

TVS Diodes

Transient Voltage Suppression Diodes

SMDJ Series



Description

Transient Voltage Suppressor (TVS) is a circuit protection component that either attenuates (reduces) or filters a transient voltage spike (overvoltage), TVS diodes provide critical protection by going into avalanche breakdown within no more than a few nanoseconds after a strike, clamping the transient voltage, and routing its current to the ground.

Applications

- Communication Equipment
- Security & Protection
- Industrial Control Equipment
- Power Supply
- Automotive Electronics
- New Energy
- Lightning Protection

Functional Diagram



Uni-Directional



Bi-Directional

Features

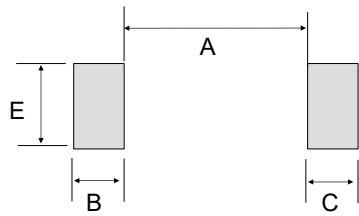
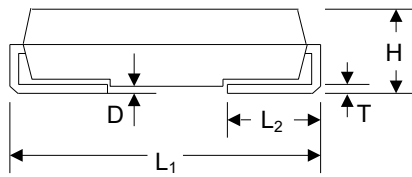
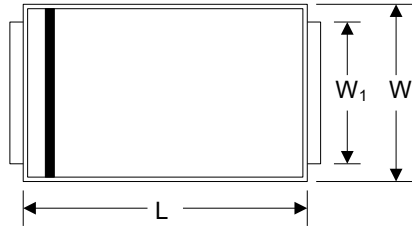
- Low incremental surge resistance
- Excellent clamping capability
- Low profile package with built-in strain relief
- Typical I_R less than 2.0 μA above 12 V
- 3000 W peak pulse power capability with a 10/1000 μs Waveform, repetition rate (duty cycle): 0.01%
- For surface mounted applications to optimize board space
- Typical failure mode is short from over-specified voltage or current
- IEC 61000-4-2 ESD 30 kV (Air), 30 kV (Contact)
- EFT protection of data lines in accordance with IEC 61000-4-4
- Very fast response time
- Glass passivated chip junction
- High temperature to reflow soldering guaranteed: 260 °C/30 sec
- $V_{BR} @ T_J = V_{BR@25\text{ °C}} \times (1 + \alpha T \times (T_J - 25))$
(αT : Temperature Coefficient, typical value is 0.1%)
- Plastic package is flammability rated V-0 per Underwriters Laboratories
- Meet MSL level1, per J-STD-020,
- 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)

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Package Outline Dimensions (DO-214AB)



Mounting Pad Layout

Symbol	Millimeters		Inches	
	Min.	Max.	Min.	Max.
L	6.60	7.11	0.260	0.280
W	5.59	6.22	0.220	0.245
W ₁	2.90	3.20	0.114	0.126
H	2.06	2.62	0.079	0.103
T	0.152	0.305	0.006	0.012
L ₁	7.75	8.13	0.305	0.320
L ₂	0.76	1.52	0.030	0.060
D	-	0.203	-	0.008
A	-	4.20	-	0.165
B	2.40	-	0.094	-
C	2.40	-	0.094	-
E	3.30	-	0.129	-

Maximum Ratings and Characteristics

(Ratings at 25 °C ambient temperature unless otherwise specified.)

Parameter	Symbol	Value	Unit
Peak Pulse Power Dissipation (Fig.2)by 10/1000us Test Waveform ⁽¹⁾⁽²⁾ (Fig.4)-Single Die Parts	P _{PPM}	3000	W
Peak Pulse Power Dissipation (Fig.2)by 10/1000us Test Waveform (1)(2)(Fig.4)-Stacked Die Parts ⁽⁵⁾	P _{PPM}	4000	W
Peak Power Dissipation on Infinite Heat Sink at T _L =50 °C	P _D	6.5	W
Peak Forward Surge Current,8.3 ms single half sinewave superimposed on rated load (JEDEC Method) ⁽³⁾	I _{FSM}	300	A
Maximum Instantaneous Forward Voltage at 100 A for Unidirectional Only ⁽⁴⁾	V _F	3.5 / 5.0	V
Operating Temperature Range	T _J	-65 to 150	°C
Storage Temperature Range	T _{STG}	-65 to 175	°C
Typical Thermal Resistance Junction to Lead	R _{θJL}	15	°C / W
Typical Thermal Resistance Junction to Ambient	R _{θJA}	75	°C / W

