

# ESD134-B1-W0201

Bi-directional ESD protection device, 2.1 V, 0.25 pF, 0201



## 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):  $\pm 28$  kV (air) /  $\pm 23$  kV (contact)
  - IEC61000-4-4 (EFT):  $\pm 2.5$  kV /  $\pm 50$  A (5/50 ns)
  - IEC61000-4-5 (Surge):  $\pm 7.5$  A (8/20  $\mu$ s)
- Bi-directional maximum working voltage:  $V_{WM} = \pm 2.1$  V
- Line capacitance:  $C_L = 0.25$  pF at  $f = 2.5$  GHz
- Clamping voltage:  $V_{cl} = 7.7$  V at  $I_{TLP} = 16$  A with  $R_{dyn} = 0.28 \Omega$
- Very low leakage current:  $I_L = 0.1$  nA
- Small form factor SMD size 0201, low profile (0.58 x 0.28 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



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

**Table 1** Part information

Product name / Ordering code	Package	Pin configuration	Marking	Pieces / Reel
ESD134-B1-W0201 / ESD134B1W0201E6327XTSA1	WLL-2-3	1 line, bi-directional	AY	15 k

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**Table of contents**

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	<b>Product description</b> .....	1
	<b>Feature list</b> .....	1
	<b>Potential applications</b> .....	1
	<b>Product validation</b> .....	1
	<b>Device information</b> .....	1
	<b>Table of contents</b> .....	2
<b>1</b>	<b>Absolute maximum ratings</b> .....	3
<b>2</b>	<b>Electrical characteristics</b> .....	4
<b>3</b>	<b>Typical characteristic diagrams</b> .....	6
<b>4</b>	<b>Package information WLL-2-3</b> .....	13
<b>5</b>	<b>References</b> .....	14
<b>6</b>	<b>Revision history</b> .....	14
	<b>Disclaimer</b> .....	15

**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	$V_{WM}$	-2.1	+2.1	V	
ESD discharge voltage	$V_{ESD}$ (contact)	-23	+23	kV	Discharge network: $R = 330 \Omega$ , $C = 150 \text{ pF}$ <sup>1)</sup>
	$V_{ESD}$ (air)	-28	+28		
Peak pulse power	$P_{PK}$	-	56	W	Stress pulse: 8/20 $\mu\text{s}$ current waveform <sup>2)</sup>
Peak pulse current	$I_{PP}$	-7.5	+7.5	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.*

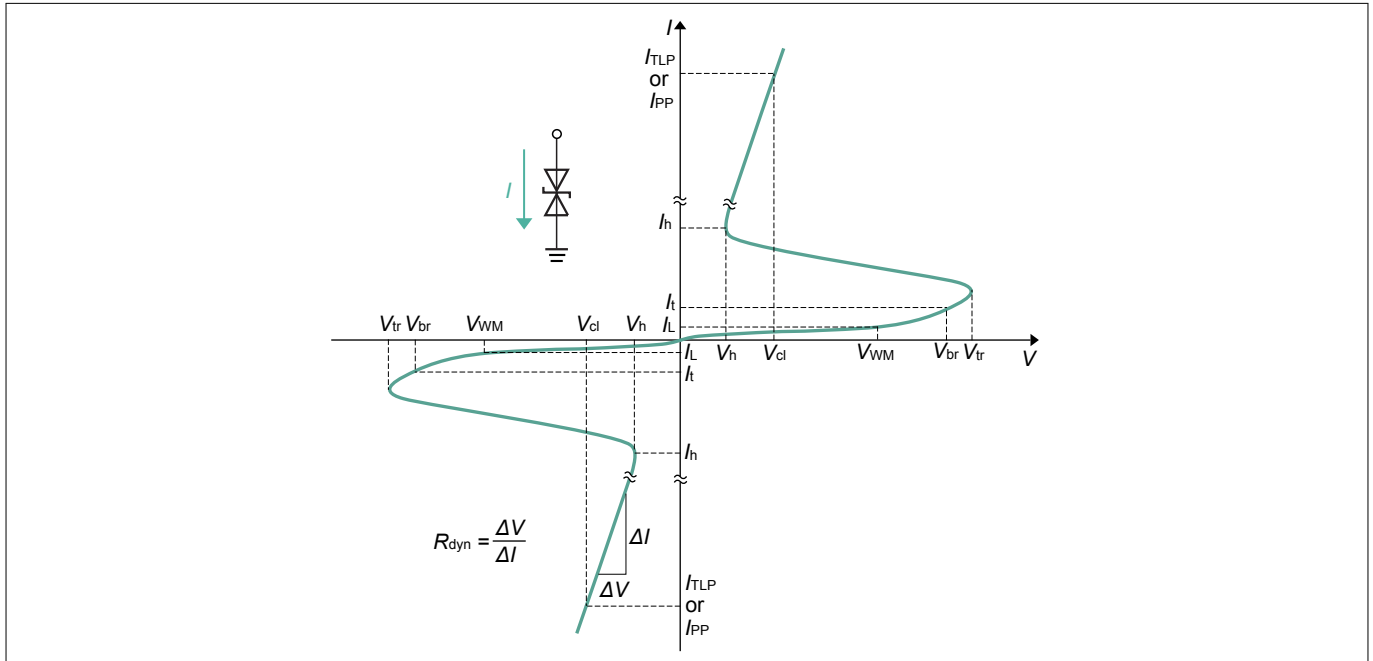
<sup>1</sup> Based on IEC61000-4-2.

<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	$V_{br}$	8	9.5	–	V	$I_t = 1 \text{ mA}$
Holding voltage	$V_h$	–	1.8	–	V	$I = I_h$
Holding current	$I_h$	–	20	–		$V = V_h$
Leakage current	$I_L$	–	0.1	20	nA	$V_{WM} = 2.1 \text{ V}$

**Table 5 AC characteristics**

Parameter	Symbol	Values			Unit	Note or test condition
		Min.	Typ.	Max.		
Line capacitance	$C_L$	–	0.3	0.35	pF	$V = 0 \text{ V}, f = 1 \text{ MHz}$
		–	0.25	–		$V = 0 \text{ V}, f = 2.5 \text{ GHz}$
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>3) 4)</sup>	$V_{cl}$	–	5.8	–	V	$I_{TLP} = 8 \text{ A}$
		–	7.7	–		$I_{TLP} = 16 \text{ A}$
Clamping voltage (8/20 $\mu\text{s}$ ) <sup>5)</sup>		–	4.5	–		$I_{PP} = 4 \text{ A}$
		–	7.5	–		$I_{PP} = 7.5 \text{ A}$
Dynamic resistance <sup>3)</sup>	$R_{dyn}$	–	0.28	–	$\Omega$	

<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.

