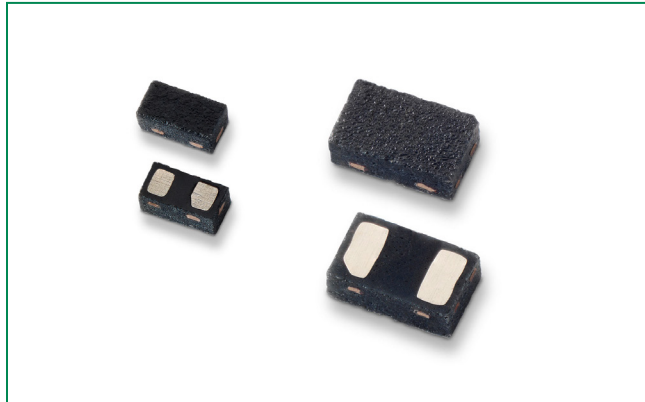
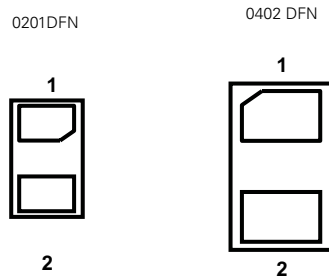


Ultra Low Capacitance Discrete TVS Series

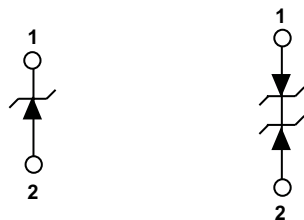


Pinout



Bottom View

Functional Block Diagram



Unidirectional

Bidirectional

Description

This Ultra Low Capacitance Discrete TVS series provides unidirectional and bidirectional ESD protection for the world's most challenging high speed serial interfaces. Ultra low capacitance permits excellent signal integrity on the most challenging consumer electronics interfaces, such as USB 3.1, HDMI 2.0, DisplayPort, and V-by-One®. This component is rated in excess of 20 kV contact and air ESD protection (IEC 61000-4-2) while maintaining extremely low leakage and dynamic resistance. This series is offered in the industry's most popular footprints (0402 and 0201) and provides a low off-state capacitance that is compatible with high speed data interfaces.

Features

- 0.13 pF MAX bidirectional
- 0.25 pF MAX unidirectional
- ESD, IEC 61000-4-2, $\pm 20\text{kV}$ contact, $\pm 20\text{kV}$ air
- Low clamping voltage of 10V @ $I_{PP}=2\text{A}$ (Bidirectional) ($t_p=8/20\mu\text{s}$)
- Low profile 0201 and 0402 DFN packages
- Facilitates excellent signal integrity
- ELV Compliant
- Halogen free, Lead free and RoHS compliant

Applications

- Ultra-high speed data lines
- USB 3.1, 3.0, 2.0
- HDMI 2.0, 1.4a, 1.3
- DisplayPort™
- Thunderbolt (Light Peak)
- V-by-One®
- LVDS interfaces
- Consumer, mobile and portable electronics
- Tablet PC and external storage with high speed interfaces
- Applications requiring high ESD performance in small packages

Absolute Maximum Ratings

Symbol	Parameter	Value	Units
I_{PP}	Peak Current ($t_p=8/20\mu s$)	2.0	A
T_{OP}	Operating Temperature	-55 to 125	°C
T_{STOR}	Storage Temperature	-55 to 150	°C

CAUTION: Stresses above those listed in "Absolute Maximum Ratings" may cause permanent damage to the component. This is a stress only rating and operation of the component at these or any other conditions above those indicated in the operational sections of this specification is not implied.

