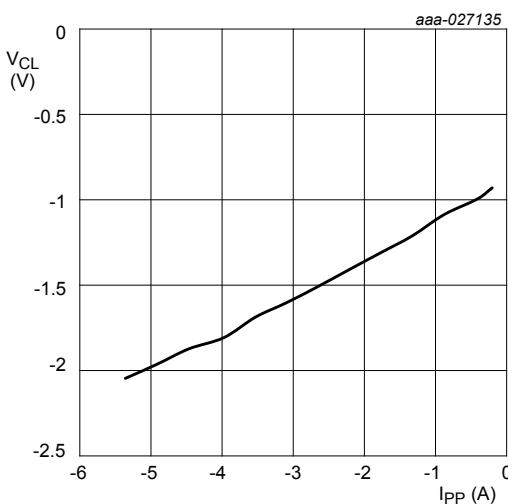
$t_p = 8/20 \mu s$ ; according to IEC 61000-4-5

Fig. 9. Negative clamping voltage (8/20  $\mu s$  pulse); typical values



$t_p = 10/1000 \mu s$ ; according to IEC 61643-321

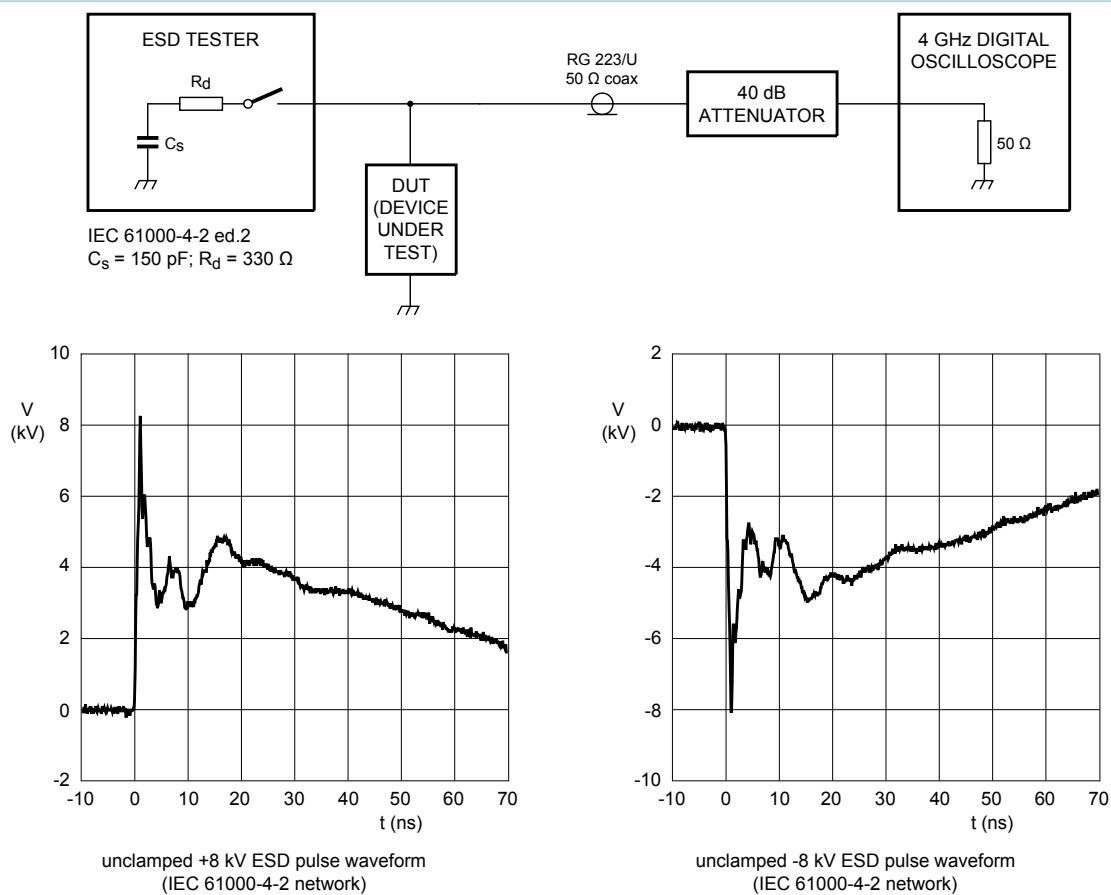
Fig. 10. Positive clamping voltage (10/1000  $\mu s$  pulse); typical values



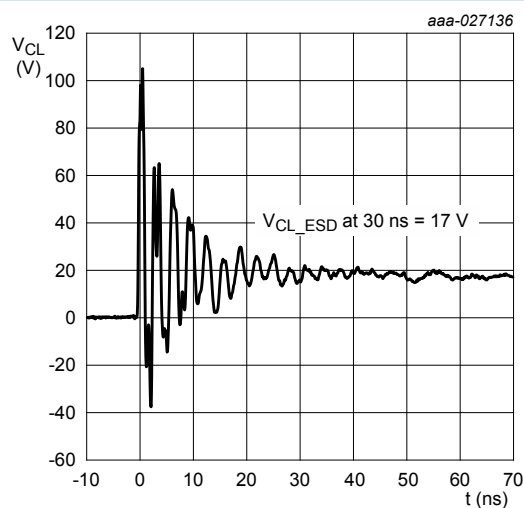
$t_p = 10/1000 \mu s$ ; according to IEC 61643-321

