

Features

- Transient protection for high-speed data lines
- IEC61000-4-2 (ESD) $\pm 30\text{kV}$ (Air)
 $\pm 30\text{kV}$ (Contact)
- IEC61000-4-5 (Lightning) 22A (8/20 μs)
- Small package saves board space
- Protects one I/O line (bidirectional)
- Low capacitance: 0.78pF @ 0V (Typical)
- Low leakage current: 10nA @ V_{RWM} (Maximum)
- Low clamping voltage
- Each I/O pin can withstand over 1000 ESD strikes for $\pm 30\text{kV}$ contact discharge

Description

TS0541 TB-HFxX is a low capacitance Transient Voltage Suppressor (TVS) designed to provide electrostatic discharge (ESD) protection for high-speed data interfaces. With typical capacitance of 0.78pF only, it 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 ($\pm 8\text{kV}$ contact, $\pm 15\text{kV}$ air discharge), IEC61000-4-5 (Lightning) (22A, 8/20 μs).

The TS0541 TB-HFxX comes in a ROHS compliant and Halogen Free 1.0mm x 0.6mm x 0.5mm DFN 1006 -2L package.

Applications

- Portable applications
- Communication systems
- Computers and peripherals
- High speed data lines:
 - USB 2.0/3.X
 - Thunderbolt
 - eSATA
 - DisplayPort
 - PCI-e

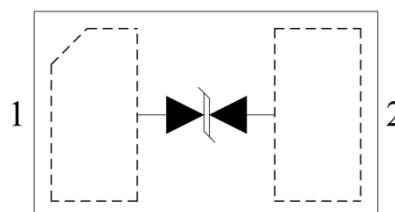
Mechanical Characteristics

- Package: DFN1006-2L
- Marking: Part number
- Packaging: Tape and Reel
- ROHS compliant
- Moisture Sensitivity Level (MSL Level-1)

Circuit Diagram



Pin Configuration

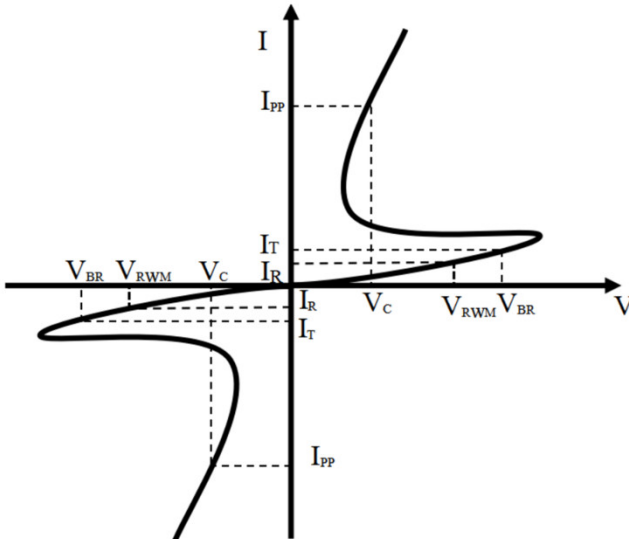


DFN1006-2L
(Top View)

Absolute Maximum Rating

Symbol	Parameter	Value	Units
I_{PP}	Peak Pulse Current (8/20 μ s)	22	A
P_{PK}	Peak Pulse Power (8/20 μ s)	115	W
V_{ESD}	ESD per IEC61000-4-2 (Air) ESD per IEC61000-4-2 (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	Diagram
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	
R_{dyn}	Dynamic Resistance	
α_{IL}	Insertion Loss	
f_{-3db}	Cut-off frequency at -3dB	

