

ESD and Surge Portfolio Overview

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APP-PSIL-PS Applications Engineer

- **ESD and Surge**
- **Smart Power Switches**

2/21/19

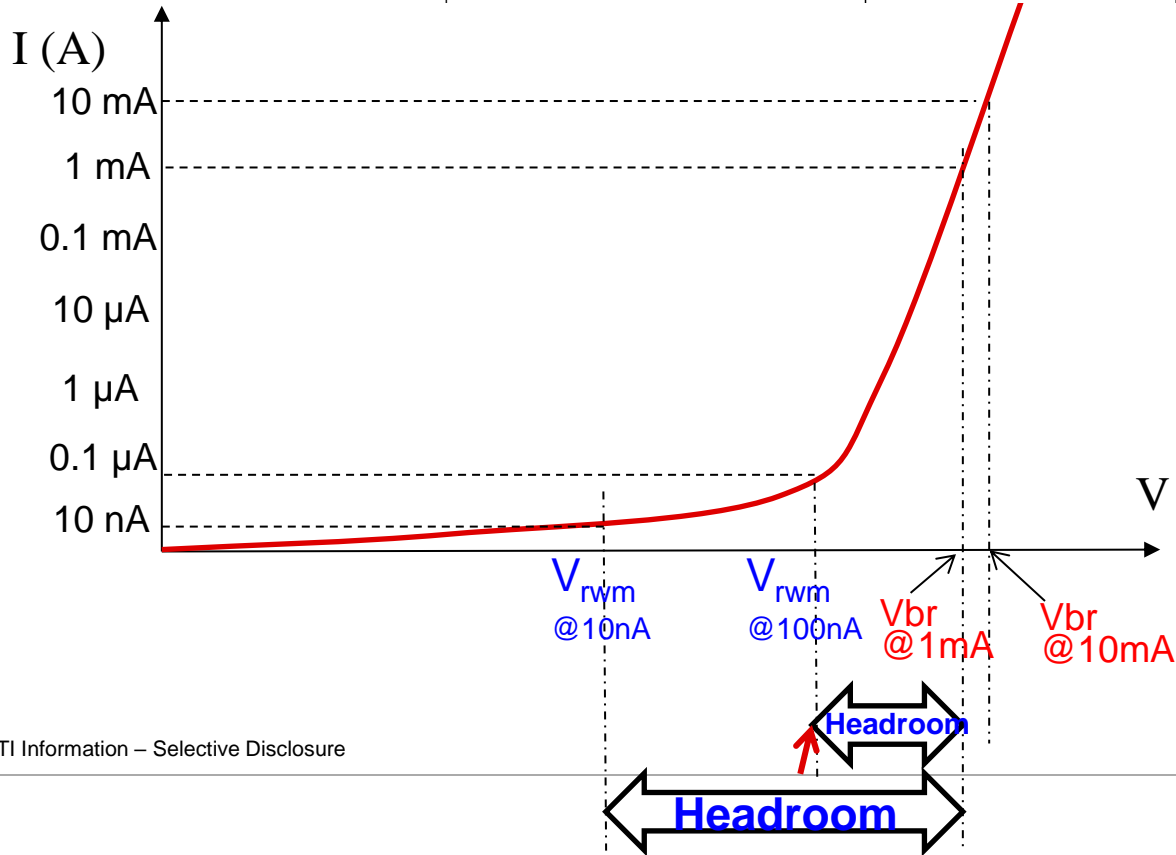
Agenda

- ESD and Surge Training
 - Associated Collateral
 - ESD Essentials Video Series
 - Demystifying Surge Protection Video Series
 - Flat Clamp Whitepaper
- ESD Portfolio Overview
 - Associated Collateral
 - ESD Selection Guide
 - ESD by Interface
 - Choosing Simulation Model for ESD Devices
- TI Flat Clamp Portfolio Overview
 - Associated Collateral
 - Flat Clamp TVS Adapter Board
 - Demystifying Surge Protection Whitepaper
 - How to select a TVS Diode

DC Characteristics and I-V Curve

over operating free-air temperature range (unless otherwise noted)

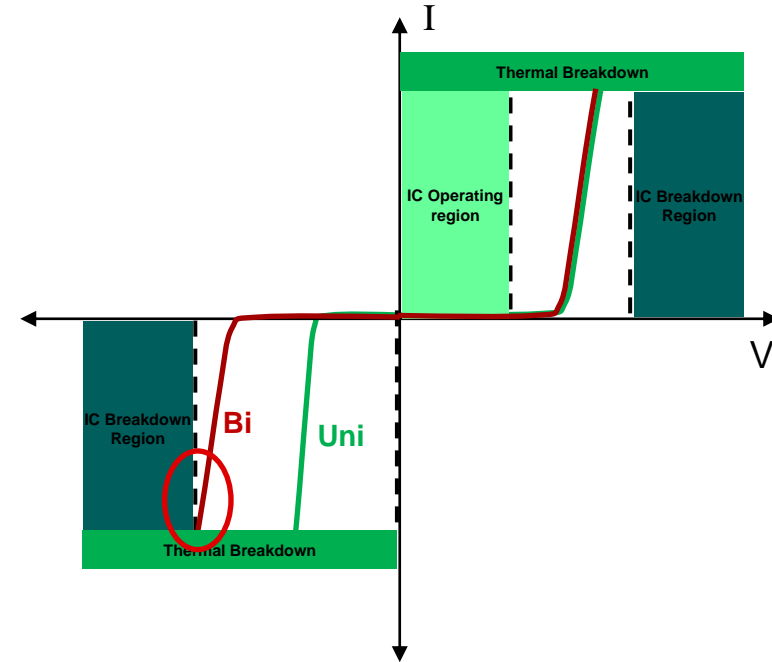
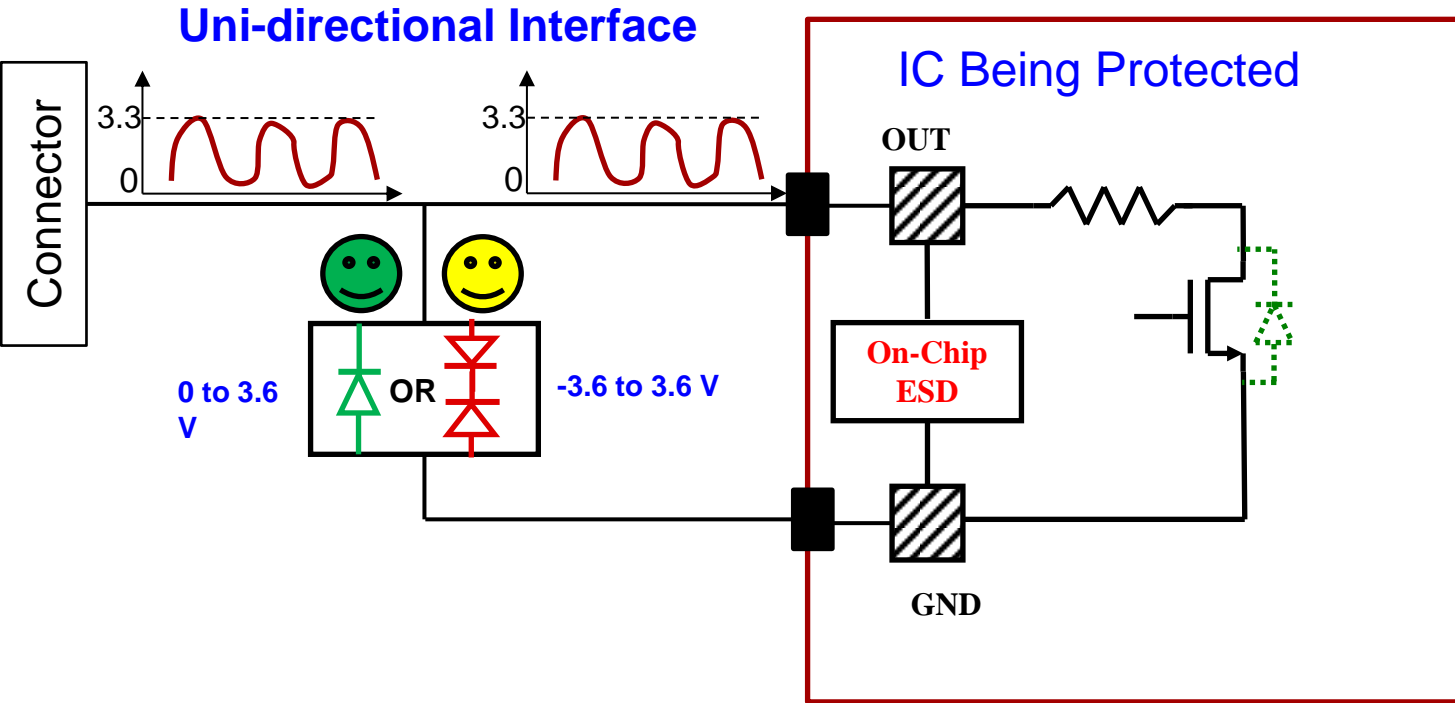
PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
V_{RWM}	Reverse stand-off voltage	$I_{IO} < 10 \text{ nA}$	-3.6	3.6	V
V_{BRF}	Breakdown voltage, any IO pin to GND ⁽¹⁾	$I_{IO} = 1 \text{ mA}, T_A = 25^\circ\text{C}$	5.1	7	V
V_{BRR}	Breakdown voltage, GND to any IO pin ⁽¹⁾	$I_{IO} = 1 \text{ mA}, T_A = 25^\circ\text{C}$	-7	-5.1	V
V_{HOLD}	Holding voltage ⁽²⁾	$I_{IO} = 1 \text{ mA}$	5.9		V



- V_{rwm} spec value depends on the I_{rwm} level
 - What is the leakage that can be tolerated at V_{rwm} ?
- V_{rwm} needs to have enough headroom when compared to V_{br-min}

Typically, V_{br} is spec'd at room temperature. However, TI measures across temp for characterization purposes to ensure margin above V_{rwm}

