

# PRTR5V0U2AX

Ultra low capacitance double rail-to-rail ESD protection diode

Rev. 3 — 15 May 2012

Product data sheet

## 1. Product profile

### 1.1 General description

Ultra low capacitance double rail-to-rail ElectroStatic Discharge (ESD) protection diode in a small SOT143B Surface-Mounted Device (SMD) plastic package.

The device is designed to protect two high-speed data lines or high-frequency signal lines from the damage caused by ESD and other transients.

PRTR5V0U2AX integrates two ultra low capacitance rail-to-rail diodes and one additional ESD protection diode to ensure signal line protection even if no supply voltage is available.

### 1.2 Features and benefits

- ESD protection of two high-speed data lines or high-frequency signal lines
- Ultra low input/output to ground capacitance:  $C_{(I/O-GND)} = 1.8$  pF
- ESD protection up to 12 kV
- IEC 61000-4-2, level 4 (ESD)
- Very low clamping voltage due to an integrated additional ESD protection diode
- Very low reverse current
- AEC-Q101 qualified
- Small SMD plastic package

### 1.3 Applications

- USB 2.0 ports
- Digital Video Interface (DVI)
- High-Definition Multimedia Interface (HDMI)
- Mobile phones
- Digital cameras
- WAN/LAN systems
- PC, notebooks, printers and other PC peripherals

### 1.4 Quick reference data

Table 1. Quick reference data

| Symbol             | Parameter                          | Conditions                            | Min                   | Typ | Max | Unit |
|--------------------|------------------------------------|---------------------------------------|-----------------------|-----|-----|------|
| <b>Per channel</b> |                                    |                                       |                       |     |     |      |
| $C_{(I/O-GND)}$    | input/output to ground capacitance | $f = 1$ MHz;<br>$V_{(I/O-GND)} = 0$ V | <a href="#">[1]</a> - | 1.8 | -   | pF   |



Table 1. Quick reference data ...continued

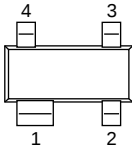
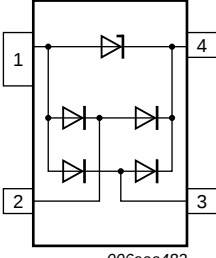
| Symbol             | Parameter                        | Conditions                                   | Min   | Typ | Max | Unit |
|--------------------|----------------------------------|----------------------------------------------|-------|-----|-----|------|
| <b>Zener diode</b> |                                  |                                              |       |     |     |      |
| $V_{RWM}$          | reverse standoff voltage         |                                              | -     | -   | 5.5 | V    |
| $C_{sup}$          | supply pin to ground capacitance | $f = 1\text{ MHz};$<br>$V_{CC} = 0\text{ V}$ | [2] - | 16  | -   | pF   |

[1] Measured from pin 2 and 3 to ground.

[2] Measured from pin 4 to ground.

## 2. Pinning information

Table 2. Pinning

| Pin | Symbol   | Description    | Simplified outline                                                                 | Graphic symbol                                                                       |
|-----|----------|----------------|------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|
| 1   | GND      | ground         |  |  |
| 2   | I/O 1    | input/output 1 |                                                                                    |                                                                                      |
| 3   | I/O 2    | input/output 2 |                                                                                    |                                                                                      |
| 4   | $V_{CC}$ | supply voltage |                                                                                    |                                                                                      |

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## 3. Ordering information

Table 3. Ordering information

| Type number | Package |                                          |         |
|-------------|---------|------------------------------------------|---------|
|             | Name    | Description                              | Version |
| PRTR5V0U2AX | -       | plastic surface-mounted package; 4 leads | SOT143B |

## 4. Marking

Table 4. Marking codes

| Type number | Marking code <sup>[1]</sup> |
|-------------|-----------------------------|
| PRTR5V0U2AX | *AE                         |

[1] \* = placeholder for manufacturing site code.

