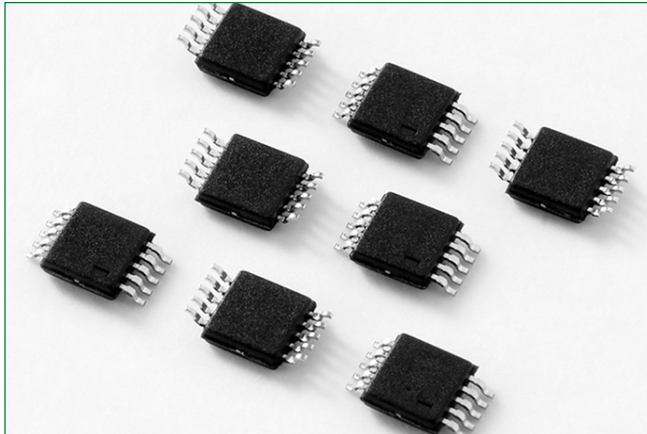


# SP4045 Series

## Lightning Surge Protection



### Additional Information



Resources

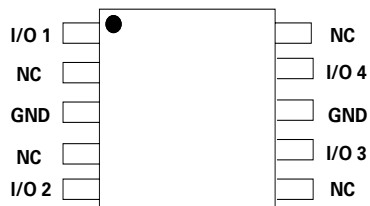


Accessories



Samples

### Pinout



### Description

The SP4045 integrates low capacitance diodes with an additional zener diode to protect each I/O pin against ESD and high surge events. This robust device can safely absorb up to 24A per IEC 61000-4-5 2nd edition ( $t_p=8/20\mu s$ ) without performance degradation and a minimum  $\pm 30kV$  ESD per IEC 61000-4-2 International Standard. Their low loading capacitance also makes them ideal for protecting high speed signal pins.

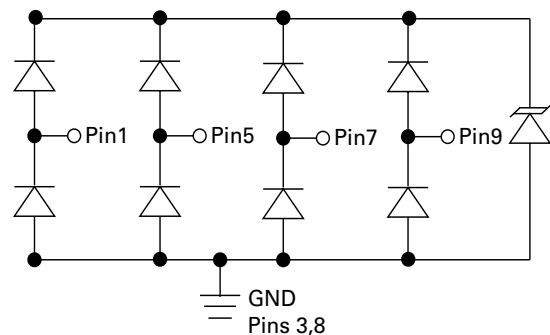
### Features

- Signal-integrity-preserving straight through routing
- Low leakage current of  $1\mu A$  (MAX) at 3.3V
- ESD, IEC 61000-4-2,  $\pm 30kV$  contact,  $\pm 30kV$  air
- EFT, IEC 61000-4-4, 40A (5/50ns)
- Lightning, IEC 61000-4-5 2nd edition, 24A (8/20 $\mu s$ )
- Low capacitance of 1.5pF (TYP) per I/O
- AEC-Q101 qualified
- Halogen free, Lead free and RoHS compliant
- Moisture Sensitivity Level (MSL Level-1)

### Applications

- HDBaseT Protector
- 10/100/1000 Ethernet
- 2.5 and 5 Gigabit Ethernet
- T1/E1 Secondary Protection
- T3/E3 Secondary Protection
- A/V Equipment
- Automotive Ethernet

### Functional Block Diagram



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.

# SP4045 Series

## Lightning Surge Protection

### Absolute Maximum Ratings

Symbol	Parameter	Value	Units
$I_{PP}$	Peak Current ( $t_p=8/20\mu s$ )	24	A
$P_{PK}$	Peak Pulse Power ( $t_p=8/20\mu s$ )	600	W
$T_{OP}$	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 device. This is a stress only rating and operation of the device at these or any other conditions above those indicated in the operational sections of this specification is not implied.