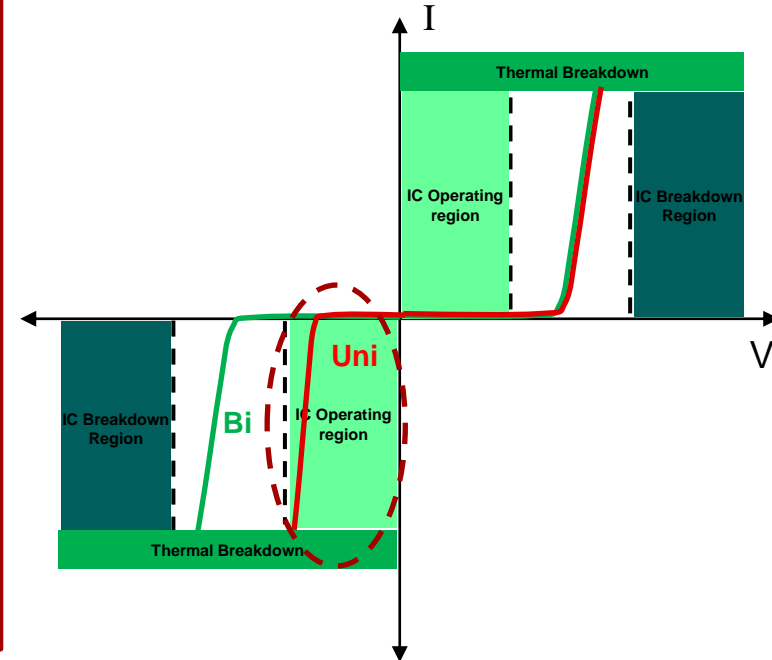
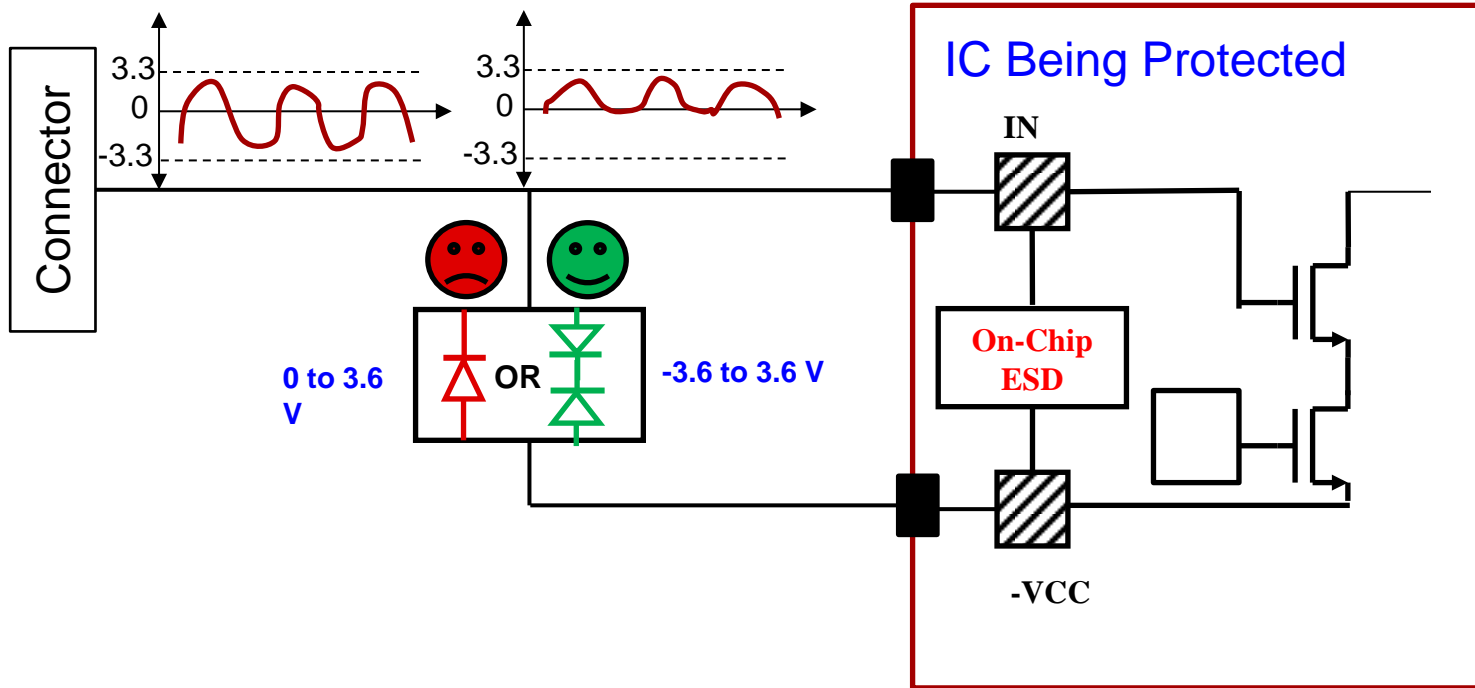
Protecting Uni-Directional Interface



1. Best to use uni-directional ESD to protect uni-directional interface
2. It may be ok to use *bi-directional ESD* device to protect *uni-directional interface* →
Watch the V_{clamp} in the negative direction

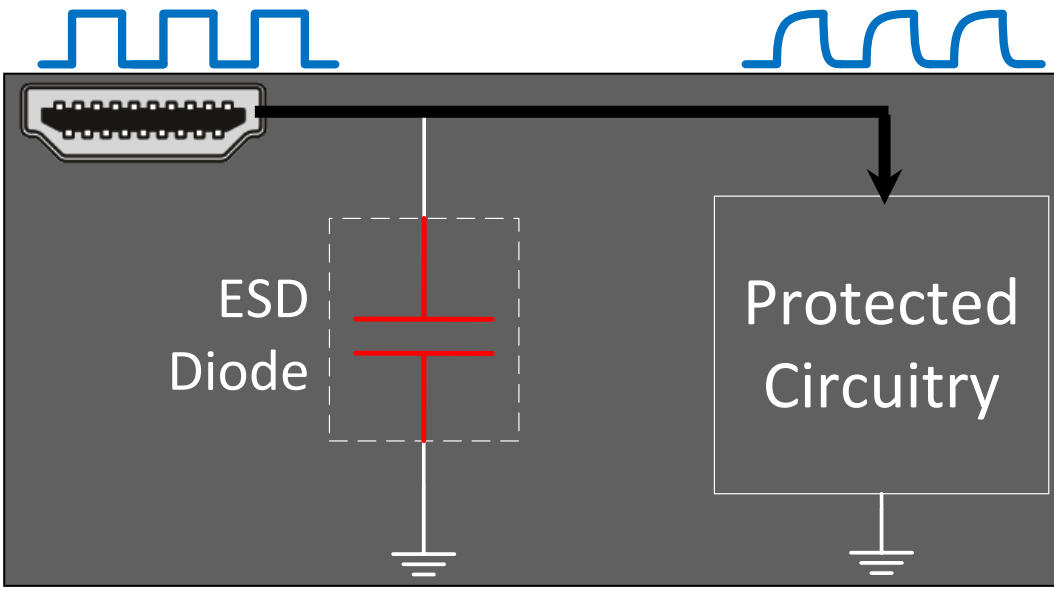
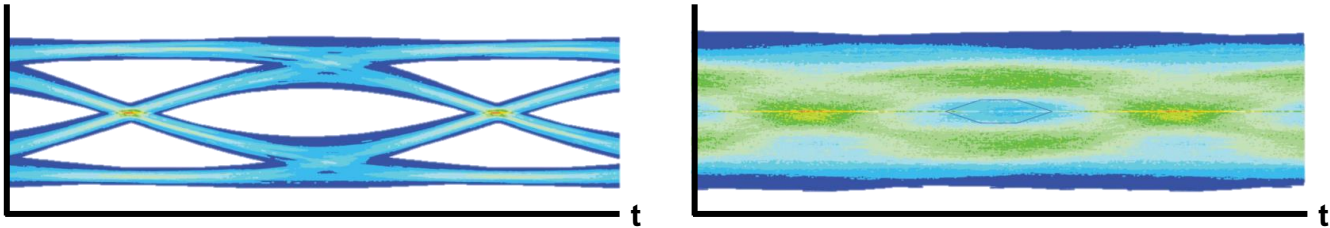
Protecting Bi-Directional Interface

Bi-directional Interface



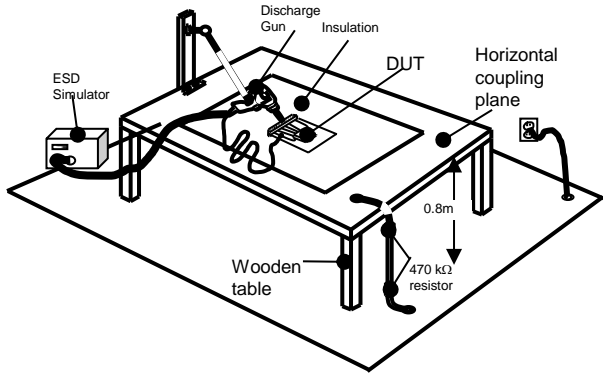
- Never use uni-directional ESD to protect Bi-directional interface
 - Clips the signal in the negative direction

Capacitance and Signal Integrity

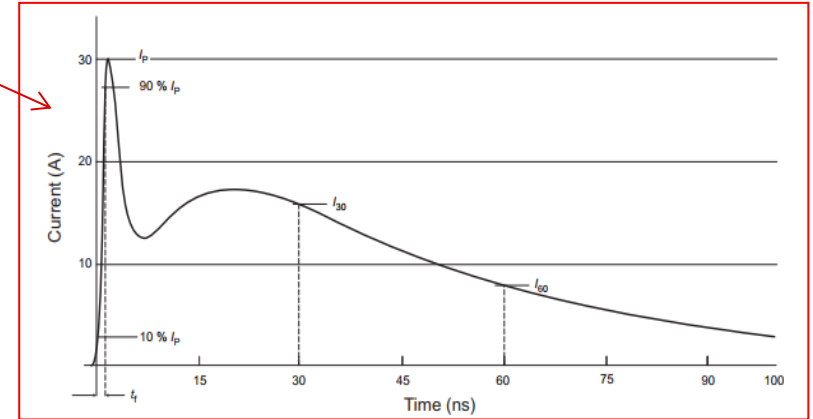
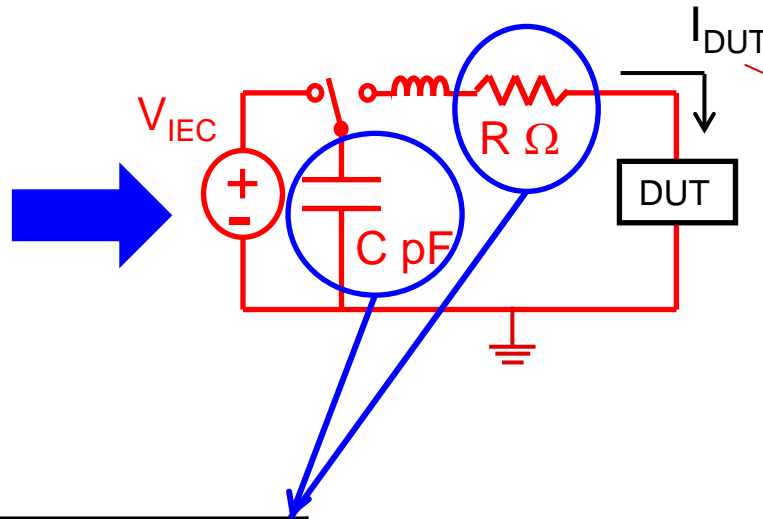


