Features

- Transient protection for super-speed data lines
  - IEC 61000-4-2 (ESD) ±30kV (Air)
  - ±30kV (Contact)
  - IEC 61000-4-4 (EFT) 40A (5/50 ns)
  - Cable Discharge Event (CDE)
- ESD protection for super-speed differential signal (above 5Gb/s) channels
- Fast turn-on and low clamping voltage
- Protects six data lines and one VCC line
- Ultra-low capacitance: 0.4 pF Typical (I/O-GND)
- Low leakage current: 0.1μA @ V_{RWM} (Typical)
- Back-drive protection for power-down mode
- Each I/O pin can withstand over 1000 ESD strikes for ±8kV contact discharge

Description

TT0516STX is an ultra-low capacitance Transient Voltage Suppressor (TVS) designed to provide electrostatic discharge (ESD) protection for super-speed data interfaces. With typical capacitance of 0.4 pF only, TT0516STX 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 (±15kV air, ±8kV contact discharge), IEC 61000-4-4 (electrical fast transient - EFT) (40A, 5/50 ns), very fast charged device model (CDM) ESD and cable discharge event (CDE), etc.

TT0516STX uses an DFN4120-10L package. Each TT0516STX device can protect six super-speed data lines. The conbined features of ultra-low capacitance, small size and high ESD robustness make TT0516STX ideal for super-speed data ports and high-frequency lines (e.g. HDMI & DVI) applications.

The low clamping voltage of the TT0516STX guarantees a minimum stress on the protected IC.

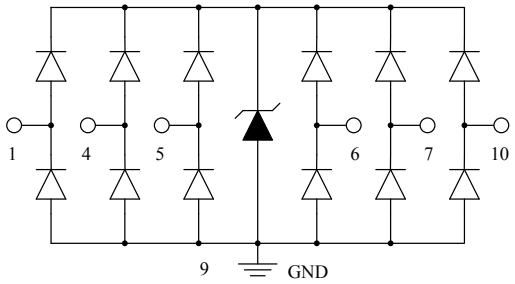
Applications

- USB3.0 Power and Data Line Protection
- Desktops, Servers and Notebooks
- MDDI Ports
- Display Ports
- High Definition Multi-Media Interface (HDMI)
- Digital Visual Interfaces (DVI)

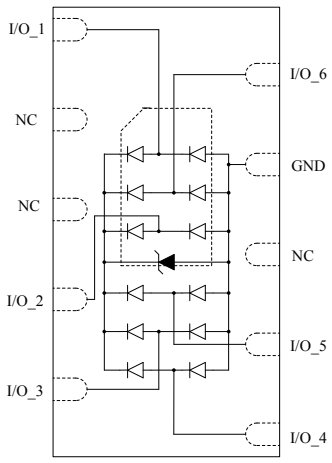
Mechanical Characteristics

- DFN4120-10L package
- Flammability Rating: UL 94V-0
- Marking: Part number, Date
- Packaging: Tape and Reel

Circuit Diagram



Pin Configuration



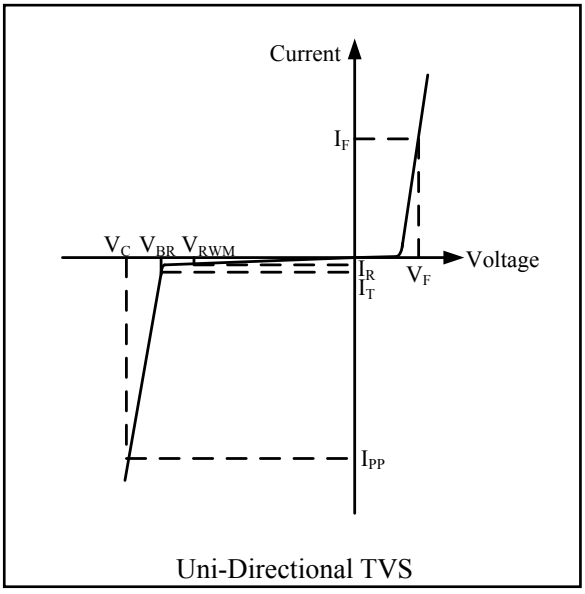
DFN4120-10L
(Top View, not to scale)

Absolute Maximum Rating

Symbol	Parameter	Value	Units
V_{ESD}	ESD per IEC 61000-4-2 (Air) ESD per IEC 61000-4-2 (Contact)	±30 ±30	kV
T_{OPT}	Operating Temperature	-55/+125	°C
T_{STG}	Storage Temperature	-55/+150	°C

