# PRTR5V0U2AX

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

**26 April 2024** **Product data sheet**

## 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.

## 2. Features and benefits

- ESD protection of two high-speed data lines or high frequency signal lines
- Ultra low input/output to ground capacitance: $C_{(I/O\text{-}GND)}$ = 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
- Small SMD plastic package

## 3. Applications

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

## 4. Quick reference data

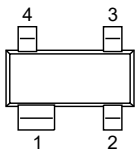
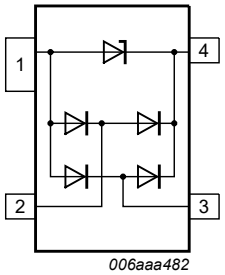
**Table 1. Quick reference data**

| Symbol | Parameter | Conditions | | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|---|
| $V_{RWM}$ | reverse standoff voltage | $T_{amb}$ = 25 °C | | - | - | 5.5 | V |
| $C_{(I/O\text{-}GND)}$ | input/output to ground capacitance | f = 1 MHz; $V_{(I/O\text{-}GND)}$ = 0 V; $T_{amb}$ = 25 °C | [1] | - | 1.8 | - | pF |
| $C_{sup}$ | supply pin to ground capacitance | f = 1 MHz; $V_{CC}$ = 0 V; $T_{amb}$ = 25 °C | [2] | - | 16 | - | pF |

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

# 5. Pinning information

**Table 2. Pinning information**

| Pin | Symbol | Description | Simplified outline | Graphic symbol |
|---|---|---|---|---|
| 1 | GND | ground |  SOT143B |  006aaa482 |
| 2 | I/O 1 | input/output 1 | | |
| 3 | I/O 2 | input/output 2 | | |
| 4 | $V_{CC}$ | supply voltage | | |

# 6. Ordering information

**Table 3. Ordering information**

| Type number | Package | | |
|---|---|---|---|
| | Name | Description | Version |
| PRTR5V0U2AX | SOT143B | plastic, surface-mounted package; 4 leads; 1.9 mm pitch; 2.9 mm x 1.3 mm x 1 mm body | SOT143B |

# 7. Marking

**Table 4. Marking codes**

| Type number | Marking code[1] |
|---|---|
| PRTR5V0U2AX | %AE |

[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 |
|---|---|---|---|---|---|---|
| $T_{amb}$ | ambient temperature | | | -40 | 125 | °C |
| $T_{stg}$ | storage temperature | | | -55 | 125 | °C |
| **ESD standards compliance** | | | | | | |
| $V_{ESD}$ | electrostatic discharge voltage | IEC 61000-4-2; level 4 (ESD) | | - | 12 | kV |

