Protection Device
TVS (Transient Voltage Suppressor)

ESD113-B1 Series
Bi-directional, 3.6 V, 0.2 pF, 0201, 0402, RoHS and Halogen Free compliant

ESD113-B1-02ELS
ESD113-B1-02EL

Data Sheet

Revision 1.2, 2014-05-14
Final
Information

For further information on technology, delivery terms and conditions and prices, please contact the nearest Infineon Technologies Office (www.infineon.com)

Warnings

Due to technical requirements, components may contain dangerous substances. For information on the types in question, please contact the nearest Infineon Technologies Office.

Infineon Technologies components may be used in life-support devices or systems only with the express written approval of Infineon Technologies, if a failure of such components can reasonably be expected to cause the failure of that life-support device or system or to affect the safety or effectiveness of that device or system. Life support devices or systems are intended to be implanted in the human body or to support and/or maintain and sustain and/or protect human life. If they fail, it is reasonable to assume that the health of the user or other persons may be endangered.
1 Product Overview

1.1 Features

- ESD / transient protection of high speed data lines according to:
  - IEC61000-4-2 (ESD): ±20 kV (air / contact)
  - IEC61000-4-4 (EFT): ±2.5 kV / ±50 A (5/50 ns)
  - IEC61000-4-5 (surge): ±3 A (8/20 μs)
- Bi-directional, working voltage up to: \( V_{RWM} = \pm 3.6 \text{ V} \)
- Ultra low capacitance \( C_L = 0.20 \text{ pF (typical) at } f = 1 \text{ GHz} \)
- Very low clamping voltage: \( V_{CL} = 14 \text{ V (typical) at } I_{TLP} = 16 \text{ A} \)
- Very low reverse current: \( I_R < 1 \text{ nA (typical)} \)
- Very low dynamic resistance: \( R_{DYN} = 0.45 \Omega \text{ (typical)} \)
- Pb-free and halogen-free package (RoHS compliant)

1.2 Application Examples

- USB 3.0, Firewire, DVI, HDMI, S-ATA, DisplayPort, Thunderbolt
- Mobile HDMI Link, MDDI, MIPI, SWP / NFC

1.3 Product Description

![Pin Configuration and Schematic Diagram](PinConf_and_SchematicDiag.vsd)

<table>
<thead>
<tr>
<th>Type</th>
<th>Package</th>
<th>Configuration</th>
<th>Marking code</th>
</tr>
</thead>
<tbody>
<tr>
<td>ESD113-B1-02ELS</td>
<td>TSSLP-2-4</td>
<td>1 line, bi-directional</td>
<td>2</td>
</tr>
<tr>
<td>ESD113-B1-02EL</td>
<td>TSLP-2-20</td>
<td>1 line, bi-directional</td>
<td>CC</td>
</tr>
</tbody>
</table>
# Maximum Ratings

Table 2-1 Maximum Rating at $T_A = 25 \, ^\circ \text{C}$, unless otherwise specified\(^1\)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Values</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>ESD air discharge(^2)</td>
<td>$I_{\text{ESD}}$</td>
<td>±20</td>
<td>kV</td>
</tr>
<tr>
<td>ESD contact discharge(^2)</td>
<td>$I_{\text{ESD}}$</td>
<td>±20</td>
<td>kV</td>
</tr>
<tr>
<td>Peak pulse power</td>
<td>$P_{PP}$</td>
<td>36</td>
<td>W</td>
</tr>
<tr>
<td>Peak pulse current(^3)</td>
<td>$I_{PP}$</td>
<td>±3</td>
<td>A</td>
</tr>
<tr>
<td>Operating temperature</td>
<td>$T_{OP}$</td>
<td>-55 to 125</td>
<td>°C</td>
</tr>
<tr>
<td>Storage temperature</td>
<td>$T_{STG}$</td>
<td>-65 to 150</td>
<td>°C</td>
</tr>
</tbody>
</table>

1) Device is electrically symmetrical
2) $V_{\text{ESD}}$ according to IEC61000-4-2
3) Non-repetitive current pulse 8/20 μs exponential decay waveform according to IEC61000-4-5

Attention: Stresses above the max. values listed here may cause permanent damage to the device. Exposure to absolute maximum rating conditions for extended periods may affect device reliability. Maximum ratings are absolute ratings; exceeding only one of these values may cause irreversible damage to the component.

## Electrical Characteristics

Electrical Characteristics at $T_A = 25 \, ^\circ \text{C}$, unless otherwise specified

![Figure 3-1 Definitions of electrical characteristics](Image)
## Electrical Characteristics at $T_A = 25 \, ^\circ $C, unless otherwise specified

### Table 3-1 DC Characteristics at $T_A = 25 \, ^\circ $C, unless otherwise specified  

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
<th>Unit</th>
<th>Note / Test Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reverse working voltage</td>
<td>$V_{RWM}$</td>
<td>-3.6</td>
<td>–</td>
<td>3.6</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>Trigger voltage</td>
<td>$V_{t1}$</td>
<td>4</td>
<td>–</td>
<td>–</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Holding voltage</td>
<td>$V_h$</td>
<td>4</td>
<td>4.6</td>
<td>5.5</td>
<td></td>
<td>$I_T = 10 , mA$</td>
</tr>
<tr>
<td>Reverse leakage current</td>
<td>$I_R$</td>
<td>–</td>
<td>&lt;1</td>
<td>20</td>
<td>nA</td>
<td>$V_R = 3.3 , V$</td>
</tr>
</tbody>
</table>

