

ESD Protection Utilizing PESD Devices for Universal Serial Bus 2.0

The USB 2.0 protocol allows for data transfer rates of up to 480Mbps and supports plug and play hot swappable installation and operation. As a result of the increase in speed, low capacitance ESD protection of the bus is even more important now to maintain data integrity between devices in the network. Tyco devices are capable of handling numerous ESD transients. When protection of the data bus is critical Tyco PESD devices are useful in these applications, with a typical capacitance of 0.25pF.

Applications:

USB devices such as:

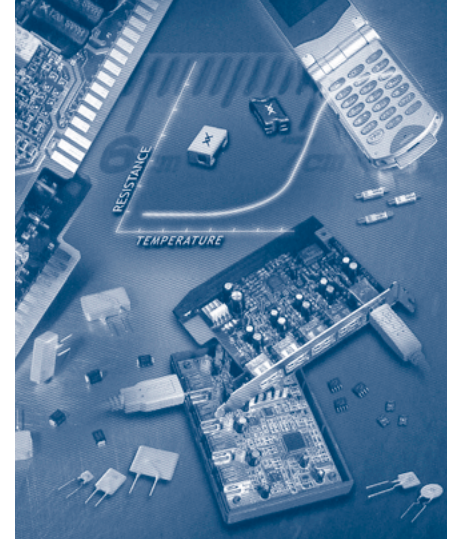
- PDAs
- CPU motherboards
- Memory keys
- Digital music players
- Printers
- Digital cameras
- Scanners
- USB hubs

Features:

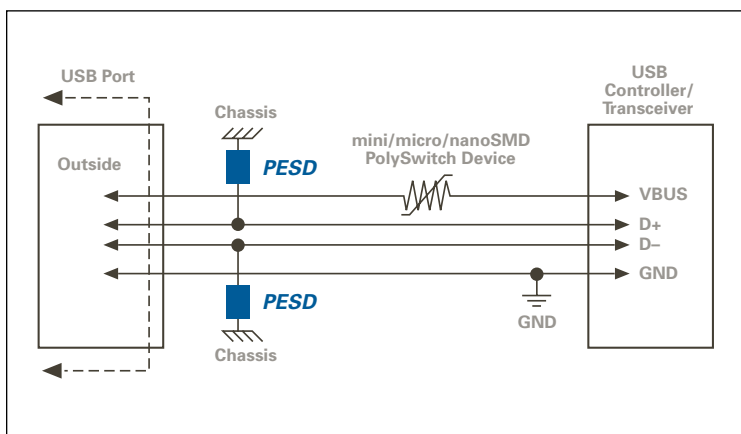
- Low capacitance (0.25pF typical)
- Low leakage current
- Low clamping voltage
- Withstands numerous ESD strikes
- EIA sizes 0402 and 0603
- RoHS compliant

Benefits:

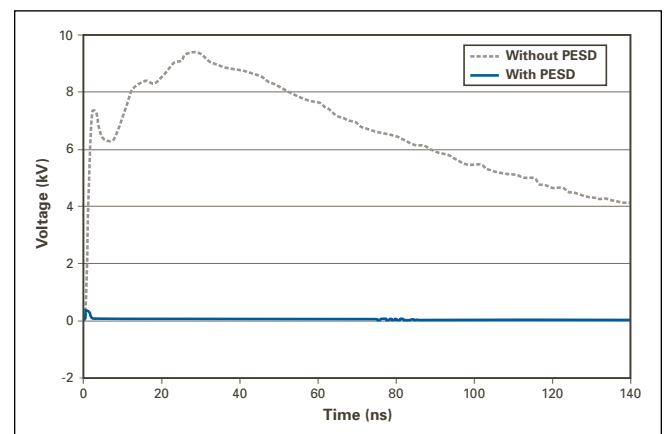
- Suitable for high speed data transmission applications
- Helps maintain signal integrity
- Longer battery life
- Protect sensitive equipment against ESD
- Helps comply with IEC61000-4-2 level 4 immunity requirements
- Typically can be added without additional agency testing
- Board space saving