Interface	ESD Typical Suggested Capacitance (C _i)	TI Recommended Device
GPIO	<30pF	TPD1E10B06
Pushbutton	<30pF	TPD1E10B06
Audio	<10pF	TPD1E10B09
USB 2.0	<2.5pF	ESD321
USB 3.0	<0.5pF	ESD204
USB 3.1 Gen 2	<0.3pF	ESD122
HDMI 1.4	<0.7pF	TPD4E05U06
HDMI 2.0	<0.5pF	TPD4E02B04
Ethernet	<5pF	ESDS314
Antenna	<0.2pF	TPD1E01B04
4-20mA Loop	<80pF	TVS3300

IEC 61000-4-2 ESD



Equivalent Circuit

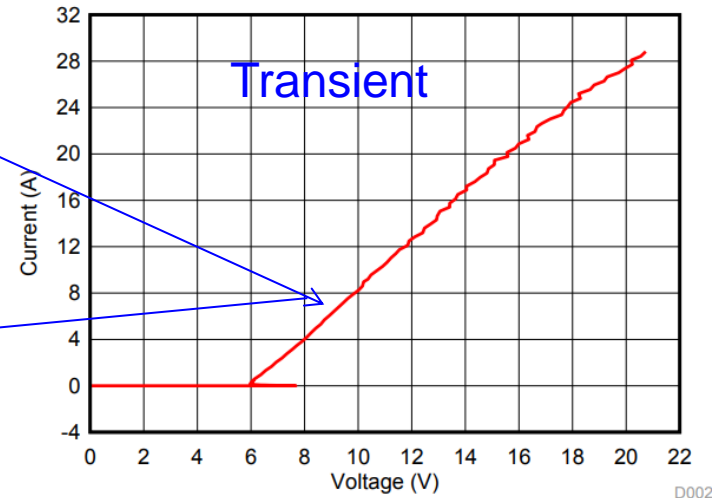
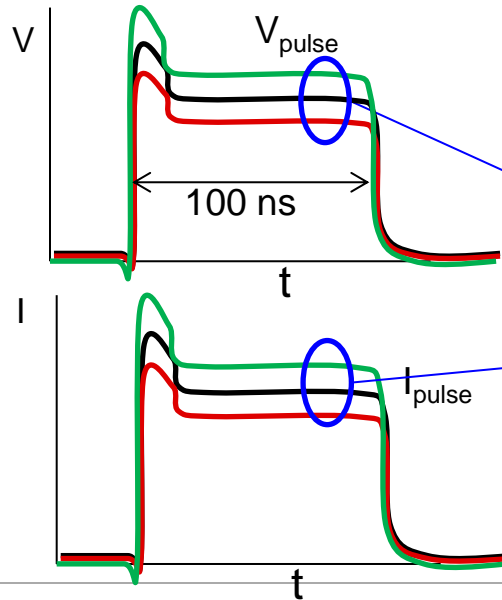
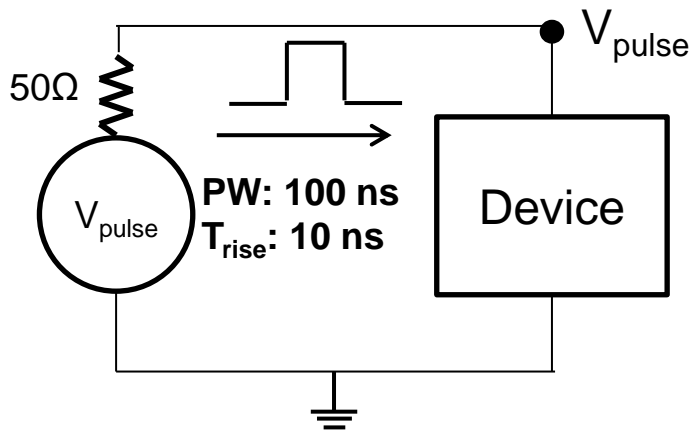
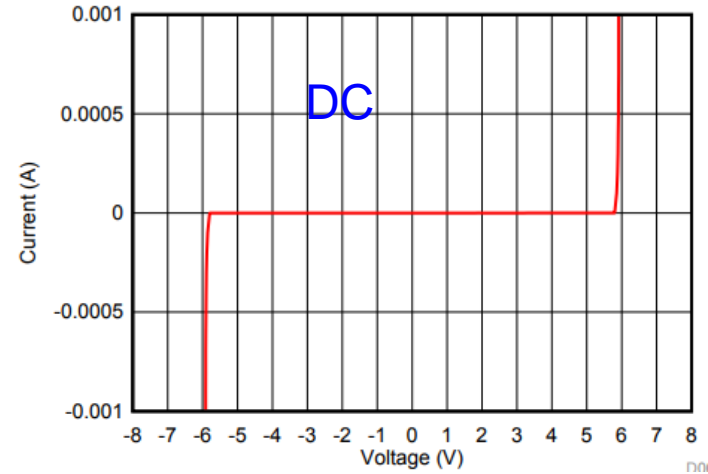
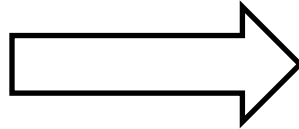
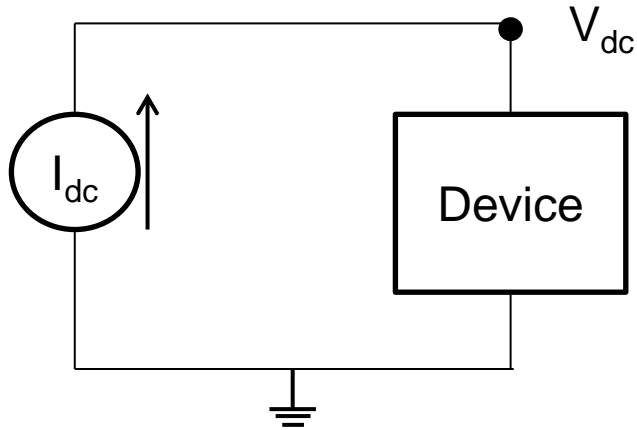


	IEC 61000-4-2 Contact
Resistor & Capacitor Combo	R = 330Ω C = 150pF

IEC61000-4-2 Test Levels

Level	Contact Discharge	Air Discharge
	Test Voltage (± kV)	Test Voltage (± kV)
1	2	2
2	4	4
3	6	8
4	8	15
X	Custom	Custom

