TVS Diodes

Transient Voltage Suppression Diodes

1.5 SMC Series

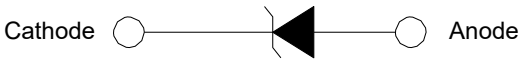
Description

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

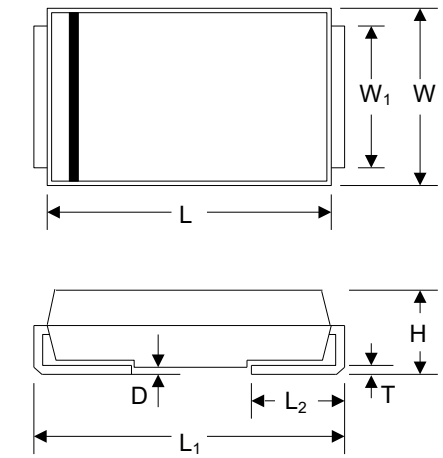
Bi-Directional

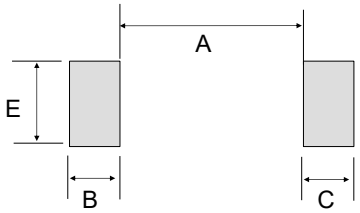
Features

- Low incremental surge resistance
- Excellent clamping capability
- Low profile package with built-in strain relief
- Typical I_R less than 1.0 μA above 12 V
- 1500 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/30sec
- 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)

TVS

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	-

TVS

Maximum Ratings and Characteristics

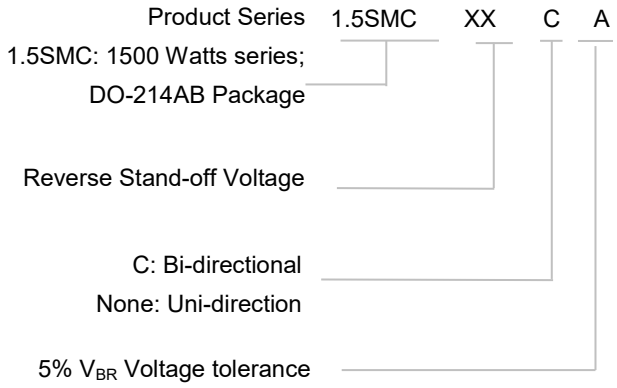
(Ratings at 25 °C ambient temperature unless otherwise specified.)

Parameter	Symbol	Value	Unit
Peak Power Dissipation(Fig.2)- with a 10/1000 μS waveform(1)(2)(Fig.4)-Single Die Parts	P_{PPM}	1500	W
Peak Power Dissipation with a 10/1000 μS waveform(1)(2)(Fig.2)-Stacked Die Parts(5)	P_{PPM}	2000	W
Peak Power Dissipation on Infinite Heat Sink at T_L=50 °C	P_D	6.5	W
Peak Forward Surge Current,8.3ms single half sinewave superimposed on rated load (JEDEC Method)(3)	I_{FSM}	200	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

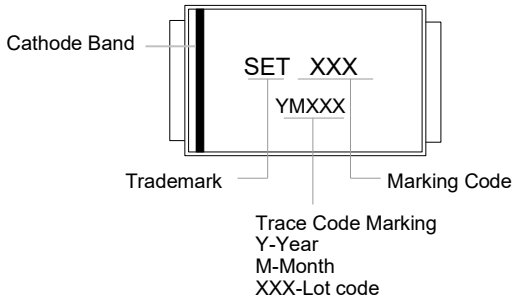
Notes
1.Non-repetitive current pulse, per Fig. 4 and derated above T_J (initial)=25 °C per Fig. 3.
2.Mounted on 8.0 mm^2 (.013 mm thick) land areas.
3.Measured of 8.3 ms single half sine-wave or equivalent square wave, duty cycle=4 pulses per minute maximum.
4.V_F < 3.5 V for single die parts and V_F< 5.0V for stacked-die parts.
5.For stacked die component details, please refer to models marked with * in electrical characteristics table.

