

# ESD157-B1-W01005

**Bi-directional ESD protection device, 3.6 V, 0.17 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):  $\pm 15$  kV (air) /  $\pm 15$  kV (contact)
  - IEC61000-4-4 (EFT):  $\pm 2.5$  kV /  $\pm 50$  A (5/50 ns)
  - IEC61000-4-5 (Surge):  $\pm 2$  A (8/20  $\mu$ s)
- Bi-directional maximum working voltage:  $V_{WM} = \pm 3.6$  V
- Line capacitance:  $C_L = 0.17$  pF at  $f = 10$  GHz
- Clamping voltage:  $V_{cl} = 5.4$  V at  $I_{TLP} = 16$  A with  $R_{dyn} = 0.18 \Omega$
- Very low leakage current:  $I_L = 0.1$  nA
- Small form factor SMD size 01005, low profile (0.43 x 0.23 x 0.15 mm<sup>3</sup>)



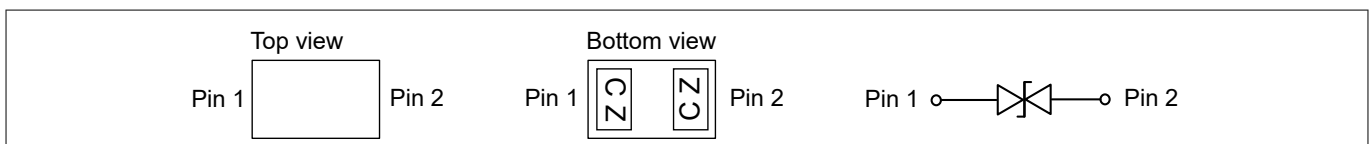
## Potential applications

- USB4, USB 3.x, USB 2.0, Thunderbolt 3
- HDMI 2.1, DisplayPort 1.4

## Product validation

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

## Device information



**Figure 1** Pin configuration and schematic diagram

**Table 1** Part information

Product name / Ordering code	Package	Pin configuration	Marking	Pieces / Reel
ESD157-B1-W01005 / ESD157B1W01005E6327XTSA1	WLL-2-2	1 line, bi-directional	CZ	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 <sup>1)</sup>	$V_{WM}$	-3.6	+3.6	V	
ESD discharge voltage	$V_{ESD}$ (contact)	-15	+15	kV	Discharge network: $R = 330 \Omega$ , $C = 150 \text{ pF}$ <sup>2)</sup>
	$V_{ESD}$ (air)	-15	+15		
Peak pulse power	$P_{PK}$	-	7.2	W	Stress pulse: 8/20 $\mu\text{s}$ current waveform <sup>3)</sup>
Peak pulse current	$I_{PP}$	-2	+2	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> Device snaps back to a low holding voltage, refer to application note [AN525](#) for latch-up prevention.

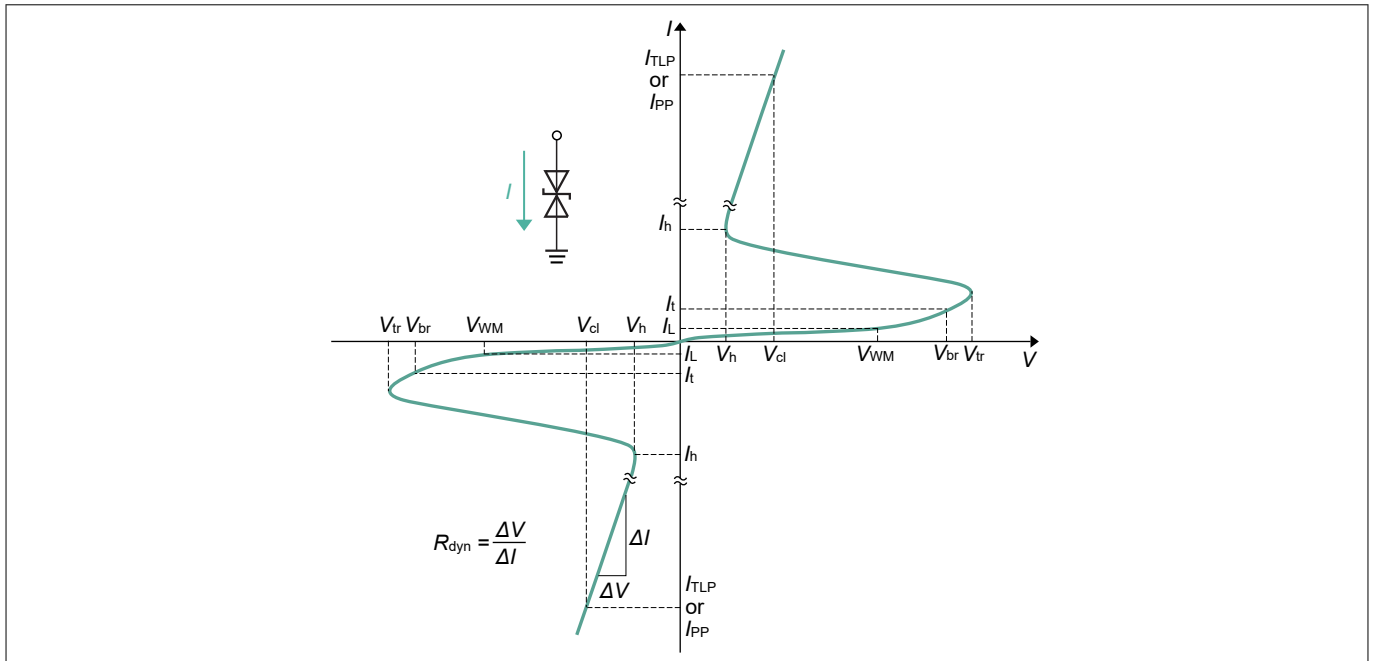
<sup>2)</sup> Based on IEC61000-4-2.

