



MMBZ20VAT-Q

Low capacitance unidirectional double ESD protection diode

24 August 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
- Very low diode capacitance: $C_d \leq 31.5$ pF
- Reverse stand-off voltage: $V_{RWM} = 17$ V
- Low clamping voltage: $V_{CL} = 32$ V typ. at $I_{PP} = 3.8$ A
- ESD protection up to 30 kV (IEC 61000-4-2)
- Ultra low leakage current: $I_{RM} < 1$ nA
- Qualified according to AEC-Q101 and recommended for use in automotive applications

3. Applications

- Computers and peripherals
- Audio and video equipment
- Cellular handsets and accessories
- Automotive electronic control units
- Portable electronics

4. Quick reference data

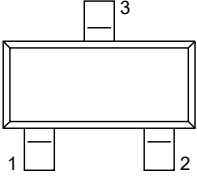
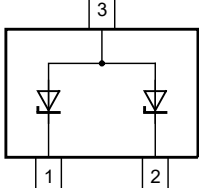
Table 1. Quick reference data

| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|-----------|--------------------------|---|-----|-----|------|------|
| V_{RWM} | reverse standoff voltage | $T_{amb} = 25$ °C | - | - | 17 | V |
| I_{PPM} | rated peak pulse current | $t_p = 8/20$ μ s | [1] | - | 3.8 | A |
| C_d | diode capacitance | $f = 1$ MHz; $V_R = 0$ V; $T_{amb} = 25$ °C | - | 26 | 31.5 | pF |

[1] Device stressed with 8/20 μ s exponential decay waveform according to IEC 61000-4-5.

5. Pinning information

Table 2. Pinning information

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

6. Ordering information

Table 3. Ordering information

| Type number | Package | | |
|-------------|---------|--|---------|
| | Name | Description | Version |
| MMBZ20VAT-Q | 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] |
|-------------|-----------------------------|
| MMBZ20VAT-Q | 8H% |

[1] % = placeholder for manufacturing site code

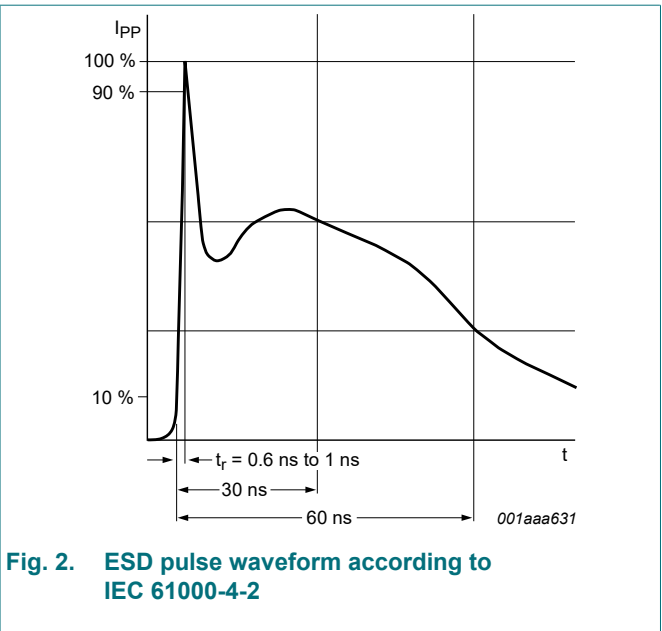
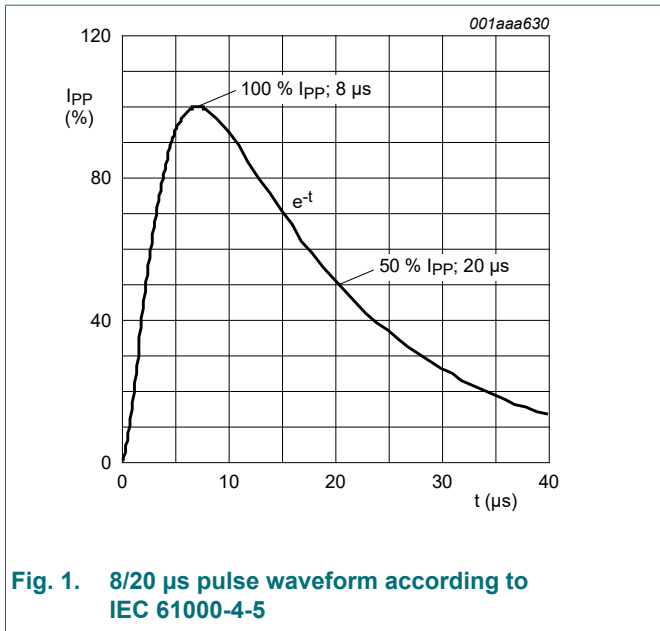
8. Limiting values

