

## Surface Mount Transient Voltage Suppressors (TVS)

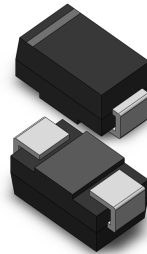
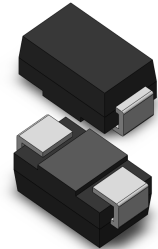
**SMAJ Series 5.0 To 440 V 400W**

### Description

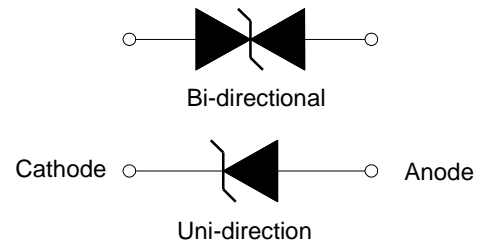
The SMAJ series is designed specifically to protect sensitive electronic equipment from voltage transients induced by lightning and other transient voltage events.

### Features

- u For surface mounted applications in order to optimize board space
- u Low leakage
- u Uni and Bidirectional unit
- u Glass passivated junction
- u Low inductance
- u Excellent clamping capability
- u 400W Peak power capability at 10 × 1000μs waveform Repetition rate (duty cycle):0.01%
- u Fast response time: typically less than 1.0ps from 0 Volts to  $V_{BR}$  min
- u Typical  $I_R$  less than 5μA above 12V
- u High Temperature soldering: 260°C/40 seconds at terminals
- u Typical maximum temperature coefficient  $\Delta V_{BR} = 0.1\% \times V_{BR}@25^\circ\text{C} \times \Delta T$
- u Plastic package has Underwriters Laboratory Flammability 94V-0
- u Matte tin lead-free Plated
- u Halogen free and RoHS compliant
- u Typical failure mode is short from over-specified voltage or current
- u Whisker test is conducted based on JEDEC JESD201A per its table 4a and 4c
- u IEC-61000-4-2 ESD 15kV(Air), 8kV (Contact)
- u ESD protection of data lines in accordance with IEC 61000-4-2 (IEC801-2)
- u EFT protection of data lines in accordance with IEC 61000-4-4 (IEC801-4)

**Uni-directional**

**Bi-directional**


### Functional Diagram



### Applications

TVS devices are ideal for the protection of I/O interfaces,  $V_{CC}$  bus and other vulnerable circuits used in Telecom, Computer, Industrial and Consumer electronic applications.

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

Parameter	Symbol	Value	Unit
Peak Pulse Power Dissipation with a 10/1000μs waveform (Fig.1)(Note 1), (Note 2)	$P_{PPM}$	400	Watts
Peak Pulse Current with a 10/1000μs waveform.(Note1, Fig.3)	$I_{PP}$	See Next Table	Amps
Power Dissipation on Infinite Heat Sink at $T_L=75^\circ\text{C}$	$P_{M(AV)}$	1.0	Watt
Peak Forward Surge Current, 8.3ms Single Half Sine Wave (Note 3)	$I_{FSM}$	40	Amps
Maximum Instantaneous Forward Voltage at 25A for Unidirectional Only (Note 4)	$V_F$	3.5/5.0	Voltage
Operating junction and Storage Temperature Range.	$T_J, T_{STG}$	-55 to +150	$^\circ\text{C}$

### Notes:

1. Non-repetitive current pulse, per Fig. 3 and derated above  $T_A = 25^\circ\text{C}$  per Fig. 2.
2. Mounted on 5.0mm x 5.0mm (0.03mm thick) Copper Pads to each terminal.
3. 8.3ms single half sine-wave, or equivalent square wave, Duty cycle = 4 pulses per minutes maximum.
4.  $V_F < 3.5\text{V}$  for  $V_{BR} < 200\text{V}$  and  $V_F < 6.5\text{V}$  for  $V_{BR} > 201\text{V}$ .

