

# ESD231-B1-W0201

Bi-directional ESD protection device, 5.5 V, 3.5 pF, 0201

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## Product description

This Infineon ESD (electrostatic discharge) protection device has a bi-directional and symmetric  $I/V$  characteristic and excellent clamping performance.

## Feature list

- ESD / transient protection according to:
  - IEC61000-4-2 (ESD):  $\pm 30$  kV (air) /  $\pm 30$  kV (contact)
  - IEC61000-4-4 (EFT):  $\pm 4$  kV /  $\pm 80$  A (5/50 ns)
  - IEC61000-4-5 (Surge):  $\pm 12$  A (8/20  $\mu$ s)
- Bi-directional maximum working voltage:  $V_{WM} = \pm 5.5$  V
- Line capacitance:  $C_L = 3.5$  pF at  $f = 1$  MHz
- Clamping voltage:  $V_{cl} = 12$  V at  $I_{TLP} = 16$  A with  $R_{dyn} = 0.3 \Omega$
- Very low leakage current:  $I_L = 1$  nA
- Small form factor SMD size 0201, low profile (0.58 x 0.28 x 0.15 mm<sup>3</sup>)



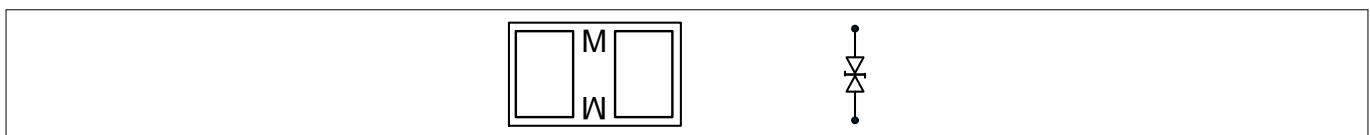
## Potential applications

- Low-speed USB lines (D+/D-, CC/SBU), MIPI, SD card, SIM card
- Keypads, touchpads, buttons, convenience keys, LCD displays, cameras, audio lines

## Product validation

Qualified for industrial applications according to the relevant tests of JEDEC47/20/22.

## Device information



**Figure 1** Pin configuration with marking (bottom view)

**Table 1** Part information

Product name / Ordering code	Package	Pin configuration	Marking	Pieces / Reel
ESD231-B1-W0201/ESD231B1W0201E6327XTSA1	WLL-2-1	1 line, bi-directional	M	15 k

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## 1 Absolute maximum ratings

### 1 Absolute maximum ratings

**Table 2** Absolute maximum ratings at  $T_A = 25^\circ\text{C}$ , unless otherwise specified

Parameter	Symbol	Values		Unit	Note or test condition
		Min.	Max.		
Working voltage	$V_{WM}$	-5.5	+5.5	V	
ESD discharge voltage	$V_{ESD}$ (contact)	-30	+30	kV	Discharge network: $R = 330 \Omega$ , $C = 150 \text{ pF}$ <sup>1)</sup>
	$V_{ESD}$ (air)	-30	+30		
Peak pulse power	$P_{PK}$	-	132	W	Stress pulse: 8/20 $\mu\text{s}$ current waveform <sup>2)</sup>
Peak pulse current	$I_{PP}$	-12	+12	A	
Operating temperature	$T_{op}$	-55	+125	$^\circ\text{C}$	
Storage temperature	$T_{stg}$	-65	+150		

**Attention:** Stresses above the maximum 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.

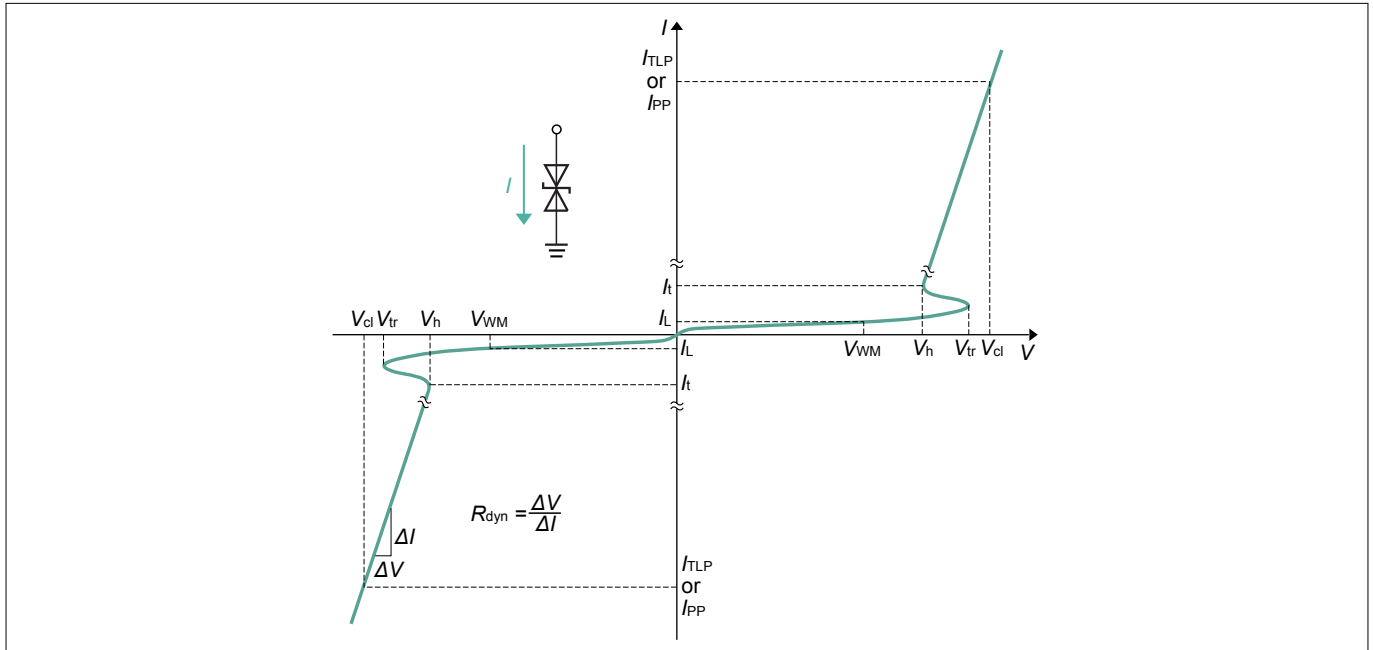
<sup>1</sup> Based on IEC61000-4-2.