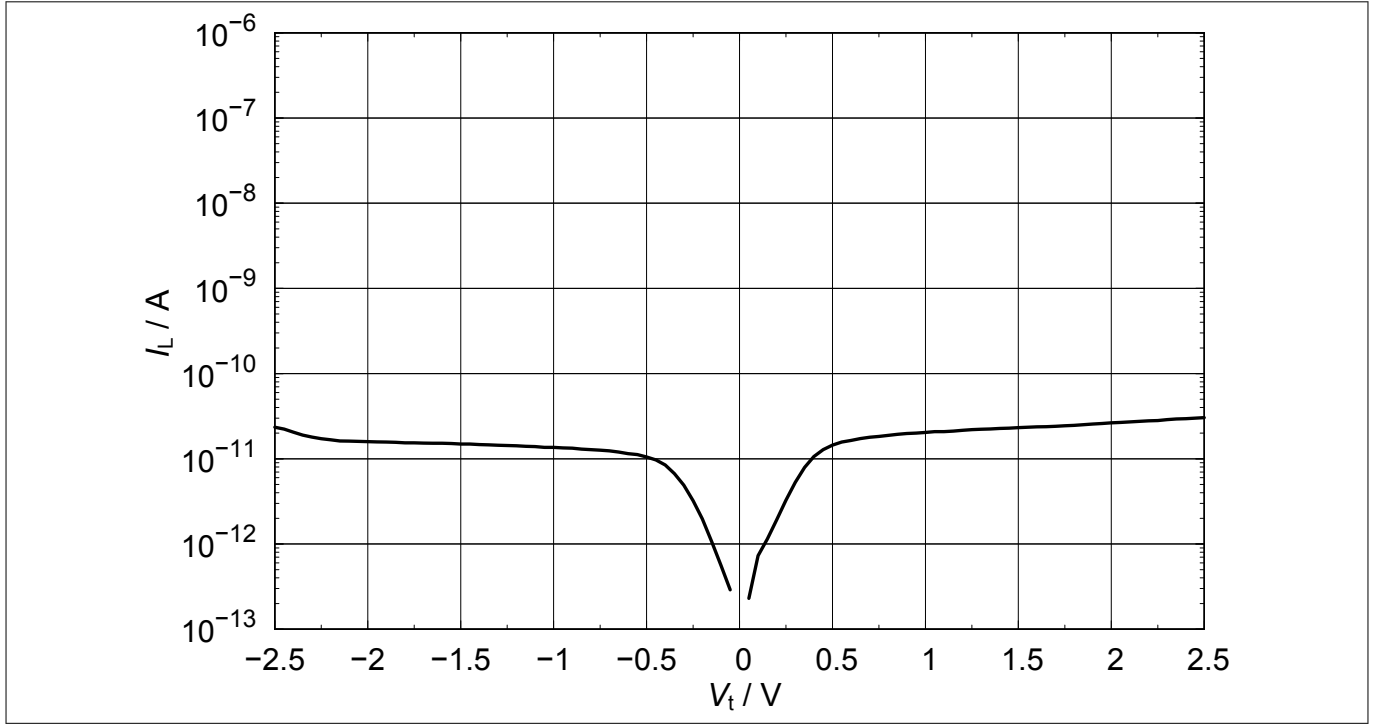


Figure 3 Leakage current:  $I_L = f(V_t)$

