



# SMF4L Series

## Surface Mount – 400W



### Additional Information



Resources



Accessories



Samples

### Agency Approvals

Agency	Agency File Number
	E230531

### Maximum Ratings and Thermal Characteristics

( $T_A = 25^\circ\text{C}$  unless otherwise noted)

Parameter	Symbol	Value	Unit	
Peak Pulse Power Dissipation at $T_A = 25^\circ\text{C}$ (Note 1)	$P_{PPM}$	8/20 $\mu\text{s}$ (Note2)	2000	W
		10/1000 $\mu\text{s}$ (Note3)	400	W
Power Dissipation On Infinite Heat Sink at $T_L = 50^\circ\text{C}$	$P_D$	1	W	
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	220	$^\circ\text{C}/\text{W}$	
Thermal Resistance Junction to Lead	$R_{\theta JL}$	100	$^\circ\text{C}/\text{W}$	
Operating and Storage Temperature Range	$T_J, T_{STG}$	-55 to 150	$^\circ\text{C}$	

#### Notes:

- Non-repetitive current pulse, per Fig. 4 and derated above  $T_J$  (initial)  $= 25^\circ\text{C}$  per Fig. 3.
- SMF4L5.0A-SMF4L8.5A Peak Pulse Power Dissipation is 1850W min, 2000W typical @ 8/20 $\mu\text{s}$
- SMF4L5.0A-SMF4L8.5A Peak Pulse Power Dissipation is 370W min, 400W typical @ 10/1000 $\mu\text{s}$ , SMF4L90A-SMF4L250A Peak Pulse Power Dissipation is 200W typical @ 10/1000 $\mu\text{s}$

### Description

The SMF4L series of SOD-123FL small and flat lead low-profile plastic package is designed specifically to protect sensitive electronic equipment from voltage transients induced by lightning and other transient voltage events.

### Features & Benefits

- 400W peak pulsepower capability at 10/1000 $\mu\text{s}$  waveform, repetition rate (duty cycle): 0.01%
- Compatible with industrial standard package SOD-123FL
- Low profile: maximum height of 1mm.
- Low inductance, excellent clamping capability
- For surface mounted applications to optimize board space
- Typical failure mode is short from over-specified voltage or current
- Whisker test is conducted based on JEDEC JESD201A per its table 4a and 4c
- IEC-61000-4-2 ESD 30kV(Air), 30kV (Contact)
- ESD protection of data lines in accordance with IEC 61000-4-2
- EFT protection of data lines in accordance with IEC 61000-4-4
- Fast response time: typically less than 1.0ns from 0 Volts to VBR min
- High temperature soldering: 260 $^\circ\text{C}$ /30 seconds at terminals
- VBR @  $T_J = \text{VBR}@25^\circ\text{C} \times (1 + \alpha T \times (T_J - 25))$  ( $\alpha T$ : Temperature Coefficient, typical value is 0.1%)
- Glass passivated junction
- Built-in strain relief
- Plastic package is flammability rated V-0 per Underwriters Laboratories
- Meet MSL level1, per J-STD-020, LF maximum peak of 260 $^\circ\text{C}$
- Matte tin lead-free plated
- Halogen-free and RoHS compliant
- Pb-free E3 means 2nd level interconnect is Pb-free and the terminal finish material is tin(Sn) (IPC/JEDEC J-STD-609A.01)
- Recognized to UL 497B as an Isolated Loop Circuit Protector

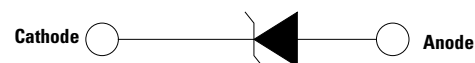
### Applications

SMF4L devices are ideal for the protection of I/O interfaces, VCC bus and other vulnerable circuit used in cellular phones, portable devices, business machines, power supplies and other consumer applications.

