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Miniature TVS Diodes for Wireless Applications

Since the introduction of the world's smallest TVS diode back in 2007, INFINEON has greatly enlarged its portfolio of small and thin TVS diodes. Today INFINEON continues successfully supporting the miniaturization's roadmap of modern wireless electronics with more and more products suited for the most challenging applications.

These diode devices are used for reliable ESD system level protection in a variety of electronic products (see graph with target applications).

External interfaces such as connectors and antenna systems are common entry points for electrostatic discharges. In today's highly susceptible electronics, ESD represents a threat to system reliability. Therefore efficient protection of critical pins via external diode devices is compulsory.

Typical applications protected by INFINEON TVS diodes include (see also Table 1):

- ◆ USB 3.0/USB 2.0, HDMI 1.3/1.4, DisplayPort and DVI
- ◆ FM radio, mobile TV and GPS antenna systems.
- ◆ Audio lines, microphone, speaker, headset.
- ◆ Trackball, keypad, keyboard, power lines.

Common Strategy for Efficient ESD Protection

Infineon's diodes are designed to exceed the maximum level (level 4: $\pm 8\text{kV}$ contact discharge, $\pm 15\text{kV}$ air discharge) specified by IEC61000-4-2 industry standard. For instance, Infineon TVS diodes are specified to endure multiple ESD events of $\pm 20\text{kV}$ and up to $\pm 30\text{kV}$ (see Table 1) without requiring supplementary components.



Target applications for ESD protection:

- Smart phones
- Tablet Computers
- MP3s
- E-Books
- Mobile TVs
- Gaming sets
- Digital Cameras
- Navigation systems and many more...!

Table 1 - Applications, part names and parameters. For further information please refer to data sheets.

Application Examples	Infineon Part Name	V_{RWM} [V]	Protected lines	ESD IEC 61000-4-2 contact [kV]	Ipp IEC61000-4-5 (8/20 μ s) [A]	V_c ⁽²⁾ [V]	I_R	Ct [pF]	Package
Audio/Speaker Headset Lines Trackball Keypad/Keyboard Power Lines	ESD5V3S1B-02LS ⁽⁴⁾	± 5.3	1	16.5	2	15 (max)	1uA max	20 (max)	TSSLP-2 (0201)
	ESD5V3S1U-02LS ⁽⁴⁾	+5.3	1	16.5	2	15 (max)	0.1uA max	40 (max)	TSSLP-2
	ESD8V0R1B-02LS	-8/14	1	15	1	23	<1nA	4.0	TSSLP-2
	ESD5V3S1B-02LRH	± 5.3	1	20	5.5	11	1uA max	17	TSLP-2
	ESD5V3S1U-02LRH	+5.3	1	20	5.5	11	1uA max	35	TSLP-2
	ESD5V3L1U-02LRH	+5.3	1	30	6	10	<1nA	1.0	TSLP-2
	ESD8V0L1B-02LRH	-8/14	1	25	2.5	26/20 @ $\pm 15kV$ ⁽³⁾	<1nA	8.5	TSLP-2
	ESD8V0R1B-02LRH	-8/14	1	15	1	23	<1nA	4.0	TSLP-2
	ESD8V0L2B-03L	-8/14	2	15	1	26/20 @ $\pm 15kV$ ⁽³⁾	<1nA	4.0	TSLP-3
USB2.0/3.0 HDMI1.3/1.4 DisplayPort DVI	ESD5V3U1U-02LS	+5.3	1	20	3	12	<10 nA	0.4	TSSLP-2
	ESD3V3U1U-02LS	+5.3	1	20	3	12	<1 nA	0.4	TSSLP-2
	ESD5V3U1U-02LRH	+5.3	1	20	3	12	<10 nA	0.4	TSLP-2
	ESD3V3U1U-02LRH	+5.3	1	20	3	12	<1 nA	0.4	TSLP-2
	ESD5V3U2U-03RLH	+5.3	2	20	3	12	<1 nA	0.4	TSLP-3
GPS antenna FM radio antenna DVB-T/H w/o GSM UWB w/o GSM	ESD0P2RF-02LS	± 5.3	1	20	3	16	<1 nA	0.2 (1GHz)	TSSLP-2 (0201)
	ESD0P2RF-02LRH	± 5.3	1	20	3	16	<1 nA	0.2 (1GHz)	TSLP-2
	ESD5V3L1U-02LRH	+5.3	1	30	6	10	<1nA	1.0	TSLP-2
	ESD0P8RFL	50	1	20	10	12	100nA (max)	0.8 (1GHz)	TSLP-4 (0402)
	ESD0P4RFL	50	1	15	5	6	20nA	0.4 (1GHz)	TSLP-4 (0402)

Typical values are given unless other indicated.

(1) Line to ground capacitance at 0V and 1MHz unless indicated.

(3) VESD according to IEC61000-4-2, see data sheets.

