Product Brief 2023

Transient Voltage Suppressors – TVS

High-performance TVS Diodes for ICT, Consumer and High-speed Applications

Features

- Ultra-small wafer-level chip-scale package with a thickness of 100 µm and 150 µm
- Available in chip scale packages WL-CSP0201 and WL-CSP01005
- High ESD robustness up to 25 kV based on IEC61000-4-2
- Low clamping voltage down to 3.8 V (I_{TLP} = 8 A)
- Low leakage current as low as 1 nA (V_{RWM} = 3.3 V)
- Very low capacitance down to 0.18 pF

Applications

General purpose

- Smartphones
- Laptops
- Tablets
- Wearables, portable devices
- Network communication devices

High-speed interfaces

- USB, FireWire
- DVI, HDMI, DisplayPort
- S-ATA
- Thunderbolt
- SWP/NFC

For further information please refer to:
www.tdk-electronics.tdk.com/tvs_diodes

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Excellent ESD protection for portable, wearable & high-speed applications

The new micro-packaged TVS diodes by TDK are designed to protect voltage-sensitive components from ESD, for existing and future applications in the direction of general-purpose and high-speed interfaces. Excellent clamping voltage, low leakage and fast response time provide state-of-the-art protection for applications exposed to ESD. Due to their ultra-slim package, they are an excellent solution for smartphones, true wireless earbuds, smart watches, and many other portable applications with tight space requirements. Ultra-low capacitance permits excellent signal integrity for demanding high-speed interfaces, such as USB, HDMI, DisplayPort and Thunderbolt.

TVS diodes for USB Type-C connectors

The USB Type-C connector is the most common interface for computers, tablets, and smartphones. It supports high-speed data transfer and fast charging of peripheral devices. Like other interfaces, USB Type-C connectors are frequently exposed to Electrostatic Discharges (ESD), which may cause damage to the sensitive electronics of the connected devices. Therefore, connector pins must be properly protected against ESD.

TDK offers TVS diodes which are specifically designed to protect USB Type-C connectors. The portfolio provides ideal solutions for high-speed data pins up to 40 Gbps using the fast USB 4 40G protocol, as well as the Thunderbolt protocol and supports fast device charging via power delivery protocol.
The USB Type-C connector is flippable with no up or down orientation, achieved by mirroring the pins on both sides of the connector. Figure 1 (page 3) shows all 24 pins densely arranged without leaving much space for protection diodes. Best practice for ESD protection is to place an ESD component as close as possible to the connector pin. Due to the miniaturized size of TDK TVS diodes, they perfectly fit and offer robust protection with the IEC 61000-4-2 system-level ESD standard.

Product range

TDK PN	B74121 U0033M060	B74111 U0033M060	B74121 U0055M060	B74111 U0055M060	B74121 G0160M060	B74121 G0200M060
Package	WLCSP 0201	WLCSP 01005	WLCSP 0201	WLCSP 01005	WLCSP 0201	WLCSP 0201
Footprint						
Thickness [µm]	150	100	150	100	150	150
Working voltage [V]	3.3	3.3	5.5	5.5	16	20
Clamping voltage I_{TLP} = 8 A [V]	3.9	3.8	4.0	3.9	22	26
Capacitance 1 MHz [pF]	0.65	0.48	0.55	0.43	6	5
ESD level contact discharge [kV]	15	15	15	15	15	>8
PIN to protect	Tx/Rx	Tx/Rx	D+/D- (Tx/Rx)	D+/D- (Tx/Rx)	V_{BUS} (CC/SBU)	V_{BUS} (CC/SBU)