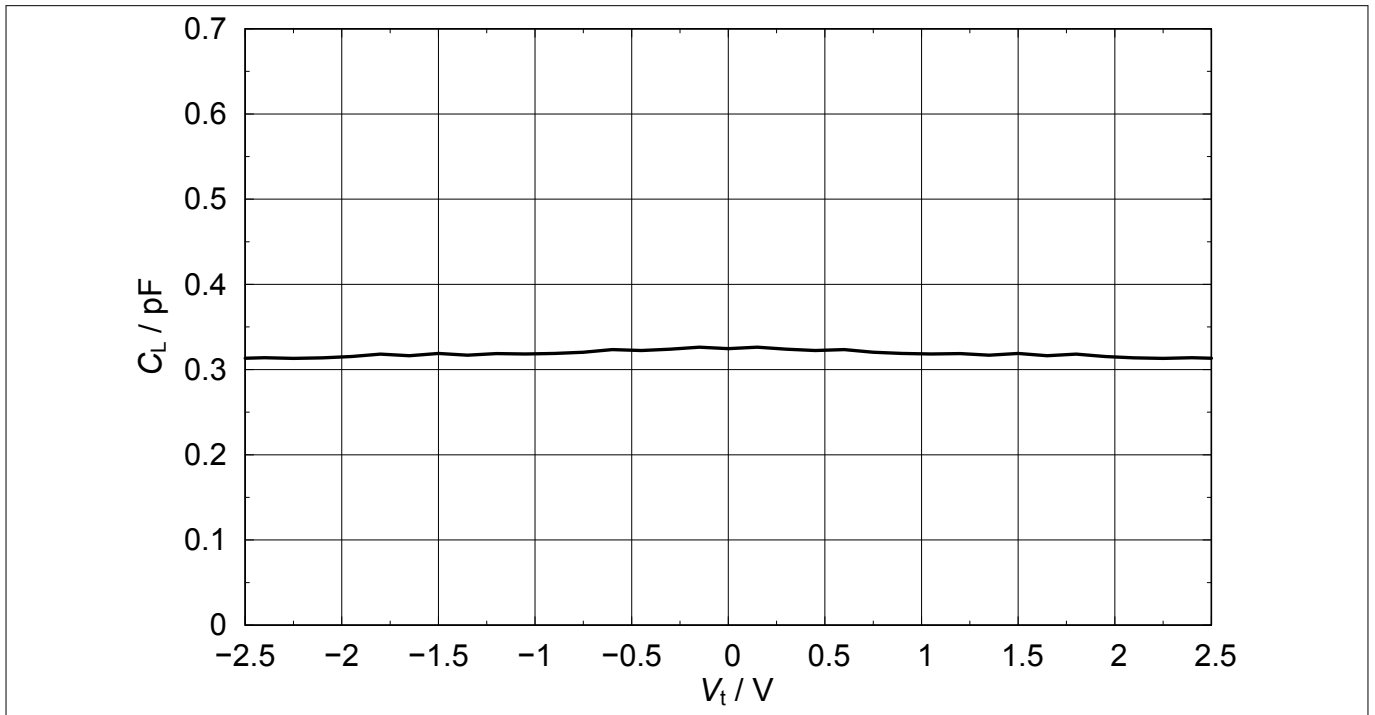
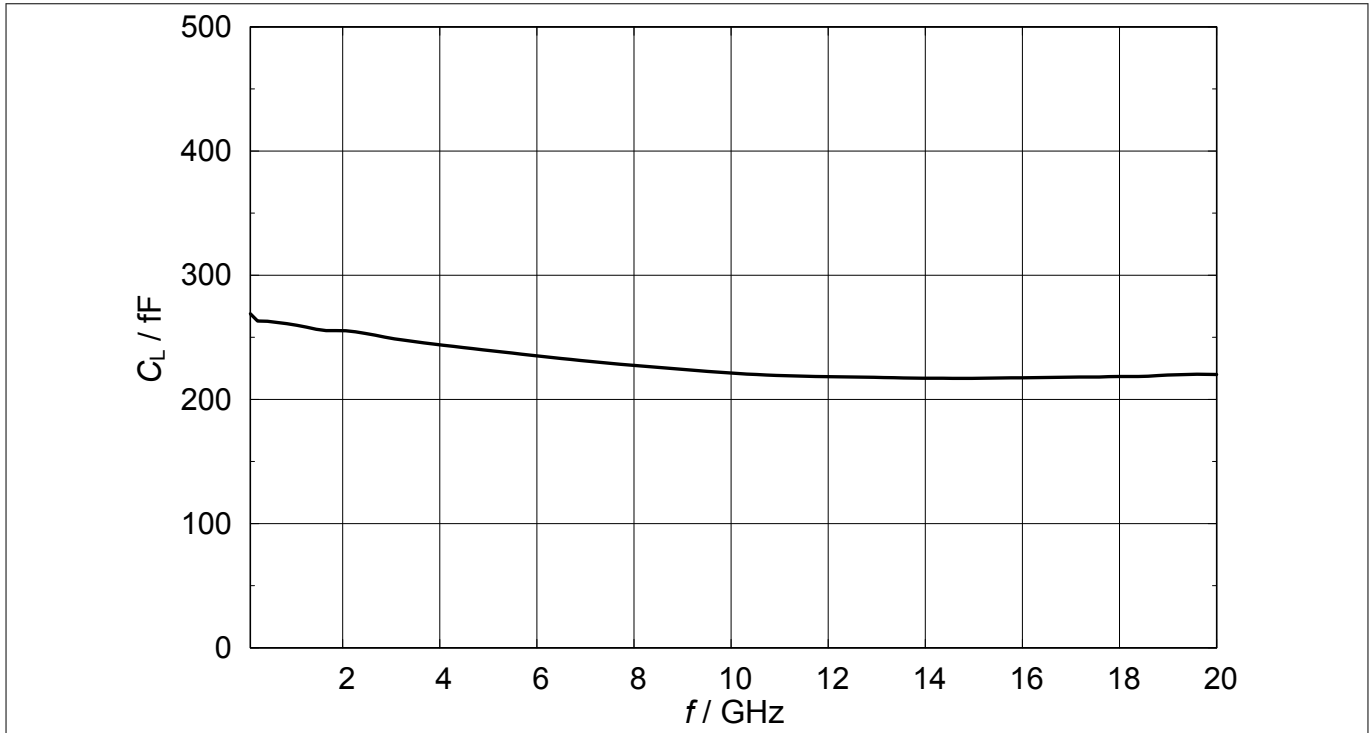
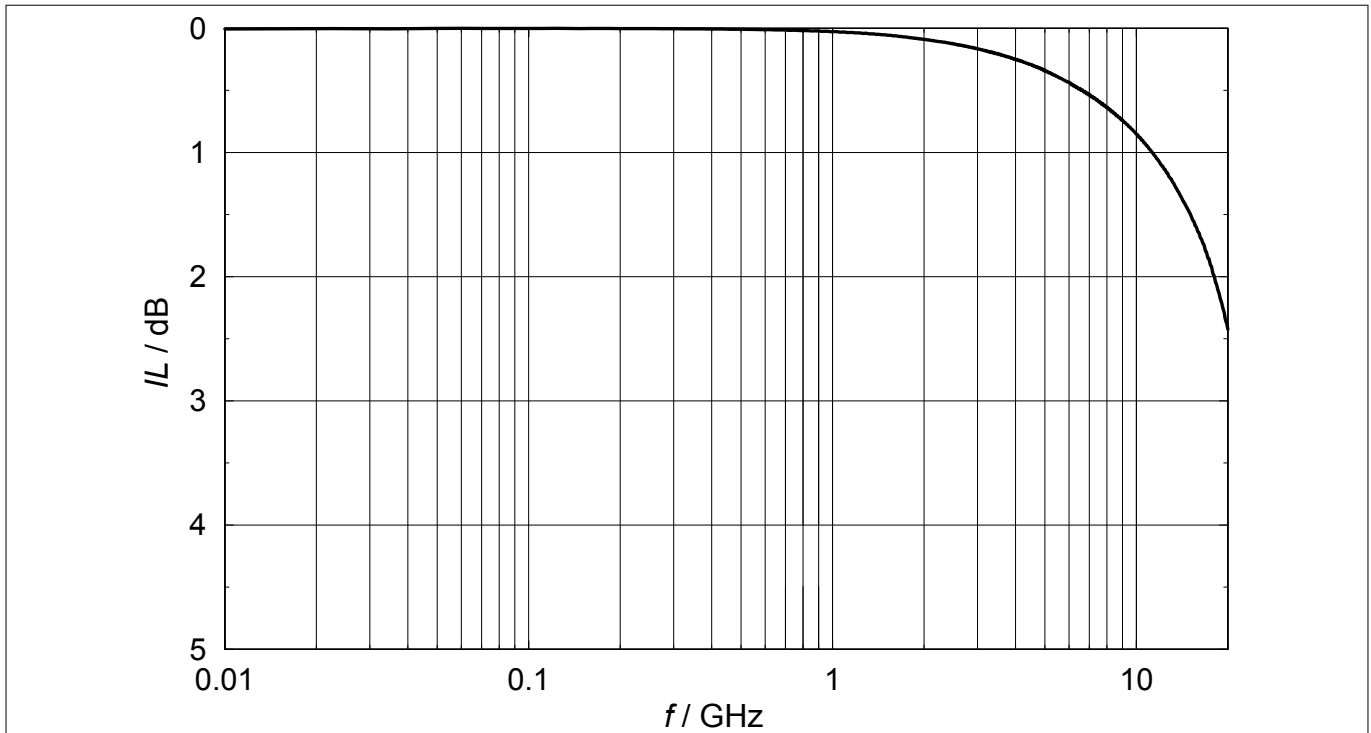