(2) Ipp according to IEC61000-4-5 unless indicated by (3)

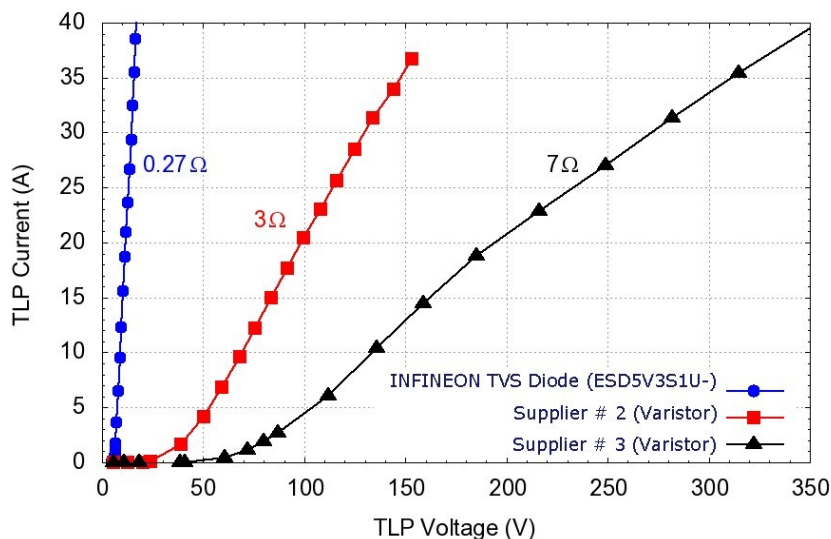
(4) Preliminary data

In addition to surviving multiple electrostatic discharge events without degradation, an efficient protection device must be able to successfully shunt the dangerous ESD current from the downstream equipment being protected. Therefore, the clamping behavior of the protection device has to match to the protected equipment in order to assure that the current through the protected I/O pins is minimized. Very low dynamic resistance relative to the protected system and very fast response time are two prime characteristics that protection devices must provide to accomplish this task.

State of the art Infineon TVS diodes have dynamic resistance values down to 0.27 Ω (Figure 2) at all transient current levels, resulting in extremely low and stable clamping voltages with response times far below 1ns. This key feature confirms Infineon TVS diodes as the ideal solution for protection of low voltage signal lines in wireless applications.

Infineon offers a variety of 0201 and 0402 EIA-equivalent devices designed to protect one or two data lines with a single component. Depending on the diode type, these

Figure 2 - TLP plot and dynamic resistance of an Infineon TVS diode compared to ceramic multilayer varistors (MLV). TLP parameters: 50 Ω , 30ns pulse width, 0.6ns pulse rise time.



devices are suited to protect exposed pins in applications having signal voltage levels swinging around zero as well as those lines with unipolar voltage levels. All Infineon TVS diodes protect against ESD strikes in both positive and negative directions.

As with other Infineon's TVS diodes, all these products endure multi-ESD strikes without requiring supplementary components. In terms of ESD absorption capability these devices are specified to exceed the toughest industry standard IEC61000-4-2 level 4 (see Table 1).

Miniature Designs with World's Smallest TVS Diodes

Available in 0201 and 0402 EIA-equivalent packages, these TVS diodes measure just 0.62 x 0.32 mm for TSSLP-2 (thin super-small leadless package) and 1.00 x 0.60 mm for TSLP-2 (thin small leadless package). See Figure 1.

Because of their small size with underneath electrode pad design these devices boast true space savings in highly populated PCB boards.

Package height is a key element in the design of modern electronic equipment. With only 0.39 mm (0402) and 0.31mm (0201) thickness these packages are the solution of preference for many major manufacturers of slim electronics.

TSSLP-2 and TSLP-2 diode packages are ROHS and Halogen-Free compliant. They are suited for all variations of pick-and-place assembly.

Features & Benefits

- ◆ World's Smallest TVS Packages: EIA 0201 and EIA 0402 equivalent.
- ◆ Excellent ESD absorption capability of up to $\pm 30\text{kV}$ contact discharge.
- ◆ Series suitable for protection of two lines with one device.
- ◆ Capacitance range down to 0.2pF typical and 0.4pF maximum.
- ◆ Leakage current down to 0.1nA typ, max 50nA to extend battery's duration.

Figure 2 - TSSLP-2 and TSLP-2 single line packages.



Lowest and stable capacitance for optimal eye pattern quality

Compliance with high speed data transmission requirements in high frequency applications like USB 3.0, HDMI 1.3 / 1.4 and also in antenna applications requires the minimization of parasitic capacitance effects along the entire application's frequency range.

A major issue typical of low capacitance protection devices designed for protection of high frequency interfaces is their drawback in ESD clamping performance. Common examples of these products are multilayer varistors (MLV) and polymer suppressors.

Infineon's technology overcomes this problem making possible ultralow parasitic capacitance values down to 0.2pF (1MHz) while ensuring very low clamping voltages (Table 1).

Longer battery's duration

Today's market, growing towards portable electronics, demands much less power consumption and extended battery duration more now than ever before. New electronic design is looking to reduce the leakage current drained

by small components in routine operating mode. Infineon TVS diodes with leakage currents down to less than 1nA (Table 1) and maximum specified as 50nA (see data sheets) represent a significant benefit for battery-powered electronics.

Supply's Excellence

As for all Infineon products, all these miniaturized TVS-protection devices come with the same superior quality level and benefit from the advantages that only a proven high volume system supplier can provide.

Further Product information

www.infineon.com/tvsdiodes

www.infineon.com/tvs.appnotes

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