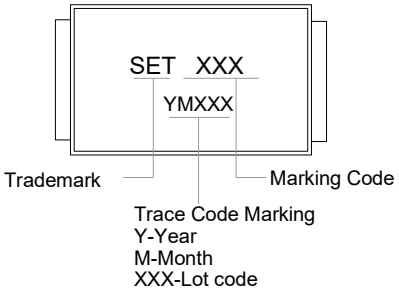
TVS

Part Numbering System



Marking





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

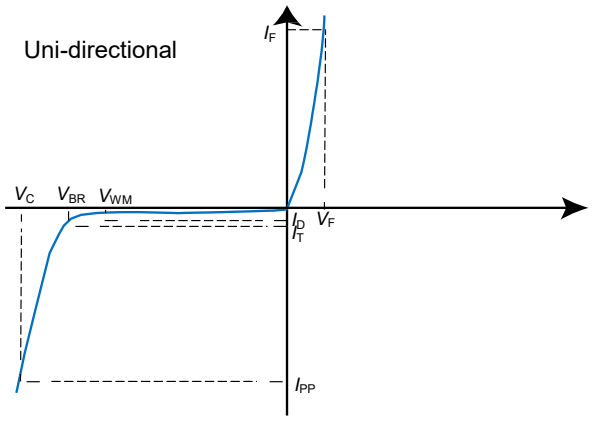
Part Number		Device Marking Code		Breakdown Voltage V_{BR}@I_T		Test Current I_T	Reverse Stand-off Voltage V_R	Max. Reverse Leakage I_R@V_R	Max. Peak Pulse Current I_{PPM}	Max. Clamping Voltage V_C@I_{PPM}
				Min	Max					
Uni	Bi	Uni	Bi	(V)		(mA)	(V)	(μA)	(A)	(V)
1.5SMC6.8A	1.5SMC6.8CA	6V8A	6V8C	6.45	7.14	10	5.8	1000	144.8	10.5
1.5SMC7.5A	1.5SMC7.5CA	7V5A	7V5C	7.13	7.88	10	6.4	500	134.5	11.3
1.5SMC8.2A	1.5SMC8.2CA	8V2A	8V2C	7.79	8.61	10	7.02	200	125.6	12.1
1.5SMC9.1A	1.5SMC9.1CA	9V1A	9V1C	8.65	9.5	1	7.78	50	113.4	13.4
1.5SMC10A	1.5SMC10CA	10A	10C	9.5	10.5	1	8.55	10	104.8	14.5
1.5SMC11A	1.5SMC11CA	11A	11C	10.5	11.6	1	9.4	5	97.4	15.6
1.5SMC12A	1.5SMC12CA	12A	12C	11.4	12.6	1	10.2	5	91	16.7
1.5SMC13A	1.5SMC13CA	13A	13C	12.4	13.7	1	11.1	1	83.5	18.2
1.5SMC15A	1.5SMC15CA	15A	15C	14.3	15.8	1	12.8	1	71.7	21.2
1.5SMC16A	1.5SMC16CA	16A	16C	15.2	16.8	1	13.6	1	67.6	22.5
1.5SMC18A	1.5SMC18CA	18A	18C	17.1	18.9	1	15.3	1	60.3	25.2
1.5SMC20A	1.5SMC20CA	20A	20C	19	21	1	17.1	1	54.9	27.7
1.5SMC22A	1.5SMC22CA	22A	22C	20.9	23.1	1	18.8	1	49.7	30.6
1.5SMC24A	1.5SMC24CA	24A	24C	22.8	25.2	1	20.5	1	45.8	33.2
1.5SMC27A	1.5SMC27CA	27A	27C	25.7	28.4	1	23.1	1	40.5	37.5
1.5SMC30A	1.5SMC30CA	30A	30C	28.5	31.5	1	25.6	1	36.7	41.4
1.5SMC33A	1.5SMC33CA	33A	33C	31.4	34.7	1	28.2	1	33.3	45.7
1.5SMC36A	1.5SMC36CA	36A	36C	34.2	37.8	1	30.8	1	30.5	49.9
1.5SMC39A	1.5SMC39CA	39A	39C	37.1	41	1	33.3	1	28.2	53.9
1.5SMC43A	1.5SMC43CA	43A	43C	40.9	45.2	1	36.8	1	25.6	59.3
1.5SMC47A	1.5SMC47CA	47A	47C	44.7	49.4	1	40.2	1	23.5	64.8
1.5SMC51A	1.5SMC51CA	51A	51C	48.5	53.6	1	43.6	1	21.7	70.1
1.5SMC56A	1.5SMC56CA	56A	56C	53.2	58.8	1	47.8	1	19.7	77
1.5SMC62A	1.5SMC62CA	62A	62C	58.9	65.1	1	53	1	17.9	85
1.5SMC68A	1.5SMC68CA	68A	68C	64.6	71.4	1	58.1	1	16.5	92