Figure 4 Line capacitance:  $C_L = f(V_t)$ ,  $f = 1\text{ MHz}$

**3 Typical characteristic diagrams**

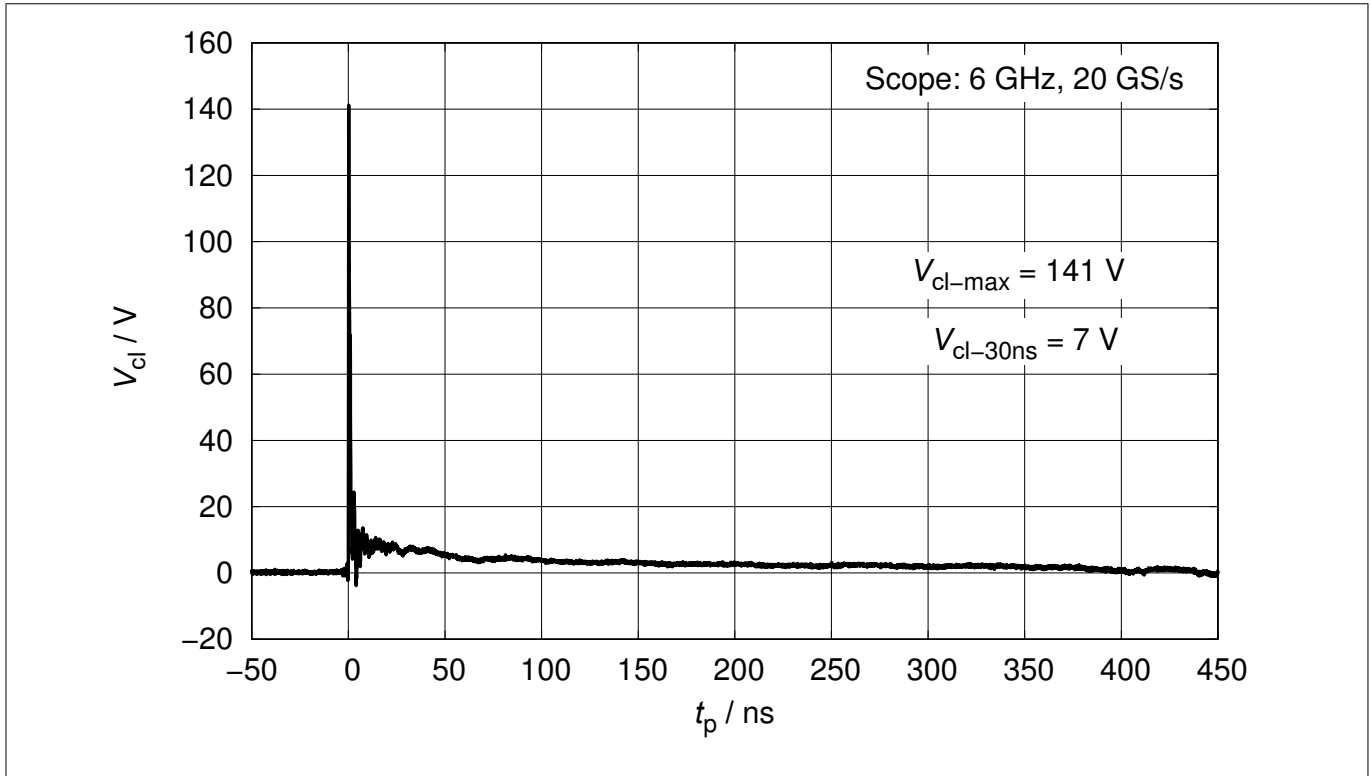


**Figure 5** Line capacitance:  $C_L = f(f) = 1$  MHz

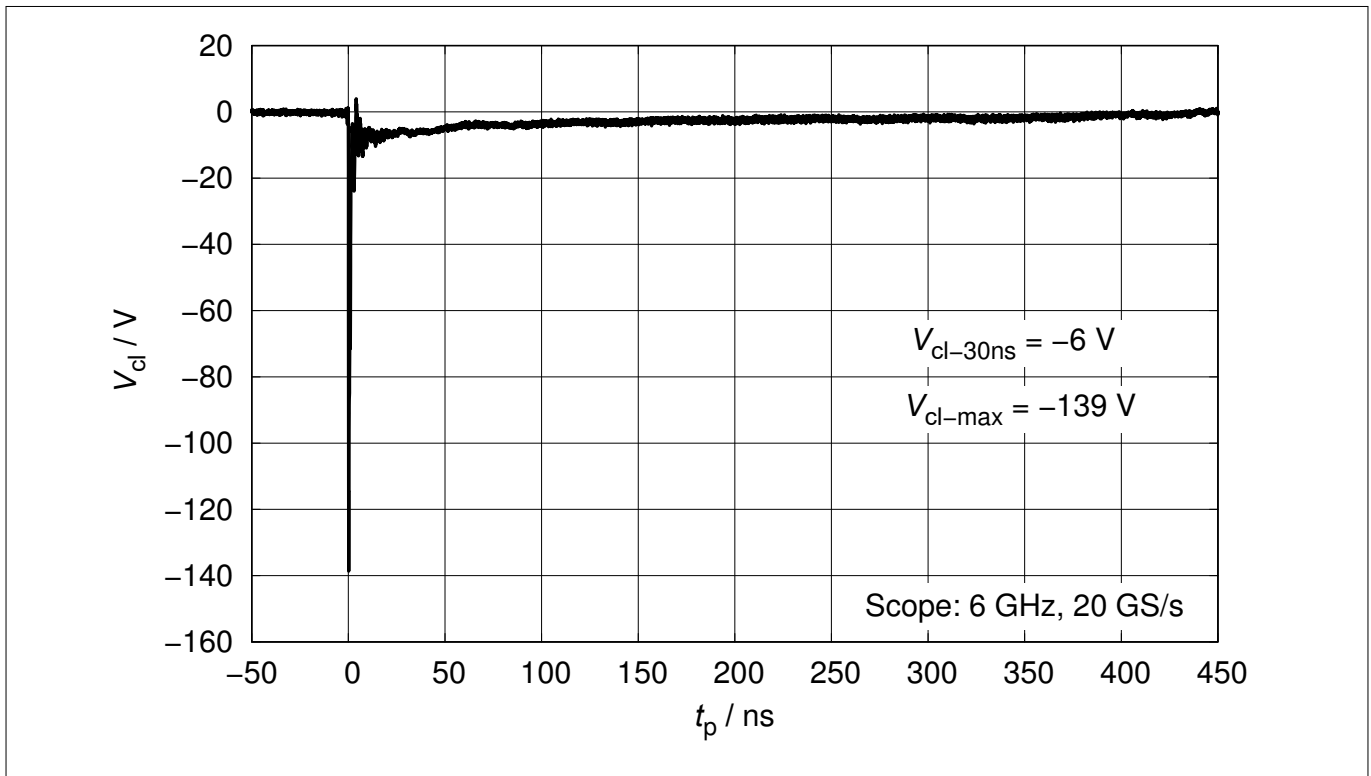


**Figure 6** Insertion loss  $IL = f(f)$ , measured in a 50  $\Omega$  system