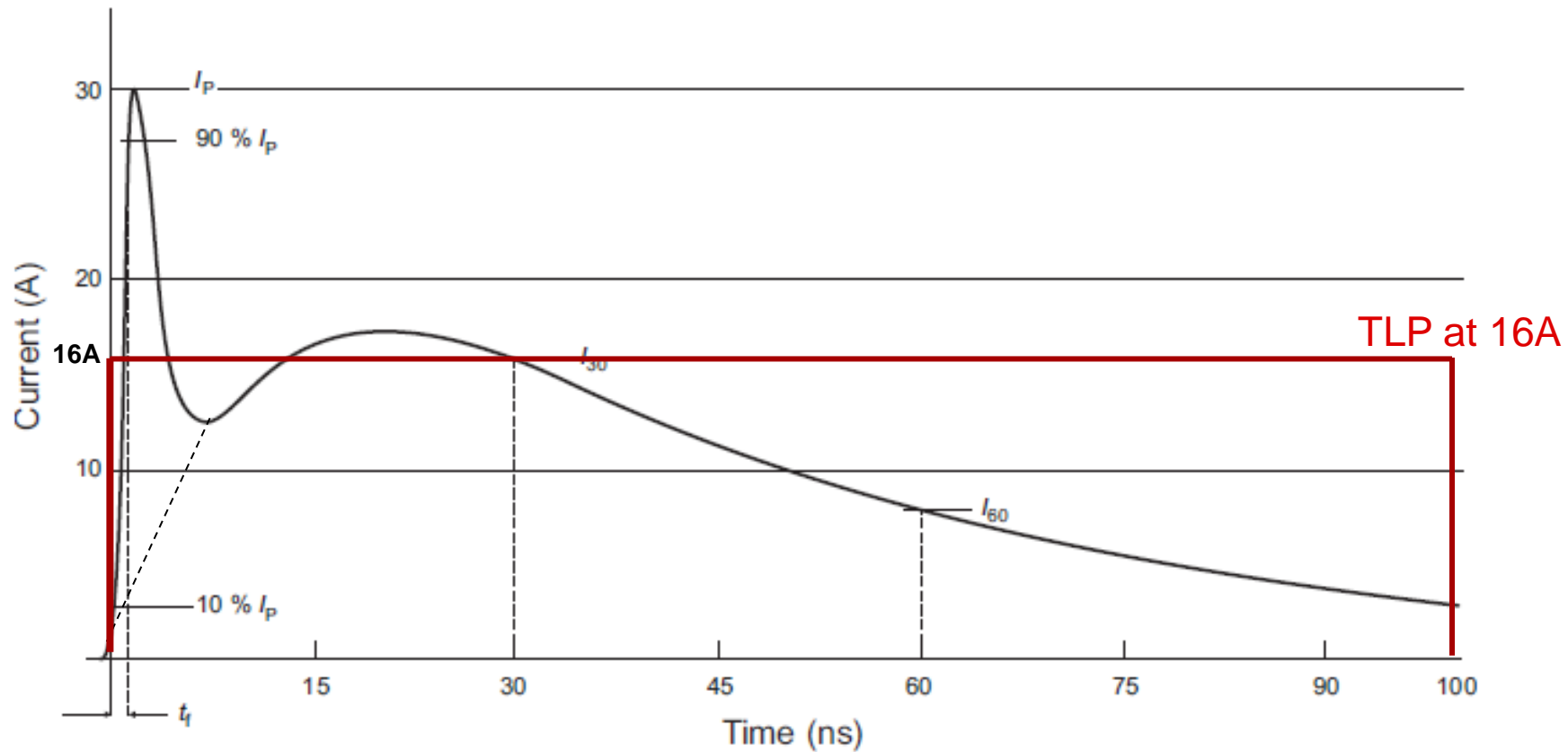
DC Vs. Transient (TLP) Characteristics



TLP → Transmission Line Pulsing

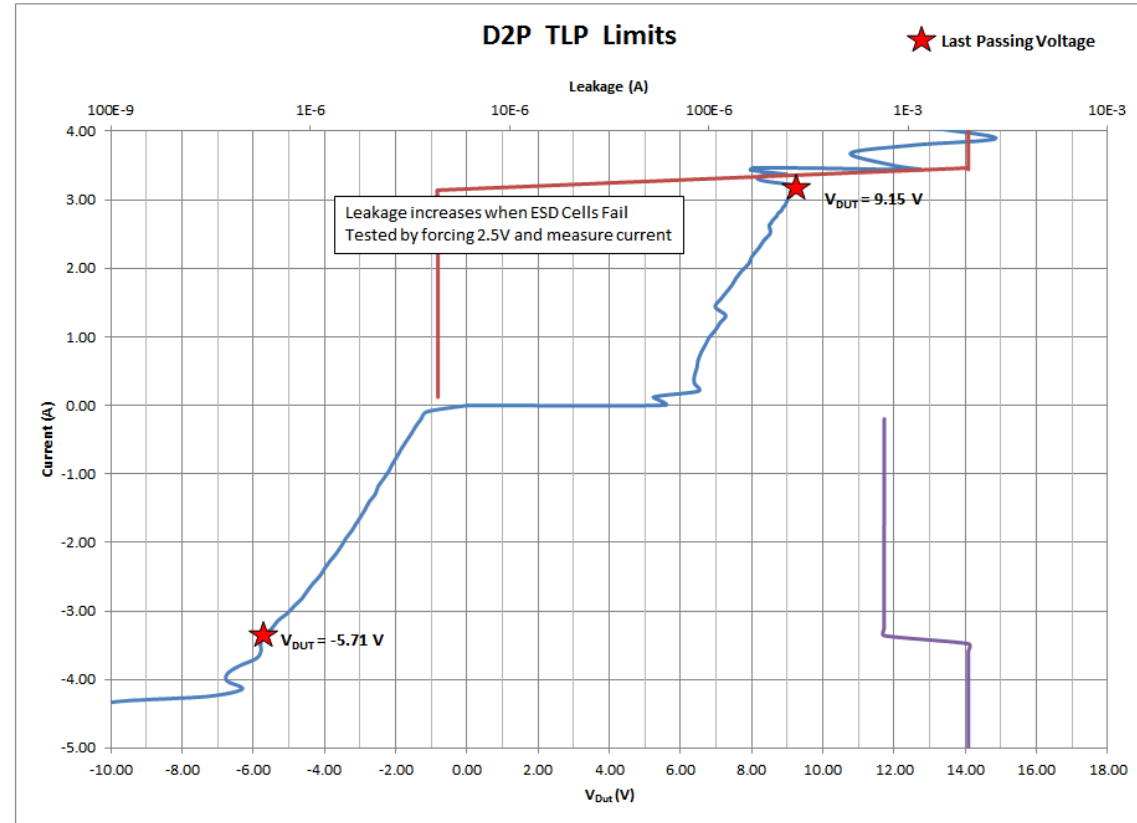
TI Information - Selective Disclosure

IEC 8kV: Correlation with TLP



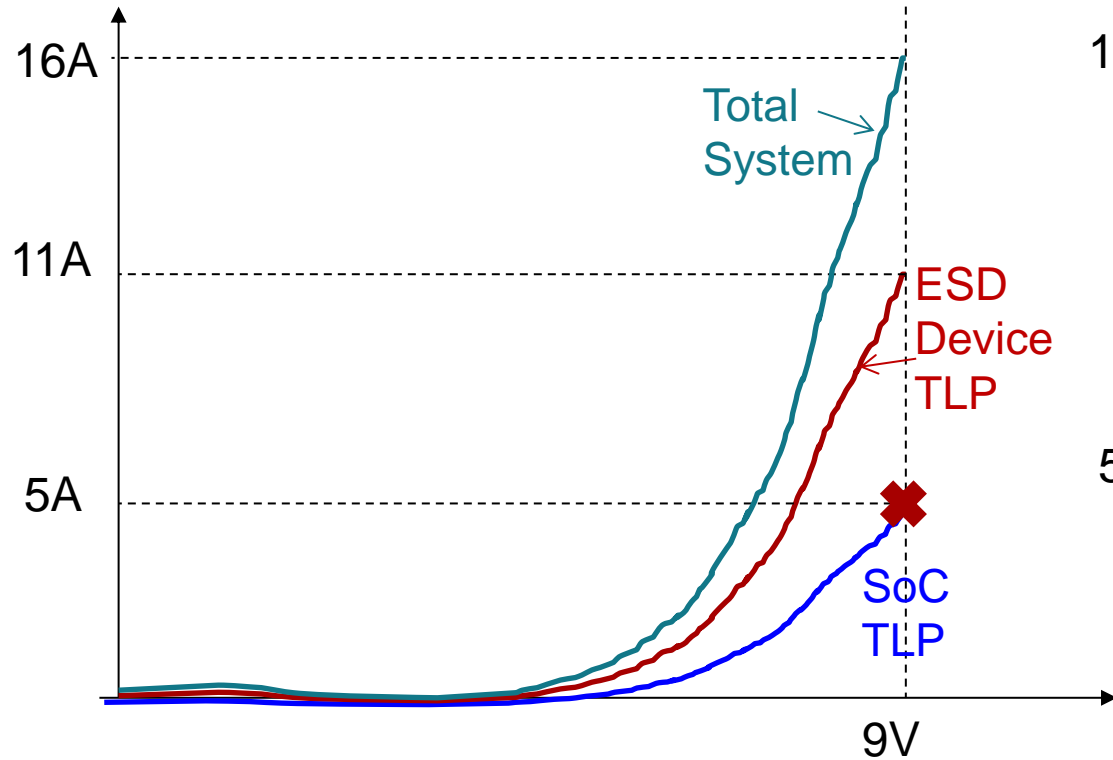
TLP Analysis of Protected ICs

- New HDMI2.0 SoCs have very sensitive high speed pins
- Customers report failing ESD at very low levels
- V_{clamp} required per TLP testing on actual SoC shows 9.1V/-5.7V clamping would protect
- Capacitance still important for eye diagram compliance

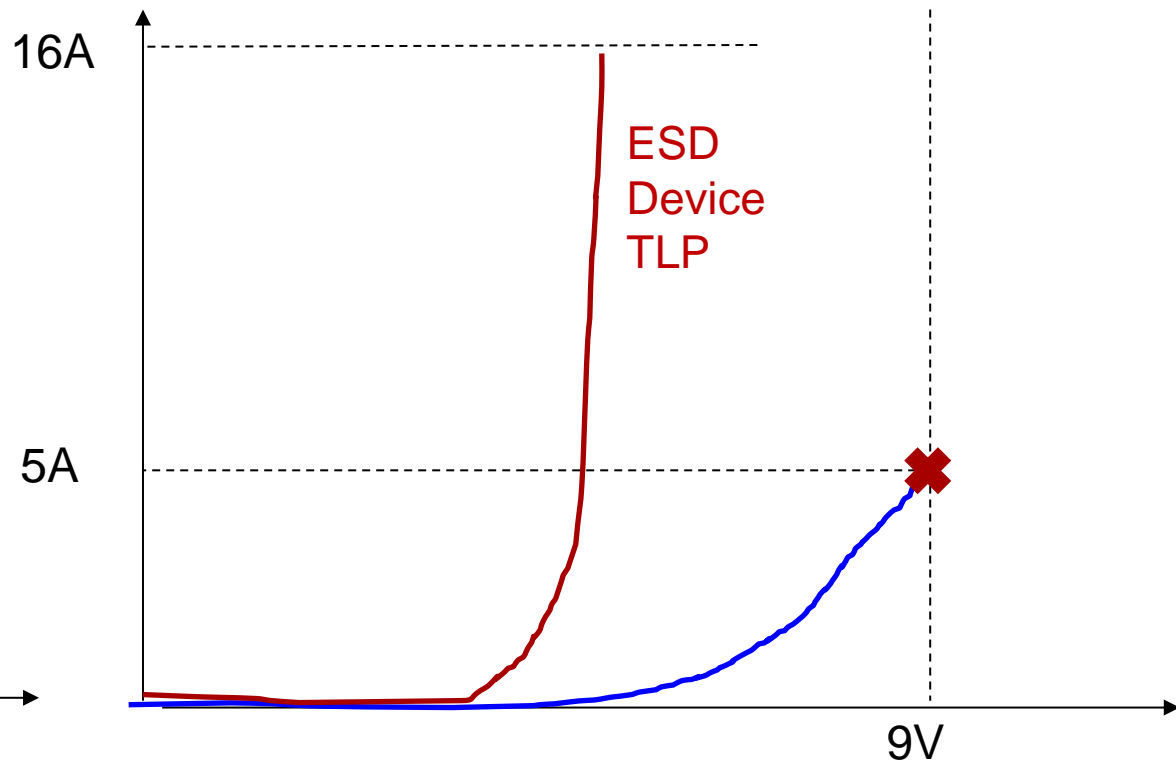


TLP Results of 28nm set top box SoC

Design ESD with System in Mind

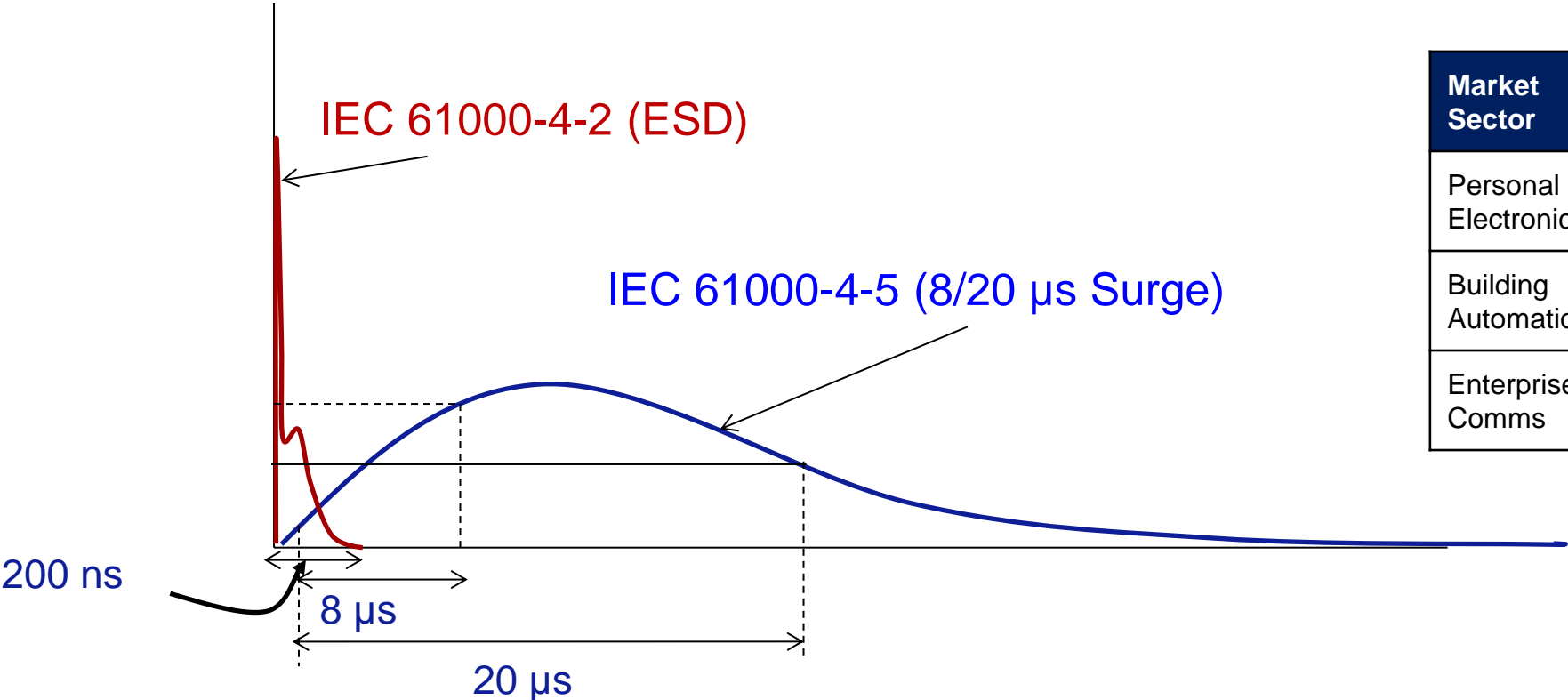


Current Sharing Between ESD Device and Downstream Device → Optimization between R_{dyn} and Capacitance



