

TVS Diodes

Transient Voltage Suppressor Diodes

ESD5V3U1U Series

Uni-directional Ultra-Low Capacitance ESD / Transient Protection Diode

ESD5V3U1U-02LS
ESD5V3U1U-02LRH

Data Sheet

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Revision History

Page or Item	Subjects (major changes since previous revision)
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Revision 1.0, 2011-05-27

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1 Uni-directional Ultra-Low Capacitance ESD / Transient Protection Diode

1.1 Features

- ESD / Transient protection of high speed data lines exceeding
 - IEC61000-4-2 (ESD): ± 20 kV (air / contact)
 - IEC61000-4-4 (EFT): 2.5 kV / 50 A (5/50 ns)
 - IEC61000-4-5 (surge): 3 A (8/20 μ s)
- Maximum working voltage: $V_{RWM} = 5.3$ V
- Ultra low capacitance: $C_L = 0.4$ pF (typical)
- Low clamping voltage, low dynamic resistance $R_{DYN} = 0.6 \Omega$ (typical)
- Very small form factor down to $0.62 \times 0.32 \times 0.31$ mm³
- Pb-free (RoHS compliant) and halogen free package



1.2 Application Examples

- USB 2.0, Mobile HDMI Link, MDDI, MIPI, etc.
- HDMI, DisplayPort, DVI, Ethernet, Firewire, S-ATA

2 Product Description

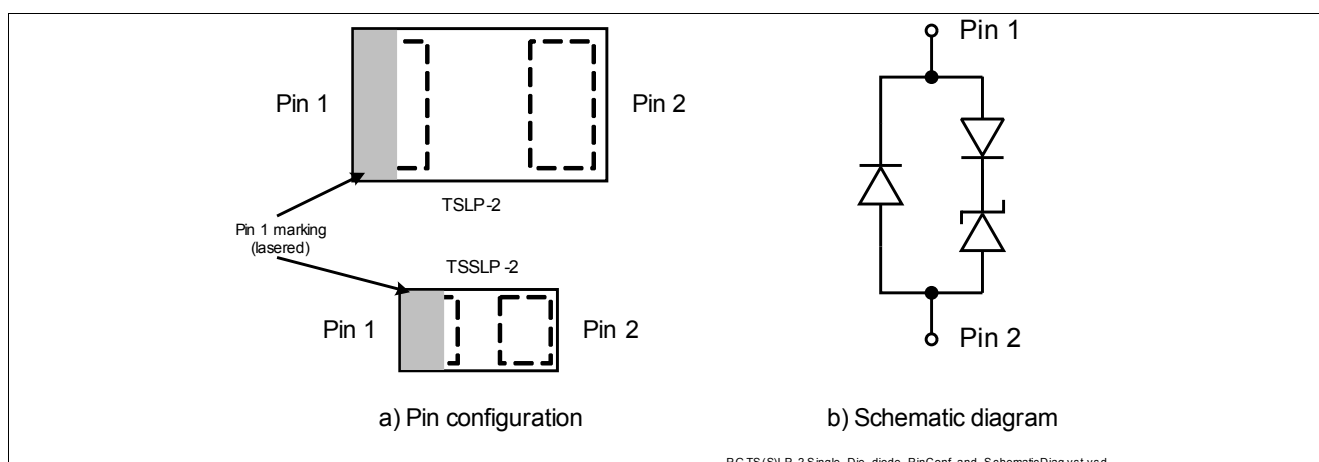


Figure 1 Pin Configuration and Schematic Diagram

Table 1 Ordering Information

Type	Package	Configuration	Marking code
ESD5V3U1U-02LS	PG-TSSLP-2-1	1 line, uni-directional	L
ESD5V3U1U-02LRH	PG-TSLP-2-7	1 line, uni-directional	E5

3 Characteristics

Table 2 Maximum Rating at $T_A = 25\text{ }^{\circ}\text{C}$, unless otherwise specified

Parameter	Symbol	Values			Unit
		Min.	Typ.	Max.	
ESD (air / contact) discharge ¹⁾	V_{ESD}	–	–	20	kV
Peak pulse current ($t_p = 8/20\text{ }\mu\text{s}$) ²⁾	I_{PP}	–	–	3	A
Operating temperature range	T_{OP}	-55	–	125	$^{\circ}\text{C}$
Storage temperature	T_{stg}	-65	–	150	$^{\circ}\text{C}$

1) V_{ESD} according to IEC61000-4-2

2) I_{PP} according to IEC61000-4-5

3.1 Electrical Characteristics at $T_A = 25\text{ }^{\circ}\text{C}$, unless otherwise specified

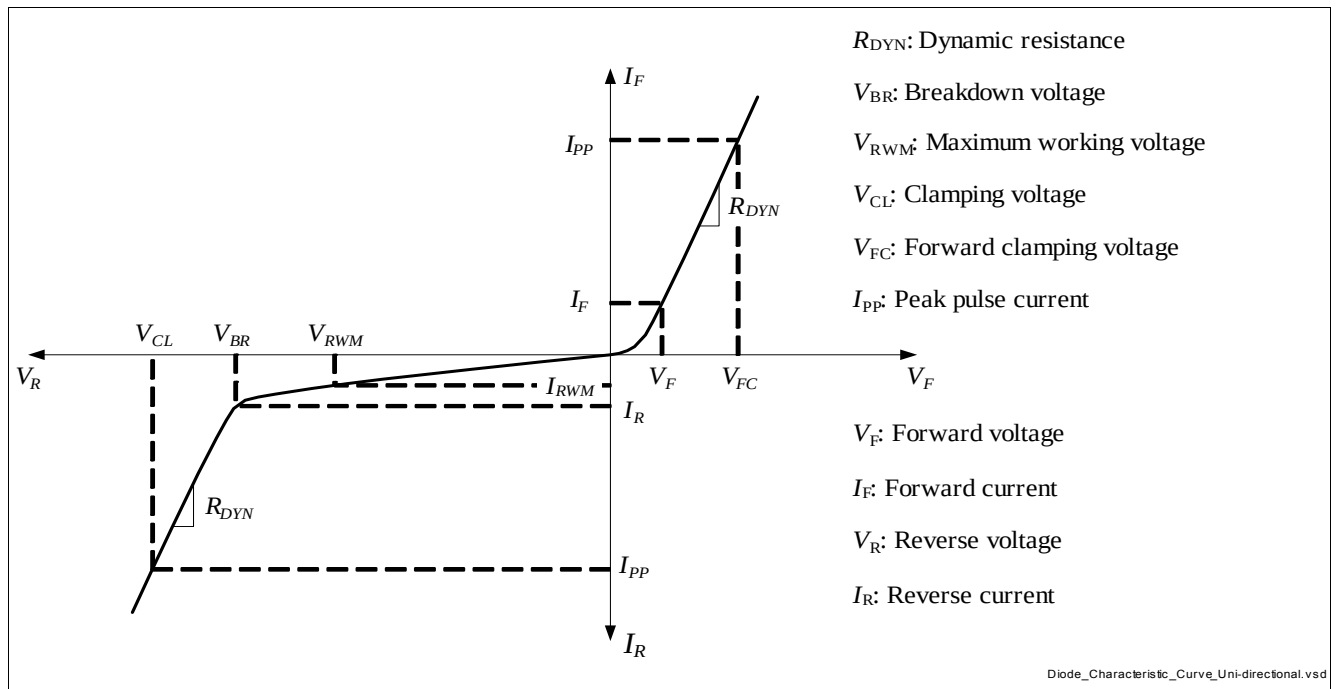

Figure 2 Definitions of Electrical Characteristics

Table 3 DC Characteristics at $T_A = 25\text{ }^{\circ}\text{C}$, unless otherwise specified