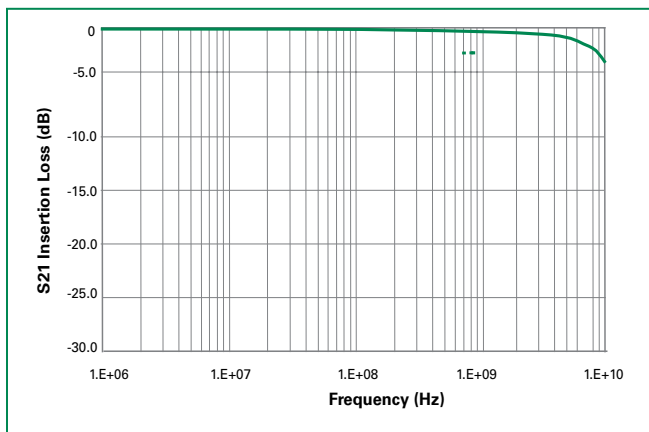
Unidirectional Electrical Characteristics - ($T_{OP}=25^{\circ}C$)

Parameter	Test Conditions	Min	Typ	Max	Units
Input Capacitance	@ $V_R = 0V$, $f = 3GHz$		0.20	0.25	pF
Breakdown Voltage	V_{BR} @ $I_T=1mA$		9.00		V
Reverse Working Voltage				7.0	V
Reverse Leakage Current	I_L @ $V_{RWM}=5.0V$		25	50	nA
Clamping Voltage	V_{CL} @ $I_{PP}=2.0A$		9.20		V
ESD Withstand Voltage	IEC 61000-4-2 (Contact)	±20			kV
	IEC 61000-4-2 (Air)	±20			

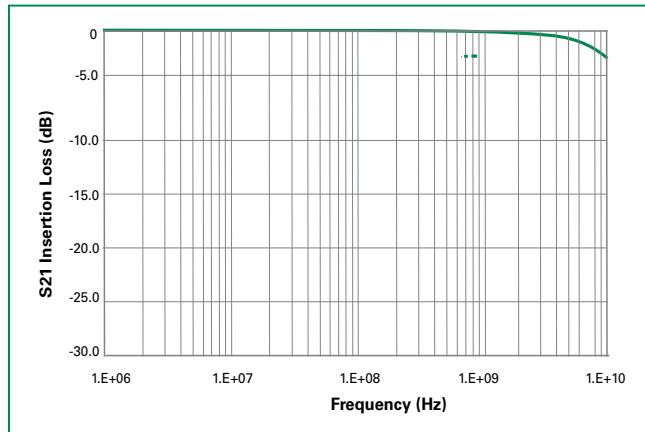
Bidirectional Electrical Characteristics - ($T_{OP}=25^{\circ}C$)

Parameter	Test Conditions	Min	Typ	Max	Units
Input Capacitance	@ $V_R = 0V$, $f = 3GHz$		0.10	0.13	pF
Breakdown Voltage	V_{BR} @ $I_T=1mA$		± 9.8		V
Reverse Working Voltage		-7.0		7.0	V
Reverse Leakage Current	I_L @ $V_{RWM}=5.0V$		25	50	nA
Clamping Voltage	V_{CL} @ $I_{PP}=2.0A$		10.0		V
ESD Withstand Voltage	IEC 61000-4-2 (Contact)	±20			kV
	IEC 61000-4-2 (Air)	±20			