Notes

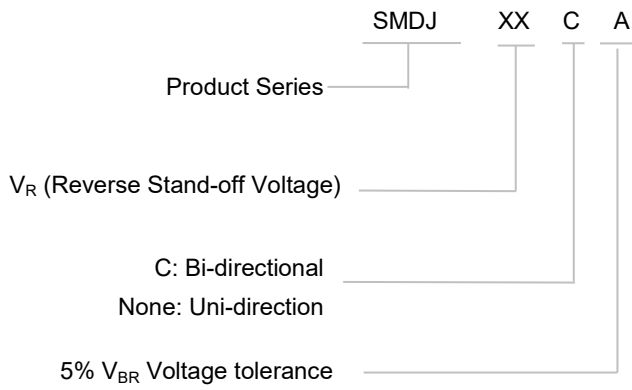
1. Non-repetitive current pulse, per Fig. 4 and derated above T_J(initial)=25 °C per Fig. 3.
2. Mounted on 8.0 mm² land areas.
3. Measured of 8.3 ms single half sine-wave or equivalent square wave, duty cycle=4 pulses per minute maximum.
4. V_F < 3.5 V for single die parts and V_F< 5.0 V for stacked-die parts.
5. For stacked die component details, please refer to models marked with * in electrical characteristics table.

TVS Diodes

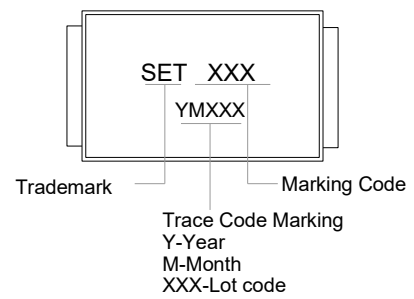
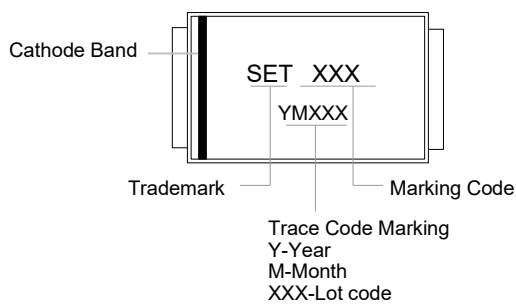
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SMDJ Series

Part Numbering System



Marking



TVS Diodes

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Electrical Characteristics (T_A=25 °C unless otherwise noted)

Part Number		Device Marking Code		Breakdown Voltage V _{BR} @I _T		Test Current I _T	Reverse Stand-off Voltage V _R	Max. Reverse Leakage I _R @V _R	Max. Peak Pulse Current I _{PPM} (10/1000 μs)	Max. Clamping Voltage V _C @I _{PPM} (10/1000 μs)	Max. Peak Pulse Current I _{PPM} (8/20 μs)	Max. Clamping Voltage V _C @I _{PPM} (8/20 μs)
				Min	Max							
Uni	Bi	Uni	Bi	(V)		(mA)	(V)	(μA)	(A)	(V)	(A)	(V)
SMDJ5.0A	SMDJ5.0CA	RDE	DDE	6.40	7.00	10	5.00	800.00	326.10	9.20	1630.50	11.89
SMDJ6.0A	SMDJ6.0CA	RDG	DDG	6.67	7.37	10	6.00	800.00	291.30	10.30	1456.50	13.31
SMDJ6.5A	SMDJ6.5CA	RDK	DDK	7.22	7.98	10	6.50	500.00	267.90	11.20	1339.50	14.47
SMDJ7.0A	SMDJ7.0CA	PDM	DDM	7.78	8.60	10	7.00	200.00	250.00	12.00	1250.00	15.50
SMDJ7.5A	SMDJ7.5CA	PDP	DDP	8.33	9.21	1	7.50	100.00	232.60	12.90	1163.00	16.67
SMDJ8.0A	SMDJ8.0CA	PDR	DDR	8.89	9.83	1	8.00	50.00	220.60	13.60	1103.00	17.57
SMDJ8.5A	SMDJ8.5CA	PDT	DDT	9.44	10.40	1	8.50	20.00	208.30	14.40	1041.50	18.60
SMDJ9.0A	SMDJ9.0CA	PDV	DDV	10.00	11.10	1	9.00	10.00	194.80	15.40	974.00	19.90
SMDJ10A	SMDJ10CA	PDX	DDX	11.10	12.30	1	10.00	5.00	176.50	17.00	882.50	21.96
SMDJ11A	SMDJ11CA	PDZ	DDZ	12.20	13.50	1	11.00	2.00	164.80	18.20	824.00	23.51
SMDJ12A	SMDJ12CA	PEE	DEE	13.30	14.70	1	12.00	2.00	150.80	19.90	754.00	25.71
SMDJ13A	SMDJ13CA	PEG	DEG	14.40	15.90	1	13.00	2.00	139.50	21.50	697.50	27.78
SMDJ14A	SMDJ14CA	PEK	DEK	15.60	17.20	1	14.00	2.00	129.30	23.20	646.50	29.97
SMDJ15A	SMDJ15CA	PEM	DEM	16.70	18.50	1	15.00	2.00	123.00	24.40	615.00	31.52
SMDJ16A	SMDJ16CA	PEP	DEP	17.80	19.70	1	16.00	2.00	115.40	26.00	577.00	33.59
SMDJ17A	SMDJ17CA	PER	DER	18.90	20.90	1	17.00	2.00	108.70	27.60	543.50	35.66
SMDJ18A	SMDJ18CA	PET	DET	20.00	22.10	1	18.00	2.00	102.70	29.20	513.50	37.73
SMDJ20A	SMDJ20CA	PEV	DEV	22.20	24.50	1	20.00	2.00	92.60	32.40	463.00	41.86
SMDJ22A	SMDJ22CA	PEX	DEX	24.40	26.90	1	22.00	2.00	84.50	35.50	422.50	45.87
SMDJ24A	SMDJ24CA	PEZ	DEZ	26.70	29.50	1	24.00	2.00	77.10	38.90	385.50	50.26
SMDJ26A	SMDJ26CA	PFE	DFE	28.90	31.90	1	26.00	2.00	71.30	42.10	356.50	54.39
SMDJ28A	SMDJ28CA	PFG	DFG	31.10	34.40	1	28.00	2.00	66.10	45.40	330.50	58.66
SMDJ30A	SMDJ30CA	PFK	DFK	33.30	36.80	1	30.00	2.00	62.00	48.40	310.00	62.53
SMDJ33A	SMDJ33CA	PFM	DFM	36.70	40.60	1	33.00	2.00	56.30	53.30	281.50	68.86
SMDJ36A	SMDJ36CA	PPF	DFP	40.00	44.20	1	36.00	2.00	51.60	58.10	258.00	75.06