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Reverse working voltage	V_{RWM}	–	–	5.3	V	Pin 1 to Pin 2
Breakdown voltage	V_{BR}	6	–	–	V	$I_{\text{BR}} = 1\text{ mA}$, from Pin 1 to Pin 2
Reverse current	I_{R}	–	<10	100	nA	$V_{\text{R}} = 5.3\text{ V}$, from Pin 1 to Pin 2

Characteristics
Table 4 RF Characteristics at $T_A = 25\text{ °C}$, unless otherwise specified

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Line capacitance ¹⁾	C_L	–	0.4	0.6	pF	$V_R = 0\text{ V}$, $f = 1\text{ MHz}$
Serie inductance	L_S	–	0.2	–	nH	ESD5V3U1U-02LS
		–	0.4	–	nH	ESD5V3U1U-02LRH

1) Total capacitance line to ground

Table 5 ESD Characteristics at $T_A = 25\text{ °C}$, unless otherwise specified

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Clamping voltage	V_{CL}	–	19	–	V	$I_{PP} = 16\text{ A}$, from Pin 1 to Pin 2
		–	28	–	V	$I_{PP} = 30\text{ A}$, from Pin 1 to Pin 2
Forward clamping voltage	V_{FC}	–	10	–	V	$I_{PP} = 16\text{ A}$, from Pin 2 to Pin 1
		–	17	–	V	$I_{PP} = 30\text{ A}$, from Pin 2 to Pin 1
Dynamic resistance ¹⁾	R_{DYN}	–	0.6	–	V	Pin 1 to Pin 2
		–	0.5	–	V	Pin 2 to Pin 1

1) Please refer to Application Note AN210[1]. TLP parameter: $Z_0 = 50\text{ }\Omega$, $t_p = 100\text{ ns}$, $t_r = 300\text{ ps}$, averaging window: $t_1 = 30\text{ ns}$ to $t_2 = 60\text{ ns}$, extraction of dynamic resistance using least squares fit of TLP characteristics between $I_{PP1} = 10\text{ A}$ and $I_{PP2} = 40\text{ A}$.

3.2 Typical Characteristics at $T_A=25^\circ\text{C}$, unless otherwise specified

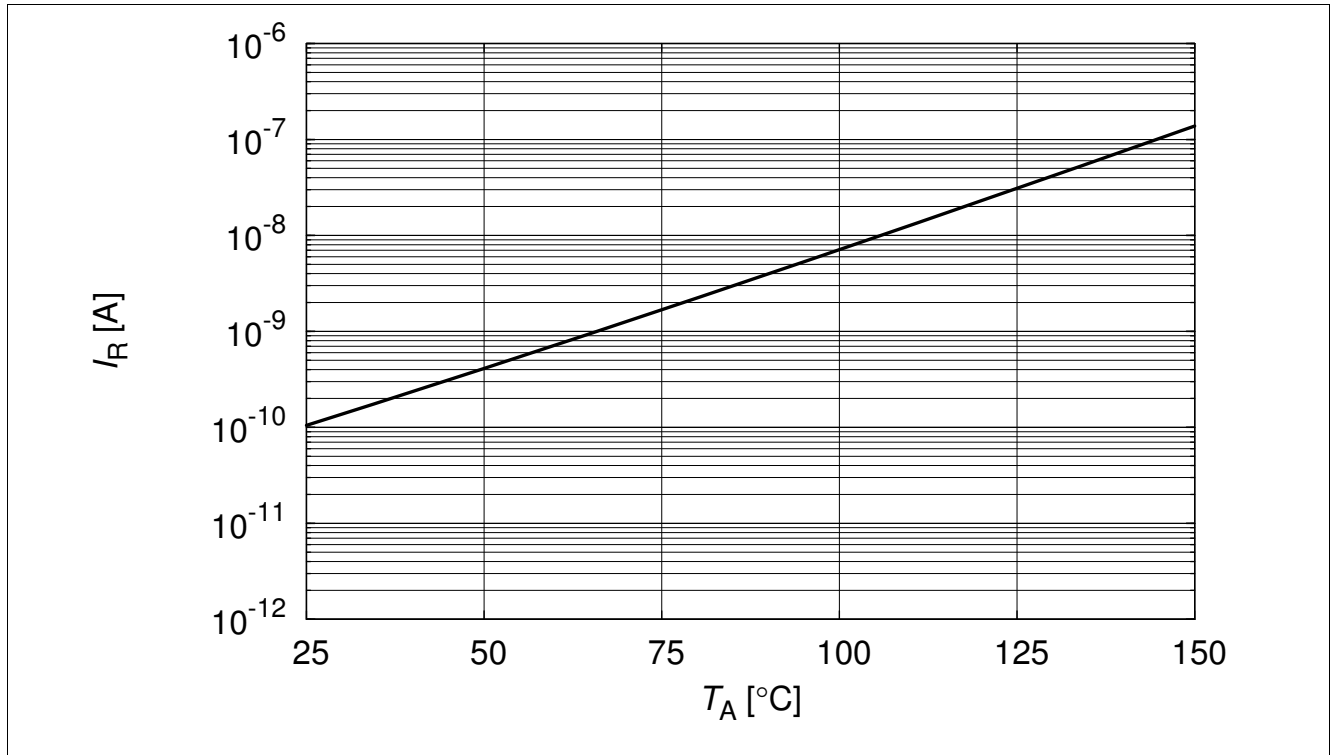


Figure 3 Reverse current $I_R = f(T_A)$, $V_R = 5.3\text{ V}$, from pin 1 to pin 2