<sup>2</sup> Based on IEC61000-4-5.

**2 Electrical characteristics**

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Note:  $T_A = 25^\circ\text{C}$ , unless otherwise specified. Device is electrically symmetrical.



**Figure 2** I/V characteristic curve

**Table 3** I/V characteristic parameters

Symbol	Parameter
$I_h$	Holding current
$I_L$	Leakage current
$I_{PP}$	Peak pulse current, based on IEC61000-4-5
$I_t$	Test current
$I_{TLP}$	TLP current
$R_{dyn}$	Dynamic resistance
$V_{cl}$	Clamping voltage
$V_h$	Holding voltage
$V_t$	Test voltage
$V_{tr}$	Trigger voltage
$V_{WM}$	Maximum working voltage

**2 Electrical characteristics**

**Table 4 DC characteristics**

Parameter	Symbol	Values			Unit	Note or test condition
		Min.	Typ.	Max.		
Trigger voltage <sup>3)</sup>	$V_{tr}$	6.1	9.5	–	V	
Holding voltage	$V_h$	6.1	7.8	12.5		$I_t = 10 \text{ mA}$
Leakage current	$I_L$	–	1	20	nA	$V_{WM} = 5.5 \text{ V}$

**Table 5 AC characteristics**

Parameter	Symbol	Values			Unit	Note or test condition
		Min.	Typ.	Max.		
Line capacitance	$C_L$	3	3.5	4.1	pF	$V = 0 \text{ V}, f = 1 \text{ MHz}$
		–	3.2	–		$V = 0 \text{ V}, f = 1 \text{ GHz}$
Series inductance	$L_S$	–	<1	–	nH	Extracted from S-parameters

**Table 6 Protection characteristics**

Parameter	Symbol	Values			Unit	Note or test condition
		Min.	Typ.	Max.		
Clamping voltage (TLP) <sup>4) 5)</sup>	$V_{cl}$	–	9.3	–	V	$I_{TLP} = 4 \text{ A}$
		–	10.5	–		$I_{TLP} = 8 \text{ A}$
		–	12	–		$I_{TLP} = 16 \text{ A}$
		–	16	–		$I_{TLP} = 30 \text{ A}$
Clamping voltage (8/20 $\mu\text{s}$ ) <sup>6)</sup>		–	8	–		$I_{PP} = 2 \text{ A}$
		–	10	–		$I_{PP} = 9 \text{ A}$
Dynamic resistance <sup>4)</sup>	$R_{dyn}$	–	0.3	–	$\Omega$	

<sup>3</sup> Verified by design.

<sup>4</sup> TLP parameters:  $Z_0 = 50 \Omega$ ,  $t_p = 100 \text{ ns}$ ,  $t_r = 0.6 \text{ ns}$ , averaging window 30-60 ns.

<sup>5</sup> Refer to application note AN210 [\[2\]](#)

<sup>6</sup>  $t_p = 8/20 \mu\text{s}$ . Stress pulse based on IEC61000-4-5.

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**3 Thermal resistance**

### **3 Thermal resistance**

**Table 7 Thermal resistance**

Parameter	Symbol	Values			Unit	Note or test condition
		Min.	Typ.	Max.		
Junction - soldering point <sup>7)</sup>	$R_{thJS}$		30	–	KW	–

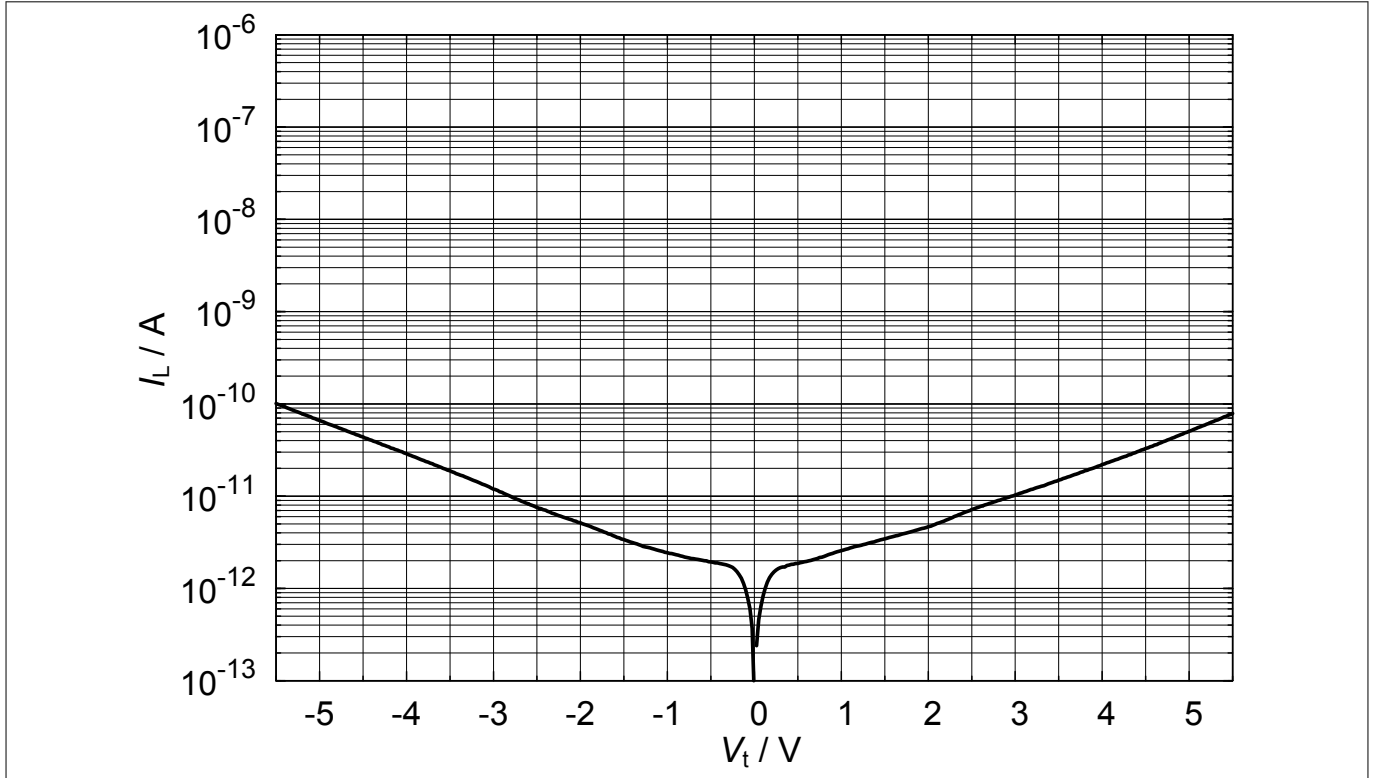
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<sup>7)</sup> For calculation of  $R_{thJA}$  please refer to application note AN077 "Thermal resistance calculation"

