

ESD Protection

Reference Guide



ESD Protection

Overview

Texas Instruments offers Transient Voltage Suppressor (TVS) based ESD protection solutions that comply with the IEC 61000-4-2 standard. The IEC61000-4-2 is the most robust ESD test and provides the best system level ESD protection. TI's ESD solutions feature High Performance TVS Diode arrays, Integrated ESD Protection and Automotive ESD Protection.

Product Families

- High Performance TVS Diodes
- Integrated ESD Protection
- Automotive ESD Protection

ESD by Interface

Interface	Device
Audio	TPD1E10B09
CAN/LIN	TPD2E007
Display	TPD6F202
DisplayPort	TPD4E05U06
Ethernet	TPD4E1U06
HDMI 1.4/1.3	TPD13S523
HDMI 2.0	TPD1E05U06
Keypad	TPD6F002
LCD	TPD4E1U06
LVDS	TPD2E2U06
Memory SDIO	TPD6F003
MHL	TPD4E05U06
PCIe Gen 2	TPD4E05U06
Precision Measurement	TPD4E1B06
Push Button/ Side Keys	TPD1E10B06
RS-485/432/422/232	TPD2E007
SATA	TPD2E009
SIM Card	TPD3F303
USB 2.0	TPD2E2U06
USB 3.0	TPD6E05U06
USB VBUS OVP	TPD1S514
USB OTG or Host	TPD4S214
USB Charging Port	TPD4S014
VGA	TPD7S019

System level ESD protection

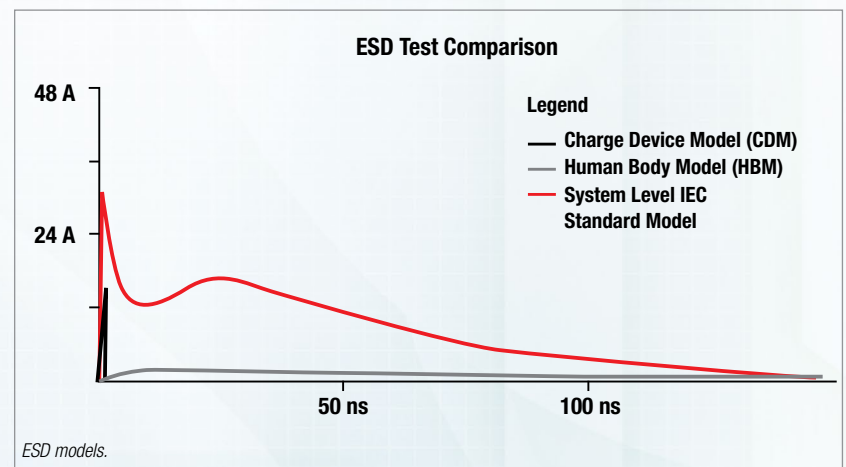
(IEC61000-4-2) for all interface connectors

- Complete portfolio: diodes, diode arrays, integrated protection

Flow-through pin mapping for easy routing

Integrated protection saves board space and increases reliability:

- System level ESD up to $\pm 30\text{kV}$
- Surge and cable plug / un-plug events
- Short to power rail / short to GND
- Over-voltage / over-current protection



