ESD188-B1-W0201

Very low insertion loss bi-directional ESD protection device, 1 V, 0.06 pF, 0201

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Product description

ESD protection device with a bi-directional *I*/*V* characteristic and excellent clamping performance, extremely low capacitance and insertion loss.

Feature list

- ESD / transient protection according to:
  - IEC61000-4-2 (ESD): ±20 kV (air) / ±15 kV (contact)
  - IEC61000-4-4 (EFT): ±2 kV / ±40 A (5/50 ns)
  - IEC61000-4-5 (Surge): ±5 A (8/20 µs)
- Bi-directional maximum working voltage: V_{WM} = ±1 V
- Diode type I/V characteristic
- Line capacitance: C_L = 0.06 pF at f = 12.8 GHz
- Insertion loss: IL = 0.1 dB at f = 12.8 GHz
- Clamping voltage: V_{cl} = 6.9 V at I_{TLP} = 16 A with R_{dyn} = 0.27 Ω
- Small form factor SMD size, low profile (0.58 x 0.28 x 0.15 mm^3)

Potential applications

- USB4, USB 3.x Gen 1/Gen 2/Gen 3/Gen 4
- Thunderbolt 5, Thunderbolt 4, Thunderbolt 3

Product validation

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

Device information

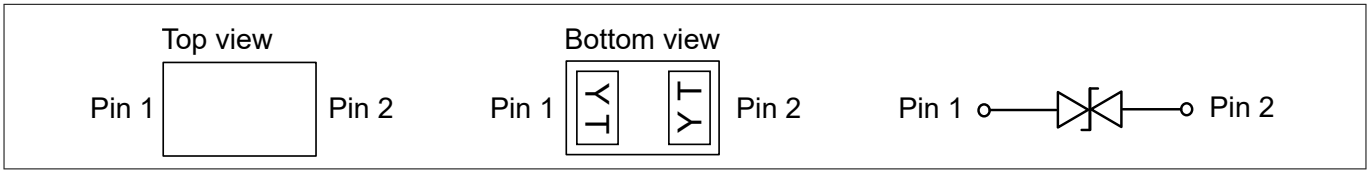

Figure 1 **Pin configuration and schematic diagram**

Table 1 **Part information**

Product name / Ordering code	Package	Pin configuration	Marking	Pieces / Reel
ESD188-B1-W0201 / ESD188B1W0201E6327XTSA1	WLL-2-11	1 line, bi-directional	YT	15 k

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1 Absolute maximum ratings

Table 2 Absolute maximum ratings at T_A = 25°C, unless otherwise specified

Parameter	Symbol	Values		Unit	Note or test condition
		Min.	Max.		
Working voltage	V_{WM}	-1	+1	V	
ESD discharge voltage	V_{ESD} (contact)	-15	+15	kV	Discharge network: R = 330 Ω, C = 150 pF [1]
	V_{ESD} (air)	-20	+20		
Peak pulse power	P_{PK}	-	22.5	W	Stress pulse: 8/20 µs current waveform [2]
Peak pulse current	I_{PP}	-5	+5	A	
Operating temperature	T_{op}	-55	+125	°C	
Storage temperature	T_{stg}	-55	+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.

