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: \(C_d \leq 60 \text{ pF}\)
- Rated peak pulse power: \(P_{PPM} = 40 \text{ W}\)
- Ultra low leakage current: \(I_{RM} = 5 \text{ nA}\)
- ESD protection up to 30 kV (contact discharge)
- IEC 61000-4-2; level 4 (ESD)
- IEC 61643-321
- 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>
<thead>
<tr>
<th>Symbol</th>
<th>Parameter</th>
<th>Conditions</th>
<th>Min</th>
<th>Typ</th>
<th>Max</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>(V_{RWM})</td>
<td>reverse standoff voltage</td>
<td>(T_{amb} = 25 ^\circ \text{C})</td>
<td>-</td>
<td>-</td>
<td>22</td>
<td>V</td>
</tr>
<tr>
<td>(C_d)</td>
<td>diode capacitance</td>
<td>(f = 1 \text{ MHz}; V_R = 0 \text{ V}; T_{amb} = 25 ^\circ \text{C})</td>
<td>-</td>
<td>48</td>
<td>60</td>
<td>pF</td>
</tr>
</tbody>
</table>
5. Pinning information

Table 2. Pinning information

<table>
<thead>
<tr>
<th>Pin</th>
<th>Symbol</th>
<th>Description</th>
<th>Simplified outline</th>
<th>Graphic symbol</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>K1</td>
<td>cathode (diode 1)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>K2</td>
<td>cathode (diode 2)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>A</td>
<td>common anode</td>
<td>SOT23</td>
<td></td>
</tr>
</tbody>
</table>

6. Ordering information

Table 3. Ordering information

<table>
<thead>
<tr>
<th>Type number</th>
<th>Package</th>
<th>Name</th>
<th>Description</th>
<th>Version</th>
</tr>
</thead>
<tbody>
<tr>
<td>MMBZ27VAL-Q</td>
<td>SOT23</td>
<td>plastic, surface-mounted package; 3 terminals; 1.9 mm pitch; 2.9 mm x 1.3 mm x 1 mm body</td>
<td>SOT23</td>
<td></td>
</tr>
</tbody>
</table>

7. Marking

Table 4. Marking codes

<table>
<thead>
<tr>
<th>Type number</th>
<th>Marking code[1]</th>
</tr>
</thead>
<tbody>
<tr>
<td>MMBZ27VAL-Q</td>
<td>%H5</td>
</tr>
</tbody>
</table>

[1] % = placeholder for manufacturing site code
8. Limiting values

Table 5. Limiting values

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

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Parameter</th>
<th>Conditions</th>
<th>Min</th>
<th>Max</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>$P_{PPM}$</td>
<td>rated peak pulse power</td>
<td>$I_p = 10/1000 \mu s$</td>
<td>[1] [2]</td>
<td>-</td>
<td>40 W</td>
</tr>
<tr>
<td>$I_{PPM}$</td>
<td>rated peak pulse current</td>
<td></td>
<td>[1] [2]</td>
<td>-</td>
<td>1 A</td>
</tr>
<tr>
<td>$P_{tot}$</td>
<td>total power dissipation</td>
<td>$T_{amb} \leq 25 ^\circ C$</td>
<td>[3]</td>
<td>-</td>
<td>265 mW</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>[4]</td>
<td>-</td>
<td>360 mW</td>
</tr>
<tr>
<td>$T_j$</td>
<td>junction temperature</td>
<td></td>
<td></td>
<td>-</td>
<td>150 °C</td>
</tr>
<tr>
<td>$T_{amb}$</td>
<td>ambient temperature</td>
<td></td>
<td></td>
<td>-55</td>
<td>150 °C</td>
</tr>
<tr>
<td>$T_{stg}$</td>
<td>storage temperature</td>
<td></td>
<td></td>
<td>-65</td>
<td>150 °C</td>
</tr>
</tbody>
</table>

**ESD maximum ratings**

| $V_{ESD}$ | electrostatic discharge voltage | IEC 61000-4-2 (contact discharge); $T_{amb} = 25 ^\circ C$ | [5] [2] | - | 30 kV |
|           |                                | IEC 61000-4-2 (air discharge); $T_{amb} = 25 ^\circ C$ | - | 15 kV |
|           |                                | MIL-STD-883; human body model (HBM); $T_{amb} = 25 ^\circ C$; machine model; $T_{amb} = 25 ^\circ C$ | - | 8 kV |
|           |                                | | [2] | - | 2 kV |

[1] In accordance with IEC 61643-321 (10/1000 μs current waveform).
[2] Measured from pin 1 or 2 to pin 3.