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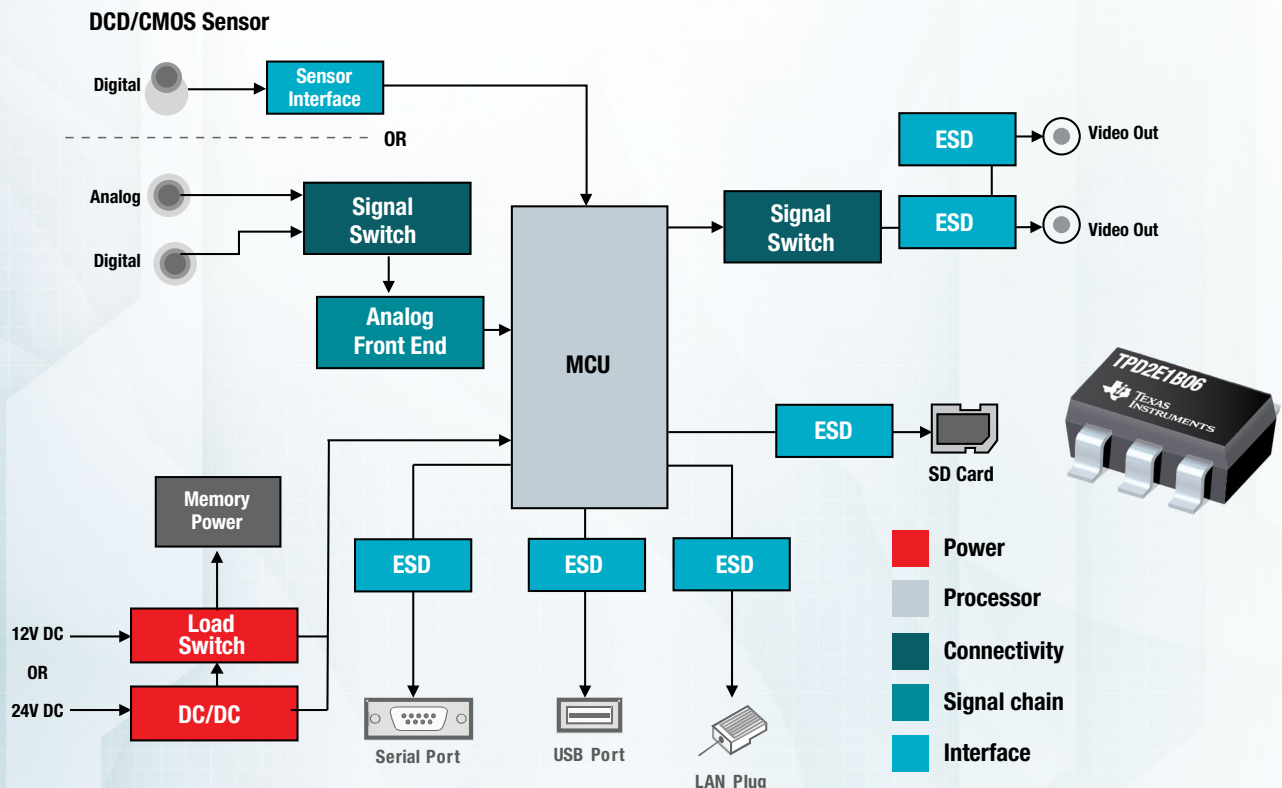
High Performance TVS Diodes

Texas Instruments offers Transient Voltage Suppressor (TVS) based ESD protection solutions that comply with the IEC 61000-4-2 standard. The IEC 61000-4-2 ESD protection requirement is common in Personal Electronic, Industrial, and Automotive applications. The TI product portfolio features low capacitance, low clamping voltage, ultra low leakage, ultra small package, high voltage, and high IEC ESD protection solutions.

Additional Features

- IEC 61000-4-2/4/5 ESD, EFT, and Surge Protection
- 1 to 8 channel solutions

IP Camera Block Diagram



Device	Key Parameters	Interface	Status
TPD1E05U06	1 ch, 0.4 pF, $\pm 12/15$ kV (Contact/Air), X2SON	USB 3.0, HDMI 1.4/2.0, PCIe	Released
TPD4E05U06	4 ch, 0.5 pF, $\pm 12/15$ kV (Contact/Air), 10SON	USB 3.0, HDMI 1.4, PCIe	Released
TPD2E2U06	2 ch, 1.5 pF, $\pm 25/30$ kV (Contact/Air), SOT	USB 2.0, LVDS	Released
TPD4E110	4 ch, 0.45 pF, $\pm 12/15$ kV (Contact/Air), X2SON	USB 3.0, HDMI 1.4/2.0, PCIe, SATA	Released
TPD4E1U06	4ch, 0.8 pF, $\pm 15/15$ kV Contact/Air, SC-70 or SOT-23	Ethernet, LED, LCD, General Purpose	Released