#### Functional Diagram



Bi-directional



Uni-directional

# SMF4L Series

## Surface Mount – 400W

### Electrical Characteristics ( $T_A=25\text{ }^\circ\text{C}$ unless otherwise noted)

Part Number		Marking Code		Breakdown Voltage $V_{BR}$ (Volts) @ $I_T$		Test Current $I_T$ (mA)	Reverse Stand off Voltage $V_R$ (V)	Maximum Reverse Leakage @ $V_R$ $I_R$ ( $\mu\text{A}$ )	Maximum Peak Pulse Current $I_{PP}$ (A)	Maximum Clamping Voltage @ $I_{PP}$ $V_C$ (V)	Agency Approval
Uni-directional	Bi-directional	Uni-directional	Bi-directional	Min	Max						
SMF4L5.0A	-	KE	-	6.40	7.00	10	5.0	800	40.1	9.2	X
SMF4L6.0A	-	KG	-	6.67	7.37	10	6.0	800	35.9	10.3	X
SMF4L6.5A	-	KK	-	7.22	7.98	10	6.5	500	33.1	11.2	X
SMF4L7.0A	-	KM	-	7.78	8.60	10	7.0	200	30.9	12.0	X
SMF4L7.5A	-	KP	-	8.33	9.21	1	7.5	100	28.7	12.9	X
SMF4L8.0A	-	KR	-	8.89	9.83	1	8.0	50	27.2	13.6	X
SMF4L8.5A	-	KT	-	9.44	10.40	1	8.5	20	25.7	14.4	X
SMF4L9.0A	SMF4L9.0CA	KV	AV	10.00	11.10	1	9.0	5	26.4	15.4	X
SMF4L10A	SMF4L10CA	KX	AX	11.10	12.30	1	10	5	23.5	17.0	X
SMF4L11A	SMF4L11CA	KZ	AZ	12.2	13.50	1	11	1	22.0	18.2	X
SMF4L12A	SMF4L12CA	LE	BE	13.30	14.70	1	12	1	20.1	19.9	X
SMF4L13A	SMF4L13CA	LG	BG	14.40	15.90	1	13	1	18.6	21.5	X
SMF4L14A	SMF4L14CA	LK	BK	15.60	17.20	1	14	1	17.2	23.2	X
SMF4L15A	SMF4L15CA	LM	BM	16.70	18.50	1	15	1	16.4	24.4	X
SMF4L16A	SMF4L16CA	LP	BP	17.80	19.70	1	16	1	15.4	26.0	X
SMF4L17A	SMF4L17CA	LR	BR	18.90	20.90	1	17	1	14.5	27.6	X
SMF4L18A	SMF4L18CA	LT	BT	20.00	22.10	1	18	1	13.7	29.2	X
SMF4L20A	SMF4L20CA	LV	BV	22.20	24.50	1	20	1	12.3	32.4	X
SMF4L22A	SMF4L22CA	LX	BX	24.40	26.90	1	22	1	11.3	35.5	X
SMF4L24A	SMF4L24CA	LZ	BZ	26.70	29.50	1	24	1	10.3	38.9	X
SMF4L26A	SMF4L26CA	ME	CE	28.90	31.90	1	26	1	9.5	42.1	X
SMF4L28A	SMF4L28CA	MG	CG	31.10	34.40	1	28	1	8.8	45.4	X
SMF4L30A	SMF4L30CA	MK	CK	33.30	36.80	1	30	1	8.3	48.4	X
SMF4L33A	SMF4L33CA	MM	CM	36.70	40.60	1	33	1	7.5	53.3	X
SMF4L36A	SMF4L36CA	MP	CP	40.00	44.20	1	36	1	6.9	58.1	X
SMF4L40A	SMF4L40CA	MR	CR	44.40	49.10	1	40	1	6.2	64.5	X
SMF4L43A	SMF4L43CA	MT	CT	47.80	52.80	1	43	1	5.8	69.4	X
SMF4L45A	SMF4L45CA	MV	CV	50.00	55.30	1	45	1	5.5	72.7	X
SMF4L48A	SMF4L48CA	MX	CX	53.30	58.90	1	48	1	5.2	77.4	X
SMF4L51A	SMF4L51CA	MZ	CZ	56.70	62.70	1	51	1	4.9	82.4	X
SMF4L54A	-	NE	-	60.00	66.30	1	54	1	4.6	87.1	X
SMF4L58A	-	NG	-	64.40	71.20	1	58	1	4.3	93.6	X
SMF4L60A	-	NK	-	66.70	73.70	1	60	1	4.1	96.8	X
SMF4L64A	-	NM	-	71.10	78.60	1	64	1	3.9	103.0	X
SMF4L70A	-	NP	-	77.80	86.00	1	70	1	3.5	113.0	X
SMF4L75A	-	NR	-	83.30	92.10	1	75	1	3.3	121.0	X
SMF4L78A	-	NT	-	86.70	95.80	1	78	1	3.2	126.0	X
SMF4L85A	-	NV	-	94.40	104.00	1	85	1	2.9	137.0	X
SMF4L90A	-	NX	-	100.00	111.00	1	90	1	1.4	146.0	X
SMF4L100A	-	NZ	-	111.00	123.00	1	100	1	1.2	162.0	X
SMF4L110A	-	OE	-	122.00	135.00	1	110	1	1.1	177.0	X
SMF4L120A	-	OG	-	133.00	147.00	1	120	1	1.0	193.0	X
SMF4L130A	-	OK	-	144.00	159.00	1	130	1	1.0	209.0	X
SMF4L150A	-	OM	-	167.00	185.00	1	150	1	0.8	243.0	X
SMF4L160A	-	OP	-	178.00	197.00	1	160	1	0.8	259.0	X
SMF4L170A	-	OR	-	189.00	209.00	1	170	1	0.7	275.0	X
SMF4L180A	-	OT	-	201.00	222.00	1	180	1	0.7	292.0	-
SMF4L188A	-	OV	-	209.00	231.00	1	188	1	0.7	304.0	-
SMF4L200A	-	OX	-	224.00	247.00	1	200	1	0.6	324.0	-
SMF4L220A	-	OZ	-	246.00	272.00	1	220	1	0.6	356.0	-
SMF4L250A	-	PE	-	279.00	309.00	1	250	1	0.5	405.0	-