Typical Circuit



Typical IEC 61000-4-2 surge pulse with and without PESD device



Typical Device Ratings and Characteristics

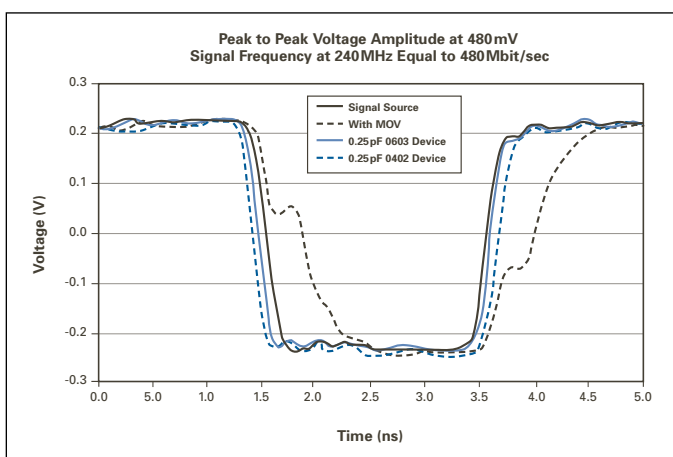
0603 Device	Continuous Max Operating Voltage	Typical IEC Trigger Voltage ¹	Typical IEC Clamping Voltage ¹ after 30ns	Typical TLP Trigger Voltage ²	Typical TLP Clamping Voltage ² after 30ns	Typical TLP Clamping Voltage ² after 60ns	Typical Capacitance @ 1MHz, 1V _{rms}	Typical Leakage Current @ 14V _{DC}	Max Leakage Current @ 14V _{DC}
Symbol	V _{DC}	V _{T (IEC)}	V _{C (IEC)}	V _{T (TLP)}	V _{C (TLP 30)}	V _{C (TLP 30)}	C _p	I _{L (TYP)}	I _{L (MAX)}
Unit	V	V	V	V	V	V	pF	μA	μA
Value	14	350	30	320	75	65	0.25	< 0.001	0.01

0402 Device	Continuous Max Operating Voltage	Typical IEC Trigger Voltage ¹	Typical IEC Clamping Voltage ¹ after 30ns	Typical TLP Trigger Voltage ²	Typical TLP Clamping Voltage ² after 30ns	Typical TLP Clamping Voltage ² after 60ns	Typical Capacitance @ 1MHz, 1V _{rms}	Typical Leakage Current @ 6V _{DC}	Max Leakage Current @ 6V _{DC}
Symbol	V _{DC}	V _{T (IEC)}	V _{C (IEC)}	V _{T (TLP)}	V _{C (TLP 30)}	V _{C (TLP 30)}	C _p	I _{L (TYP)}	I _{L (MAX)}
Unit	V	V	V	V	V	V	pF	μA	μA
Value	6	150	25	225	40	35	0.25	< 0.001	0.05

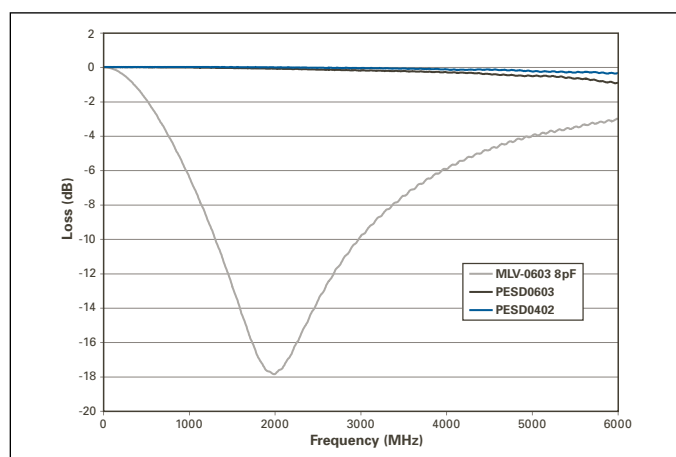
Note 1: IEC 61000-4-2, level 4, 8kV contact test method
 Note 2: TLP test method at 500V

ESD voltage capability (tested per IEC 61000-4-2, level 4, contact method)
 • Typically 1,000 pulses

Typical Performance



Insertion Loss of PESD0603 and 8pF MLV



Summary

Critical to optimum performance of the USB bus is the integrity of the data circuits on the bus. Tyco PESD device suppresses ESD transients to a level which prevents damage to electronic components in the circuit. Tyco ESD devices can typically survive 500 – 1,000 pulses as described in IEC61000-4-2, level 4 contact method.

Good performance of the USB circuits also depends on good layout practices. Data signal ground (GND) and V_{bus} transients must be suppressed for proper operation. Good design practices mandate that data signal ground and chassis ground not be tied together at the board level. Decoupling capacitors between V_{bus} and chassis

ground should be used to minimize EMC issues. Having both grounds connected together on the board level may allow transients to propagate via the signal ground with respect to chassis ground. This is especially critical when inserting cables into a USB device's connector.

Increasing ESD protection in various applications is critical to long term reliability of end-use equipment. The application note helps explain how a simple device delivers protection levels of IEC61000-4-2, 8kV contact mode, and 15kV for air discharge mode.

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