Electrical Characteristics (T = 25°C)

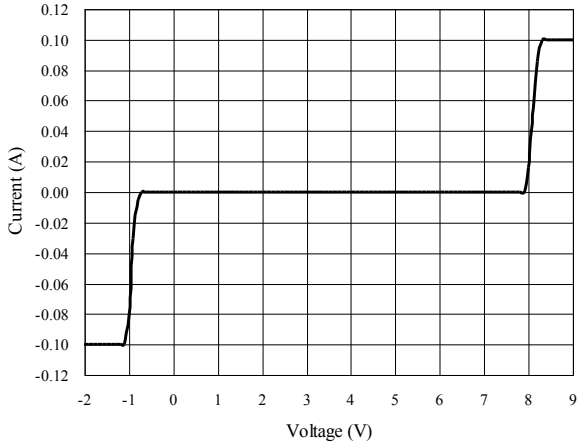
Symbol	Parameter
V_{RWM}	Nominal Reverse Working Voltage
I_R	Reverse Leakage Current @ V_{RWM}
V_{BR}	Reverse Breakdown Voltage @ I_T
I_T	Test Current for Reverse Breakdown
V_C	Clamping Voltage @ I_{PP}
I_{PP}	Maximum Peak Pulse Current
C_{ESD}	Parasitic Capacitance
V_R	Reverse Voltage
f	Small Signal Frequency
I_F	Forward Current
V_F	Forward Voltage @ I_F



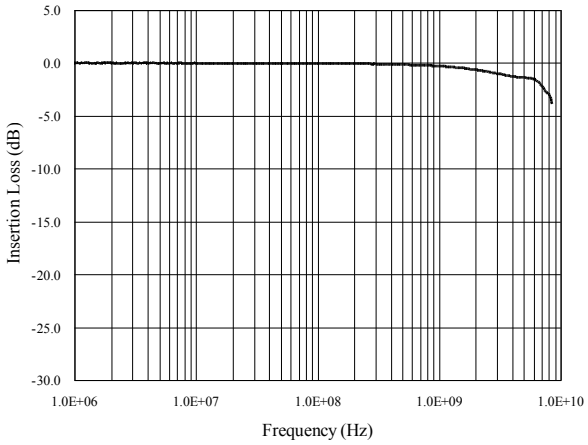
Uni-Directional TVS

Symbol	Test Condition	Minimum	Typical	Maximum	Units
V_{RWM}				5.0	V
I_R	V_{RWM} = 5V, T = 25°C Between Any Pin and GND		0.1	1.0	μA
V_{BR}	I_T = 1mA Between Any Pin and GND	6.0	8.0	10.0	V
V_C	I_{PP} = 1A, t_p = 8/20μs Between Any Pin and GND			12	V
C_{ESD}	V_R = 0V, f = 1MHz Between Any Pin and GND		0.4	0.6	pF
C_{ESD}	V_R = 0V, f = 1MHz Between I/O and I/O		0.2		pF

Voltage Sweeping of I/O to GND

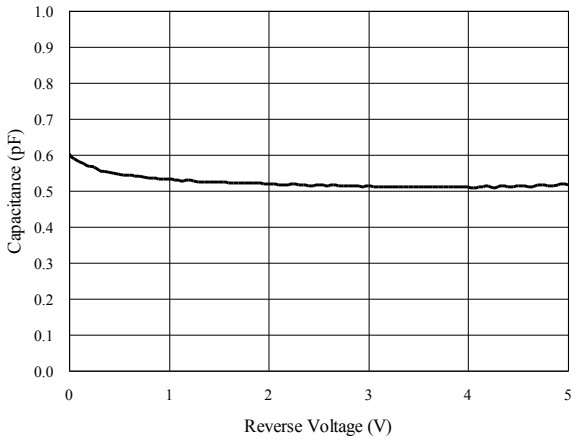


Insertion Loss S21 of I/O to GND

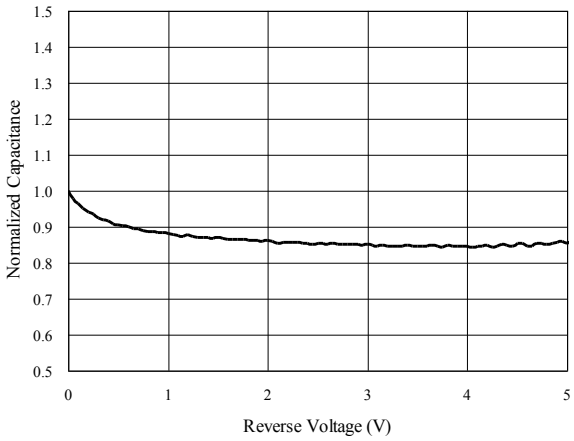


Capacitance *vs.* Voltage of I/O to GND (f = 1MHz)