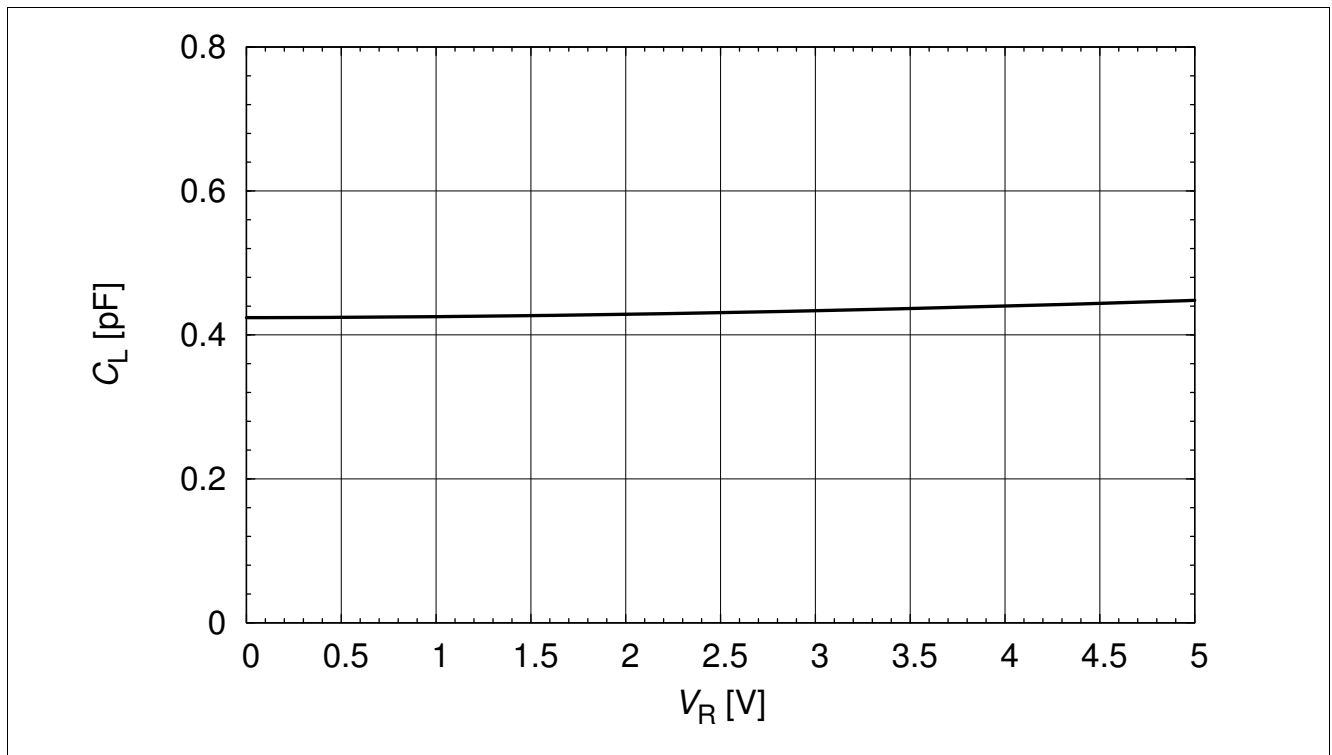


Figure 4 Line capacitance $C_L = f(V_R)$, $f = 1\text{ MHz}$, from pin 1 to pin 2