## Surface Mount Transient Voltage Suppressors (TVS)

**SMAJ Series 5.0 To 440 V 400W**
**Electrical Characteristics (T<sub>A</sub>=25°C unless otherwise noted)**

Part Number		Marking		Reverse Stand-Off Voltage V <sub>RWM</sub> (V)	Breakdown Voltage V <sub>BR</sub> (V) @I <sub>T</sub>		Test Current I <sub>T</sub> (mA)	Maximum Clamping Voltage V <sub>C</sub> @I <sub>PP</sub> (V)	Maximum Peak Pulse Current I <sub>PP</sub> (A)	Maximum Reverse Leakage I <sub>R</sub> @V <sub>RWM</sub> (μA)
Uni	Bi	Uni	Bi		MIN	MAX				
SMAJ5.0	SMAJ5.0C	AD	WD	5.0	6.40	7.30	10	9.6	41.67	800
SMAJ5.0A	SMAJ5.0CA	AE	WE	5.0	6.40	7.00	10	9.2	43.48	800
SMAJ6.0	SMAJ6.0C	AF	WF	6.0	6.67	8.15	10	11.4	35.09	800
SMAJ6.0A	SMAJ6.0CA	AG	WG	6.0	6.67	7.37	10	10.3	38.83	800
SMAJ6.5	SMAJ6.5C	AH	WH	6.5	7.22	8.82	10	12.3	32.52	500
SMAJ6.5A	SMAJ6.5CA	AK	WK	6.5	7.22	7.98	10	11.2	35.71	500
SMAJ7.0	SMAJ7.0C	AL	WL	7.0	7.78	9.51	10	13.3	30.08	200
SMAJ7.0A	SMAJ7.0CA	AM	WM	7.0	7.78	8.60	10	12.0	33.33	200
SMAJ7.5	SMAJ7.5C	AN	WN	7.5	8.33	10.20	1	14.3	27.97	100
SMAJ7.5A	SMAJ7.5CA	AP	WP	7.5	8.33	9.21	1	12.9	31.01	100
SMAJ8.0	SMAJ8.0C	AQ	WQ	8.0	8.89	10.90	1	15.0	26.67	50
SMAJ8.0A	SMAJ8.0CA	AR	WR	8.0	8.89	9.83	1	13.6	29.41	50
SMAJ8.5	SMAJ8.5C	AS	WS	8.5	9.44	11.50	1	15.9	25.16	10
SMAJ8.5A	SMAJ8.5CA	AT	WT	8.5	9.44	10.40	1	14.4	27.78	10
SMAJ9.0	SMAJ9.0C	AU	WU	9.0	10.00	12.20	1	16.9	23.67	5
SMAJ9.0A	SMAJ9.0CA	AV	WV	9.0	10.00	11.10	1	15.4	25.97	5
SMAJ10	SMAJ10C	AW	WW	10.0	11.10	13.60	1	18.8	21.28	5
SMAJ10A	SMAJ10CA	AX	WX	10.0	11.10	12.30	1	17.0	23.53	5
SMAJ11	SMAJ11C	AY	WY	11.0	12.20	14.90	1	20.1	19.90	5
SMAJ11A	SMAJ11CA	AZ	WZ	11.0	12.20	13.50	1	18.2	21.98	5
SMAJ12	SMAJ12C	BD	XD	12.0	13.30	16.30	1	22.0	18.18	5
SMAJ12A	SMAJ12CA	BE	XE	12.0	13.30	14.70	1	19.9	20.10	5
SMAJ13	SMAJ13C	BF	XF	13.0	14.40	17.60	1	23.8	16.81	5