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				Min	Max							
Uni	Bi	Uni	Bi	(V)		(mA)	(V)	(μ A)	(A)	(V)	(A)	(V)
SMDJ40A	SMDJ40CA	PFR	DFR	44.40	49.10	1	40.00	2.00	46.50	64.50	232.50	83.33
SMDJ43A	SMDJ43CA	PFT	DFT	47.80	52.80	1	43.00	2.00	43.20	69.40	216.00	89.66
SMDJ45A	SMDJ45CA	PFV	DFV	50.00	55.30	1	45.00	2.00	41.30	72.70	206.50	93.93
SMDJ48A	SMDJ48CA	PFX	DFX	53.30	58.90	1	48.00	2.00	38.80	77.40	194.00	100.00
SMDJ51A	SMDJ51CA	PFZ	DFZ	56.70	62.70	1	51.00	2.00	36.40	82.40	182.00	106.46
SMDJ54A	SMDJ54CA	RGE	DGE	60.00	66.30	1	54.00	2.00	34.40	87.10	172.00	112.53
SMDJ58A	SMDJ58CA	PGG	DGG	64.40	71.20	1	58.00	2.00	32.10	93.60	160.50	120.93
SMDJ60A	SMDJ60CA	PGK	DGK	66.70	73.70	1	60.00	2.00	31.00	96.80	155.00	125.06
SMDJ64A	SMDJ64CA	PGM	DGM	71.10	78.60	1	64.00	2.00	29.10	103.00	145.50	133.07
SMDJ70A	SMDJ70CA	PGP	DGP	77.80	86.00	1	70.00	2.00	26.50	113.00	132.50	145.99
SMDJ75A	SMDJ75CA	PGR	DGR	83.30	92.10	1	75.00	2.00	24.80	121.00	124.00	156.33
SMDJ78A	SMDJ78CA	PGT	DGT	86.70	95.80	1	78.00	2.00	23.80	126.00	119.00	162.79
SMDJ85A	SMDJ85CA	PGV	DGV	94.40	104.00	1	85.00	2.00	21.90	137.00	109.50	177.00
SMDJ90A	SMDJ90CA	PGX	DGX	100.00	111.00	1	90.00	2.00	20.50	146.00	102.50	188.63
SMDJ100A	SMDJ100CA	PGZ	DGZ	111.00	123.00	1	100.00	2.00	18.50	162.00	92.50	209.30
SMDJ110A	SMDJ110CA	PHE	DHE	122.00	135.00	1	110.00	2.00	16.90	177.00	84.50	228.68