1 Based on IEC61000-4-2.
2 Based on IEC61000-4-5.

2 Electrical characteristics

***Note**: T_A = 25°C, unless otherwise specified. Device is electrically symmetrical.*

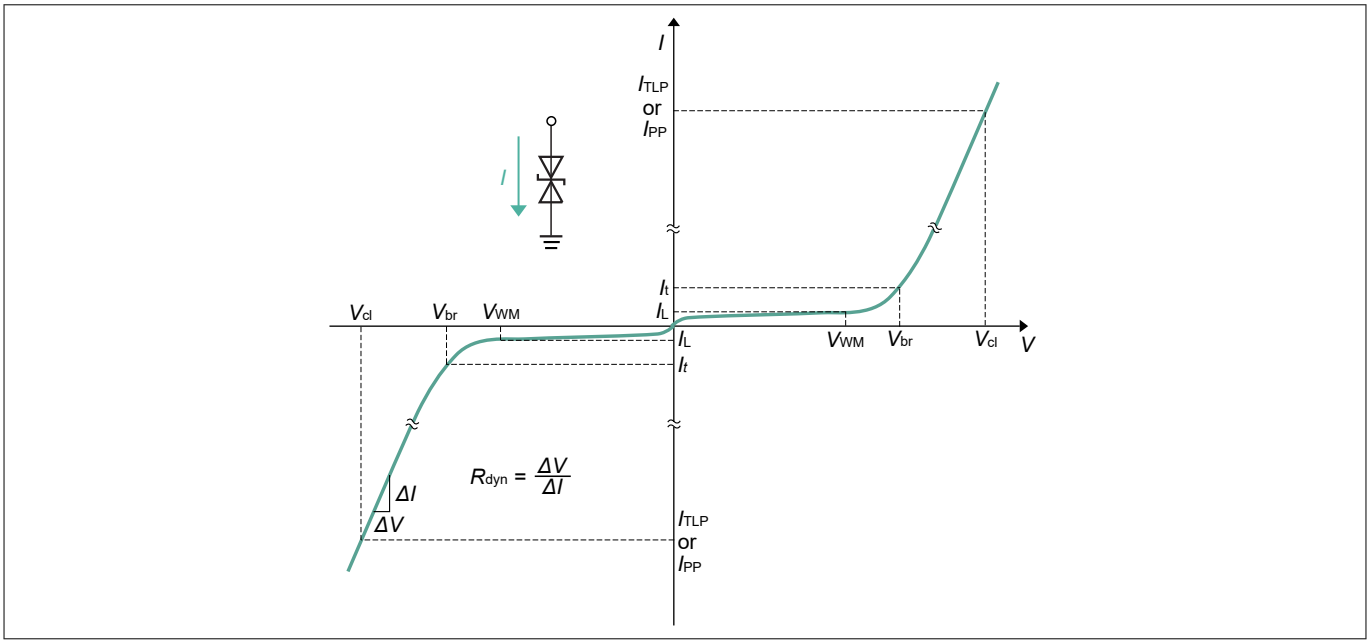

Figure 2 *I/V* characteristic curve

Table 3 *I/V* characteristic parameters

Symbol	Parameter
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_t	Test 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}	-	1.1	-	V	I_t = 1 mA
Leakage current	I_L	-	20	40	µA	V_t = 0.7 V

Table 5 AC characteristics

Parameter	Symbol	Values			Unit	Note or test condition
		Min.	Typ.	Max.		
Line capacitance	C_L	-	0.10	-	pF	V = 0 V, f = 2 MHz
		-	0.06	-		V = 0 V, f = 12.8 GHz
Insertion loss [3]	IL	-	0.03	-	dB	V = 0 V, f = 5 GHz
		-	0.07	-		V = 0 V, f = 10 GHz
		-	0.1	-		V = 0 V, f = 12.8 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) [4] [5]	V_{cl}	-	3.5	-	V	I_{TLP} = 4 A
		-	4.6	-		I_{TLP} = 8 A
		-	6.9	-		I_{TLP} = 16 A
Clamping voltage (8/20 µs) [6]		-	3.0	-		I_{PP} = 2 A
		-	3.5	-		I_{PP} = 3 A
		-	3.9	-		I_{PP} = 4 A
		-	4.5	-		I_{PP} = 5 A
Dynamic resistance [4]	R_{dyn}	-	0.27	-	Ω	

3 Extracted from S-parameters, measured in a 50 Ω system.
4 TLP parameters: Z_0 = 50 Ω, t_p = 100 ns, t_r = 0.6 ns, averaging window 30-60 ns.
5 Refer to application note AN210 [2].
6 t_p = 8/20 µs. Stress pulse based on IEC61000-4-5.