**3 Typical characteristic diagrams**



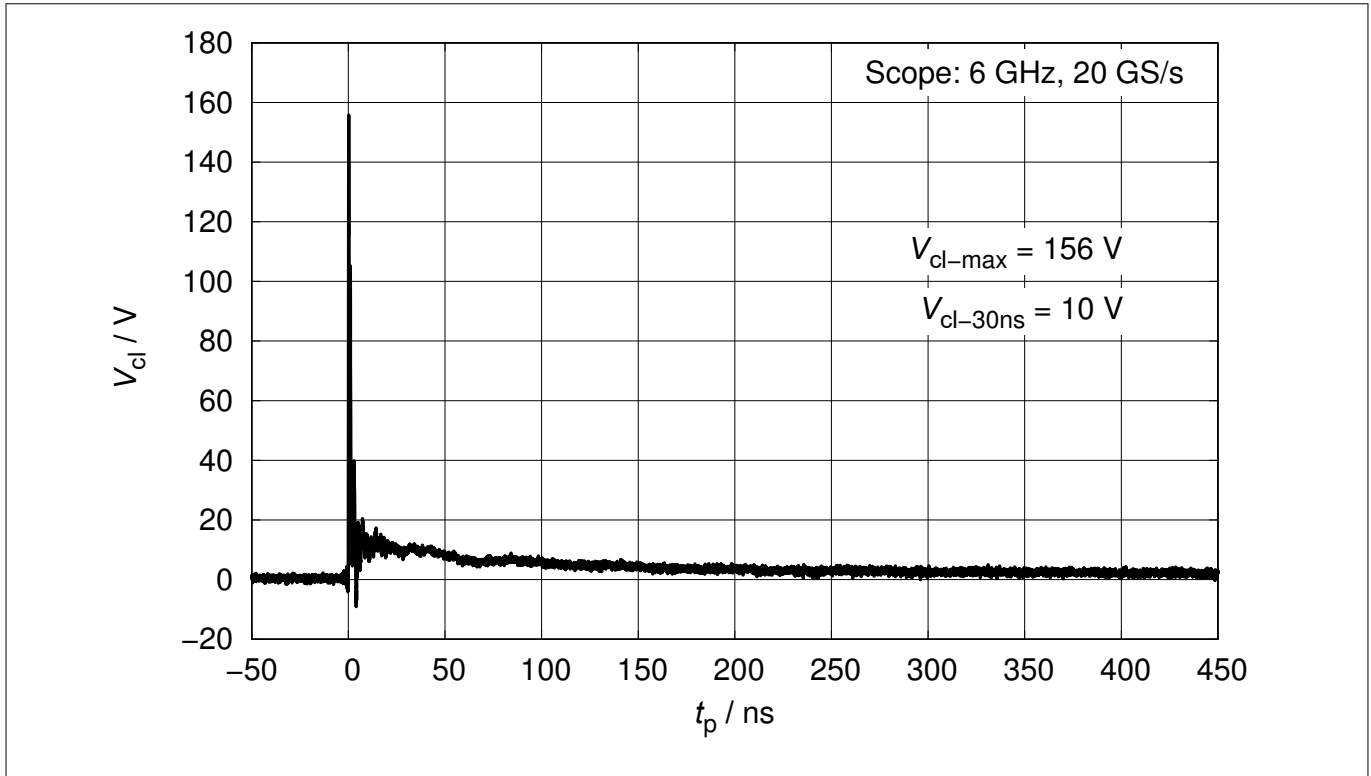
**Figure 7 Clamping voltage (ESD):  $V_{cl} = f(t_p)$ , 8 kV positive pulse based on IEC61000-4-2**



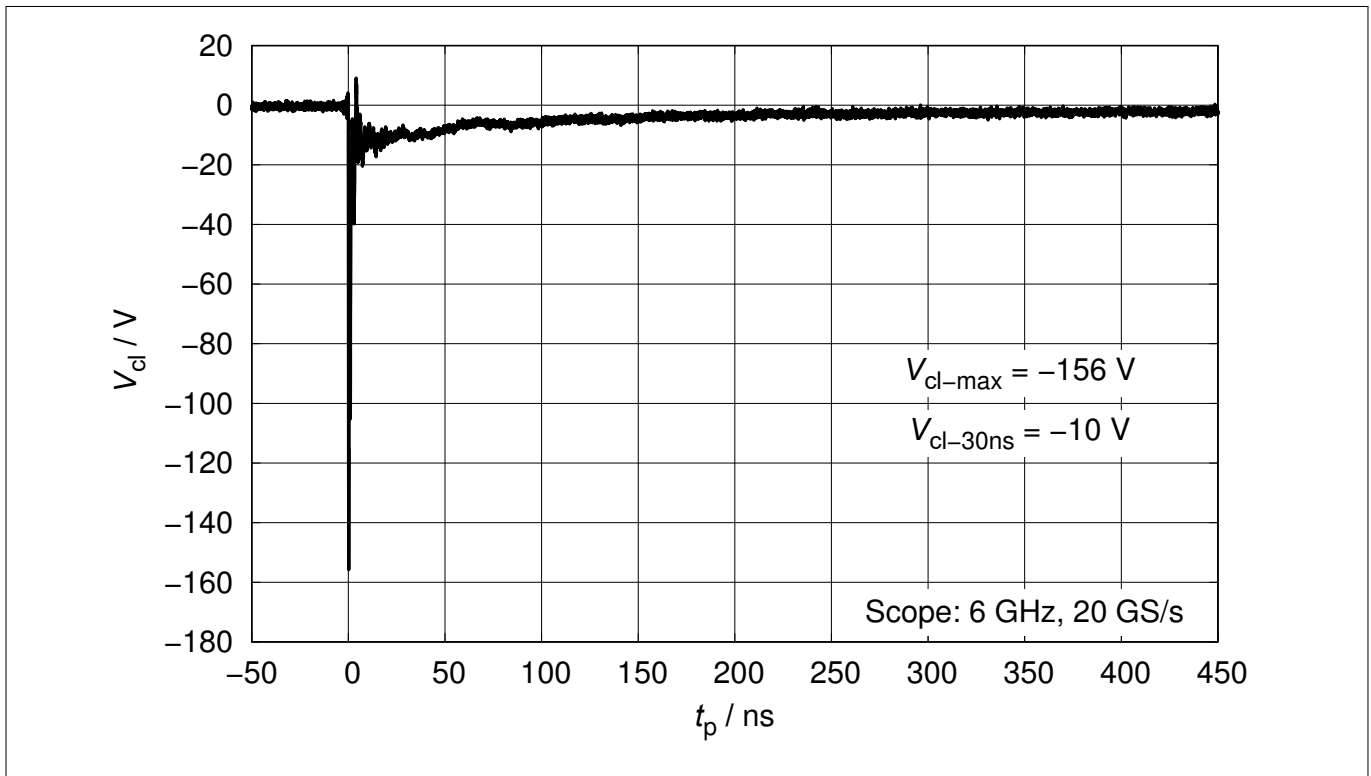
**Figure 8 Clamping voltage (ESD):  $V_{cl} = f(t_p)$ , 8 kV negative pulse based on IEC61000-4-2**