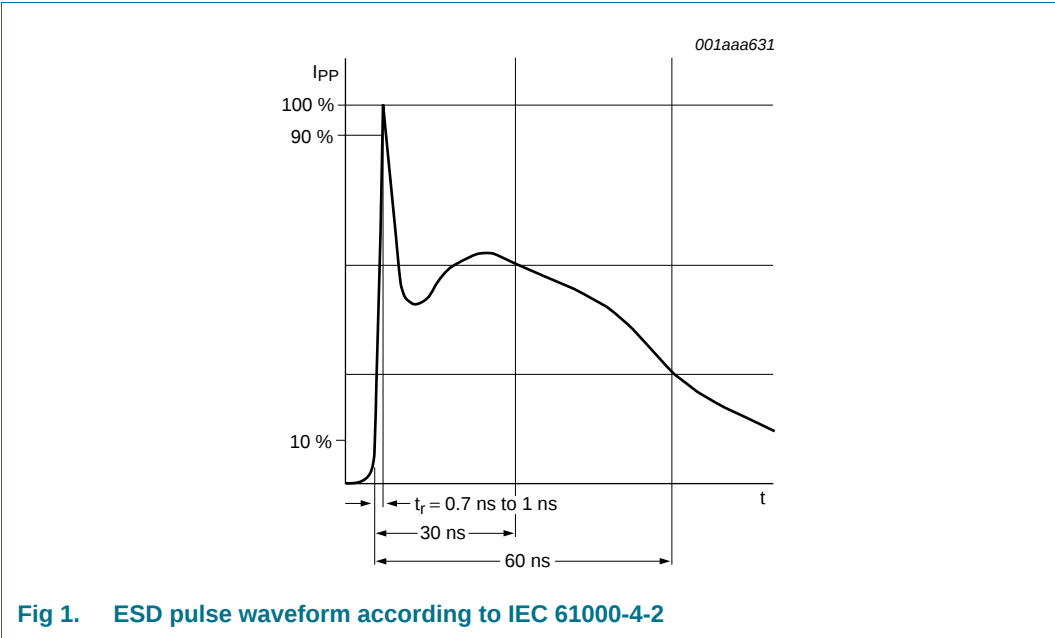
5. Limiting values

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

| Symbol           | Parameter           | Conditions | Min | Max  | Unit |
|------------------|---------------------|------------|-----|------|------|
| T <sub>amb</sub> | ambient temperature |            | −40 | +85  | °C   |
| T <sub>stg</sub> | storage temperature |            | −55 | +125 | °C   |

Table 6. ESD standards compliance

| Standard                     | Conditions        |
|------------------------------|-------------------|
| IEC 61000-4-2; level 4 (ESD) | > 12 kV (contact) |