Fig. 11. Negative clamping voltage (10/1000  $\mu s$  pulse); typical values

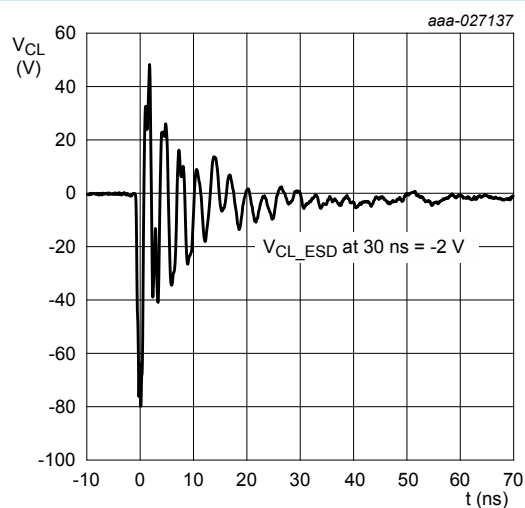
## High surge current unidirectional double ESD protection diodes



**Fig. 12. ESD clamping test setup and waveforms**



**Fig. 13. Clamped +8 kV pulse waveform (IEC61000-4-2 network)**



**Fig. 14. Clamped -8 kV pulse waveform (IEC61000-4-2 network)**

10. Application information

The device is designed for the protection of one bidirectional or up to two unidirectional data or signal lines from the damage caused by ESD and surge pulses.

The devices may be used on lines where the signal polarities are either positive or negative with respect to ground for the unidirectional configuration or both positive and negative for the bidirectional configuration.

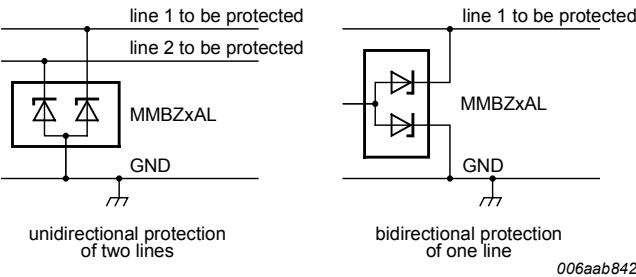


Fig. 15. Application diagram

11. Package outline

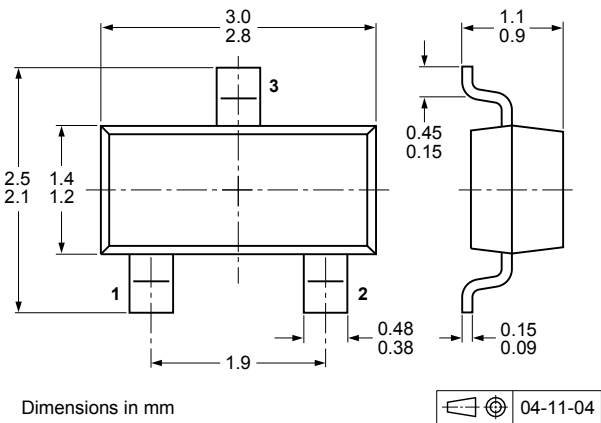


Fig. 16. Package outline TO-236AB (SOT23)