### Thermal Information

Parameter	Rating	Units
Storage Temperature Range	-55 to 150	°C
Maximum Junction Temperature	150	°C
Maximum Lead Temperature (Soldering 20-40s)	260	°C

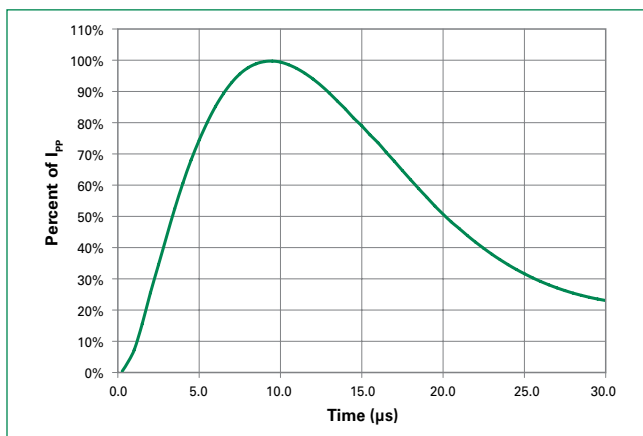
### Electrical Characteristics ( $T_{OP}=25^\circ C$ )

Parameter	Symbol	Test Conditions	Min	Typ	Max	Units
Reverse Standoff Voltage	$V_{RWM}$				3.3	V
Snap Back Voltage	$V_{SB}$	$I_{SB}=50mA$	2.8			V
Reverse Leakage Current	$I_{LEAK}$	$V_R=3.3V$ , I/O to GND		0.5	1.0	$\mu A$
Clamp Voltage <sup>1</sup>	$V_C$	$I_{PP}=1A$ , $t_p=8/20\mu s$ , Fwd		6.0		V
		$I_{PP}=2A$ , $t_p=8/20\mu s$ , Fwd		7.0		V
Dynamic Resistance <sup>2</sup>	$R_{DYN}$	TLP $t_p=100ns$ , Pin 1 to Pin 2		0.3		$\Omega$
ESD Withstand Voltage <sup>1</sup>	$V_{ESD}$	IEC 61000-4-2 (Contact)	$\pm 30$			kV
		IEC 61000-4-2 (Air)	$\pm 30$			kV
Diode Capacitance <sup>1</sup>	$C_{I/O-GND}$	Reverse Bias=0V		1.5		pF

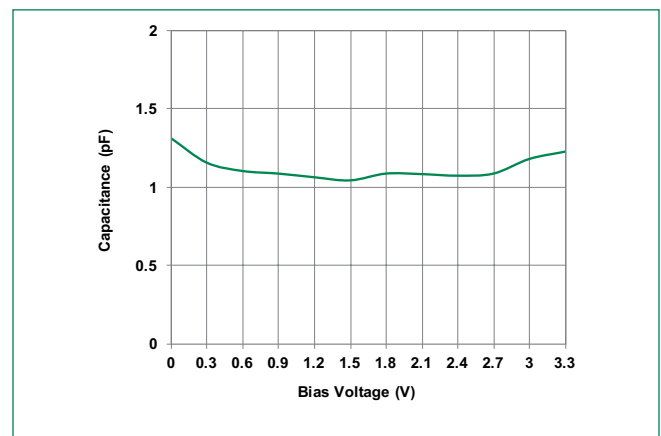
**Note:** 1. Parameter is guaranteed by design and/or device characterization.

