

## Low Capacitance ESD/Surge Protection for Gigabit Ethernet Interfaces

### DESCRIPTION

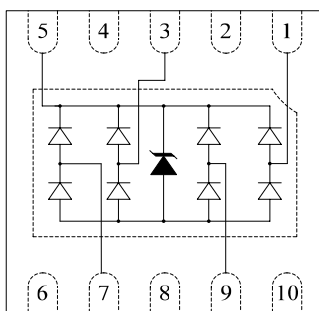
TEP2201-33LC is a low-capacitance Transient Voltage Suppressor (TVS) array designed to provide electrostatic discharge (ESD) protection for high-speed data interfaces. With typical capacitance of 3.8pF only, TEP2201-33LC is designed to protect parasitic-sensitive systems against over-voltage and over-current transient events. It complies with IEC 61000-4-2 (ESD), Level 4 ( $\pm 15\text{kV}$  air,  $\pm 8\text{kV}$  contact discharge), IEC 61000-4-4 (electrical fast transient - EFT) (40A, 5/50 ns), IEC 61000-4-5 (Surge) (25A, 8/20 $\mu\text{s}$ ), very fast charged device model (CDM) ESD and cable discharge event (CDE), etc.

TEP2201-33LC is in a DFN2.6 $\times$ 2.6-10L package. Each TEP2201-33LC device can protect two high-speed line pairs. The combined features of low capacitance and high ESD robustness make TEP2201-33LC ideal for high-speed data port and high-frequency line (e.g., Gigabit Ethernet Ports) applications. The low clamping voltage of the TEP2201-33LC guarantees a minimum stress on the protected IC.

### ORDERING INFORMATION

- ✧ Device: TEP2201-33 LC
- ✧ Package: DFN2.6\*2.6-10L
- ✧ Marking: part number, date code
- ✧ Material: Halogen free
- ✧ Packing: Tape & Reel
- ✧ Quantity per reel: 3,000pcs

### PIN CONFIGURATION



### FEATURES

- ✧ Transient protection for high-speed data lines  
IEC 61000-4-2 (ESD)  $\pm 15\text{kV}$  (Air)  
 $\pm 8\text{kV}$  (Contact)
- IEC 61000-4-4 (EFT) 40A (5/50 ns)
- IEC 61000-4-5 (Surge) 25A (8/20 $\mu\text{s}$ )
- ✧ Package optimized for high-speed lines
- ✧ Provides protection for two line pairs
- ✧ Low capacitance: 3.8pF @ 0V (Typical)
- ✧ Low leakage current: 0.1 $\mu\text{A}$  @ VRWM (Typical)
- ✧ Low operating and clamping voltage
- ✧ Each I/O pin can withstand over 1000 ESD strikes for  $\pm 8\text{kV}$  contact discharge

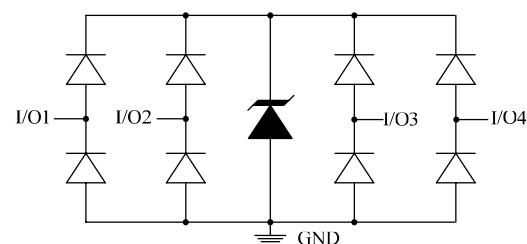
### MACHANICAL DATA

- ✧ DFN2.6\*2.6-10L package
- ✧ Flammability Rating: UL 94V-0
- ✧ MSL 1 & Thermally-Enhanced
- ✧ Flow-Through
- ✧ Packaging: Tape and Reel
- ✧ Reel size: 7 inch
- ✧ High temperature soldering guaranteed: 260 $^{\circ}\text{C}$ /10s

### APPLICATIONS

- ✧ 10/100/1000M Ethernet Ports
- ✧ WAN/LAN Equipment
- ✧ Desktops, Servers and Notebooks
- ✧ Cellular Phones
- ✧ Switching Systems
- ✧ Audio/Video Inputs

