TVS Diodes

Transient Voltage Suppression Diodes

SMDJ Series

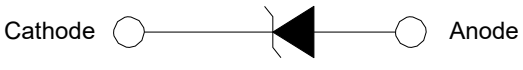
Description

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.

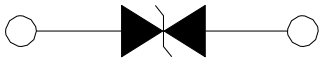
Applications

- 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 °C x (1+αT x (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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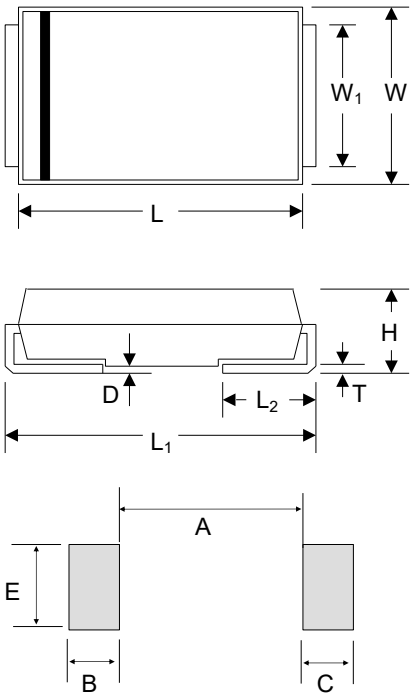
Package Outline Dimensions (DO-214AB)



Mounting Pad Layout

Symbol	Millimeters		Inches	
	Min.	Max.	Min.	Max.
L	6.600	7.110	0.260	0.280
W	5.590	6.220	0.220	0.245
W_1	2.900	3.200	0.114	0.126
H	2.060	2.620	0.079	0.103
T	0.1520	0.305	0.006	0.012
L_1	7.750	8.130	0.305	0.320
L_2	0.760	1.520	0.030	0.060
D	-	0.203	-	0.008
A	-	4.200	-	0.165
B	2.400	-	0.094	-
C	2.400	-	0.094	-
E	3.300	-	0.129	-

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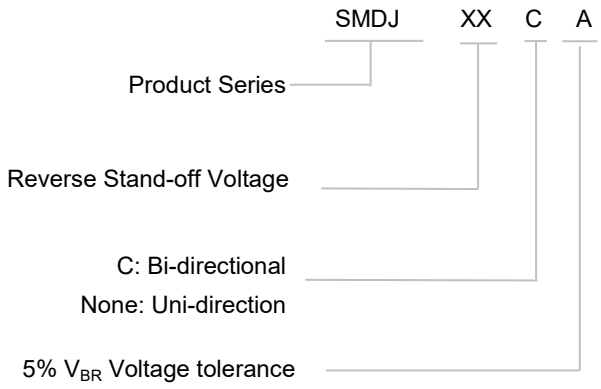
Maximum Ratings and Characteristics

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

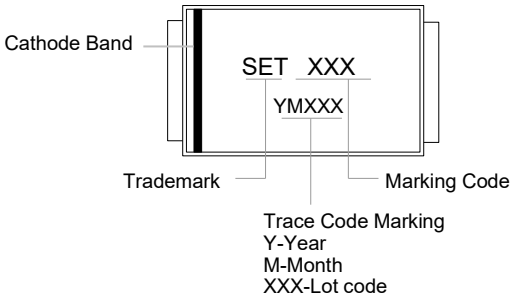
Parameter	Symbol	Value	Unit
Peak Power Dissipation (Fig.2)- with a 10/1000 μS waveform[1][2](Fig.4)-Single Die Parts	P_{PPM}	3000	W
Peak Pulse Power Dissipation(Fig.2) by 10/1000 μS Test Waveform[1][2]((Fig.4) -Stacked Die Parts [5]	P_{PPM}	4000	W
Peak Power Dissipation on Infinite Heat Sink at T_L=50 °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	$R_{\theta JL}$	15	°C / W
Typical Thermal Resistance Junction to Ambient	$R_{\theta JA}$	75	°C / W