1) Device is electrically symmetrical

### Table 3-2 AC Characteristics at $T_A = 25 \, ^\circ $C, unless otherwise specified

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
<th>Unit</th>
<th>Note / Test Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Line capacitance</td>
<td>$C_L$</td>
<td>–</td>
<td>0.2</td>
<td>0.35</td>
<td>pF</td>
<td>$V_R = 0 , V, f = 1 , MHz$</td>
</tr>
<tr>
<td></td>
<td></td>
<td>–</td>
<td>0.2</td>
<td>–</td>
<td></td>
<td>$V_R = 0 , V, f = 1 , GHz$</td>
</tr>
<tr>
<td>Series inductance</td>
<td>$L_S$</td>
<td>–</td>
<td>0.2</td>
<td>–</td>
<td>nH</td>
<td>ESD113-B1-02ELS</td>
</tr>
<tr>
<td></td>
<td></td>
<td>–</td>
<td>0.4</td>
<td>–</td>
<td></td>
<td>ESD113-B1-02EL</td>
</tr>
</tbody>
</table>

### Table 3-3 ESD and Surge Characteristics at $T_A = 25 \, ^\circ $C, unless otherwise specified

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
<th>Unit</th>
<th>Note / Test Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clamping voltage$^2)$</td>
<td>$V_{CL}$</td>
<td>–</td>
<td>14</td>
<td>–</td>
<td>V</td>
<td>$I_{TLP} = 16 , A, t_p = 100 , ns$</td>
</tr>
<tr>
<td></td>
<td></td>
<td>–</td>
<td>20</td>
<td>–</td>
<td></td>
<td>$I_{TLP} = 30 , A, t_p = 100 , ns$</td>
</tr>
<tr>
<td>Clamping voltage$^3)$</td>
<td>–</td>
<td>–</td>
<td>6</td>
<td>–</td>
<td>V</td>
<td>$I_{PP} = 1 , A, t_p = 8/20 , \mu s$</td>
</tr>
<tr>
<td></td>
<td>–</td>
<td>–</td>
<td>8</td>
<td>–</td>
<td></td>
<td>$I_{PP} = 3 , A, t_p = 8/20 , \mu s$</td>
</tr>
<tr>
<td>Dynamic resistance$^2)$</td>
<td>$R_{DYN}$</td>
<td>–</td>
<td>0.45</td>
<td>–</td>
<td>$\Omega$</td>
<td>$t_p = 100 , ns$</td>
</tr>
</tbody>
</table>

1) Device is electrically symmetrical

2) Please refer to Application Note AN210[1]. TLP parameter: $Z_0 = 50 \, \Omega, t_p = 100ns, t_c = 300ps$.

3) Non-repetitive current pulse 8/20µs exponential decay waveform according to IEC61000-4-5
4 Typical Characteristics Diagrams

Typical characteristics diagrams at $T_A=25^\circ C$, unless otherwise specified

Figure 4-1 Reverse leakage current $I_R=f(V_R)$

Figure 4-2 Line capacitance $C_L=f(V_R)$
Figure 4-3  Line capacitance: $C_L = f(f), \ V_R = 0 \ \text{V}$

Figure 4-4  Insertion loss vs. frequency in a 50 Ω system
Figure 4-5  Clamping voltage (ESD): $V_{CL} = f(t)$, 8 kV positive pulse from pin 1 to pin 2

Figure 4-6  Clamping voltage (ESD): $V_{CL} = f(t)$, 8 kV negative pulse from pin 1 to pin 2
Figure 4-7  Clamping voltage (ESD): $V_{CL} = f(t)$, 15 kV positiv pulse from pin 1 to pin 2

Figure 4-8  Clamping voltage (ESD): $V_{CL} = f(t)$, 15 kV negativ pulse from pin 1 to pin 2
Figure 4-9  Clamping voltage (TLP): $I_{TLP} = f(V_{TLP})$ [1], pin 1 to pin 2
Figure 4-10 Clamping voltage (Surge): $I_{pp} = f(V_{CL})$ [1], pin 1 to pin 2
5 Package Information

5.1 TSSLP-2-4

Figure 5-1 TSSLP-2-4 Package outline (dimension in mm)

Figure 5-2 TSSLP-2-4 Footprint (dimension in mm)

Figure 5-3 TSSLP-2-4 Packing (dimension in mm)

Figure 5-4 TSSLP-2-4 Marking example Table 1-1 “Part Information” on Page 3
5.2 TSLP-2-20

Figure 5-5 TSLP-2-20 Package outline (dimension in mm)

Figure 5-6 TSLP-2-20 Footprint (dimension in mm)

Figure 5-7 TSLP-2-20 Packing (dimension in mm)

Figure 5-8 TSSLP-2-4 Marking example Table 1-1 “Part Information” on Page 3
References


[2] Infineon AG - Recommendations for PCB Assembly of Infineon TSLP and TSSLP Package
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Page or Item | Subjects (major changes since previous revision)
--- | ---
Revision 1.2, 2014-05-14
All | New type ESD113-B1-02EL inserted

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