<sup>3)</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	$V_{br}$	5.9	8.4	9.6	V	$I_t = 1 \text{ mA}$
Holding voltage	$V_h$	–	2.5	–		$I = I_h$
Holding current	$I_h$	–	30	–	mA	$V = V_h$
Leakage current	$I_L$	–	0.1	20	nA	$V_{WM} = 3.6 \text{ V}$

**Table 5 AC characteristics**

Parameter	Symbol	Values			Unit	Note or test condition
		Min.	Typ.	Max.		
Line capacitance	$C_L$	–	0.26	–	pF	$V = 0 \text{ V}, f = 1 \text{ MHz}$
		–	0.18	–		$V = 0 \text{ V}, f = 1 \text{ GHz}$
		–	0.17	–		$V = 0 \text{ V}, f = 5 \text{ GHz}$
		–	0.17	–		$V = 0 \text{ V}, f = 10 \text{ GHz}$
Series inductance	$L_S$	–	<0.1	–	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>	$V_{cl}$	–	3.4	–	V	$I_{TLP} = 4 \text{ A}$
		–	4	–		$I_{TLP} = 8 \text{ A}$
		–	5.4	–		$I_{TLP} = 16 \text{ A}$
		–	8.1	–		$I_{TLP} = 30 \text{ A}$
Clamping voltage (8/20 $\mu\text{s}$ ) <sup>6)</sup>		–	3.2	–		$I_{PP} = 1 \text{ A}$
		–	3.6	–		$I_{PP} = 2 \text{ A}$
Dynamic resistance <sup>4)</sup>	$R_{dyn}$	–	0.18	–	$\Omega$	

<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.

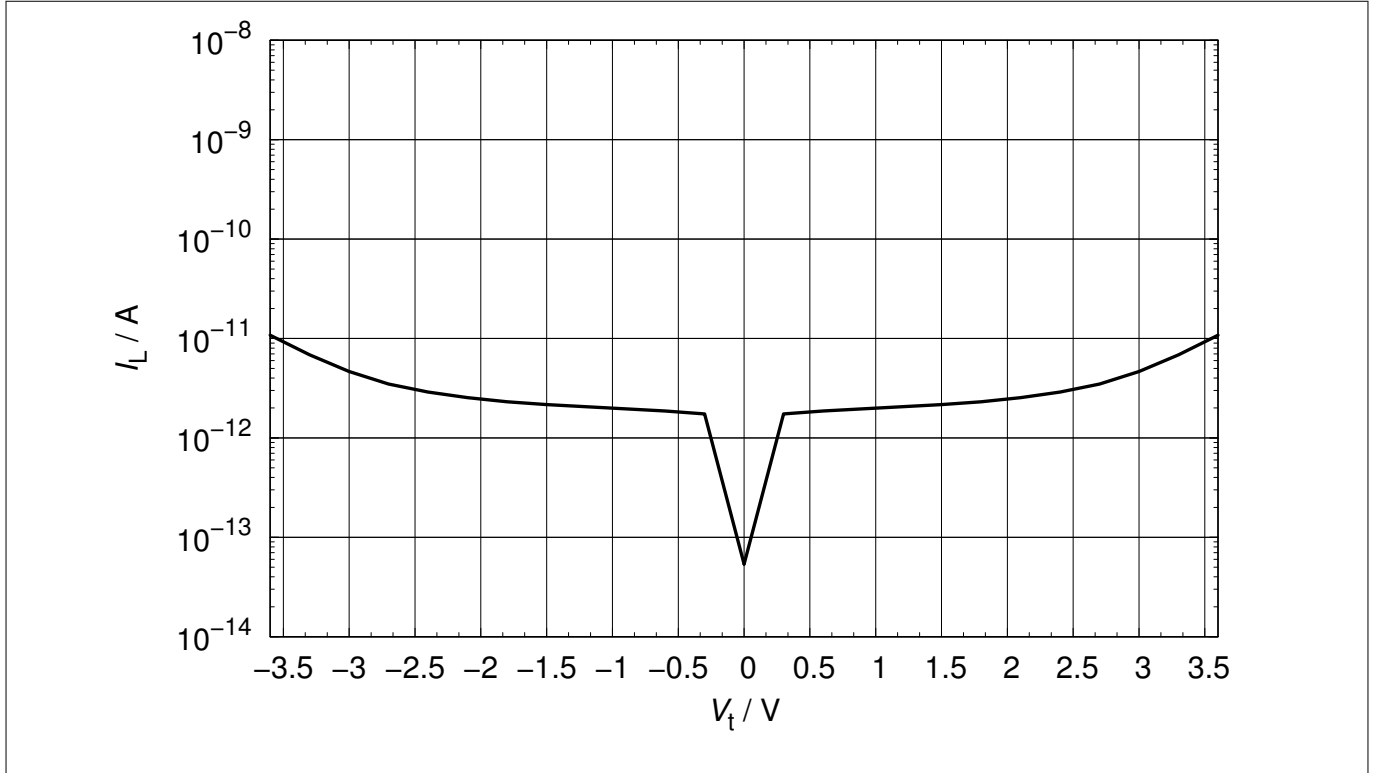
<sup>5)</sup> Refer to application note AN210 [2]

