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# Protection Devices

TVS (Transient Voltage Suppressor)

## ESD102-U1-02ELS

Uni-directional, 3.3 V, 0.4 pF, 0201, RoHS

ESD102-U1-02ELS

## Data Sheet

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Final

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# 1 Product Overview

## 1.1 Features

- ESD / transient protection of high speed data lines according to:
  - IEC61000-4-2 (ESD):  $\pm 20$  kV (air / contact)
  - IEC61000-4-4 (EFT):  $\pm 2.5$  kV / 50 A (5/50 ns)
  - IEC61000-4-5 (surge):  $\pm 3$  A (8/20  $\mu$ s)
- Uni-directional working voltage:  $V_{RWM} = 3.3$  V
- Ultra low capacitance:  $C_L = 0.4$  pF (typical)
- Very low clamping voltage:  $V_{CL} = 8$  V (typical) at  $I_{PP} = 16$  A
- Low reverse current:  $I_R = 1$  nA (typical)
- Very low dynamic resistance:  $R_{DYN} = 0.19$   $\Omega$  (typical)
- Pb-free (RoHS compliant) and halogen free package, very small form factor 0.62 x 0.32 x 0.31 mm<sup>3</sup>



## 1.2 Application Examples

- USB 3.0, 10/100/1000 Ethernet, Firewire, DVI, HDMI, S-ATA, DisplayPort
- Mobile HDMI Link, MDDI, MIPI, SWP / NFC

## 1.3 Product Description

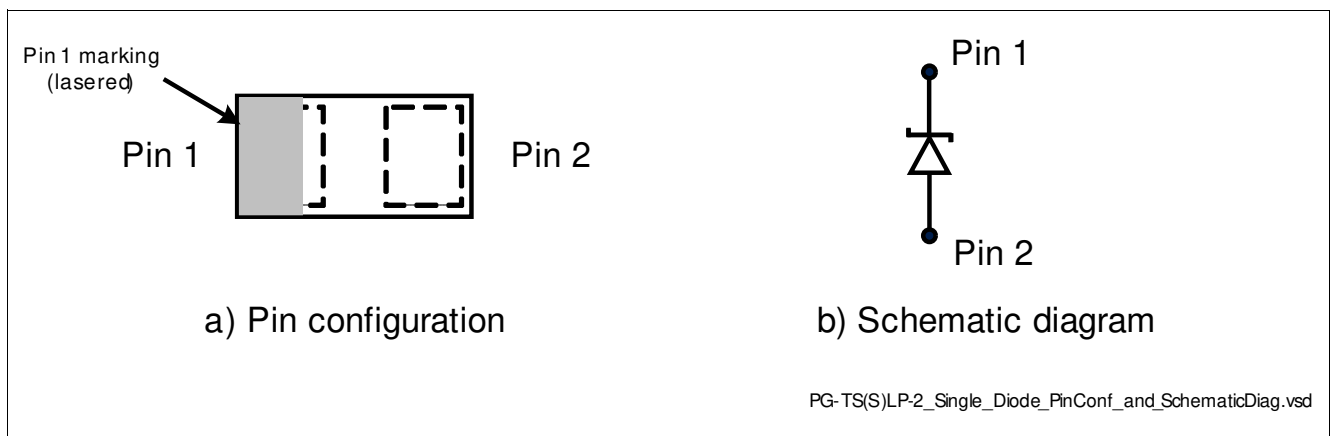


Figure 1 Pin Configuration and Schematic Diagram

Table 1 Part Information

Type	Package	Configuration	Marking code
ESD102-U1-02ELS	TSSLP-2-3	1 line, uni-directional	<u>E</u>

## 2 Maximum Ratings

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

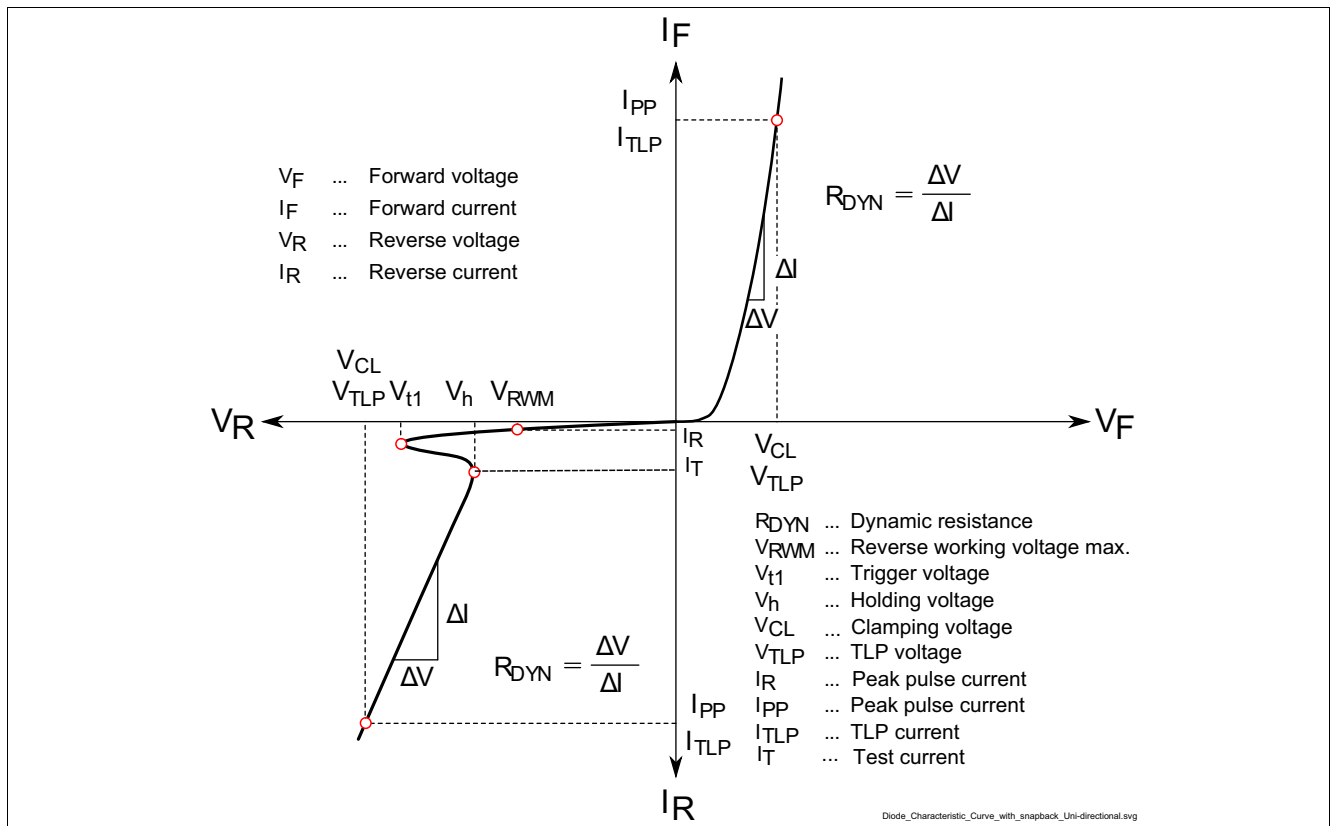
Parameter	Symbol	Values	Unit
ESD air discharge <sup>1)</sup>	$V_{ESD}$	$\pm 20$	kV
ESD contact discharge <sup>1)</sup>		$\pm 20$	
Peak pulse current <sup>2)</sup>	$I_{PP}$	$\pm 3$	A
Operating temperature	$T_{OP}$	-55 to 125	$^\circ\text{C}$
Storage temperature	$T_{stg}$	-65 to 150	$^\circ\text{C}$

