tyco Electronics

Raychem CIRCUIT PROTECTION

APPLICATION NOTE

ESD Protection for HDMI Applications

High-Definition Multimedia Interface (HDMI) is rapidly being adopted as the standard interface for digital consumer devices such as digital TVs, DVD and recordable DVD players, flat panel monitors and set-top boxes. HDMI supports standard, enhanced, or high-definition video, as well as an array of consumer enhancements.

The HDMI protocol is based on Transition-Minimized Differential Signaling (TMDS) such as high-speed serial link technology. An HDMI link consists of a single clock channel and three data channels, with a maximum signal frequency of ~1.65 GHz. To assure signal integrity low capacitance ESD protection devices such as the ~0.25 pf Raychem Circuit Protection PESD can help protect HDMI signal lines exposed to the outside world.

Benefits:

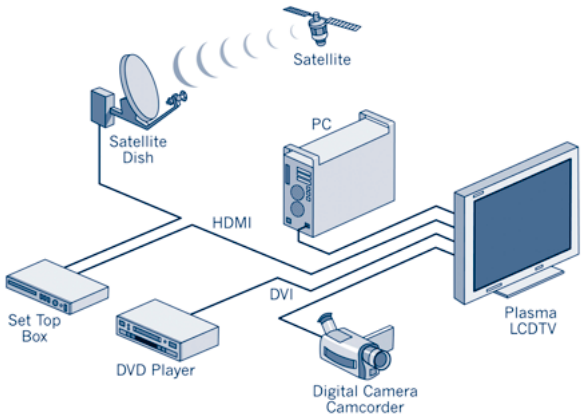
- Protects sensitive equipment against ESD
- Suitable for high speed data transmission applications
- Helps maintain signal integrity between devices
- Helps comply with IEC61000-4-2 level 4 immunity requirements
- In most cases, can be added without additional agency testing
- Helps conserve valuable board space

Features:

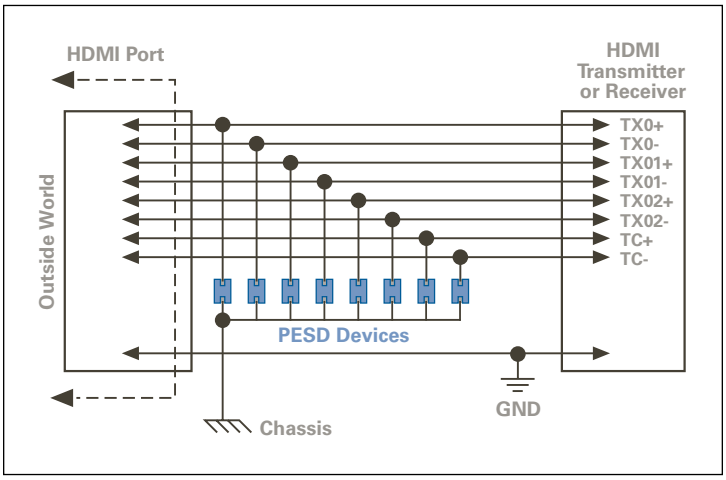
- Low capacitance (0.25 pF typical)
- Low leakage current
- Low clamping voltage
- Capable of withstanding numerous ESD strikes
- EIA sizes 0402 and 0603
- RoHS compliant

Applications:

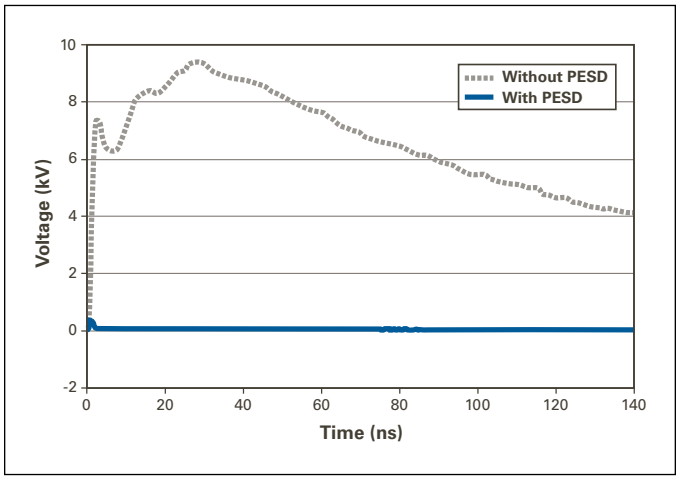
- HDTV, LCD and Plasma monitors and projectors
- Set-top boxes
- DVD players
- A/V receivers
- Digital video recorders
- Computers
- Video projectors