2. Transmission Line Pulse (TLP) test setting : Std.TDR(50 $\Omega$ ), $t_p=100ns$ ,  $t_r=0.2ns$  ITLP and VTLP averaging window: star  $t_1=70ns$  to end  $t_2=80ns$

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



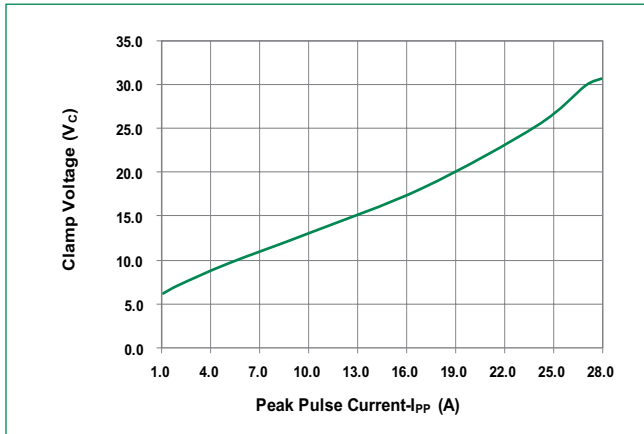
### Capacitance vs. Reverse Bias



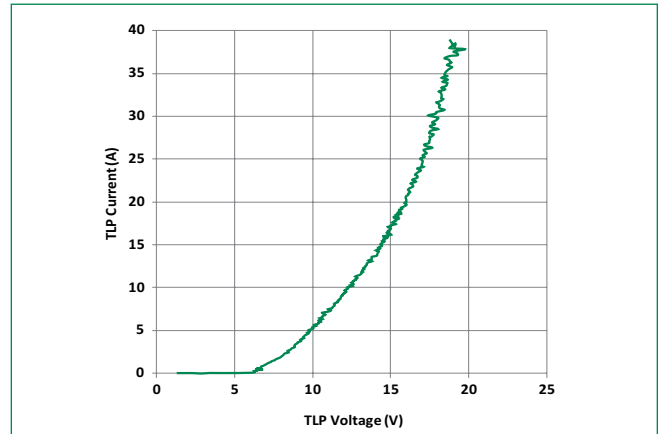
# SP4045 Series

## Lightning Surge Protection

Clamping Voltage vs. IPP

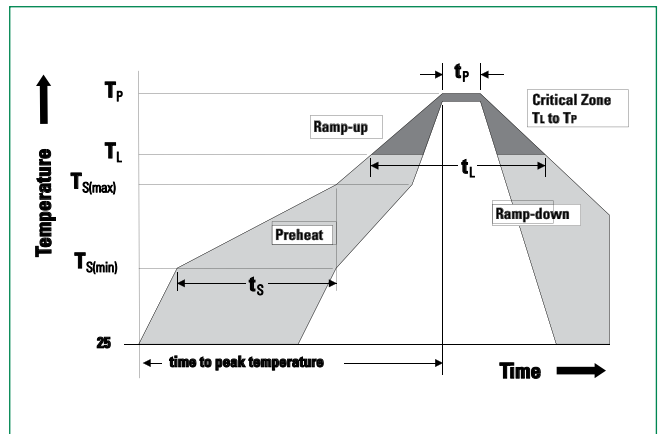


Transmission Line Pulsing (TLP) Plot (Pin 1 to Pin2)

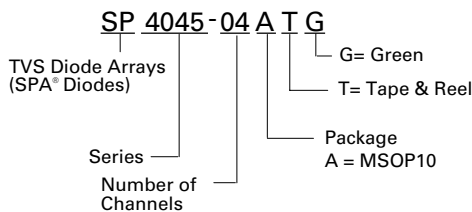


### Soldering Parameters

<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	



### Part Numbering System



### Ordering Information

Part Number	Package	Marking	Min. Order Qty.
SP4045-04ATG	MSOP-10	ⒺH4	4000

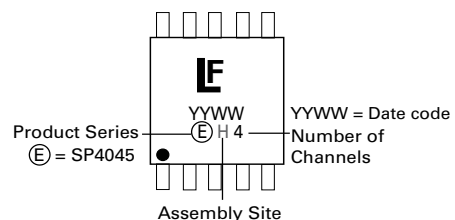
### Product Characteristics

<b>Lead Plating</b>	Pre-Plated Frame
<b>Lead Material</b>	Copper Alloy
<b>Lead Coplanarity</b>	0.0004 inches (0.102mm)
<b>Substrate material</b>	Silicon
<b>Body Material</b>	V-0 per UL 94 Molded Epoxy