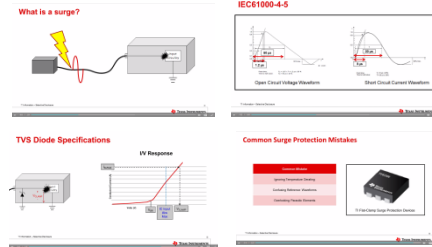
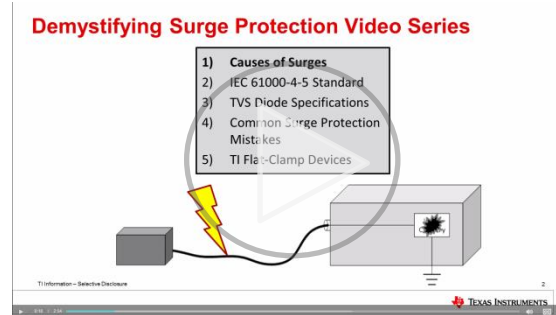
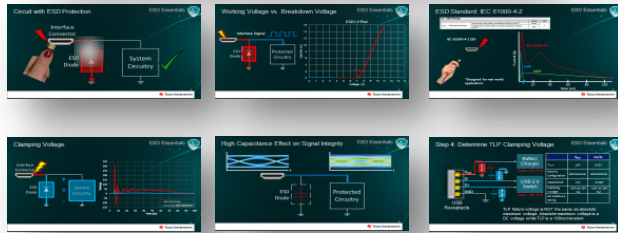
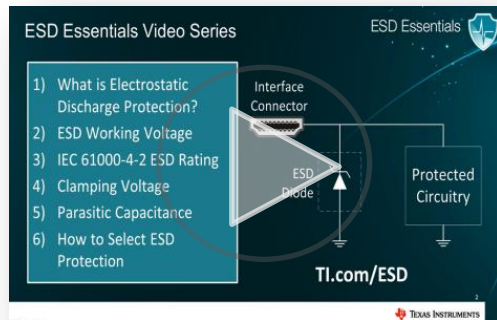
All the current goes through ESD Device → Very low R_{dyn} → Higher Cap

Surge vs IEC ESD Waveforms



Market Sector	Protection Need
Personal Electronics	ESD
Building Automation	ESD + Surge
Enterprise/ Comms	ESD + Surge

Surge pulses contain significantly more energy than ESD pulses and require more robust protection



ESD Essentials Video Series

- Video series on ESD protection
- Introduces the important parameters to consider when selecting ESD protection & selecting a diode
- **See Also:**
 - Blog Series on [ESD Fundamentals](#)
 - [IEC Standards App note](#)
 - [Automotive ESD standard App note](#)

Demystifying Surge Video Series

- Video Series on Surge Protection
- Shows what the surge pulse is, how it is defined and mitigation devices for it
- **See Also:**
 - [Layout Guide for SMA/SMB Footprint](#)
 - [Demystifying Surge Protection Whitepaper](#)

Flat-Clamp White Paper

- Technical overview of Flat-Clamp technology
- Highlights key value propositions and strengths vs. competition
- **See Also:**
 - [Layout Guide for SMA/SMB Footprint](#)
 - [Protecting field transmitters from surge transients](#)

TI ESD and Surge Protection Overview

High Performance ESD Diodes

Products

- ESD protection offered in industry standard and space saving multi-channel and 1-channel 0402/0201 packages
- Capacitance as low as 0.13pF
- R_{DYN} as low as 0.04 Ω
- Meets or exceeds the maximum specified level in the IEC 61000-4-2 standard

Hero Products

- TPD4E02B04
- TPD4E05U06
- TPD1E05U06
- TPD1E01B04



Flat-Clamp Surge Protection

Products

- Space saving protection device to protect sensitive circuitry from ESD and surge events
- Flat and low clamping voltage offers better protection and system cost savings
- Packages are 80-90% smaller than that of the competition
- Low leakage provides better fidelity

Hero Products

- TVS3300
- TVS2700
- TVS2200
- TVS1400
- TVS0500



TI.com/ESD

Discrete ESD Summary Portfolio Overview

Data rate	1 Channel	2 Channel	4 Channel	
20 Gbps	<p>TPD1E01B04 ★ 0.18pF, 0.6Ω, 15kV/17kV IEC USB 3.1 Gen2, Antenna 0201 0402</p> <p>TPD1E0B04 0.13pF, 1.0Ω, 8kV/9kV IEC USB 3.1 Gen2, Antenna 0201 0402</p>			
10 Gbps		<p>ESD122 0.2pF, 0.5Ω, 18kV/18kV IEC USB Type-C, USB 3.1 Gen2 DMX DMY</p>	<p>TPD4E02B04 ★ 0.25pF, 0.5Ω, 12kV/15kV IEC USB Type-C, USB 3.1 Gen2 USON</p>	
6 Gbps	<p>TPD1E04U04 ★ 0.5pF, 0.2Ω, 16kV/16kV IEC USB 3.0, HDMI 2.0/1.4 0201 0402</p> <p>TPD1E05U06 ★ 0.4pF, 0.8Ω, 12kV/15kV IEC USB 3.0, HDMI 2.0/1.4 0402</p>		<p>TPD4E05U06 ★ 0.5pF, 0.8Ω, 12kV/15kV IEC HDMI 1.4, USB 2.0, USB 3.0 USON</p> <p>ESD204 0.6pF, 0.3Ω, 5.5A, 30kV/30kV IEC USB 3.0, HDMI 2.0/1.4 USON</p> <p>ESD224 0.5pF, ultra low clamping 17kV/17kV IEC USB 3.0, HDMI 2.0/1.4 USON</p>	
General Purpose	<p>ESD401 0.85pF, 5V tolerant, 0.77Ω, 24kV/30kV IEC Mobile, USB 2.0 0402</p> <p>TPD1E1B04 1pF, 0.15Ω, 30kV/30kV IEC USB, GPIO, Pushbuttons 0402</p> <p>TPD1E6B06 ★ 6pF, 0.55Ω, 15kV/15kV IEC Audio, GPIO, Pushbuttons 0201</p>	<p>ESD321/ESD351 0.95pF to 2pF, 30kV/30kV IEC USB, Ethernet, GPIO 0402</p> <p>TPD1E10B06 ★ 12pF, 0.4Ω, 30kV/30kV IEC Audio, GPIO, Pushbuttons 0402</p> <p>TPD1E10B09 10pF, 0.5Ω, 20kV/20kV IEC Audio, GPIO, Pushbuttons 0402</p>	<p>TPD2E001DRY 1.5pF, 0.6Ω, 8kV/15kV IEC USB 2.0, Ethernet, Pushbuttons SOT</p> <p>TPD2E2U06DRL 1.5pF, 0.5Ω, 25kV/30kV IEC USB 2.0, Ethernet, I2C SOT</p> <p>ESDS302, ESDS312 2.5pF/4pF, 3.6V, 12A/25A Surge Ethernet 10/100/1G, USB SOT</p>	<p>TPD4E101 4.8pF, 0.45Ω, 15kV/15kV IEC SIM/SD Card, GPIO, Pushbuttons SON</p> <p>TPD4E001DRL ★ 1.5pF, 0.6Ω, 8kV/15kV IEC USB 2.0, Ethernet, Pushbuttons SOT</p> <p>TPD4E1U06 0.8pF, 0.8Ω, 15kV/15kV IEC USB 2.0, Ethernet, HDMI DDC/CEC SOT SC70</p> <p>ESDS304, ESDS314 2.5pF/4pF, 3.6V, 12A/25A Surge Ethernet 10/100/1G, USB SOT</p>

Legend

0402 Package

Production

New

U / B Configuration (Uni/Bi)



Automotive Qualified as well



TEXAS INSTRUMENTS

4-Channel ESD Diode Array | High Speed

10 pin (1 x 2.5mm)

[TPD4E05U06](#)

[TPD4E02B04](#)

[ESD224](#) (new)

[ESD204](#) (new)

Interfaces:



As used in Notebooks, DVR, Set-Top Box, DSL Modem, Phone, Tablet, etc



High Speed, All Purpose
System-level IEC ESD
Level 4 Protection

**Low capacitance for very
High B/W** systems (up to
10Gbps)

**Clamps ESD events to very
low voltages** to protect very
sensitive components

Robust ESD/Surge Ratings for
Harsh Environments/
Requirements

Example Use Cases

Multiple high speed data lines
with external connectors or
interfaces (USB 3, HDMI 2.0)

Systems with high B/W
requirements & tight B/W
budgets for example, due to long
traces

*Systems with small geometry
process nodes transceivers &
SoCs (ex. Broadcom BC7521)*

*Systems having connectors with long
outdoor cables (Surge) attached or in
very dry climates (ESD)*

Links

[Sample](#) | [Datasheet](#)

[Sample](#) | [Datasheet](#)

[Sample](#) | [Datasheet](#)

[Sample](#) | [Datasheet](#)

Max Working Voltage (V_{RWM})

+ 5.5V (Unidirectional)

+/-3.6V (Bidirectional)

+/-3.6V (Bidirectional)

+/- 3.6V (Bidirectional)

IEC 61000-4-2 (Contact/Airgap)

12kV / 15kV

12kV / 15 kV

12 kV / 15kV

30kV / 30kV

TLP: $V_{CLAMP}(16A)$:
(Transient Voltage <100ns)

23V / -14V

+/-14V

8V/-5V (IEC system-side)