1)  $V_{ESD}$  according to IEC61000-4-2

2) Stress pulse: 8/20 $\mu\text{s}$  current 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 integrated circuit.**

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



**Figure 2** Definitions of Electrical Characteristics

**Electrical Characteristics at  $T_A = 25\text{ °C}$ , unless otherwise specified**
**Table 3 DC Characteristics at  $T_A = 25\text{ °C}$ , unless otherwise specified**

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Reverse working voltage	$V_{RWM}$	–	–	3.3	V	Pin 1 to Pin 2
Trigger voltage	$V_{t1}$	–	6.2	–		
Holding voltage	$V_h$	3.35	4	4.4		Pin 1 to Pin 2, $I_R = 10\text{ mA}$
Reverse current	$I_R$	–	1	50	nA	$V_R = 3.3\text{ V}$ , from Pin 1 to Pin 2

**Table 4 AC Characteristics at  $T_A = 25\text{ °C}$ , unless otherwise specified**

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Line capacitance	$C_L$	–	0.4	0.65	pF	$V_R = 0\text{ V}$ , $f = 1\text{ MHz}$
		–	0.4	0.65	pF	$V_R = 0\text{ V}$ , $f = 1\text{ GHz}$
Series inductance	$L_S$	–	0.2	–	nH	

**Table 5 ESD and Surge Characteristics at  $T_A = 25\text{ °C}$ , unless otherwise specified**

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Clamping voltage <sup>1)</sup>	$V_{CL}$	–	8	–	V	$I_{TLP} = 16\text{ A}$ , $t_p = 100\text{ ns}$ , from Pin 1 to Pin 2
		–	11	–		$I_{TLP} = 30\text{ A}$ , $t_p = 100\text{ ns}$ from Pin 1 to Pin 2
Forward clamping voltage <sup>1)</sup>	$V_{FC}$	–	6	–		$I_{TLP} = 16\text{ A}$ , $t_p = 100\text{ ns}$ , from Pin 2 to Pin 1
		–	9	–		$I_{TLP} = 30\text{ A}$ , $t_p = 100\text{ ns}$ , from Pin 2 to Pin 1
Dynamic resistance <sup>1)</sup>	$R_{DYN}$	–	0.19	–	$\Omega$	$t_p = 100\text{ ns}$ from Pin 1 to Pin 2
		–	0.23	–	$\Omega$	$t_p = 100\text{ ns}$ from Pin 2 to Pin 1

1) Please refer to Application Note AN210[1]. TLP parameter:  $Z_0 = 50\ \Omega$ ,  $t_p = 100\text{ ns}$ ,  $t_r = 0.6\text{ ns}$ .