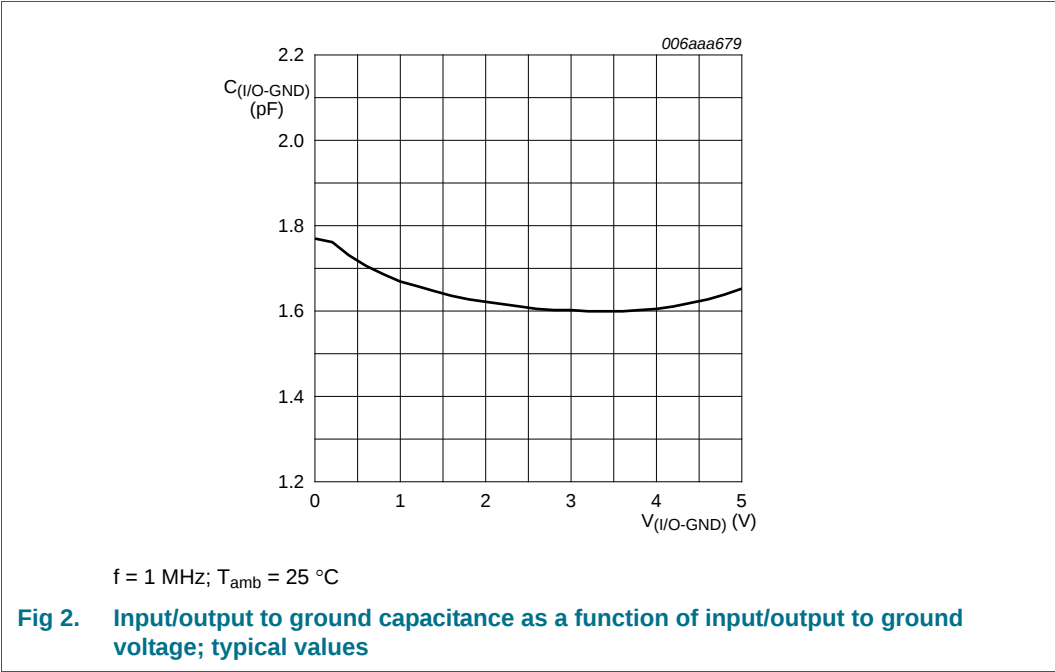


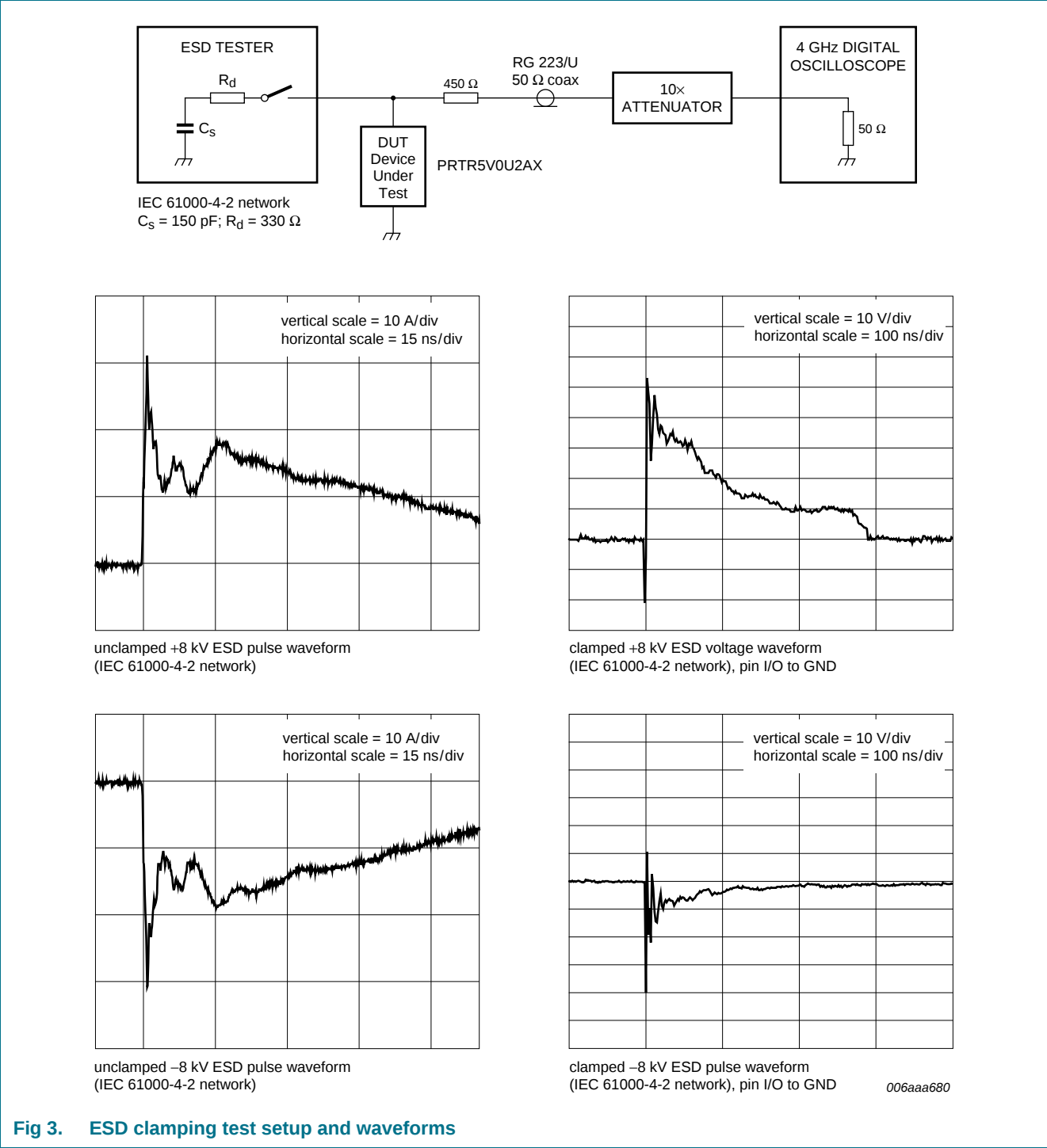
6. Characteristics

Table 7. Characteristics  
*T<sub>amb</sub> = 25 °C unless otherwise specified.*

| Symbol                 | Parameter                          | Conditions                                 | Min   | Typ | Max | Unit |
|------------------------|------------------------------------|--------------------------------------------|-------|-----|-----|------|
| Per channel            |                                    |                                            |       |     |     |      |
| I <sub>R</sub>         | reverse current                    | V <sub>R</sub> = 3 V                       | [1] - | < 1 | 100 | nA   |
| C <sub>(I/O-GND)</sub> | input/output to ground capacitance | f = 1 MHz;<br>V <sub>(I/O-GND)</sub> = 0 V | [3] - | 1.8 | -   | pF   |
| V <sub>F</sub>         | forward voltage                    | I <sub>F</sub> = 1 mA                      | -     | 0.7 | -   | V    |
| Zener diode            |                                    |                                            |       |     |     |      |
| V <sub>RWM</sub>       | reverse standoff voltage           |                                            | -     | -   | 5.5 | V    |
| V <sub>BR</sub>        | breakdown voltage                  |                                            | [2] 6 | -   | 9   | V    |
| C <sub>sup</sub>       | supply pin to ground capacitance   | f = 1 MHz;<br>V <sub>CC</sub> = 0 V        | [2] - | 16  | -   | pF   |