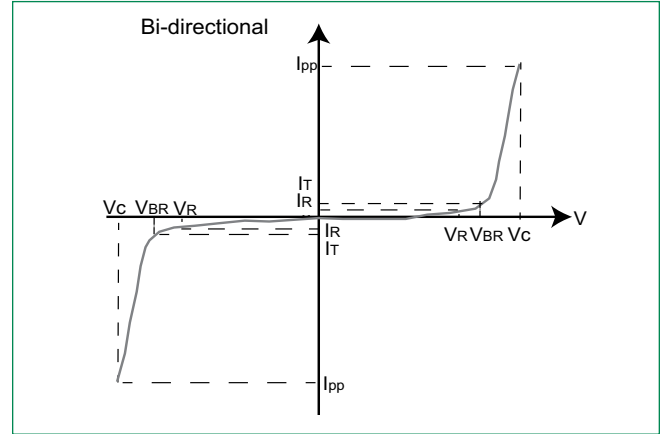
#### Notes:

- $V_{BR}$  measured after  $I_T$  applied for 300 $\mu\text{s}$ ,  $I_T$  = square wave pulse or equivalent.
- Surge current waveform per 10/1000 $\mu\text{s}$  exponential wave and derated per Fig.3.
- All terms and symbols are consistent with ANSI/IEEE C62.35.

# SMF4L Series

## Surface Mount – 400W

### I-V Curve Characteristics



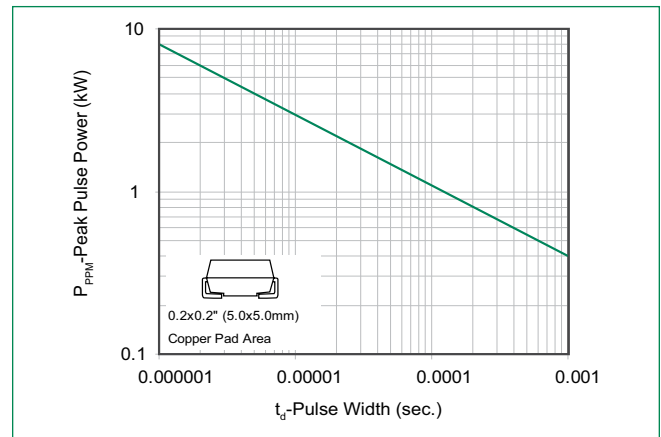
- $P_{PPM}$  Peak Pulse Power Dissipation** -- Max power dissipation
- $V_R$  Stand-off Voltage** -- Maximum voltage that can be applied to the TVS without operation
- $V_{BR}$  Breakdown Voltage** -- Maximum voltage that flows though the TVS at a specified test current ( $I_T$ )
- $V_C$  Clamping Voltage** -- Peak voltage measured across the TVS at a specified  $I_{ppm}$  (peak impulse current)
- $I_R$  Reverse Leakage Current** -- Current measured at  $V_R$
- $V_F$  Forward Voltage Drop for Uni-directional**