3 Typical characteristic diagrams

***Note**: T_A = 25 °C, unless otherwise specified.*

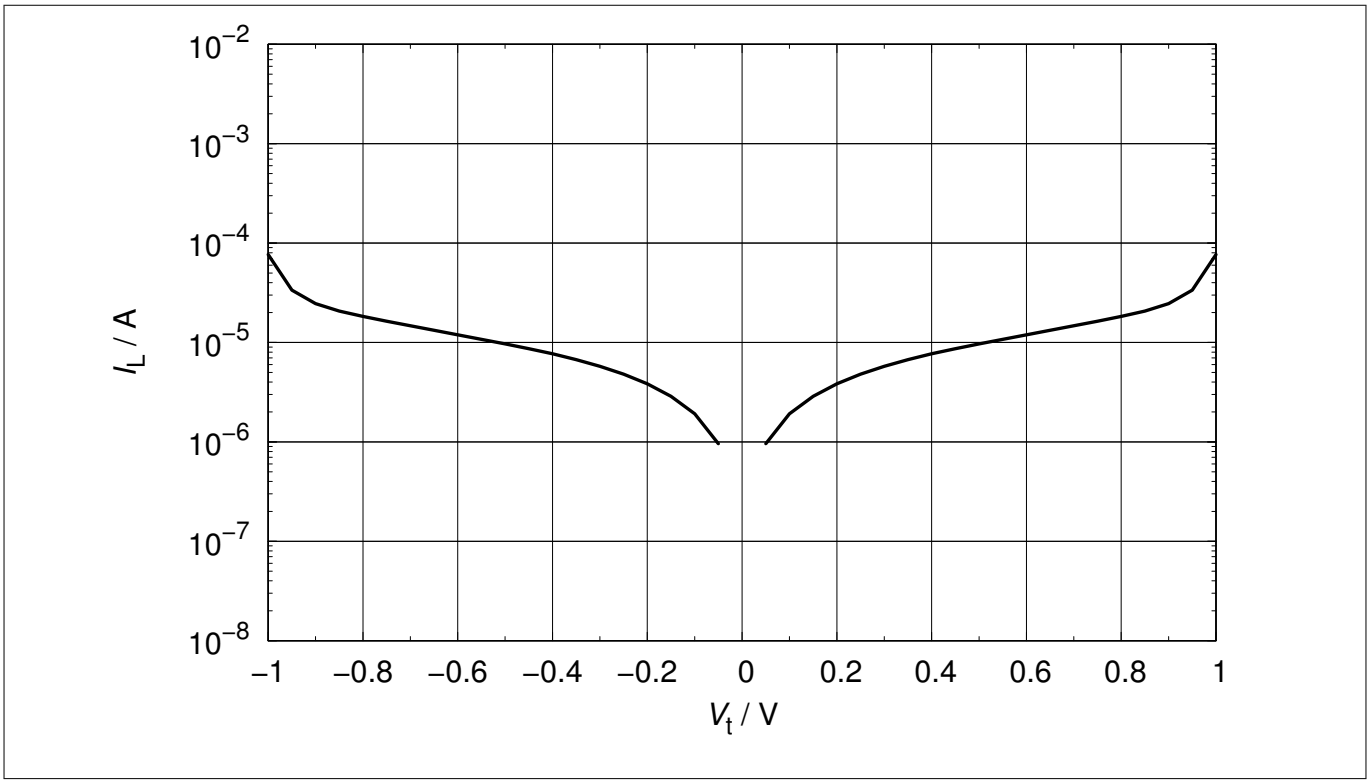

Figure 3 Leakage current: $I_L = f(V_t)$

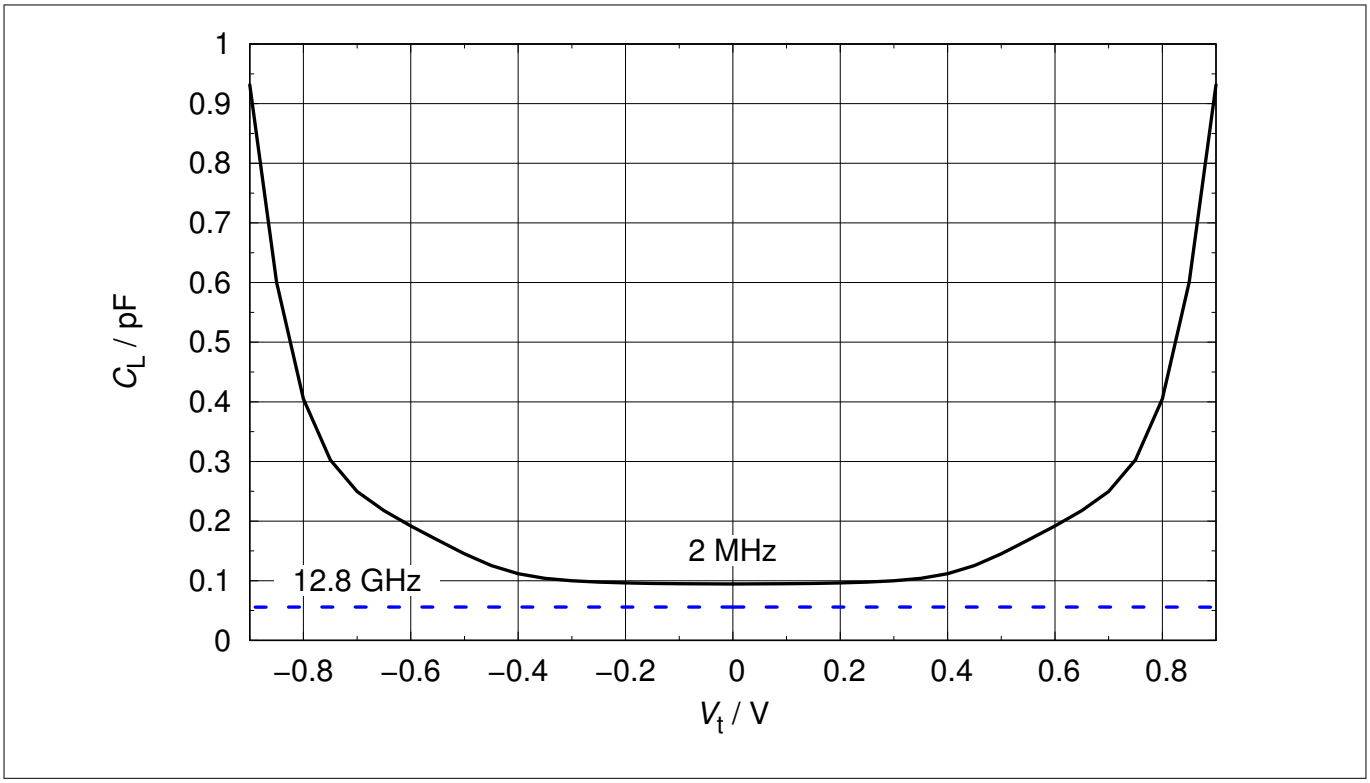

Figure 4 Line capacitance: $C_L = f(V_t)$, f = 2 MHz, 12.8 GHz