### CIRCUIT DIAGRAM



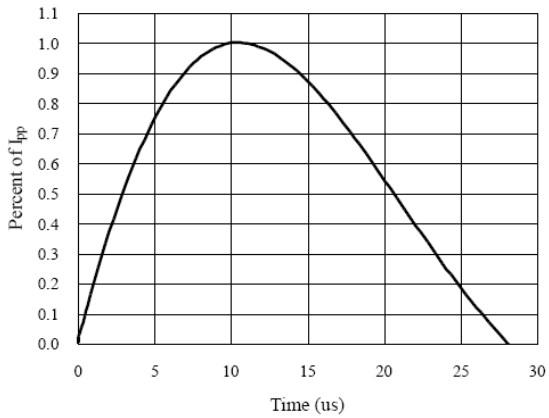
<b>ABSOLUTE MAXIMUM RATING</b>			
<b>Symbol</b>	<b>Parameter</b>	<b>Value</b>	<b>Units</b>
P <sub>PP</sub>	Peak Pulse Power (8/20μs)	450	W
I <sub>PP</sub>	Peak Pulse Current (8/20μs)	25	A
V <sub>ESD</sub>	ESD per IEC 61000-4-2 (Air) ESD per IEC 61000-4-2 (Contact)	±25 ±15	kV
T <sub>OPT</sub>	Operating Temperature	-55/+125	°C
T <sub>STG</sub>	Storage Temperature	-55/+150	°C

<b>ELECTRICAL CHARACTERISTICS (T<sub>amb</sub>=25° C)</b>						
<b>Symbol</b>	<b>Parameter</b>	<b>Test Condition</b>	<b>Min</b>	<b>Typ</b>	<b>Max</b>	<b>Units</b>
V <sub>RWM</sub>	Reverse Working Voltage				3.3	V
I <sub>R</sub>	Reverse Leakage Current	V <sub>RWM</sub> = 3.3V Any I/O pin to GND		0.1	1.0	μA
V <sub>t1</sub>	Trigger Voltage	I <sub>t1</sub> = 1μA Any I/O pin to GND	3.5	4.2	5.0	V
V <sub>h</sub>	Holding Voltage	I <sub>h</sub> = 1mA Any I/O pin to GND	3.3		4.5	V
V <sub>C1</sub>	Clamping Voltage 1	I <sub>PP</sub> = 1A, t <sub>p</sub> = 8/20μs Any I/O pin to GND			5.5	V
V <sub>C2</sub>	Clamping Voltage 2	I <sub>PP</sub> = 10A, t <sub>p</sub> = 8/20μs Any I/O pin to GND			8.5	V
V <sub>C3</sub>	Clamping Voltage 3	I <sub>PP</sub> = 25A, t <sub>p</sub> = 8/20μs Any I/O pin to GND			16.0	V
C <sub>J1</sub>	Junction Capacitance 1	V <sub>R</sub> = 0V, f = 1MHz Any I/O pin to GND		3.8	5.0	pF
C <sub>J2</sub>	Junction Capacitance 2	V <sub>R</sub> = 0V, f = 1MHz Between I/O pins		2.0	2.5	pF

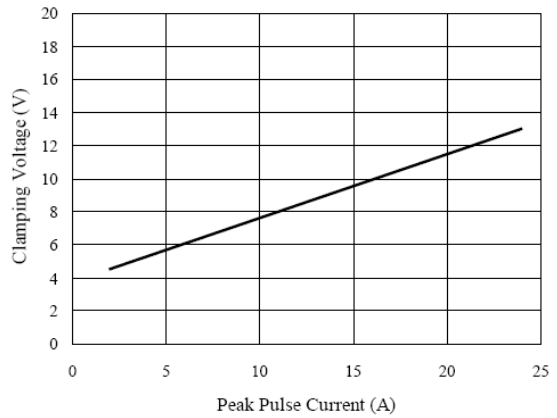
# RATING AND CHARACTERISTIC CURVES ( TEP2201-33LC)

