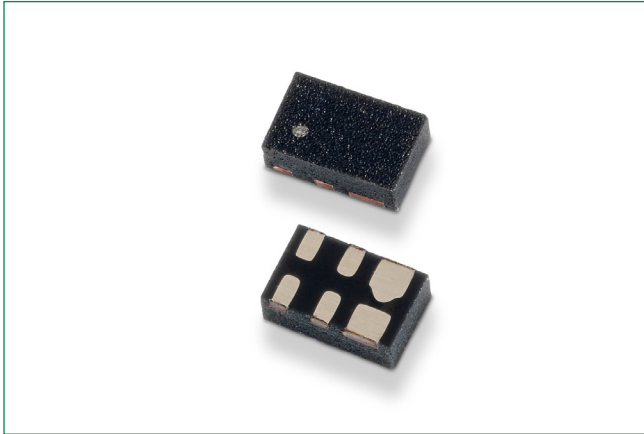


# SP3401 Series

## Low Capacitance ESD Protection

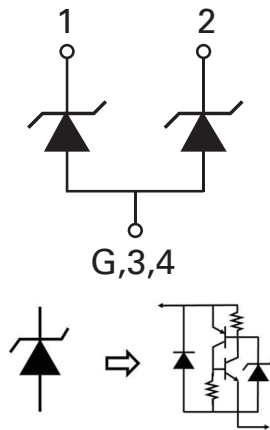
**GREEN** **AUTOMOTIVE GRADE** **HF** **RoHS** **Pb**



### Pinout

I/O1	1	6	NC
I/O2	2	5	NC
GND	3	4	GND

### Functional Block Diagram



### Description

SP3401 is specifically designed to protect high-speed interfaces against ElectroStatic Discharge (ESD), such as DisplayPort interfaces and USB 3.1 Gen 1.

The signal line is protected by a TVS diode offering low line capacitance of 0.35 pF typical. SP3401 can safely absorb repetitive ESD strikes up to  $\pm 18$  kV contact exceeding IEC 61000-4-2, level 4 ( $\pm 8$  kV contact discharge).

Excellent low capacitance, clamping capability, low leakage, and fast response time make this parts an ideal solution for protecting high speed data lines.

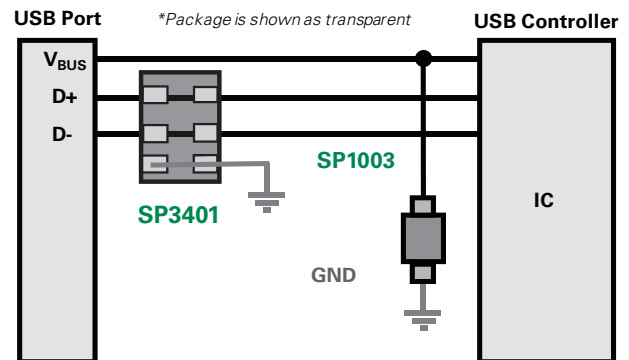
### Features

- ESD, IEC 61000-4-2,  $\pm 18$  kV contact,  $\pm 30$  kV air
- EFT, IEC 61000-4-4, 80A (tP=5/50ns)
- Lightning, IEC 61000-4-5 2nd edition, 10A (tP=8/20 $\mu$ s)
- Low capacitance of 0.35pF (TYP) per I/O
- Low leakage current of 1nA (TYP) at 3.3V
- Small form factor  $\mu$ DFN (JEDEC MO-229) package provides flow through routing to simplify PCB layout
- AEC-Q101 qualified
- Moisture Sensitivity Level(MSL -1)
- Halogen free, lead free and RoHS compliant

### Applications

- USB 3.1 Gen1
- DisplayPort
- S-ATA
- NFC
- 1G/2.5G/10G Ethernet
- HDBaseT

### USB Protection Application Example



Life Support Note:

#### Not Intended for Use in Life Support or Life Saving Applications

The products shown herein are not designed for use in life sustaining or life saving applications unless otherwise expressly indicated.

# SP3401 Series

## Low Capacitance ESD Protection

### Absolute Maximum Ratings

Symbol	Parameter	Value	Units
$I_{PP}$	Peak Current ( $t_p=8/20\mu s$ )	10	A
$T_{OP}$	Operating Temperature	-40 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.