SMAJ13A	SMAJ13CA	BG	XG	13.0	14.40	15.90	1	21.5	18.60	5
SMAJ14	SMAJ14C	BH	XH	14.0	15.60	19.10	1	25.8	15.50	5
SMAJ14A	SMAJ14CA	BK	XK	14.0	15.60	17.20	1	23.2	17.24	5
SMAJ15	SMAJ15C	BL	XL	15.0	16.70	20.40	1	26.9	14.87	5
SMAJ15A	SMAJ15CA	BM	XM	15.0	16.70	18.50	1	24.4	16.39	5
SMAJ16	SMAJ16C	BN	XN	16.0	17.80	21.80	1	28.8	13.89	5
SMAJ16A	SMAJ16CA	BP	XP	16.0	17.80	19.70	1	26.0	15.38	5
SMAJ17	SMAJ17C	BQ	XQ	17.0	18.90	23.10	1	30.5	13.11	5
SMAJ17A	SMAJ17CA	BR	XR	17.0	18.90	20.90	1	27.6	14.49	5
SMAJ18	SMAJ18C	BS	XS	18.0	20.00	24.40	1	32.2	12.42	5
SMAJ18A	SMAJ18CA	BT	XT	18.0	20.00	22.10	1	29.2	13.70	5
SMAJ19	SMAJ19C	BA	XA	19.0	21.13	25.76	1	34.0	11.76	5
SMAJ19A	SMAJ19CA	BB	XB	19.0	21.10	23.30	1	30.8	13.00	5
SMAJ20	SMAJ20C	BU	XU	20.0	22.20	27.10	1	35.8	11.17	5
SMAJ20A	SMAJ20CA	BV	XV	20.0	22.20	24.50	1	32.4	12.35	5
SMAJ22	SMAJ22C	BW	XW	22.0	24.40	29.80	1	39.4	10.15	5
SMAJ22A	SMAJ22CA	BX	XX	22.0	24.40	26.90	1	35.5	11.27	5
SMAJ24	SMAJ24C	BY	XY	24.0	26.70	32.60	1	43.0	9.30	5
SMAJ24A	SMAJ24CA	BZ	XZ	24.0	26.70	29.50	1	38.9	10.28	5
SMAJ26	SMAJ26C	CD	YD	26.0	28.90	35.30	1	46.6	8.56	5
SMAJ26A	SMAJ26CA	CE	YE	26.0	28.90	31.90	1	42.1	9.50	5
SMAJ28	SMAJ28C	CF	YF	28.0	31.10	38.00	1	50.0	8.00	5
SMAJ28A	SMAJ28CA	CG	YG	28.0	31.10	34.40	1	45.4	8.81	5
SMAJ30	SMAJ30C	CH	YH	30.0	33.30	40.70	1	53.5	7.48	5
SMAJ30A	SMAJ30CA	CK	YK	30.0	33.30	36.80	1	48.4	8.26	5
SMAJ33	SMAJ33C	CL	YL	33.0	36.70	44.90	1	59.0	6.78	5
SMAJ33A	SMAJ33CA	CM	YM	33.0	36.70	40.60	1	53.3	7.50	5
SMAJ36	SMAJ36C	CN	YN	36.0	40.00	48.90	1	64.3	6.22	5
SMAJ36A	SMAJ36CA	CP	YP	36.0	40.00	44.20	1	58.1	6.88	5
SMAJ40	SMAJ40C	CQ	YQ	40.0	44.40	54.30	1	71.4	5.60	5
SMAJ40A	SMAJ40CA	CR	YR	40.0	44.40	49.10	1	64.5	6.20	5
SMAJ43	SMAJ43C	CS	YS	43.0	47.80	58.40	1	76.7	5.22	5
SMAJ43A	SMAJ43CA	CT	YT	43.0	47.80	52.80	1	69.4	5.76	5