**Notes :**

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

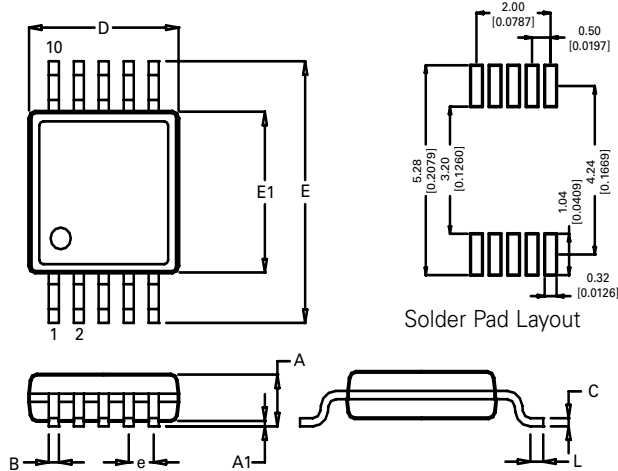
### Part Marking System



# SP4045 Series

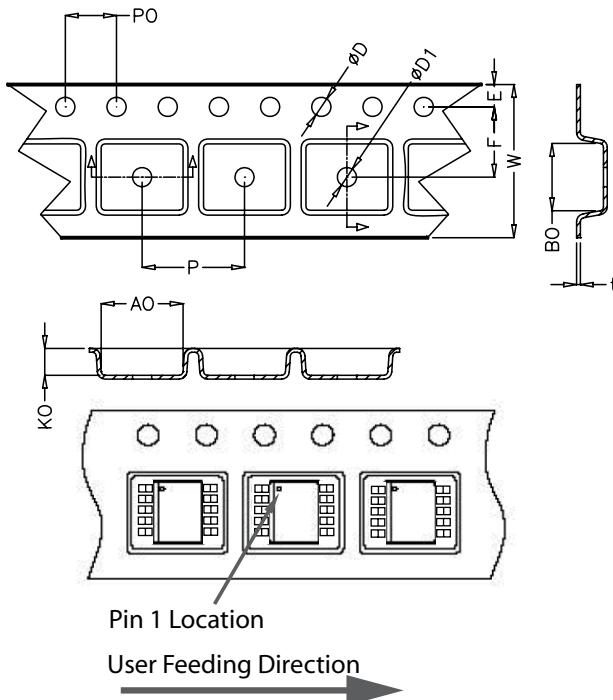
## Lightning Surge Protection

### Package Dimensions – MSOP-10



Package	MSOP			
Pins	10			
JEDEC	MO-187			
	Millimeters		Inches	
DIM	Min	Max	Min	Max
A	-	1.10	-	0.043
A1	0.00	0.15	0.000	0.006
B	0.17	0.27	0.007	0.011
c	0.08	0.23	0.003	0.009
D	2.90	3.10	0.114	0.122
E	4.67	5.10	0.184	0.200
E1	2.90	3.10	0.114	0.122
e	0.50 BSC		0.020 BSC	
L	0.40	0.80	0.016	0.032

### Embossed Carrier Tape & Reel Specification – MSOP-10



	Millimeters		Inches	
	Min	Max	Min	Max
E	1.65	1.85	0.065	0.073
F	5.40	5.60	0.213	0.220
D	1.50	1.60	0.059	0.063
D1	1.50 Min		0.059 Min	
P0	3.90	4.10	0.154	0.161
W	11.70	12.30	0.460	0.484
P	7.90	8.10	0.311	0.319
A0	5.20	5.40	0.205	0.213
B0	3.20	3.50	0.126	0.138
K0	1.20	1.50	0.047	0.059
t	0.30 +/- 0.05		0.012 +/- 0.002	

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