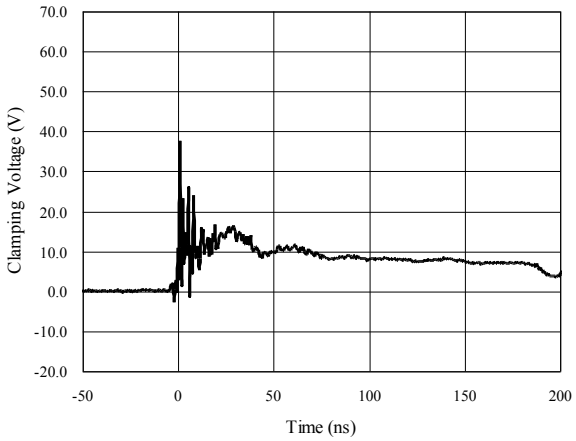
Capacitance *vs.* Reverse Voltage



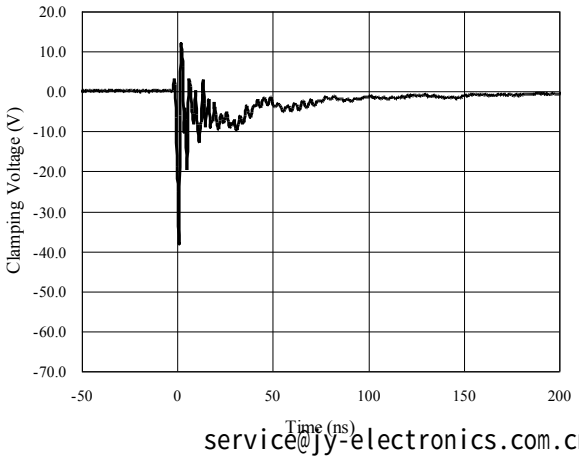
Normalized Capacitance *vs.* Reverse Voltage



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)



Application Information

Pin Connection in PCB

TT0516STX provides ESD protection for six data lines The pin connection is shown in Figure 1.
Six parallel data lines, from inner IC to I/O port connector, could connect to TT0516STX six I/O pins directly. Pin 9 of TT0516STX is the GND pin, which should connect to the GND of PCB. The wire should be as short as possible in order to minimize the parasitic inductance.

In some cases, systems are not allowed to be reset or restart after zapping ESD stress at the I/O port connector.

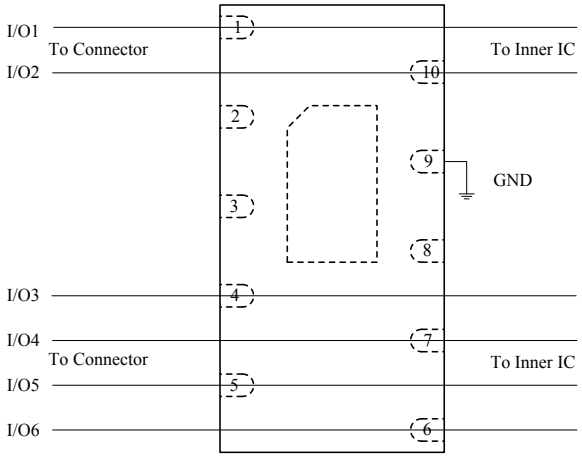


Figure 1 TT0516STX pin connection in PCB providing data lines

Application Information

USB3.0 Protection for Super Speed Differential signals

TT0516STX provides ESD protection for super-speed data lines. Thus, a lot of kinds of high speed I/O ports can be the applications of TT0516STX, especially, the USB3.0 port.

USB3.0 is expected to transmit and receive above 5Gb/s data, which needs differential signaling. For differential signaling, keep the differential impedance at constant is the most importance.

ESD protection devices have an inherent junction capacitance. Usually, this added capacitance on a USB3.0 port will drop the impedance of the differential pair to interfere with the signaling. TT0516STX presents only 0.1pF maximum capacitance to each differential signal while being rated to handle 8kV ESD contact/air discharges as outlined in IEC 61000-4-2 and providing a low clamping voltage to protect the downstream devices.

