

# ESD133-B1-W01005

Bi-directional ESD protection device, 5.5 V, 0.2 pF, 01005



## 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):  $\pm 20$  kV (air) /  $\pm 20$  kV (contact)
  - IEC61000-4-4 (EFT):  $\pm 2.5$  kV /  $\pm 50$  A (5/50 ns)
  - IEC61000-4-5 (Surge):  $\pm 3$  A (8/20  $\mu$ s)
- Bi-directional maximum working voltage:  $V_{WM} = \pm 5.5$  V
- Line capacitance:  $C_L = 0.2$  pF at  $f = 1$  MHz
- Clamping voltage:  $V_{cl} = 13$  V at  $I_{TLP} = 16$  A with  $R_{dyn} = 0.56 \Omega$
- Very low leakage current:  $I_L = 1$  nA
- Small form factor SMD size 01005, low profile (0.43 x 0.23 x 0.15 mm<sup>3</sup>)



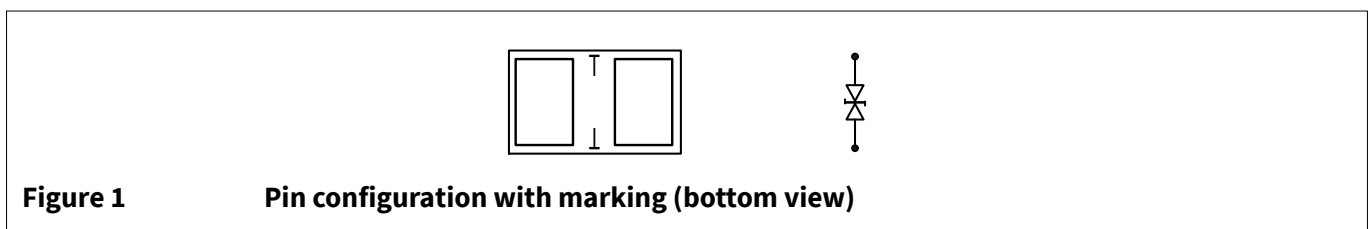
## Potential applications

- USB 3.x Gen 1 / Gen 2, Thunderbolt
- HDMI, DisplayPort

## Product validation

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

## Device information



**Table 1** Part information

Product name / Ordering code	Package	Pin configuration	Marking	Pieces / Reel
ESD133-B1-W01005/ ESD133B1W01005E6327XTSA1	WLL-2-2	1 line, bi-directional	T	15 k

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**1 Absolute maximum ratings**

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**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)	-20	+20	kV	Discharge network: $R = 330 \Omega$ , $C = 150 \text{ pF}$ <sup>1)</sup>
	$V_{ESD}$ (air)	-20	+20		
Peak pulse power	$P_{PK}$	-	21	W	Stress pulse: 8/20 $\mu\text{s}$ current waveform <sup>2)</sup>
Peak pulse current	$I_{PP}$	-3	+3	A	
Operating temperature	$T_{op}$	-55	+125	°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.*

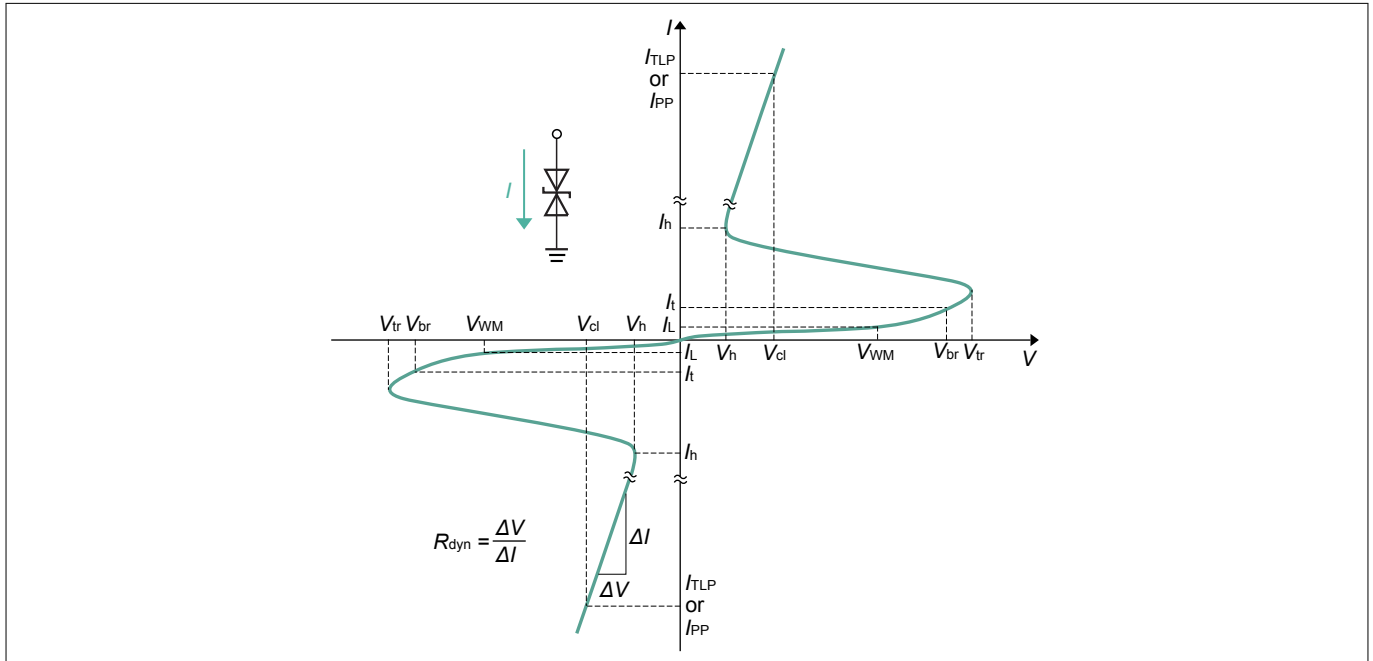
<sup>1</sup> Based on IEC61000-4-2.