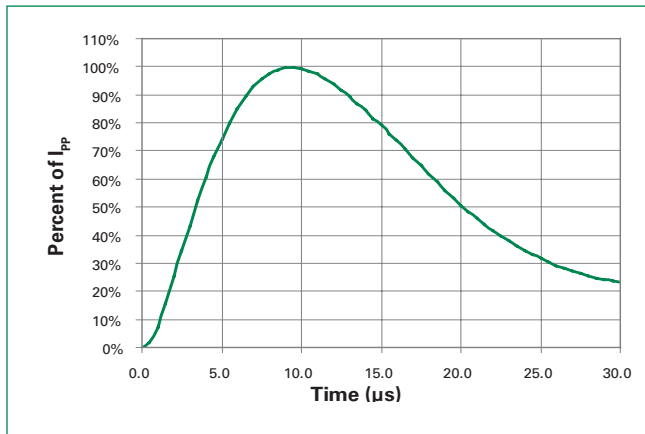
### Electrical Characteristics ( $T_{OP}=25^\circ C$ )

Parameter	Symbol	Test Conditions	Min	Typ	Max	Units
Reverse Standoff Voltage	$V_{RWM}$	$I_R = 1\mu A$			3.3	V
Breakdown Voltage	$V_{BR}$	$I_R = 1mA$ , I/O to I/O	6.5	8.2	11.5	V
Reverse Leakage Current	$I_{LEAK}$	$V_R=3.3V$		1	100	nA
Clamp Voltage <sup>1</sup>	$V_C$	$I_{PP}=1A$ , $t_p=8/20\mu s$ , I/O to I/O		4	5	V
		$I_{PP}=10A$ , $t_p=8/20\mu s$ , I/O to I/O		7.5	9	V
Dynamic Resistance <sup>2</sup>	$R_{DYN}$	TLP, $t_p=100ns$ , I/O to I/O		0.28		$\Omega$
ESD Withstand Voltage <sup>1</sup>	$V_{ESD}$	IEC 61000-4-2 (Contact Discharge)	$\pm 18$			kV
		IEC 61000-4-2 (Air Discharge)	$\pm 30$			kV
Diode Capacitance <sup>1</sup>	$C_{I/O-GND}$	Reverse Bias=0V, f=1MHz		0.8	1	pF
	$C_{I/O-I/O}$			0.35	0.55	

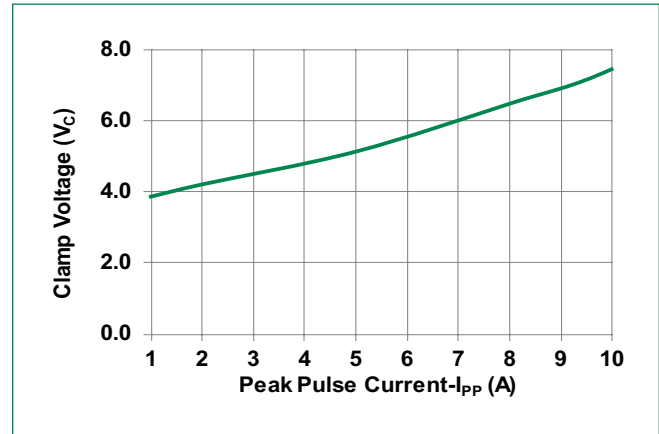
**Note:** 1 Parameter is guaranteed by design and/or component characterization.

2. Transmission Line Pulse (TLP) with 100ns width, 2ns rise time, and average window  $t_1=70ns$  to  $t_2=90ns$ .

#### 8/20 $\mu s$ Pulse Waveform



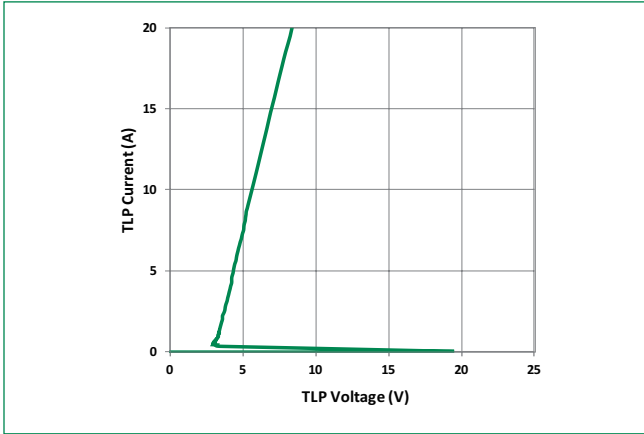
#### Clamping voltage vs. IPP for 8/20 $\mu s$ waveshape