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Part Number		Marking		Reverse Stand-Off Voltage V <sub>RWM</sub> (V)	Breakdown Voltage V <sub>BR</sub> (V) @I <sub>T</sub>		Test Current I <sub>T</sub> (mA)	Maximum Clamping Voltage V <sub>C</sub> @I <sub>PP</sub> (V)	Maximum Peak Pulse Current I <sub>PP</sub> (A)	Maximum Reverse Leakage I <sub>R</sub> @V <sub>RWM</sub> (μA)
Uni	Bi	Uni	Bi		MIN	MAX				
SMAJ45	SMAJ45C	CU	YU	45.0	50.00	61.10	1	80.3	4.98	5
SMAJ45A	SMAJ45CA	CV	YV	45.0	50.00	55.30	1	72.7	5.50	5
SMAJ48	SMAJ48C	CW	YW	48.0	53.30	65.10	1	85.5	4.68	5
SMAJ48A	SMAJ48CA	CX	YX	48.0	53.30	58.90	1	77.4	5.17	5
SMAJ51	SMAJ51C	CY	YY	51.0	56.70	69.30	1	91.1	4.39	5
SMAJ51A	SMAJ51CA	CZ	YZ	51.0	56.70	62.70	1	82.4	4.85	5
SMAJ54	SMAJ54C	RD	ZD	54.0	60.00	73.30	1	96.3	4.15	5
SMAJ54A	SMAJ54CA	RE	ZE	54.0	60.00	66.30	1	87.1	4.59	5
SMAJ58	SMAJ58C	RF	ZF	58.0	64.40	78.70	1	103.0	3.88	5
SMAJ58A	SMAJ58CA	RG	ZG	58.0	64.40	71.20	1	93.6	4.27	5
SMAJ60	SMAJ60C	RH	ZH	60.0	66.70	81.50	1	107.0	3.74	5
SMAJ60A	SMAJ60CA	RK	ZK	60.0	66.70	73.70	1	96.8	4.13	5
SMAJ64	SMAJ64C	RL	ZL	64.0	71.10	86.90	1	114.0	3.51	5
SMAJ64A	SMAJ64CA	RM	ZM	64.0	71.10	78.60	1	103.0	3.88	5
SMAJ70	SMAJ70C	RN	ZN	70.0	77.80	95.10	1	125.0	3.20	5
SMAJ70A	SMAJ70CA	RP	ZP	70.0	77.80	86.00	1	113.0	3.54	5
SMAJ75	SMAJ75C	RQ	ZQ	75.0	83.30	102.00	1	134.0	2.99	5
SMAJ75A	SMAJ75CA	RR	ZR	75.0	83.30	92.10	1	121.0	3.31	5
SMAJ78	SMAJ78C	RS	ZS	78.0	86.70	106.00	1	139.0	2.88	5
SMAJ78A	SMAJ78CA	RT	ZT	78.0	86.70	95.80	1	126.0	3.17	5
SMAJ80	SMAJ80C	RA	ZA	80.0	88.96	108.80	1	143.2	2.79	5
SMAJ80A	SMAJ80CA	RB	ZB	80.0	88.80	97.60	1	129.6	3.09	5
SMAJ85	SMAJ85C	RU	ZU	85.0	94.40	115.00	1	151.0	2.65	5
SMAJ85A	SMAJ85CA	RV	ZV	85.0	94.40	104.00	1	137.0	2.92	5
SMAJ90	SMAJ90C	RW	ZW	90.0	100.00	122.00	1	160.0	2.50	5
SMAJ90A	SMAJ90CA	RX	ZX	90.0	100.00	111.00	1	146.0	2.74	5
SMAJ100	SMAJ100C	RY	ZY	100.0	111.00	136.00	1	179.0	2.23	5
SMAJ100A	SMAJ100CA	RZ	ZZ	100.0	111.00	123.00	1	162.0	2.47	5
SMAJ110	SMAJ110C	SD	VD	110.0	122.00	149.00	1	196.0	2.04	5
SMAJ110A	SMAJ110CA	SE	VE	110.0	122.00	135.00	1	177.0	2.26	5
SMAJ120	SMAJ120C	SF	VF	120.0	133.00	163.00	1	214.0	1.87	5
SMAJ120A	SMAJ120CA	SG	VG	120.0	133.00	147.00	1	193.0	2.07	5
SMAJ130	SMAJ130C	SH	VH	130.0	144.00	176.00	1	231.0	1.73	5
SMAJ130A	SMAJ130CA	SK	VK	130.0	144.00	159.00	1	209.0	1.91	5
SMAJ140	SMAJ140C	SA	VA	140.0	155.68	190.40	1	250.6	1.60	5
SMAJ140A	SMAJ140CA	SB	VB	140.0	155.00	171.00	1	226.8	1.76	5
SMAJ150	SMAJ150C	SL	VL	150.0	167.00	204.00	1	268.0	1.49	5
SMAJ150A	SMAJ150CA	SM	VM	150.0	167.00	185.00	1	243.0	1.65	5
SMAJ160	SMAJ160C	SN	VN	160.0	178.00	218.00	1	287.0	1.39	5
SMAJ160A	SMAJ160CA	SP	VP	160.0	178.00	197.00	1	259.0	1.54	5
SMAJ170	SMAJ170C	SQ	VQ	170.0	189.00	231.00	1	304.0	1.32	5
SMAJ170A	SMAJ170CA	SR	VR	170.0	189.00	209.00	1	275.0	1.45	5
SMAJ180	SMAJ180C	SS	VS	180.0	201.00	244.80	1	322.2	1.24	5
SMAJ180A	SMAJ180CA	ST	VT	180.0	201.00	220.00	1	291.6	1.37	5
SMAJ190	SMAJ190C	SU	VU	190.0	211.21	258.40	1	340.1	1.18	5
SMAJ190A	SMAJ190CA	SV	VV	190.0	211.00	232.00	1	307.8	1.30	5
SMAJ200A	SMAJ200CA	SW	VW	200.0	224.00	247.00	1	324.0	1.23	5
SMAJ220A	SMAJ220CA	SX	VX	220.0	246.00	272.00	1	356.0	1.12	5
SMAJ250A	SMAJ250CA	SZ	VZ	250.0	279.00	309.00	1	405.0	0.99	5
SMAJ300A	SMAJ300CA	DE	HE	300.0	335.00	371.00	1	486.0	0.82	5
SMAJ350A	SMAJ350CA	DG	HG	350.0	391.00	432.00	1	567.0	0.71	5
SMAJ400A	SMAJ400CA	DK	HK	400.0	447.00	494.00	1	648.0	0.62	5
SMAJ440A	SMAJ440CA	DM	HM	440.0	492.00	543.00	1	713.0	0.56	5