<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
$V_{br}$	Breakdown voltage
$V_{cl}$	Clamping voltage
$V_h$	Holding voltage
$V_t$	Test voltage
$V_{tr}$	Trigger voltage
$V_{WM}$	Maximum working voltage

Note: For more detailed explanation of electrical parameters refer to [\[1\]](#)

## 2 Electrical characteristics

**Table 4 DC characteristics**

Parameter	Symbol	Values			Unit	Note or test condition
		Min.	Typ.	Max.		
Breakdown voltage	$V_{br}$	6.5	8	10	V	$I_t = 1 \text{ mA}$
Holding voltage	$V_h$	–	1.9	–	V	$I = I_h$
Holding current	$I_h$	–	25	–		$V = V_h$
Leakage current	$I_L$	–	1	100	nA	$V_{WM} = 5.5 \text{ V}$

**Table 5 AC characteristics**

Parameter	Symbol	Values			Unit	Note or test condition
		Min.	Typ.	Max.		
Line capacitance	$C_L$	–	0.2	–	pF	$V = 0 \text{ V}, f = 1 \text{ MHz}$
		–	0.2	–		$V = 0 \text{ V}, f = 2.5 \text{ GHz}$
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>3) 4)</sup>	$V_{cl}$	–	8.5	–	V	$I_{TLP} = 8 \text{ A}$
		–	13	–		$I_{TLP} = 16 \text{ A}$
Clamping voltage (8/20 $\mu\text{s}$ ) <sup>5)</sup>		–	3	–		$I_{PP} = 1 \text{ A}$
		–	7	–		$I_{PP} = 3 \text{ A}$
Dynamic resistance <sup>3)</sup>	$R_{dyn}$	–	0.56	–	$\Omega$	

<sup>3</sup> TLP parameters:  $Z_0 = 50 \Omega$ ,  $t_p = 100 \text{ ns}$ ,  $t_r = 0.6 \text{ ns}$ , averaging window 30-60 ns.

<sup>4</sup> Refer to application note AN210 [2]