**3 Typical characteristic diagrams**

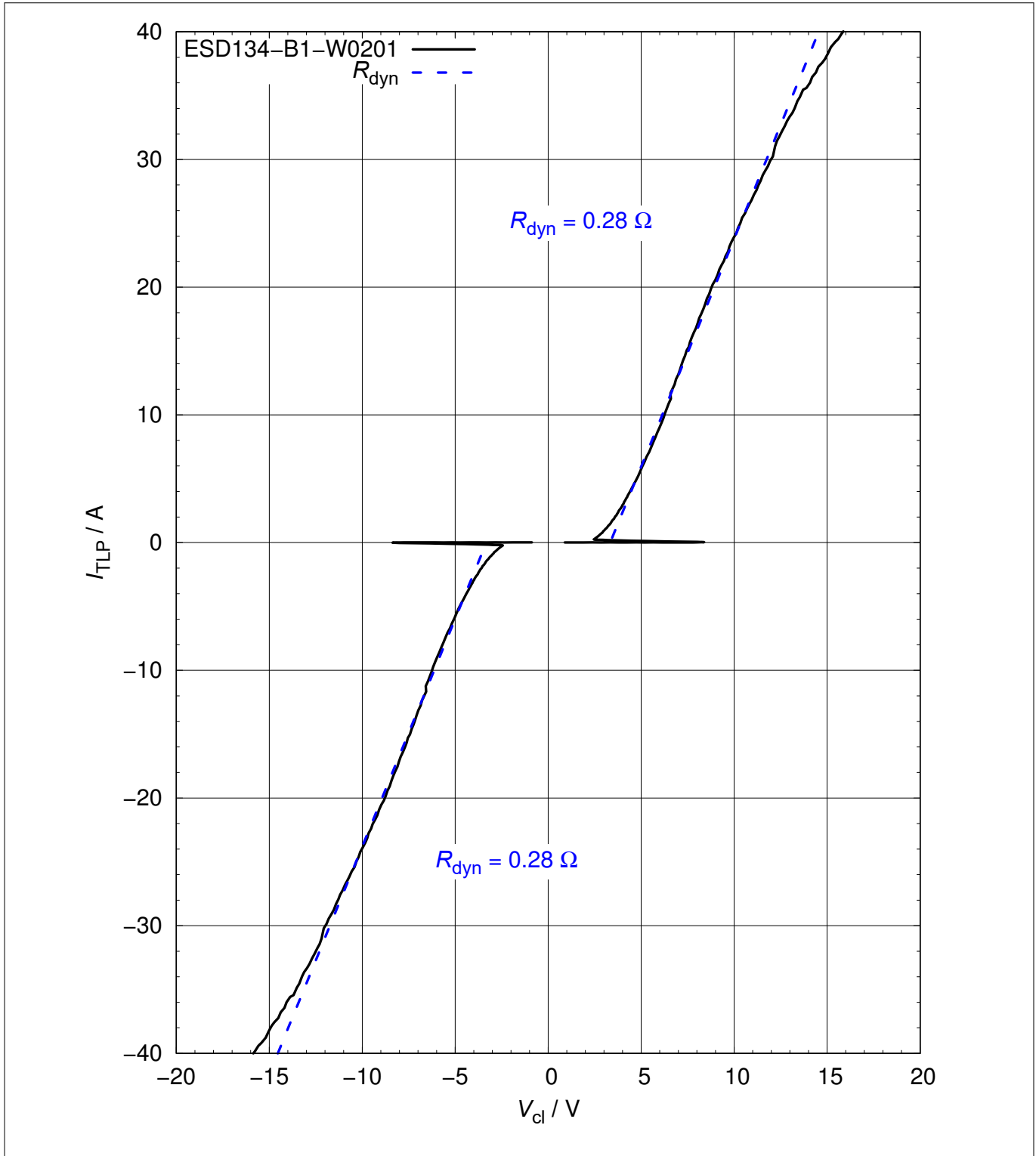


**Figure 9** Clamping voltage (ESD):  $V_{cl} = f(t_p)$ , 15 kV positive pulse based on IEC61000-4-2



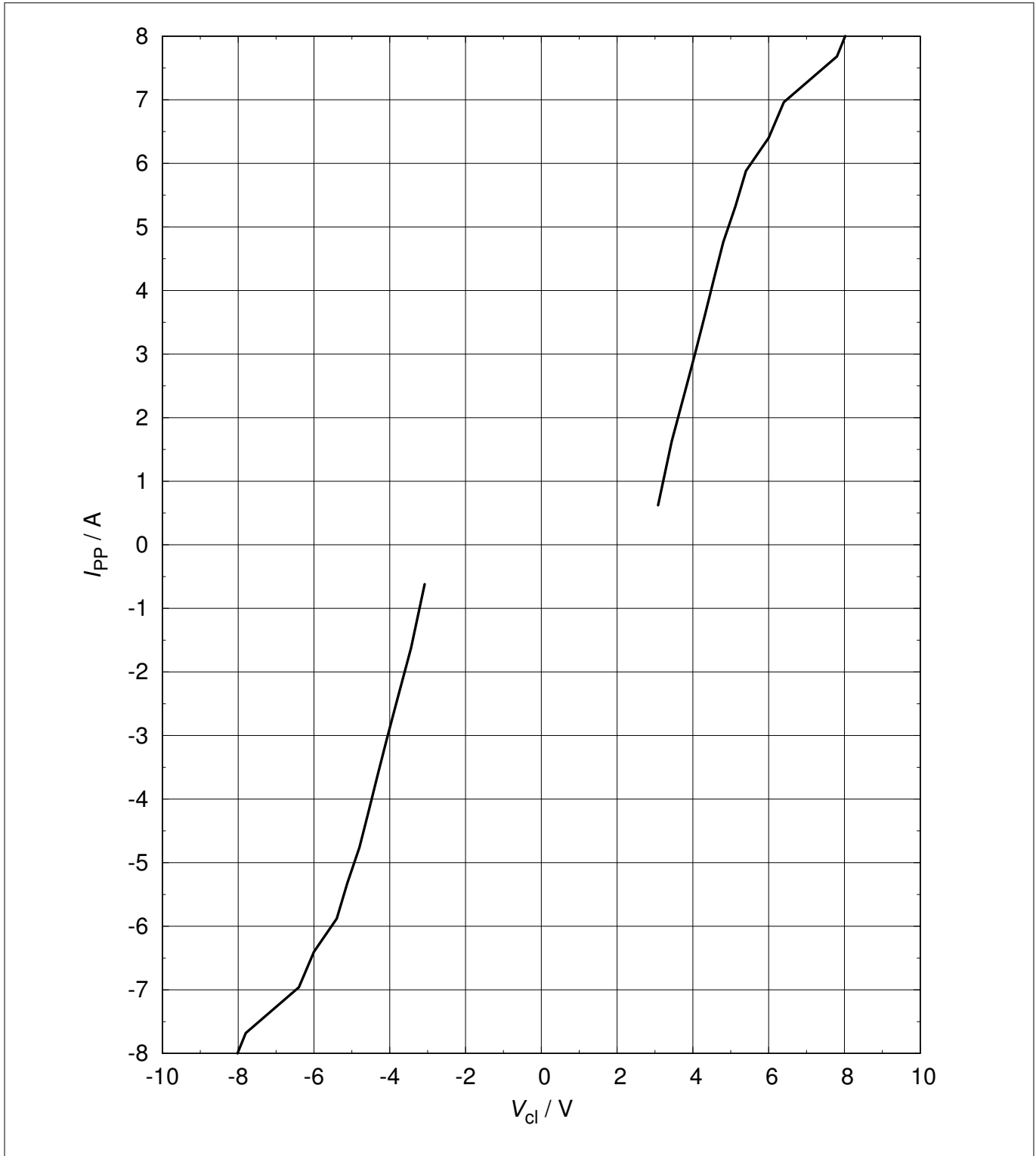
**Figure 10** Clamping voltage (ESD):  $V_{cl} = f(t_p)$ , 15 kV negative pulse based on IEC61000-4-2