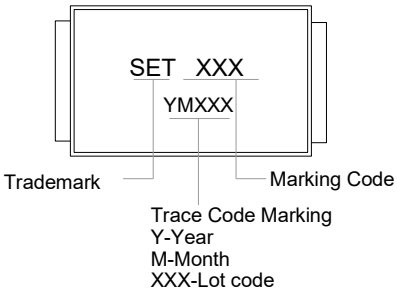
Notes
1. Non-repetitive current pulse, per Fig. 4 and derated above T_J (initial)=25 °C per Fig. 3.
2. Mounted on 8.0 mm^2 land areas.
3. Measured of 8.3 ms single half sine-wave or equivalent square wave, duty cycle=4 pulses per minute maximum.
4. V_F < 3.5 V for single die parts and V_F< 5.0 V for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

Part Numbering System



Marking





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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)

Electrical Characteristics (T_A=25 °C unless otherwise noted)Table 1

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	6.4	7	10	5	800	326.1	9.2	1630.5	11.89
SMDJ6.0A	SMDJ6.0CA	RDG	DDG	6.67	7.37	10	6	800	291.3	10.3	1456.5	13.31
SMDJ6.5A	SMDJ6.5CA	RDK	DDK	7.22	7.98	10	6.5	500	267.9	11.2	1339.5	14.47
SMDJ7.0A	SMDJ7.0CA	PDM	DDM	7.78	8.6	10	7	200	250	12	1250	15.5
SMDJ7.5A	SMDJ7.5CA	PDP	DDP	8.33	9.21	1	7.5	100	232.6	12.9	1163	16.67
SMDJ8.0A	SMDJ8.0CA	PDR	DDR	8.89	9.83	1	8	50	220.6	13.6	1103	17.57
SMDJ8.5A	SMDJ8.5CA	PDT	DDT	9.44	10.4	1	8.5	20	208.3	14.4	1041.5	18.6
SMDJ9.0A	SMDJ9.0CA	PDV	DDV	10	11.1	1	9	10	194.8	15.4	974	19.9
SMDJ10A	SMDJ10CA	PDX	DDX	11.1	12.3	1	10	5	176.5	17	882.5	21.96
SMDJ11A	SMDJ11CA	PDZ	DDZ	12.2	13.5	1	11	2	164.8	18.2	824	23.51
SMDJ12A	SMDJ12CA	PEE	DEE	13.3	14.7	1	12	2	150.8	19.9	754	25.71
SMDJ13A	SMDJ13CA	PEG	DEG	14.4	15.9	1	13	2	139.5	21.5	697.5	27.78
SMDJ14A	SMDJ14CA	PEK	DEK	15.6	17.2	1	14	2	129.3	23.2	646.5	29.97
SMDJ15A	SMDJ15CA	PEM	DEM	16.7	18.5	1	15	2	123	24.4	615	31.52
SMDJ16A	SMDJ16CA	PEP	DEP	17.8	19.7	1	16	2	115.4	26	577	33.59
SMDJ17A	SMDJ17CA	PER	DER	18.9	20.9	1	17	2	108.7	27.6	543.5	35.66
SMDJ18A	SMDJ18CA	PET	DET	20	22.1	1	18	2	102.7	29.2	513.5	37.73
SMDJ20A	SMDJ20CA	PEV	DEV	22.2	24.5	1	20	2	92.6	32.4	463	41.86
SMDJ22A	SMDJ22CA	PEX	DEX	24.4	26.9	1	22	2	84.5	35.5	422.5	45.87
SMDJ24A	SMDJ24CA	PEZ	DEZ	26.7	29.5	1	24	2	77.1	38.9	385.5	50.26
SMDJ26A	SMDJ26CA	PFE	DFE	28.9	31.9	1	26	2	71.3	42.1	356.5	54.39
SMDJ28A	SMDJ28CA	PFG	DFG	31.1	34.4	1	28	2	66.1	45.4	330.5	58.66
SMDJ30A	SMDJ30CA	PFK	DFK	33.3	36.8	1	30	2	62	48.4	310	62.53
SMDJ33A	SMDJ33CA	PFM	DFM	36.7	40.6	1	33	2	56.3	53.3	281.5	68.86
SMDJ36A	SMDJ36CA	PFP	DFP	40	44.2	1	36	2	51.6	58.1	258	75.06