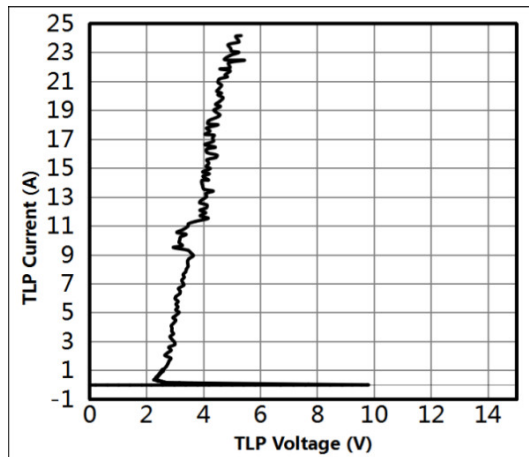
Symbol	Test Condition	Minimum	Typical	Maximum	Units
V_{RWM}				5.0	V
I_R	$V_{RWM} = 5.0V, T = 25^\circ C$		1	10	nA
V_{BR}	$I_T = 1mA$	5.5	9.0		V
V_C	$I_{PP} = 22A, t_p = 8/20\mu s$		6.0		V
V_C	$I_{PP} = 8A, t_p = 100ns^{(1)}$		3.5		V
	$I_{PP} = 16A, t_p = 100ns^{(1)}$		4.5		V
R_{dyn}	$I_{PP} = 12.0A, t_p = 100ns^{(1)}$		0.1		Ω

Notes: (1) Measurements performed using a 100ns Transmission Line Pulse (TLP) system.

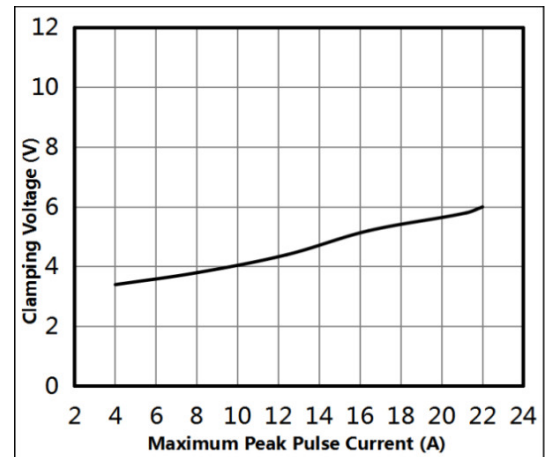
Symbol	Test Condition	Minimum	Typical	Maximum	Units
C _{ESD}	V _R = 0V, f = 1MHz		0.78		pF
	V _R = 0V, f = 5GHz		0.70		pF
f _{3db}	α _{IL} = -3db		6.3		GHz