ESD Protection

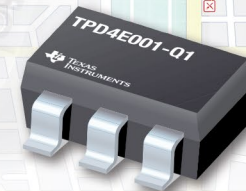
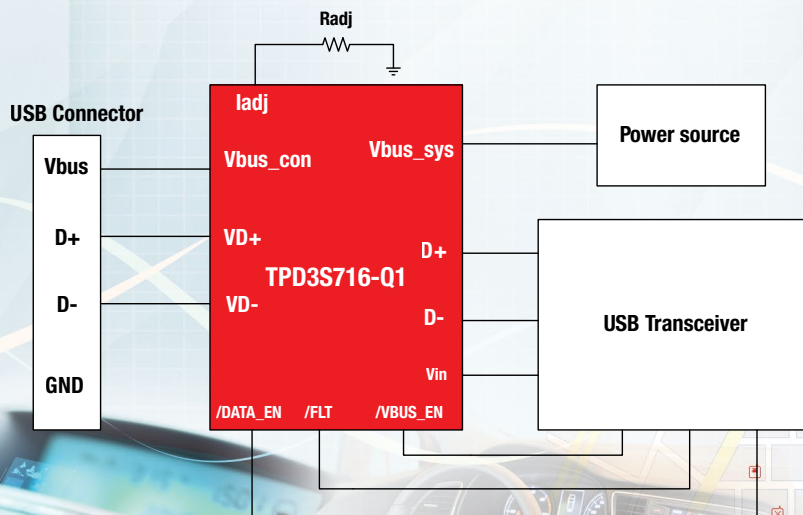
Automotive ESD Protection

TI delivers differentiated protection solutions for Automotive Infotainment, ADAS/Camera, Body Electronics, and Sensor Modules.

Additional Features

- AEC-Q100 and AEC-Q101
- Short-to-Battery
- Short-to-Ground
- Current Limited Load Switch
- EMI Protection

Device	Key Parameters	Interface	Status
TPD4E001-Q1	4ch, 1.5pF, $\pm 8/15\text{kV}$ (Contact/Air), 6SOT-23	USB 2.0, Ethernet, SD Card	Released
TPD4E05U06-Q1	4ch, 0.5pF, $\pm 12/15\text{kV}$ (Contact/Air), 10SON	USB 3.0, HDMI 1.4, Capacitive Touch	Released
TPD2E001-Q1	2ch, 1.5pF, $\pm 8/15\text{kV}$ (Contact/Air), SOT-533	USB 2.0, LVDS, Ethernet, Antenna	Released
TPD2E2U06-Q1	2ch, 1.5pF, $\pm 25/30\text{kV}$ (Contact/Air), SOT-23	USB 2.0, LVDS, Ethernet, Antenna	Preview
TPD6F002-Q1	6ch, $\pm 20/30\text{kV}$ (Contact/Air), 100MHz EMI Filter, 12SON	FPD-Link, Display	Preview
TPD3S714-Q1	3ch, $\pm 8/15\text{kV}$ (Contact/Air), Short-to-Vbatt and Gnd, 0.6A Current Limit, TSSOP	USB 2.0	Preview
TPD3S715-Q1	3ch, $\pm 8/15\text{kV}$ (Contact/Air), Short-to-Vbatt and Gnd, 0.6A Current Limit, 800MHz, Advanced Diagnostics, TSSOP	USB 2.0	Preview
TPD3S716-Q1	3ch, $\pm 8/15\text{kV}$ (Contact/Air), Short-to-Vbatt and Gnd, Adjustable Current Limit, 800MHz, Advanced Diagnostics, TSSOP	USB 2.0	Preview



ESD Protection

Integrated ESD Protection

TI's Integrated ESD Protection portfolio provides ESD protection combined with functions specific to the interface. This allows for single chip solutions that save board space and reduce BOM count.

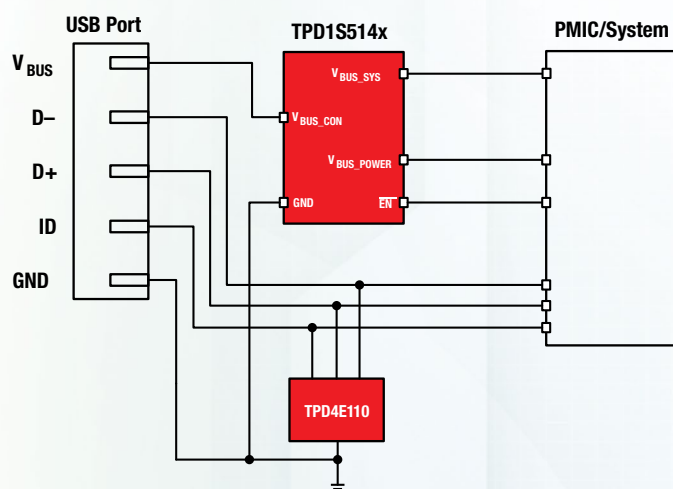
TPD1S514: USB Vbus OVP, Surge and ESD Protection

TPD1S514 is a single chip protection solution for the USB Vbus line in mobile and wearable applications.