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

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

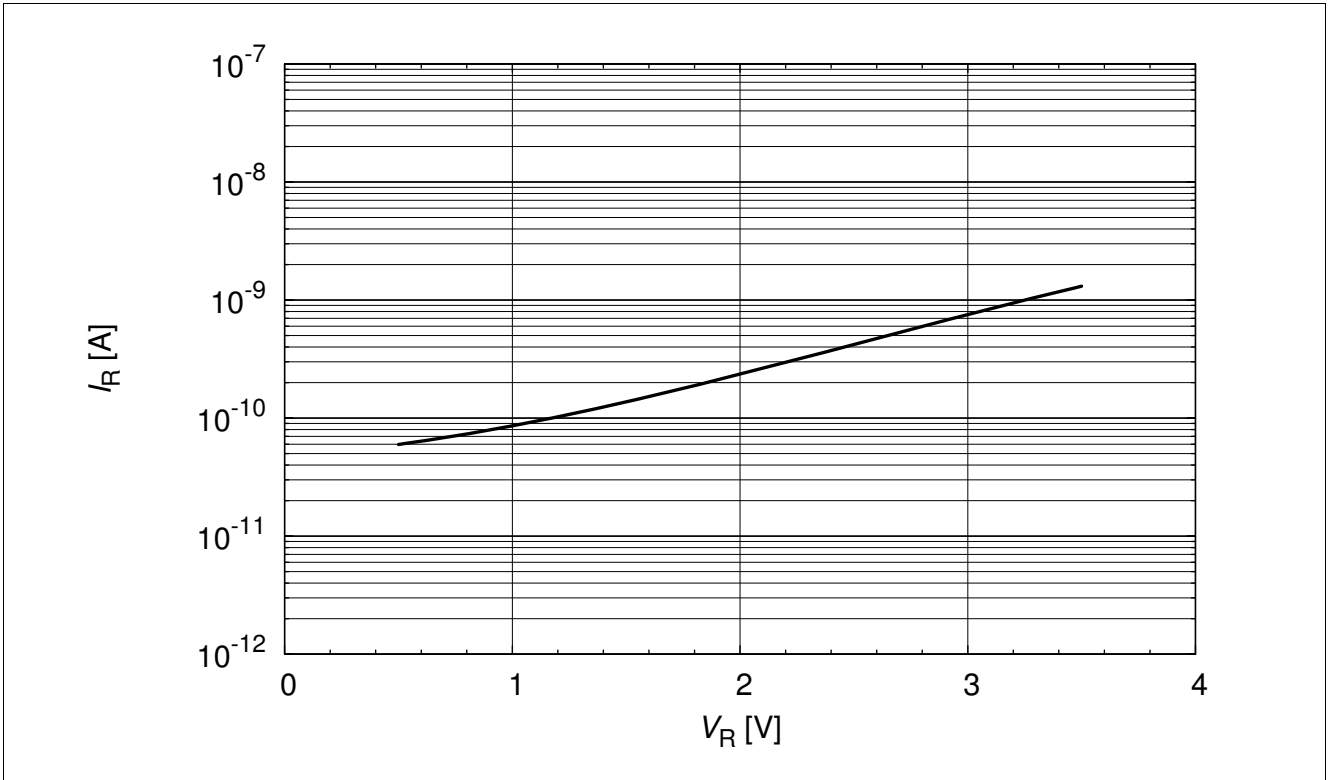


Figure 3 Reverse leakage current,  $I_R = f(V_R)$

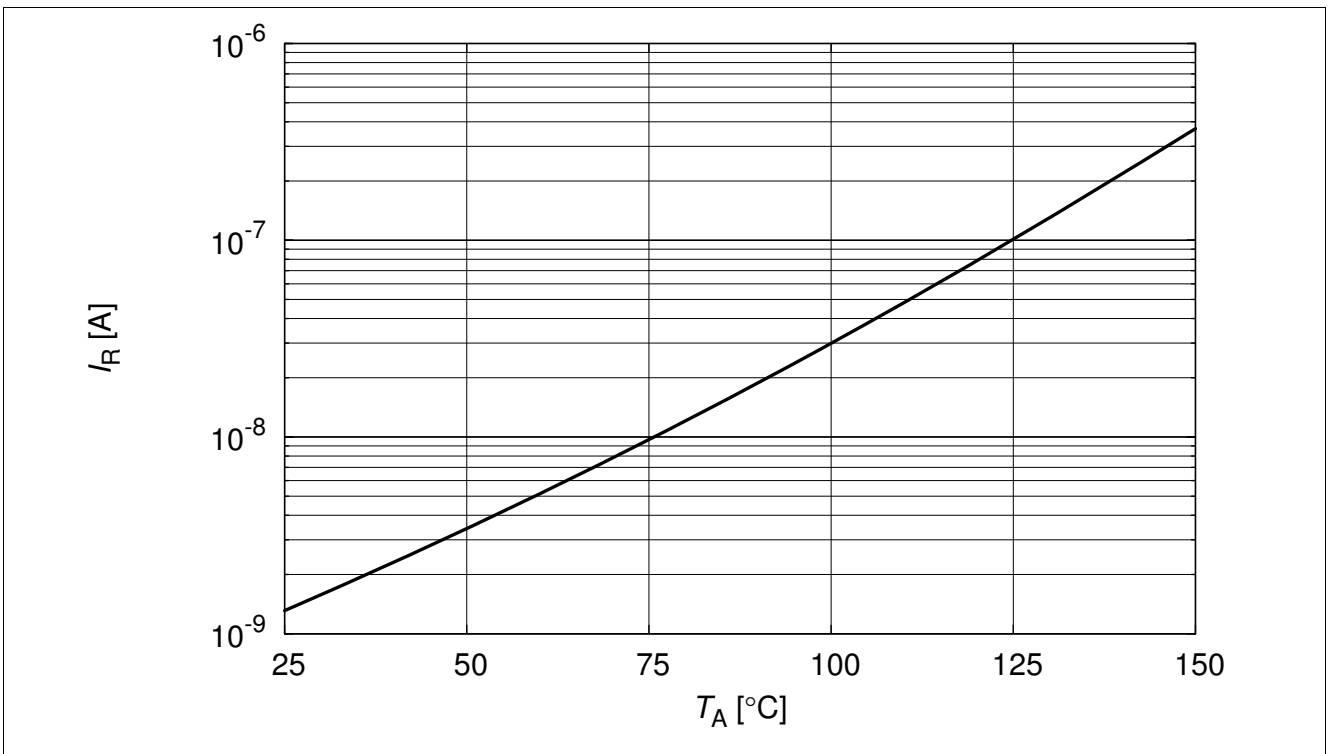


Figure 4 Reverse current  $I_R = f(T_A)$ ,  $V_R = 3.3 \text{ V}$

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

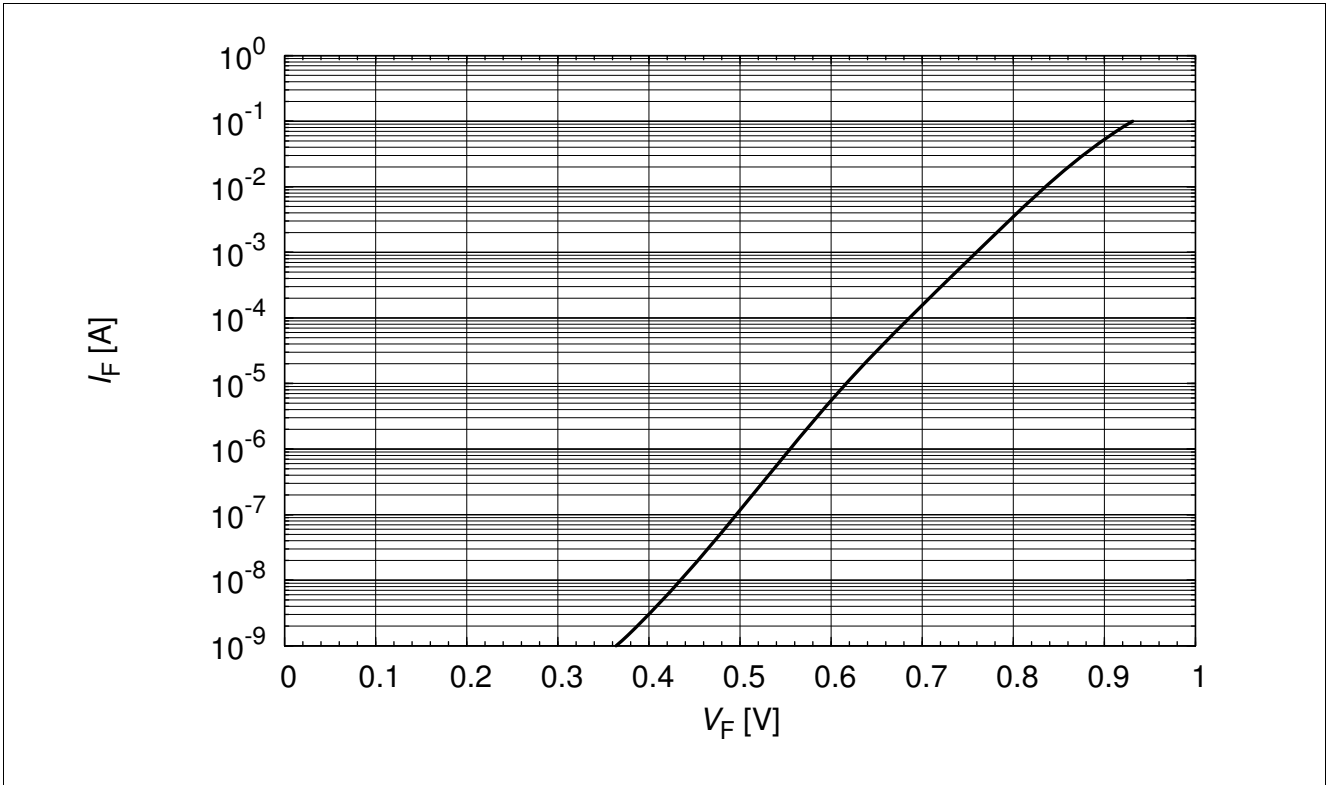