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Uni	Bi	Uni	Bi	Min	Max							
				(V)		(mA)	(V)	(μ A)	(A)	(V)	(A)	(V)
SMDJ120A	SMDJ120CA	PHG	DHG	133.00	147.00	1	120.00	2.00	15.50	193.00	77.50	249.35
SMDJ130A	SMDJ130CA	PHK	DHK	144.00	159.00	1	130.00	2.00	14.40	209.00	72.00	270.03
SMDJ150A	-	PHM	-	167.00	185.00	1	150.00	2.00	12.30	243.00	61.50	313.95
-	SMDJ150CA*	-	DHM	167.00	185.00	1	150.00	2.00	12.30	243.00	61.50	313.95
SMDJ160A	-	PHP	-	178.00	197.00	1	160.00	2.00	11.60	259.00	58.00	334.63
-	SMDJ160CA*	-	DHP	178.00	197.00	1	160.00	2.00	11.60	259.00	58.00	334.63
SMDJ170A	-	PHR	-	189.00	209.00	1	170.00	2.00	10.90	275.00	54.50	355.30
-	SMDJ170CA*	-	DHR	189.00	209.00	1	170.00	2.00	10.90	275.00	54.50	355.30
SMDJ180A*	SMDJ180CA*	PHT	DHT	200.00	221.00	1	180.00	2.00	10.30	292.00	51.50	377.26
SMDJ200A*	SMDJ200CA*	PHV	DHV	224.00	247.00	1	200.00	2.00	9.30	324.00	46.50	418.60
SMDJ220A*	SMDJ220CA*	PKE	DKE	244.00	270.00	1	220.00	2.00	8.40	356.00	42.00	459.95
SMDJ250A*	SMDJ250CA*	PKG	DKG	279.00	309.00	1	250.00	2.00	7.40	405.00	37.50	523.26
SMDJ300A*	SMDJ300CA*	PKI	DKI	335.00	371.00	1	300.00	2.00	6.20	486.00	31.00	627.91
SMDJ350A*	SMDJ350CA*	PKJ	DKJ	391.00	432.00	1	350.00	2.00	5.30	567.00	26.50	732.56
SMDJ400A*	SMDJ400CA*	PKL	DKL	447.00	494.00	1	400.00	2.00	4.60	648.00	23.50	837.21
SMDJ440A*	SMDJ440CA*	PKN	DKN	492.00	543.00	1	440.00	2.00	4.20	713.00	21.50	921.19

Notes:

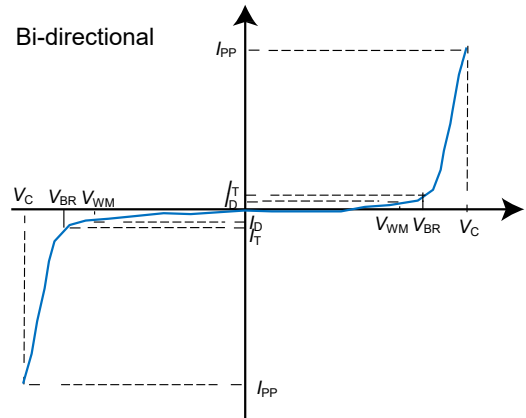
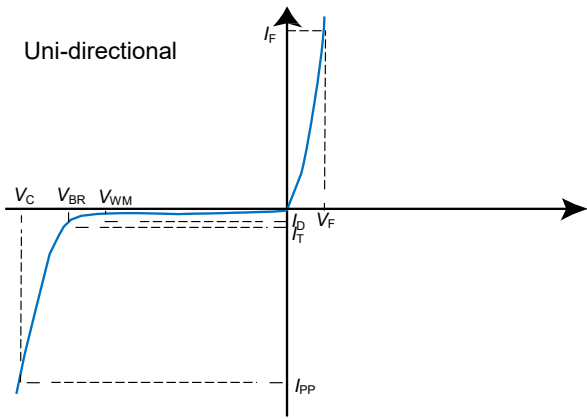
1. For bidirectional type having V_R of 10 volts and less, the I_R should be doubled.
2. For parts without A in the PN, the V_{BR} tolerance is $\pm 10\%$ and V_C is 5% higher than parts with A. The parts without A are currently available, but not recommended for new designs. The parts with A are preferred.
3. For stacked die component details, please refer to models marked with * in electrical characteristics table.