Insertion Loss Diagram - Unidirectional



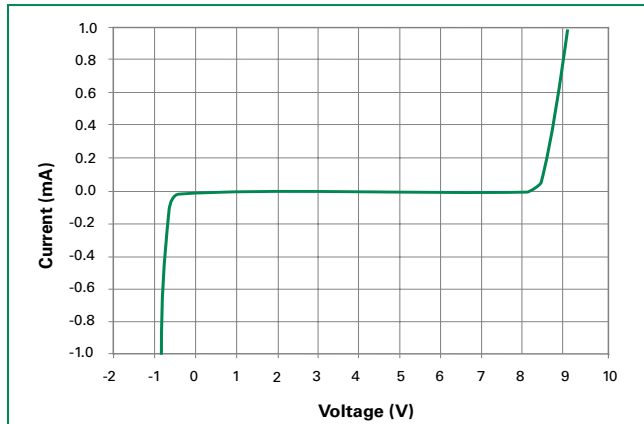
Insertion Loss Diagram - Bidirectional



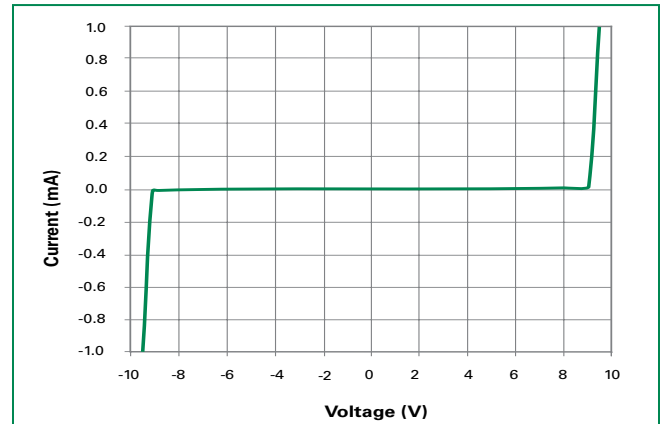
TVS Diode Arrays (SPA® Diodes)

Ultra Low Capacitance Discrete TVS Series

Device IV Curve - Unidirectional

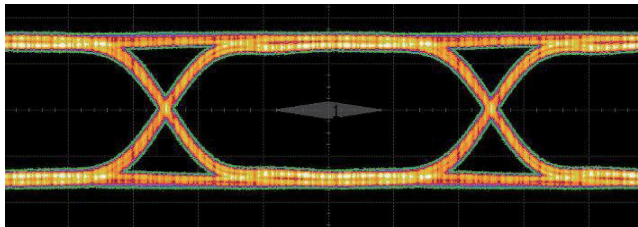


Device IV Curve - Bidirectional

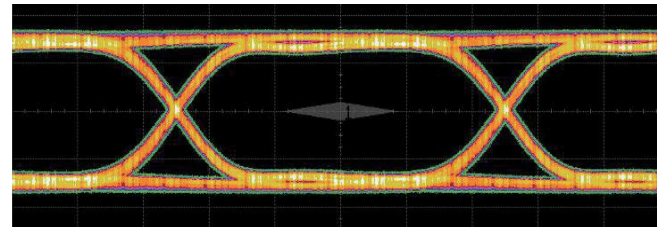


USB3.0 Eye Diagram

5.0 Gb/s, 1000mV differential, CPO Compliant Test Pattern



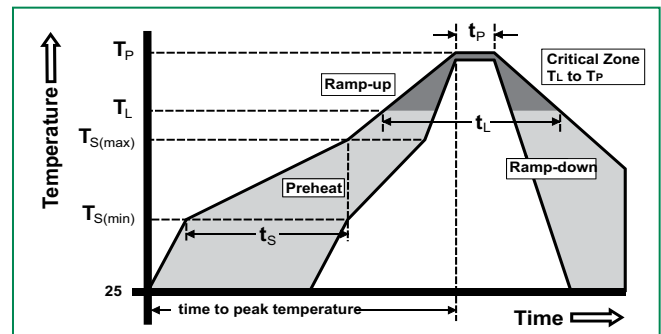
Without Device



With Device

Soldering Parameters

Reflow Condition		Pb – Free assembly
Pre Heat	- Temperature Min ($T_{s(min)}$)	150°C
	- Temperature Max ($T_{s(max)}$)	200°C
	- Time (min to max) (t_s)	60 – 180 secs
Average ramp up rate (Liquidus) Temp (T_L) to peak		3°C/second max
$T_{s(max)}$ to T_L - Ramp-up Rate		3°C/second max
Reflow	- Temperature (T_L) (Liquidus)	217°C
	- Temperature (t_L)	60 – 150 seconds
Peak Temperature (T_p)		260 ^{+0/-5} °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 (T_p)		8 minutes Max.
Do not exceed		260°C