+/- 11.5V

IEC 61000-4-5 (8/20uS)

2.5A

2A

2A

5.5A

Capacitance

0.5pF (6Gbps)

0.25pF (10Gbps)

0.5pF (6 Gbps)

0.55pF (5 Gbps)

TI Alternates (# of Channels)

[TPD1E05U06](#) (1ch)
[TPD6E05U06](#) (6ch)

[ESD122](#) (2ch)
[TPD1E01B04](#) (1ch)

[TPD1E04U04](#) (1ch)

[ESD321](#) (1ch)
[TPD1E1B04](#) (1ch)

TI Information – Selective Disclosure

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30kV ESD Portfolio

Device Comparison							
Features	TPD1E10B06	TPD1E1B04	ESD351	ESD321	ESD204	ESDS302/4	ESDS312/4
Channel Count	1	1	1	1	4	2/4	2/4
V_{RWM}	5.5V	3.6V	3.6V	3.6V	3.6V	3.6V	3.6V
IEC 61000-4-2 ESD Rating	30kV/30kV	30kV/30kV	30kV/30kV	30kV/30kV	30kV/30kV	30kV/30kV	30kV/30kV
Capacitance	12pF	1pF	1.8pF	0.9pF	0.55pF	2.3pF	4.5pF
Polarity	Bidirectional	Bidirectional	Unidirectional	Unidirectional	Unidirectional	Unidirectional	Unidirectional
V_{CLAMP} (16A TLP)	±16V	+8.5V	+6.5V	+6.8V	+11.5V	+5.8V	5.5V
IEC 61000-4-5 Surge Rating (8/20us)	6.1A	6.3A	6A	6A	5.5A	12A	24A
Package	0402 (1x0.6mm)	0402 (1x0.6mm)	0402 (1x0.6mm)	0402 (1x0.6mm)	DQA (2.5x1mm)	DBV (1.6x2.9mm)	DBV (1.6x2.9mm)

ESD204

In Production

4-ch Surge/ESD Protection for High Speed Data Lines (Up To 5Gbps)

Features

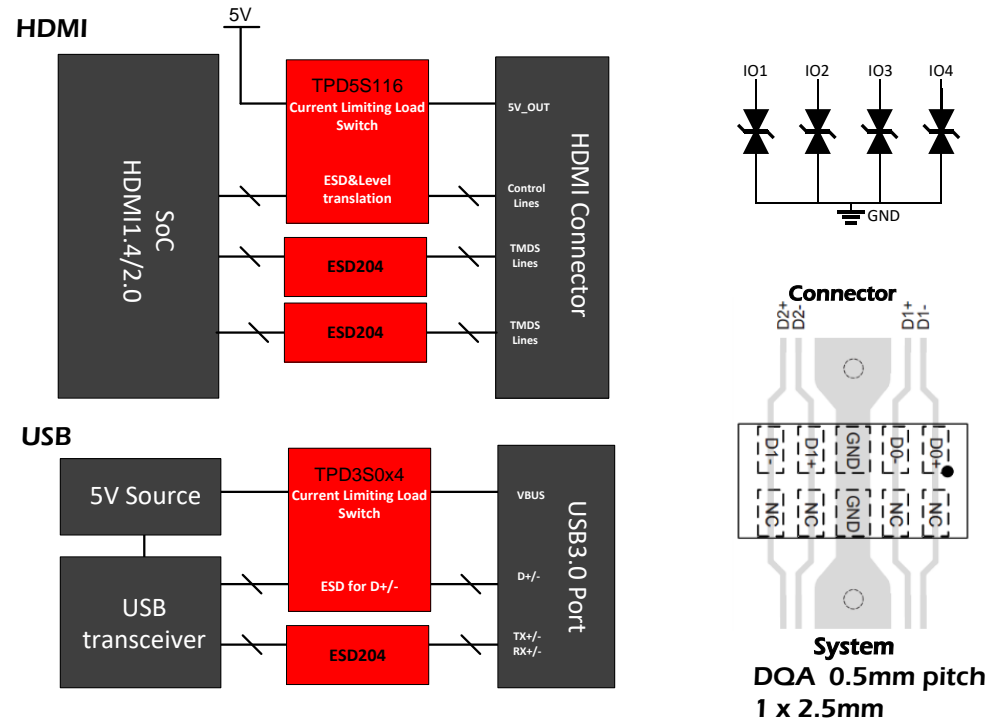
- IEC 61000-4-5 Surge (8/20us): 5.5 A
- IO Capacitance: 0.53 pF (Typ), 0.65 pF (Max)
- $R_{dyn} = 0.3 \Omega$
- $V_{cl} @6A \text{ surge (8/20us): } +/- 9 V$
- $V_{cl} @16A \text{ TLP: } +/- 11V$
- $V_{rwm} = +/-3.6V$
- IEC 61000-4-2 Level 4:
 - +/- 30kV Contact Rating
 - +/- 30kV Air Gap Rating
- IEC 61000-4-4 EFT Protection: 80A (5/50ns)

Applications

- Interfaces
 - HDMI 1.4
 - USB 2.0/3.0
 - 10/100/1000Mb Ethernet
- End Equipment
 - Video Surveillance DVR/NVR
 - Set-Top Boxes
 - Laptops and Desktops
 - TV and Monitors
 - Ethernet Switches

Benefits

- Low clamping voltage and 6A surge to protect sensitive downstream ICs
- Low cap insures signal integrity in data transmission
- Flow-through pin mapping for easy routing with industry standard footprint
- High IEC to increase system robustness



ESDS302, ESDS312

In Production

2-ch family of uni-directional devices for data-line surge protection

Features

- IEC 61000-4-5 Surge Protection upto 25 A (8/20 μ s)
 - ESDS302: 12 A Ipp
 - ESDS312: 25 A Ipp
- Low capacitance:
 - ESDS302 : 2.3 pF (Typ)
 - ESDS312 : 4.5 pF (Typ)
- Max working voltage 3.6V
- Low clamping voltage
 - 5.8V @12 A surge
 - 5.5V @25 A surge
- IEC61000-4-2 IEC (\pm 30kV contact, \pm 30kV air gap)

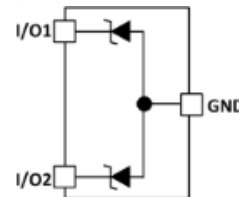
Applications

- **Interfaces**
 - USB 2.0 data lines
 - 10/100BaseT Ethernet (Industrial)
 - 100/1000BaseT1 Auto Ethernet (Automotive)
 - General data line ESD/surge protection
- **End Equipment**
 - Ethernet switches
 - Routers
 - IP Camera/Video Surveillance Equipment
 - Network Printers

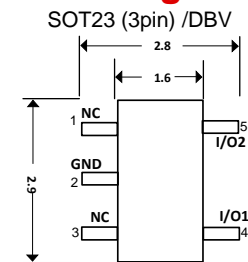
Benefits

- Handles 12A and 25A surge current with ultra low clamping voltage
 - Robustly protects the downstream ICs from surge and ESD
- Low capacitance for reliable data transmission
- Easy to route, industry standard package

Schematic

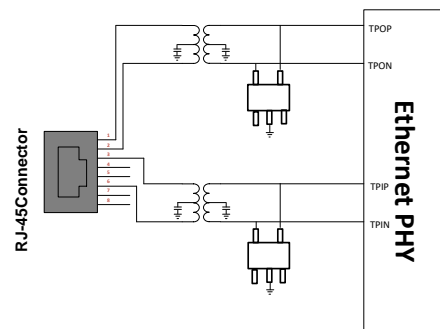


Package

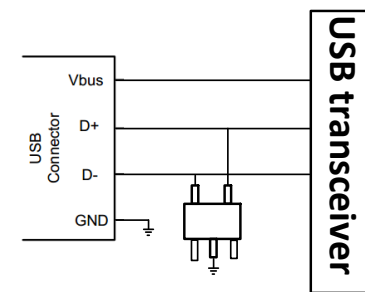


Application Diagram

10/100M Ethernet



USB



ESDS304, ESDS314

In Production

4-ch family of uni-directional devices for data-line surge protection

Features

- IEC 61000-4-5 Surge Protection upto 25 A (8/20 μ s)
 - ESDS304: 12 A Ipp
 - ESDS314: 25 A Ipp
- Low capacitance:
 - ESDS304 : 2.3 pF (Typ)
 - ESDS314 : 4.5 pF (Typ)
- Max working voltage 3.6V
- Low clamping voltage
 - 5.8 V @12 A surge
 - 5.5 V @25 A surge
- IEC 61000-4-2 (\pm 30kV contact, \pm 30kV air gap)
 - ESDS304: SOT-23 (5)
 - ESDS314: SOT-23 (5)

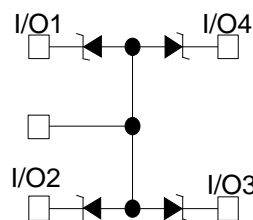
Applications

- **Interfaces**
 - 10/100/1000BaseT Ethernet (Industrial)
 - General data line ESD/surge protection
- **End Equipment**
 - Ethernet switches
 - Routers
 - IP Camera/Video Surveillance Equipment
 - Network Printers

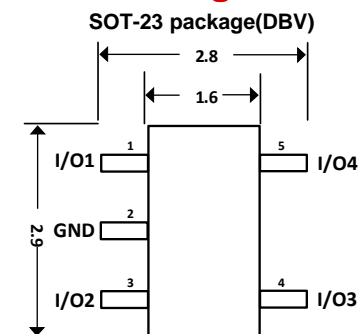
Benefits

- Handles up to 25A surge current with low Rdynamic \rightarrow Low clamping voltage
 - Robustly protects the downstream ICs from surge and ESD
- Low capacitance for reliable data transmission
- Easy to route, industry standard packages

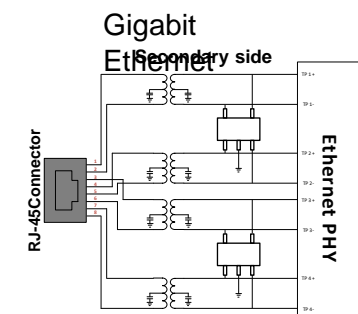
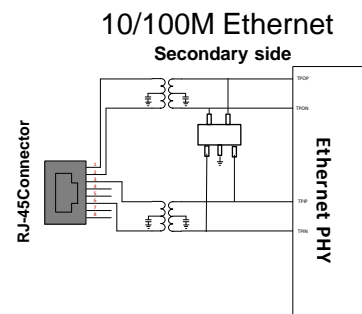
Schematic