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I-V Curve Characteristics



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

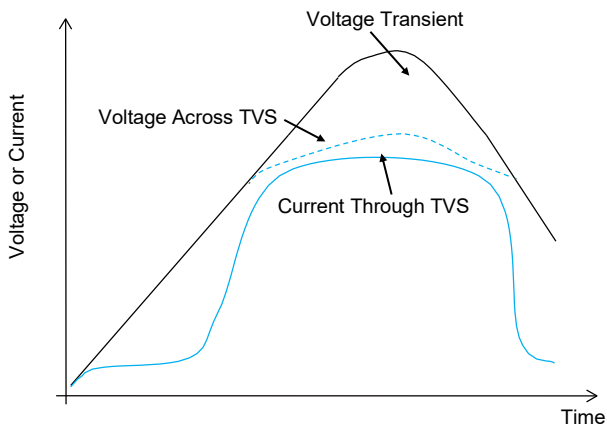


FIGURE 1 TVS Transients Clamping Waveform

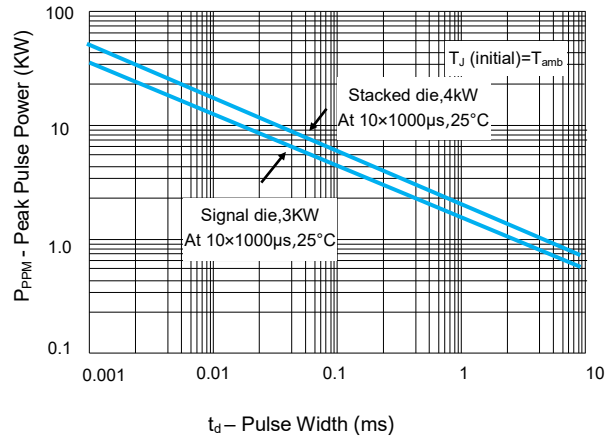


FIGURE 2 Peak Pulse Power Rating Curve

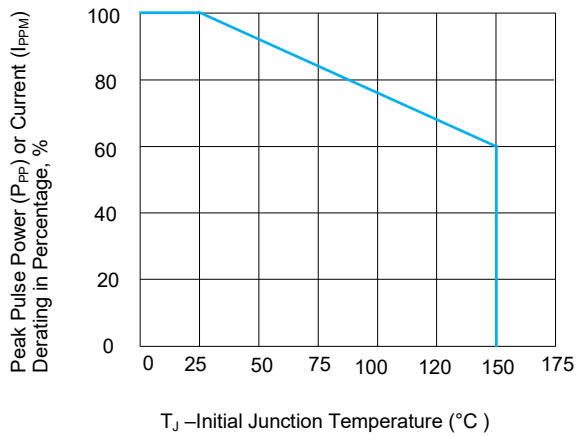


FIGURE 3 Peak Pulse Power Derating Curve

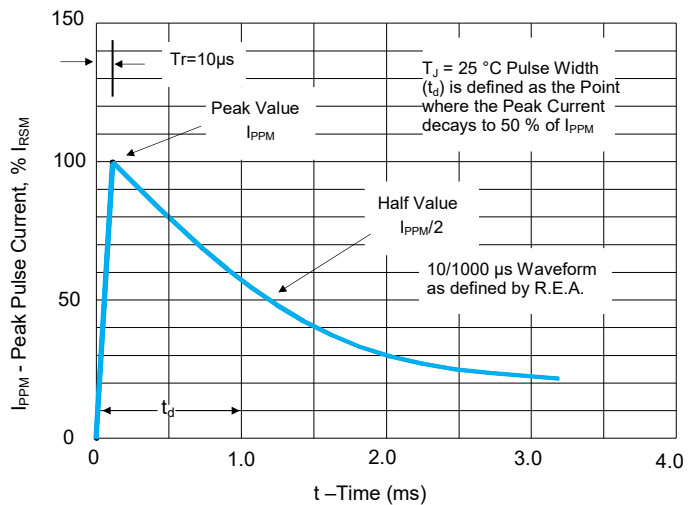


FIGURE 4 Pulse Waveform

TVS Diodes

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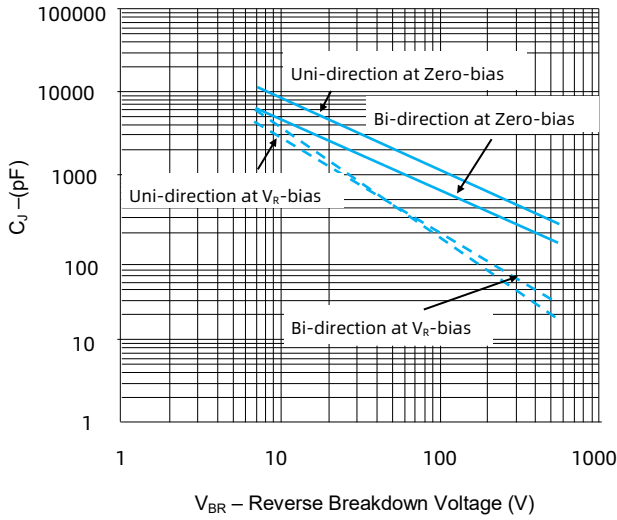