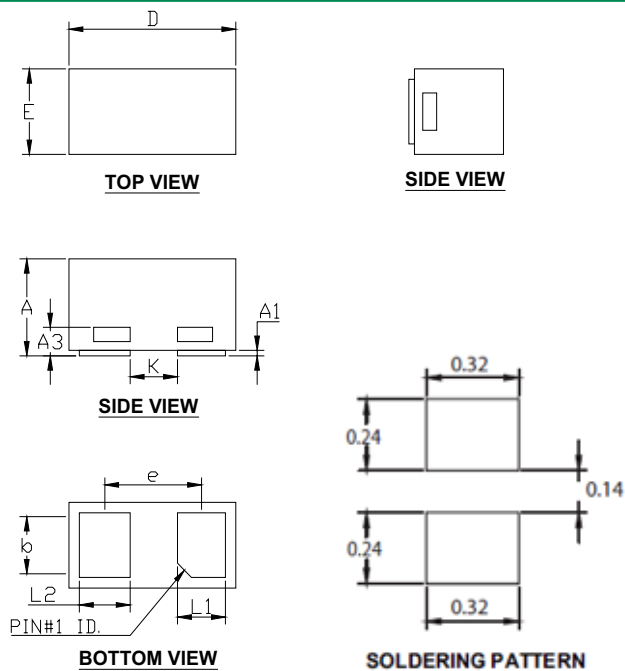
Product Characteristics of 0402 DFN Package

Lead Plating	Pre-Plated Frame
Lead Material	Copper Alloy
Lead Coplanarity	0.004 inches(0.102mm)
Substrate material	Silicon
Body Material	Molded Epoxy
Flammability	UL Recognized epoxy meeting flammability rating V-0.

Notes :

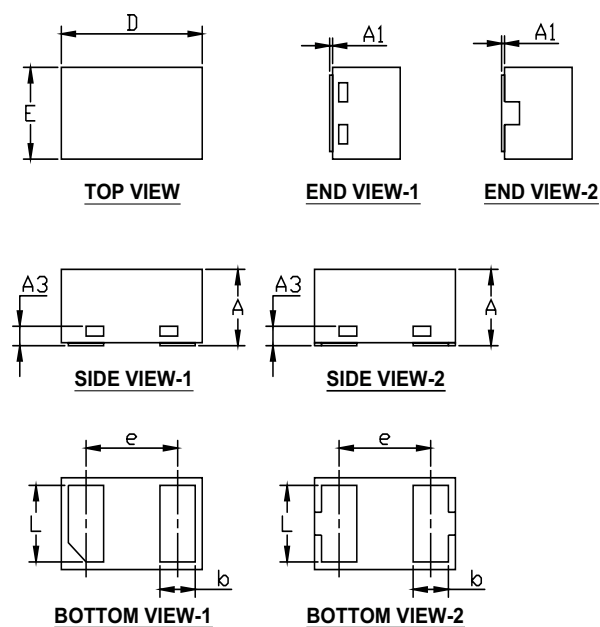
1. All dimensions are in millimeters
2. Dimensions include solder plating.
3. Dimensions are exclusive of mold flash & metal burr.
4. Blo is facing up for mold and facing down for trim/form, i.e. reverse trim/form.
5. Package surface matte finish VDI 11-13.

Package Dimensions — 0201 DFN

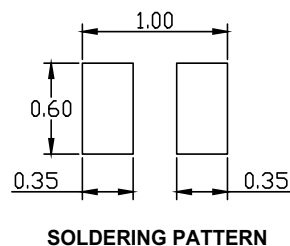


Symbol	Millimeters		Inches	
	Min	Max	Min	Max
A	0.23	0.33	0.009	0.013
A1	0.00	0.05	0.000	0.002
A3	0.100 ref.		0.004 ref.	
b	0.2	0.3	0.008	0.012
D	0.55	0.65	0.022	0.026
E	0.25	0.35	0.010	0.014
e	0.35-0.40 BSC		0.014-0.016 BSC	
L1	0.12	0.23	0.005	0.009
L2	0.12	0.24	0.005	0.009
K	0.17 BSC		0.007 BSC	

