1. General description

This unidirectional ESD protection device is designed to protect high-speed interfaces such as SuperSpeed USB 3.2, HDMI, DisplayPort, external Serial Advanced Technology Attachment (eSATA), Low Voltage Differential Signaling (LVDS), and Gigabit Multimedia Serial Link (GMSL) Serializer/Deserializer (SerDes) against ElectroStatic Discharge (ESD).

The device is encapsulated in a leadless small DFN2510A-10 (SOT1176-2) plastic package and provides ESD protection up to 15 kV exceeding IEC 61000-4-2 level 4 and fulfilling ISO 10605.

2. Features and benefits

- Unidirectional ESD protection for four signal lines
- $V_{RWM} = 3.3$ V device
- Extremely low clamping voltage to protect sensitive I/Os
- Extremely low clamping voltage: 2.8 V for 8 A 100 ns TLP and 4.4 V for 16 A 100 ns TLP
- IEC 61000-4-4 robust up to 36 A into a 50 Ohm termination (1.8 kV)
- IEC 61000-4-5 (surge): $I_{PP} = 8.2$ A peak pulse (average measured)
- Typical line capacitance of only 0.29 pF
- ESD protection up to ±15 kV according to IEC 61000-4-2
- Leadless ultra small DFN2510A-10 (SOT1176-2) surface mount package
- Qualified according to AEC-Q101 and recommended for use in automotive applications

3. Applications

- Infotainment applications: USB 2.0, USB 3.2 and HDMI 2.1
- Automotive A/V monitors, display and cameras
- SerDes: GMSL, APIX, FPD-Link and LVDS

4. Quick reference data

<table>
<thead>
<tr>
<th>Table 1. Quick reference data</th>
<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>$f = 1$ MHz; $V_R = 1.5$ V; $T_{amb} = 25$ °C</td>
<td>-0.5</td>
<td>-</td>
<td>3.3</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>$C_d$</td>
<td>diode capacitance</td>
<td>$f = 1$ MHz; $V_R = 1.5$ V; $T_{amb} = 25$ °C</td>
<td>[1]</td>
<td>0.29</td>
<td>0.34</td>
<td>pF</td>
<td></td>
</tr>
</tbody>
</table>

[1] Measured on pin 1
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>CH1</td>
<td>channel 1 ESD protection</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>CH2</td>
<td>channel 2 ESD protection</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>GND</td>
<td>ground</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>CH3</td>
<td>channel 3 ESD protection</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>CH4</td>
<td>channel 4 ESD protection</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>n.c.</td>
<td>not connected</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>n.c.</td>
<td>not connected</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>GND</td>
<td>ground</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>n.c.</td>
<td>not connected</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>n.c.</td>
<td>not connected</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>Name</th>
<th>Description</th>
<th>Version</th>
</tr>
</thead>
<tbody>
<tr>
<td>PESD4USB3UCTBR-Q</td>
<td>DFN2510A-10</td>
<td>SOT1176-2</td>
<td>plastic, extremely thin small outline package; no leads; 10 terminals; body 1.0 x 2.5 x 0.5 mm</td>
<td></td>
</tr>
</tbody>
</table>

7. Marking

Table 4. Marking codes

<table>
<thead>
<tr>
<th>Type number</th>
<th>Marking code</th>
</tr>
</thead>
<tbody>
<tr>
<td>PESD4USB3UCTBR-Q</td>
<td>QA</td>
</tr>
</tbody>
</table>
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>( V_{RWM} )</td>
<td>reverse standoff voltage</td>
<td></td>
<td>-0.5</td>
<td>3.3</td>
<td>V</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>-6.5</td>
<td>6.5</td>
</tr>
<tr>
<td>( T_{stg} )</td>
<td>storage temperature</td>
<td></td>
<td>-65</td>
<td>150</td>
<td>°C</td>
</tr>
<tr>
<td>( T_{amb} )</td>
<td>ambient temperature</td>
<td></td>
<td>-55</td>
<td>150</td>
<td>°C</td>
</tr>
</tbody>
</table>