3 Typical characteristic diagrams

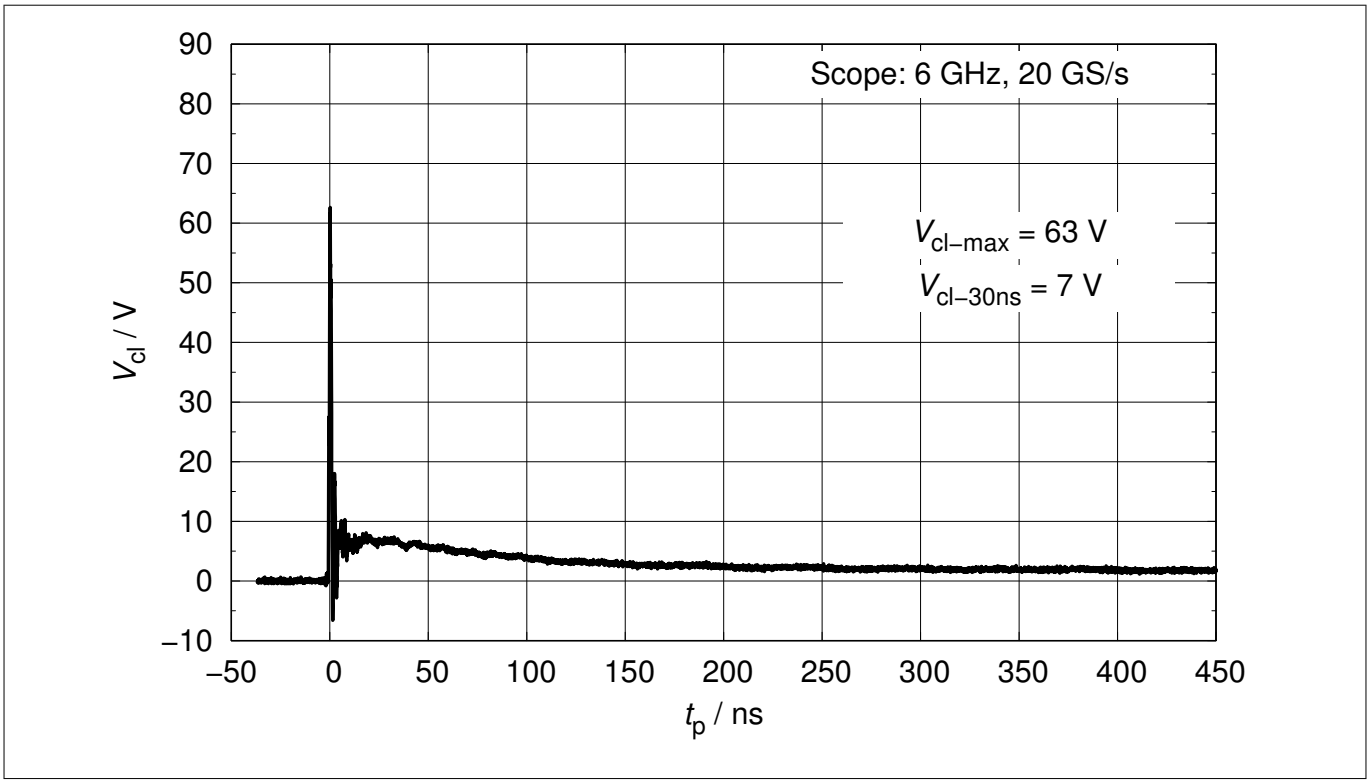

Figure 5 **Clamping voltage (ESD): V_{cl} = f(t_p), 8 kV positive pulse based on IEC61000-4-2**

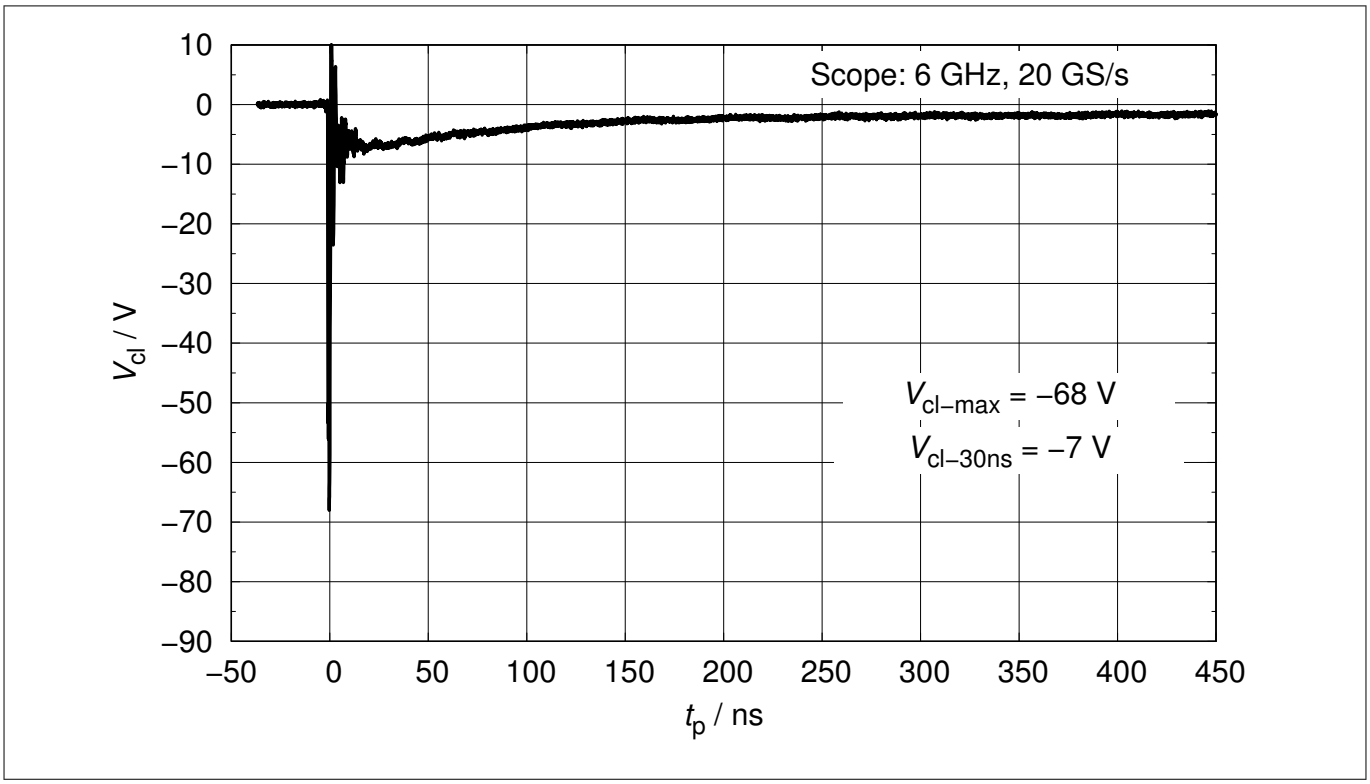

Figure 6 **Clamping voltage (ESD): V_{cl} = f(t_p), 8 kV negative pulse based on IEC61000-4-2**