- [1] Measured from pin 2, 3 and 4 to ground  
[2] Measured from pin 4 to ground  
[3] Measured from pin 2 and 3 to ground





## 7. Application information

Handling data rates up to 480 Mbit/s, USB 2.0 interfaces require ESD protection devices with an extremely low line capacitance in order to avoid signal distortion.

With a capacitance of only 1.8 pF, the NXP PRTR5V0U2AX offers IEC 61000-4-2, level 4 compliant ESD protection.

The PRTR5V0U2AX integrates two ultra-low capacitance rail-to-rail ESD protection diodes and an additional ESD protection diode in a small 4-lead SOT143B package.

The additional ESD protection diode connected between ground and  $V_{CC}$  prevents charging of the supply.

To achieve the maximum ESD protection level, no additional external capacitors are required.

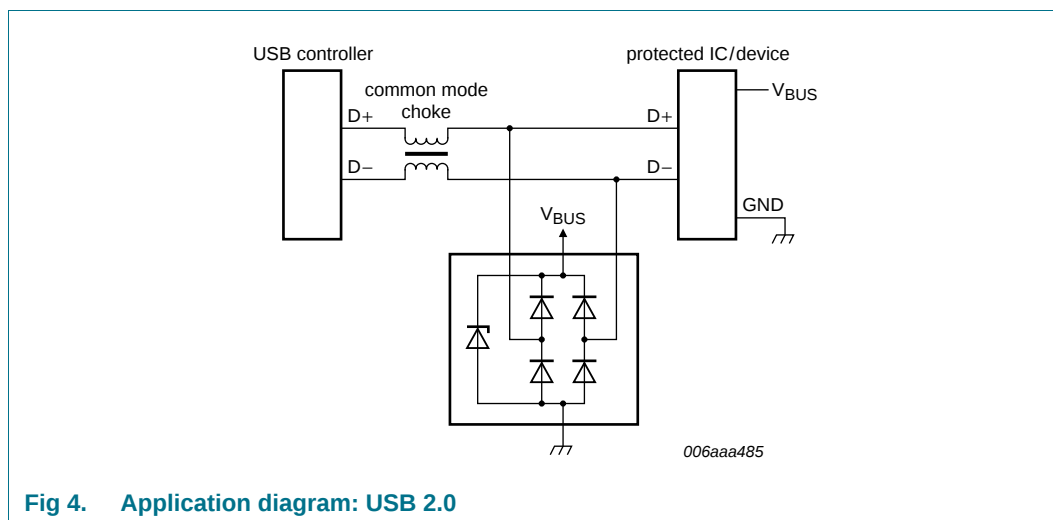


Fig 4. Application diagram: USB 2.0

### 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:

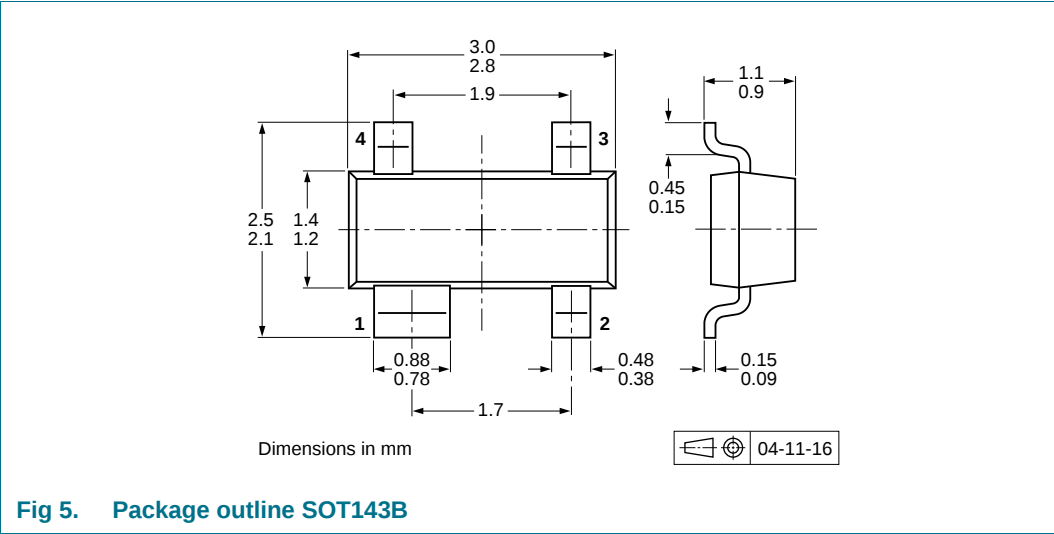
1. Place the device as close to the input terminal or connector as possible.
2. Minimize the path length between the device and the protected line.
3. Keep parallel signal paths to a minimum.
4. Avoid running protected conductors in parallel with unprotected conductors.
5. Minimize all Printed-Circuit 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.