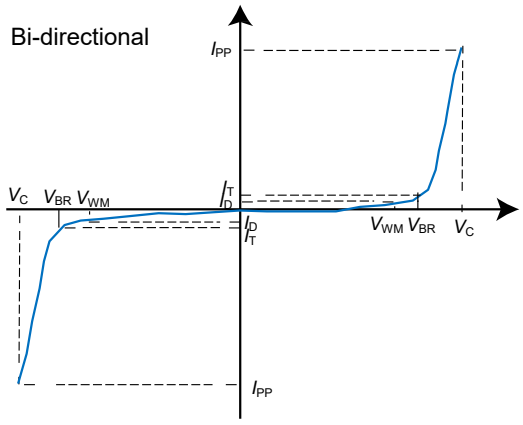
TVS

Part Number		Device Marking Code		Breakdown Voltage $V_{BR}@I_T$		Test Current I_T	Reverse Stand-off Voltage V_{WM}	Max. Reverse Leakage $I_R@V_{WM}$	Max. Peak Pulse Current I_{PPM}	Max. Clamping Voltage $V_C@I_{PPM}$
				Min	Max					
Uni	Bi	Uni	Bi	(V)		(mA)	(V)	(μA)	(A)	(V)
1.5SMC75A	1.5SMC75CA	75A	75C	71.3	78.8	1	64.1	1	14.8	103
1.5SMC82A	1.5SMC82CA	82A	82C	77.9	86.1	1	70.1	1	13.5	113
1.5SMC91A	1.5SMC91CA	91A	91C	86.5	95.5	1	77.8	1	12.2	125
1.5SMC100A	1.5SMC100CA	100A	100C	95	105	1	85.5	1	11.1	137
1.5SMC110A	1.5SMC110CA	110A	110C	105	116	1	94	1	10	152
1.5SMC120A	1.5SMC120CA	120A	120C	114	126	1	102	1	9.2	165
1.5SMC130A	1.5SMC130CA	130A	130C	124	137	1	111	1	8.5	179
1.5SMC150A	1.5SMC150CA	150A	150C	143	158	1	128	1	7.3	207
1.5SMC160A	1.5SMC160CA	160A	160C	152	168	1	136	1	6.9	219
1.5SMC170A	1.5SMC170CA	170A	170C	162	179	1	145	1	6.5	234
1.5SMC180A	1.5SMC180CA	180A	180C	171	189	1	154	1	6.2	246
1.5SMC200A	1.5SMC200CA	200A	200C	190	210	1	171	1	5.5	274
1.5SMC220A	1.5SMC220CA	220A	220C	209	231	1	185	1	4.6	328
1.5SMC250A	1.5SMC250CA	250A	250C	237	263	1	214	1	4.4	344
1.5SMC300A	1.5SMC300CA	300A	300C	285	315	1	256	1	3.7	414
1.5SMC350A*	1.5SMC350CA*	350A	350C	332	368	1	300	1	4.2	482
1.5SMC400A*	1.5SMC400CA*	400A	400C	380	420	1	342	1	3.7	548
1.5SMC440A*	1.5SMC440CA*	440A	440C	418	462	1	376	1	3.4	602
1.5SMC480A*	1.5SMC480CA*	480A	480C	456	504	1	408	1	3.1	658
1.5SMC510A*	1.5SMC510CA*	510A	510C	485	535	1	434	1	2.9	698
1.5SMC530A*	1.5SMC530CA*	530A	530C	503.5	556.5	1	451	1	2.8	725
1.5SMC540A*	1.5SMC540CA*	540A	540C	513	567	1	460	1	2.8	740
1.5SMC550A*	1.5SMC550CA*	550A	550C	522.5	577.5	1	468	1	2.7	760
1.5SMC600A*	1.5SMC600CA*	600A	600C	570	630	1	512	1	2.5	828

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)