## ELECTRICAL CHARACTERISTICS CURVE

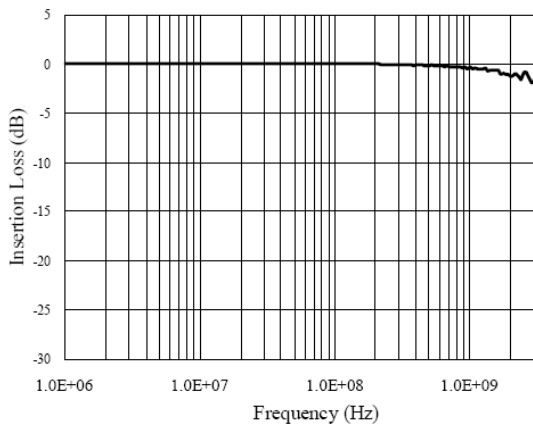
**8/20µs Pulse Waveform**



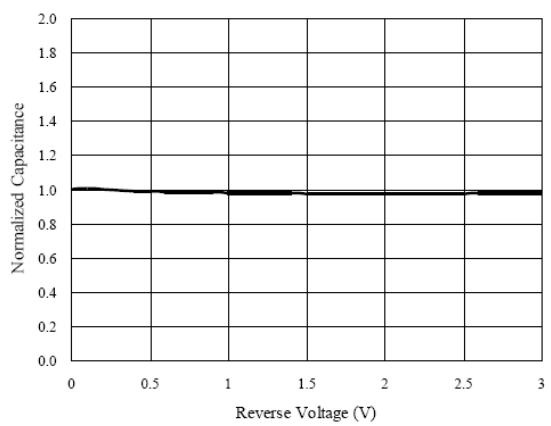
**Clamping Voltage  $V_C$  vs. Current  $I_{PP}$**