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

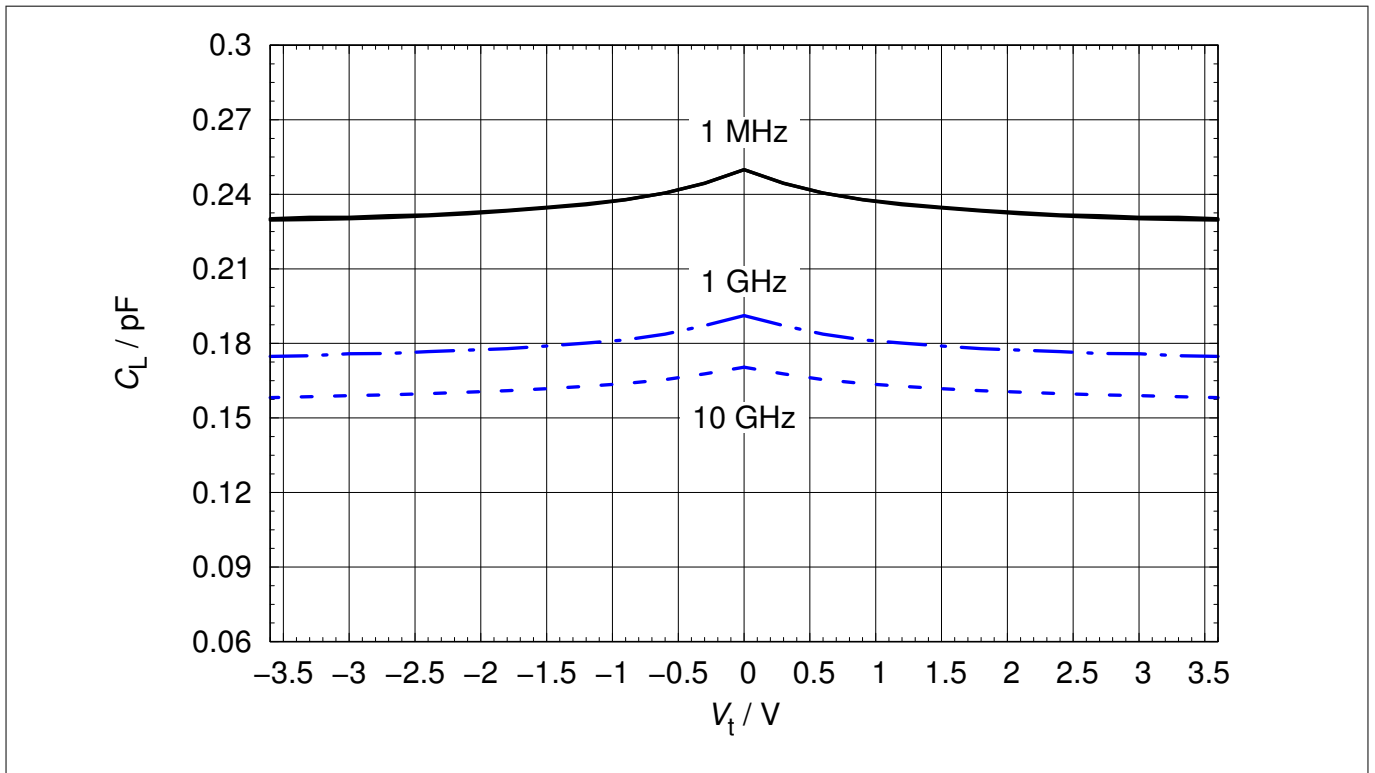
**3 Typical characteristic diagrams**

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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:  $C_L = f(V_t)$ ,  $f = 1\text{ MHz}, 1\text{ GHz}, 10\text{ GHz}$

3 Typical characteristic diagrams

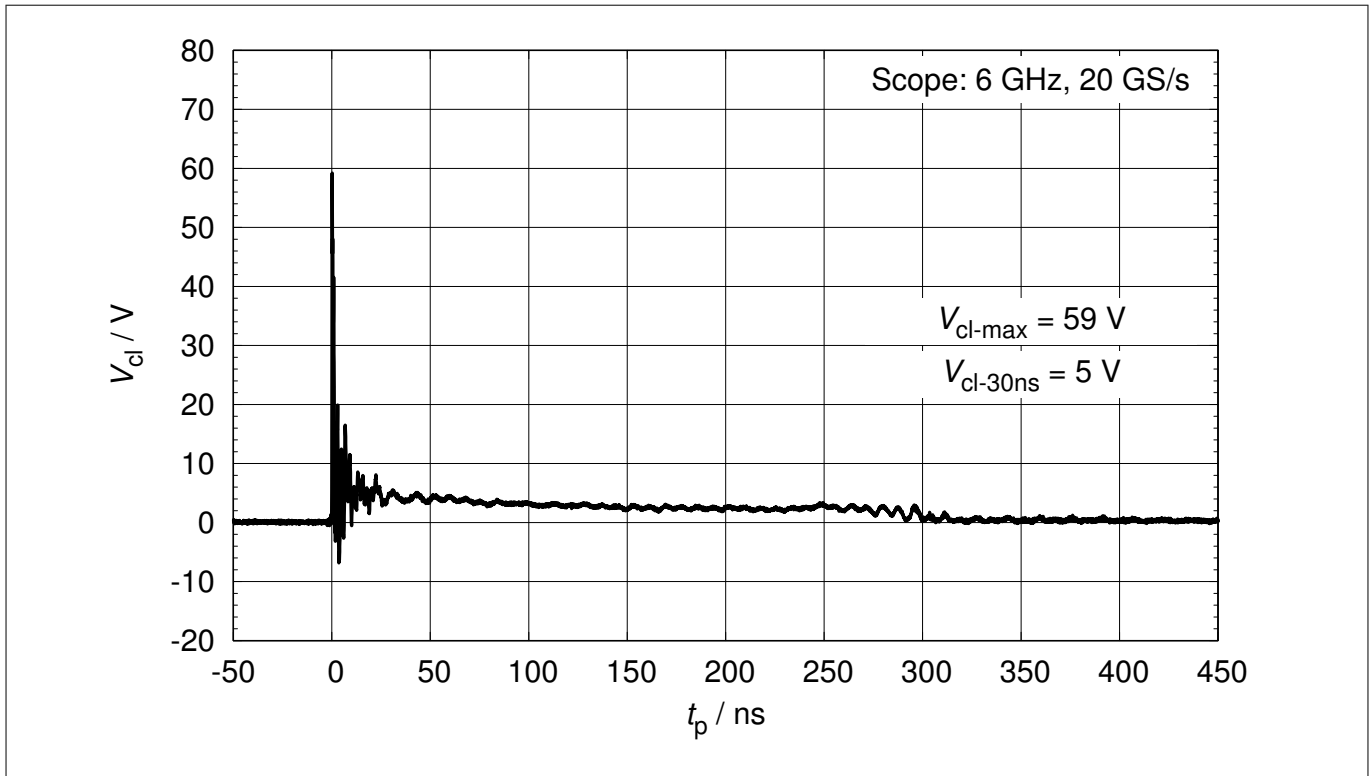


Figure 5 Clamping voltage (ESD):  $V_{cl} = f(t_p)$ , 8 kV positive pulse based on IEC61000-4-2