Typical Performance Characteristics

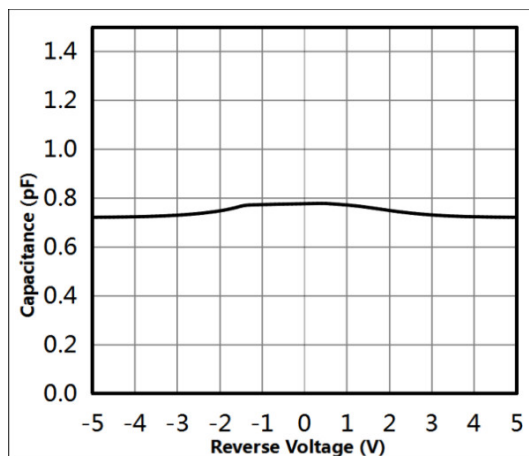
TLP Measurement of I/O to I/O



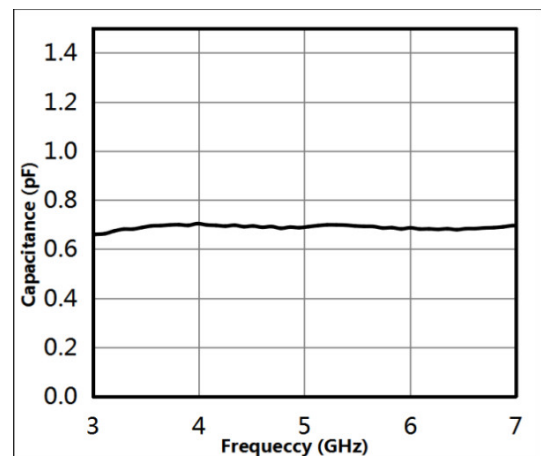
8/20us Current I/O to I/O



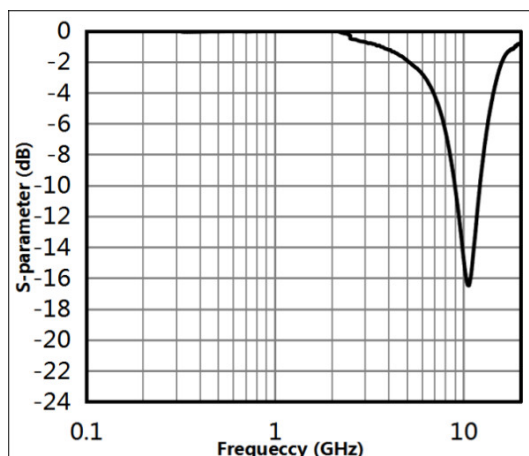
Capacitance vs Reverse Voltage of I/O to I/O



