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 DFN2510D-10 (SOT1165D) 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

- System-level ESD protection for USB 2.0 and SuperSpeed USB 3.2, HDMI, DisplayPort, eSATA and LVDS
- \( V_{RWM} = 5 \) V device
- Typical line capacitance of only 0.4 pF
- Outstanding system protection: extremely deep snap-back combined with dynamic resistance of 0.2 \( \Omega \)
- ESD protection level up to \( \pm 15 \) kV (IEC 61000-4-2, level 4; ISO 10605)
- Matched 0.5 mm trace spacing and side-wettable flanks (SWF) for AOI
- Design-friendly 'pass-through' signal routing
- Qualified according to AEC-Q101 and recommended for use in automotive applications

3. Applications

- Infotainment systems: 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>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></td>
<td>-</td>
<td>-</td>
<td>5</td>
<td>V</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>[1]</td>
<td>0.4</td>
<td>0.5</td>
<td>pF</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>PESD4USB5UBTTS-Q</td>
<td>DFN2510D-10</td>
<td>plastic, leadless thin small outline package with Side-Wettable Flanks (SWF); 10 terminals; 0.5 mm pitch; 2.5 mm x 1 mm x 0.75 mm body</td>
<td>SOT1165D</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>PESD4USB5UBTTS-Q</td>
<td>Q2B</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&lt;sub&gt;RWM&lt;/sub&gt;</td>
<td>reverse standoff voltage</td>
<td>-</td>
<td>5</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>I&lt;sub&gt;PPM&lt;/sub&gt;</td>
<td>rated peak pulse current</td>
<td>t&lt;sub&gt;p&lt;/sub&gt; = 8/20 µs</td>
<td>[1] -6.5</td>
<td>6.5</td>
<td>A</td>
</tr>
<tr>
<td>T&lt;sub&gt;stg&lt;/sub&gt;</td>
<td>storage temperature</td>
<td>-65</td>
<td>150</td>
<td>°C</td>
<td></td>
</tr>
<tr>
<td>T&lt;sub&gt;amb&lt;/sub&gt;</td>
<td>ambient temperature</td>
<td>-55</td>
<td>150</td>
<td>°C</td>
<td></td>
</tr>
</tbody>
</table>

ESD maximum ratings

| V<sub>ESD</sub> | electrostatic discharge voltage | IEC 61000-4-2; contact discharge | [2] | -15 | 15 kV |
| ISO 10605; contact discharge; R = 330 Ω; C = 150 pF | [2] | -15 | 15 kV |
| ISO 10605; contact discharge; R = 330 Ω; C = 330 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 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>$V_{BR}$</td>
<td>breakdown voltage</td>
<td>$I_R = 1 \text{ mA}; \ T_{amb} = 25 ^\circ \text{C}$</td>
<td>5.5</td>
<td>9</td>
<td>11.5</td>
<td>V</td>
</tr>
<tr>
<td>$V_{CL}$</td>
<td>clamping voltage</td>
<td>$I_{TLP} = 8 \text{ A}; \ t_p = 100 \text{ ns}; \ T_{amb} = 25 ^\circ \text{C}$</td>
<td>[1]</td>
<td>2.8</td>
<td>-</td>
<td>V</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$I_{TLP} = 16 \text{ A}; \ t_p = 100 \text{ ns}; \ T_{amb} = 25 ^\circ \text{C}$</td>
<td>[1]</td>
<td>4.2</td>
<td>-</td>
<td>V</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$I_{PPM} = 6.5 \text{ A}; \ t_p = 8/20 \mu \text{s}; \ T_{amb} = 25 ^\circ \text{C}$</td>
<td>[2]</td>
<td>2.9</td>
<td>-</td>
<td>V</td>
</tr>
<tr>
<td>$I_{RM}$</td>
<td>reverse leakage current</td>
<td>$V_{RWM} = 5 \text{ V}; \ T_{amb} = 25 ^\circ \text{C}$</td>
<td>-</td>
<td>1</td>
<td>100</td>
<td>nA</td>
</tr>
<tr>
<td>$R_{dyn}$</td>
<td>dynamic resistance</td>
<td>$I_R = 10 \text{ A}; \ t_p = 100 \text{ ns}; \ T_{amb} = 25 ^\circ \text{C}$</td>
<td>[1]</td>
<td>0.2</td>
<td>-</td>
<td>Ω</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$I_R = -10 \text{ A}; \ t_p = 100 \text{ ns}; \ T_{amb} = 25 ^\circ \text{C}$</td>
<td>[1]</td>
<td>0.2</td>
<td>-</td>
<td>Ω</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>[3]</td>
<td>0.4</td>
<td>0.5</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

Fig. 3. Insertion loss; typical values

\[
S_{21dd} (\text{dB}) = 10 \log_{10} \left( \frac{V_2}{V_1} \right)
\]

\[
f (\text{Hz})
\]

Fig. 4. Relative capacitance as a function of input voltage; typical values

\[
a = \frac{C_{line}(V_i = 0 \text{ V})}{C_{line}(V_i = 0 \text{ V})}
\]
Extremely low capacitance unidirectional ESD protection diode array

Transmission Line Pulse (TLP); $t_p = 100$ ns; $t_r = 1$ ns; pin 2

Fig. 5. Dynamic resistance with positive clamping; typical values

Transmission Line Pulse (TLP); $t_p = 100$ ns; $t_r = 1$ ns; pin 2

Fig. 6. Dynamic resistance with negative clamping; typical values

IEC 61000-4-5; $t_p = 8/20$ µs; positive pulse

Fig. 7. Dynamic resistance with positive clamping; typical values

IEC 61000-4-5; $t_p = 8/20$ µs; negative pulse

Fig. 8. Dynamic resistance with negative clamping; typical values
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

DFN2510D-10: plastic, leadless thin small outline package with Side-Wettable Flanks (SWF);
10 terminals; 0.5 mm pitch; 2.5 mm x 1 mm x 0.75 mm body

Fig. 9. Package outline DFN2510D-10 (SOT1165D)
## 13. Soldering

### Footprint information for reflow soldering of DFN2510D-10 package

<table>
<thead>
<tr>
<th>Dimension</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>solder paste</td>
<td>0.5 (2x)</td>
</tr>
<tr>
<td>solder resist</td>
<td>0.2 (8x)</td>
</tr>
<tr>
<td>solder land</td>
<td>0.2</td>
</tr>
<tr>
<td>occupied area</td>
<td>0.1</td>
</tr>
<tr>
<td>recommended stencil thickness</td>
<td>0.1 mm</td>
</tr>
<tr>
<td>Dimensions in mm</td>
<td></td>
</tr>
</tbody>
</table>

Fig. 10. Reflow soldering footprint for DFN2510D-10 (SOT1165D)
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>PESD4USB5UBTTS-Q v.1</td>
<td>20231026</td>
<td>Product data sheet</td>
<td>-</td>
<td>-</td>
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</tbody>
</table>
15. Legal information

### Data sheet status

<table>
<thead>
<tr>
<th>Document status</th>
<th>Product status</th>
<th>Definition</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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Extremely low capacitance unidirectional ESD protection diode array

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