**3 Typical characteristic diagrams**



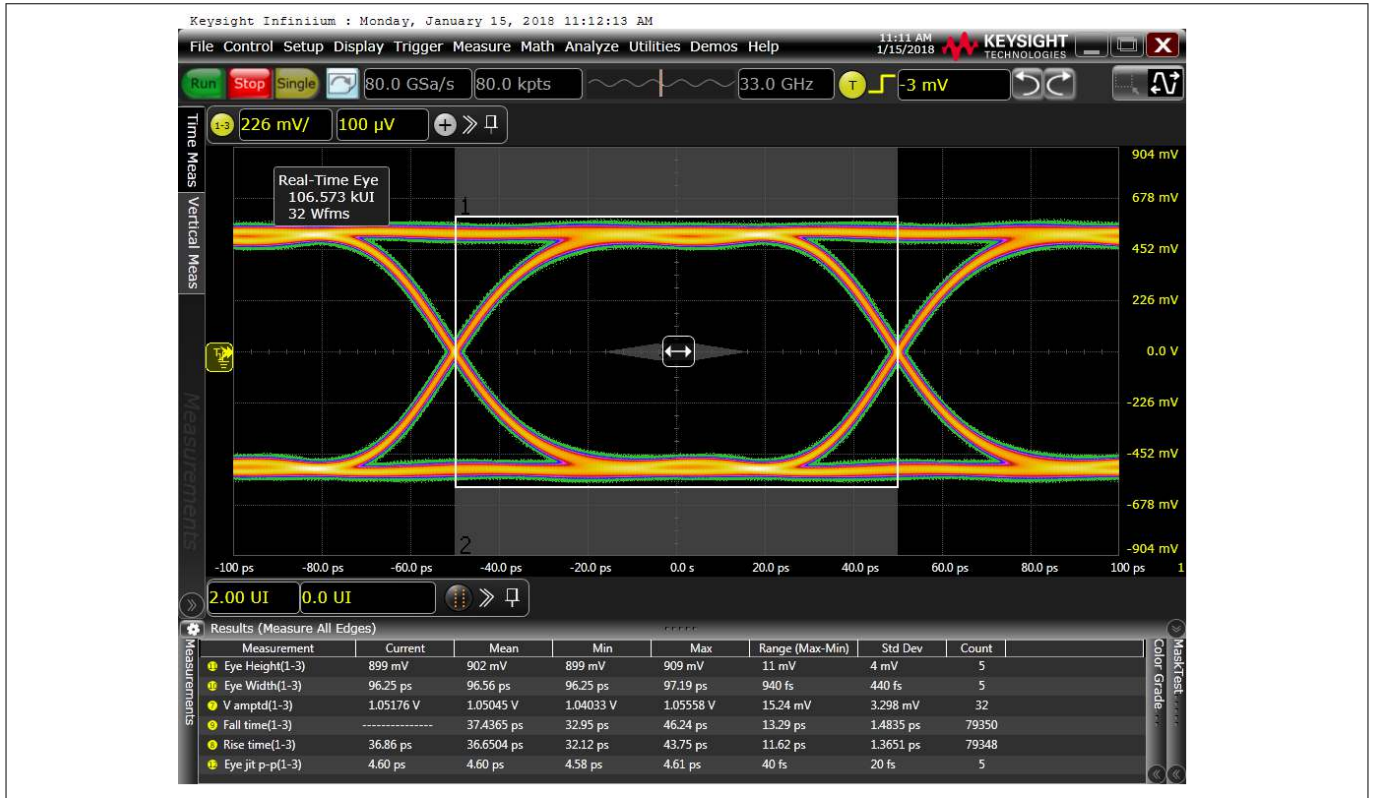
**Figure 11** Clamping voltage (TLP):  $I_{TLP} = f(V_{cl})$