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

3 Typical characteristic diagrams

### 3 Typical characteristic diagrams

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

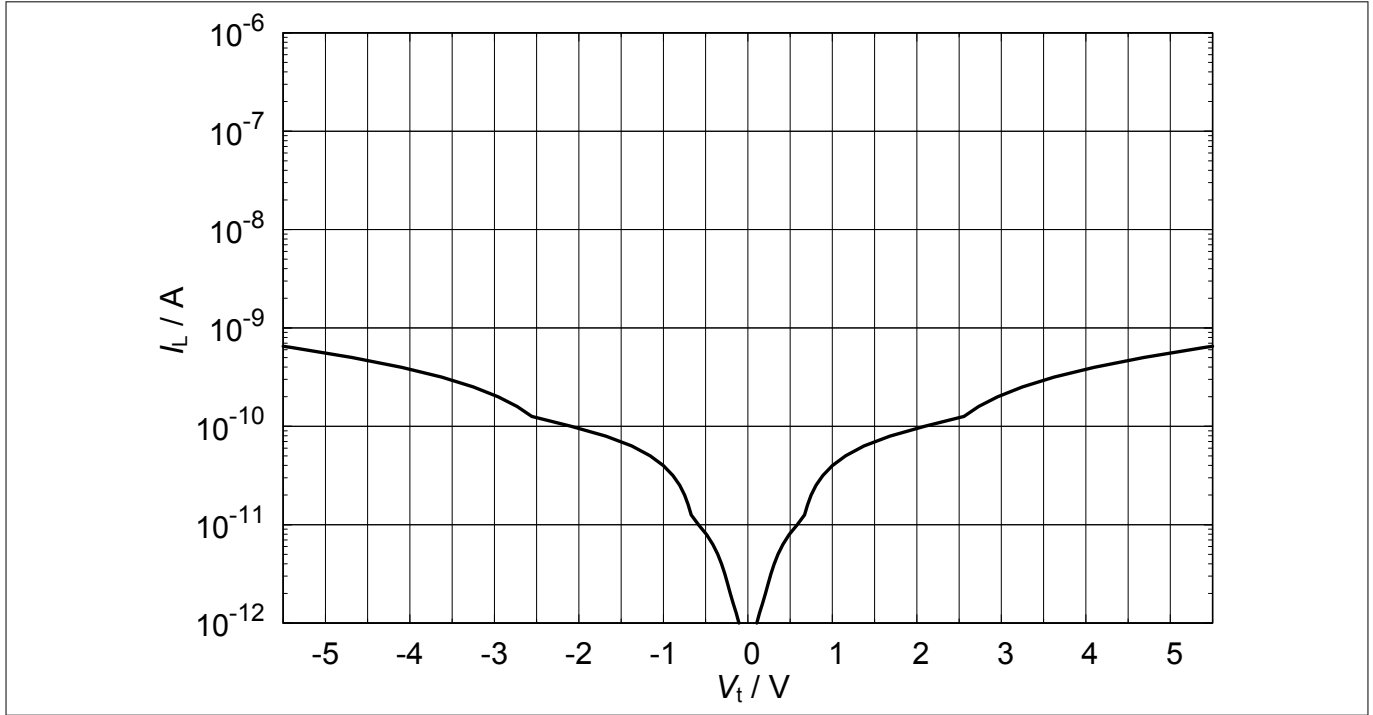


Figure 3 Leakage current:  $I_L = f(V_t)$

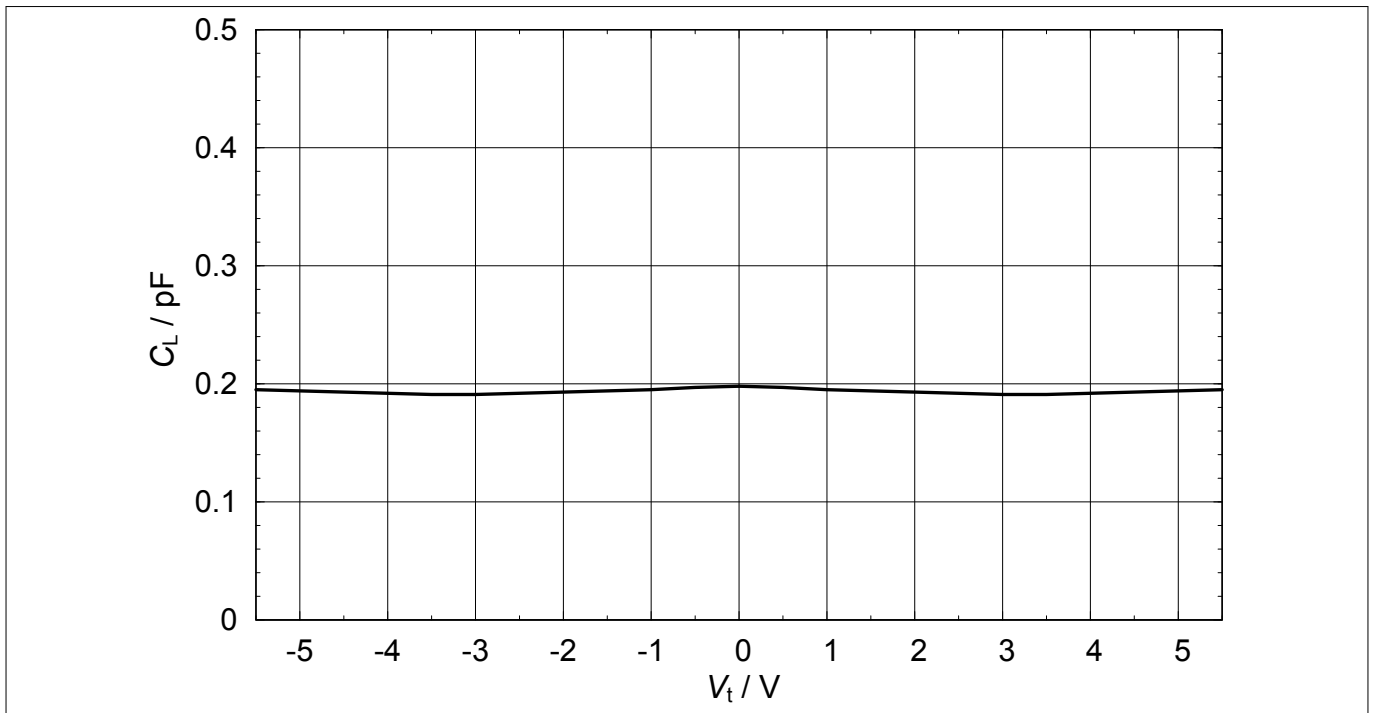


Figure 4 Line capacitance:  $C_L = f(V_t)$ ,  $f = 1\text{ MHz}$