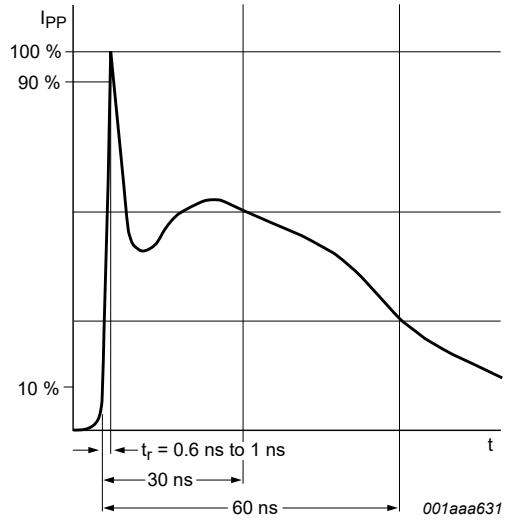


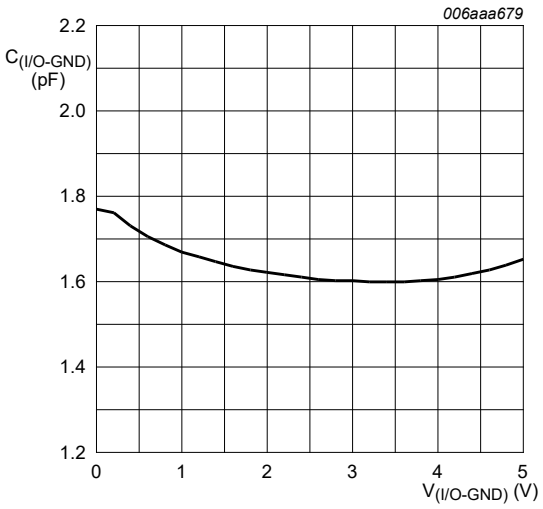

**Fig. 1. ESD pulse waveform according to IEC 61000-4-2**

# 9. Characteristics

**Table 6. Characteristics**

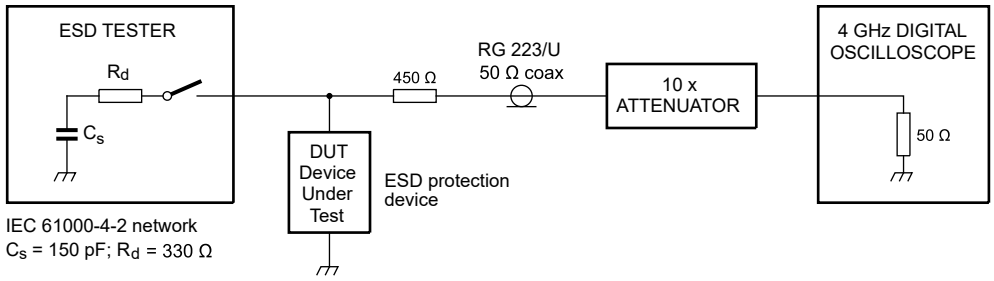
| Symbol | Parameter | Conditions | | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|---|
| $I_R$ | reverse current | $V_R$ = 3 V; $T_{amb}$ = 25 °C | [1] | - | 1 | 100 | nA |
| $C_{(I/O-GND)}$ | input/output to ground capacitance | f = 1 MHz; $V_{(I/O-GND)}$ = 0 V; $T_{amb}$ = 25 °C | [2] | - | 1.8 | - | pF |
| $V_F$ | forward voltage | $I_F$ = 1 mA; $T_{amb}$ = 25 °C | | - | 0.7 | - | V |
| $V_{RWM}$ | reverse standoff voltage | $T_{amb}$ = 25 °C | | - | - | 5.5 | V |
| $V_{BR}$ | breakdown voltage | | [3] | 6 | - | 9 | V |
| $C_{sup}$ | supply pin to ground capacitance | f = 1 MHz; $V_{CC}$ = 0 V; $T_{amb}$ = 25 °C | [3] | - | 16 | - | pF |

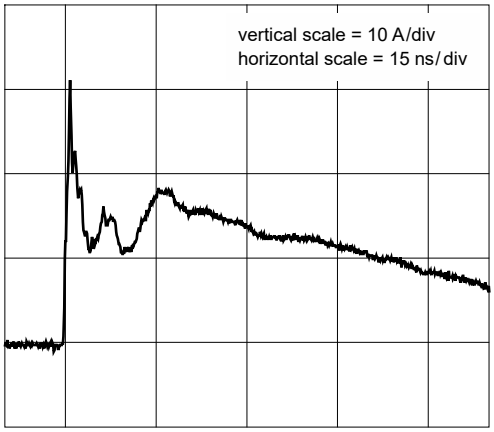
[1] Measured from pin 2, 3 and 4 to ground
[2] Measured from pin 2 and 3 to ground
[3] Measured from pin 4 to ground