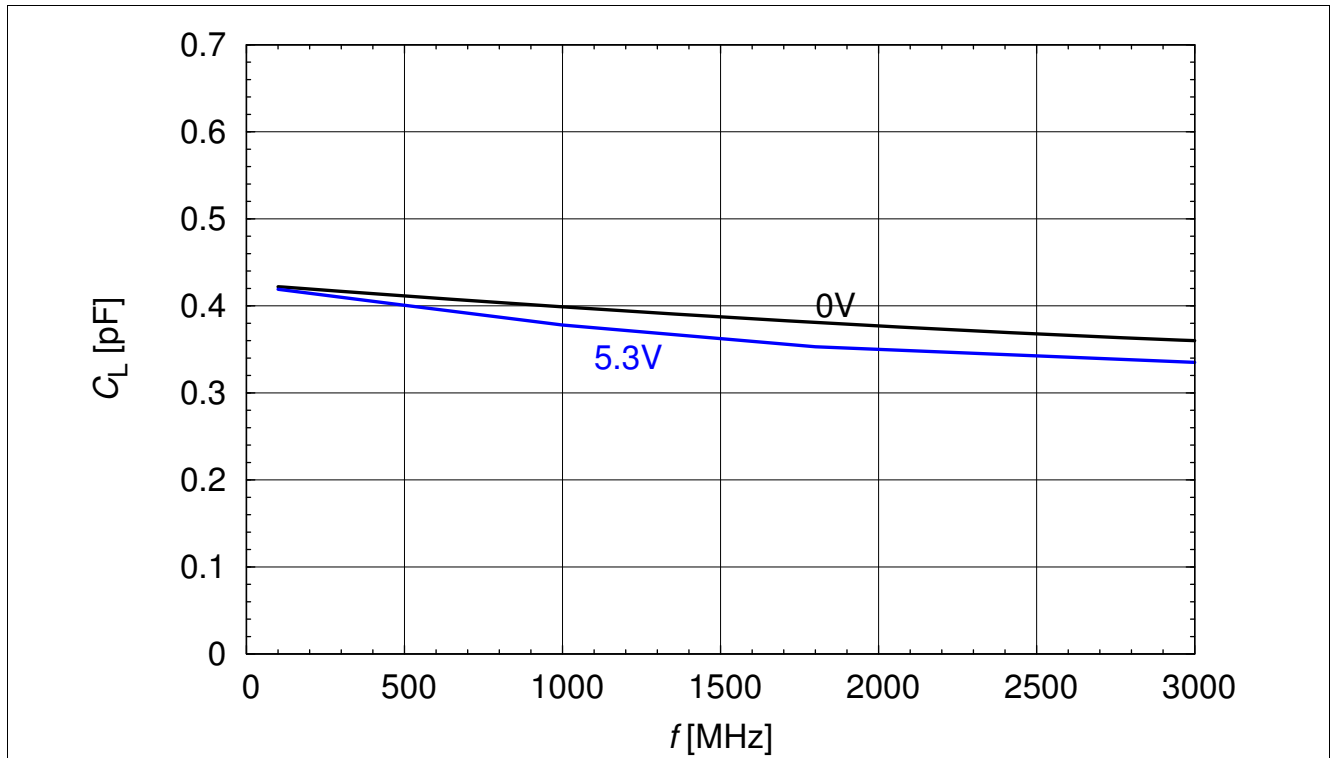


Figure 5 Line capacitance $C_L = f(f)$, from pin 1 to pin 2

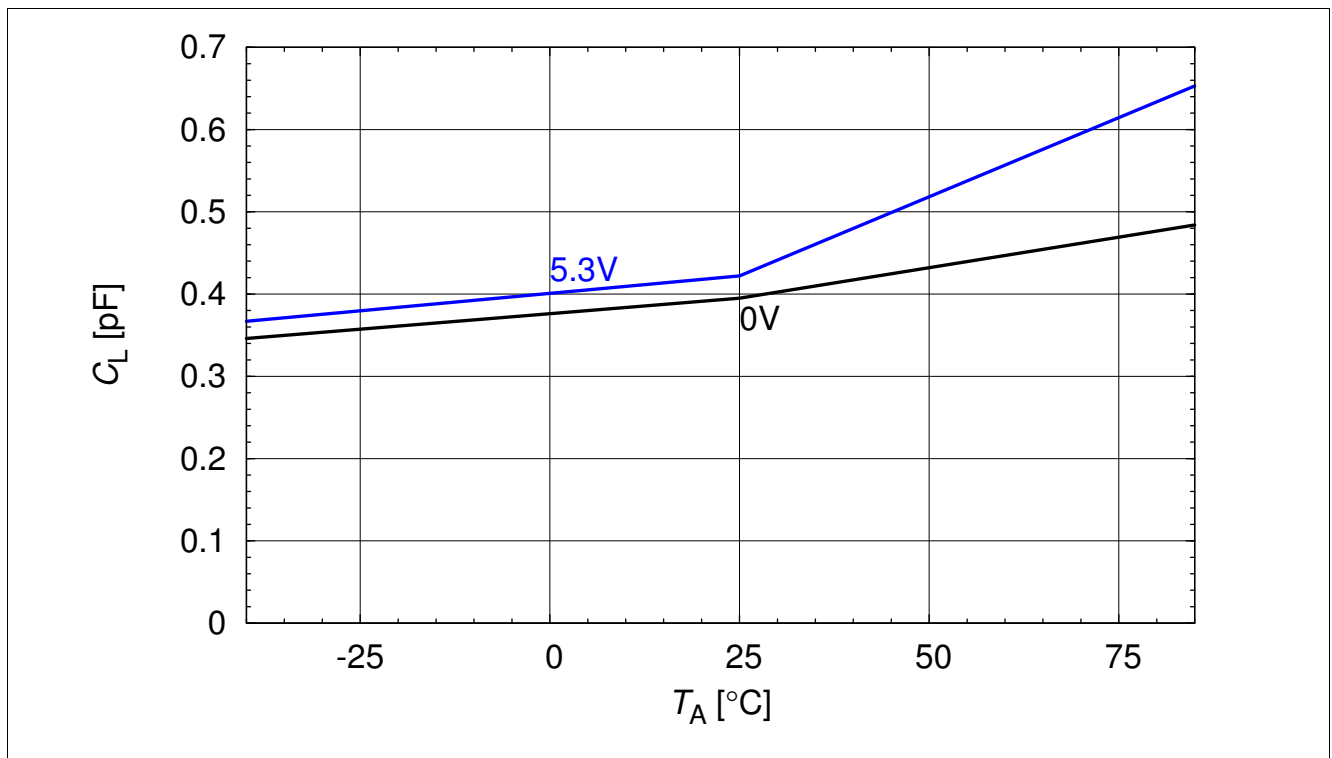


Figure 6 Line capacitance $C_L = f(T_A)$, from pin 1 to pin 2

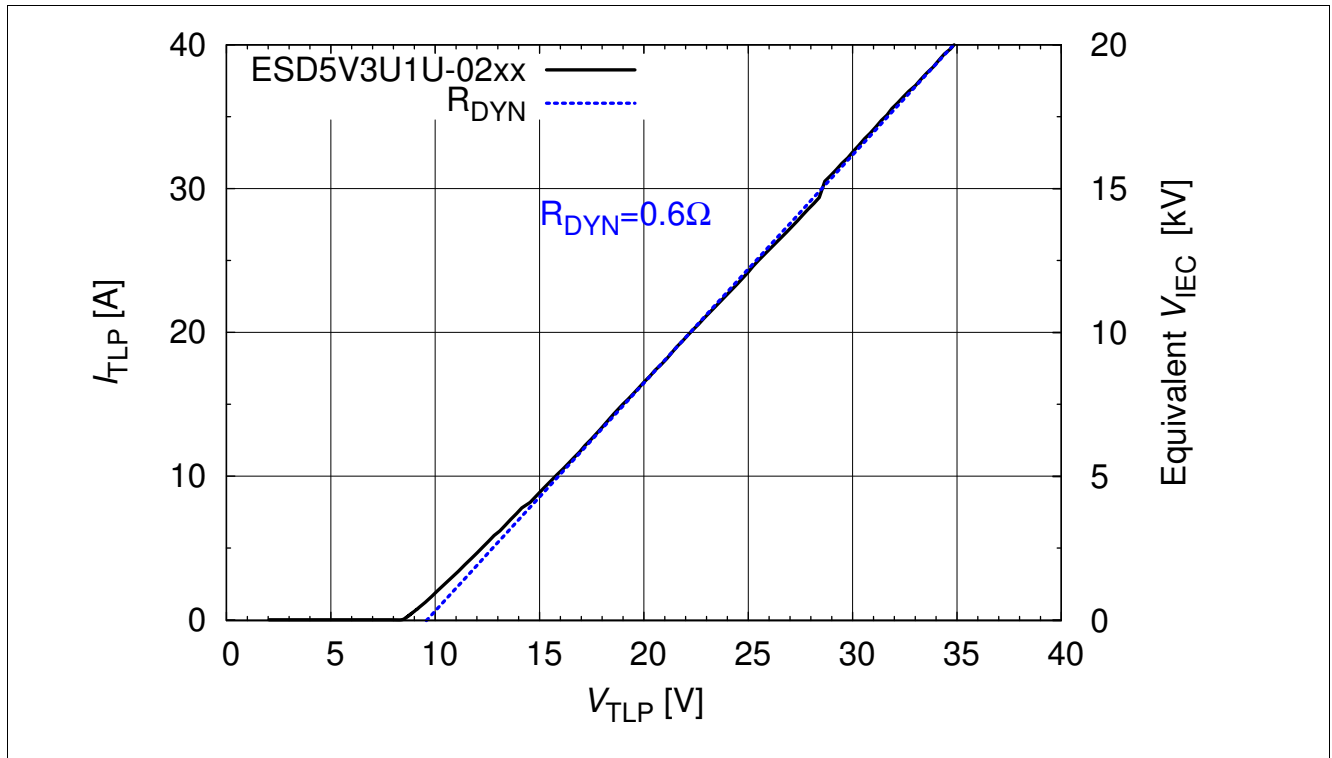


Figure 7 Clamping voltage $V_{TLP} = f(I_{TLP})$, from pin 1 to pin 2[1]