12. Soldering

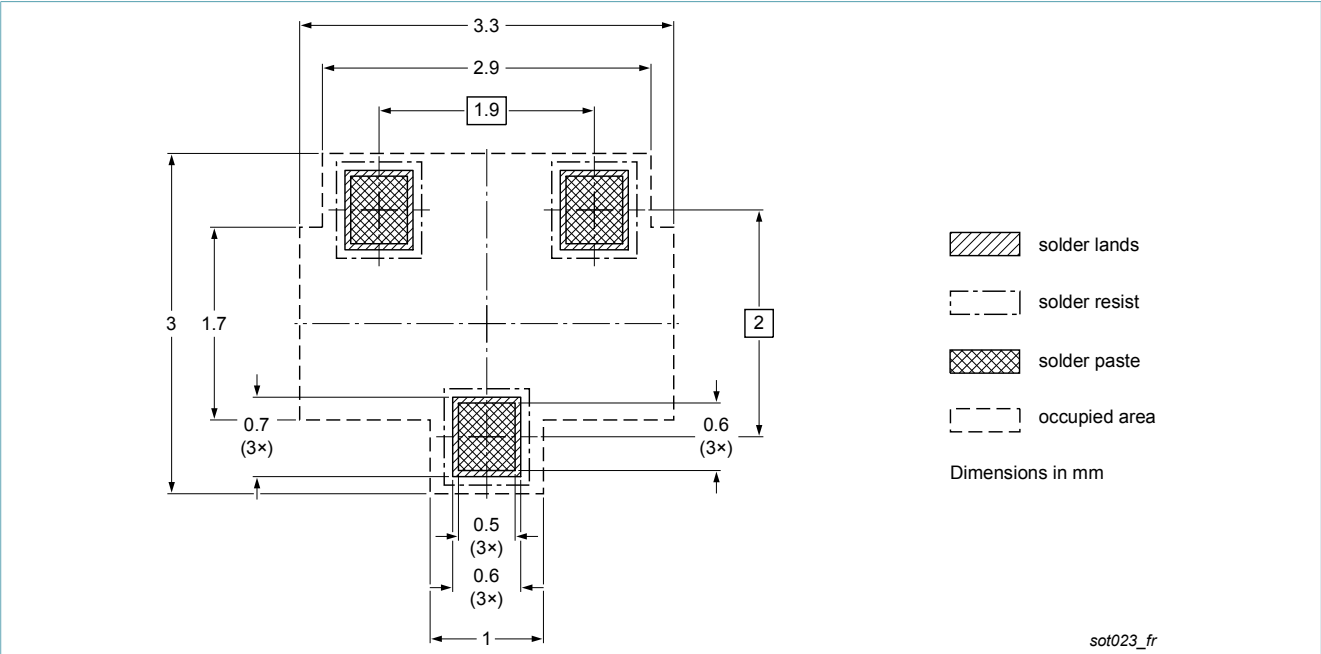


Fig. 17. Reflow soldering footprint for TO-236AB (SOT23)

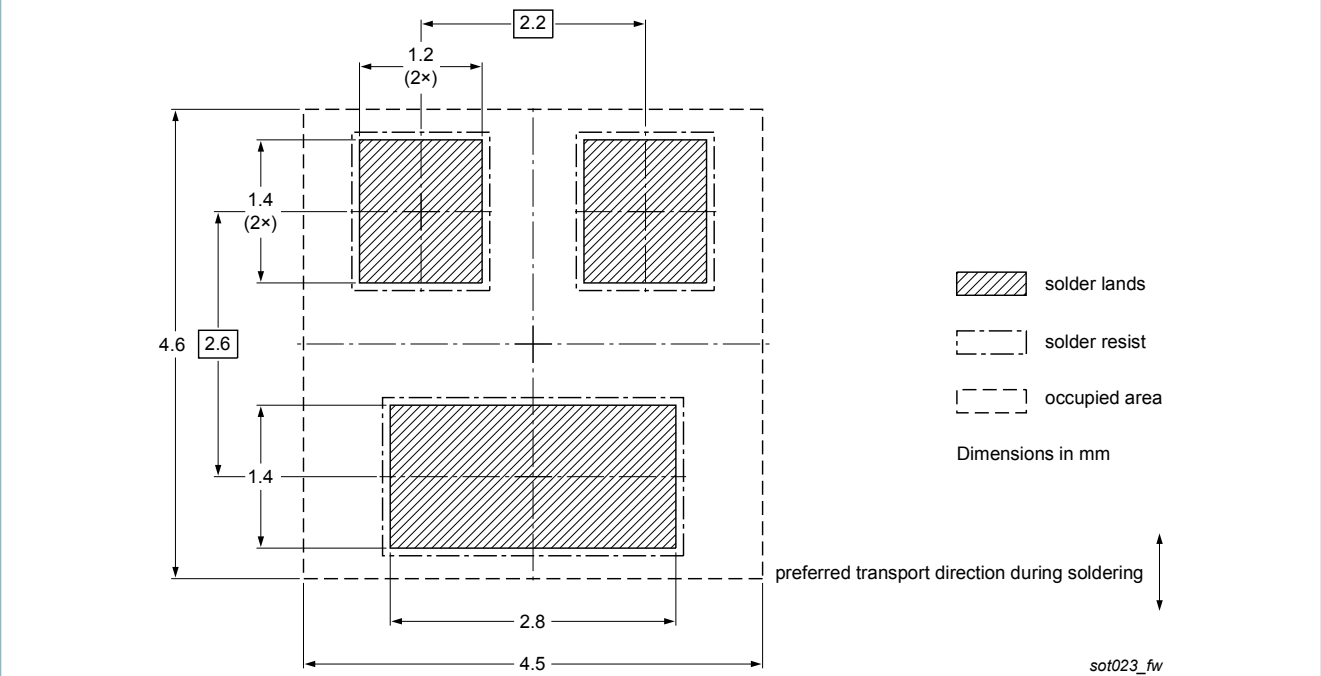


Fig. 18. Wave soldering footprint for TO-236AB (SOT23)

13. Revision history

Table 7. Revision history

| Data sheet ID | Release date | Data sheet status  | Change notice | Supersedes |
|---------------|--------------|--------------------|---------------|------------|
| MMBZ16VAL v.1 | 20171106     | Product data sheet | -             | -          |

## 14. 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.                                     |

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