Features

- Transient protection for super-speed data lines
  - IEC 61000-4-2 (ESD) ±25kV (Air)
  - ±17kV (Contact)
  - IEC 61000-4-2(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: 0.5pF Typical (I/O - I/O)
- Low leakage current: 0.1uA @ V_{RWM} (Typical)
- Back-drive protection for power-down mode
- Each I/O pin cann withstand over 1000 ESD strikes for ±8kV contact discharge

Description

T0516ST 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 0.5pF only, T0516ST 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.

T0516ST uses an DFN4120-10L package..Each T0516ST device can protect six super-speed data lines and one VCC line. The combined features of ultra-low capacitance, small size and high ESD robustness make T0516ST ideal for super-speed data ports and high-frequency lines (e.g., HDMI & DVI) applications. The low clamping voltage of the T0516ST guarantees a minimum stress on the protected IC.

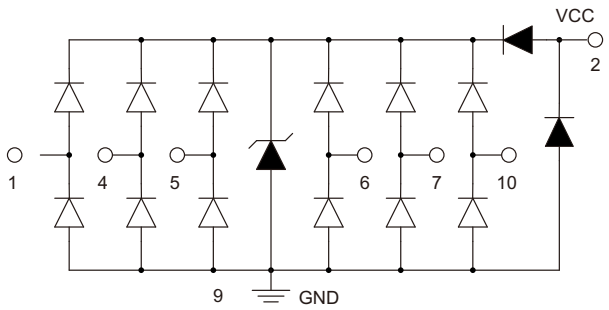
Applications

- 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)

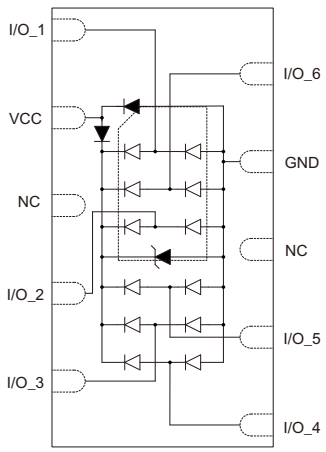
Mechanical Characteristics

- DFN4120-10L package
- Flammability Rating: UL 94V-0
- Packaging: Tape and Reel

Circuit Diagram



Pin Configuration



DFN4120-10L

(Top View, not to scale)

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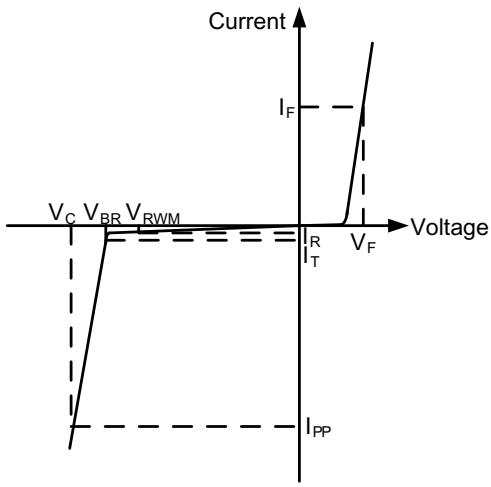
Revision : C

Absolute Maximum Rating

Symbol	Parameter	Value	Units
V_{ESD}	ESD per IEC 61000-4-2 (Air) ESD per IEC 61000-4-2 (Contact)	±25 ±17	kV
T_{OPT}	Operating Temperature	-55 / +125	°C
T_{STG}	Storage Temperature	-55 / +150	°C

Electrical Characteristics (T=25°C)