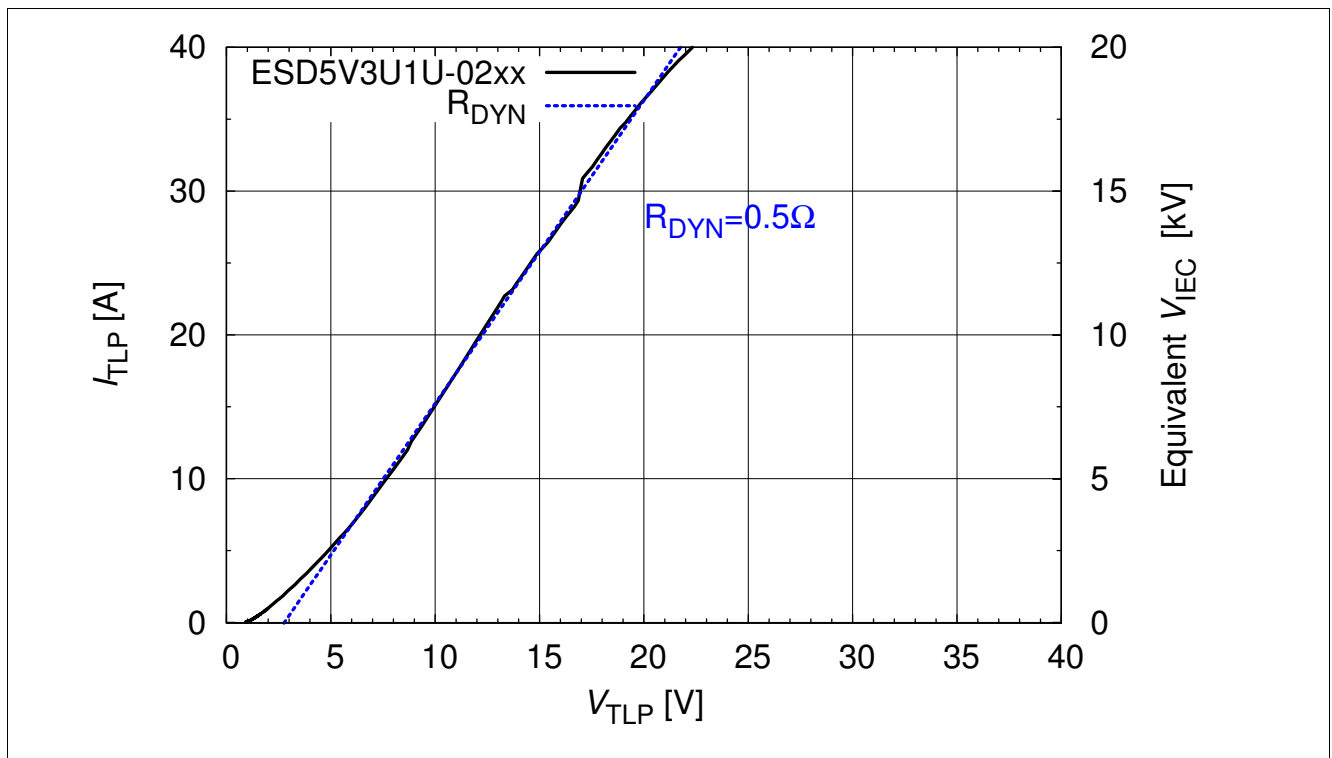


Figure 8 Forward clamping voltage $V_{TLP} = f(I_{TLP})$, from pin 2 to pin 1[1]