**Note:**

1. Suffix 'A' denotes 5% tolerance device. Without 'A' denotes 10% tolerance device
2. Add suffix 'C' or 'CA' after part number to specify Bi-directional devices
3. For Bi-Directional devices having V<sub>R</sub> of 10 volts and under, the I<sub>R</sub> limit is double

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

Figure 1 - Peak Pulse Power Rating Curve

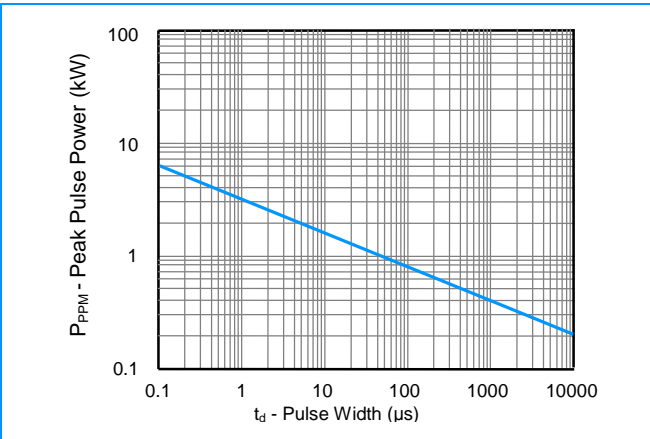