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] | - | 20 | W |
| I_{PPM} | rated peak pulse current | $t_p = 8/20 \mu s$ | [2] | - | 3.8 | A |
| | | $t_p = 10/1000 \mu s$ | [1] | - | 0.68 | A |
| T_j | junction temperature | | | - | 150 | °C |
| T_{amb} | ambient temperature | | | -55 | 150 | °C |
| T_{stg} | storage temperature | | | -65 | 150 | °C |
| ESD maximum ratings | | | | | | |
| V_{ESD} | electrostatic discharge voltage | IEC 61000-4-2; contact discharge | [3] | - | 30 | kV |
| | | IEC 61000-4-2; air discharge | [3] | - | 30 | kV |

- [1] In accordance with IEC 61643-321 (10/1000 μs current waveform).
- [2] Device stressed with 8/20 μs exponential decay waveform according to IEC 61000-4-5.
- [3] 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] | 417 | - | K/W |
| $R_{th(j-sp)}$ | thermal resistance from junction to solder point | | [2] | 100 | - | K/W |

- [1] Device mounted on an FR4PCB, single-sided copper, tin-plated and standard footprint.
- [2] Soldering points at pin 1 and 2.

10. Characteristics

Table 7. Characteristics

| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|-----------|--------------------------|---|-----|------|------|------|
| V_F | forward voltage | $I_F = 1 \text{ mA}$; $T_{amb} = 25 \text{ }^\circ\text{C}$ | - | 0.73 | - | 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 | $V_{RWM} = 17 \text{ V}$; $T_{amb} = 25 \text{ }^\circ\text{C}$ | - | 1 | 50 | nA |
| C_d | diode capacitance | $f = 1 \text{ MHz}$; $V_R = 0 \text{ V}$; $T_{amb} = 25 \text{ }^\circ\text{C}$ | - | 26 | 31.5 | pF |
| V_{CL} | clamping voltage | $I_{PPM} = 3.8 \text{ A}$; $t_p = 8/20 \text{ } \mu\text{s}$; $T_{amb} = 25 \text{ }^\circ\text{C}$ | [1] | 32 | - | V |
| S_Z | temperature coefficient | $I_Z = 1 \text{ mA}$ | - | 17.3 | - | mV/K |

- [1] Device stressed with 8/20 μs exponential decay waveform according to IEC 61000-4-5.