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USB-C pinout

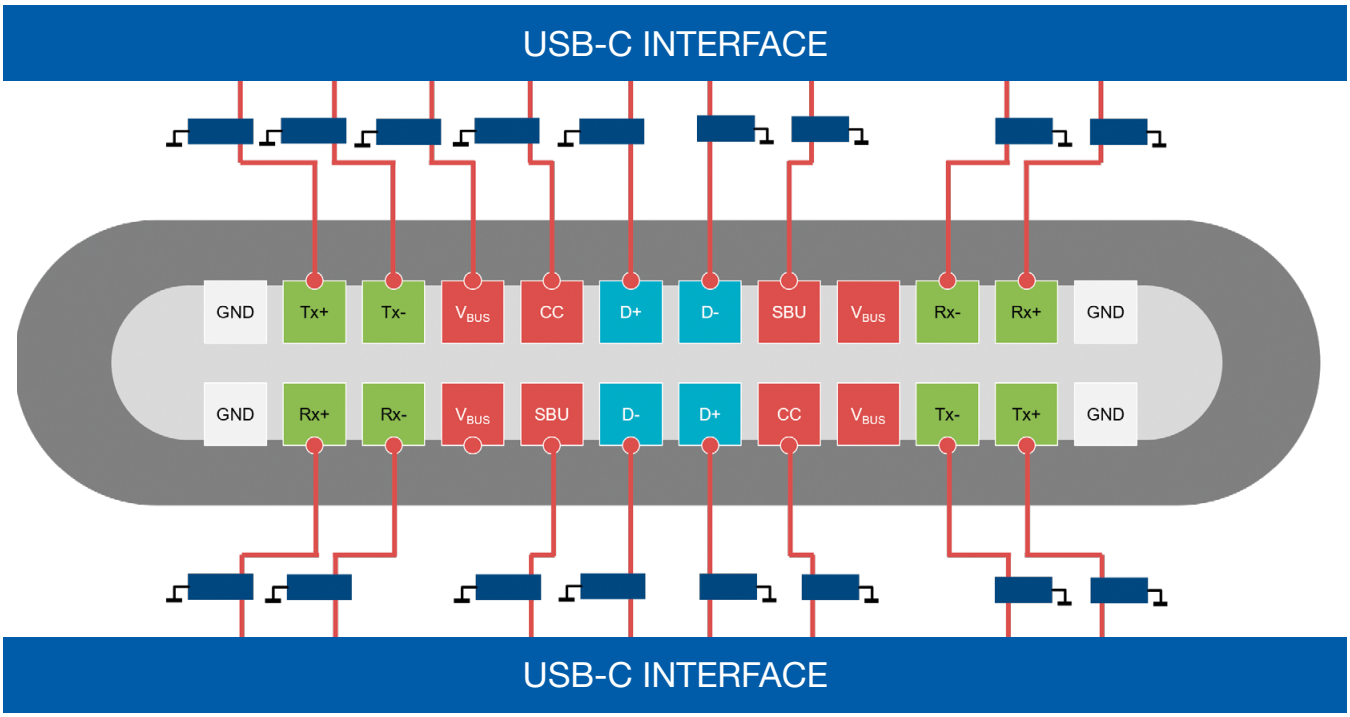

Figure 1

ESD protection is needed on 20 pins except for the four GND (ground) pins. By connecting the TVS diodes from the pin to GND, a transient current will be redirected to GND at an ESD event. TDK TVS diodes are designed with a snap-back feature with extremely low clamping voltage characteristics due to their “thyristor structure”. This feature guarantees a reliable limitation of over-voltage.

For USB-C Tx/Rx high data-rate pins, TDK offers ULC TVS diodes with low reverse working voltage (±3.3 V) and ultra-low capacitance. ULC TVS diodes are certified for applications with USB 4 40 Gbps and Thunderbolt signals. Test results show that TDK TVS protection diodes do not impair the communication signal on the lines.

For the protection the differential signal D+/D- pins, TDK offers TVS diodes with a working voltage of ±5.5 V, perfectly suited to USB 2 signal levels.

For VBUS power pins and neighboring CC (Configuration Channel) and SBU (Sideband Use) pins, TDK TVS diodes support reverse working voltages up to ±20 V and fast charging functionality with a USB PD (USB Power Delivery) of up to 100 W with 5 A/20 V.