Figure 2 - Pulse Derating Curve



Figure 3 - Pulse Waveform

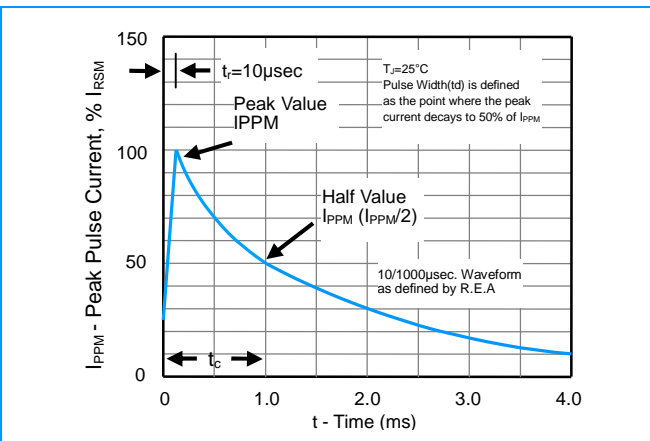


Figure 4 - Typical Junction Capacitance

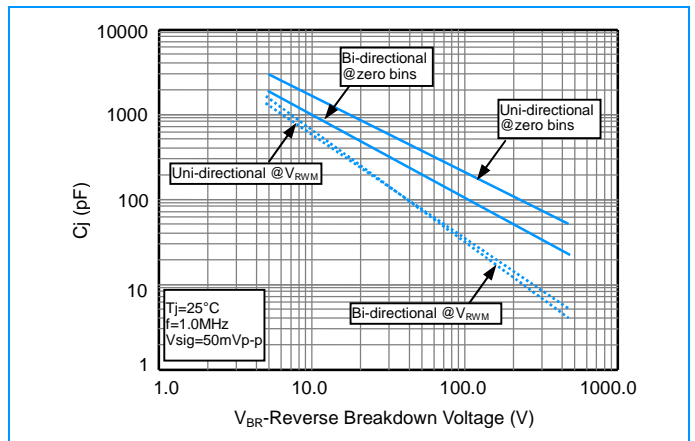


Figure 5 - Steady State Power Derating Curve

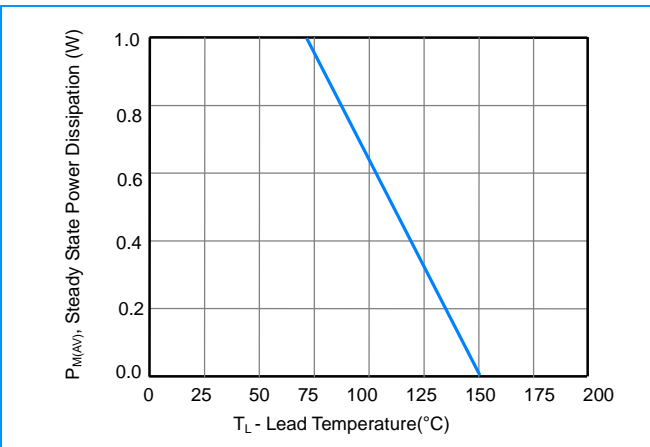
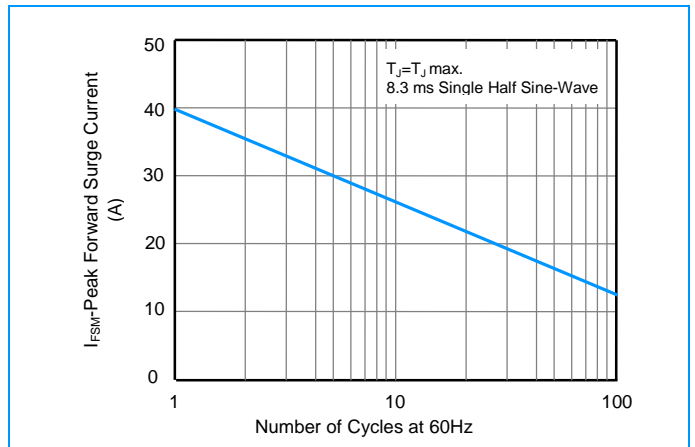


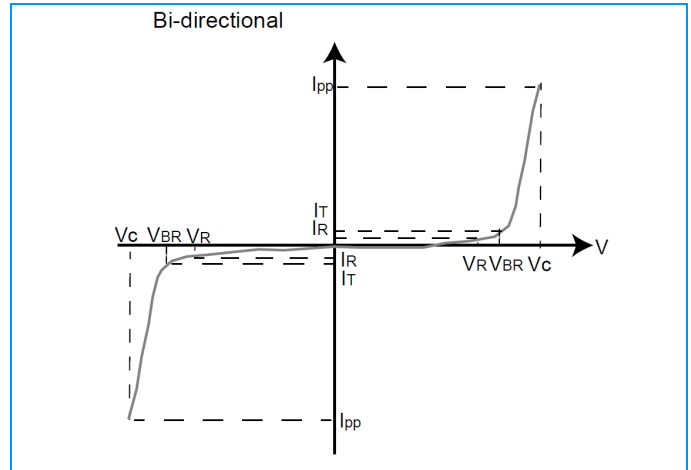
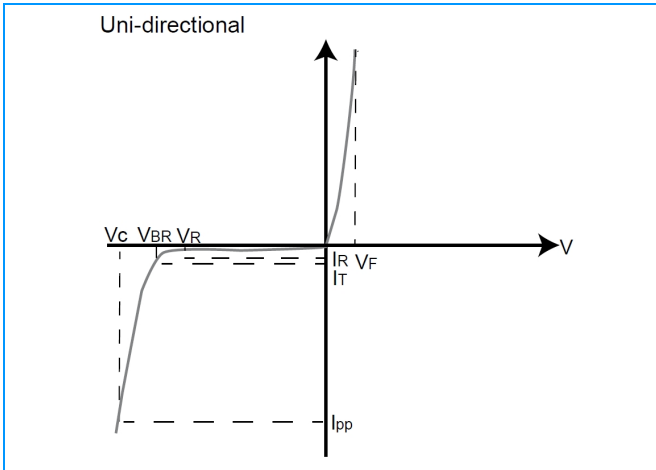
Figure 6 - Maximum Non-Repetitive Surge Current