Figure 5 Forward current,  $I_F = (V_F)$

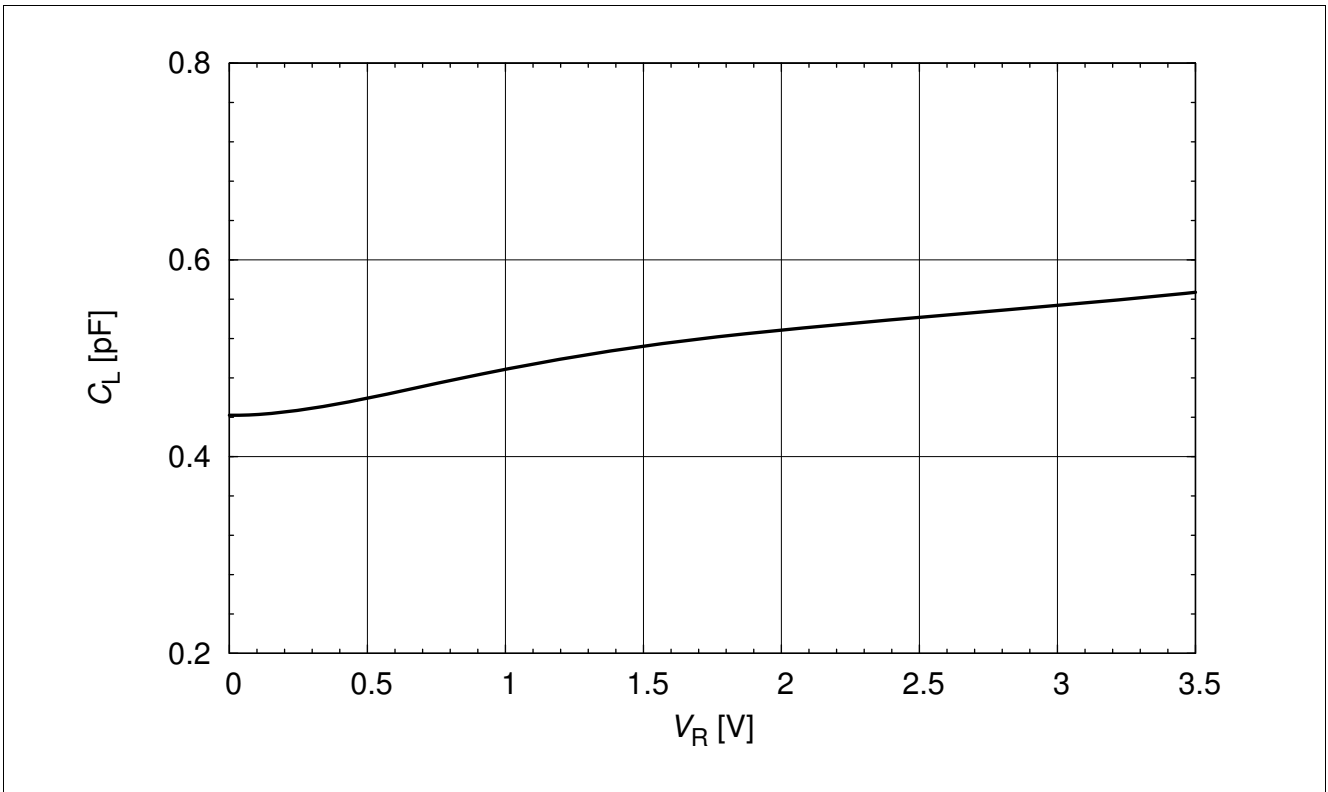


Figure 6 Line capacitance  $C_L = f(V_R)$ ,  $f = 1\text{MHz}$ , from pin 1 to pin 2



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

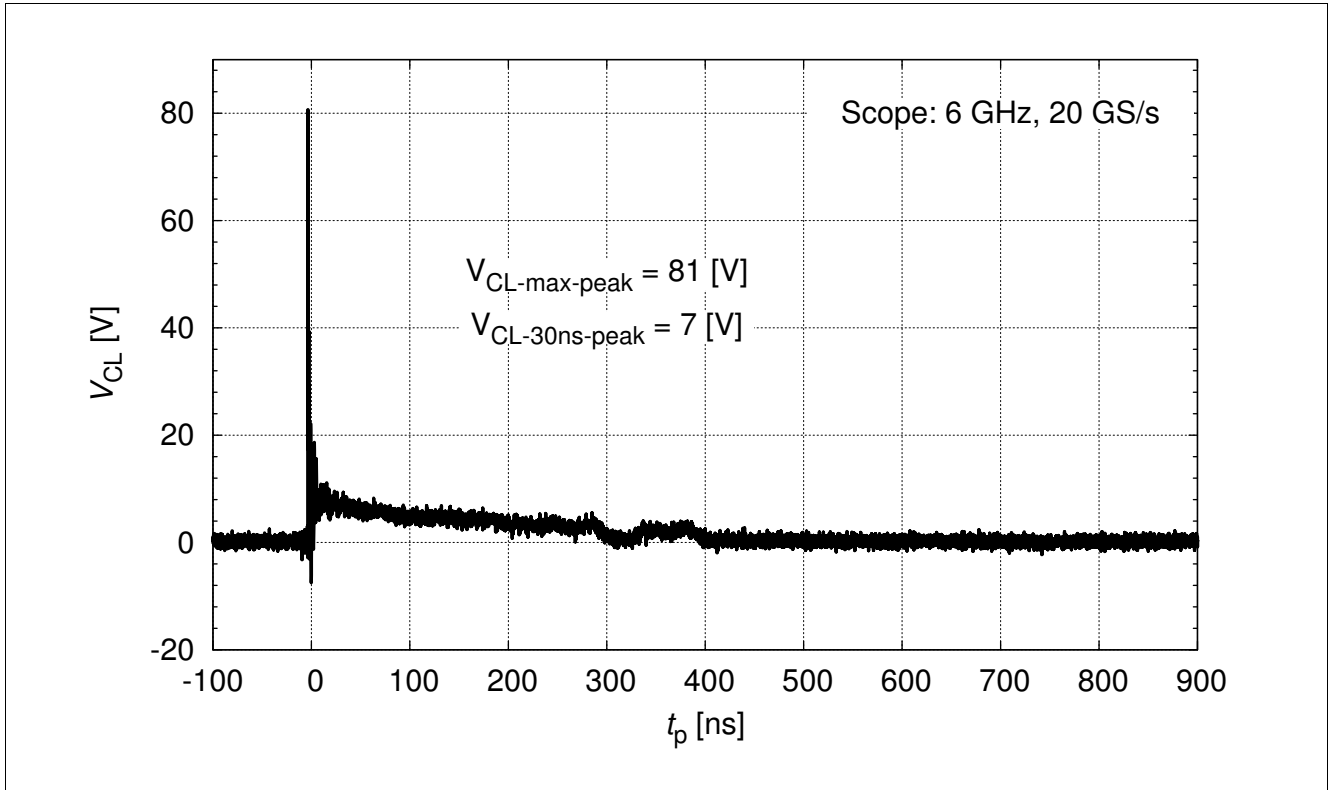


Figure 7 Clamping voltage (ESD):  $V_{\text{CL}} = f(t)$ , 8 kV positive pulse from pin 1 to pin 2