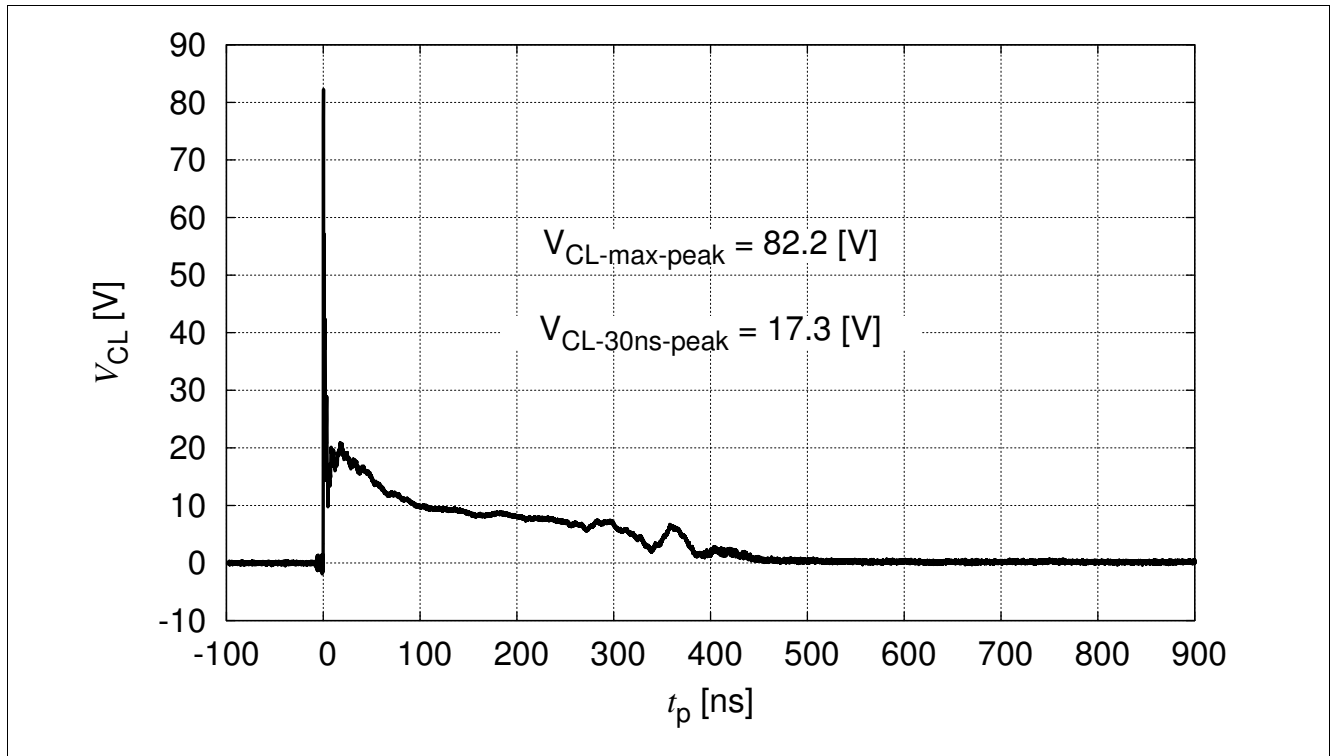


Figure 9 IEC61000-4-2: $V_{CL} = f(t)$, 8 kV positive pulse from pin 1 to pin 2

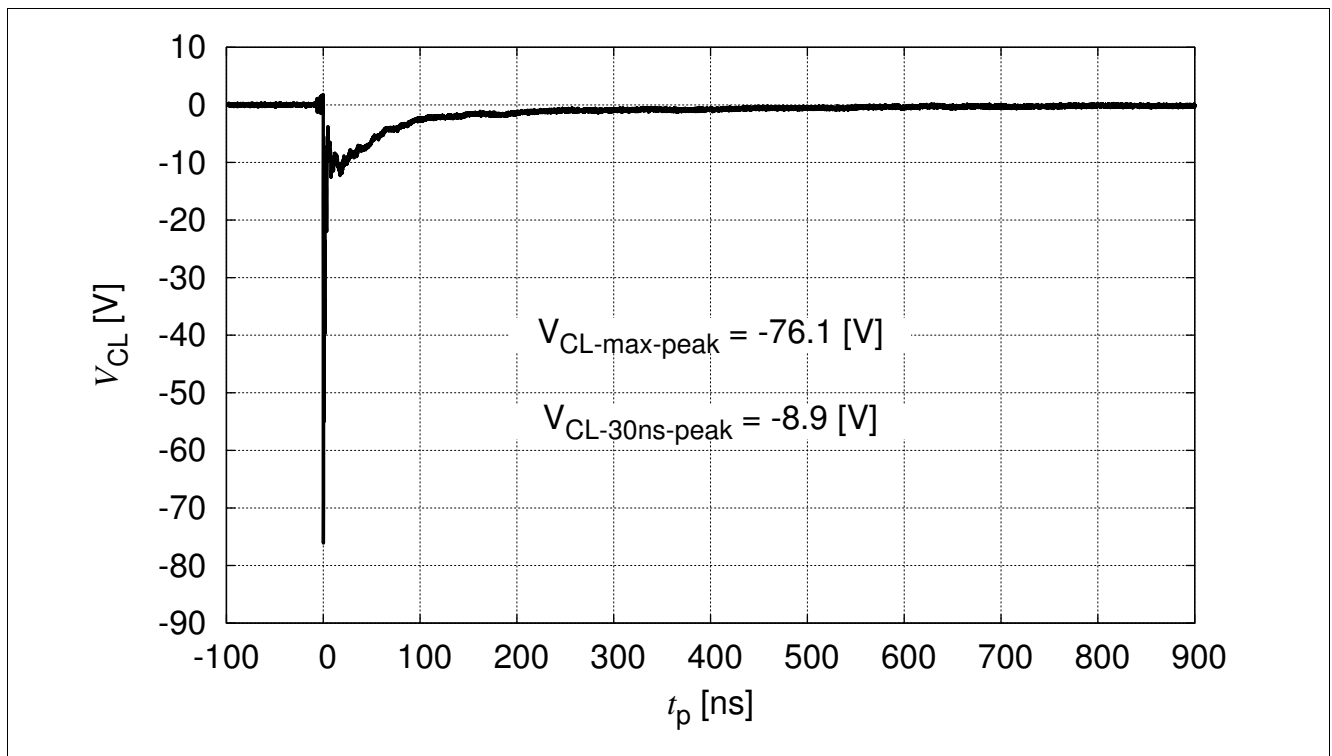


Figure 10 IEC61000-4-2: $V_{CL} = f(t)$, 8 kV negative pulse from pin 1 to pin 2

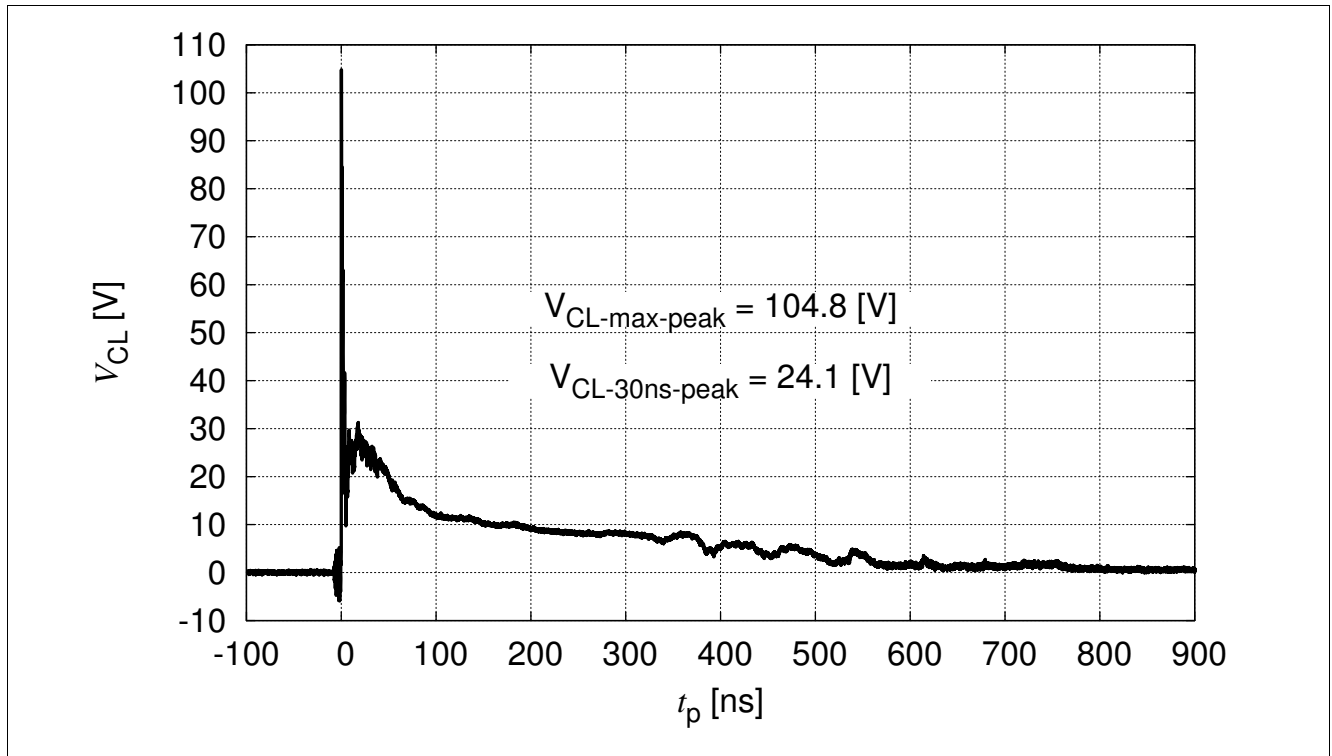


Figure 11 IEC61000-4-2: $V_{CL} = f(t)$, 15 kV positive pulse from pin 1 to pin 2