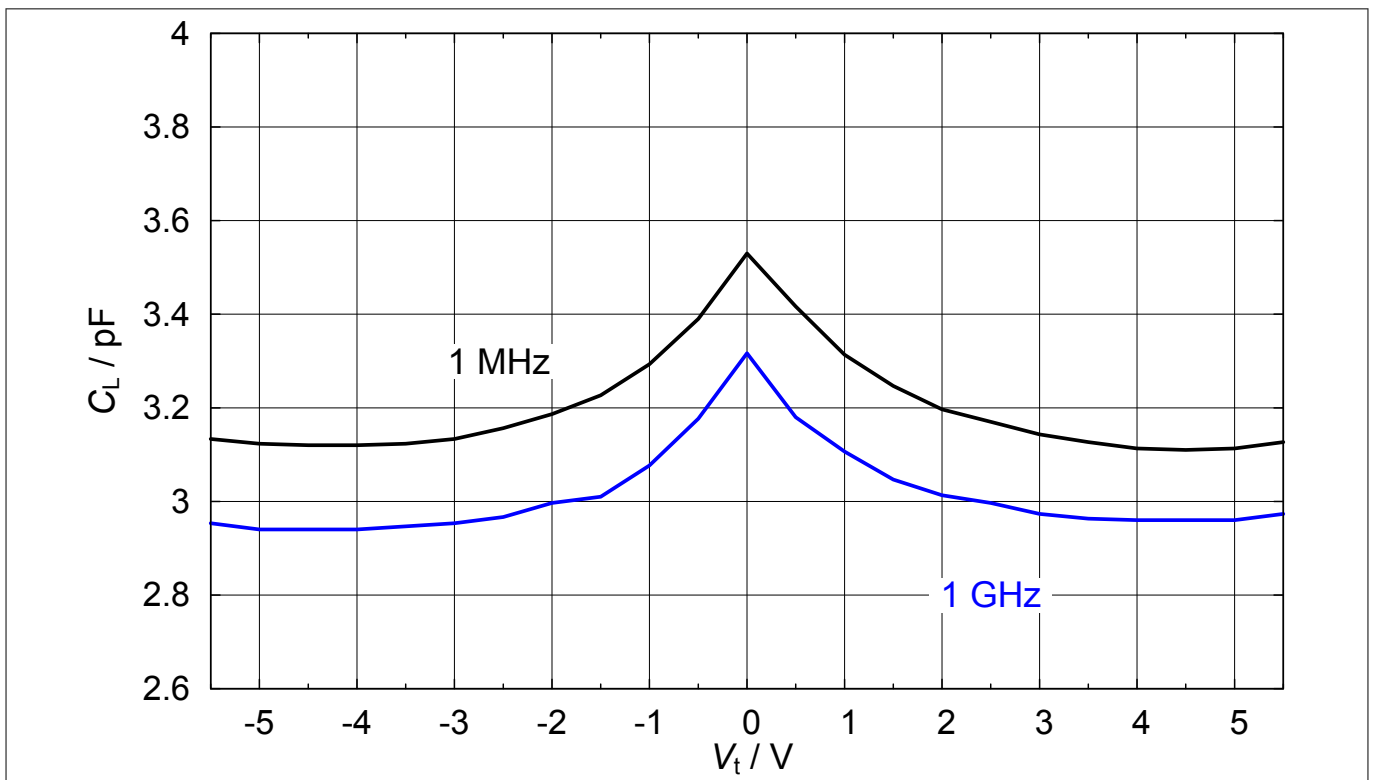
**4 Typical characteristic diagrams**

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Note:  $T_A = 25\text{ }^\circ\text{C}$ , unless otherwise specified.