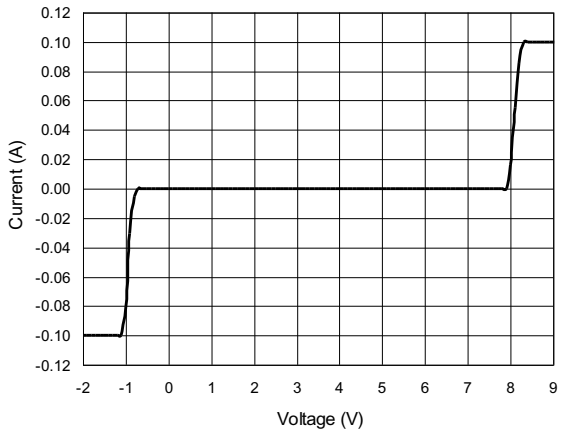
Symbol	Parameter
V_{RWM}	Nominal Reverse Working Voltage
I_R	Reverse Leakage Vurrent @ V_{RWM}
V_{BR}	Reverse Bearkdown Voltage @ I_T
I_T	Test Current for Reverse Breakdown
V_C	Clamping Voltage @ I_{PP}
I_{PP}	Maximum Peak Pulse Current
C_{ESD}	Parasitic Capacitance
V_R	Reverse Voltage
f	Small Signal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



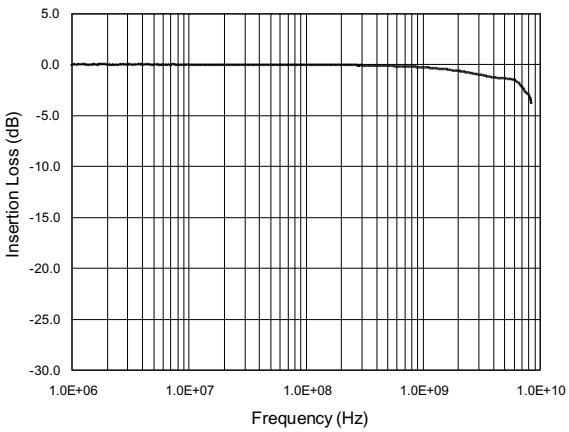
Uni-Directional TVS

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		0.5		pF
C_{ESD}	V_R = 0V, f = 1MHz Between I/O and I/O		0.1		pF

Voltage Sweeping of I/O to GND

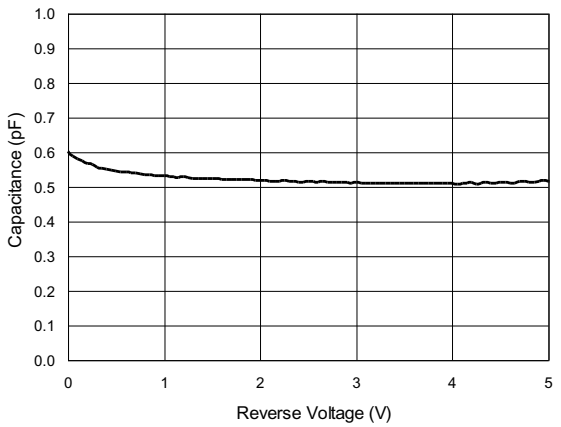


Insertion Loss S21 of I/O to GND

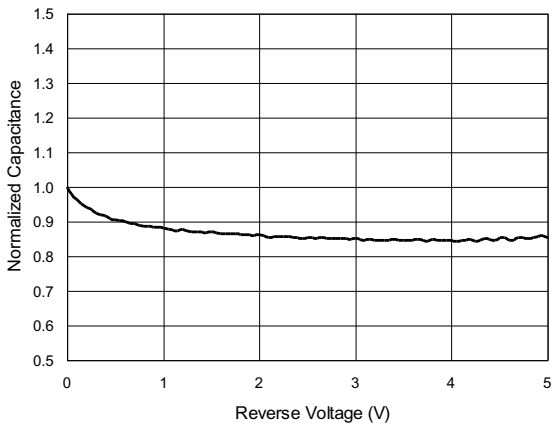


Capacitance vs. Voltage of I/O to GND (f=1MHz)