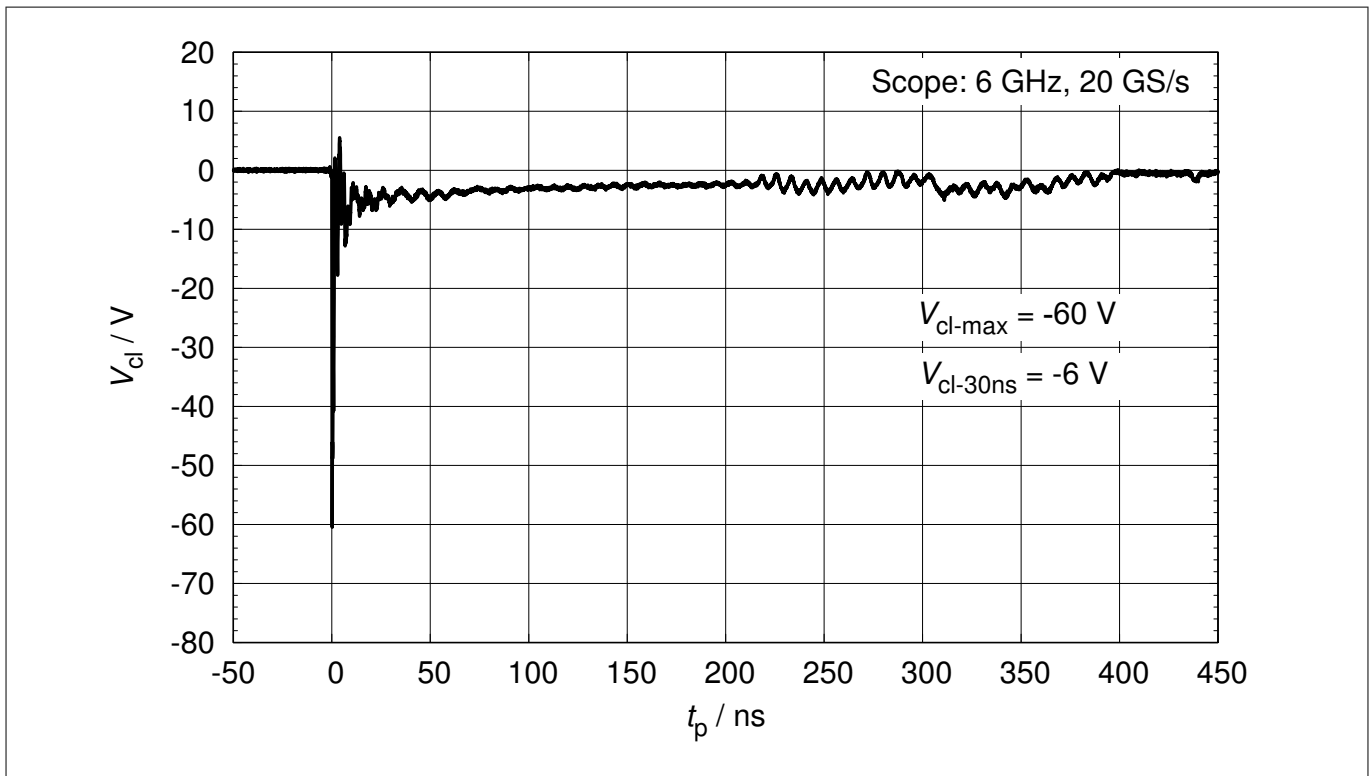


Figure 6 Clamping voltage (ESD):  $V_{cl} = f(t_p)$ , 8 kV negative pulse based on IEC61000-4-2