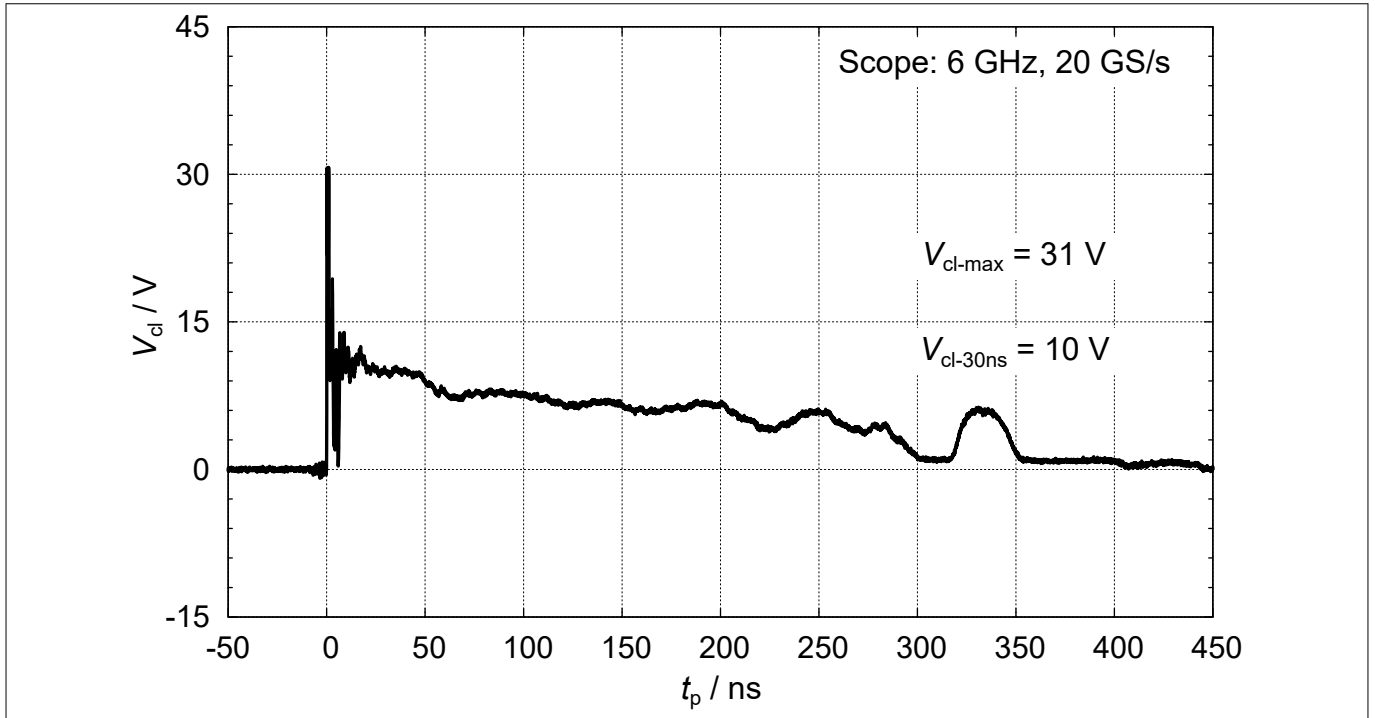


**Figure 3** Leakage current:  $I_L = f(V_t)$

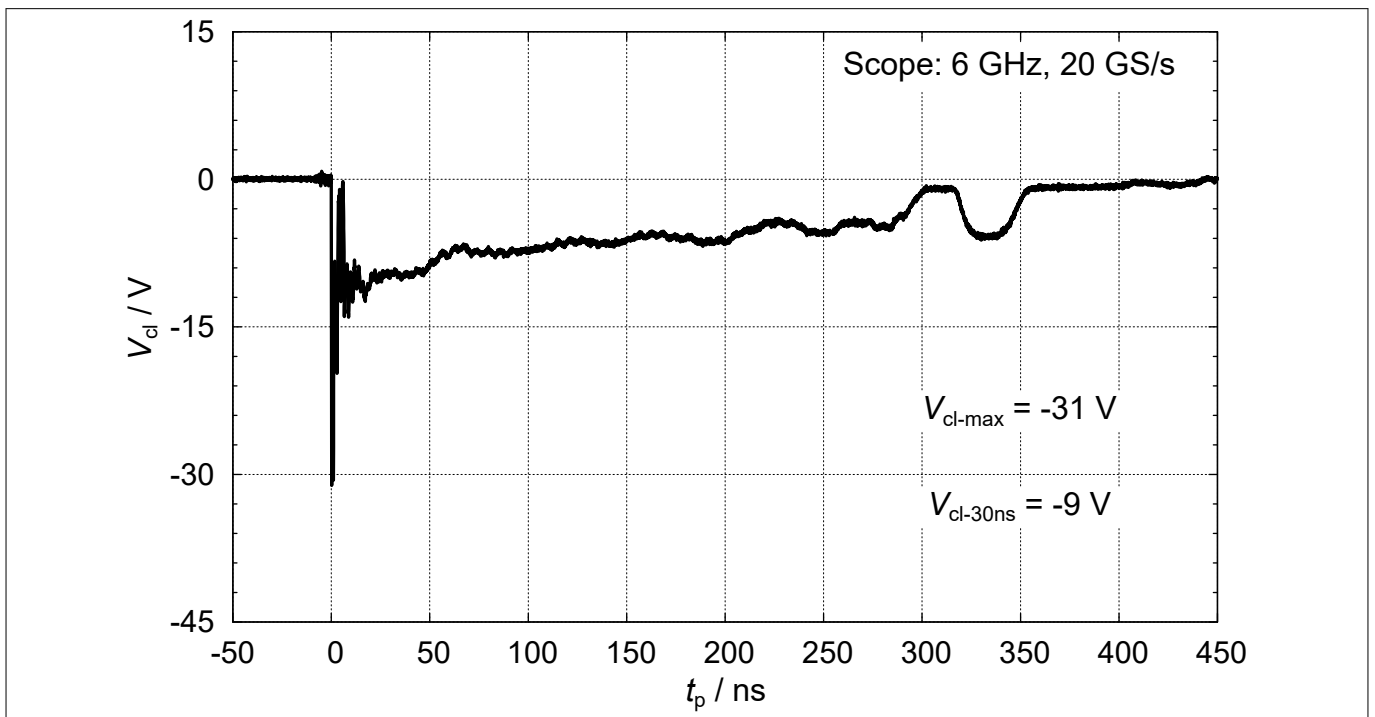


**Figure 4** Line capacitance:  $C_L = f(V_t)$ ,  $f = 1\text{ MHz}, 1\text{ GHz}$

**4 Typical characteristic diagrams**



**Figure 5 Clamping voltage (ESD):  $V_{cl} = f(t_p)$ , 8 kV positive pulse based on IEC61000-4-2**



**Figure 6 Clamping voltage (ESD):  $V_{cl} = f(t_p)$ , 8 kV negative pulse based on IEC61000-4-2**



4 Typical characteristic diagrams

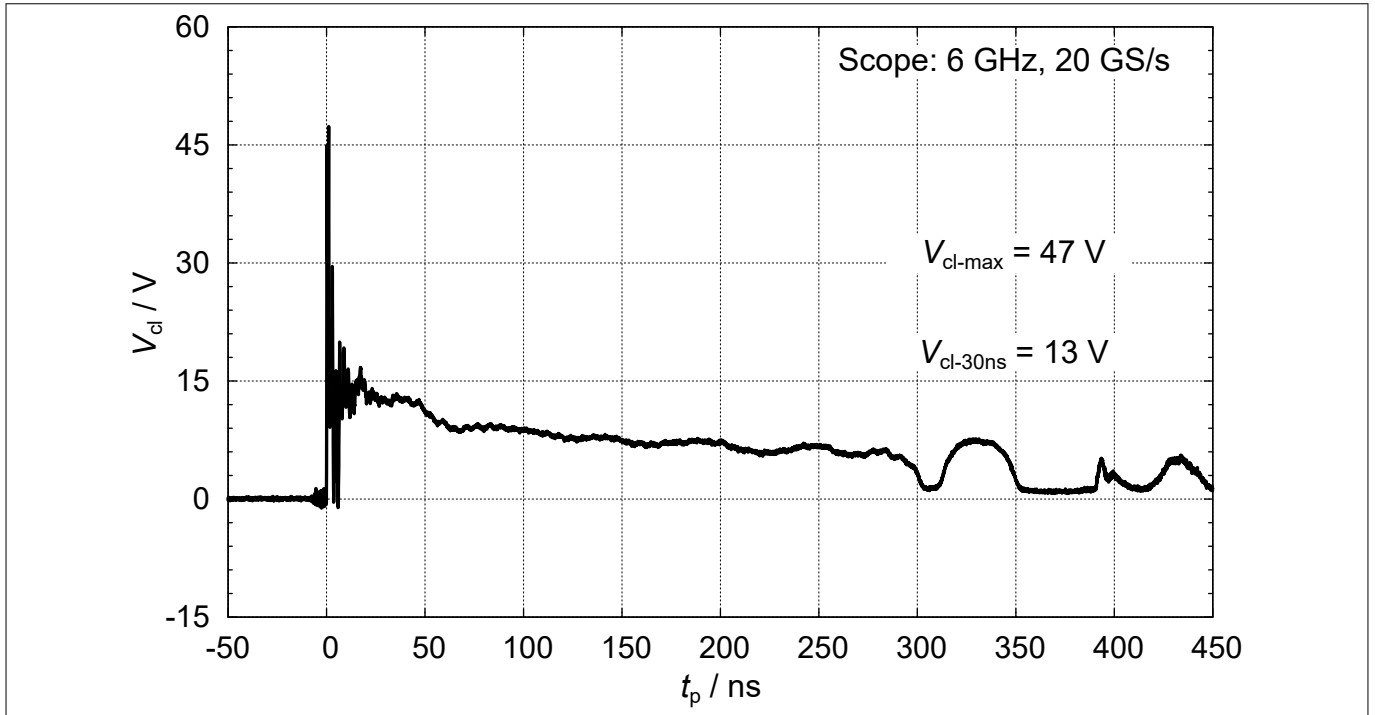


Figure 7 Clamping voltage (ESD):  $V_{cl} = f(t_p)$ , 15 kV positive pulse based on IEC61000-4-2