3 Typical characteristic diagrams

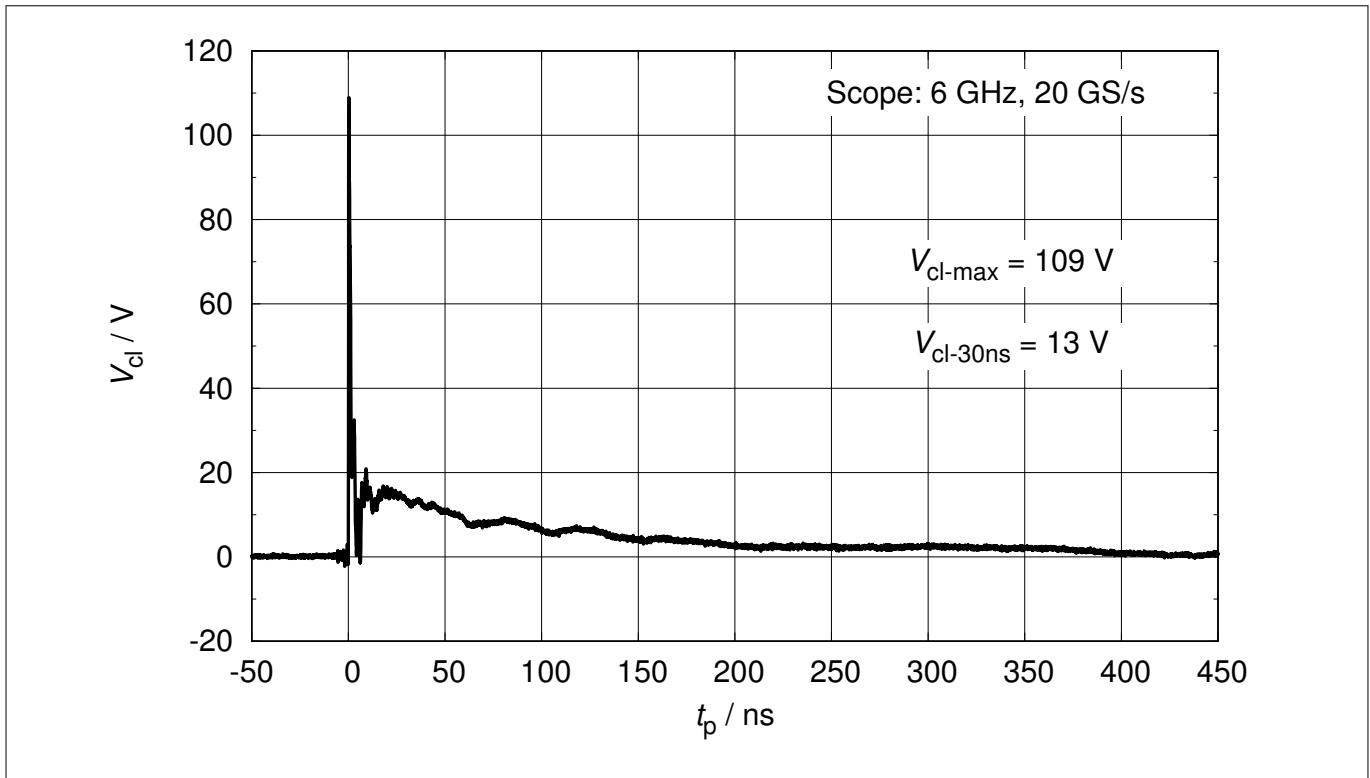


Figure 5 Clamping voltage (ESD):  $V_{cl} = f(t_p)$ , 8 kV positive pulse based on IEC61000-4-2

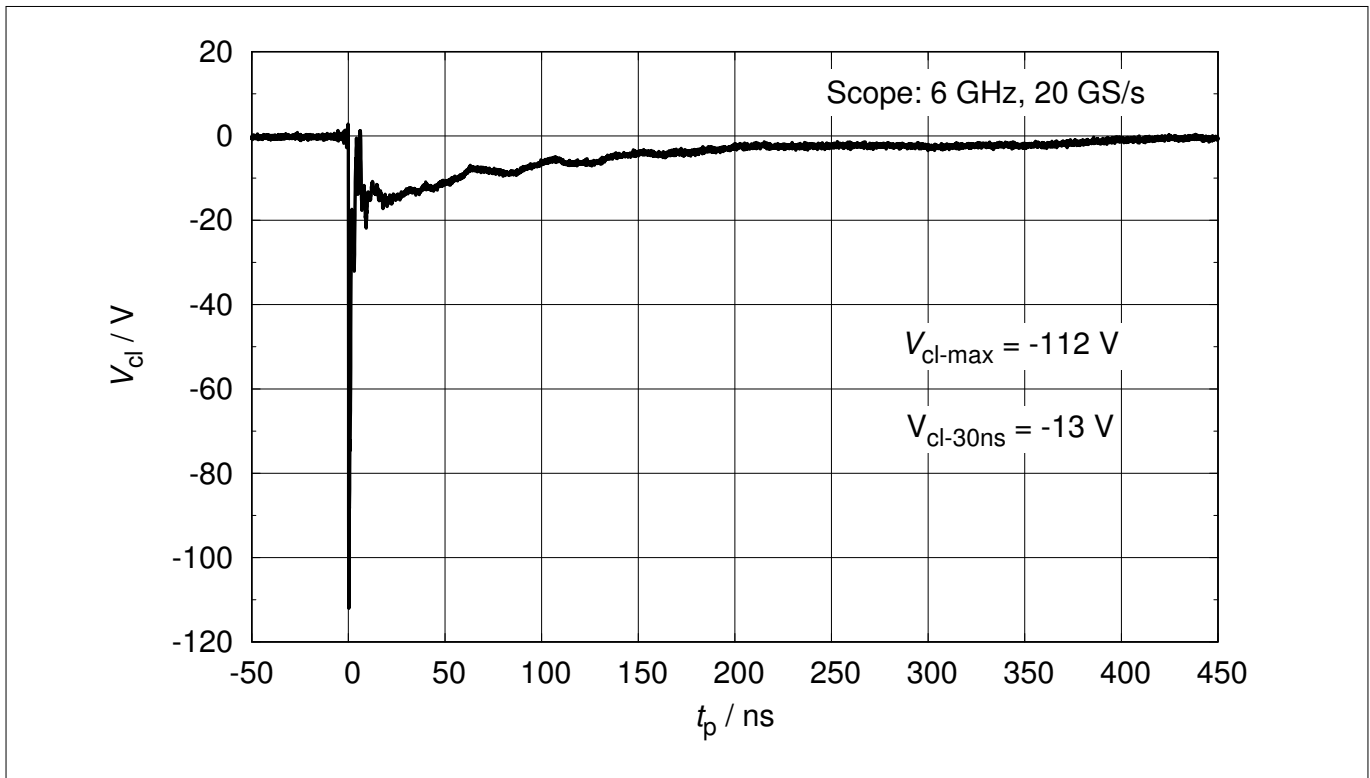


Figure 6 Clamping voltage (ESD):  $V_{cl} = f(t_p)$ , 8 kV negative pulse based on IEC61000-4-2