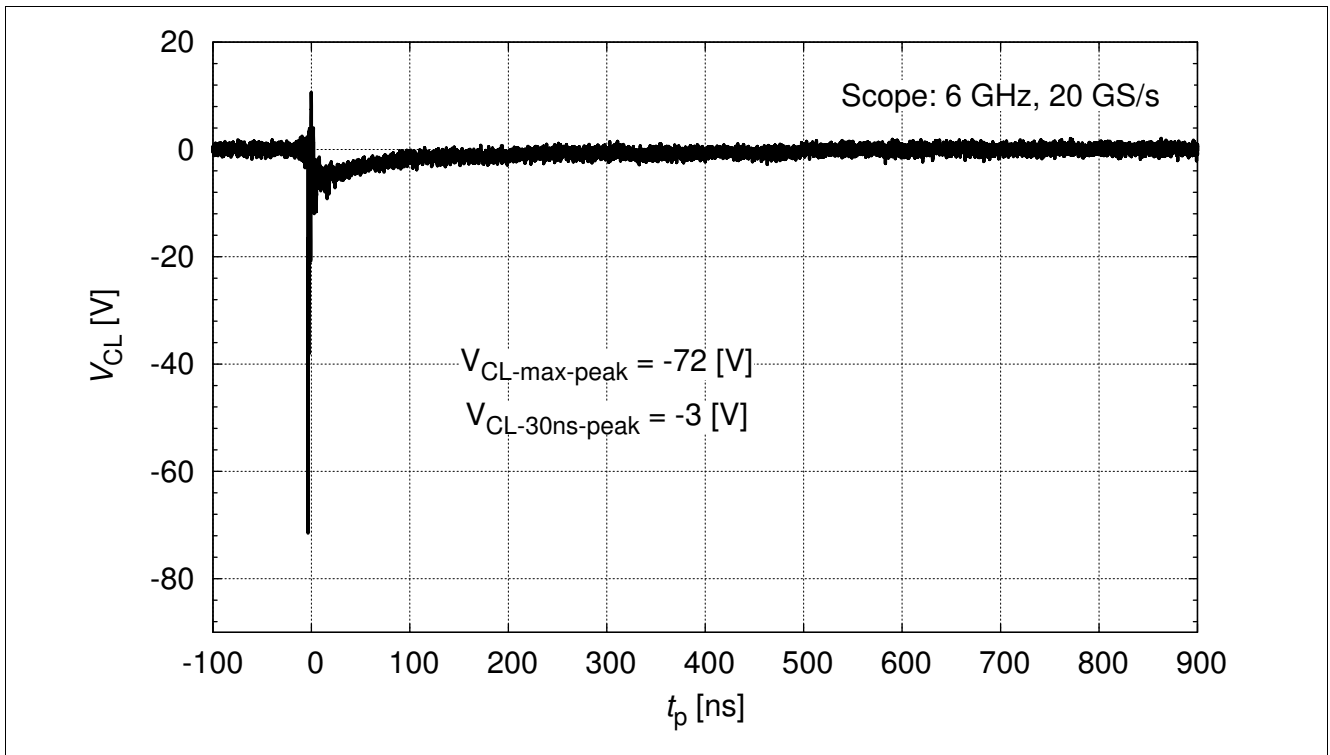


Figure 8 Clamping voltage (ESD):  $V_{\text{CL}} = f(t)$ , 8 kV negative pulse from pin 1 to pin 2

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

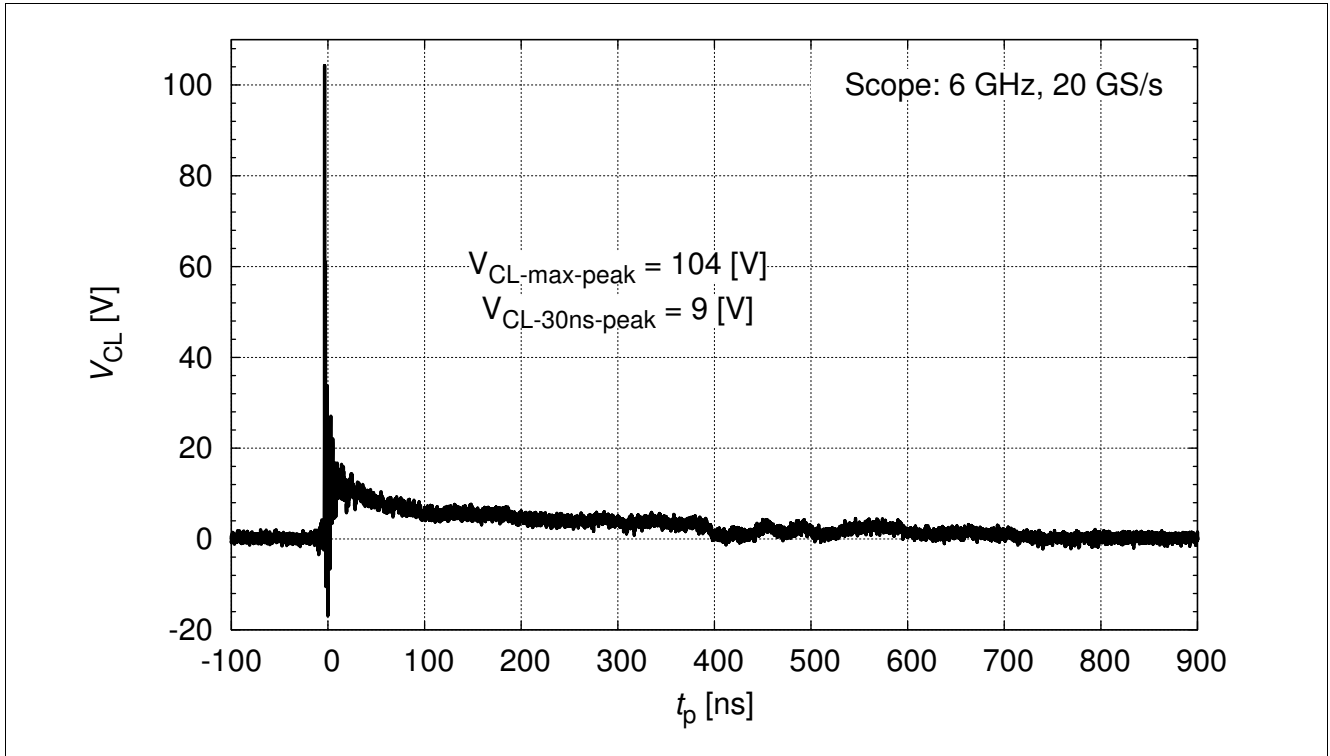


Figure 9 Clamping voltage (ESD):  $V_{CL} = f(t)$ , 15 kV positive pulse from pin 1 to pin 2