**3 Typical characteristic diagrams**

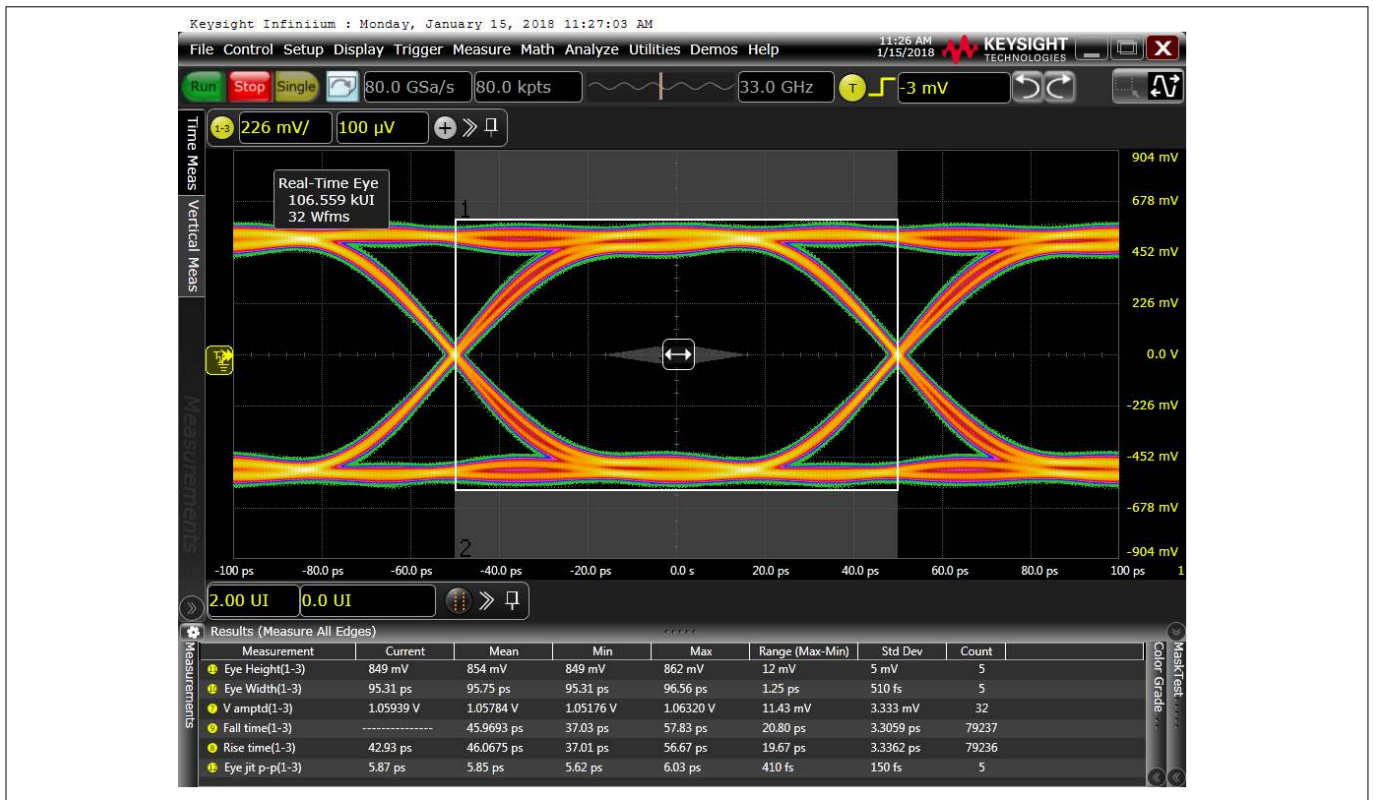


**Figure 12** Clamping voltage (Surge):  $I_{PP} = f(V_{Cl})$ , based on IEC61000-4-5

**3 Typical characteristic diagrams**



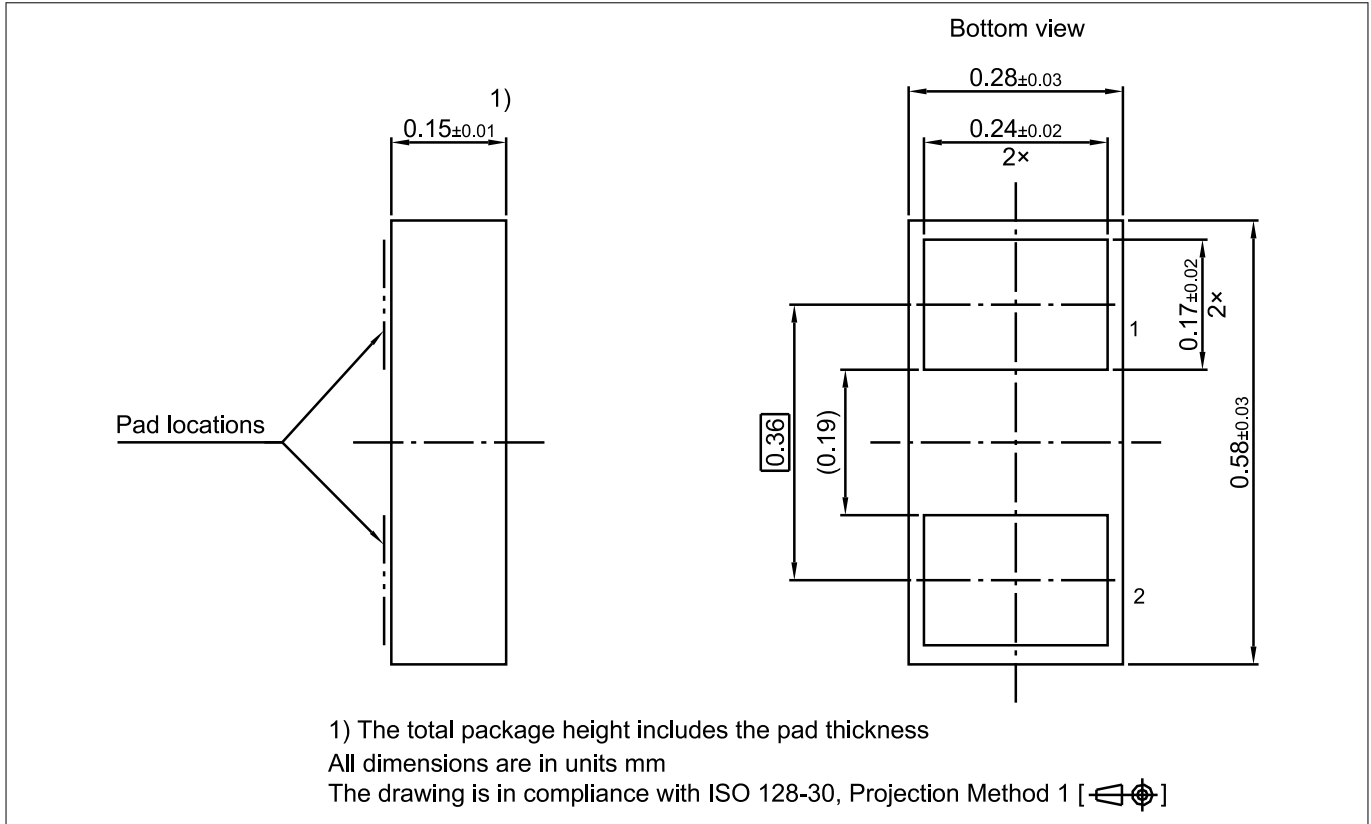
**Figure 13** 10 Gbps Eye diagram with USB 3.1/3.2 Gen 2 Mask, test board only



**Figure 14** 10 Gbps Eye diagram with USB 3.1/3.2 Gen 2 Mask, test board + ESD134-B1-W0201

**4 Package information WLL-2-3**

**4 Package information WLL-2-3**



**Figure 15 WLL-2-3 package**

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

<https://www.infineon.com/packages/SG-WLL-2-3/>

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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**

Document version	Date of release	Description of changes
1.0	2018-11-23	<ul style="list-style-type: none"> <li>ESD values updated</li> <li>Capacitance diagram <math>C_L = f(f)</math> added</li> </ul>
2.0	2019-08-09	<ul style="list-style-type: none"> <li>New datasheet layout</li> </ul>
3.0	2020-11-30	<ul style="list-style-type: none"> <li>Editorial changes</li> </ul>

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**Edition 2020-11-30**

**Published by**

**Infineon Technologies AG**

**81726 Munich, Germany**

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**IFX-zks1602769358028**

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