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: $I_{PPM} = 14 \text{ A (8/20 \mu s)}/I_{PPM} = 2.54 \text{ A (10/1000 \mu s)}$
- 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>
<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>$T_j = 25 \text{ °C}$</td>
<td>-</td>
<td>-</td>
<td>13</td>
<td>V</td>
</tr>
<tr>
<td>$I_{PPM}$</td>
<td>rated peak pulse current</td>
<td>$t_p = 10/1000 \mu s$</td>
<td>[1] [2]</td>
<td>-</td>
<td>1.9</td>
<td>A</td>
</tr>
<tr>
<td>$V_{CL}$</td>
<td>clamping voltage</td>
<td>$I_{PP} = 1.7 \text{ A}; t_p = 10/1000 \mu s; T_j = 25 \text{ °C}$</td>
<td>[1] [2]</td>
<td>19.5</td>
<td>23</td>
<td>V</td>
</tr>
</tbody>
</table>

[2] Measured from pin 1 or 2 to pin 3.
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</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>K2</td>
<td>cathode</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>A</td>
<td>common anode</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

6. Ordering information

Table 3. Ordering information

<table>
<thead>
<tr>
<th>Type number</th>
<th>Package</th>
<th>Description</th>
<th>Version</th>
</tr>
</thead>
<tbody>
<tr>
<td>MMBZ16VAL</td>
<td>TO-236AB</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>
</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>MMBZ16VAL</td>
<td>%H7</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Table 5. Limiting values</th>
</tr>
</thead>
<tbody>
<tr>
<td>In accordance with the Absolute Maximum Rating System (IEC 60134)</td>
</tr>
</tbody>
</table>

<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>$t_p = 8/20 \mu s$</td>
<td>[1]</td>
<td>-</td>
<td>300 W</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$t_p = 10/1000 \mu s$</td>
<td>[3]</td>
<td>-</td>
<td>45 W</td>
</tr>
<tr>
<td>$I_{PPM}$</td>
<td>rated peak pulse current</td>
<td>$t_p = 8/20 \mu s$</td>
<td>[1]</td>
<td>-</td>
<td>11 A</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$t_p = 10/1000 \mu s$</td>
<td>[3]</td>
<td>-</td>
<td>1.9 A</td>
</tr>
<tr>
<td>$T_j$</td>
<td>junction temperature</td>
<td>-</td>
<td>-</td>
<td>150 °C</td>
<td></td>
</tr>
<tr>
<td>$T_{amb}$</td>
<td>ambient temperature</td>
<td>-55</td>
<td>150 °C</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$T_{stg}$</td>
<td>storage temperature</td>
<td>-65</td>
<td>150 °C</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>ESD maximum ratings</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$V_{ESD}$</td>
<td>electrostatic discharge voltage</td>
<td>IEC 61000-4-2; contact discharge</td>
<td>[4]</td>
<td>-</td>
<td>30 kV</td>
</tr>
<tr>
<td></td>
<td></td>
<td>IEC 61000-4-2; air discharge</td>
<td>[4]</td>
<td>-</td>
<td>30 kV</td>
</tr>
</tbody>
</table>

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

---

**Fig. 1.** 8/20 µs pulse waveform according to IEC 61000-4-5

**Fig. 2.** ESD pulse waveform according to IEC 61000-4-2
9. Characteristics

Table 6. 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>$V_{RWM}$</td>
<td>reverse standoff voltage</td>
<td>$T_j = 25 , ^\circ C$</td>
<td>-</td>
<td>-</td>
<td>13</td>
<td>V</td>
</tr>
<tr>
<td>$V_{BR}$</td>
<td>breakdown voltage</td>
<td>$I_R = 1 , mA; T_j = 25 , ^\circ C$</td>
<td>15.2</td>
<td>16</td>
<td>16.8</td>
<td>V</td>
</tr>
<tr>
<td>$I_{RM}$</td>
<td>reverse leakage current</td>
<td>$V_{RWM} = 13 , V; T_j = 25 , ^\circ C$</td>
<td>-</td>
<td>0.1</td>
<td>5</td>
<td>nA</td>
</tr>
<tr>
<td>$C_d$</td>
<td>diode capacitance</td>
<td>$f = 1 , MHz; V_R = 0 , V; T_j = 25 , ^\circ C$</td>
<td>-</td>
<td>76</td>
<td>95</td>
<td>pF</td>
</tr>
<tr>
<td>$V_{CL}$</td>
<td>clamping voltage</td>
<td>$I_{PP} = 11 , A; t_p = 8/20 , \mu s; T_j = 25 , ^\circ C$</td>
<td>23</td>
<td>28</td>
<td></td>
<td>V</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$I_{PP} = 1.7 , A; t_p = 10/1000 , \mu s; T_j = 25 , ^\circ C$</td>
<td>19.5</td>
<td>23</td>
<td></td>
<td>V</td>
</tr>
</tbody>
</table>

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

Fig. 3. 10/1000 µs pulse waveform according to IEC 61643-321
### High surge current unidirectional double ESD protection diodes

#### 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
High surge current unidirectional double ESD protection diodes

Fig. 8. Positive clamping voltage (8/20 μs pulse); typical values

Fig. 9. Negative clamping voltage (8/20 μs pulse); typical values

Fig. 10. Positive clamping voltage (10/1000 μs pulse); typical values

Fig. 11. Negative clamping voltage (10/1000 μs pulse); typical values
High surge current unidirectional double ESD protection diodes

**ESD TESTER**

- **Rd**
- **Cs**

IEC 61000-4-2 ed.2

**DUT (DEVICE UNDER TEST)**

RG 223/U 50 Ω coax

40 dB ATTENUATOR

50 Ω

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

Undclamped +8 kV ESD pulse waveform (IEC 61000-4-2 network)

Undclamped -8 kV ESD pulse waveform (IEC 61000-4-2 network)

**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.

![Application diagram](image)

Fig. 15. Application diagram

11. Package outline

![Package outline TO-236AB (SOT23)](image)

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

<table>
<thead>
<tr>
<th>Data sheet ID</th>
<th>Release date</th>
<th>Data sheet status</th>
<th>Change notice</th>
<th>Supersedes</th>
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<tr>
<td>MMBZ16VAL v.1</td>
<td>20171106</td>
<td>Product data sheet</td>
<td>-</td>
<td>-</td>
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</table>
14. Legal information

Data sheet status

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

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For sales office addresses, please send an email to: salesaddresses@nexperia.com
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