3 Typical characteristic diagrams

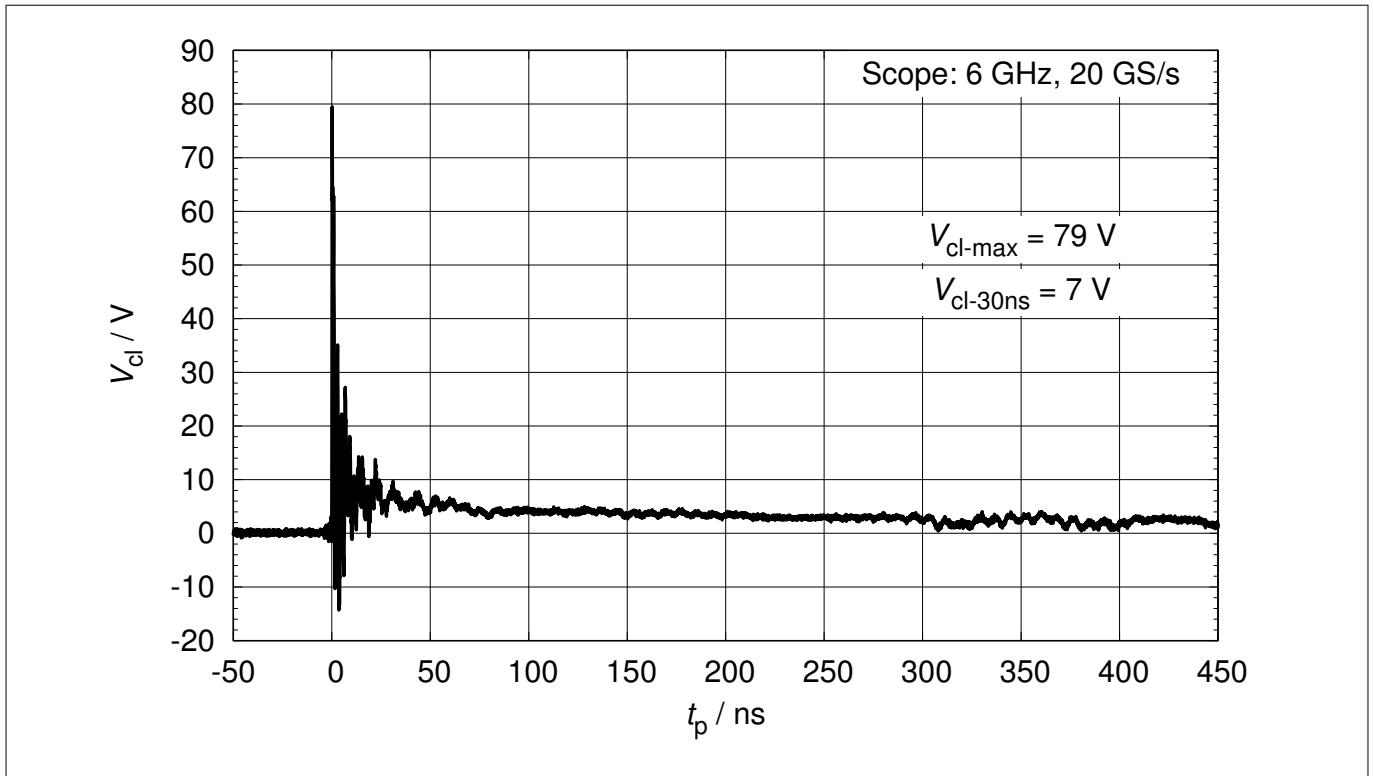


Figure 7 Clamping voltage (ESD):  $V_{cl} = f(t_p)$ , 15 kV positive pulse based on IEC61000-4-2

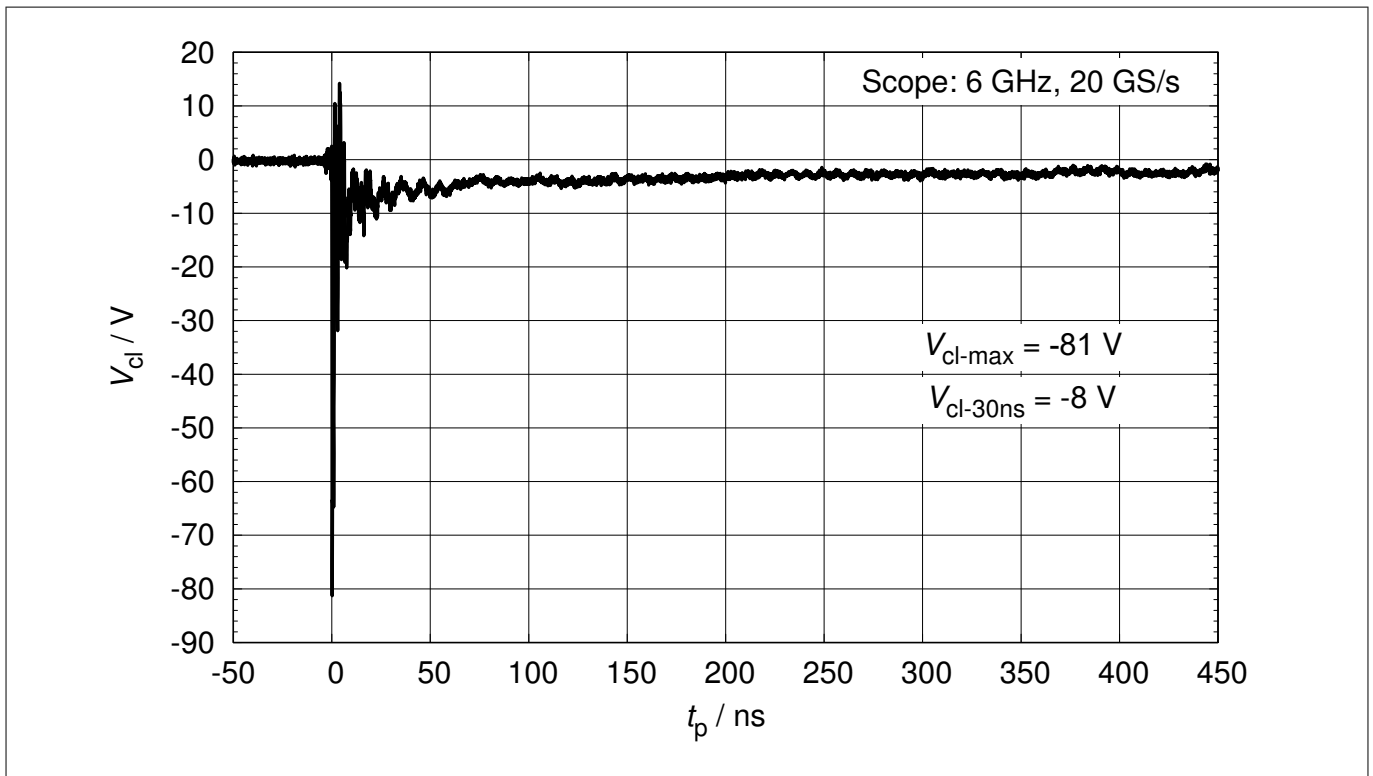
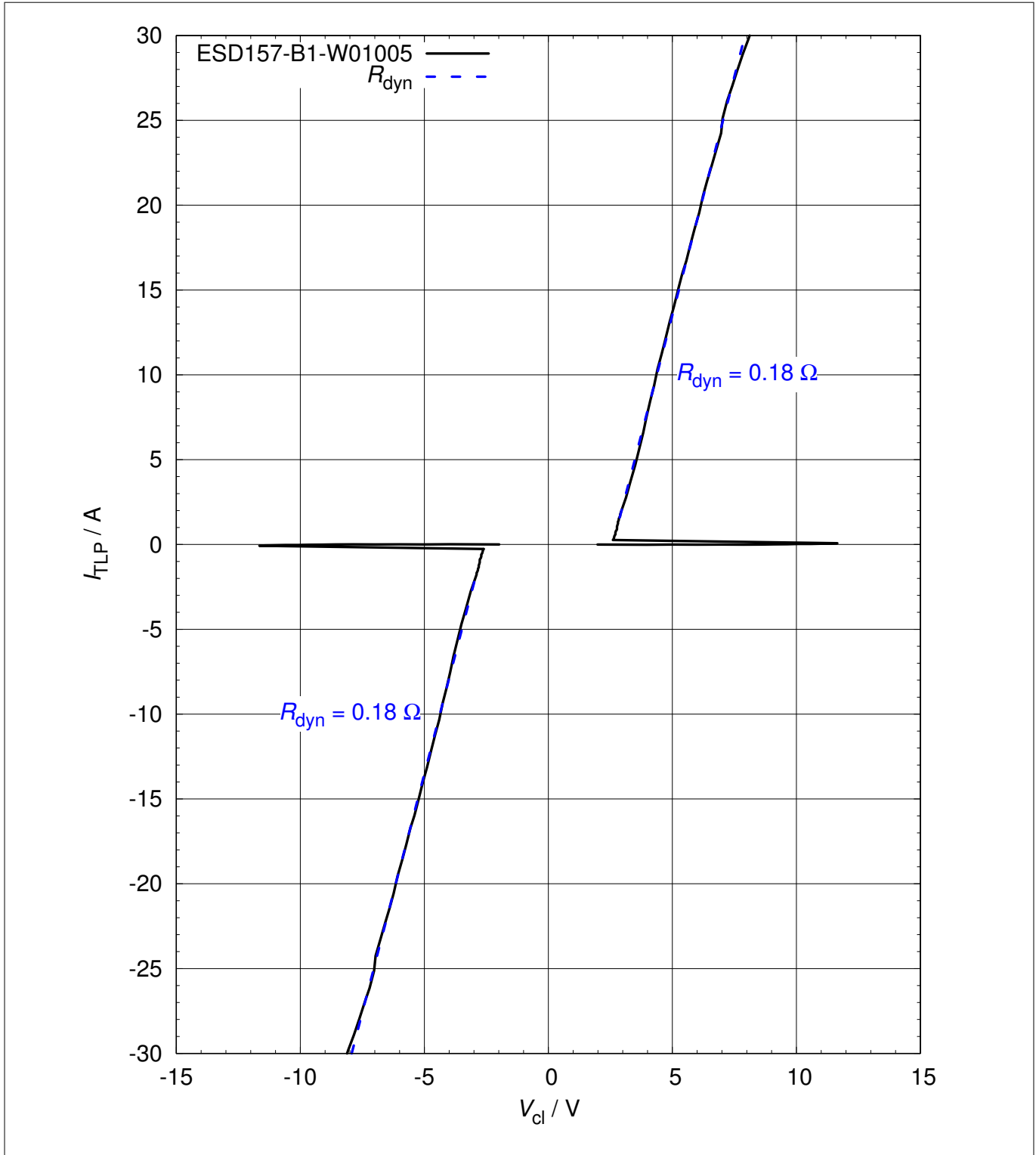