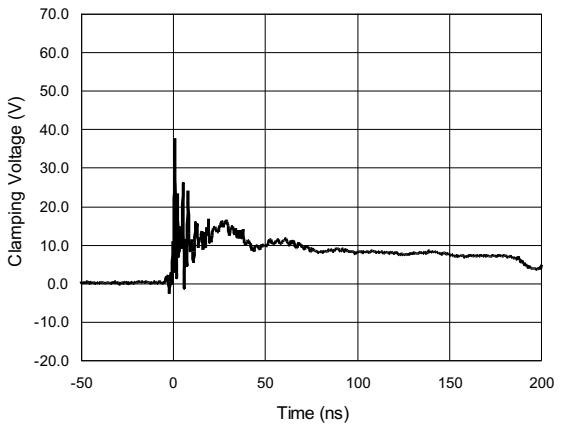
Capacitance vs. Reverse Voltage



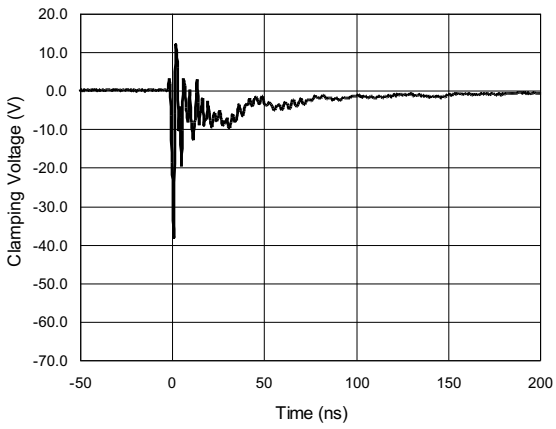
Normalized Capacitance vs. Reverse Voltage



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

T0516ST provides ESD protection for six data lines and one power rail line simultaneously. The pin connection is shown in Figure 1.
Six parallel data lines, from inner IC to I/O port connector, could connect to T0516ST six I/O pins directly. Pin 9 of T0516ST 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. Pin 2 of T0516ST is the VCC pin, which should connect to the VCC rail of PCB.

In some cases, systems are not allowed to be reset or restart after zapping ESD stress at the I/O port connector Under this situation, to enhance the sustainable ESD level, a 0.1uF capacitor can be used berween the VCC and GND rails. Place the capacitor as close as possible to T0516ST. .
In some cases, VCC rail is not presented on the PCB. Under this situation, the pin 2 of T0516ST can be left as floating. The pin connection is show

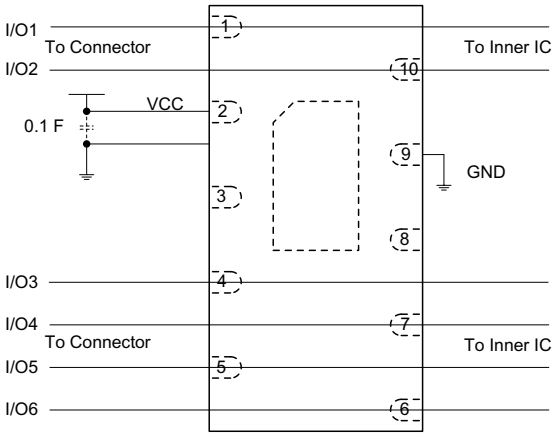


Figure 1 T0516ST pin connection in PCB providing data lines and power rail line protection.

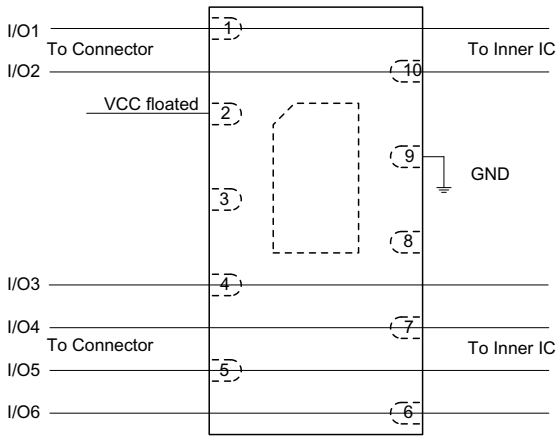


Figure 2 T0516ST pin connection in PCB providing data line protection.
VCC pin is left as floating when no VCC rail is presented in PCB

Application Information

USB3.0 Protection for Super Speed Differential signals

T0516ST provides ESD protection for super-speed data lines. Thus, a lot of kids of high speed I/O ports can be the applications of T0516ST, 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.