3 Typical characteristic diagrams

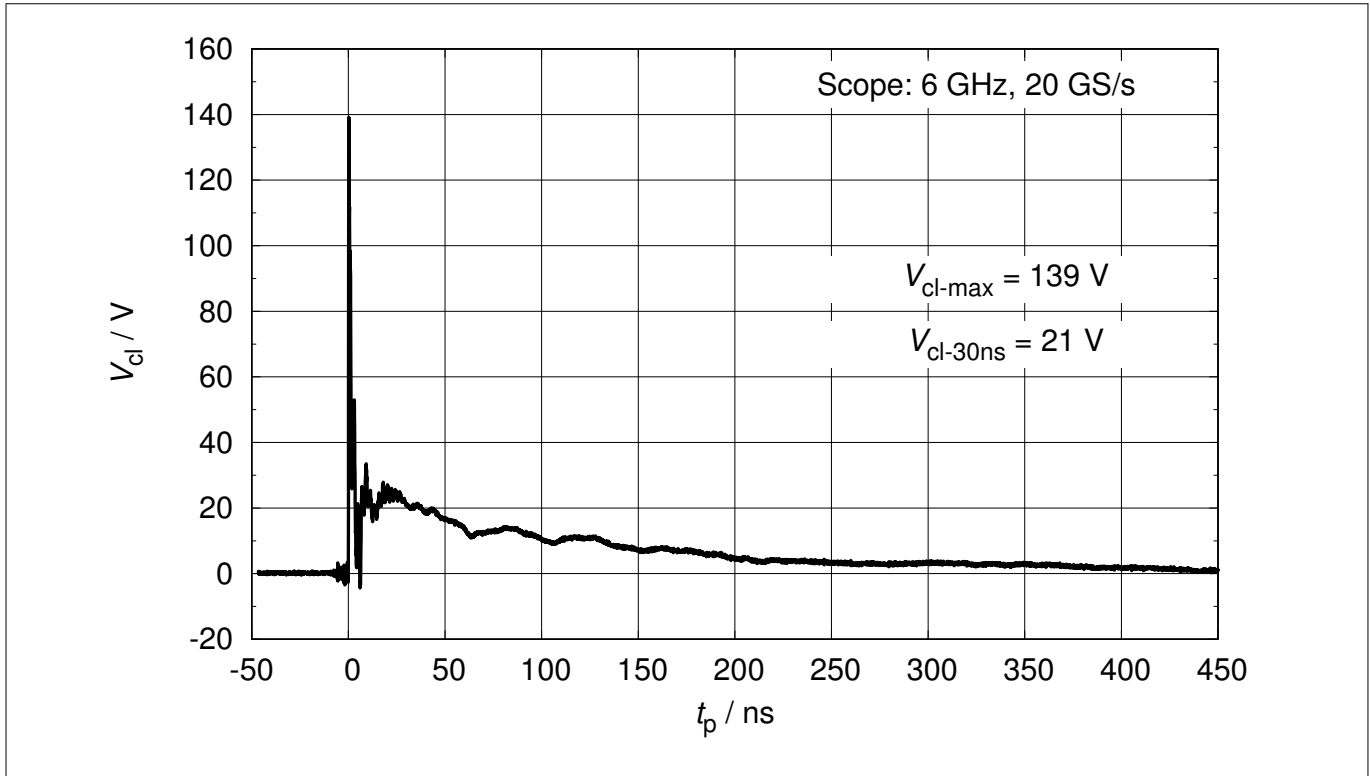


Figure 7 Clamping voltage (ESD):  $V_{cl} = f(t_p)$ , 15 kV positive pulse based on IEC61000-4-2