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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)
SMDJ40A	SMDJ40CA	PFR	DFR	44.4	49.1	1	40	2	46.5	64.5	232.5	83.33
SMDJ43A	SMDJ43CA	PFT	DFT	47.8	52.8	1	43	2	43.2	69.4	216	89.66
SMDJ45A	SMDJ45CA	PFV	DFV	50	55.3	1	45	2	41.3	72.7	206.5	93.93
SMDJ48A	SMDJ48CA	PFX	DFX	53.3	58.9	1	48	2	38.8	77.4	194	100
SMDJ51A	SMDJ51CA	PFZ	DFZ	56.7	62.7	1	51	2	36.4	82.4	182	106.46
SMDJ54A	SMDJ54CA	RGE	DGE	60	66.3	1	54	2	34.4	87.1	172	112.53
SMDJ58A	SMDJ58CA	PGG	DGG	64.4	71.2	1	58	2	32.1	93.6	160.5	120.93
SMDJ60A	SMDJ60CA	PGK	DGK	66.7	73.7	1	60	2	31	96.8	155	125.06
SMDJ64A	SMDJ64CA	PGM	DGM	71.1	78.6	1	64	2	29.1	103	145.5	133.07
SMDJ70A	SMDJ70CA	PGP	DGP	77.8	86	1	70	2	26.5	113	132.5	145.99
SMDJ75A	SMDJ75CA	PGR	DGR	83.3	92.1	1	75	2	24.8	121	124	156.33
SMDJ78A	SMDJ78CA	PGT	DGT	86.7	95.8	1	78	2	23.8	126	119	162.79
SMDJ85A	SMDJ85CA	PGV	DGV	94.4	104	1	85	2	21.9	137	109.5	177
SMDJ90A	SMDJ90CA	PGX	DGX	100	111	1	90	2	20.5	146	102.5	188.63
SMDJ100A	SMDJ100CA	PGZ	DGZ	111	123	1	100	2	18.5	162	92.5	209.3
SMDJ110A	SMDJ110CA	PHE	DHE	122	135	1	110	2	16.9	177	84.5	228.68