ESD maximum ratings

| \( V_{ESD} \) | electrostatic discharge voltage | IEC 61000-4-2; contact discharge | [2] | -15 | 15 | kV |
| | | IEC 61000-4-2; air discharge | [2] | -15 | 15 | kV |
| | | ISO 10605; contact discharge; \( R = 330 \Omega; \) \( C = 150 \text{ pF} \) | [2] | -15 | 15 | kV |
| | | ISO 10605; contact discharge; \( R = 330 \Omega; \) \( C = 330 \text{ pF} \) | [2] | -13 | 13 | kV |

[1] Non-repetitive current pulse 8/20 µs exponentially decaying waveform according to IEC 61000-4-5.


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>
<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_{BR}</td>
<td>breakdown voltage</td>
<td>( I_R = 1 \text{ mA}; \ T_{\text{amb}} = 25 , ^\circ \text{C} )</td>
<td>6</td>
<td>8.5</td>
<td>10</td>
<td>V</td>
</tr>
<tr>
<td>V_{CL}</td>
<td>clamping voltage</td>
<td>( I_{\text{TLP}} = 8 \text{ A}; \ t_p = 100 \text{ ns}; \ T_{\text{amb}} = 25 , ^\circ \text{C} ) [1]</td>
<td>-</td>
<td>2.8</td>
<td>-</td>
<td>V</td>
</tr>
<tr>
<td></td>
<td></td>
<td>( I_{\text{TLP}} = 16 \text{ A}; \ t_p = 100 \text{ ns}; \ T_{\text{amb}} = 25 , ^\circ \text{C} ) [1]</td>
<td>-</td>
<td>4.4</td>
<td>-</td>
<td>V</td>
</tr>
<tr>
<td></td>
<td></td>
<td>( I_{\text{FPM}} = 6.5 \text{ A}; \ t_p = 8/20 , \mu \text{s}; \ T_{\text{amb}} = 25 , ^\circ \text{C} ) [2]</td>
<td>-</td>
<td>2.9</td>
<td>-</td>
<td>V</td>
</tr>
<tr>
<td>I_{RM}</td>
<td>reverse leakage current</td>
<td>( V_{\text{RWM}} = 3.3 \text{ V}; \ T_{\text{amb}} = 25 , ^\circ \text{C} )</td>
<td>-</td>
<td>1</td>
<td>100</td>
<td>nA</td>
</tr>
<tr>
<td>R_{dyh}</td>
<td>dynamic resistance</td>
<td>( I_R = 10 \text{ A}; \ t_p = 100 \text{ ns}; \ T_{\text{amb}} = 25 , ^\circ \text{C} ) [1]</td>
<td>-</td>
<td>0.19</td>
<td>-</td>
<td>Ω</td>
</tr>
<tr>
<td></td>
<td></td>
<td>( I_R = -10 \text{ A}; \ t_p = 100 \text{ ns}; \ T_{\text{amb}} = 25 , ^\circ \text{C} ) [1]</td>
<td>-</td>
<td>0.19</td>
<td>-</td>
<td>Ω</td>
</tr>
<tr>
<td>C_d</td>
<td>diode capacitance</td>
<td>( f = 1 \text{ MHz}; \ V_R = 1.5 \text{ V}; \ T_{\text{amb}} = 25 , ^\circ \text{C} ) [3]</td>
<td>-</td>
<td>0.29</td>
<td>0.34</td>
<td>pF</td>
</tr>
</tbody>
</table>

[1] Non-repetitive current pulse, Transmission Line Pulse (TLP); square pulse; ANSI / ESD STM5.5.1-2008 on pin 2
[2] Device stressed with 8/20 μs exponential decay waveform according to IEC 61000-4-5.
[3] Measured on pin 1
Extremely low capacitance unidirectional ESD protection diode array