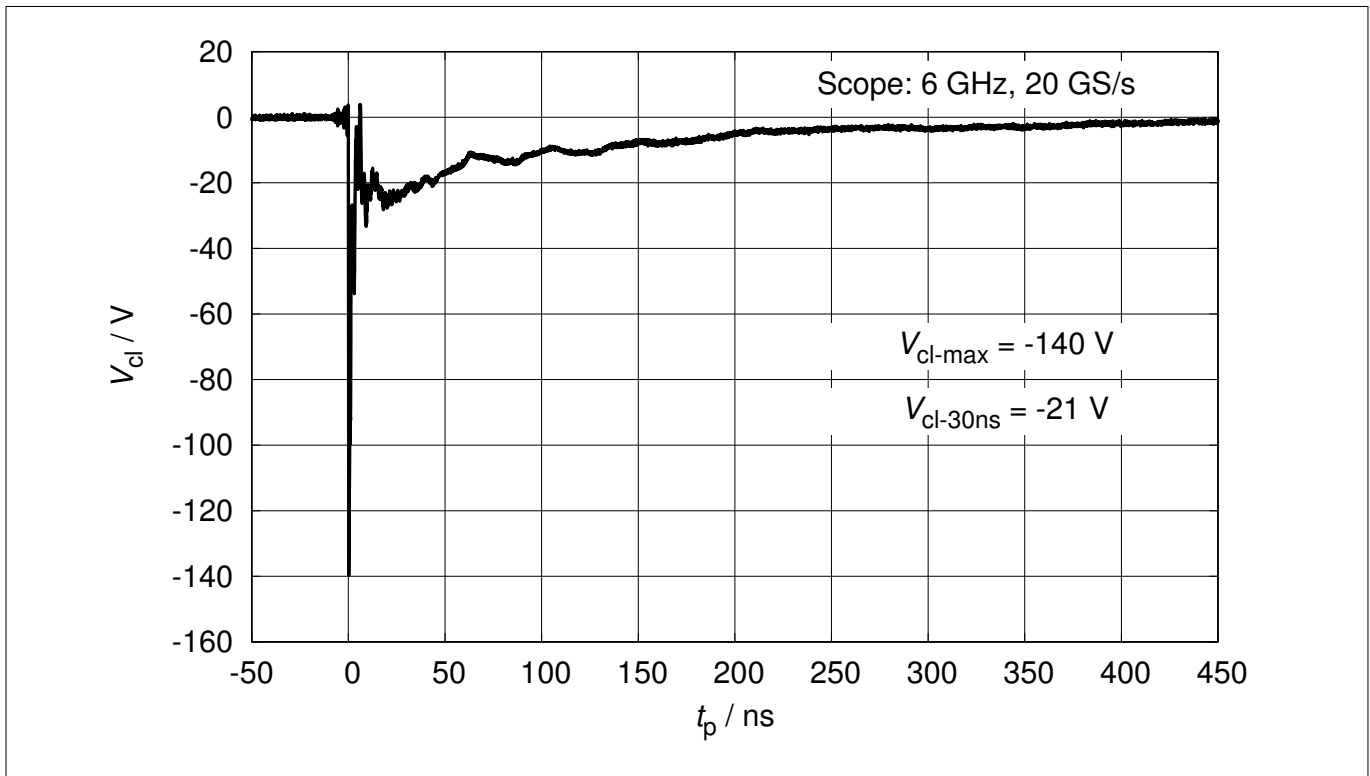


Figure 8 Clamping voltage (ESD):  $V_{cl} = f(t_p)$ , 15 kV negative pulse based on IEC61000-4-2



3 Typical characteristic diagrams

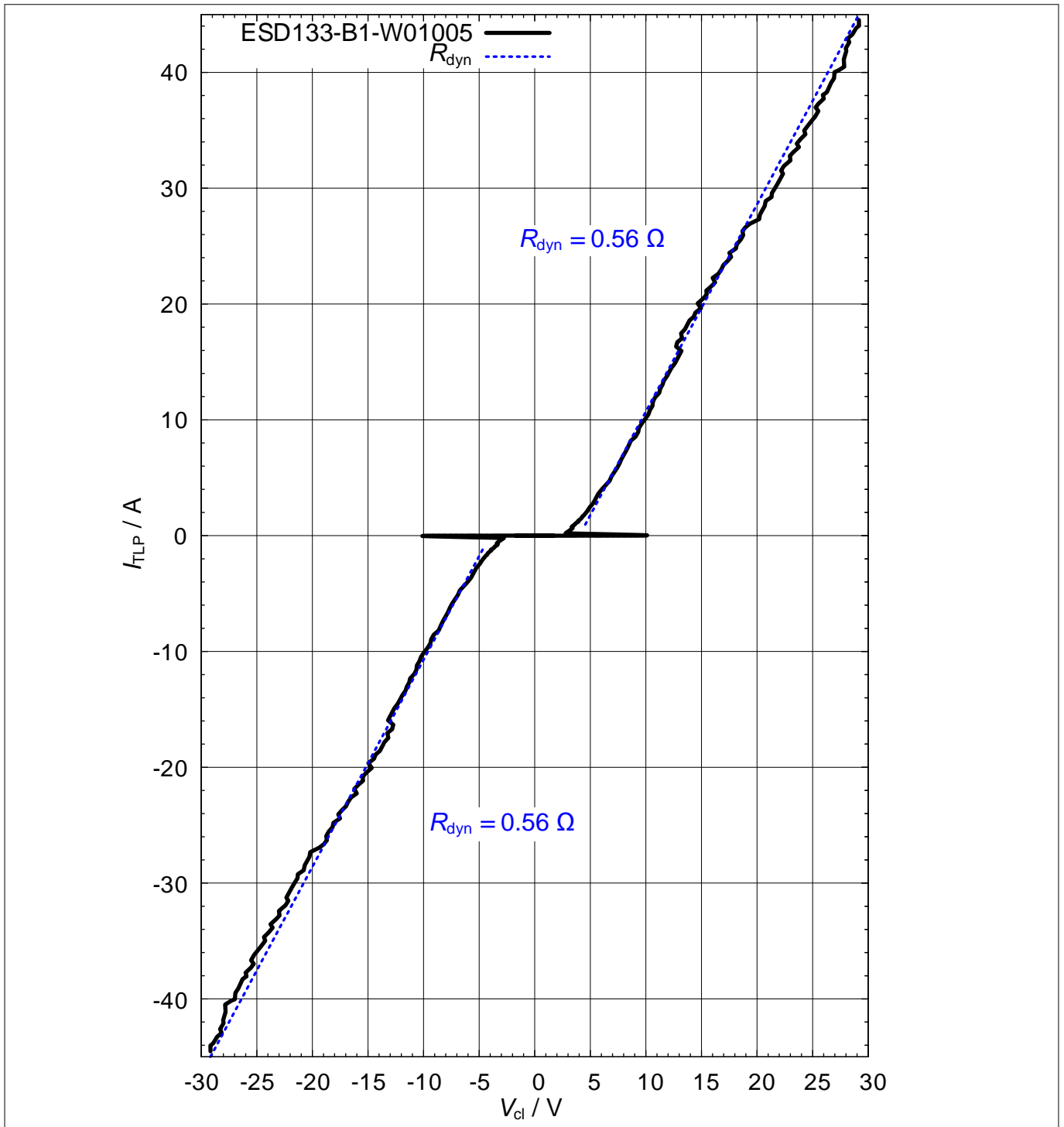
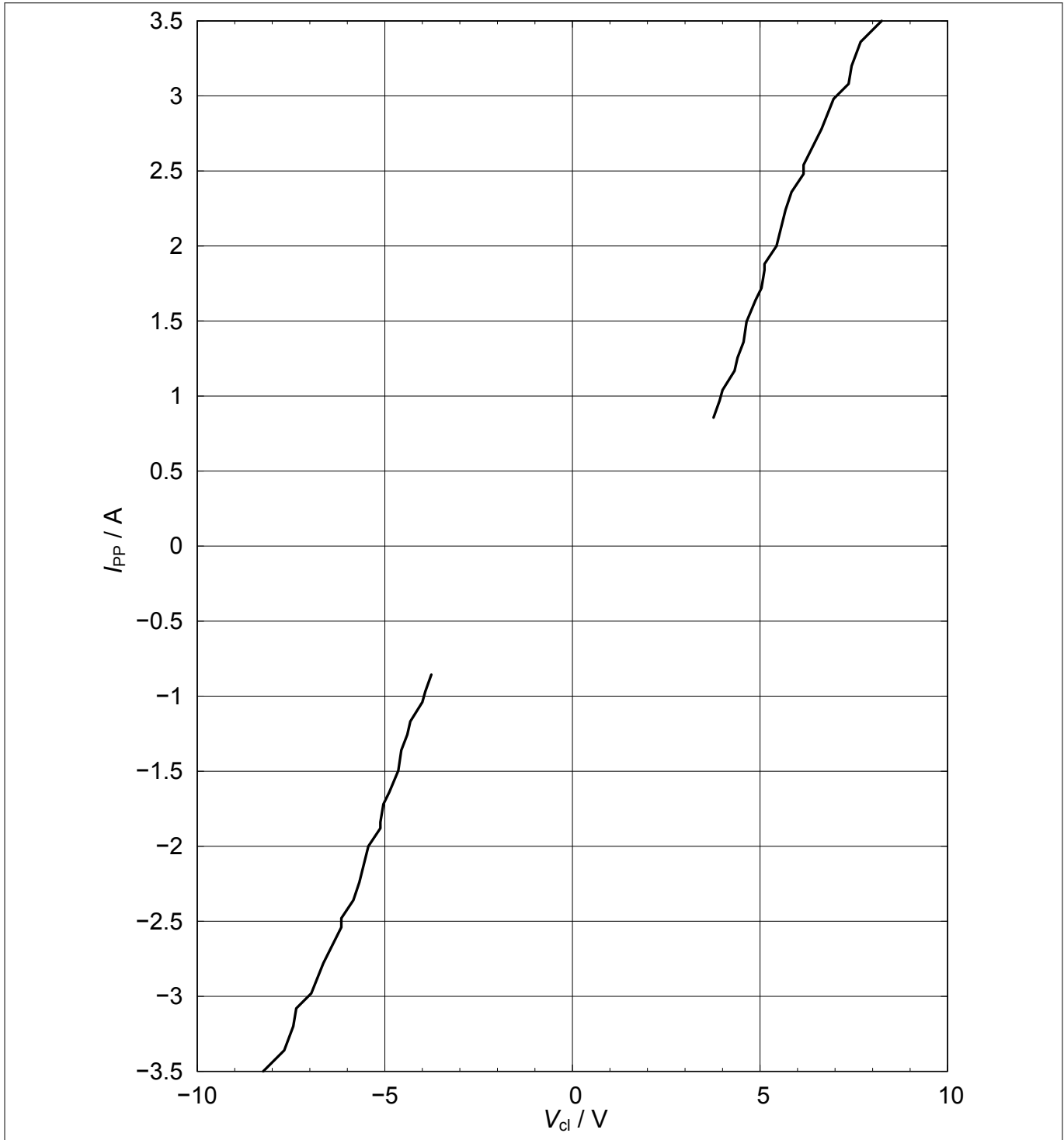