3 Typical characteristic diagrams

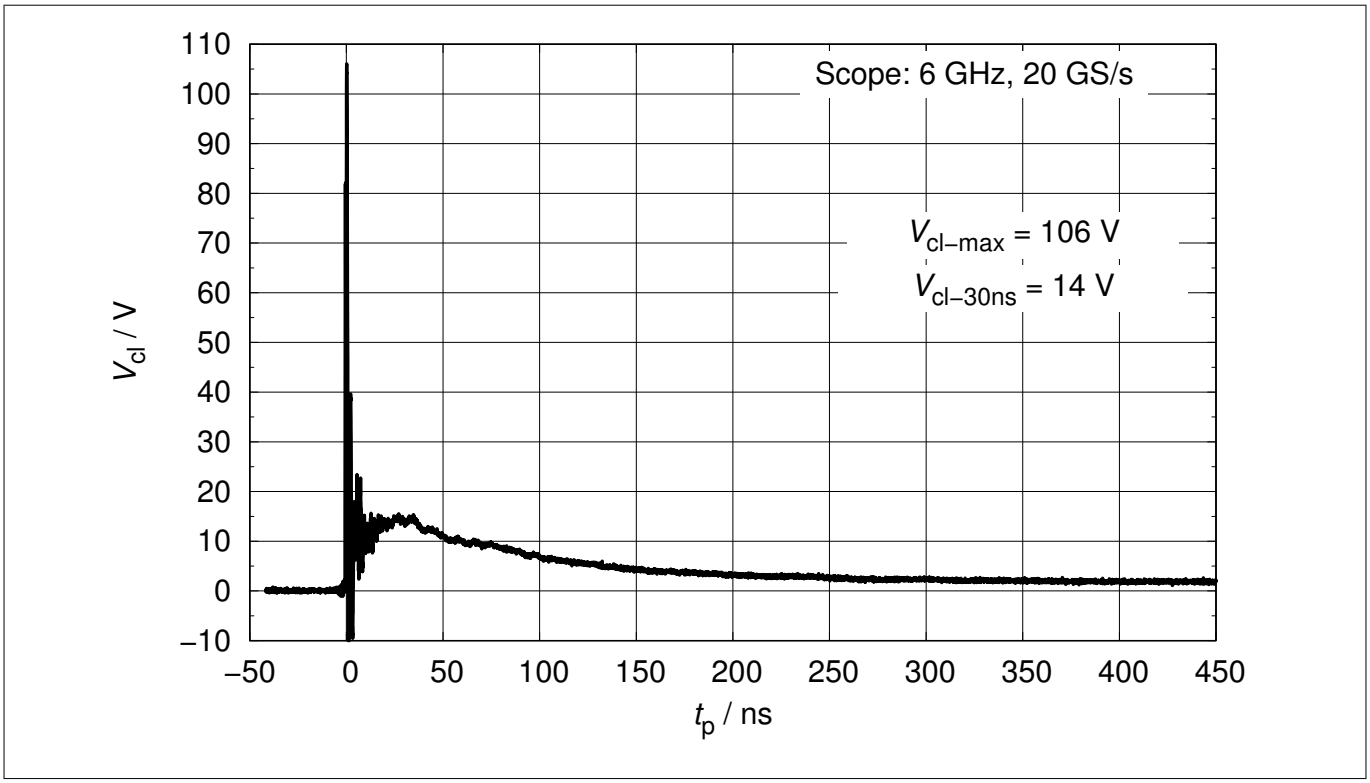

Figure 7 **Clamping voltage (ESD): V_{cl} = f(t_p), 15 kV positive pulse based on IEC61000-4-2**