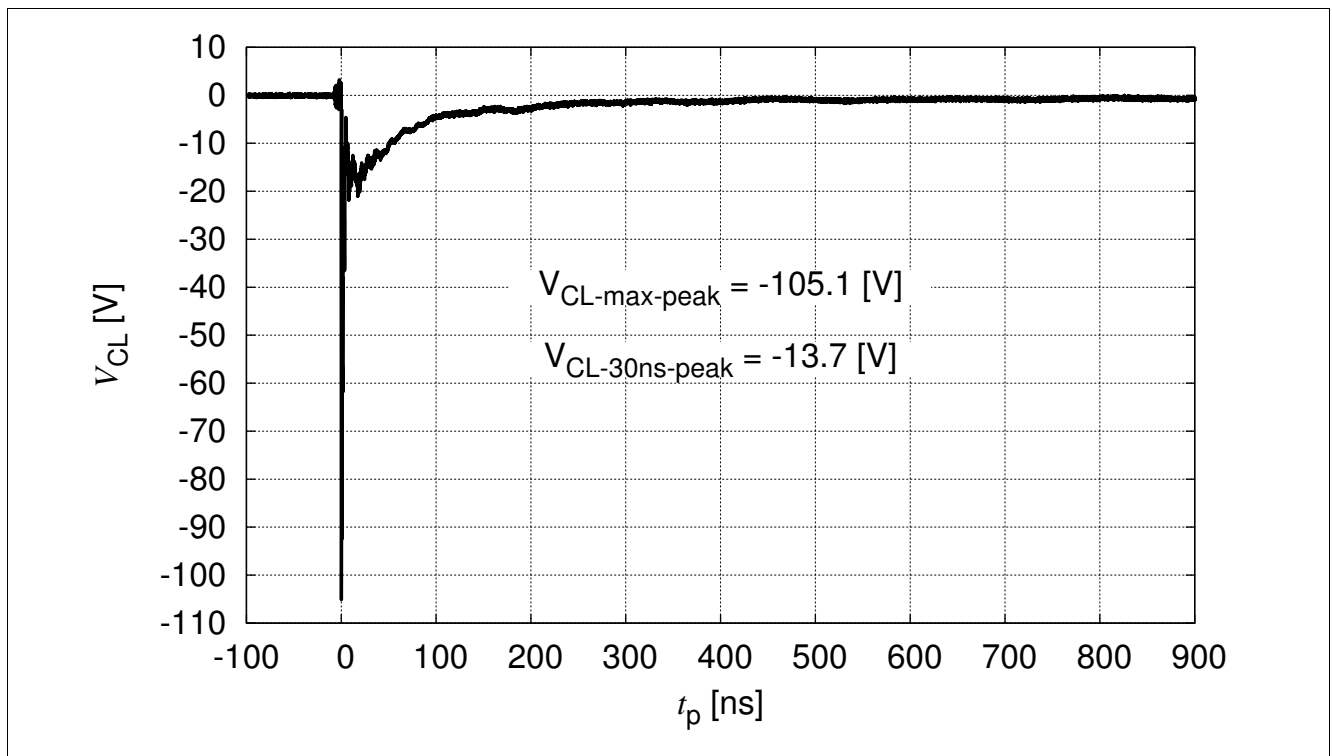


Figure 12 IEC61000-4-2: $V_{CL} = f(t)$, 15 kV negative pulse from pin 1 to pin 2

4 Application Information

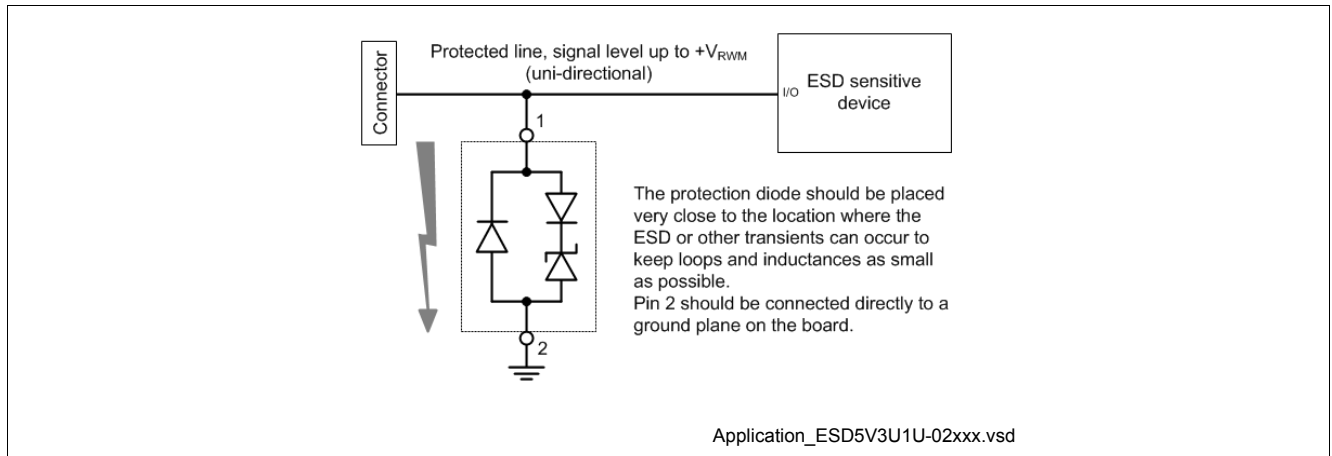


Figure 13 Single line, uni-directional ESD / Transient protection[2]