## Surface Mount Transient Voltage Suppressors (TVS)

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### I-V Curve Characteristics



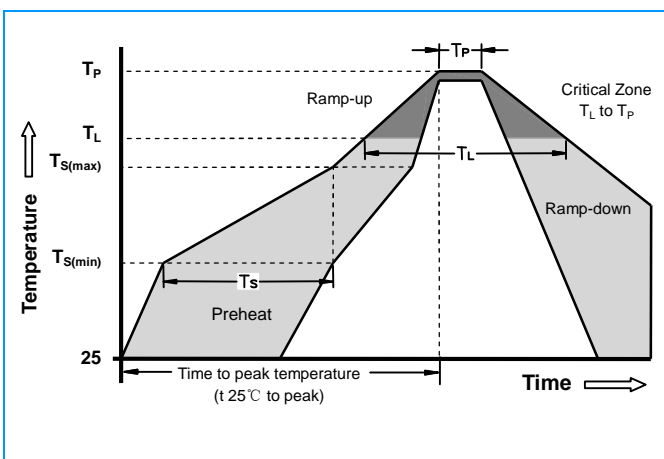
### Physical Specifications

<b>Weight</b>	0.002 ounce, 0.061 gram
<b>Case</b>	JEDEC DO-214AC Molded Plastic over glass passivated junction
<b>Polarity</b>	Color band denotes cathode except Bipolar
<b>Terminal</b>	Matte Tin-plated leads, Solderable per JESD22-B102D

### Environmental Specifications

<b>Temperature Cycle</b>	JESD22-A104
<b>Pressure Cooker</b>	JESD22-A102
<b>High Temp. Storage</b>	JESD22-A103
<b>HTRB</b>	JESD22-A108
<b>Thermal Shock</b>	JESD22-A106

### Soldering Parameters

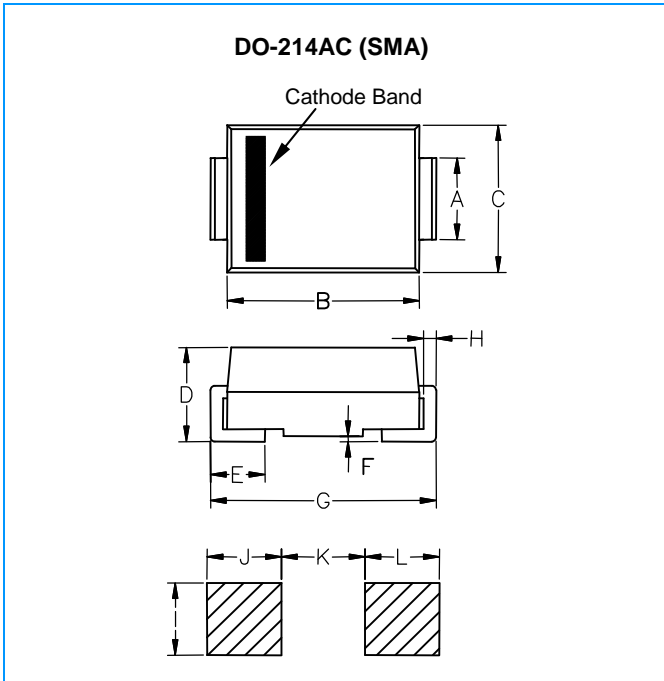


Reflow Condition		Lead-free assembly
Pre Heat	- Temperature Min ( $T_{s(min)}$ )	150°C
	- Temperature Max ( $T_{s(max)}$ )	200°C
	- Time (min to max) ( $t_s$ )	60 - 180 Seconds
Average ramp up rate ( Liquidus Temp $T_L$ ) to peak		3°C/second max
$T_{s(max)}$ to $T_L$ - Ramp-up Rate		3°C/second max
Reflow	- Temperature ( $T_L$ ) (Liquidus)	217°C
	- Time (min to max) ( $t_s$ )	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		280°C