FIGURE 5 Typical Junction Capacitance

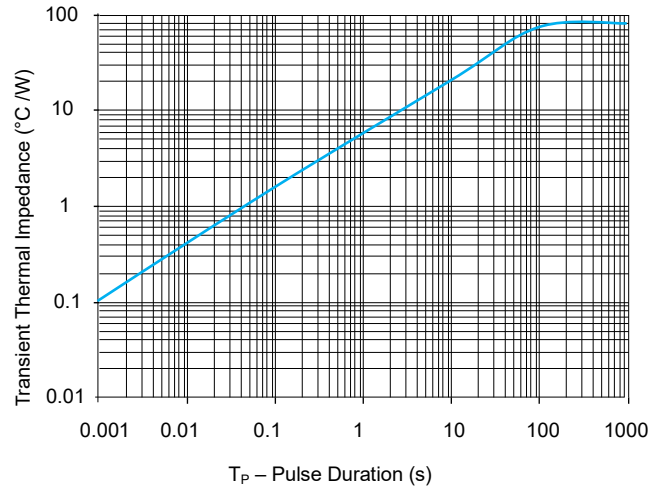


FIGURE 6 Typical Transient Thermal Impedance

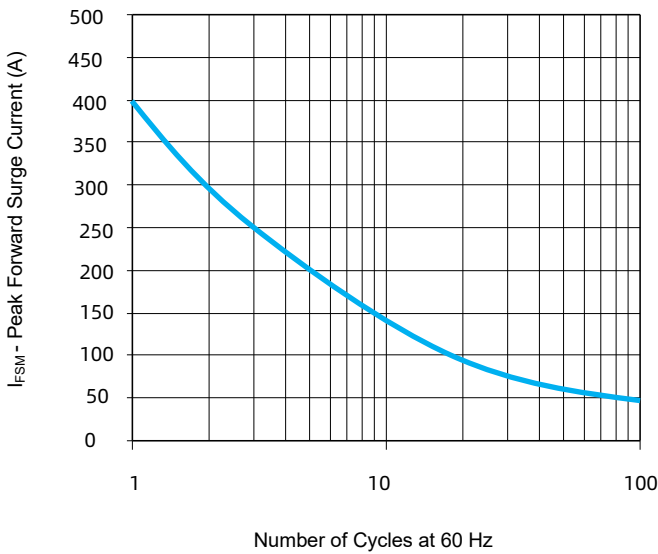


FIGURE 7 Maximum Non-Repetitive Forward Surge Current Uni-Directional only

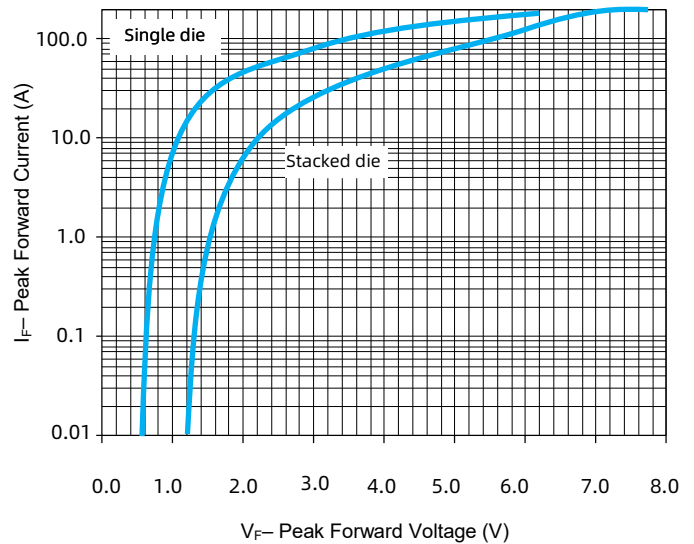


FIGURE 8 Peak Forward Drop vs Peak Forward Current (Typical Values)