Package

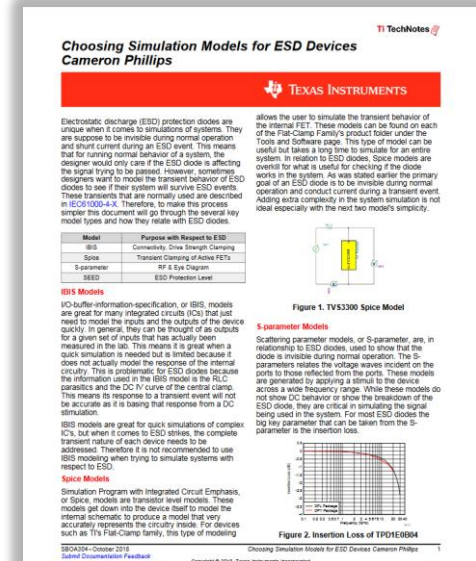
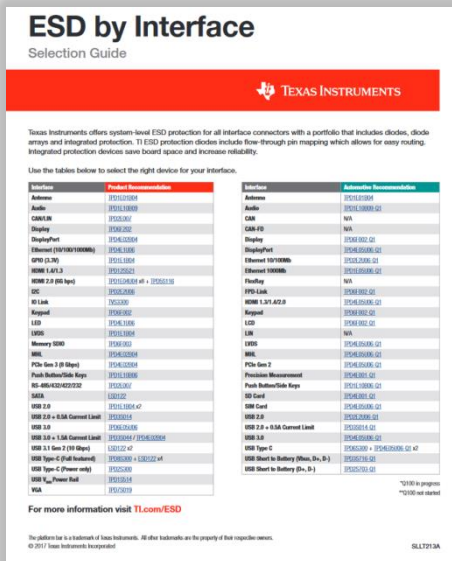
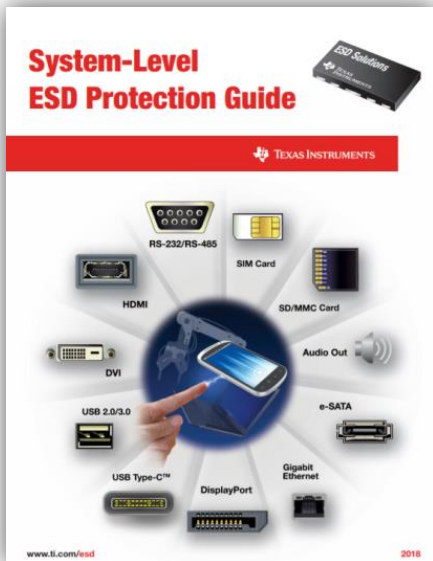


Application Diagrams



ESD & Surge Training Collateral

Tl.com/esd



System Level ESD Protection Guide

- Updated Selection Guide for several popular interfaces
- Educates customer on protection needs for specific interfaces and provides part recommendations
- **See also:**
 - [ESD by Interface Starter](#)
 - [HDMI ESD Protection Tech Note](#)

ESD by Interface

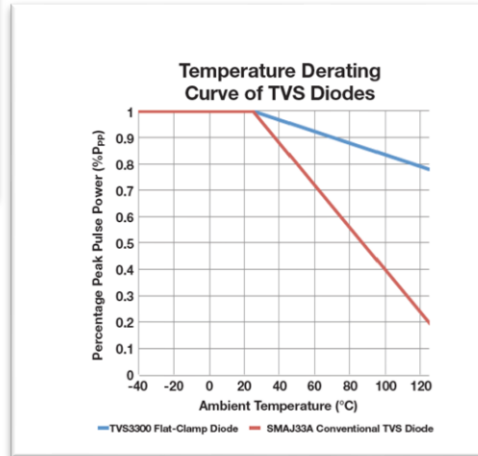
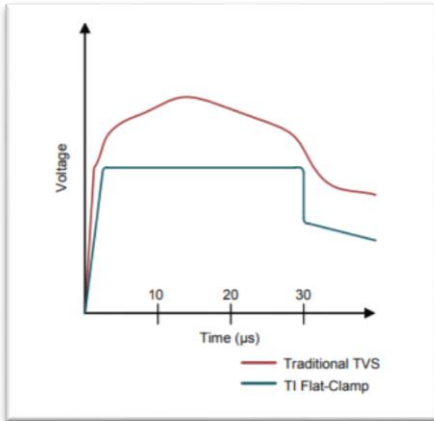
- Quick reference tool for the industry's most popular interfaces
- **See Also:**
 - [Protecting Ethernet Ports from Surge Events](#)
 - [Picking ESD Diodes for Ultra High-Speed Data Lines](#)

Choosing simulations models for ESD devices

- Goes through the different simulation models and give pros and cons to each

TI Information – Selective Disclosure

Circuit Protection – Flat-Clamp TVS Diodes



>50% footprint reduction is ideal for space constrained environments

Flat-Clamping surge response decreases voltage tolerance requirements, lowering system costs

Significantly lower leakage and capacitance than traditional TVS improves protection flexibility

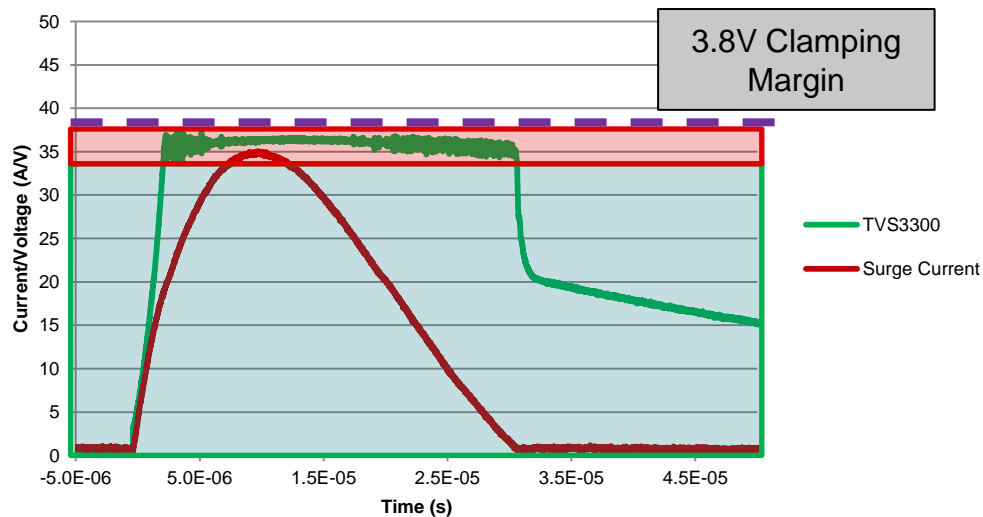
Less temperature variation increases system reliability in harsh industrial environments

Voltage Clamp Response to 8/20 μs Surge Event

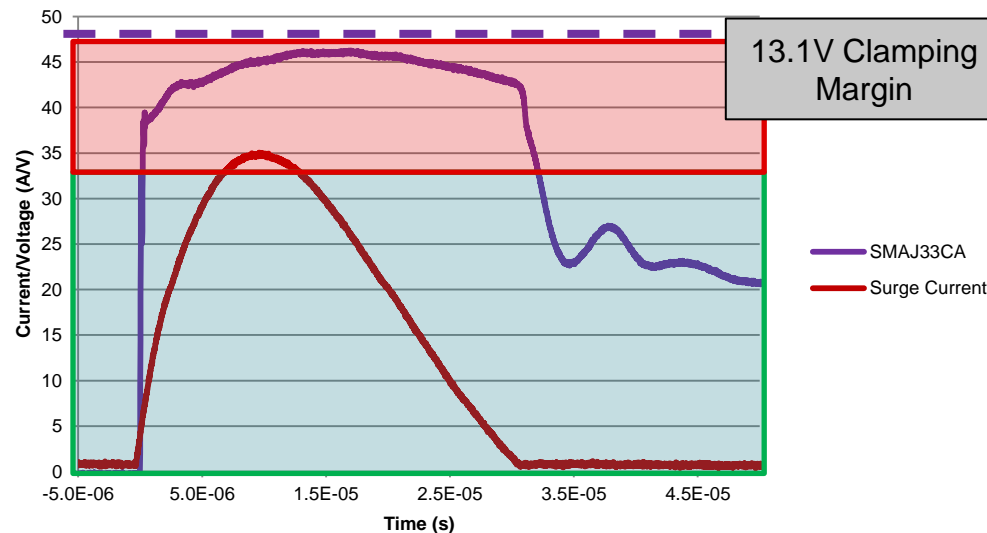
TI's Flat-Clamp TVS provides next-generation surge protection, increasing system reliability while increasing system design flexibility.

Clamping Region Comparison

TVS3300 Surge Response



SMAJ33CA Surge Response



TVS3300:





- $V_{rwm} = 33V$, $V_{br} = 35.8V$
- $I_{TVS} = 35A$
- $R_{dyn} (typ, 25C) = 0.03\Omega$
- $V_{clamp} = 35.8 V + 35 A * 0.03 \Omega = 36.8 V$
- **Voltage Tolerance Requirement = 36.8V**

SMAJ33CA:

- $V_{rwm} = 33V$, $V_{br} = 37.6V$
- $I_{TVS} = 35A$
- $R_{dyn} (typ, 25C) = 0.1\Omega$
- $V_{clamp} = 37.6V + 35A * 0.25 \Omega = 46.1 V$
- **Voltage Tolerance Requirement = >46.1 V**