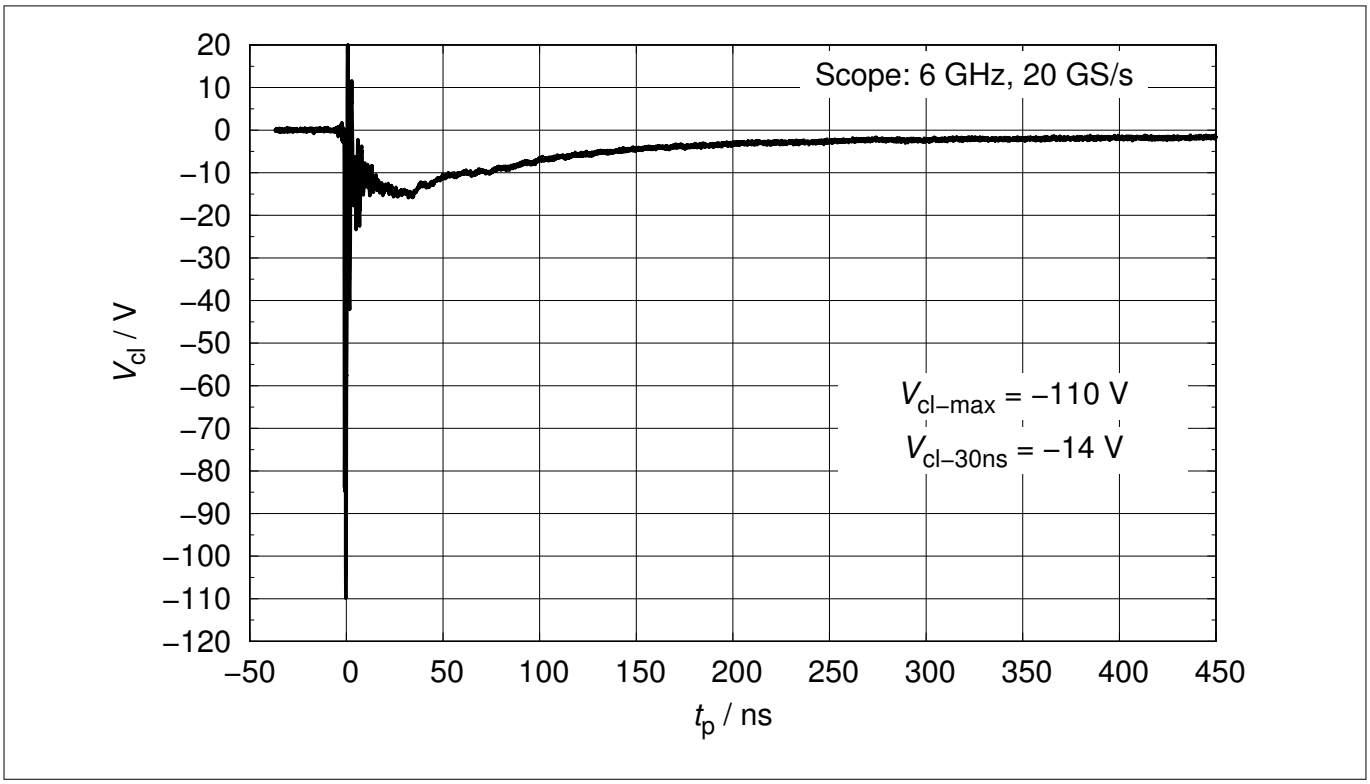

Figure 8 **Clamping voltage (ESD): V_{cl} = f(t_p), 15 kV negative pulse based on IEC61000-4-2**