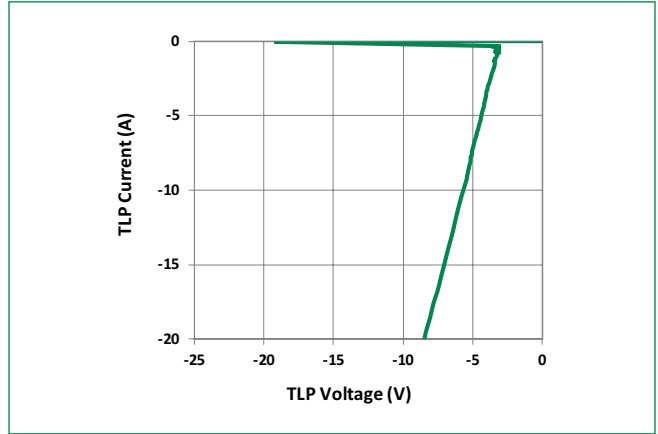
# SP3401 Series

## Low Capacitance ESD Protection

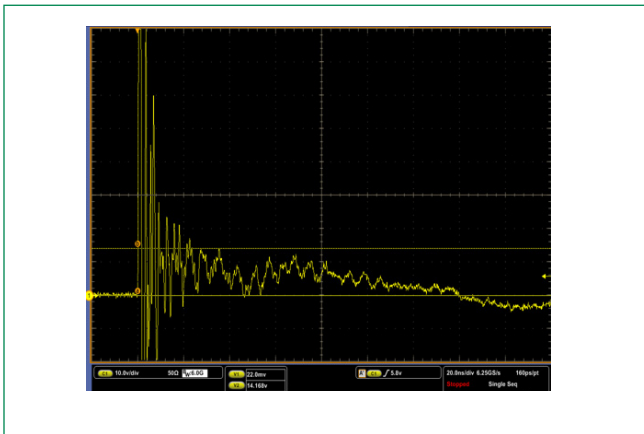
Positive Transmission Line Pulsing (TLP) Plot



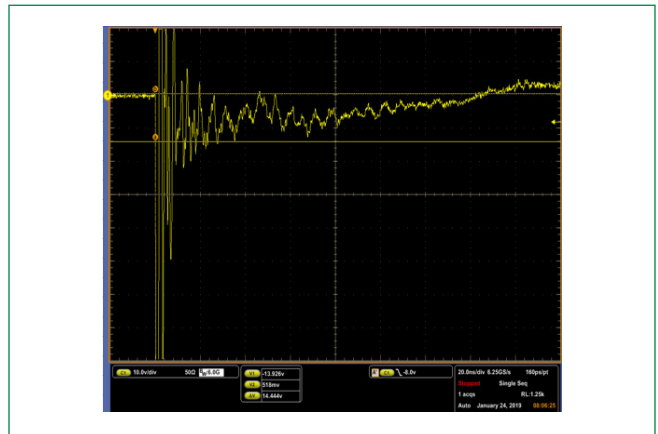
Negative Transmission Line Pulsing (TLP) Plot



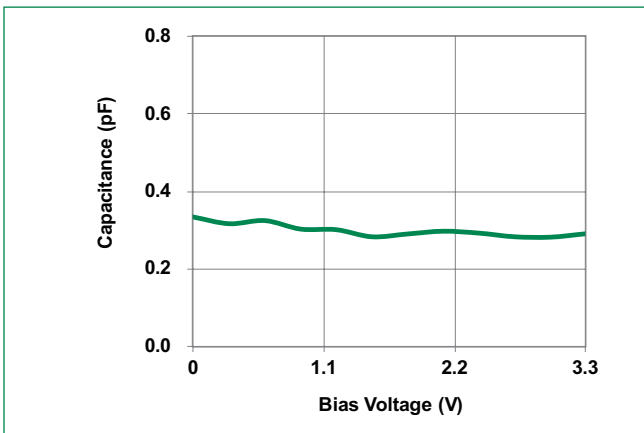
IEC 61000-4-2 +8 kV Contact ESD Clamping Voltage