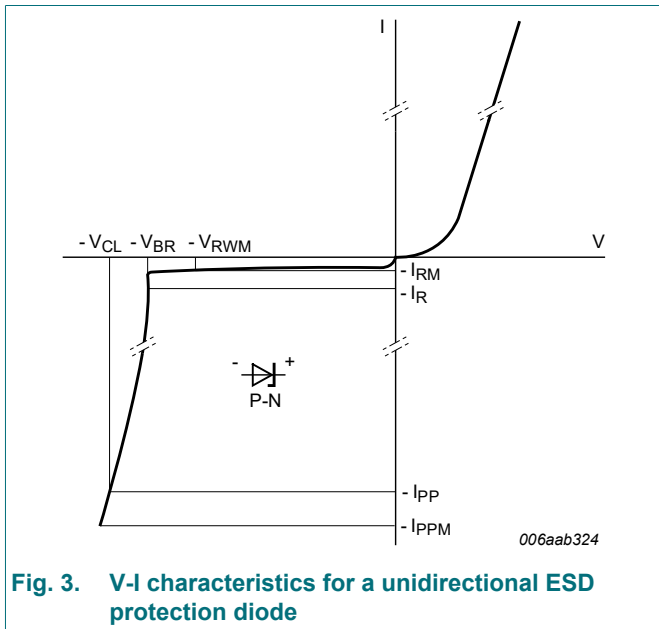


Fig. 3. V-I characteristics for a unidirectional ESD protection diode

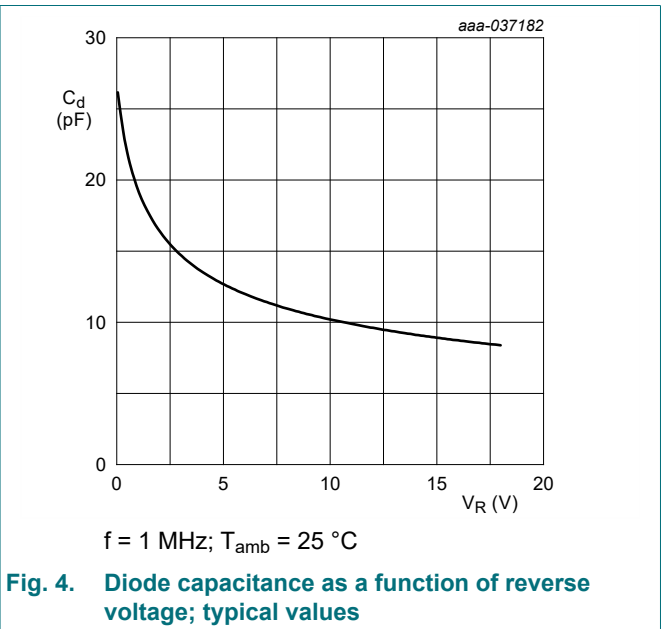
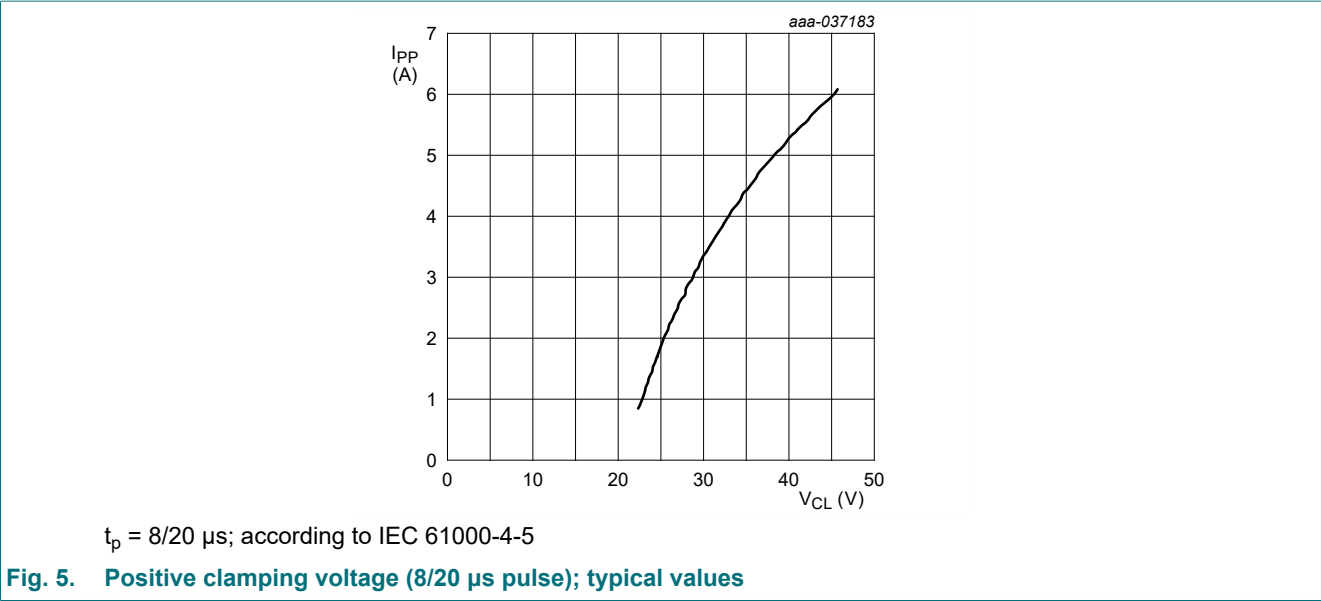


Fig. 4. Diode capacitance as a function of reverse voltage; typical values



11. Application information

The device is designed for the protection of two lines from the damage caused by ESD and surge pulses.