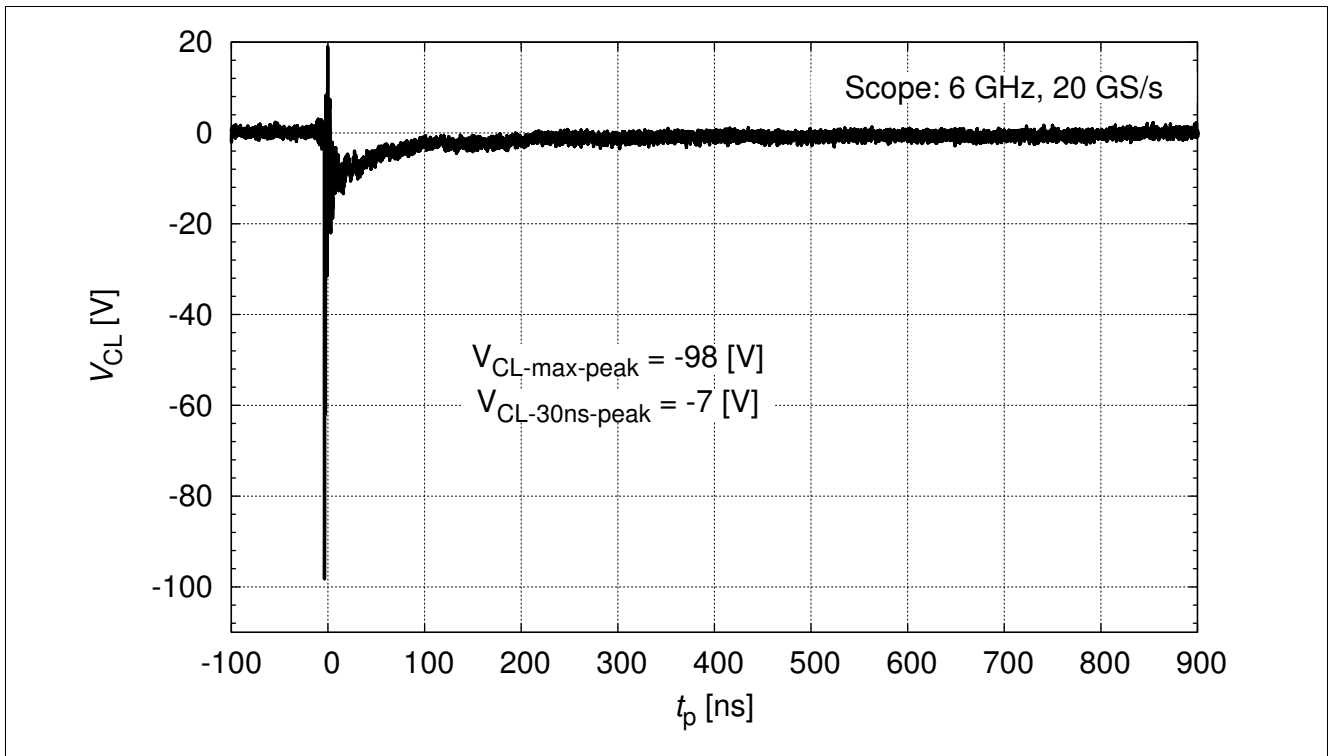


Figure 10 Clamping voltage (ESD):  $V_{CL} = f(t)$ , 15 kV negative pulse from pin 1 to pin 2