Typical HDMI circuit schematic with PESD devices (based on HDMI Specification Version 1.2)



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



Typical Device Ratings and Characteristics

0603 and 1206Q-140 Devices	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

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

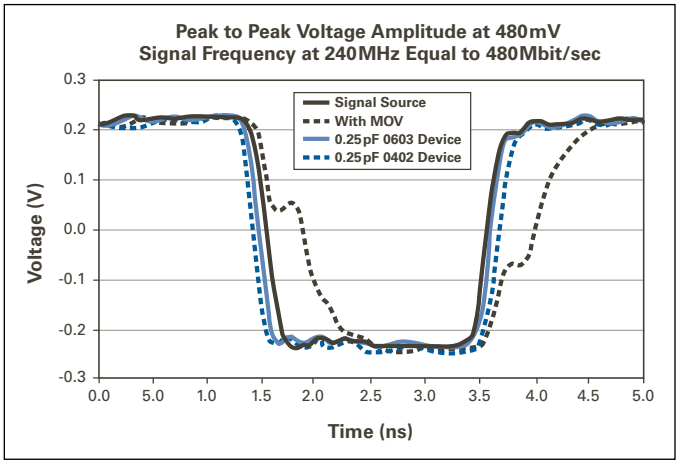
ESD voltage capability (tested per IEC 61000-4-2, level 4, contact method)
• Typically 1,000 pulses

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

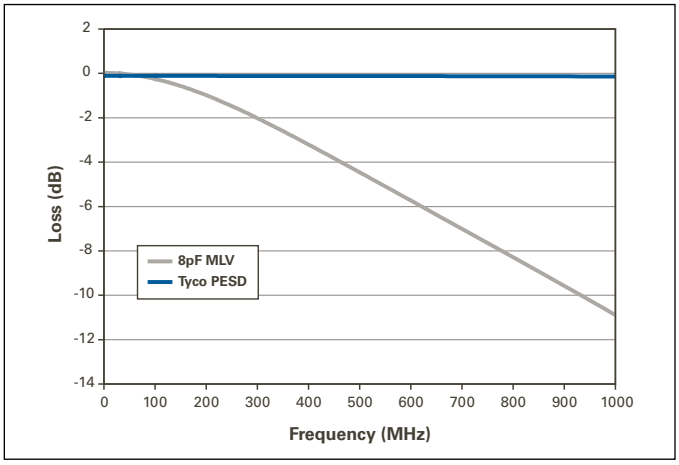
Note 1: IEC 61000-4-2, level 4, 8kV contact test method
Note 2: TLP test method at 500V

ESD voltage capability (tested per IEC 61000-4-2, level 4, contact method)
• Typically 500 pulses

Typical Performance



Insertion Loss of PESD and 8pF MLV



Design Guidelines

Careful design and placement decisions help optimize HDMI connectivity. Good design practices mandate that data signal ground and chassis ground not be tied together at the board level. Decoupling capacitors between Vbus and chassis ground can help minimize EMC issues.

Upon connection, ESD surges may occur when using HDMI connectors. Decoupling of the signal and chassis ground can help to reduce this occurrence. Care must be taken to ensure that the grounding is done properly to avoid propagation of differential signals between signal and chassis. For maximum protection, PESD suppression devices should be installed as close to the source of ESD transients as possible.

Summary

Raychem Circuit Protection's low-capacitance PESD suppression components reduce ESD transients to a level that helps prevent damage to electronic HDMI interface. PESD devices provide exceptionally low capacitance—typically ~0.25pF—and perform better than other comparable components in transmission line pulse (TLP) testing, as well as IEC61000-4-2 testing (8kV contact, 15kV air discharge). They are capable of handling numerous ESD transients—up to 1000—without performance degradation and offer a lower trigger voltage and a lower clamping voltage than typical polymer ESD devices.

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