Figure 8 Clamping voltage (ESD):  $V_{cl} = f(t_p)$ , 15 kV negative pulse based on IEC61000-4-2

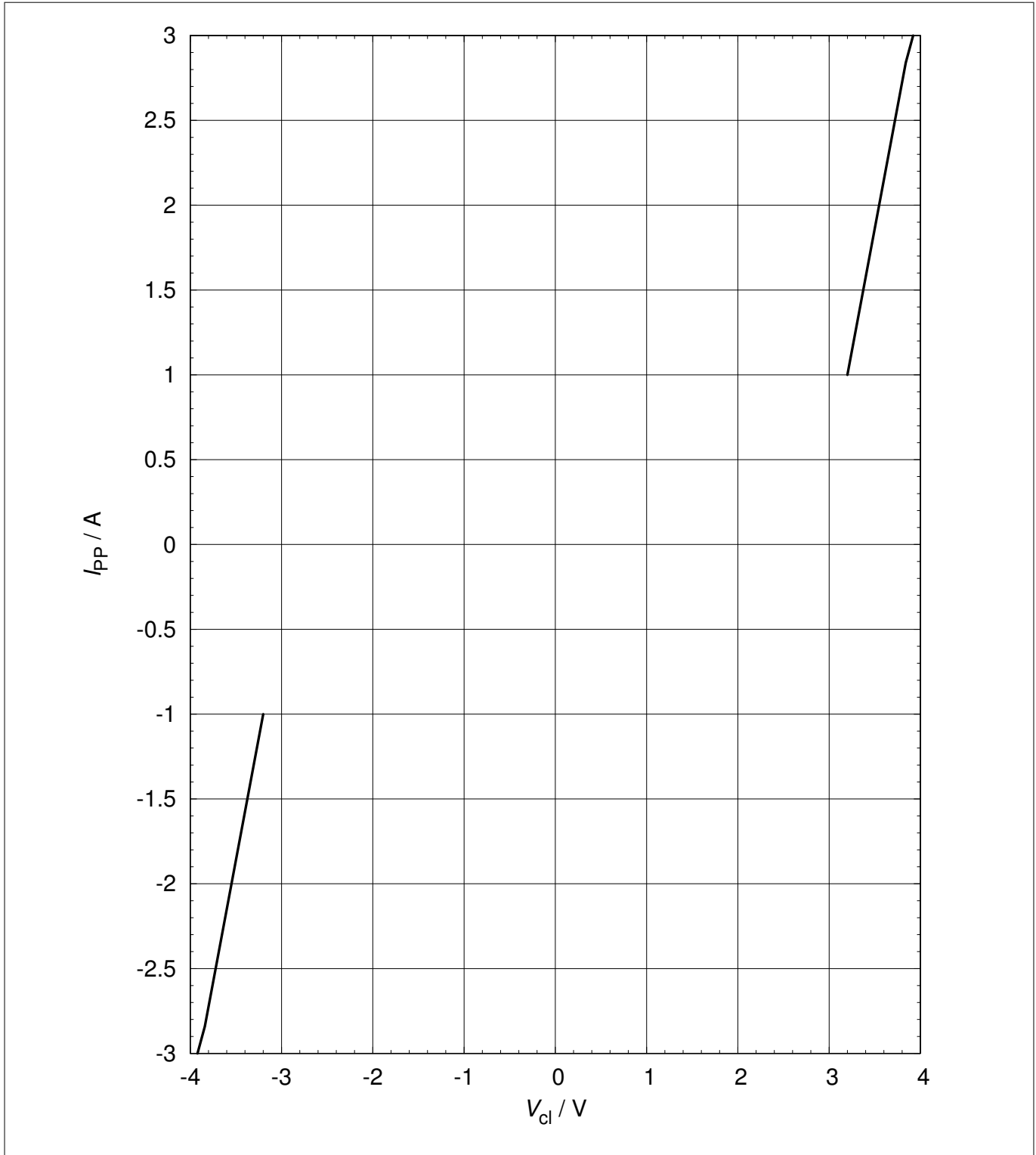


**3 Typical characteristic diagrams**



**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

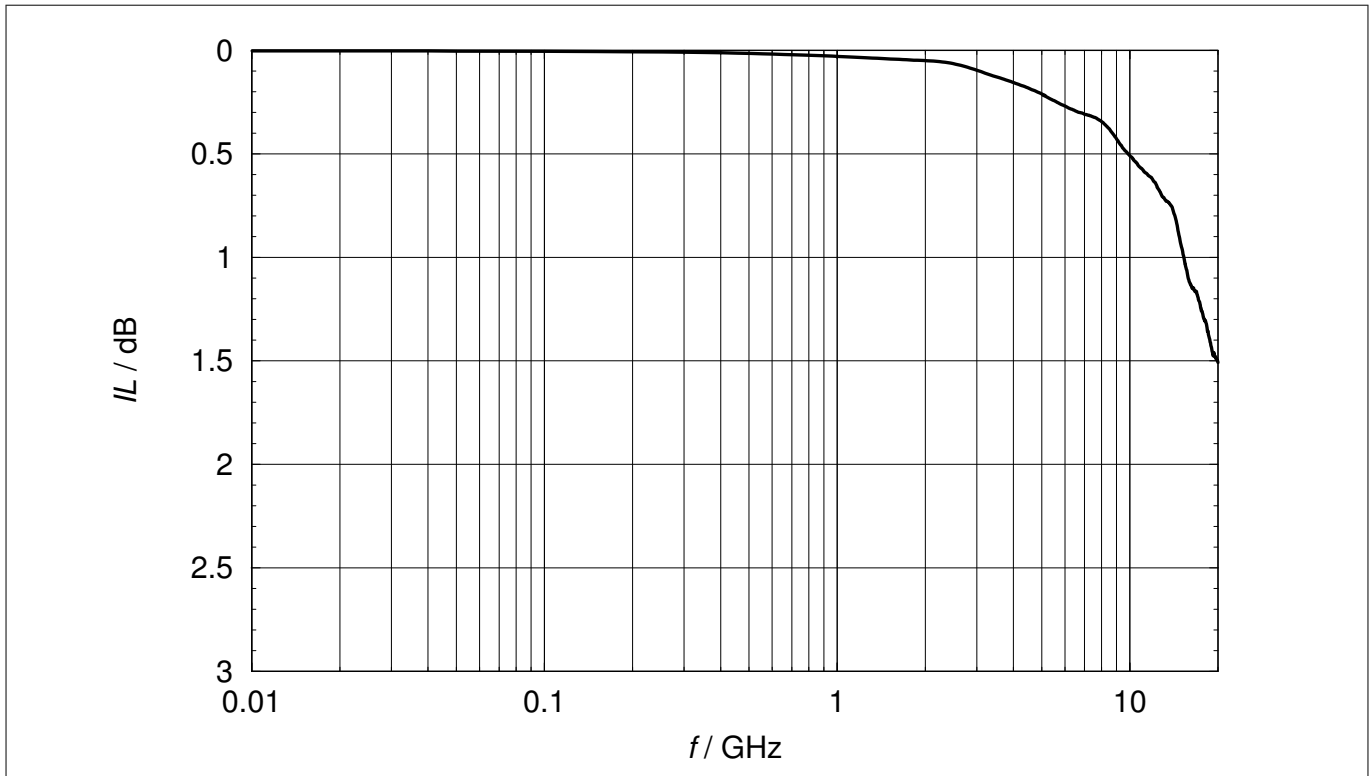


Figure 11 Insertion loss  $IL = f(f)$ , measured in a 50  $\Omega$  system

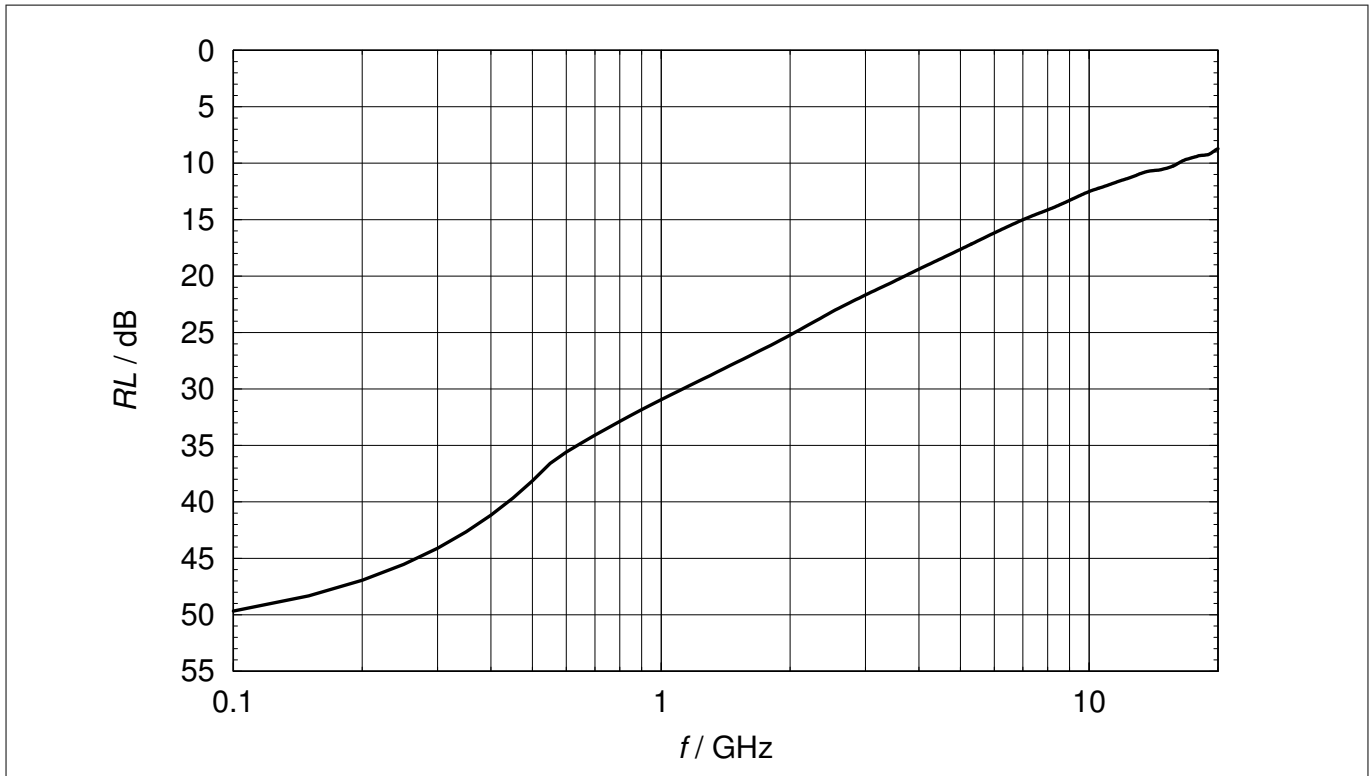


Figure 12 Return loss:  $R_L = f(f)$ , measured in a 50  $\Omega$  system

4 Package information WLL-2-2