Package Dimensions — 0402 DFN



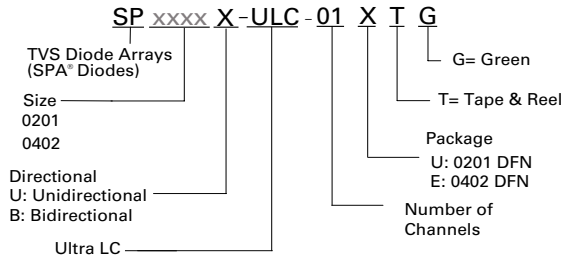
Symbol	Millimeters			Inches		
	Min	Typ	Max	Min	Typ	Max
A	0.33	-	0.55	0.013	-	0.022
A1	0	-	0.05	0.000	-	0.002
A3	0.13REF			0.005REF		
b	0.20	0.25	0.30	0.008	0.010	0.012
D	0.95	1.00	1.05	0.037	0.039	0.041
E	0.55	0.60	0.65	0.022	0.024	0.026
e	0.65BSC			0.026BSC		
L	0.45	0.50	0.55	0.018	0.020	0.022



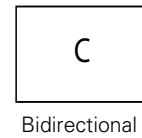
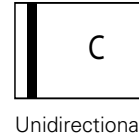
TVS Diode Arrays (SPA® Diodes)

Ultra Low Capacitance Discrete TVS Series

Part Numbering System



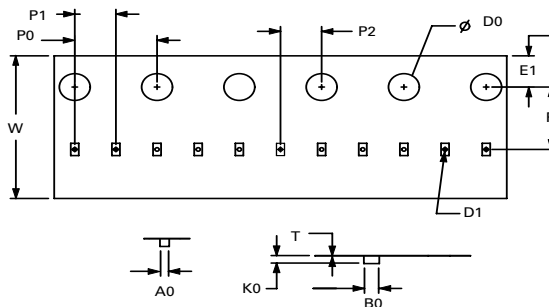
Part Marking System



Ordering Information

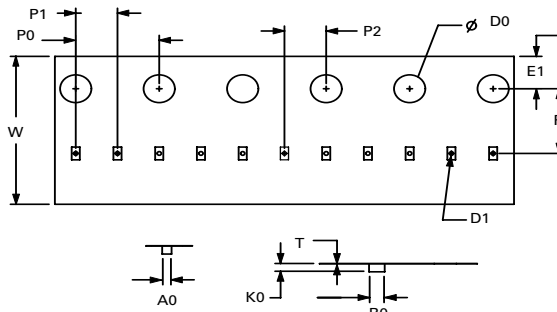
Part Number	Package	Marking	Reel Quantity
SP0201U-ULC-01UTG	0201 DFN	I C	15000
SP0201B-ULC-01UTG	0201 DFN	C	15000
SP0402U-ULC-01ETG	0402 DFN	I C	10000
SP0402B-ULC-01ETG	0402 DFN	C	10000

Embossed Carrier Tape & Reel Specification — 0201 DFN



Symbol	Millimeters
A0	0.33 min/0.41 max
B0	0.63 min/0.71 max
D0	ø 1.50 +0.10/-0
D1	ø 0.20 +/- 0.05
E1	1.75+/-0.10
F	3.50+/-0.05
K0	0.30 min/0.39 max
P0	4.00+/-0.10
P1	2.00+/-0.10
P2	2.00+/-0.05
W	8.00+0.30/-0.10
T	0.13 min/0.25 max

Embossed Carrier Tape & Reel Specification — 0402 DFN



Symbol	Millimeters
A0	0.70+/-0.05
B0	1.15+/-0.05
D0	ø 1.50+/-0.10
D1	ø 0.40 +/-0.10
E1	1.75+/-0.10
F	3.50+/-0.10
K0	0.55+/-0.05
P0	4.00+/-0.10
P1	2.00+/-0.10
P2	2.00+/-0.05
W	8.00+0.30/-0.10
T	0.20+/-0.05

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