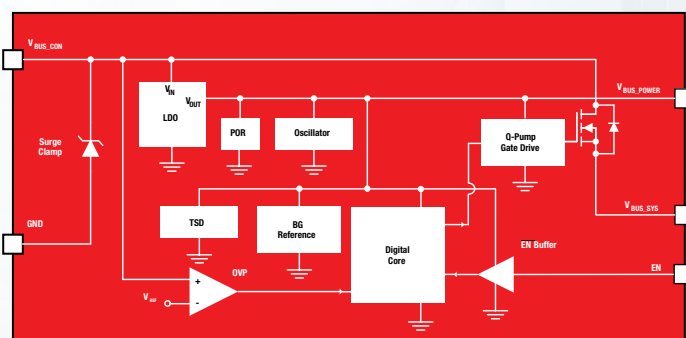
Additional Features

- IEC61000-4-2 ESD Protection (Level 4)
- IEC61000-4-5 Surge Protection
- Over Voltage Protection up to 30V DC
- Available in 5-V and 9-V versions

TPD1S514 Block Diagram



USB 2.0 with Over Voltage Protection Block Diagram



TPD3S044: USB Current Limit Switch and ESD Protection

The TPD3S044 is an integrated solution for USB Host ports found in laptops, desktops, TVs, and set-top box.

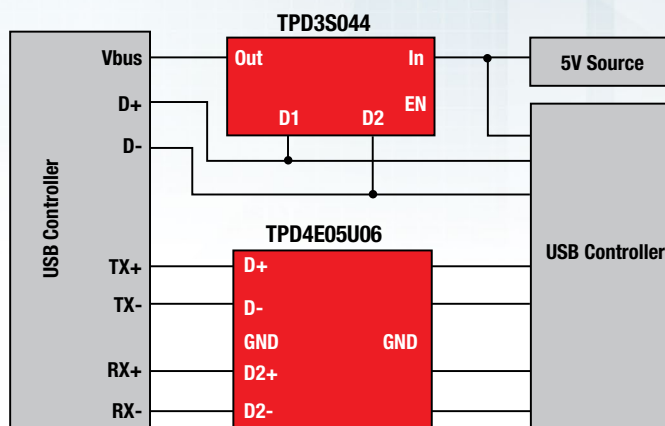
Additional Features

- IEC 61000-4-2 ESD Protection
- 1.5A Current Limit Switch
- Reverse Current Blocking
- Short Circuit Protection

HDMI Integrated ESD Protection

Device	Key Parameters	Interfaces	Status
TPD12S521	12ch, ±8 kV, 55 mA Current Limit, Voltage Level Translation, TSSOP	HDMI 1.3/1.4	Released
TPD12S520	12ch, ±8 kV, Voltage Level Translation, TSSOP or WQFN	HDMI 1.3/1.4	Released
TPD13S523	13ch, ±8 kV, 55 mA Current Limit, TSSOP or WQFN	HDMI 1.3/1.4	Released
TPD5S116	5ch, ±15 kV, 55 mA Current Limit, Voltage Level Translation, WCSP	HDMI 1.3/1.4, HDMI 2.0	Released

USB 3.0 with Current Limit Protection Block Diagram



Design Resources, References and Support

TI provides many resources to help you design systems faster, including TI designs and guides. We also offer world-wide support to ensure your questions are answered fast.

Guides

- System-Level ESD/EMI Device Protection Guide (sszb130)
- Reading and Understanding an ESD Protection Datasheet (slla305)

TI Designs

- **TIDA-00079:** High Efficiency IP Camera Power Module Reference Design

Evaluation Modules

- **TPD1S514-1EVM:** USB Charger Over Voltage Surge and ESD Protection Evaluation Module
- **TPD4E110DPWEVM:** Super-Speed ESD Protection Evaluation Module



ESD/EMI Forum: http://e2e.ti.com/support/interface/etc_interface/f/389.aspx

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