T0516ST presents only 0.4pF maximum capacitance to each differential signal while being rated to handle 8kV ESD contact/air discharges as outlined in IEC 61000-4-2and providing a low clamping voltage to protect the downstream devices.

Therefore, T0516ST 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.

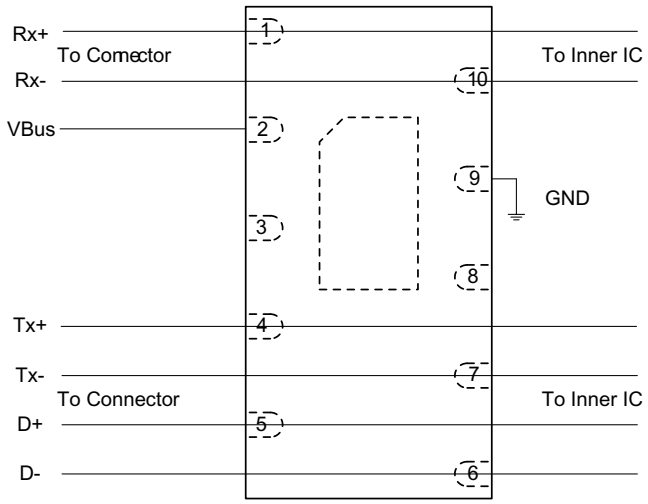
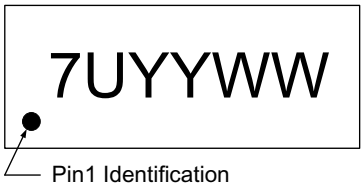


Figure 3 T0516ST pin connection for USB3.0 protection.

Marking Codes



Ordering Information

Part Number	Working Voltage	Quantity Per Reel	Reel Size
T0516ST	5V	3,000	7 Inch

Note:

(1) "7U" is part number, while "YYWW" is date code.

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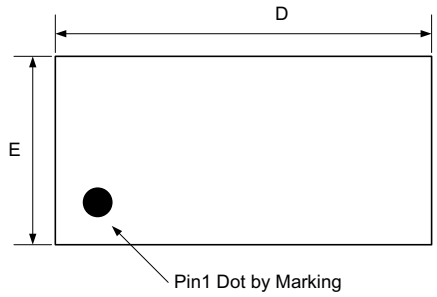
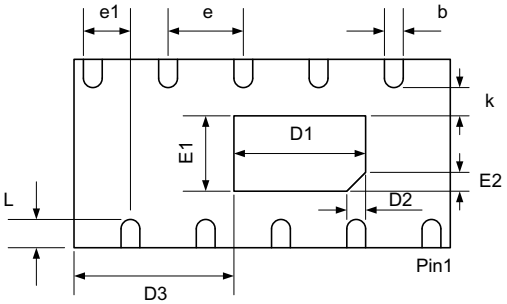
Package Outline

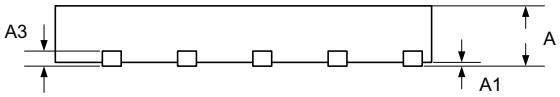
DFN4120-10L package



Top View



Bottom View



Side View

Package Dimensions (Controlling dimensions are in millimeters)

Symbol	Dimensions (mm)		Dimensions (Inches)	
	Minimum	Maximum	Minimum	Maximum
A	0.450	0.550	0.018	0.022
A1	0.000	0.050	0.000	0.002
A3	0.152REF.		0.006REF.	
D	4.050	4.150	0.159	0.163
E	1.950	2.050	0.077	0.081
D1	1.300	1.500	0.051	0.059
E1	0.700	0.900	0.028	0.035
D3	1.650	1.850	0.065	0.073
D2	0.200REF		0.008REF	
E2	0.200REF		0.008REF	
k	0.200MIN		0.008MIN	
b	0.150	0.250	0.006	0.010
e	0.800TYP		0.031TYP	
e1	0.350	0.450	0.014	0.018
L	0.250	0.350	0.010	0.014

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