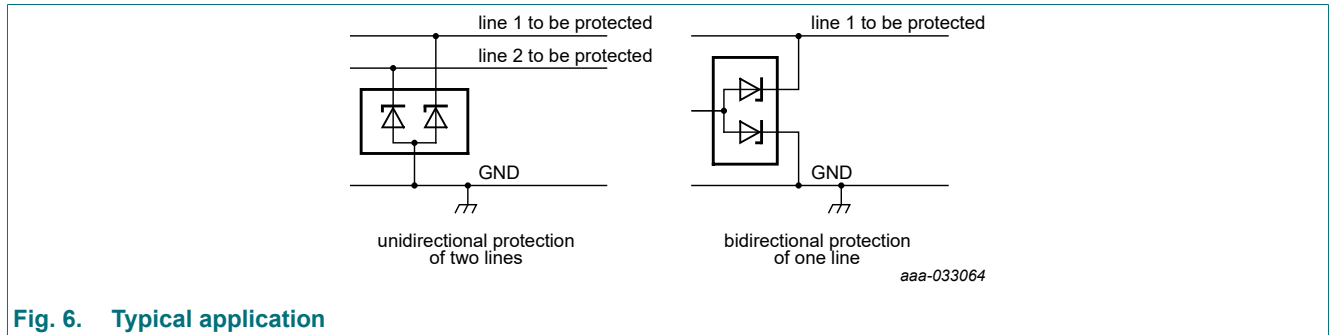


Fig. 6. Typical application

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. Test information

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.