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

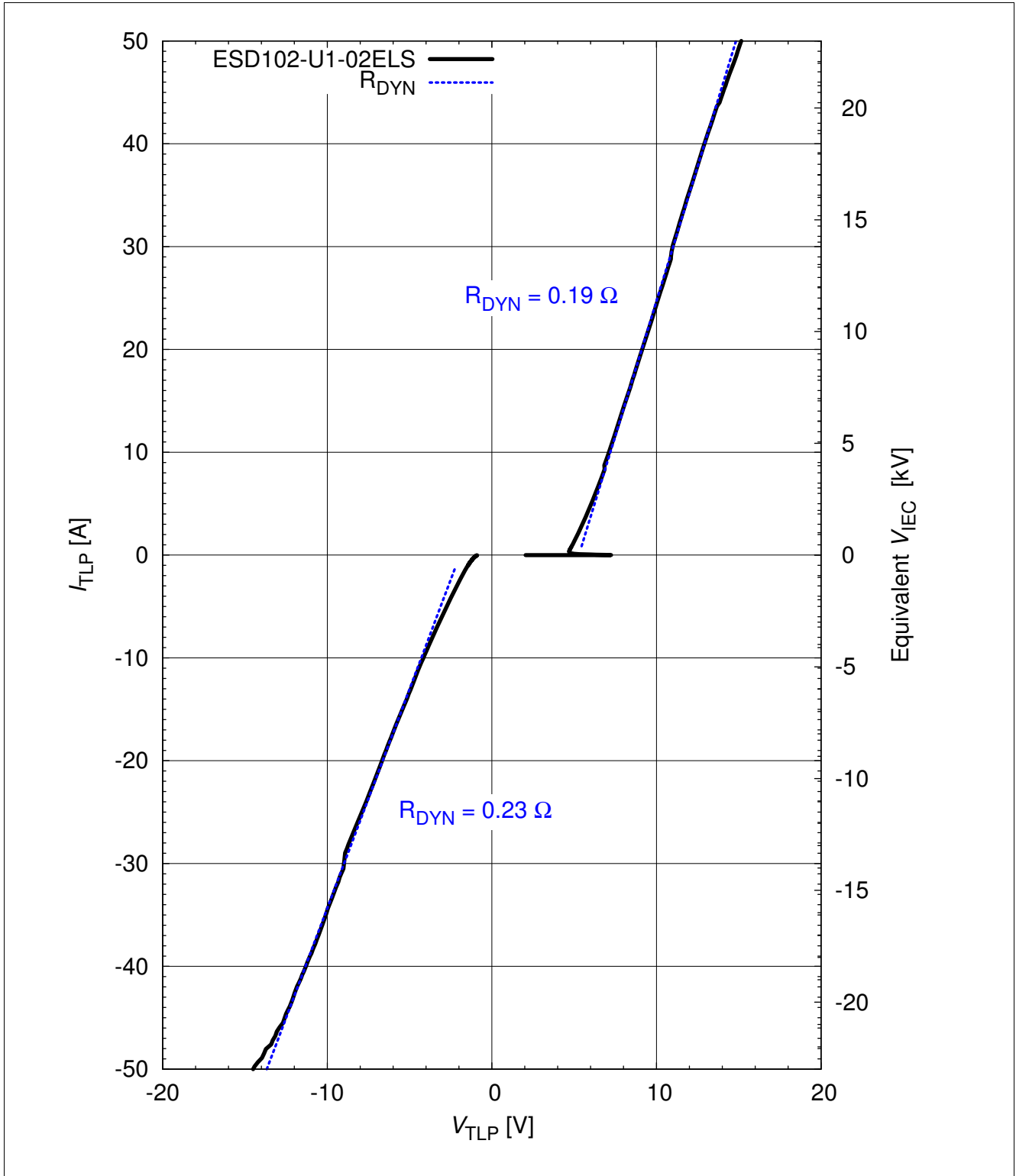


Figure 11 Clamping voltage (TLP):  $I_{TLP} = f(V_{TLP})$  [1], pin 1 to pin 2

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

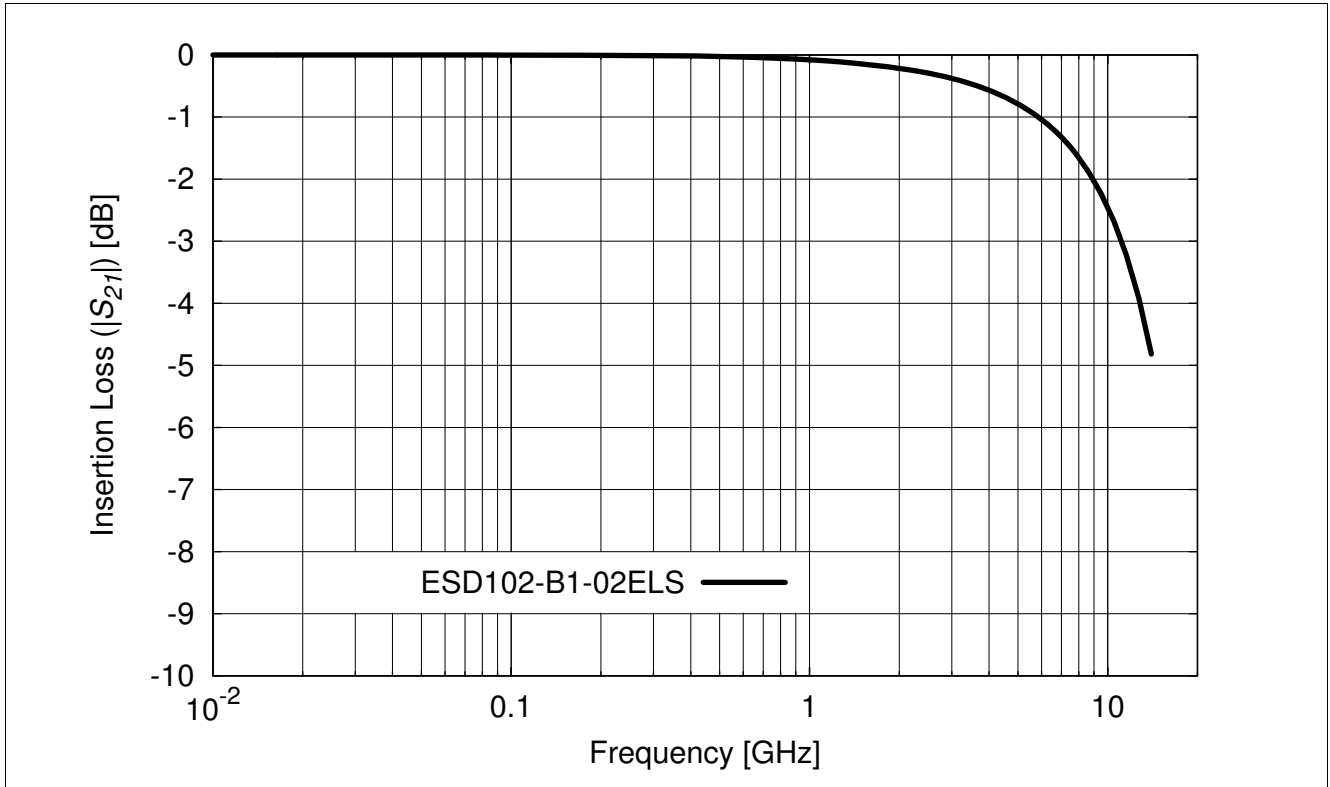


Figure 12 Insertion loss vs. frequency in a 50 Ω system

## 5 Application Information

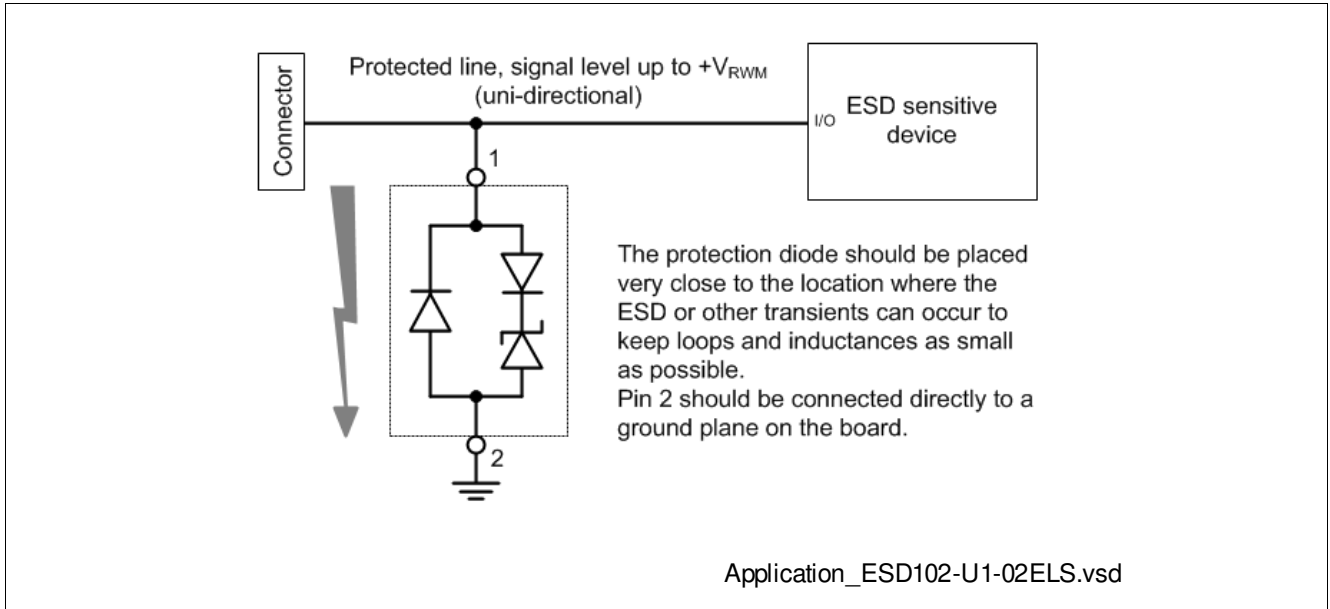


Figure 13 Single line, uni-directional ESD / Transient protection[2]