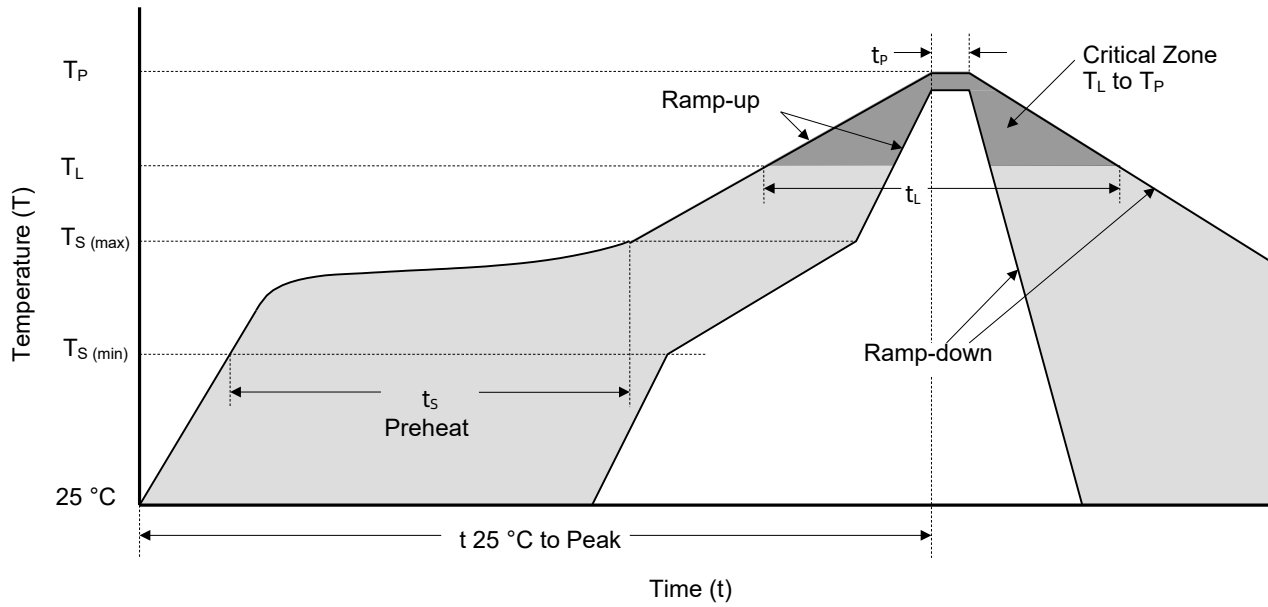
Environmental Specifications

High Temp. Storage	JESD22-A103
HTRB	JESD22-A108
Temperature Cycling	JESD22-A104
MSL	JESDEC-J-STD-020, Level 1
H3TRB	JESD22-A101
RSH	JESD22-A111

Physical Specifications

Weight	0.007 ounce, 0.21 grams
Case	JESD22DO214AB. Molded plastic body over glass passivated junction
Polarity	Color band denotes positive end (cathode) except Bidirectional
Terminal	Matte Tin-plated leads, Solderability per JESD22-B102

Soldering Parameters



Reflowing Condition

Reflow Soldering Parameters		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 ~ 120 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_L)	60 ~ 150 seconds
Peak Temperature (T_P)		260 ^{+0/-5} °C
Time of within 5 °C of Actual Peak Temperature (t_p)		20 ~ 40 seconds
Ramp-down Rate		6 °C / second max.
Time from 25 °C to Peak Temperature		8 Minutes max.
Do Not Exceed		260 °C

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Packaging Information

Tape	Symbol	Dimension (mm)
	W	16.00 + 0.3 / -0.1
	P ₀	4.00 ± 0.10
	P ₁	8.00 ± 0.10
	P ₂	2.00 ± 0.10
	D ₀	1.55 ± 0.05
	D ₁	1.55 ± 0.05
	E	1.75 ± 0.10
	F	7.50 ± 0.10
	A ₀	6.15 ± 0.10
	B ₀	8.30 ± 0.10
	K ₀	2.48 ± 0.10
	T	0.30 ± 0.05

Reel Size	13" Reel	
	A	330 mm
	C	13.2 mm
	W ₁	16.4 mm

Part Number	Package	QTY (Reel)	Packaging Option	Packaging Specification
SMDJxxx	DO-214AB	3000 PCS	Tape & Reel – 16 mm tape/13" reel	EIA STD RS-481

Glossary

Item	Description
V_C	Clamping Voltage Voltage across TVS in a region of low differential resistance that serves to limit the voltage across the device terminals.
V_R	Reverse Stand-off Voltage Maximum voltage that can be applied to the TVS without operation. NOTE : It is also shown as V_{WM} (maximum working voltage (maximum d.c. voltage)) and known as rated stand-off voltage (V_{so}).
I_R	Reverse Leakage Current Current measured at V_R . NOTE : Also shown as I_D for stand-by current.
V_{BR}	Breakdown Voltage Voltage across TVS at a specified current I_T in the breakdown region.
I_{PPM}	Rated Random Recurring Peak Impulse Current Maximum-rated value of random recurring peak impulse current that may be applied to a device.
$P_{M(AV)}$	Rated Average Power Dissipation Maximum-rated value of power dissipation resulting from all sources, including transients and standby current, averaged over a short period of time.
P_{PPM}	Rated Random Recurring Peak Impulse Power Dissipation Maximum-rated value of the product of rated random recurring peak impulse current (I_{PPM}) multiplies by specified maximum clamping voltage (V_C).
C_J	Capacitance Capacitance across the TVS measured at a specified frequency and voltage.
V_{FS}	Peak Forward Surge Voltage Peak voltage across an TVS for a specified forward surge current (I_{FS}) and time duration. NOTE : Also shown as V_F .
I_{FS}	Forward Surge Current Pulsed current through TVS in the forward conducting region. NOTE : Also shown as I_F .
$\alpha_{V(BR)}$	Temperature Coefficient of Breakdown Voltage The change of breakdown voltage divided by the change of temperature.
I_{PP}	Peak pulse Current Peak pulse current value applied across the TVS to determine the clamping voltage V_C for a specified wave shape.
I_T	Pulsed D.C. Test Current Test current for measurement of the breakdown voltage V_{BR} . This is defined by the manufacturer and usually given in milliamperes with a pulse duration of less than 40 ms. NOTE : Also shown as I_{BR} .