5 Ordering Information Scheme (Examples)

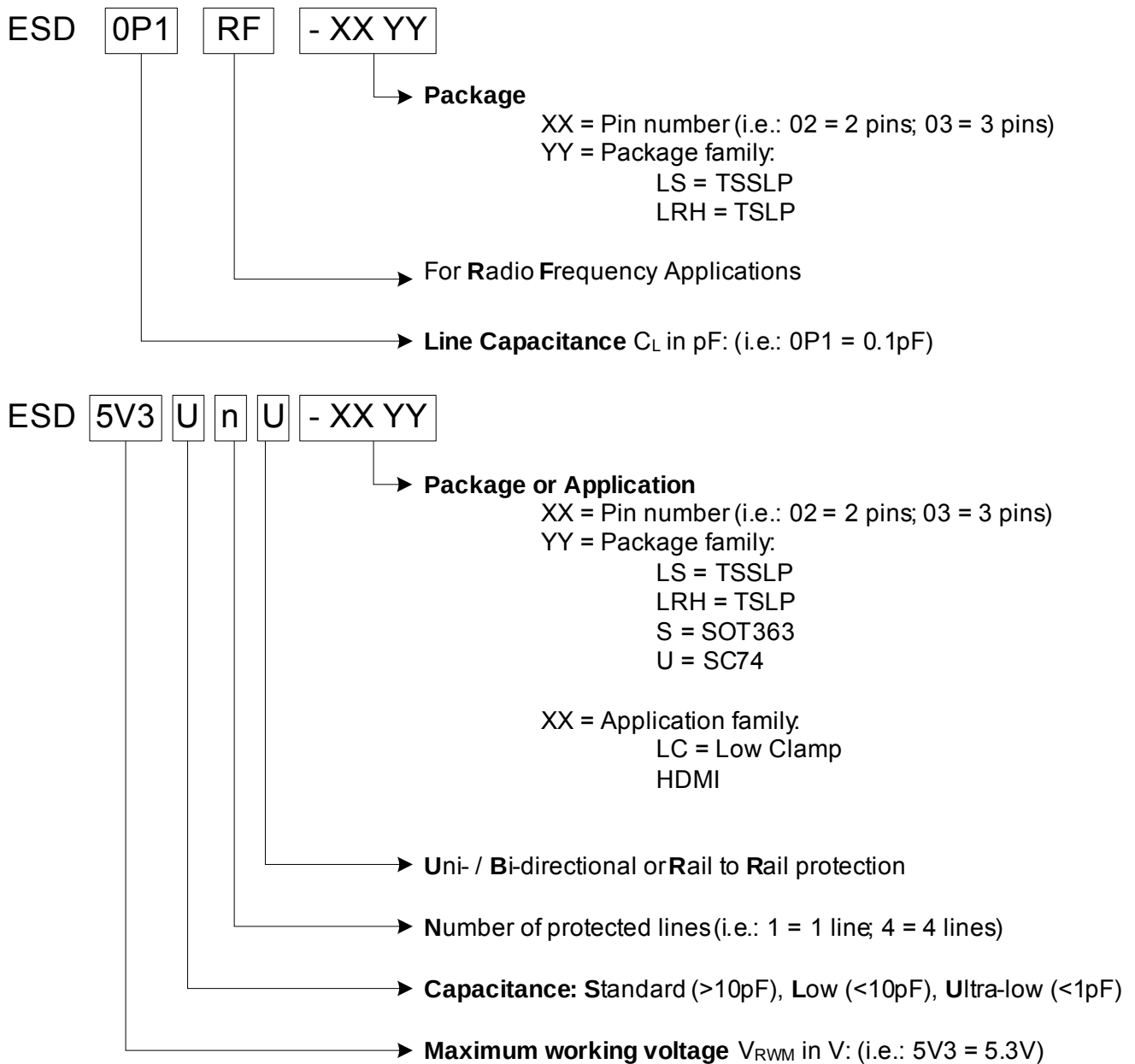


Figure 14 Ordering information scheme

6 Package Information

6.1 PG-TSSLP-2-1 (mm)[3]

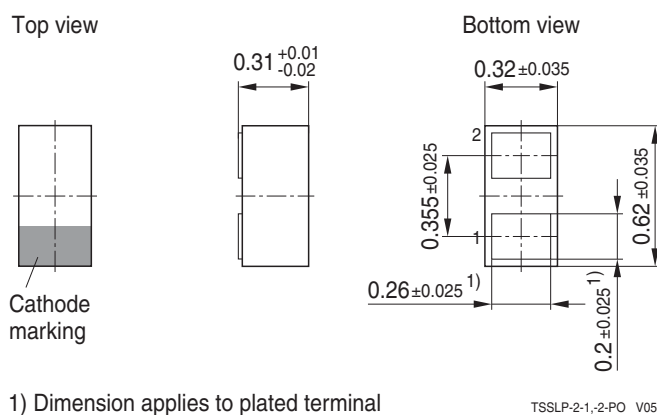


Figure 15 PG-TSSLP-2-1: Package overview

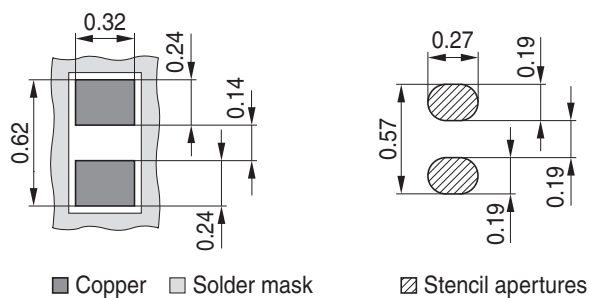


Figure 16 PG-TSSLP-2-1: Footprint

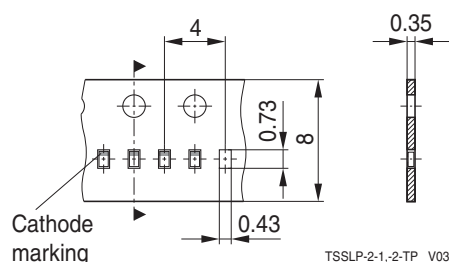


Figure 17 PG-TSSLP-2-1: Packing

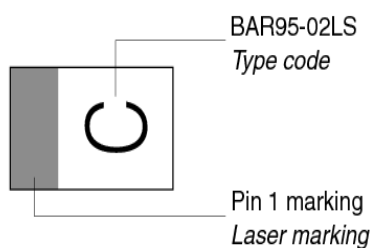


Figure 18 PG-TSSLP-2-1: Marking (example)

6.2 PG-TSLP-2-7 (mm)[3]

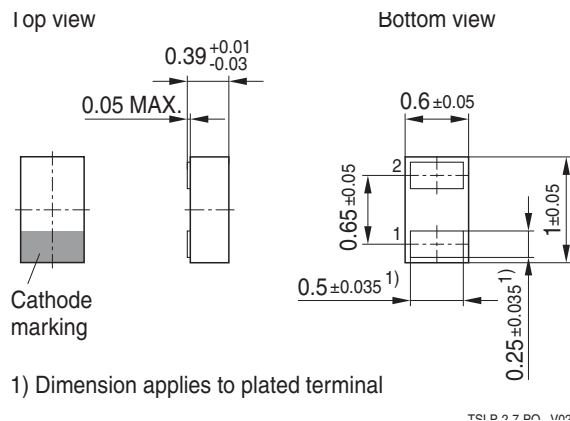


Figure 19 PG-TSLP-2-7: Package Overview

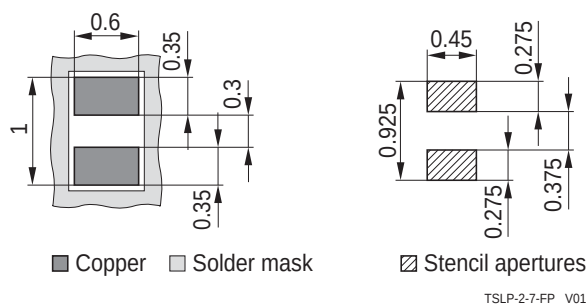


Figure 20 PG-TSLP-2-7: Footprint

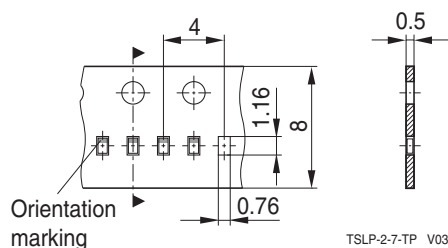


Figure 21 PG-TSLP-2-7: Packing

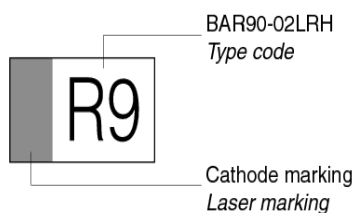


Figure 22 PG-TSLP-2-7: Marking (example)

Terminology

C_L	Line capacitance
DVI	Digital Visual Interface
EFT	Electrical Fast Transient
ESD	Electrostatic Discharge
HDMI	High Definition Multimedia Interface
IEC	International Electrotechnical Commission
I_{PP}	Peak pulse current
I_R	Reverse current
I_{RWM}	Maximum Reverse working Current
L_S	Serial inductance
MDDI	Mobile Display Digital Interface
MIPI	Mobile Industrial Processor Interface
RoHS	Restriction of Hazardous Substances Directive
S-ATA	Serial Advanced Technology Attachment
T_A	Ambient temperature
T_{OP}	Operation temperature
t_p	Pulse duration
T_{stg}	Storage temperature
USB	Universal Serial Bus
V_{BR}	Breakdown Voltage
V_{CL}	Reverse clamping voltage
V_{ESD}	Electrostatic discharge voltage
V_{FC}	Forward Clamping Voltage
V_R	Reverse voltage
V_{RWM}	Maximum Reverse Working Voltage

References

- [1] Infineon AG - **Application Note AN210**: Effective ESD Protection Design at System Level Using VF-TLP
- [2] Infineon AG - **Application Note AN140**: ESD Protection for Digital High-Speed Interfaces (HDMI, FireWire, ...) using ESD5V3U1U)
- [3] Infineon AG - Recommendations for PCB Assembly of Infineon TSLP and TSSLP Package

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