13. Package outline

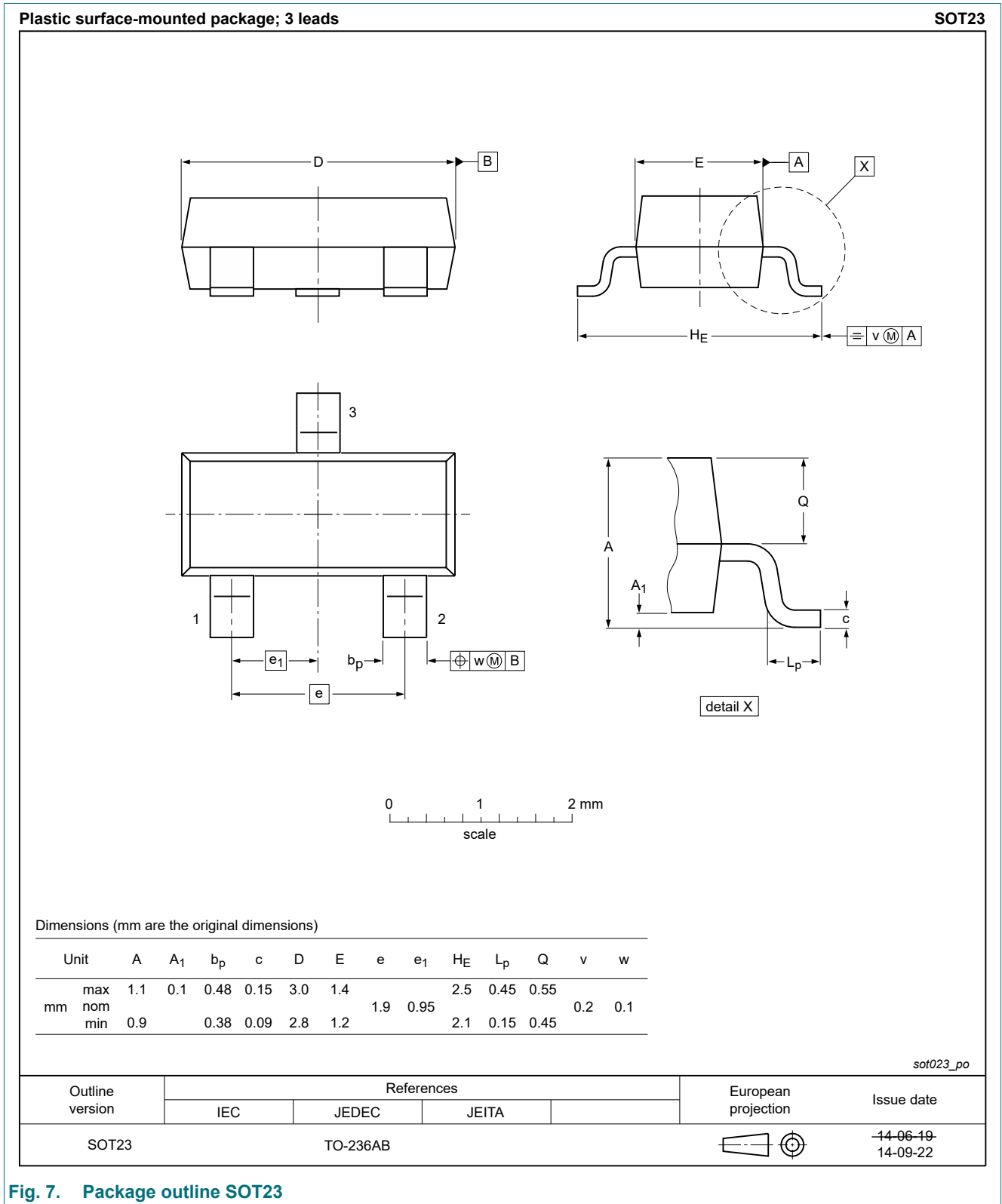


Fig. 7. Package outline SOT23

14. Soldering



Fig. 8. Reflow soldering footprint for SOT23

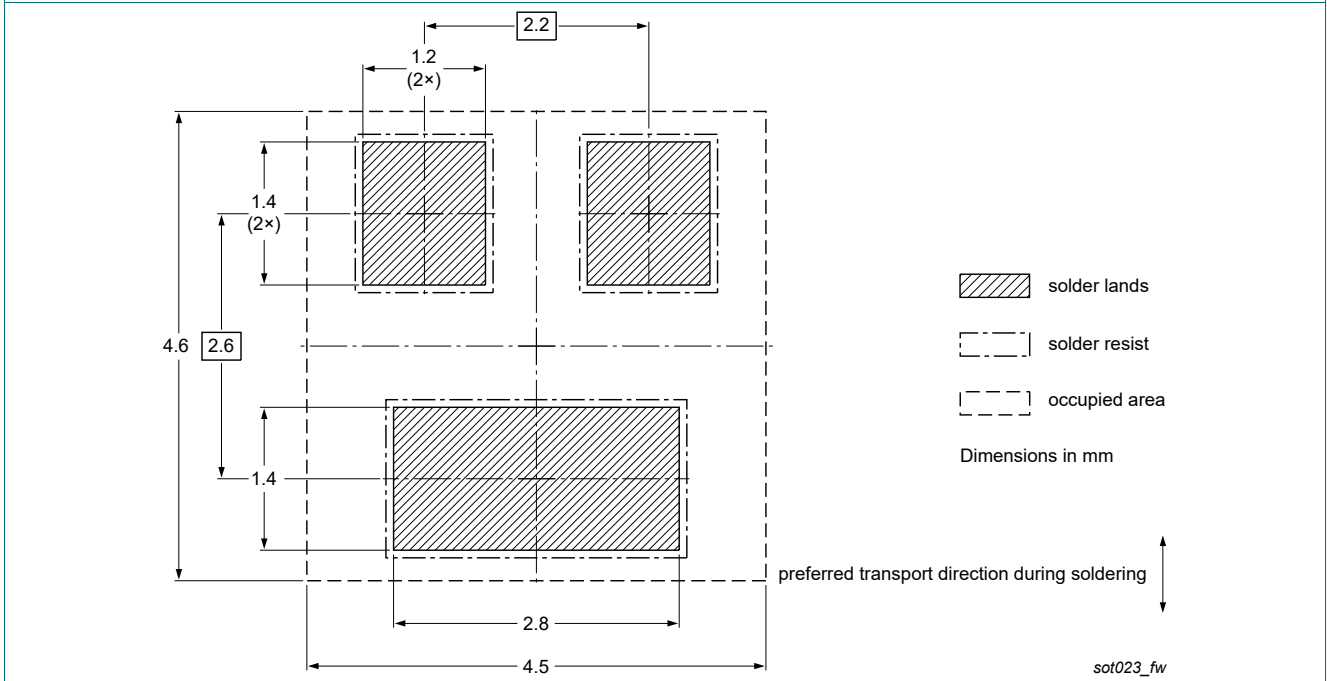


Fig. 9. Wave soldering footprint for SOT23

15. Revision history

Table 8. Revision history

| Data sheet ID | Release date | Data sheet status | Change notice | Supersedes |
|-----------------|--------------|--------------------|---------------|------------|
| MMBZ20VAT-Q v.1 | 20230824 | Product data sheet | - | - |

16. 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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