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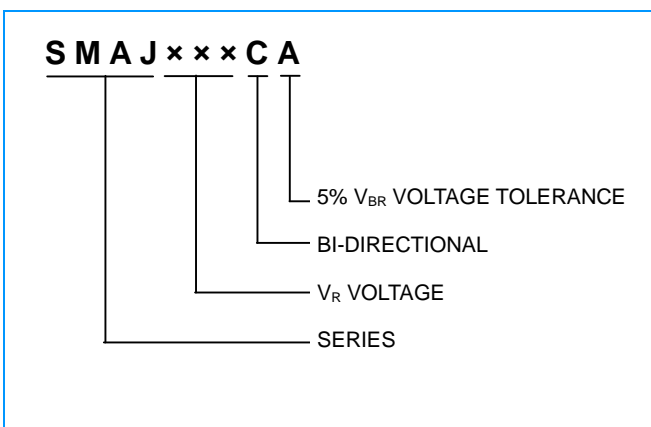
SMAJ Series 5.0 To 440 V 400W

### Dimensions



Dimensions	Inches		Millimeters	
	Min	Max	Min	Max
A	0.049	0.064	1.230	1.630
B	0.162	0.179	4.10	4.550
C	0.099	0.109	2.510	2.760
D	0.077	0.089	1.960	2.260
E	0.030	0.060	0.750	1.510
F	-	0.008	-	0.203
G	0.192	0.206	4.87	5.220
H	0.006	0.012	0.152	0.305
I	0.070	-	1.800	-
J	0.082	-	2.100	-
K	-	0.090	-	2.300
L	0.082	-	2.100	-

### Part Numbering



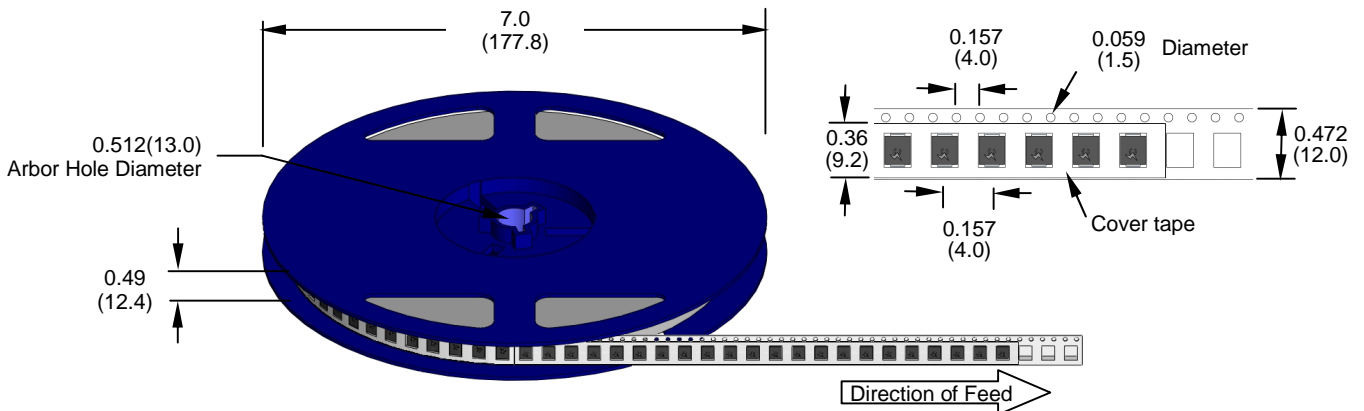
## Surface Mount Transient Voltage Suppressors (TVS)

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### Packaging

Part Number	Component Package	Quantity	Packaging Option	Packaging Specification
SMAJXXXXX	DO-214AC (SMA)	1000	Tape & Reel -12mm/7"tape	EIA STD RS-481

### Tape and Reel Specifications



Dimensions are in inches  
(and millimeters)