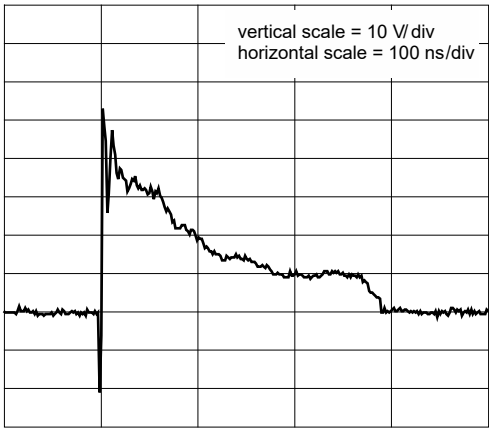

f = 1 MHz; $T_{amb}$ = 25 °C

**Fig. 2. Input/output to ground capacitance as a function of input/output to ground voltage; typical values**

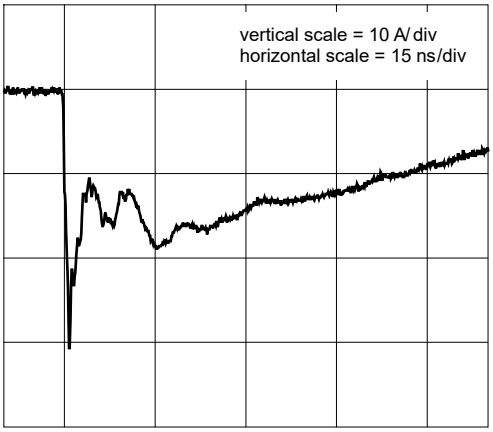


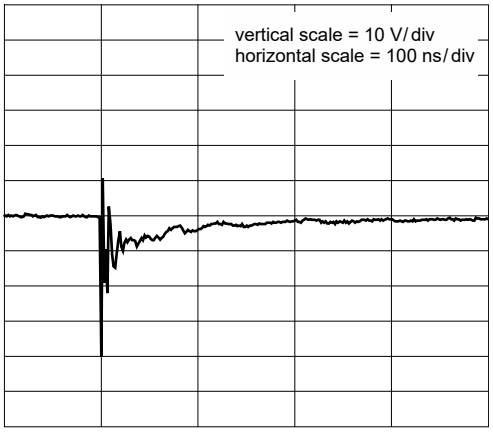

unclamped +8 kV ESD pulse waveform
(IEC 61000-4-2 network)




clamped +8 kV ESD voltage waveform
(IEC 61000-4-2 network), pin I/O to GND




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




clamped -8 kV ESD pulse waveform
(IEC 61000-4-2 network), pin I/O to GND

006aaa680

**Fig. 3. ESD clamping test setup and waveforms**

## 10. 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 device offers IEC 61000-4-2, level 4 compliant ESD protection.

The device 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.