IEC 61000-4-2 -8 kV Contact ESD Clamping Voltage



Capacitance vs. Reverse Bias

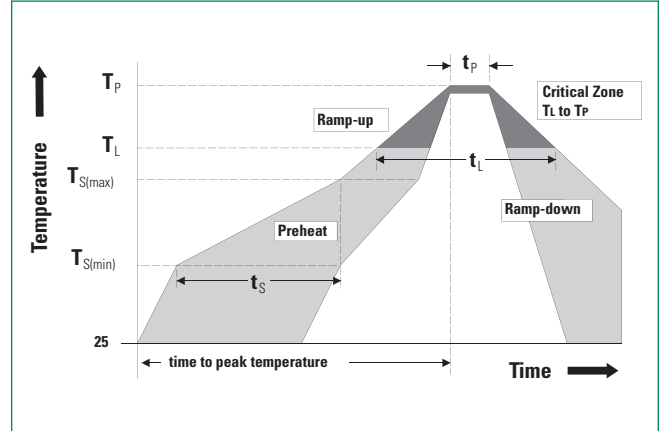


# SP3401 Series

## Low Capacitance ESD Protection

### Soldering Parameters

<b>Reflow Condition</b>		Pb – Free assembly
<b>Pre Heat</b>	- Temperature Min ( $T_{s(min)}$ )	150°C
	- Temperature Max ( $T_{s(max)}$ )	200°C
	- Time (min to max) ( $t_s$ )	60 – 120 secs
<b>Average ramp up rate (Liquidus) Temp (<math>T_L</math>) to peak</b>		3°C/second max
<b><math>T_{s(max)}</math> to <math>T_L</math> - Ramp-up Rate</b>		3°C/second max
<b>Reflow</b>	- Temperature ( $T_L$ ) (Liquidus)	217°C
	- Temperature ( $t_L$ )	60 – 150 seconds
<b>Peak Temperature (<math>T_p</math>)</b>		260 <sup>+0/-5</sup> °C
<b>Time within 5°C of actual peak Temperature (<math>t_p</math>)</b>		30 seconds
<b>Ramp-down Rate</b>		6°C/second max
<b>Time 25°C to peak Temperature (<math>T_p</math>)</b>		8 minutes Max.
<b>Do not exceed</b>		260°C



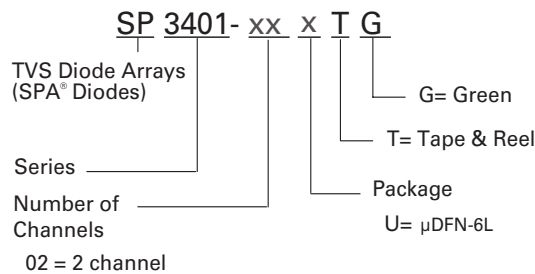
### Product Characteristics

<b>Lead Plating</b>	Pre-Plated Frame
<b>Lead Material</b>	Copper Alloy
<b>Substrate Material</b>	Silicon
<b>Body Material</b>	Molded Compound
<b>Flammability</b>	UL Recognized compound meeting flammability rating V-0