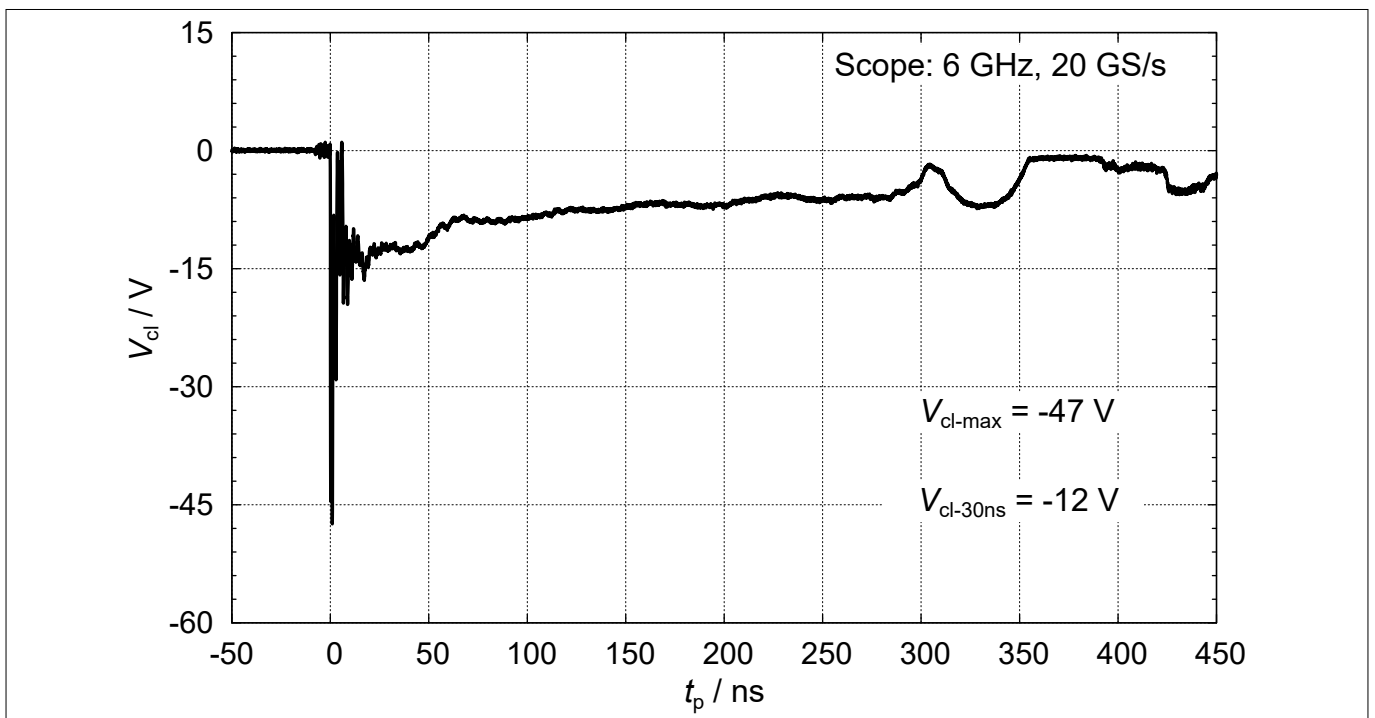


Figure 8 Clamping voltage (ESD):  $V_{cl} = f(t_p)$ , 15 kV negative pulse based on IEC61000-4-2