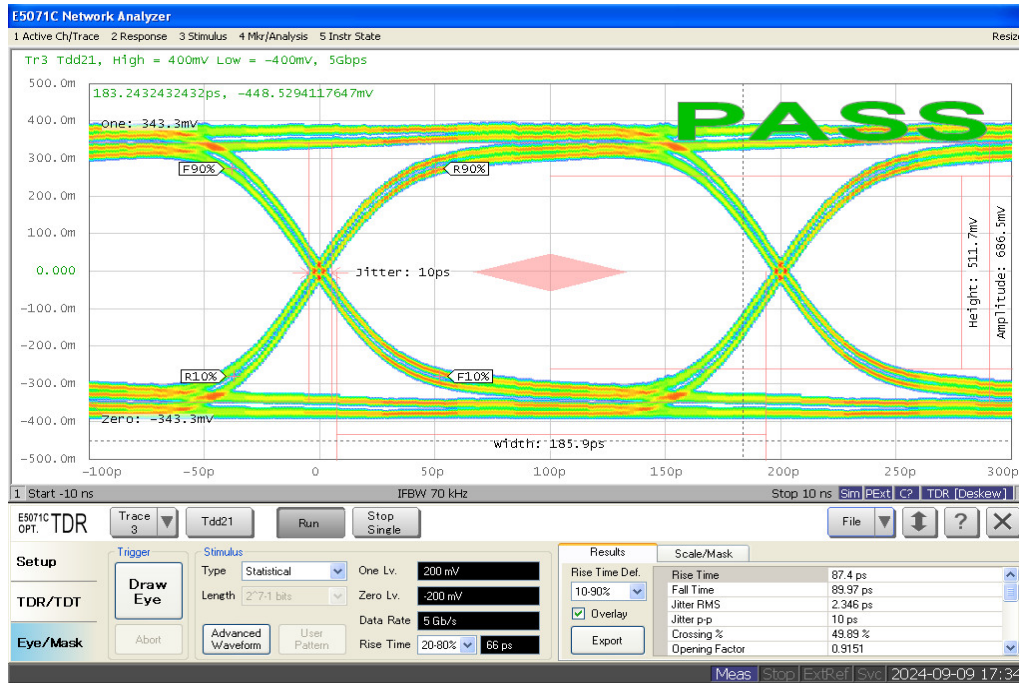
Capacitance vs Frequency of I/O to I/O



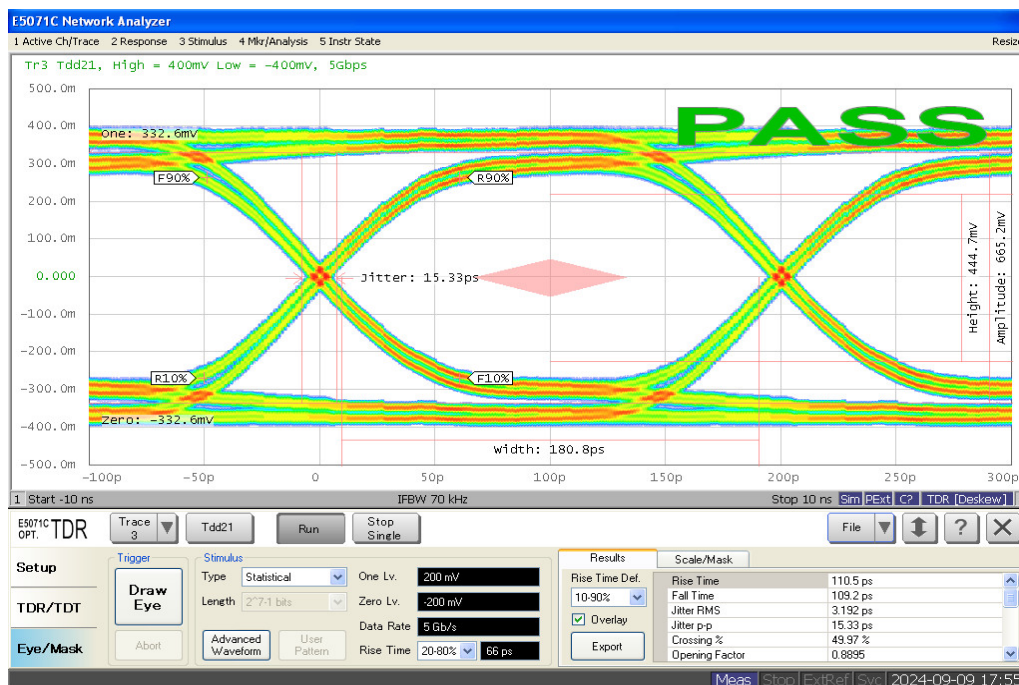
Insertion loss of I/O to I/O



Application Curves

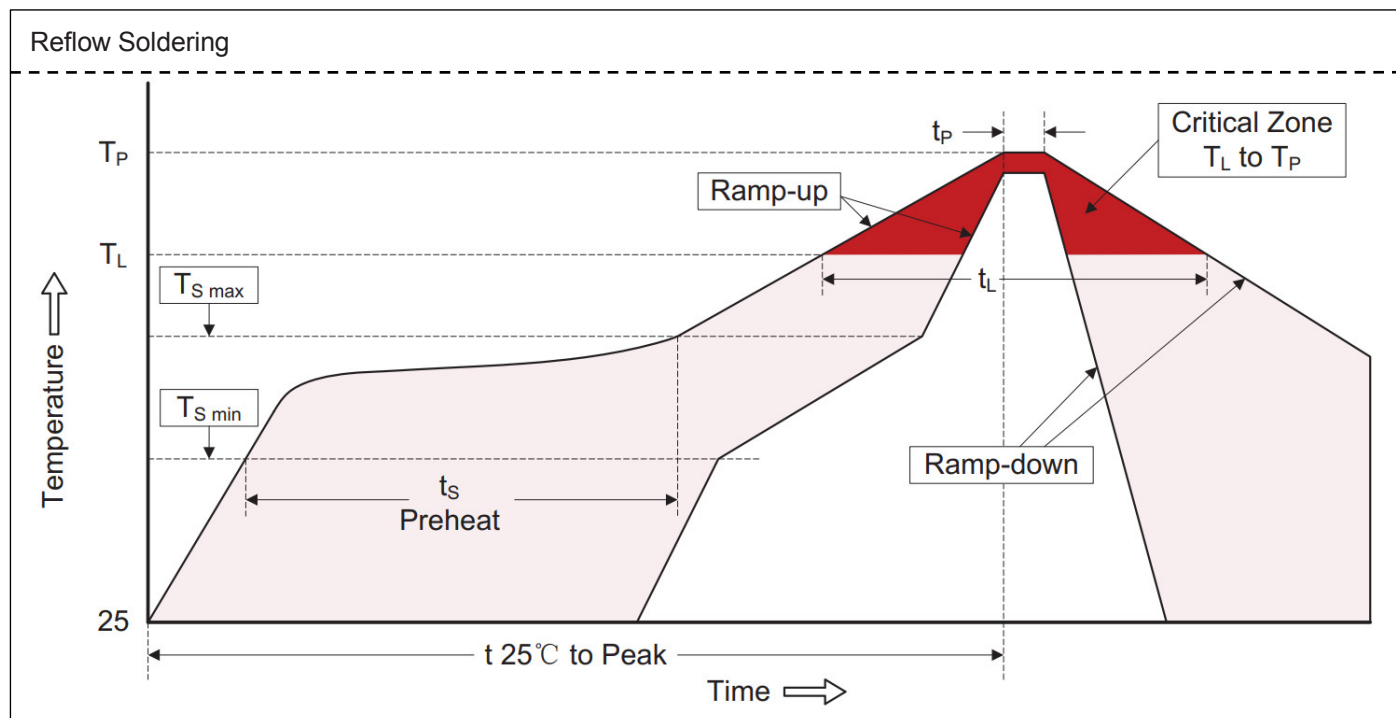


USB3.2 Gen1 Eye Diagram W/O Device (5Gbps)



USB3.2 Gen1 Eye Diagram W/I Device (5Gbps)

Recommended Soldering Conditions

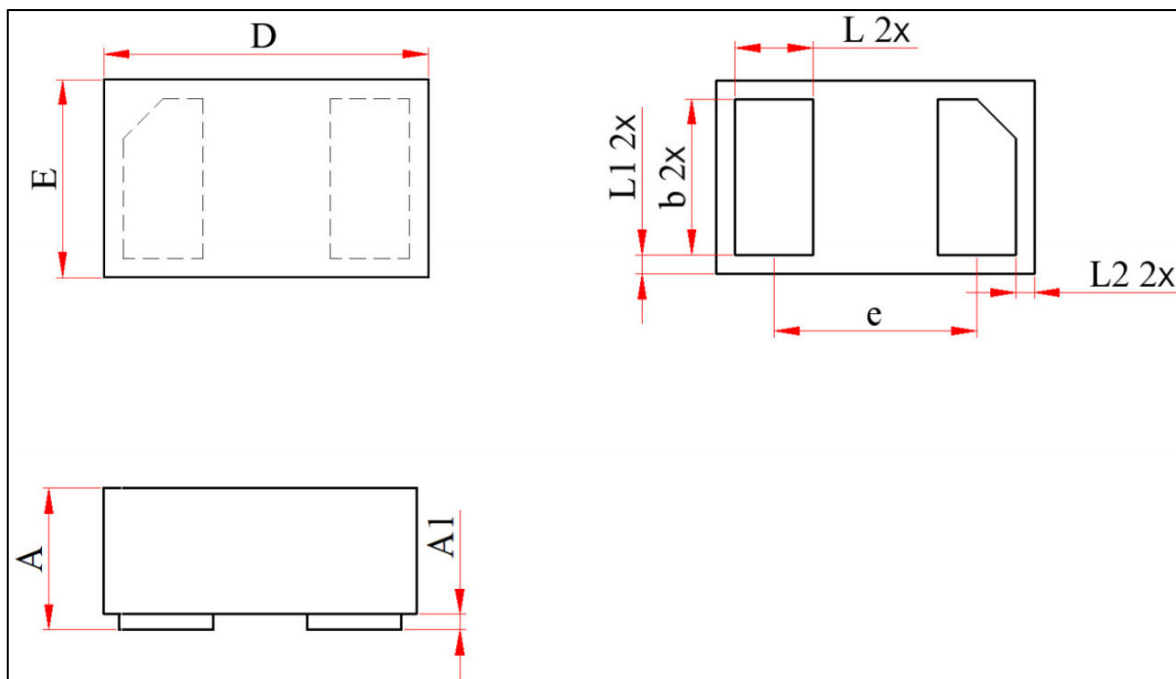


Recommended Conditions

Profile Feature	Pb-Free Assembly
Average ramp-up rate (T_L to T_P)	3°C/second max
Preheat -Temperature Min ($T_{S\ min}$) -Temperature Max ($T_{S\ max}$) -Time (min to max) (t_s)	150°C 200°C 60-180 seconds
$T_{S\ max}$ to T_L -Ramp-up Rate	3°C/second max
Time maintained above: -Temperature (T_L) -Time (t_L)	217°C 60-150 seconds
Peak Temperature (T_P)	260°C
Time within 5°C of actual Peak Temperature (t_P)	20-40 seconds
Ramp-down Rate	6°C/second max
Time 25°C to Peak Temperature	8 minutes max