Therefore, TT0516STX is the most suitable ESD protector for USB3.0 I/O ports and other high speed, above 5Gb/s, I/O ports in any electronic product. Figure 3 shows the pin connection example for USB3.0 I/O ports.

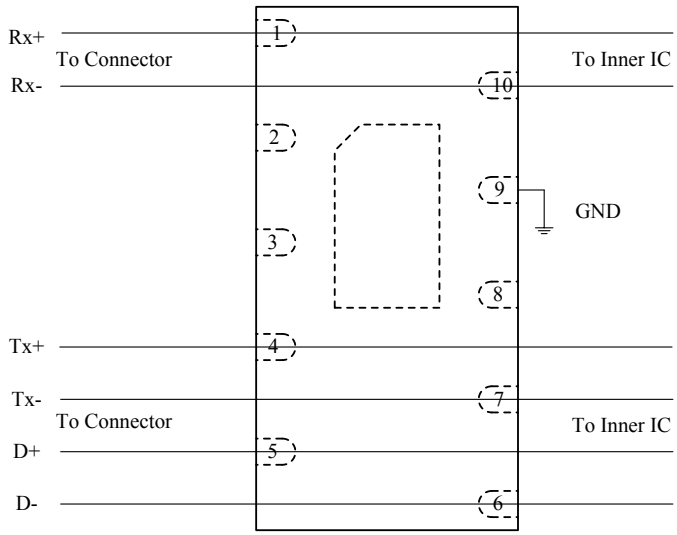
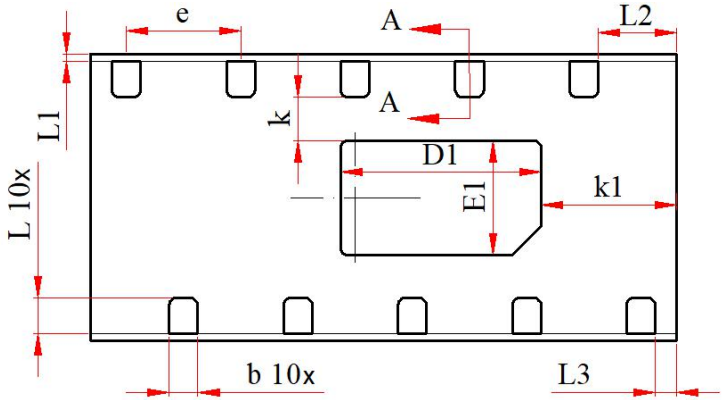


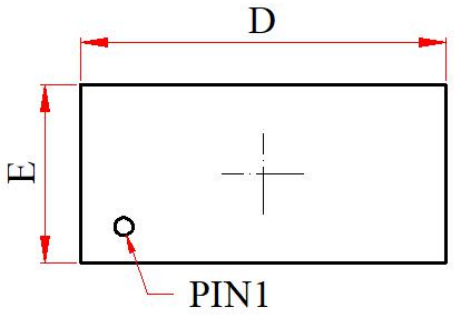
Figure 3 TT0516STX pin connection for USB3.0 protection.