4 Typical characteristic diagrams

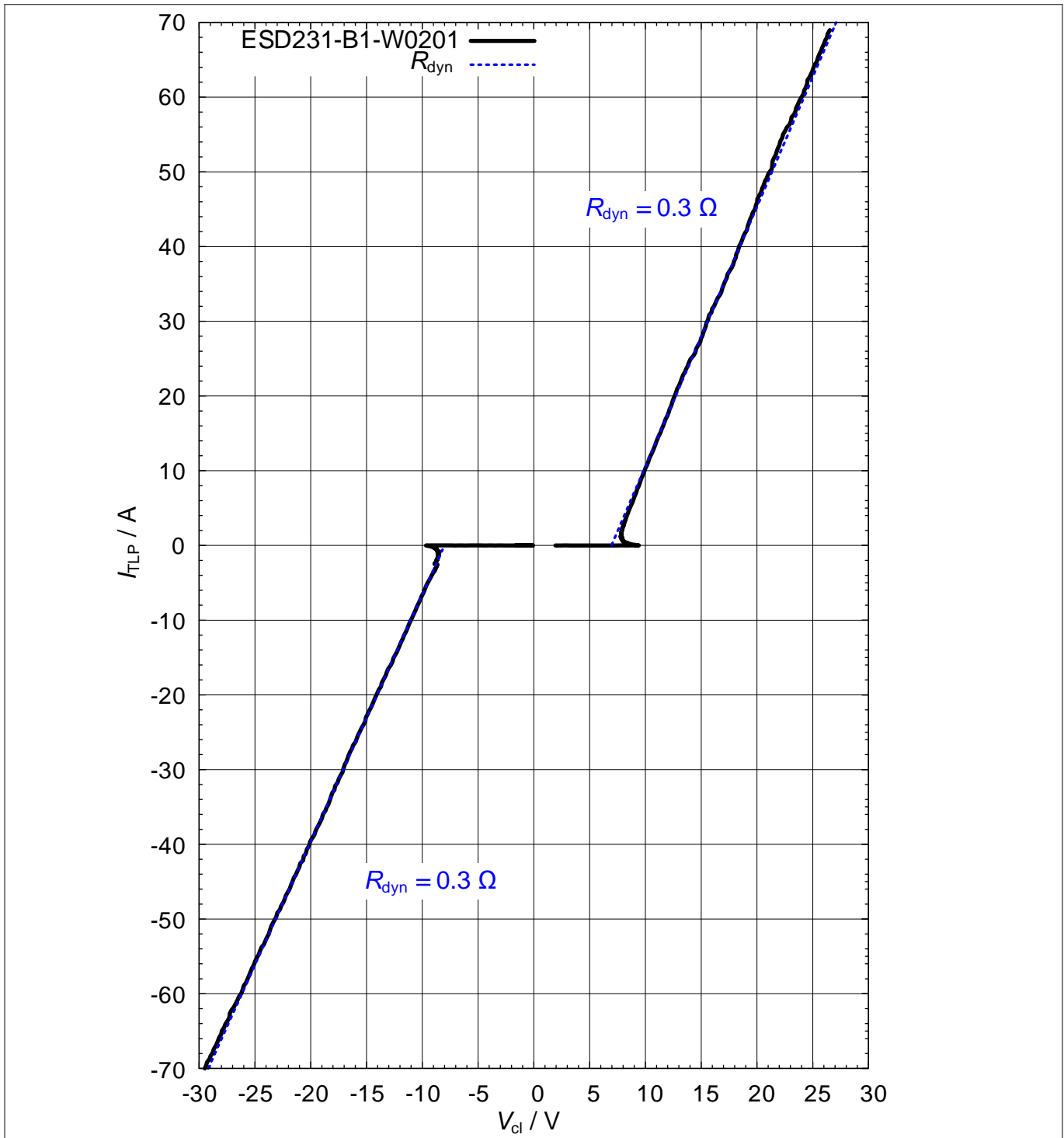


Figure 9 Clamping voltage (TLP):  $I_{TLP} = f(V_{cl})$