## 6 Package Information

### 6.1 TSSLP-2-3

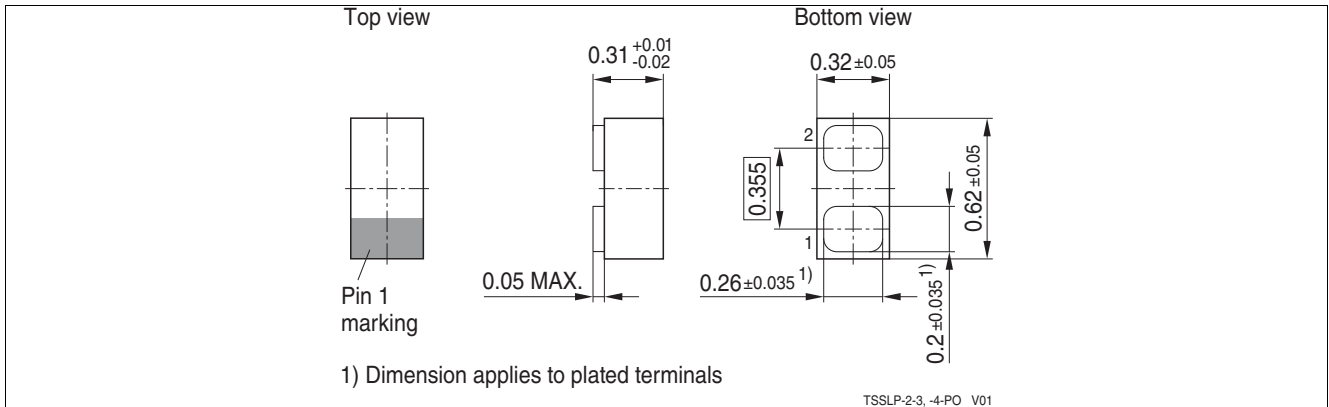


Figure 14 TSSLP-2-3 Package outline (dimension in mm)

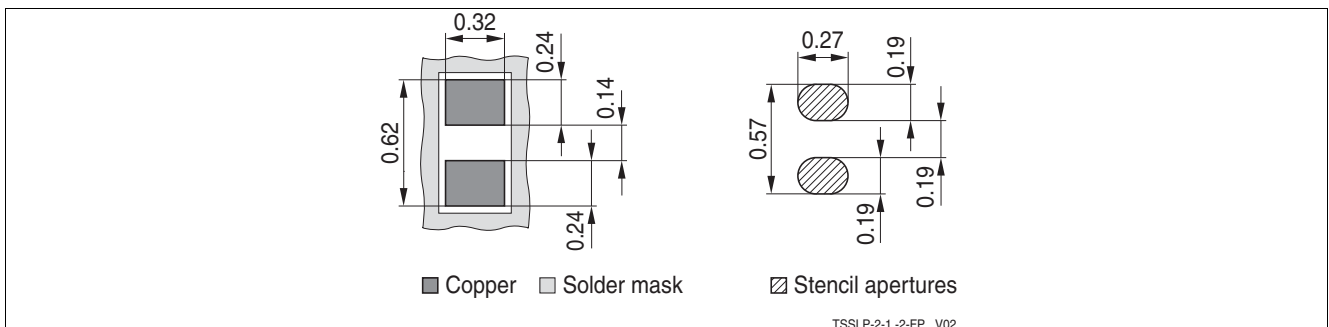


Figure 15 TSSLP-2-3 Footprint (dimension in mm)

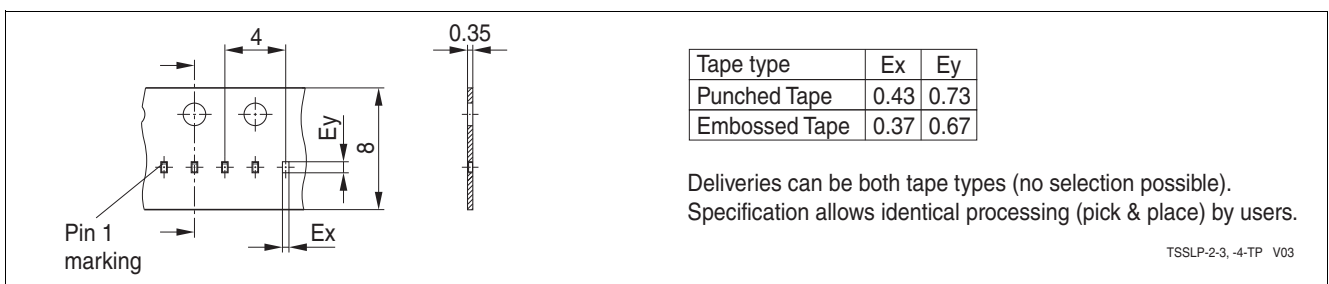


Figure 16 TSSLP-2-3 Packing (dimension in mm)

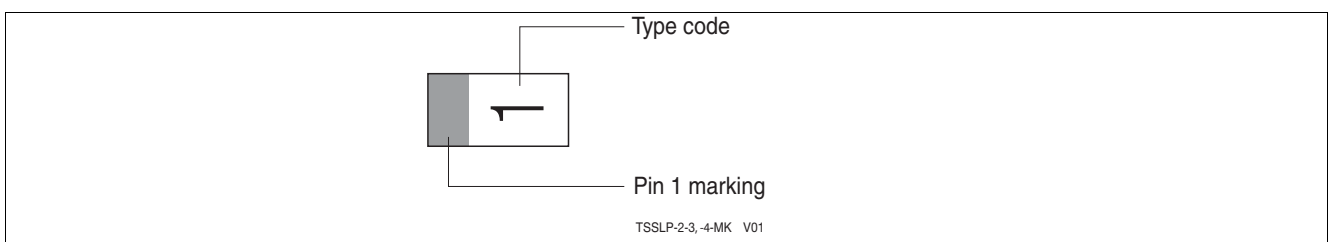


Figure 17 TSSLP-2-3 Marking example Table 1 "Part Information" on Page 3



**References**

- [1] On-chip ESD protection for integrated circuits, Albert Z. H. Wang, ISBN:0-7923-7647-1
- [2] Infineon AG - **Application Note AN210**: Effective ESD Protection Design at System Level Using VF-TLP Characterization Methodology
- [3] Infineon AG - Recommendations for PCB Assembly of Infineon TSLP and TSSLP Package

**Revision History: Revision 1.1, 2014-02-13**

Page or Item	Subjects (major changes since previous revision)
<b>Revision 1.2, 2015-12-14</b>	
All	Layout change

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