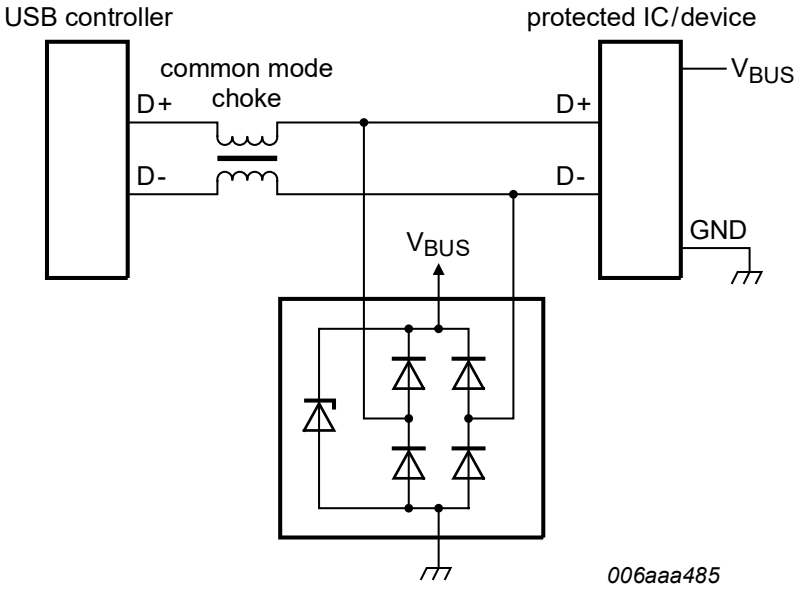



**Fig. 4. Application diagram: USB 2.0**

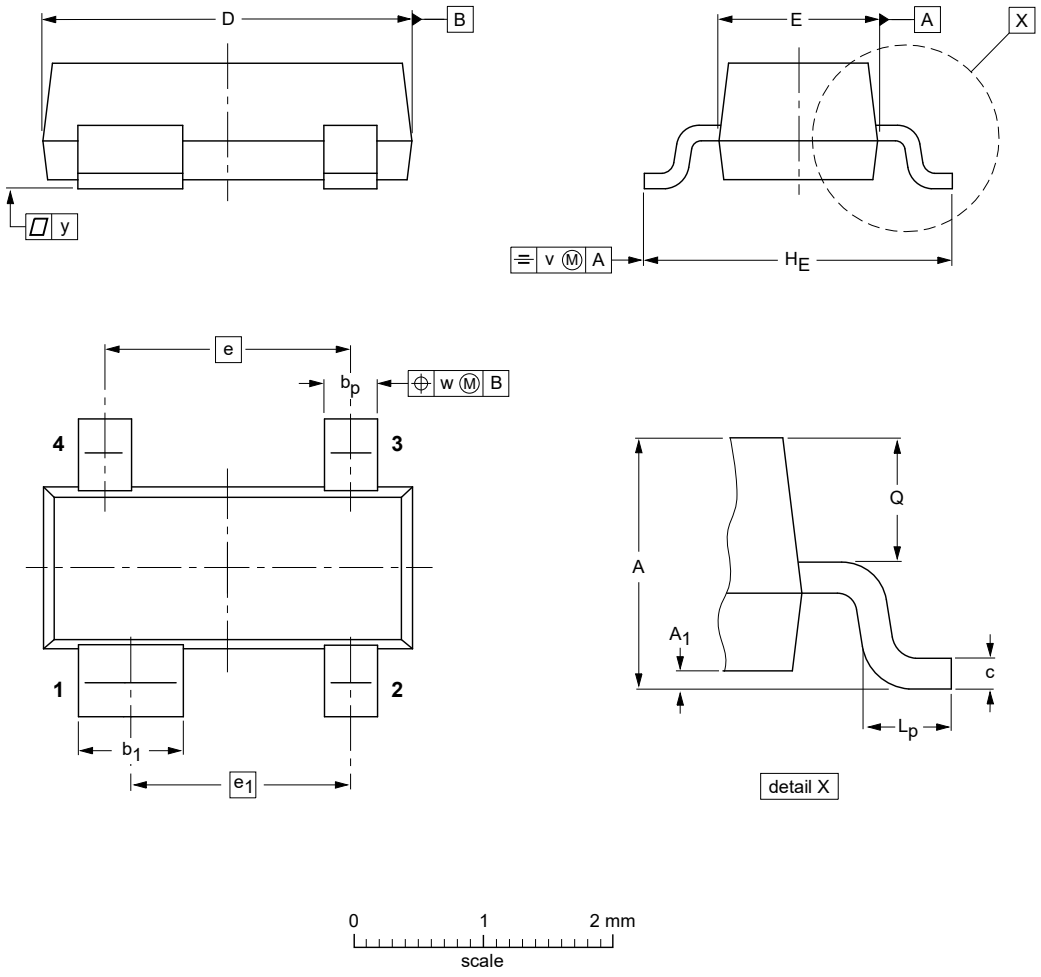
**Circuit board layout and protection device placement**

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. The path length between the device and the protected line should be minimized.
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. Ground planes should be used whenever possible. For multilayer PCBs, use ground vias.

# 11. Package outline

**Plastic surface-mounted package; 4 leads** **SOT143B**




**DIMENSIONS (mm are the original dimensions)**

| UNIT | A | $A_1$ max | $b_p$ | $b_1$ | c | D | E | e | $e_1$ | $H_E$ | $L_p$ | Q | v | w | y |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| mm | 1.1<br>0.9 | 0.1 | 0.48<br>0.38 | 0.88<br>0.78 | 0.15<br>0.09 | 3.0<br>2.8 | 1.4<br>1.2 | 1.9 | 1.7 | 2.5<br>2.1 | 0.45<br>0.15 | 0.55<br>0.45 | 0.2 | 0.1 | 0.1 |

| OUTLINE VERSION | REFERENCES | | | | EUROPEAN PROJECTION | ISSUE DATE |
|---|---|---|---|---|---|---|
| | IEC | JEDEC | JEITA | | | |
| SOT143B | | | | | | ~~04-11-16~~<br>06-03-16 |