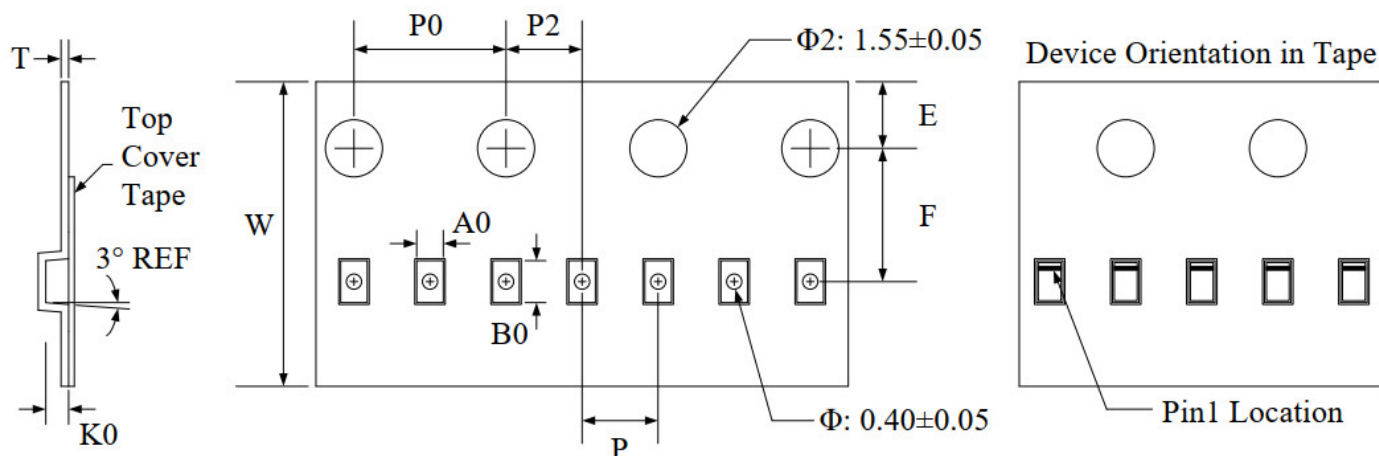
Package Outline

- DFN1006-2L package
- 2 leads, very small package
- MSL-1



Symbol	Dimension In Millimeters			Dimension In Inches		
	Normal	Min	Max	Normal	Min	Max
A	--	0.400	0.500	--	0.016	0.020
A1	--	--	0.050	--	--	0.002
D	1.020	0.990	1.050	0.040	0.039	0.041
E	0.620	0.590	0.650	0.024	0.023	0.026
b	0.500	0.450	0.550	0.020	0.018	0.022
L	0.250	0.200	0.300	0.010	0.008	0.012
L1	0.060	0.020	0.100	0.002	0.001	0.004
L2	0.060	0.020	0.100	0.002	0.001	0.004
e	0.650 BSC			0.026 BSC		

Tape and Reel Specification



Symbol	W	A0	B0	K0	E	F	P	P0	P2	T
Dimensions (mm)	8.00±0.1	0.7±0.05	1.15±0.05	0.55±0.05	1.75±0.1	3.5±0.05	2.0±0.1	4.0±0.1	2.0±0.05	0.2±0.05

Marking Codes



Note:

- (1) "5" is part number.
- (2) "X" is the internal code.

Ordering Information

Part Number	Working Voltage	Quantity Per Reel	Reel Size
TS0541TB-HFxX	5.0V	10,000	7 Inch