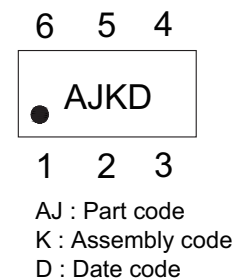
### Ordering Information

Part Number	Package	Min. Order Qty.
SP3401-02UTG	μDFN-6L	3000

### Part Numbering System



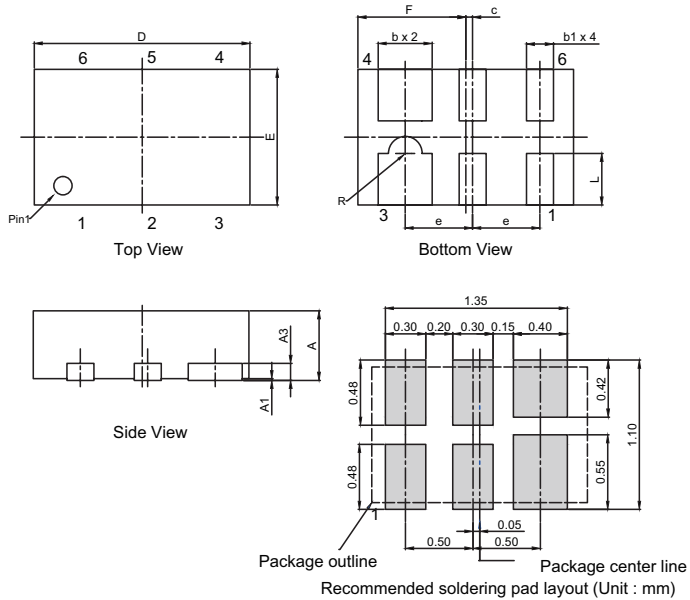
### Part Marking System



# SP3401 Series

## Low Capacitance ESD Protection

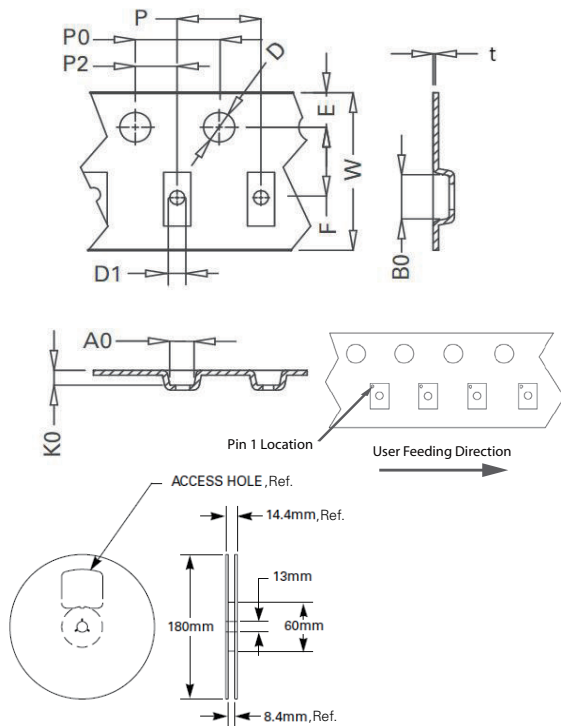
### Package Dimensions — $\mu$ DFN-6L



Drawing# : U03-A

Package	$\mu$ DFN-6L			
JEDEC	MO-229			
Pins	6			
	Millimeters		Inches	
	Min	Max	Min	Max
A	0.45	0.55	0.018	0.022
A1	0.00	0.05	0.000	0.002
A3	0.125 REF		0.005 REF	
b	0.35	0.45	0.014	0.018
b1	0.15	0.25	0.006	0.010
c	0.05 REF		0.002 REF	
D	1.55	1.65	0.062	0.065
E	0.95	1.05	0.038	0.042
F	0.80 REF		0.031 REF	
e	0.50 REF		0.020 REF	
R	0.125 REF		0.005 REF	
L	0.33	0.43	0.013	0.017

### Embossed Carrier Tape & Reel Specification — $\mu$ DFN-6L



8mm TAPE AND REEL

Symbol	Millimeters		Inches	
	Min	Max	Min	Max
E	1.65	1.85	0.064	0.073
F	3.45	3.55	0.135	0.139
P2	1.95	2.05	0.076	0.081
D	1.40	1.60	0.055	0.063
D1	0.45	0.55	0.017	0.021
P	3.90	4.10	0.154	0.161
10P0	40.0+/-0.20		1.574+/-0.008	
W	7.90	8.30	0.311	0.319
P0	3.90	4.10	0.154	0.161
A0	1.15	1.25	0.045	0.049
B0	1.75	1.85	0.069	0.073
K0	0.65	0.75	0.026	0.03
t	0.22 max		0.009 max	

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