4 Package information WLL-2-2

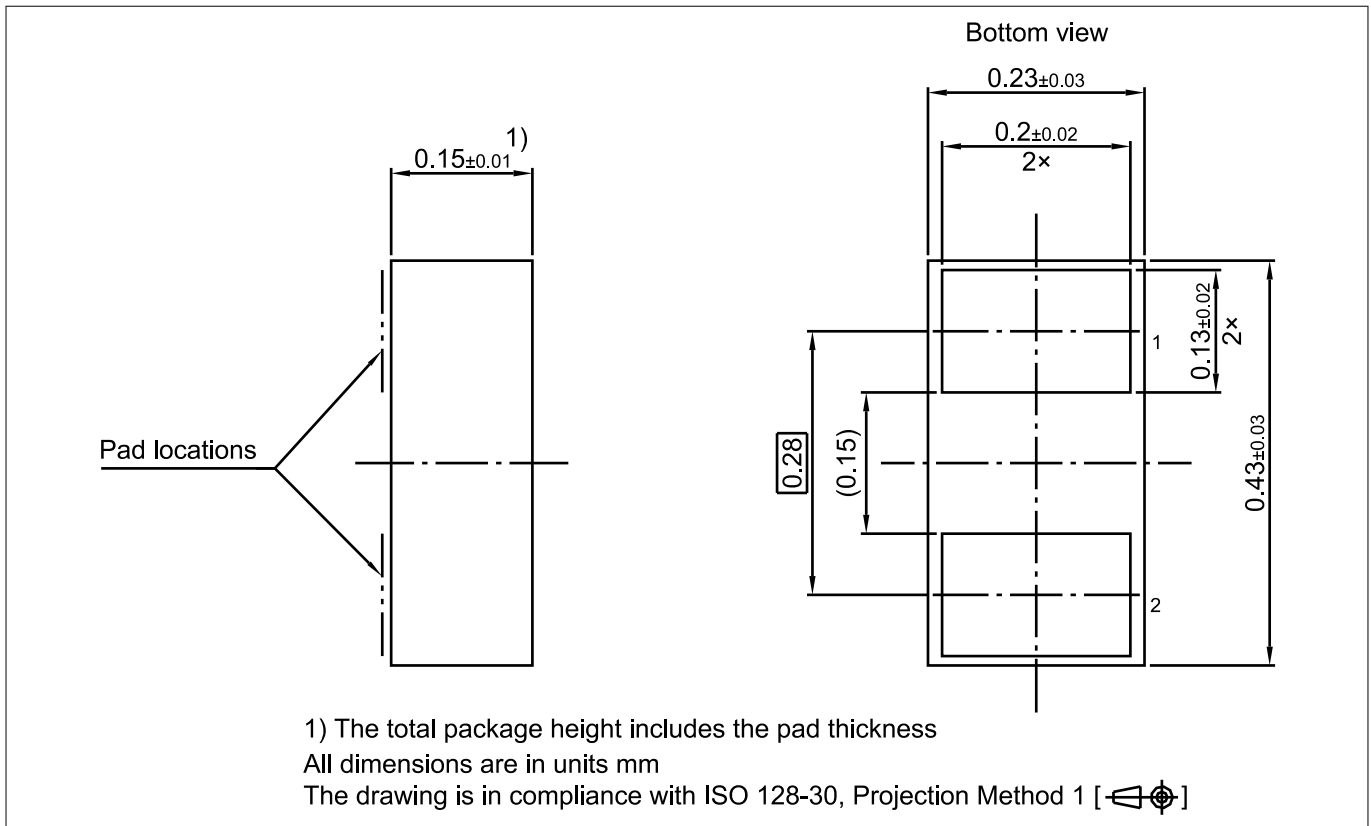


Figure 13 WLL-2-2 package

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

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

**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>
v1.0	2022-05-20	First final datasheet version
v1.1	2023-03-08	Working voltage and typical characteristic diagrams updated
v1.2	2023-07-28	Working voltage and typical characteristic diagrams updated

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