8. Test information

8.1 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.

9. Package outline



10. Packing information

Table 8. Packing methods  
The indicated -xxx are the last three digits of the 12NC ordering code.<sup>[1]</sup>

| Type number | Package | Description                    | Packing quantity |       |
|-------------|---------|--------------------------------|------------------|-------|
|             |         |                                | 3000             | 10000 |
| PRTR5V0U2AX | SOT143B | 4 mm pitch, 8 mm tape and reel | -215             | -235  |

[1] For further information and the availability of packing methods, see [Section 14](#).



## 12. Revision history

**Table 9.** Revision history

| Document ID     | Release date                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Data sheet status  | Change notice | Supersedes      |
|-----------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|---------------|-----------------|
| PRTR5V0U2AX v.3 | 20120515                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Product data sheet | -             | PRTR5V0U2AX v.2 |
| Modifications:  | <ul style="list-style-type: none"><li>• <a href="#">Section 1 "Product profile"</a>: editorial update</li><li>• <a href="#">Section 4 "Marking"</a>: updated</li><li>• <a href="#">Section 6 "Characteristics"</a>: editorial update; added condition to <math>V_F</math></li><li>• <a href="#">Section 8.1 "Quality information"</a>: added</li><li>• <a href="#">Section 11 "Soldering"</a>: added</li><li>• <a href="#">Section 13 "Legal information"</a>: updated</li></ul> |                    |               |                 |
| PRTR5V0U2AX v.2 | 20061221                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Product data sheet | -             | PRTR5V0U2AX v.1 |
| PRTR5V0U2AX v.1 | 20060522                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Product data sheet | -             | -               |

## 13. Legal information

### 13.1 Data sheet status

| Document status <sup>[1][2]</sup> | Product status <sup>[3]</sup> | 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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## 15. Contents

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|           |                                          |           |
|-----------|------------------------------------------|-----------|
| <b>1</b>  | <b>Product profile</b> . . . . .         | <b>1</b>  |
| 1.1       | General description . . . . .            | 1         |
| 1.2       | Features and benefits . . . . .          | 1         |
| 1.3       | Applications . . . . .                   | 1         |
| 1.4       | Quick reference data . . . . .           | 1         |
| <b>2</b>  | <b>Pinning information</b> . . . . .     | <b>2</b>  |
| <b>3</b>  | <b>Ordering information</b> . . . . .    | <b>2</b>  |
| <b>4</b>  | <b>Marking</b> . . . . .                 | <b>2</b>  |
| <b>5</b>  | <b>Limiting values</b> . . . . .         | <b>3</b>  |
| <b>6</b>  | <b>Characteristics</b> . . . . .         | <b>4</b>  |
| <b>7</b>  | <b>Application information</b> . . . . . | <b>6</b>  |
| <b>8</b>  | <b>Test information</b> . . . . .        | <b>7</b>  |
| 8.1       | Quality information . . . . .            | 7         |
| <b>9</b>  | <b>Package outline</b> . . . . .         | <b>7</b>  |
| <b>10</b> | <b>Packing information</b> . . . . .     | <b>7</b>  |
| <b>11</b> | <b>Soldering</b> . . . . .               | <b>8</b>  |
| <b>12</b> | <b>Revision history</b> . . . . .        | <b>9</b>  |
| <b>13</b> | <b>Legal information</b> . . . . .       | <b>10</b> |
| 13.1      | Data sheet status . . . . .              | 10        |
| 13.2      | Definitions . . . . .                    | 10        |
| 13.3      | Disclaimers . . . . .                    | 10        |
| 13.4      | Trademarks . . . . .                     | 11        |
| <b>14</b> | <b>Contact information</b> . . . . .     | <b>11</b> |
| <b>15</b> | <b>Contents</b> . . . . .                | <b>12</b> |

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