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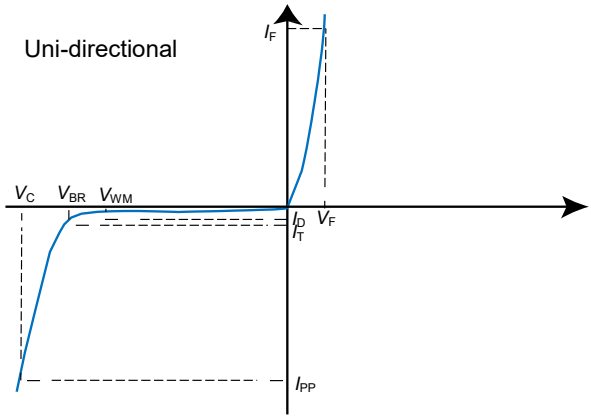
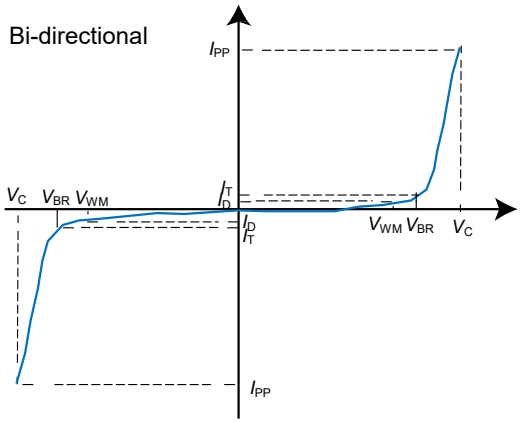
Part Number		Device Marking Code		Breakdown Voltage $V_{BR}@I_T$		Test Current I_T	Reverse Stand-off Voltage V_R	Max. Reverse Leakage $I_R@V_R$	Max. Peak Pulse Current I_{PPM}(10/1000 μS)	Max. Clamping Voltage $V_C@I_{PPM}$ (10/1000 μS)	Max. Peak Pulse Current I_{PPM}(8/20 μS)	Max. Clamping Voltage $V_C@I_{PPM}$ (8/20 μS)
				Min	Max							
Uni	Bi	Uni	Bi	(V)		(mA)	(V)	(μA)	(A)	(V)	(A)	(V)
SMDJ120A	SMDJ120CA	PHG	DHG	133	147	1	120	2	15.5	193	77.5	249.35
SMDJ130A	SMDJ130CA	PHK	DHK	144	159	1	130	2	14.4	209	72	270.03
SMDJ150A	-	PHM	-	167	185	1	150	2	12.3	243	61.5	313.95
-	SMDJ150CA*	-	DHM	167	185	1	150	2	12.3	243	61.5	313.95
SMDJ160A	-	PHP	-	178	197	1	160	2	11.6	259	58	334.63
-	SMDJ160CA*	-	DHP	178	197	1	160	2	11.6	259	58	334.63
SMDJ170A	-	PHR	-	189	209	1	170	2	10.9	275	54.5	355.3
-	SMDJ170CA*	-	DHR	189	209	1	170	2	10.9	275	54.5	355.3
SMDJ180A*	SMDJ180CA*	PHT	DHT	200	221	1	180	2	10.3	292	51.5	377.26
SMDJ200A*	SMDJ200CA*	PHV	DHV	224	247	1	200	2	9.3	324	46.5	418.6
SMDJ220A*	SMDJ220CA*	PKE	DKE	244	270	1	220	2	8.4	356	42	459.95
SMDJ250A*	SMDJ250CA*	PKG	DKG	279	309	1	250	2	7.6	405	37.5	523.26
SMDJ300A*	SMDJ300CA*	PKI	DKI	335	371	1	300	2	6.2	486	31	627.91
SMDJ350A*	SMDJ350CA*	PKJ	DKJ	391	432	1	350	2	5.4	567	26.5	732.56
SMDJ400A*	SMDJ400CA*	PKL	DKL	447	494	1	400	2	4.8	648	23.5	837.21
SMDJ440A*	SMDJ440CA*	PKN	DKN	492	543	1	440	2	4.4	713	21.5	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 ± 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.

I-V Curve Characteristics





Performance Curve for Reference (T_A=25 °C unless otherwise noted)