4 Typical characteristic diagrams

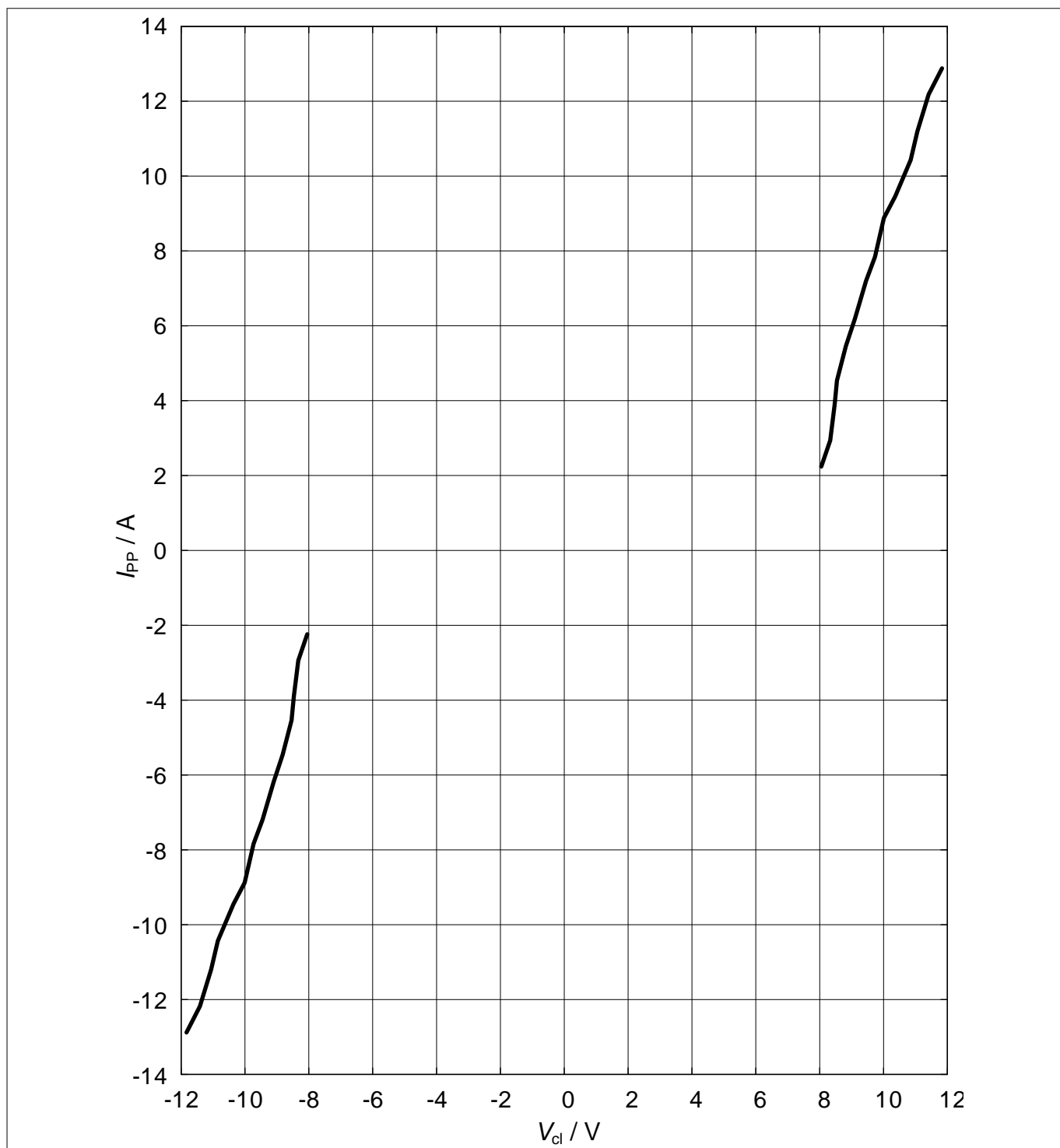
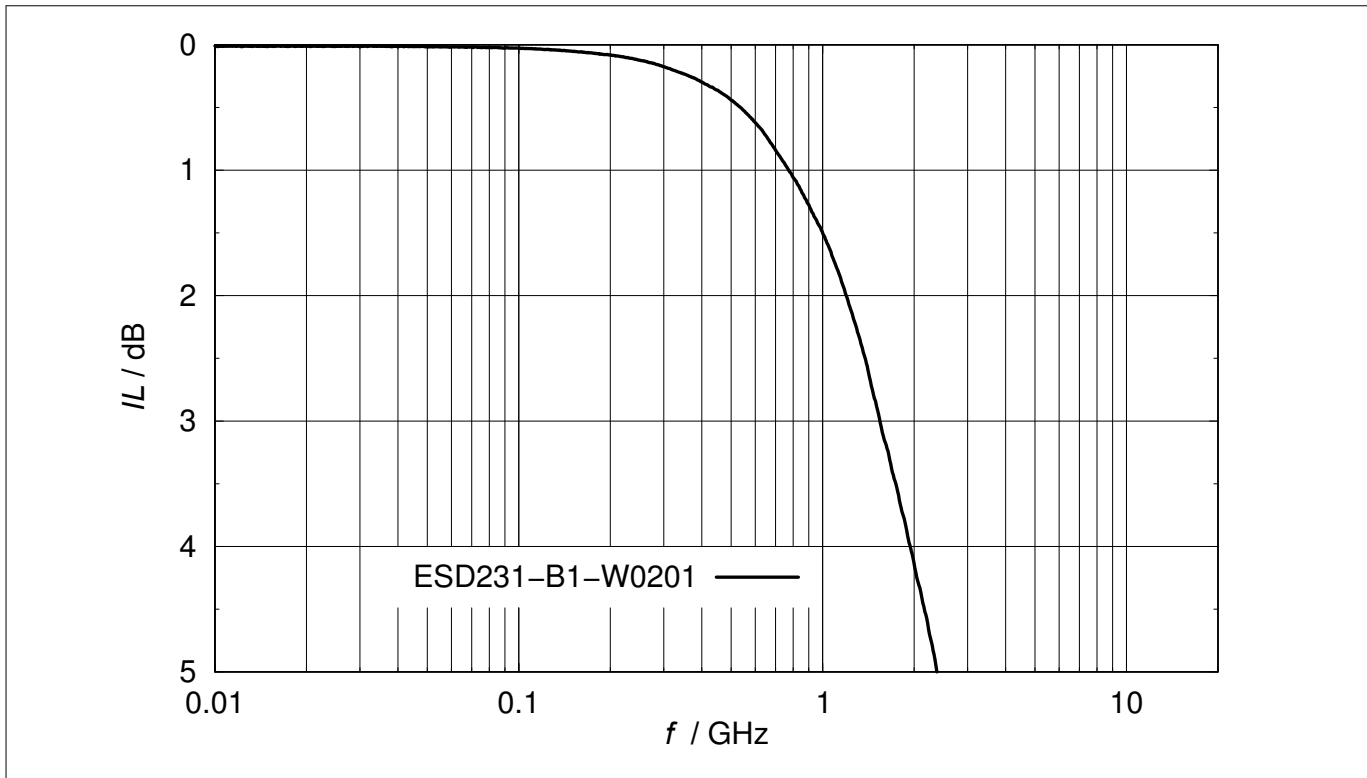