3 Typical characteristic diagrams

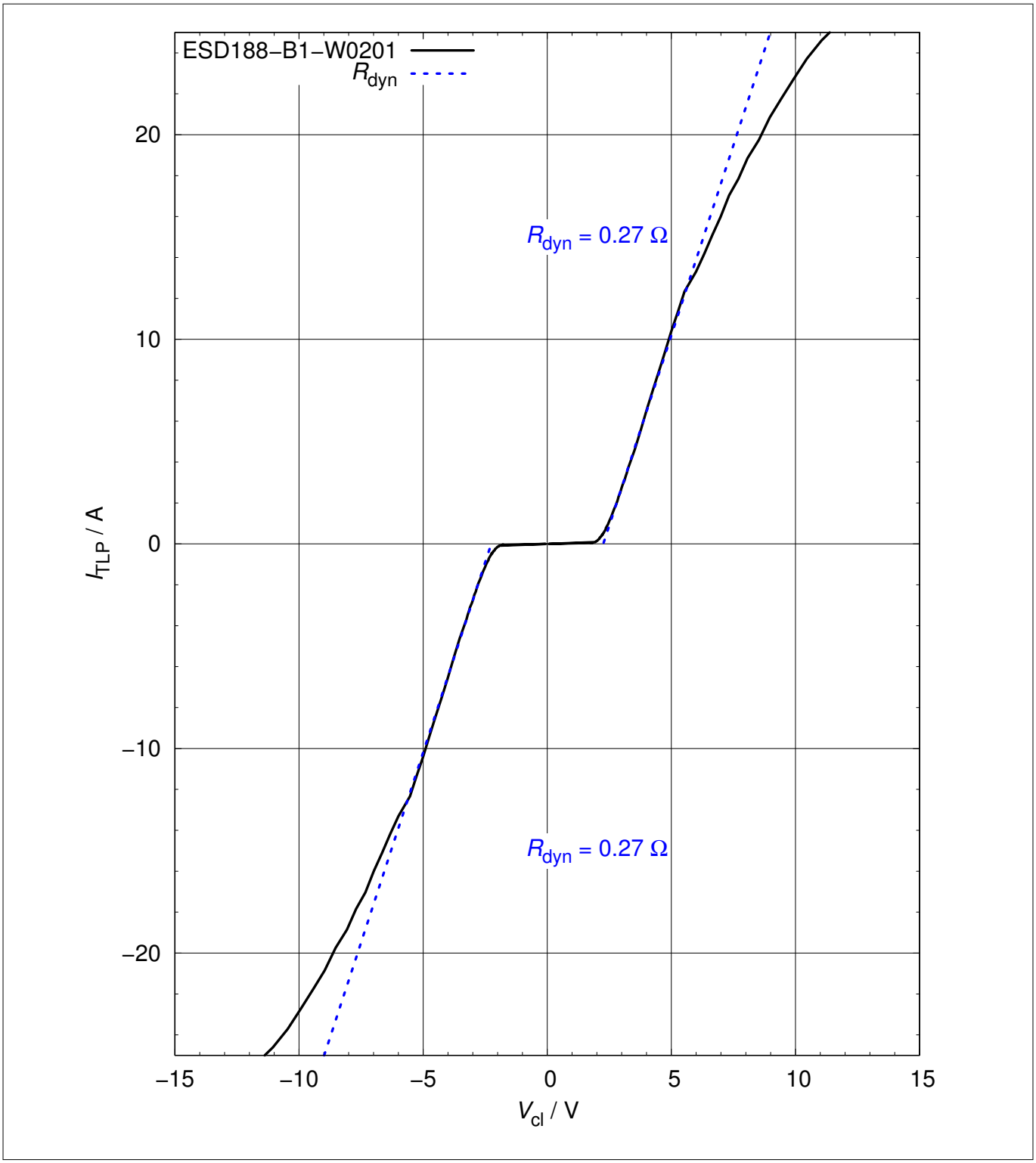

Figure 9 **Clamping voltage (TLP): I_{TLP} = f(V_{cl})**

3 Typical characteristic diagrams

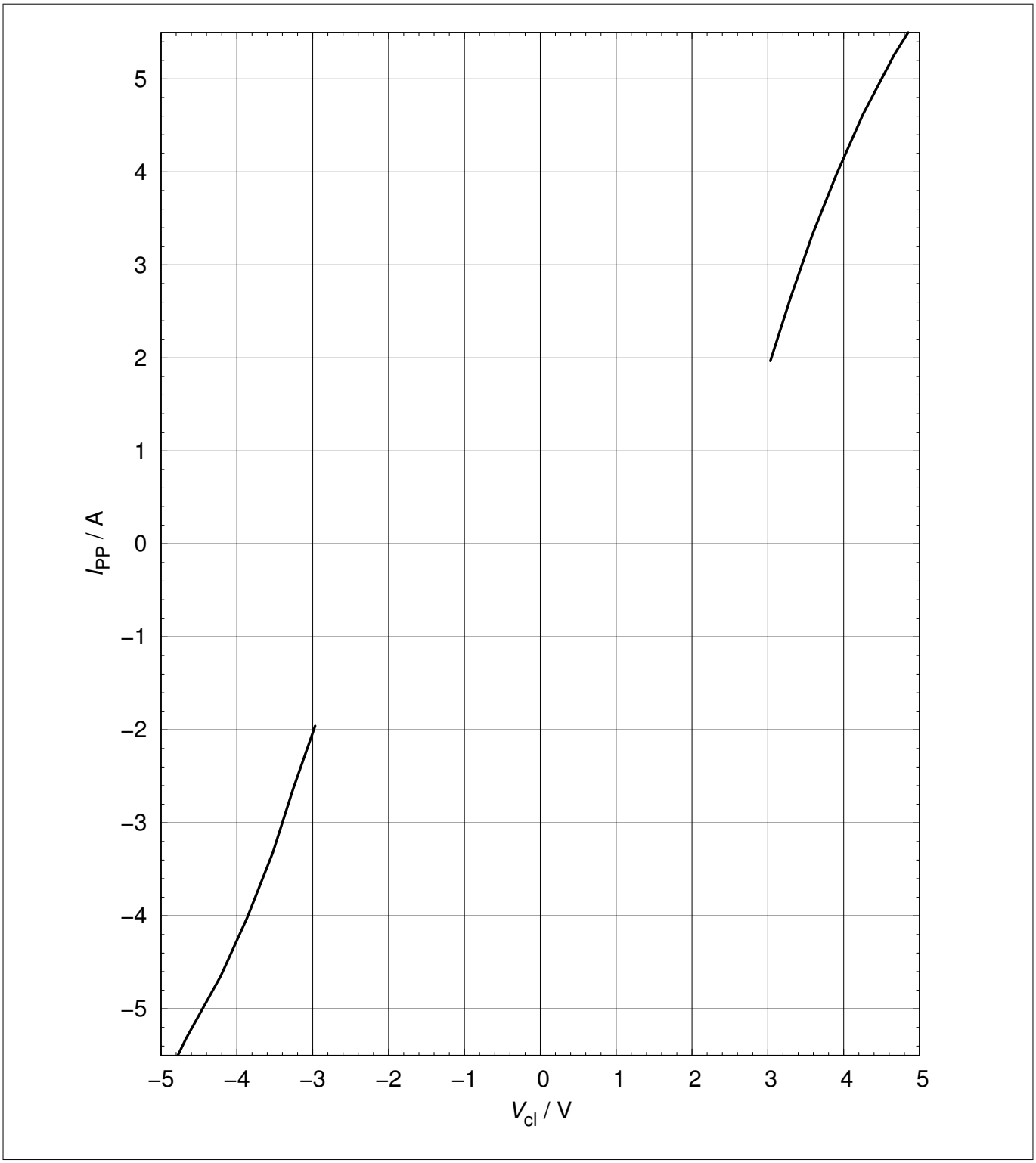

Figure 10 **Clamping voltage (Surge): I_{PP} = f(V_{cl}), based on IEC61000-4-5**