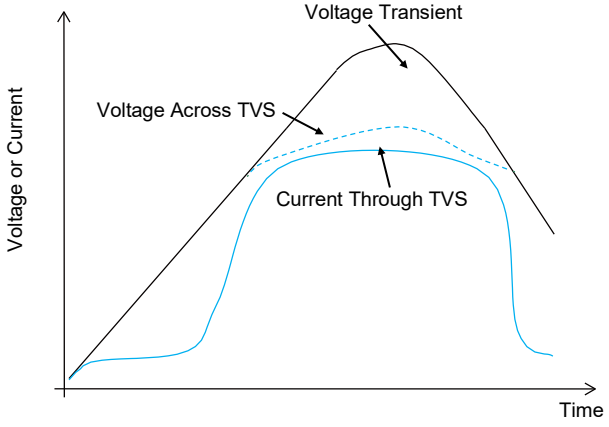


FIGURE 1 TVS Transients Clamping Waveform

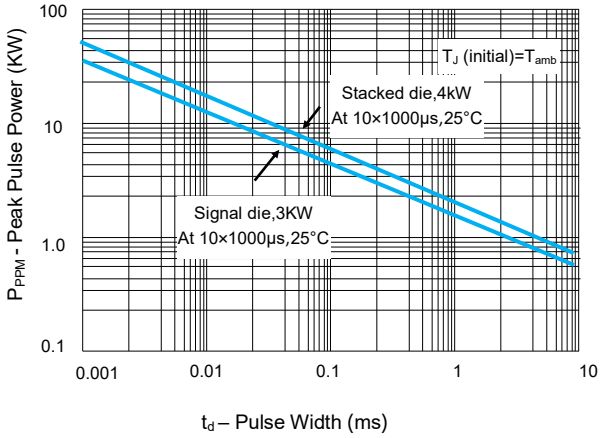


FIGURE 2 Peak Pulse Power Rating Curve

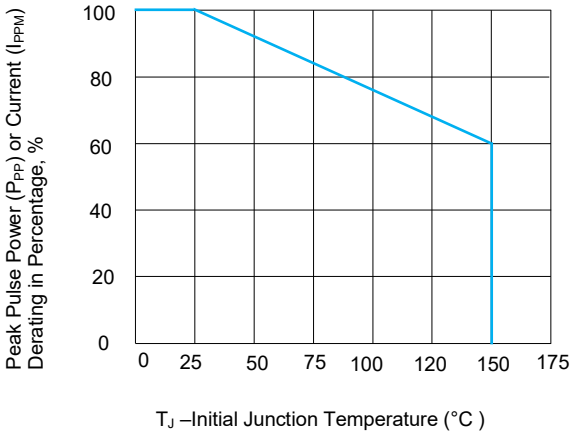


FIGURE 3 Peak Pulse Power Derating Curve

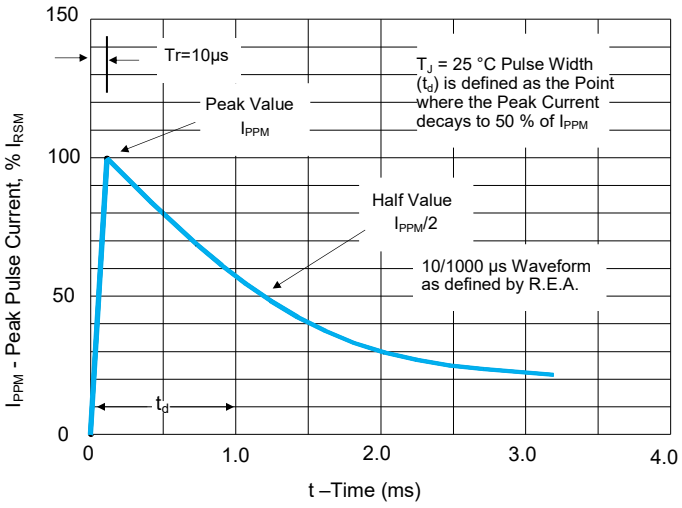


FIGURE 4 Pulse Waveform

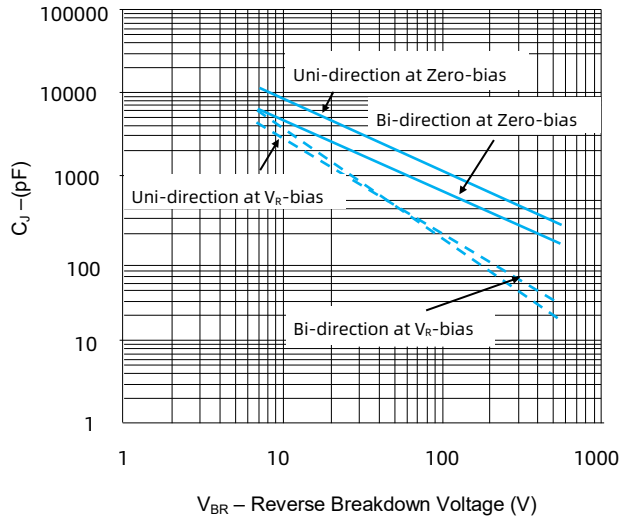