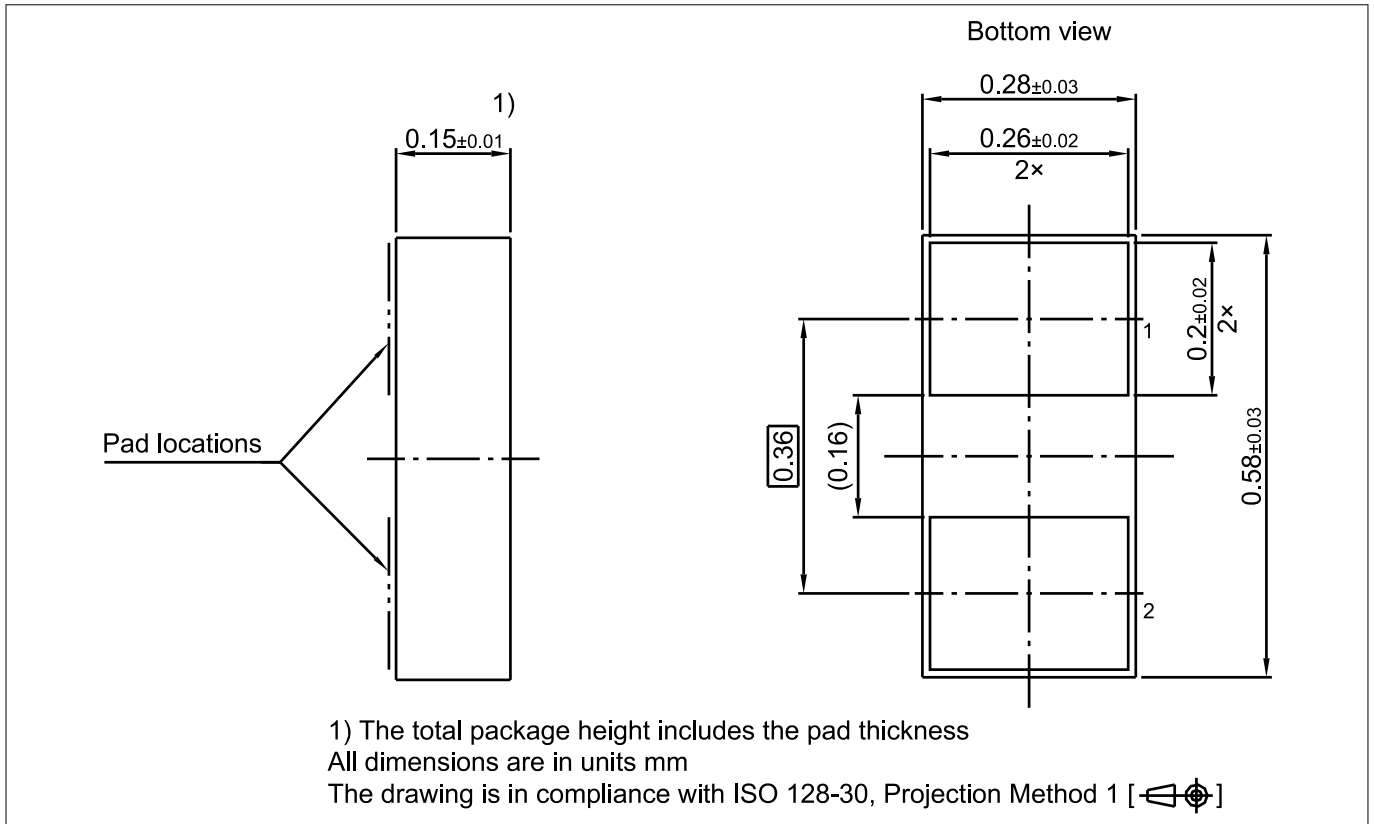
Figure 10 Clamping voltage (Surge):  $I_{pp} = f(V_{cl})$ , based on IEC61000-4-5

4 Typical characteristic diagrams



**Figure 11** Insertion loss vs. frequency in a 50 Ω system

## 5 Package information WLL-2-1



**Figure 12** WLL-2-1 package

Note: For package information including footprint, packing and assembly recommendation refer to:

<https://www.infineon.com/cms/en/product/packages/SG-WLL/SG-WLL-2-1/>

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## 6 References

### 6 References

[1]	Infineon AG - Understanding ESD protection device characteristics
[2]	Infineon AG - <b>Application note AN210</b> : Effective ESD Protection Design at System Level Using VF-TLP Characterization Methodology

### 7 Revision history

Document version	Date of release	Description of changes
1.2	2017-10-17	<ul style="list-style-type: none"><li>• First final datasheet release</li></ul>
1.3	2018-11-07	<ul style="list-style-type: none"><li>• Insertion loss diagram updated</li><li>• Minor editorial changes</li></ul>
2.0	2020-11-30	<ul style="list-style-type: none"><li>• New datasheet layout</li></ul>
2.1	2021-05-17	<ul style="list-style-type: none"><li>• Diagram updated</li></ul>

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