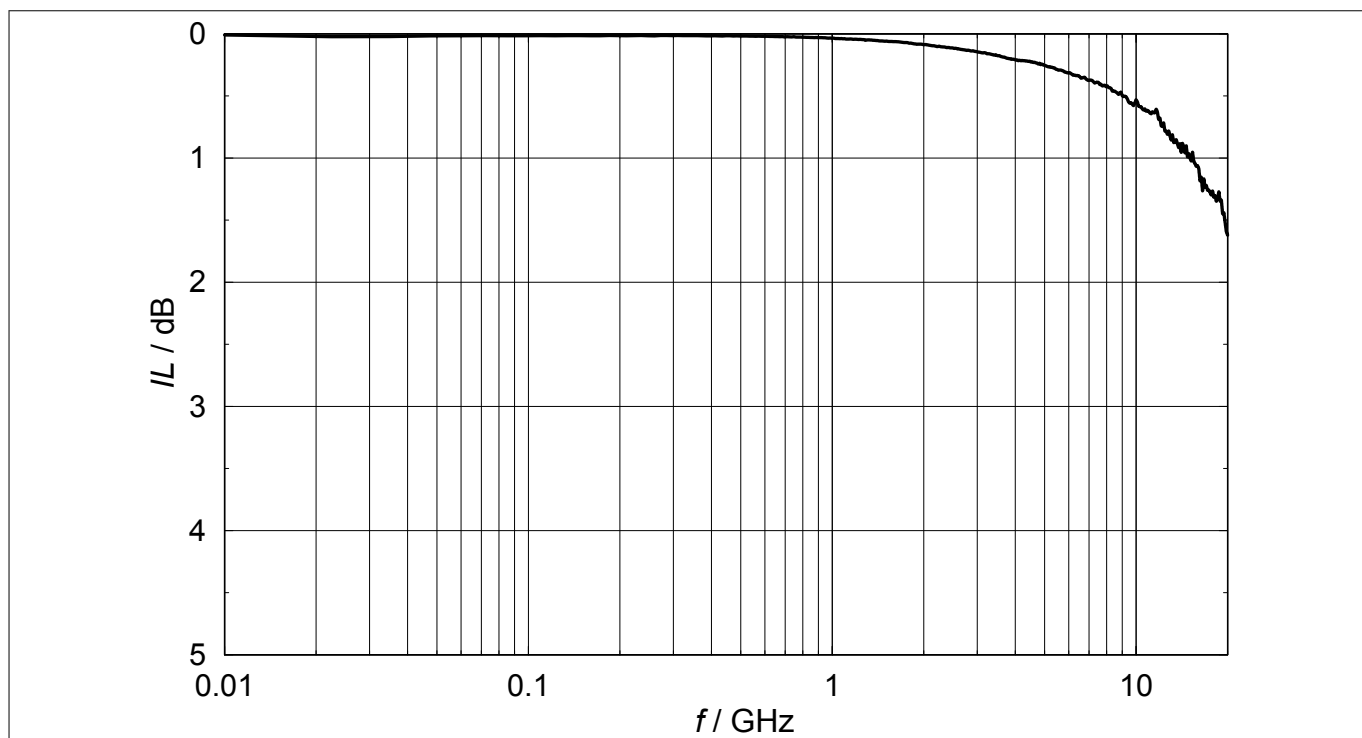
Figure 9 Clamping voltage (TLP):  $I_{TLP} = f(V_{cl})$