Data rate: 10 Gbit/s

Fig. 5. **USB3.2 eye diagram, PCB with device; typical values**

Data rate: 10 Gbit/s

Fig. 6. **USB3.2 eye diagram, PCB without device; typical values**
Fig. 7. HDMI 2.1 12G FRL eye diagram, PCB with device; typical values

Fig. 8. HDMI 2.1 12G FRL eye diagram, PCB without device; typical values
Extremely low capacitance unidirectional ESD protection diode array

Worst cable model (WCM3), 7dB

Fig. 9. HDMI 2.1 12G FRL eye diagram, PCB with device; typical values

Worst cable model (WCM3), 6dB

Fig. 10. HDMI 2.1 12G FRL eye diagram, PCB without device; typical values
Extremely low capacitance unidirectional ESD protection diode array

Fig. 11. Dynamic resistance with positive clamping; typical values
Transmission Line Pulse (TLP); $t_p = 100$ ns; $t_r = 1$ ns; pin 2

Fig. 12. Dynamic resistance with negative clamping; typical values
Transmission Line Pulse (TLP); $t_p = 100$ ns; $t_r = 1$ ns; pin 2

Fig. 13. Dynamic resistance with positive clamping; typical values
Very Fast Transmission Line Pulse (VF-TLP); $t_p = 5$ ns; $t_r = 600$ ps; pin 2

Fig. 14. Dynamic resistance with negative clamping; typical values
Very Fast Transmission Line Pulse (VF-TLP); $t_p = 5$ ns; $t_r = 600$ ps; pin 2
Nexperia

Extremely low capacitance unidirectional ESD protection diode array

Fig. 15. Dynamic resistance with positive clamping; typical values

IEC 61000-4-5; \( t_p = 8/20 \) µs; positive pulse

Fig. 16. Dynamic resistance with negative clamping; typical values

IEC 61000-4-5; \( t_p = 8/20 \) µs; negative pulse
10. Application information

The device is designed to provide high-level ESD protection for high-speed serial data buses such as HDMI, DisplayPort, automotive video-links, eSATA and LVDS data lines.

Note: When designing the PCB, give careful consideration to impedance matching and signal coupling. Do not connect the signal lines to unlimited current sources like, for example, a battery.

Dynamic resistance
The device uses an advanced clamping structure showing a negative dynamic resistance.
This snap-back behavior strongly reduces the clamping voltage to the system behind the ESD protection during an ESD event. Do not connect unlimited DC current sources to the data lines to avoid keeping the ESD protection device in snap-back state after exceeding breakdown voltage (due to an ESD pulse for instance).

11. 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.
12. Package outline

DFN2510A-10: plastic, extremely thin small outline package; no leads; 10 terminals; body 1.0 x 2.5 x 0.5 mm

Fig. 17. Package outline DFN2510A-10 (SOT1176-2)
13. Soldering

Footprint information for reflow soldering of DFN2510A-10 package

- Generic footprint pattern
- Refer to the package outline drawing for actual layout
- Recommended stencil thickness: 0.1 mm

<table>
<thead>
<tr>
<th>Dimensions in mm</th>
<th>P</th>
<th>A_y</th>
<th>B_y</th>
<th>C</th>
<th>D</th>
<th>H_x</th>
<th>H_y</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.5</td>
<td>1.25</td>
<td>0.3</td>
<td>0.475</td>
<td>0.2</td>
<td>2.45</td>
<td>1.5</td>
</tr>
</tbody>
</table>

Issue date: 21-07-05

Fig. 18. Reflow soldering footprint for DFN2510A-10 (SOT1176-2)
14. 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>
</tr>
</thead>
<tbody>
<tr>
<td>PESD4USB3UCTBR-Q v.1</td>
<td>20231026</td>
<td>Product data sheet</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

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15. Legal information

Data sheet status

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<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>

[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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Date of release: 26 October 2023