**Fig. 5. Package outline SOT143B**

## 12. Soldering

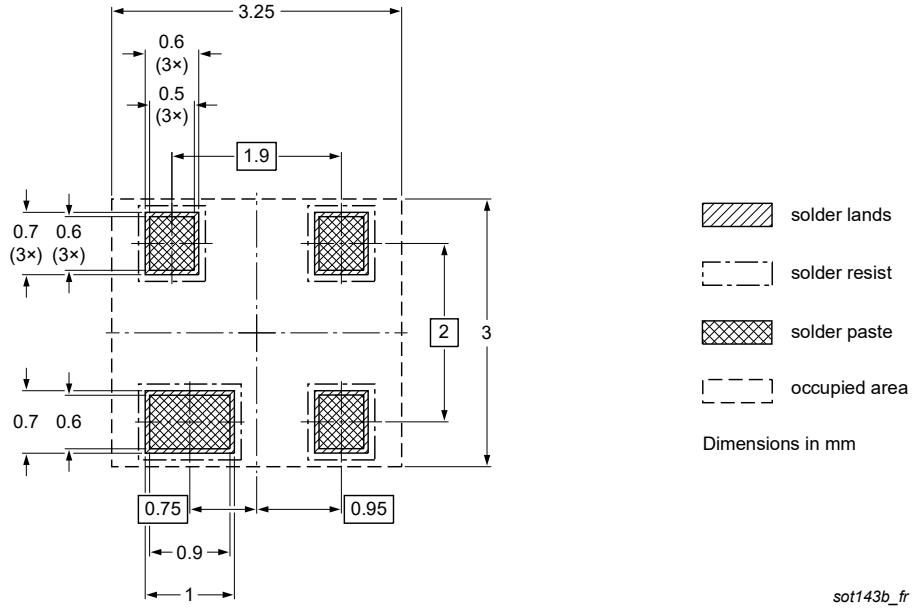



**Fig. 6. Reflow soldering footprint for SOT143B**

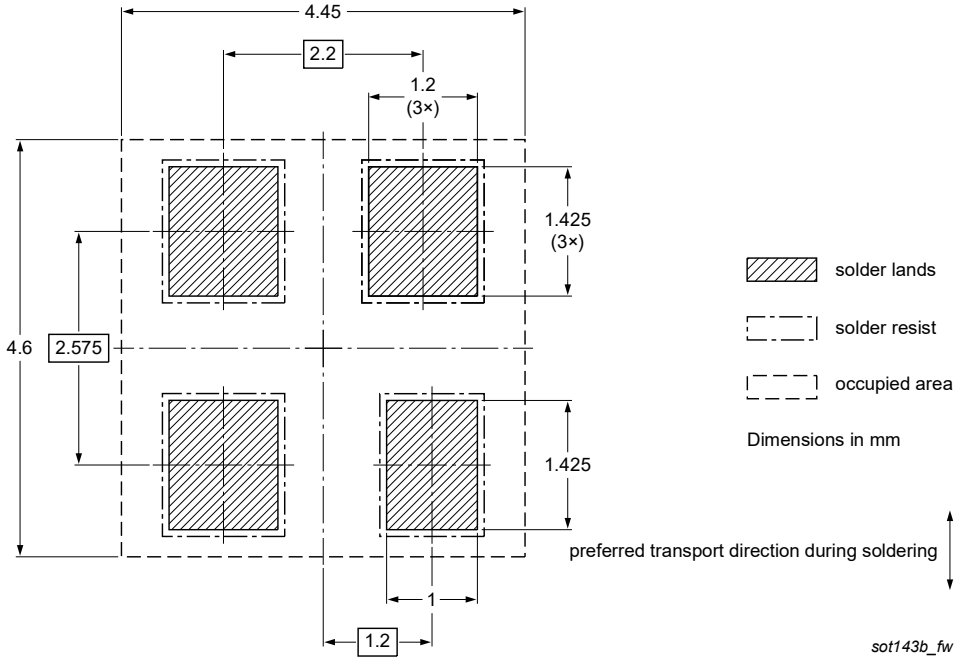



**Fig. 7. Wave soldering footprint for SOT143B**

# 13. Revision history

**Table 7. Revision history**

| Data sheet ID | Release date | Data sheet status | Change notice | Supersedes |
|---|---|---|---|---|
| PRTR5V0U2AX v.5 | 20240426 | Product data sheet | - | PRTR5V0U2AX v.4 |
| Modifications: | • Product changed to non-automotive qualification. Please refer to nexperia.com for automotive (-Q) product alternative(s). | | | |
| PRTR5V0U2AX v.4 | 20170418 | Product data sheet | - | PRTR5V0U2AX v.3 |
| PRTR5V0U2AX v.3 | 20120515 | Product data sheet | - | PRTR5V0U2AX v.2 |
| PRTR5V0U2AX v.2 | 20061221 | Product data sheet | - | PRTR5V0U2AX v.1 |
| PRTR5V0U2AX v.1 | 20060522 | 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. |

[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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