FIGURE 5 Typical Junction Capacitance

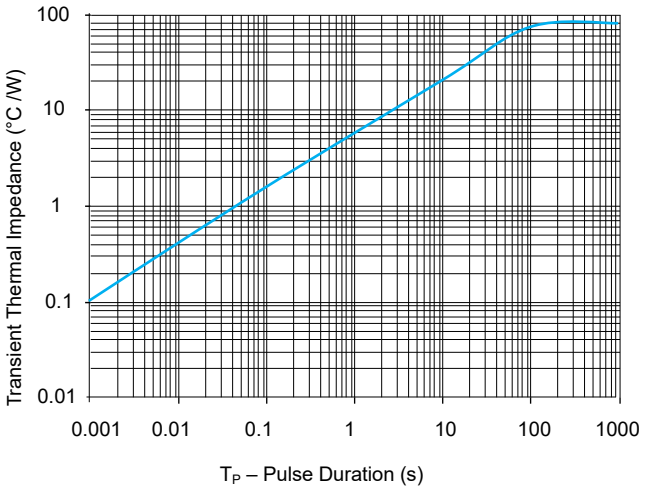


FIGURE 6 Typical Transient Thermal Impedance

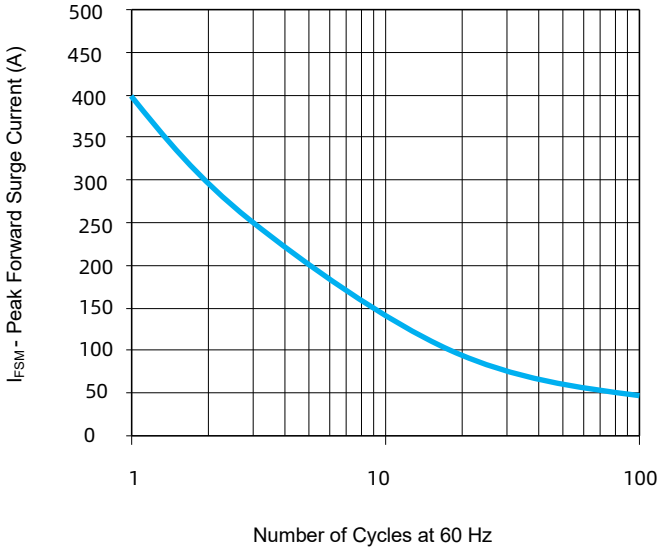


FIGURE 7 Maximum Non-Repetitive Forward Surge Current Uni-Directional only

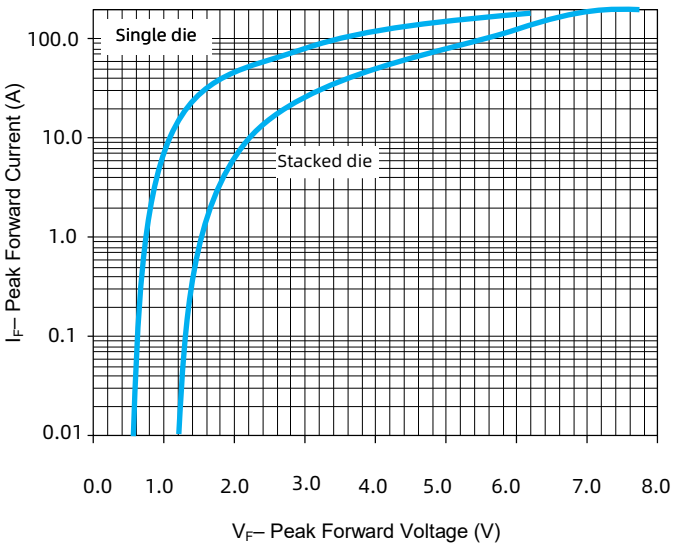


FIGURE 8 Peak Forward Drop vs Peak Forward Current (Typical Values)