Fig. 1. 10/1000 μs pulse waveform according to IEC 61643-321

Fig. 2. ESD pulse waveform according to IEC 61000-4-2
9. Thermal characteristics

### Table 6. Thermal characteristics

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Parameter</th>
<th>Conditions</th>
<th>Min</th>
<th>Typ</th>
<th>Max</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>$R_{th(j-a)}$</td>
<td>thermal resistance from junction to ambient</td>
<td>in free air</td>
<td>[1]</td>
<td>-</td>
<td>460</td>
<td>K/W</td>
</tr>
<tr>
<td>$R_{th(j-sp)}$</td>
<td>thermal resistance from junction to solder point</td>
<td>[3]</td>
<td>-</td>
<td>-</td>
<td>50</td>
<td>K/W</td>
</tr>
</tbody>
</table>

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

10. Characteristics

### Table 7. Characteristics

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Parameter</th>
<th>Conditions</th>
<th>Min</th>
<th>Typ</th>
<th>Max</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>$V_F$</td>
<td>forward voltage</td>
<td>$I_F = 10$ mA; $T_{amb} = 25$ °C</td>
<td>-</td>
<td>-</td>
<td>0.9</td>
<td>V</td>
</tr>
<tr>
<td>$V_{RWM}$</td>
<td>reverse standoff voltage</td>
<td>$T_{amb} = 25$ °C</td>
<td>-</td>
<td>-</td>
<td>22</td>
<td>V</td>
</tr>
<tr>
<td>$V_{BR}$</td>
<td>breakdown voltage</td>
<td>$I_R = 1$ mA; $T_{amb} = 25$ °C</td>
<td>25.65</td>
<td>27</td>
<td>28.35</td>
<td>V</td>
</tr>
<tr>
<td>$I_{RM}$</td>
<td>reverse leakage current</td>
<td>$V_{RWM} = 22$ V; $T_{amb} = 25$ °C</td>
<td>-</td>
<td>0.1</td>
<td>5</td>
<td>nA</td>
</tr>
<tr>
<td>$C_d$</td>
<td>diode capacitance</td>
<td>$f = 1$ MHz; $V_R = 0$ V; $T_{amb} = 25$ °C</td>
<td>-</td>
<td>48</td>
<td>60</td>
<td>pF</td>
</tr>
<tr>
<td>$V_{CL}$</td>
<td>clamping voltage</td>
<td>$I_{PPM} = 1$ A; $T_{amb} = 25$ °C</td>
<td>[1]</td>
<td>[2]</td>
<td>40</td>
<td>V</td>
</tr>
</tbody>
</table>

[1] In accordance with IEC 61643-321 (10/1000 μs current waveform).
[2] Measured from pin 1 or 2 to pin 3.

Fig. 3. Rated peak pulse power as a function of exponential pulse duration (rectangular waveform); typical values

Fig. 4. Relative variation of rated peak pulse power as a function of junction temperature; typical values
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

Fig. 7. Diode capacitance as a function of reverse voltage; typical values

Fig. 8. Reverse leakage current as a function of ambient temperature; typical values
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.

![Diagram showing ESD protection diode connections for bidirectional and unidirectional protection of data lines.]

**Fig. 9. 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. 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

Plastic surface-mounted package; 3 leads

Dimensions (mm are the original dimensions)

<table>
<thead>
<tr>
<th>Unit</th>
<th>A</th>
<th>A1</th>
<th>b_p</th>
<th>c</th>
<th>D</th>
<th>E</th>
<th>e1</th>
<th>H_E</th>
<th>L_p</th>
<th>Q</th>
<th>V</th>
<th>W</th>
</tr>
</thead>
<tbody>
<tr>
<td>mm</td>
<td>max</td>
<td>1.1</td>
<td>0.1</td>
<td>0.48</td>
<td>0.15</td>
<td>3.0</td>
<td>1.4</td>
<td>0.95</td>
<td>2.5</td>
<td>0.45</td>
<td>0.55</td>
<td></td>
</tr>
<tr>
<td>min</td>
<td>0.9</td>
<td>0.38</td>
<td>0.08</td>
<td>2.8</td>
<td>1.2</td>
<td></td>
<td>1.9</td>
<td>2.1</td>
<td></td>
<td>0.15</td>
<td>0.45</td>
<td>0.2</td>
</tr>
</tbody>
</table>

Fig. 10. Package outline SOT23
14. Soldering

Fig. 11. Reflow soldering footprint for SOT23

Fig. 12. Wave soldering footprint for SOT23
# 15. Revision history

<table>
<thead>
<tr>
<th>Data sheet ID</th>
<th>Release date</th>
<th>Data sheet status</th>
<th>Change notice</th>
<th>Supersedes</th>
</tr>
</thead>
<tbody>
<tr>
<td>MMBZ27VAL-Q v.1</td>
<td>20220613</td>
<td>Product data sheet</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>
16. Legal information

Data sheet status

<table>
<thead>
<tr>
<th>Document status</th>
<th>Product status</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Draft[1][2]</td>
<td>Preliminary</td>
<td>This document contains data from the preliminary specification.</td>
</tr>
<tr>
<td>Objective [short] data sheet</td>
<td>Qualification</td>
<td>This document contains data from the objective specification for product development.</td>
</tr>
<tr>
<td>Preliminary [short] data sheet</td>
<td>Production</td>
<td>This document contains the product specification.</td>
</tr>
</tbody>
</table>

[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".
[3] The product status of device(s) described in this document may have changed since this document was published and may differ in case of multiple devices. The latest product status information is available on the internet at https://www.nexperia.com.

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