3 Typical characteristic diagrams

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

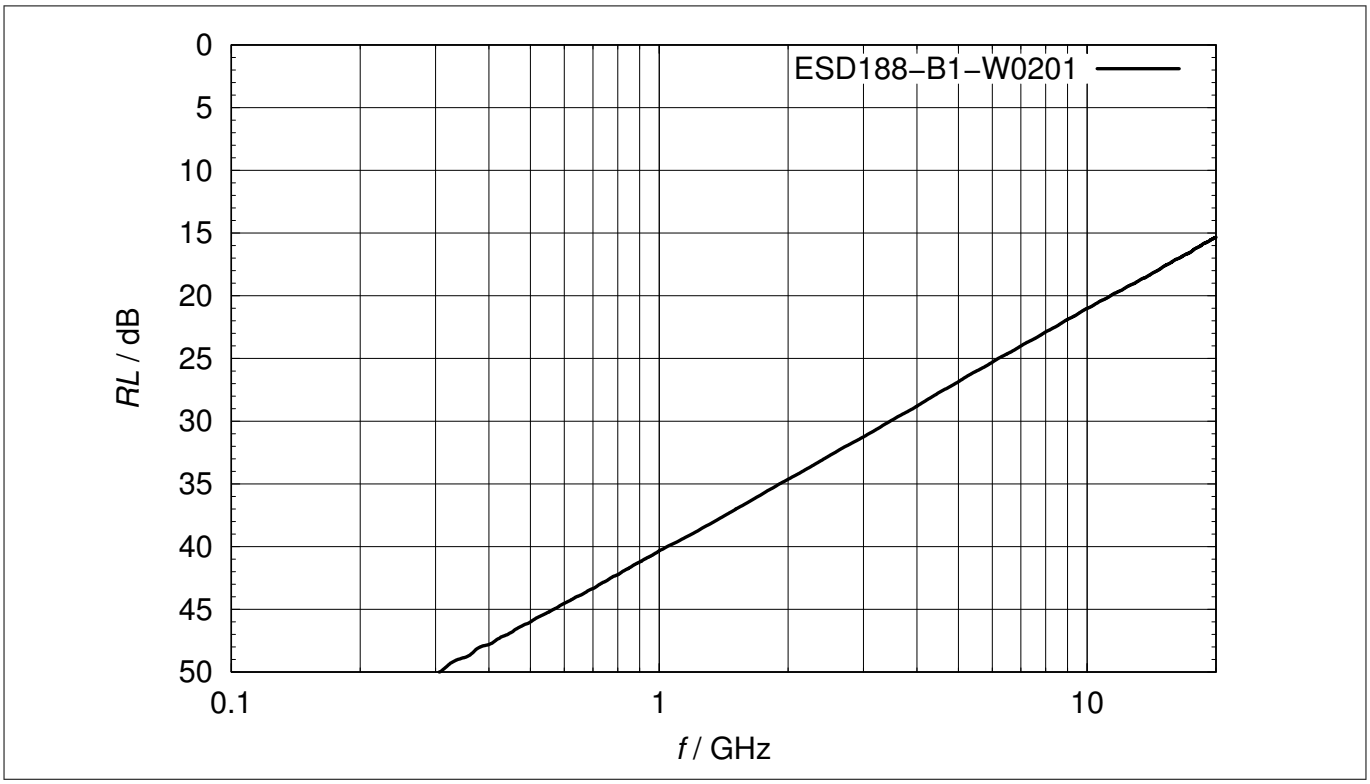

Figure 12 **Return loss R_L = f(*f*), measured in a 50 Ω system**

4 Package information WLL-2-11

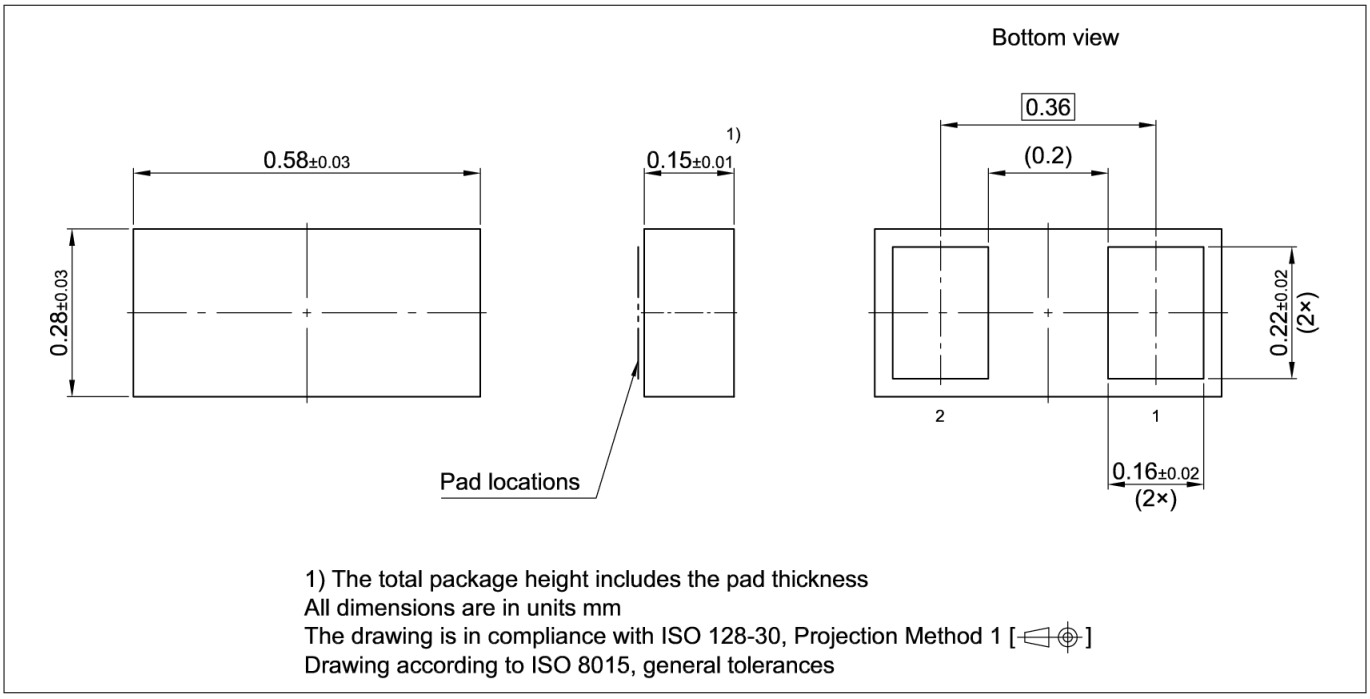

Figure 13 WLL-2-11 package

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

https://www.infineon.com/cms/en/product/packages/SG-WLL/SG-WLL-2-11/

5 References

[1]	Infineon AG - Understanding ESD protection device characteristics
[2]	Infineon AG - **Application note AN210**: 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	2025-01-20	• First final datasheet version

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Email: erratum@infineon.com

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