**3 Typical characteristic diagrams**



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

**3 Typical characteristic diagrams**



**Figure 11** Insertion loss  $IL = f(f)$ , measured in a 50  $\Omega$  system

4 Package information WLL-2-2

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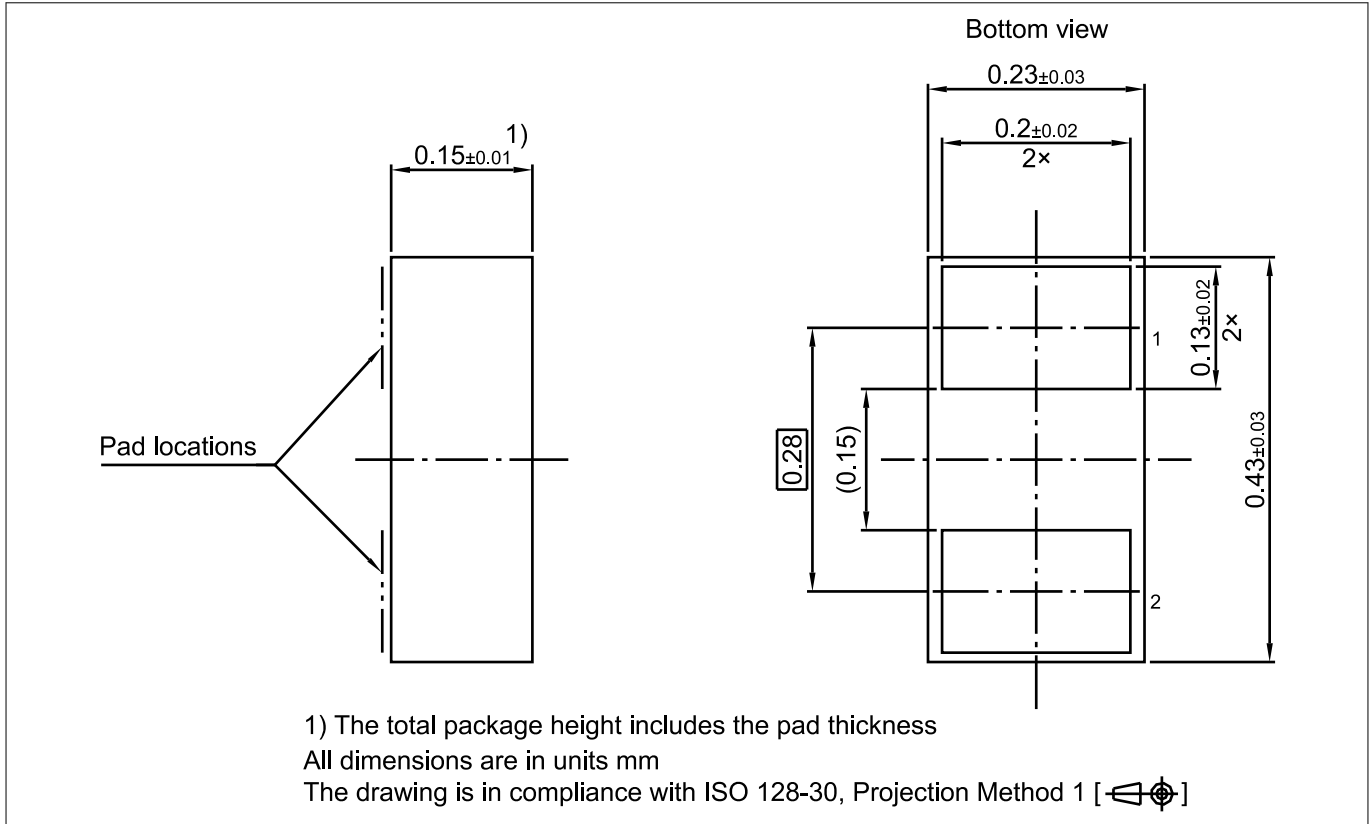


Figure 12 WLL-2-2 package

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

<https://www.infineon.com/packages/SG-WLL-2-2/>

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**5 References**

## **5 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

## **6 Revision history**

<b>Document version</b>	<b>Date of release</b>	<b>Description of changes</b>
1.0	2018-01-12	<ul style="list-style-type: none"><li>• Electrical characteristics updated</li><li>• Missing typical characteristic diagrams added</li><li>• Minor editorial changes</li></ul>
2.0	2020-11-30	<ul style="list-style-type: none"><li>• New datasheet layout</li></ul>

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