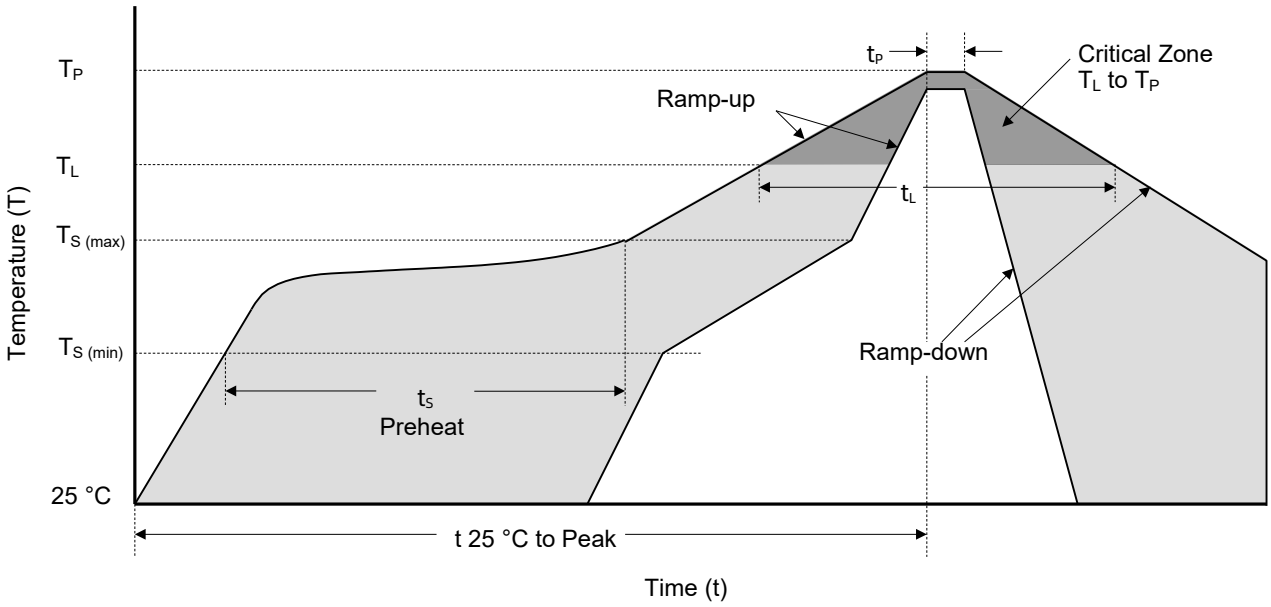
Environmental Specifications

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

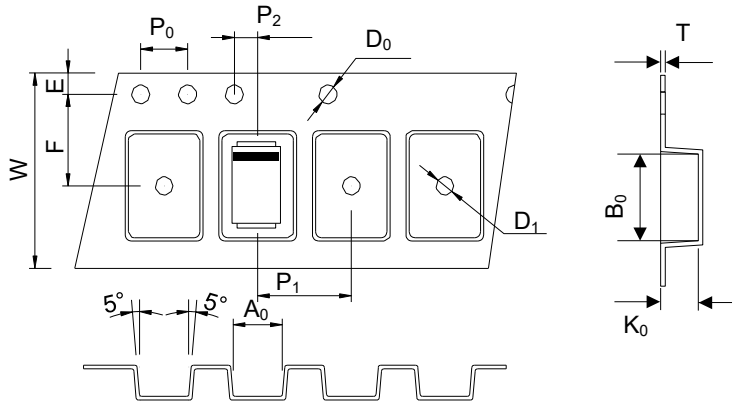
Soldering Parameters

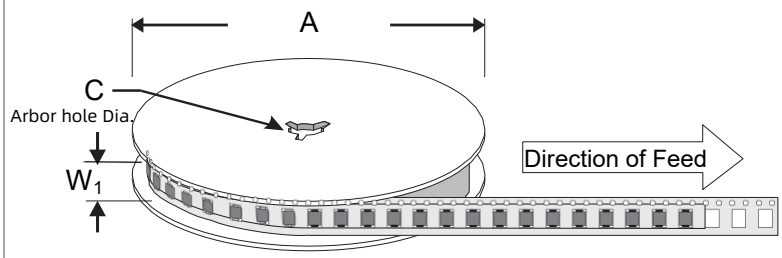


Reflowing Condition

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 (TL) 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

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
SMDJ×××	DO-214AB	3000 PCS	Tape & Reel – 16 mm tape/13" reel	EIA STD RS-481

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.