Package Outline

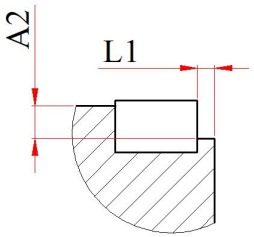
- DFN4120-10L package



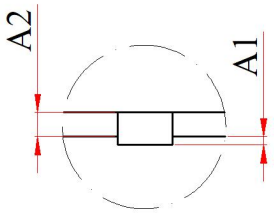
Bottom View



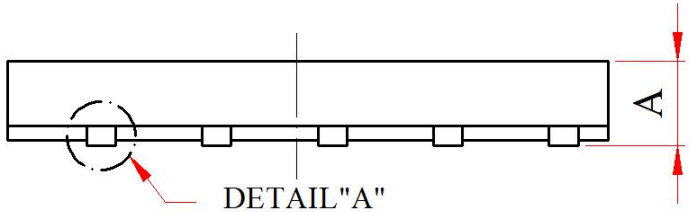
Top View



Section A-A



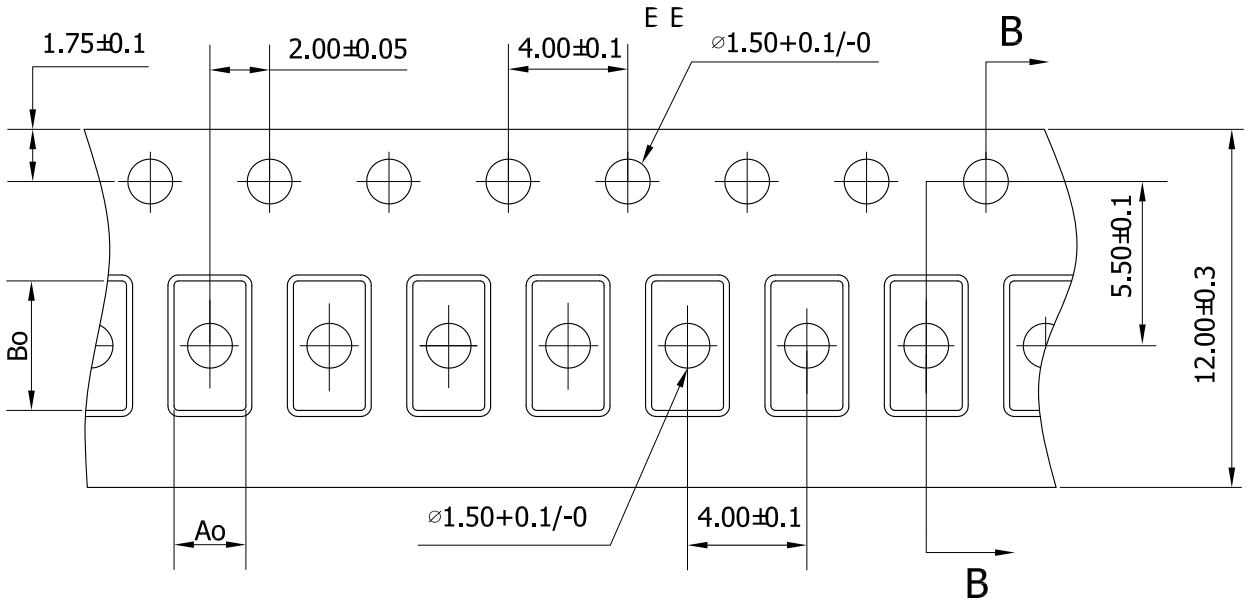
Detail "A"

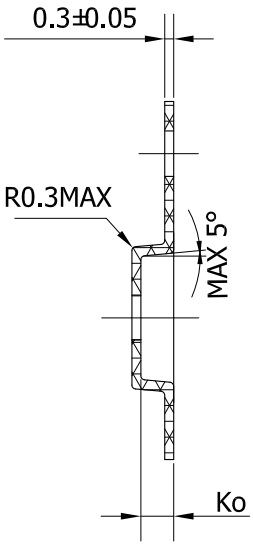


Side View

Symbol	Dimension In Millimeters			Dimension In Inches		
	Normal	Min	Max	Normal	Min	Max
A	--	0.500	0.600	--	0.020	0.024
A1	--	--	0.005	--	--	0.000
A2	--	0.050	0.250	--	0.002	0.010
D	4.100	4.000	4.200	0.161	0.157	0.165
E	2.000	1.900	2.100	0.079	0.075	0.083
D1	1.400	1.300	1.500	0.055	0.051	0.059
E1	0.800	0.700	0.900	0.031	0.028	0.035
b	0.200	0.150	0.250	0.008	0.006	0.010
L	0.250	0.200	0.300	0.010	0.008	0.012
L1	0.050	0.010	0.090	0.002	0.000	0.004
L2	0.550 REF			0.022 REF		
L3	0.150 REF			0.006 REF		
k	0.300 REF			0.012 REF		
k1	0.950 REF			0.037 REF		
e	0.800 BSC			0.031 BSC		

Tape and Reel Specification

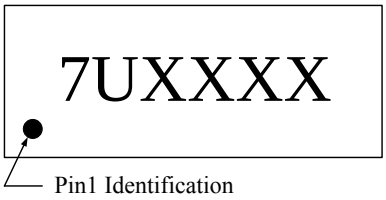




Ao=2.30±0.1
Bo=4.40±0.1
Ko=0.80±0.1

NOTES:
1 10 SPROCKET HOLE PITCH CUMULATIVE TOLERANCE ±0.2
2 CAMBER IN COMPLANCE WITH EIA 481
3 POCKET POSITION RELATIVE TO SPROCKET HOLE MEASURED AS TRUE POSITION OF POCKET,NOT POCKET HOLE

Marking Codes



Note:

(1) "7U" is part number, fixed.

(2) "XXXX" is internal code.

Ordering Information

Part Number	Working Voltage	Quantity Per Reel	Reel Size
TT0516STX	5V	3,000	7 Inch