—(GB-T 18802.321 / IEC 61643-321 / JESD210A)



ATTENTION

Usage

1. TVS must be operated in the specified ambient temp.
2. Do not clean the TVS with strong polar solvent such as ketone, esters, benzene and halogenated hydrocarbon, to avoid damaging the encapsulating layer.
3. Please do not apply severe vibration, shock or pressure to TVS, to avoid element cracking.

Replacement

1. If TVS is visually damaged, please replace it.
2. TVS is a non-repairable product. For safety sake, please use equivalent TVS for replacement.

Storage

1. Storage Temp. Range: (-55 to 150) °C.
2. Do not store the TVS at the high temp., high humidity or corrosive gas environment, to avoid influencing the solder- ability of the lead wires. The product shall be used up within 1 year after receiving the goods.

Environmental Conditions

1. TVS should not be exposed to the open air, nor direct sunshine.
2. TVS should avoid rain, water vapor or other condition of high temp. and high humidity.
3. TVS should avoid sand dust, salt mist, or other harmful gases.


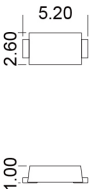
Max. Typical Capacitance of TVS

The typical capacitance of TVS is listed in the specifications. Designers may refer to it when designing TVS in High frequency circuit.

Installation Mechanical Stress

1. Do not knock TVS when installing, to avoid mechanical damage.
2. Please do not apply severe vibration, shock or pressure to TVS, to avoid surface resin or element cracking.

Transient Voltage Suppressor (Surface Mount) Features Overview

Package Type	Series	Series	Series	Series	Series	Series	Series	Series	Series
DO-221AC	○	○	○	○	○	SMA6L	○	○	○
DO-214AA	○	○	○	○	○	○	SACB	SMBJ	P6SMB
DO-214AB	○	○	○	○	○	○	○	○	○
DO-214AC	○	○	SMAJ	P4SMA	SMA6J	○	○	○	○
SOD-123FL	SMF	P4SMF	○	○	○	○	○	○	○
SMT0-218	○	○	○	○	○	○	○	○	○
Product Outline (mm)									
V_R / V_{WM} (V) Reverse Stand-off Voltage	5.0 ~ 250	5.0 ~ 85	5.0 ~ 440	5.8 ~ 468	5.0 ~ 250	5.0 ~ 50	5.0 ~ 440	5.8 ~ 512	
P_{PPM} (W) (10/1000 μ s) Rated Peak ImPulse Power Dissipation	200		400		600	500		600	
I_{PPM} (kA) (8/20 μ s) Rated Peak ImPulse Current					○				
Operating Temperature (°C)	-55 to +150								

Transient Voltage Suppressor (Surface Mount) Features Overview

Package Type	Series									
	DO-221AC	DO-214AA	DO-214AB	DO-214AC	SOD-123FL	SMT0-218	SPC1	SPC3	SPC6	SPC10
Product Outline (mm)										
V_R / V_{WM} (V) Reverse Stand-off Voltage	5.0 ~ 440	5.8 ~ 512	5.0 ~ 440		12 ~ 170	380 / 430	66	58 ~ 76	58 ~ 86	
P_{PPM} (W) (10/1000 μ s) Rated Peak ImPulse Power Dissipation	1500		3000		5000	○				
I_{PPM} (kA) (8/20 μ s) Rated Peak ImPulse Current	○					1	3	6	10	
Operating Temperature (°C)	-55 to +150					-55 to +125				

Transient Voltage Suppressor (Axial Lead) Features Overview

Package Type	Series																
	DO-201	DO-41	DO-15	P600	Radial lead	1.5KE	LCE										
	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	
	P4KE	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	
	○	SAC	P6KE	○	○	○	○	○	○	○	○	○	○	○	○	○	
	○	○	○	○	○	○	○	5KP	15KPA	20KPA	30KPA	○	○	○	○	○	
	○	○	○	○	○	○	○	○	○	○	○	SPCL1	SPCL3	SPCL6	SPCL10	SPCL15	SPCL20
Product Outline (mm)																	
V_R / V_{WM} (V) Reverse Stand-off Voltage	5.8 ~ 468	5.0 ~ 50	5.8 ~ 512	5.8 ~ 512	6.5 ~ 90	5.0 ~ 250	17 ~ 280	20 ~ 300	28 ~ 360	76	15 ~ 430	30 ~ 430	15 ~ 530	58 ~ 380	16 ~ 76		
P_{PPM} (W) (10/1000 μ s) Rated Peak ImPulse Power Dissipation	400	500	600	1500	5000	15000	20000	30000					○				
I_{PPM} (kA)(8/20 μ s) Rated Peak ImPulse Current					○					1	3	6	10	15	20		
Operating Temperature (°C)					-55 to +150												-55 to +125