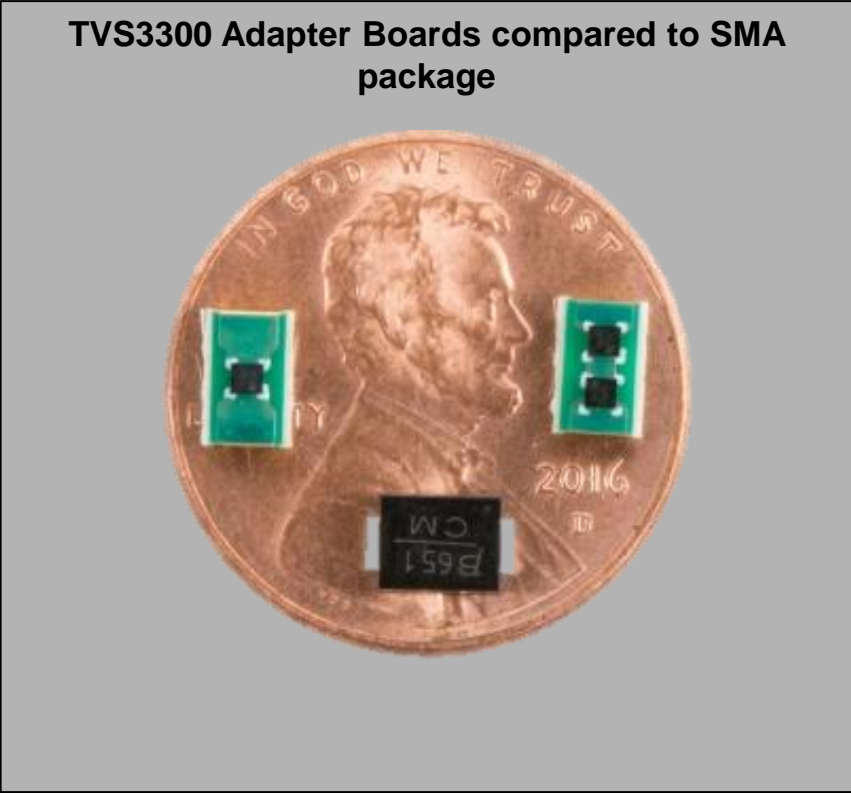
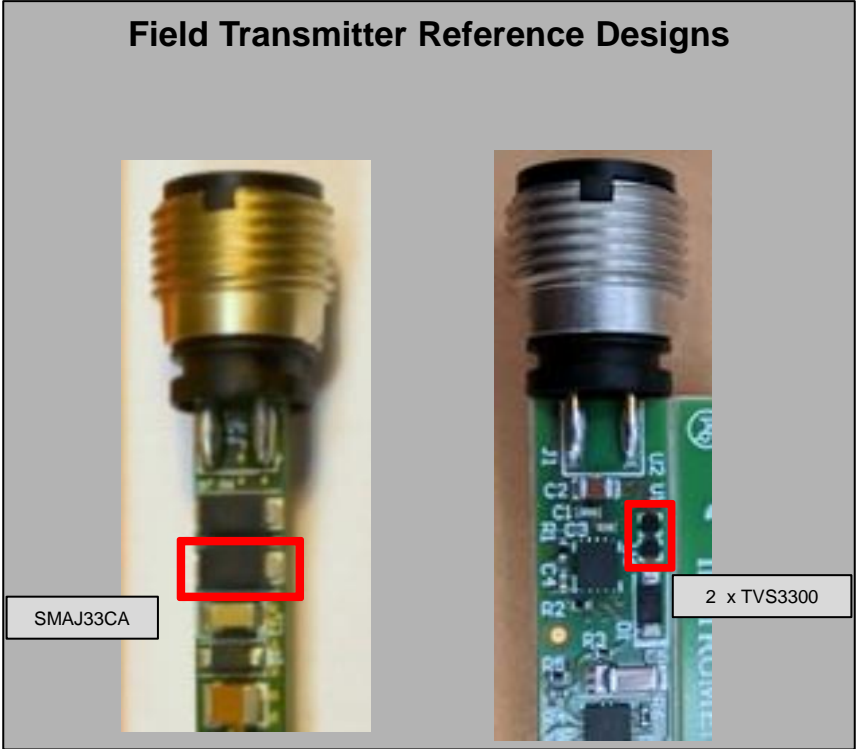
Footprint Advantage

Traditional TVS R_{dyn} goes up as package size goes down

Device	SMAJ13	SD12T1G	Flat-Clamp	Flat-Clamp
Package	13mm ² SMA	3.2mm ² SOD323	4mm ² SON	1.2mm ² WCSP
Drawing (To Scale)				
R_{dyn}	0.160 ohm	0.4 ohm	0.03 ohm	0.03 ohm
I_{pp} (8/20uS surge)	33A	15A	35A	35A

Flat-Clamp R_{dyn} is *not* a function of package size, enabling the **only** solution with low clamping voltage, small form factor, and high surge dissipation

Footprint Advantage



Small footprint offers critical advantage in space constrained applications

Unidirectional Flat-Clamp Surge Protection Diodes

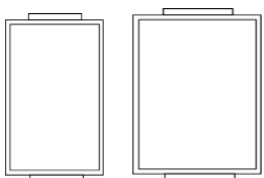
Features

- 35 A IEC 61000-4-5 Surge Protection (8/20 μ s)
 - Passes 1 kV / 42 ohm surge standard for industrial signal lines
- Ultra low leakage: <5 nA (typ), <30 nA (85°C)
- TI Flat-Clamp technology enables low dynamic resistance
- IEC Transient Immunity:
 - IEC 61000-4-2 IEC level 4 (\pm 8 kV contact, \pm 15 kV air gap)
 - IEC 61000-4-4 EFT 80A

Benefits

- **30%** lower clamping voltage compared to traditional SMA & SMB TVS diodes ensures robust protection
- QFN package is **79%** smaller than standard SMB package for space critical applications
- **50%** lower leakage current improves measurement accuracy and lowers power consumption

Tiny Package



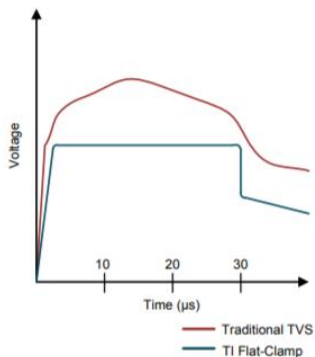
VS



SMA: 13mm² SMB: 19.1mm²
*Drawn to scale

TVSxx00: 2x2mm SON
>70% area reduction from SMA/SMB

Flat Clamping



Applications

- USB VBS Protection
- 4-20mA Transmitters
- PLC I/O Modules
- Industrial Sensors
- Medical Devices
- Appliances
- EPOS Systems
- Motor Drivers

Status	Device	Working Voltage	Clamping Voltage (max)	Leakage at V_{rwm} (typ)	Leakage at V_{rwm} (85C)
Released!	<u>TVS3300</u>	33V	39.6V	19 nA	28 nA
Released!	<u>TVS2700</u>	27V	33.7V	1.7 nA	12nA
Released!	<u>TVS2200</u>	22V	27.1V	3.2 nA	22 nA
Released!	<u>TVS1800</u>	18V	23.2V	.3 nA	7.5nA
Released!	<u>TVS1400</u>	14V	18.2V	2 nA	20nA
Released!	<u>TVS0500</u>	5V	8.4V	.07 nA	5nA

Bidirectional Flat-Clamp Surge Protection Clamps

Features

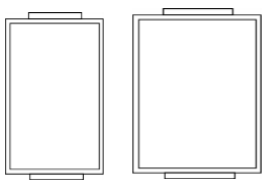
- Passes industrial signal lines surge standard
 - 1kV/42ohm immunity (25 A of IEC 61000-4 surge protection)
- Bidirectional configuration enables bipolar signals or miswiring protection
- TI Flat-Clamp technology enables ultra low dynamic resistance
- IEC Transient Immunity:
 - IEC 61000-4-2 IEC level 4
- Low leakage current: <10 nA at 27°C

Benefits

- **30%** lower clamping voltage compared to traditional SMA & SMB TVS diodes ensures robust protection
- QFN package is **50%** smaller than standard SMB package for space critical application.
- **50%** lower leakage current improves measurement accuracy and lowers power consumption

Tiny Package

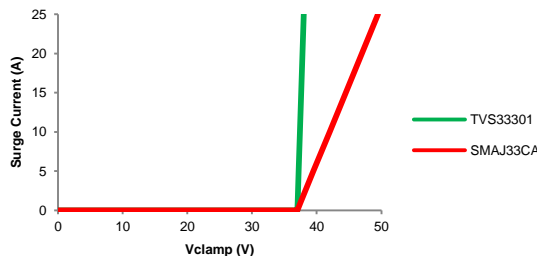
Flat Clamping



VS



TVSxx01: 3x3mm SON
>50% area reduction
from SMA/SMB



SMA: 13mm² SMB: 19.1mm²

*Drawn to scale

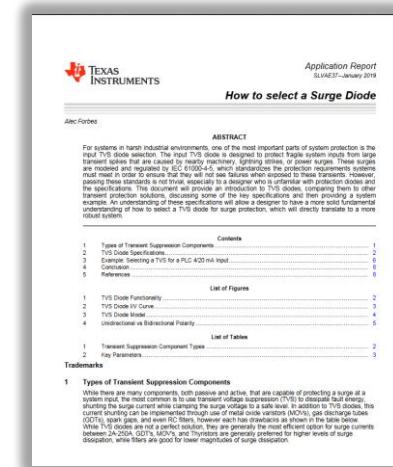
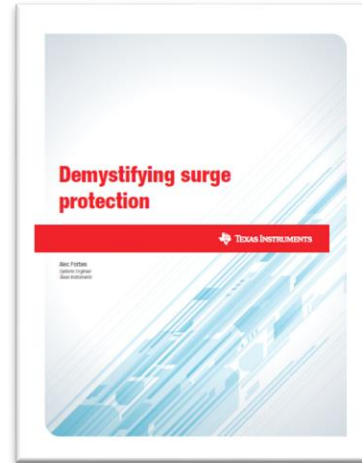
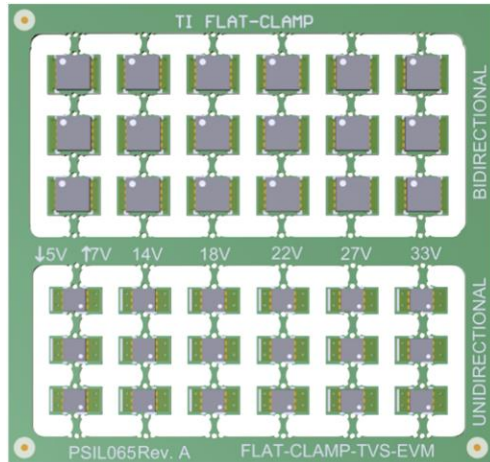
Applications

- 4-20 mA Transmitters
- PLC I/O Modules
- Industrial Sensors
- Grid Infrastructure
- Building Automation
- Medical Devices
- Appliances
- Automated Machinery

Status	Device	Working Voltage (V)	Clamping Voltage (27C, V)	Surge I _{pp} (A)	Polarity
Released!	<u>TVS3301</u>	±33	±39.5	25	Bidirectional
Released!	<u>TVS2701</u>	±27	±34	25	Bidirectional
Released!	<u>TVS2201</u>	±22	±28	25	Bidirectional
Released!	<u>TVS1801</u>	±18	±24	25	Bidirectional
Released!	<u>TVS1401</u>	±14	±18.5	25	Bidirectional
Released!	<u>TVS0701</u>	±5	±9.7	25	Bidirectional

Flat Clamp Selection Collateral

TI.com/esd



Flat Clamp TVS EVM

- Places the Flat Clamp Devices in footprint to fit industry standard SMA/SMB footprints
- Has entire portfolio on one EVM
- **See also:**
 - [TIDA-01438 Surge Protection Reference Design for PLC Analog Input Modules](#)

Demystifying Surge Protection

- Goes through what surge is and why it is needed for systems
- **See also:**
 - [TIDA-010008 Flat-Clamp TVS base Reference Design for Protection Against Transient for Grid Applications](#)

How to select a Surge Diode

- Goes through the key areas of surge diodes to look for when choosing the correct one

Thank you!