### Ratings and Characteristic Curves ( $T_A=25\text{ }^\circ\text{C}$ unless otherwise noted)

**Figure 1 -**  
TVS Transients Clamping Waveform



**Figure 2 -**  
Peak Pulse Power Rating Curve



# SMF4L Series

## Surface Mount – 400W

### Ratings and Characteristic Curves ( $T_A=25\text{ }^\circ\text{C}$ unless otherwise noted) (Continued)

**Figure 3 -**  
Peak Pulse Power Derating Curve



**Figure 4 -**  
Pulse Waveform - 10/1000 $\mu\text{S}$



**Figure 5 -**  
Forward Voltage



**Figure 6 -**  
Typical Junction Capacitance



**Figure 7 -**  
Peak Forward Voltage Drop vs. Peak Forward Current



**Figure 8 -**  
Maximum Non-Repetitive Forward Surge Current  
Uni-Directional Only



# SMF4L Series

## Surface Mount – 400W

### Soldering Parameters

<b>Reflow Condition</b>		Lead-free assembly
<b>Pre Heat</b>	- Temperature Min ( $T_{s(min)}$ )	150°C
	- Temperature Max ( $T_{s(max)}$ )	200°C
	- Time (min to max) ( $t_p$ )	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
	- Time (min to max) ( $t_L$ )	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 Max
<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



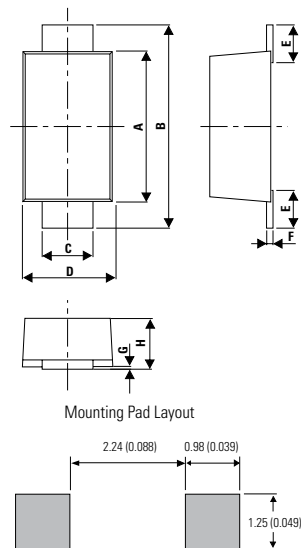
### Physical Specifications

<b>Case</b>	SOD-123FL plastic over glass passivated junction
<b>Polarity</b>	Color band denotes cathode except bipolar
<b>Terminal</b>	Matte tin-plated leads, solderable per JESD22-B102

### Environmental Specifications

<b>High Temp. Storage</b>	JESD22-A103
<b>HTRB</b>	JESD22-A108
<b>Temperature Cycling</b>	JESD22-A104
<b>MSL</b>	JEDEC-J-STD-020, Level 1
<b>H3TRB</b>	JESD22-A101
<b>RSH</b>	JESD22-A111

### Dimensions - SOD-123FL Package



Dimensions	Millimeters		Inches	
	Min	Max	Min	Max
<b>A</b>	2.90	3.10	0.114	0.122
<b>B</b>	3.50	3.90	0.138	0.154
<b>C</b>	0.85	1.05	0.033	0.041
<b>D</b>	1.70	2.00	0.067	0.079
<b>E</b>	0.43	0.83	0.017	0.033
<b>F</b>	0.10	0.25	0.004	0.010
<b>G</b>	0.00	0.10	0.000	0.004
<b>H</b>	0.90	1.08	0.035	0.043

# SMF4L Series

## Surface Mount – 400W

### Part Numbering System



### Part Marking System



### Packaging Options

Part number	Component Package	Quantity	Packaging Option	Packaging Specification
SMF4LXXX	SOD-123FL	3000	Tape & Reel – 8mm tape/7" reel	EIA RS-481

### Tape and Reel Specification



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