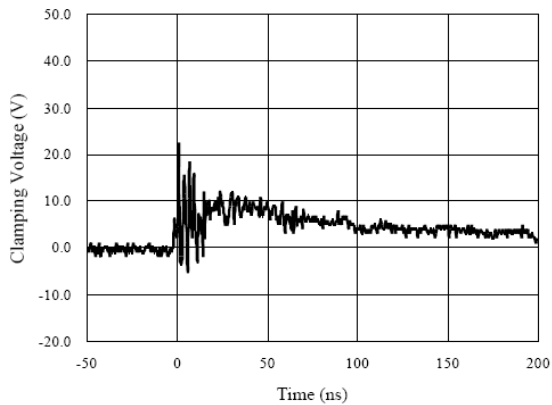
**Insertion Loss S21**



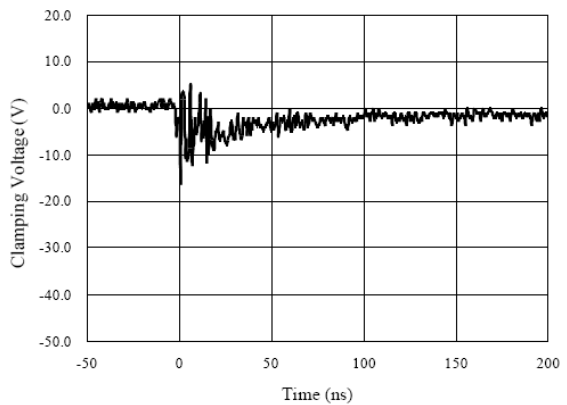
**Normalized Capacitance vs. Voltage**



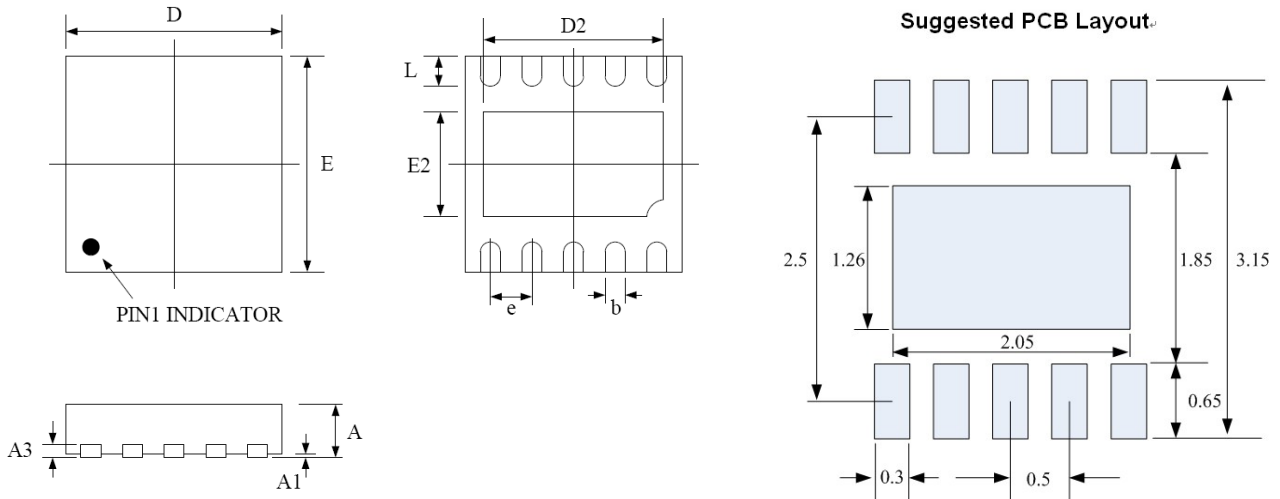
**ESD Clamping of I/O to GND  
(+8kV Contact per IEC 61000-4-2)**



**ESD Clamping of I/O to GND  
(-8kV Contact per IEC 61000-4-2)**



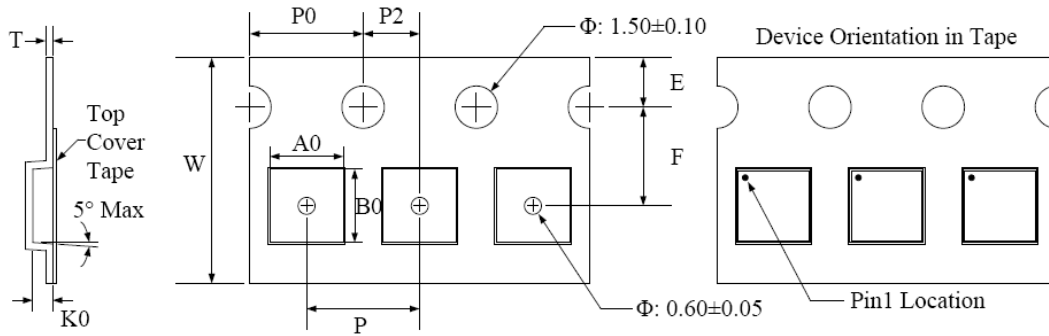
## DFN2.6\*2.6-10L PACKAGE OUTLINE DIMENSIONS



**Package Dimensions (Controlling dimensions are in millimeters)**

Symbol	Dimensions (mm)			Dimensions (Inches)		
	Minimum	Typical	Maximum	Minimum	Typical	Maximum
A	0.500	0.550	0.600	0.020	0.022	0.024
A1	0.000	—	0.050	0.000	—	0.002
A3	0.15 REF			0.006 REF		
b	0.200	0.250	0.300	0.008	0.010	0.012
D	2.550	2.600	2.650	0.100	0.102	0.104
D2	2.000	2.150	2.250	0.079	0.085	0.089
e	0.500 BSC			0.020 BSC		
E	2.550	2.600	2.650	0.100	0.102	0.104
E2	1.110	1.260	1.360	0.044	0.050	0.054
L	0.250	0.350	0.450	0.010	0.014	0.018

## Carrier Tape



Symbol	W	A0	B0	K0	E	F	P	P0	P2	T
Dimensions (mm)	8.00+0.3 -0.1	2.74±0.05	2.74±0.05	0.72±0.05	1.75±0.1	3.5±0.05	4.0±0.1	4.0±0.1	2.0±0.05	0.25±0.02

## Packing Quantity

Reel		Inner Box		Carton	
Size	Quantity Per Reel	Size	Quantity Per Reel	Size	Quantity Per Reel
7 (inch)	3,000pcs	210*208*203 (mm)	45,000pcs	440*440*230 (mm)	180,000pcs
7 (inch)	3,000pcs	183*188*80 (mm)	18,000pcs	386*265*215 (mm)	108,000pcs

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