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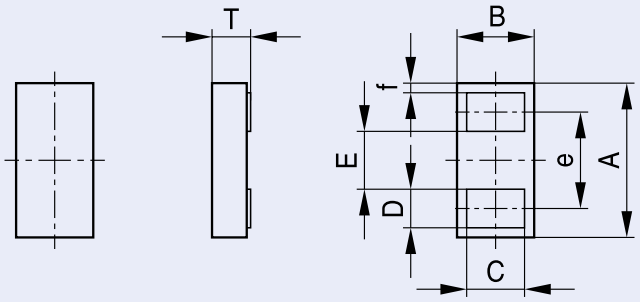
Product range

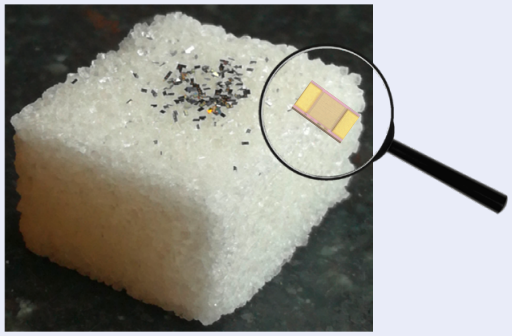
Electrical specifications and ordering codes

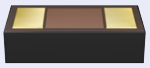
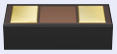
$V_{RWM, max}$ I/O to GND [V]	C_{typ} [pF]	$V_{BR, typ}$ 1 mA [V]	$I_{leak, typ}$ 3.3 V [nA]	$V_{clamp1, typ}$ I_{TLP} = 8 A [V]	$V_{clamp2, typ}$ I_{TLP} = 16 A [V]	$V_{ESD, max}$ 10 pulses [kV]	$R_{dyn, typ}$ [Ω]	Ordering code Type
General purpose applications, GP series								
±5.0	12	6.8	40	7.2	8.0	±25	0.10	B74121G0050M060 WL-CSP0201 SL
±5.0	5	6.8	20	7.6	8.9	±15	0.16	B74111G0050M060 WL-CSP01005 SL
±5.5	5	7.5	10	8.5	10.1	±15	0.2	B74111G0055M060 WL-CSP01005 SL
±16	5.5	21	5	23	25.7	±15	0.33	B74121G0160M060 WL-CSP0201 SL
±20	4.0	22	20	27	32	±15	0.6	B74121G0200M060 WL-CSP0201 SL
High-speed interface applications, ULC series								
±2.8	0.18	5.9	5	5.5	8.2	±15	0.27	B74121U0028M060 WL-CSP0201 SL
±3.3	0.65	6.3	1	3.9	5.2	±15	0.16	B74121U0033M060 WL-CSP0201 SL
±3.3	0.48	6.3	1	3.8	5.0	±15	0.15	B74111U0033M060 WL-CSP01005 SL
±5.5	0.55	10.3	1	4.1	5.6	±15	0.19	B74121U0055M060 WL-CSP0201 SL
±5.5	0.43	10.3	1	3.9	5.1	±15	0.15	B74111U0055M060 WL-CSP01005 SL

Transient Voltage Suppressors – TVS

Dimensional drawings





					
	WL-CSP0201 SL			**WL-CSP01005 SL**	
	B74121G0050M060 2			B74111G0050M060	
	B74121G0160M060 2			B74111G0055M060	
	B74121G0200M060 1				
	B74121U0028M060 1			B74111U0033M060	
	B74121U0033M060 2			B74111U0055M060	
	B74121U0055M060 2				
Symbol	**Mean**		**Tol.**	**Me Mean an**	**Tol.**
	1	2			
A	0.58	0.60	±0.025	0.40	±0.020
B	0.28	0.30	±0.025	0.20	±0.020
T	0.15	0.15	±0.010	0.10	±0.010
C	0.24	0.22	±0.020	0.15	±0.020
D	0.17	0.13	±0.020	0.10	±0.020
E	0.19	0.26	(typical)	0.15	(typical)
e	0.36	0.39	(typical)	0.25	(typical)
f	0.025	0.04	(typical)	0.025	(typical)
Size	**580 x 280 µm / 600 x 300 µm**			**400 x 200 µm**	
Thickness	**150 µm**			**100 µm**	

Dimensions in mm

Symbols and terms

C	Capacitance	I_{TLP}	Transmission-line pulse current	R_{dyn}	Dynamic resistance	V_{ESD}	ESD voltage
I_{leak}	Reverse leakage current	SL	Slim-line	V_{BR}	Breakdown voltage	V_{RWM}	Reverse working voltage
I_{PP}	Peak pulse current (8/20 µs)	TLP	Transmission-line pulse	V_{clamp}	Clamping voltage TLP		

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