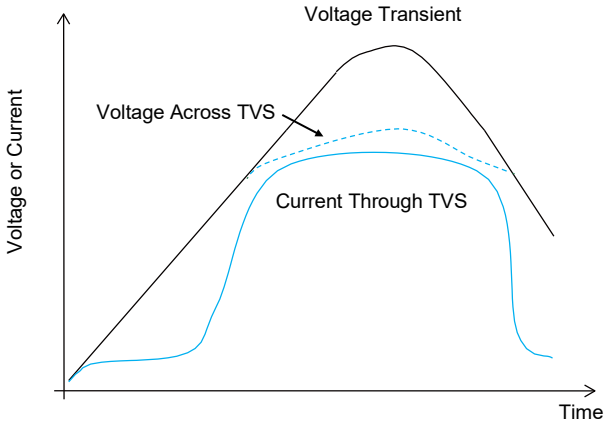


FIGURE 1 TVS Transients Clamping Waveform

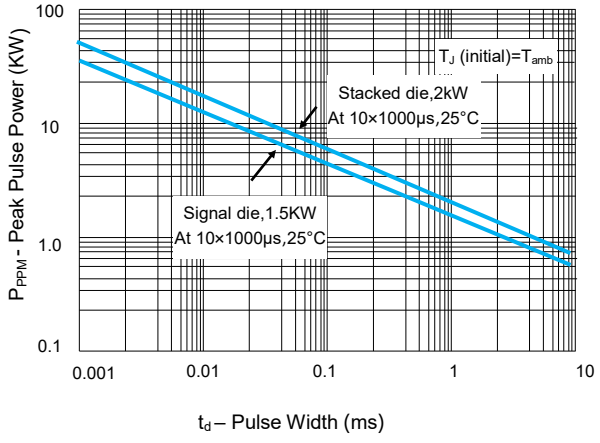


FIGURE 2 Peak Pulse Power Rating Curve

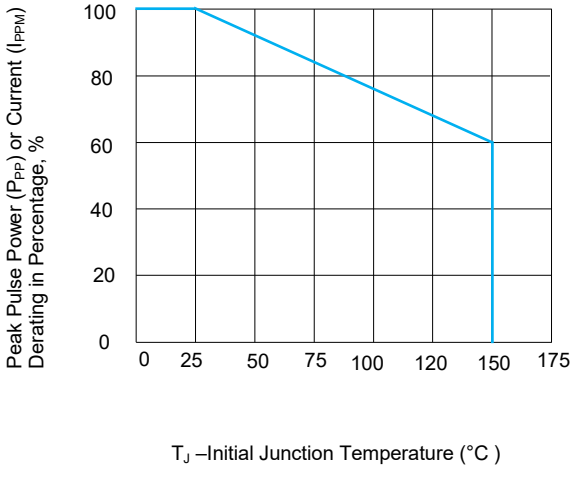


FIGURE 3 Peak Pulse Power Derating Curve

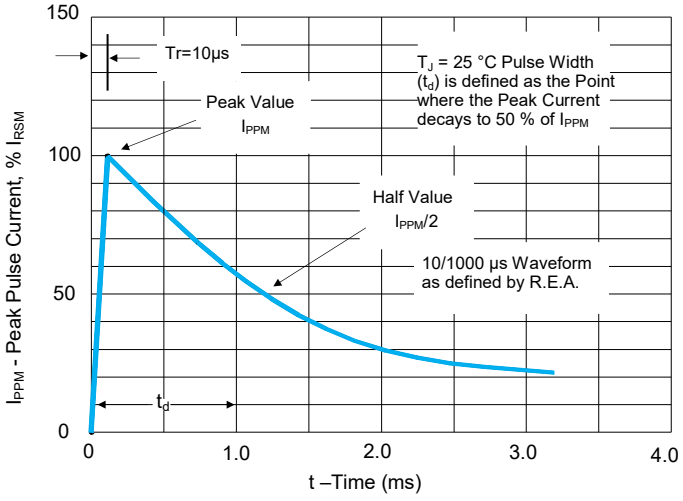


FIGURE 4 Pulse Waveform

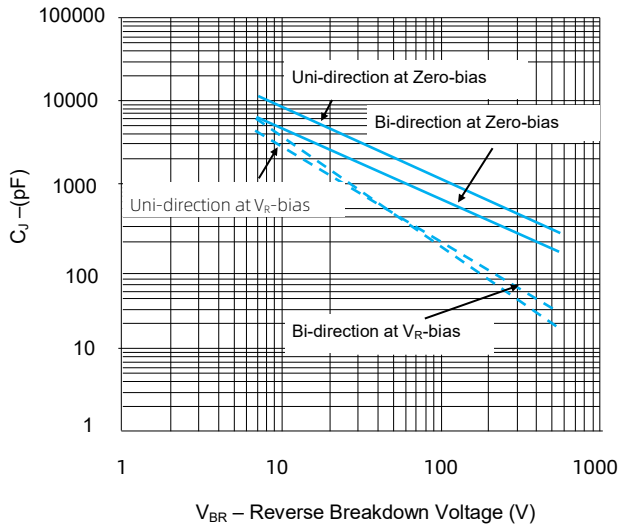


FIGURE 5 Typical Junction Capacitance

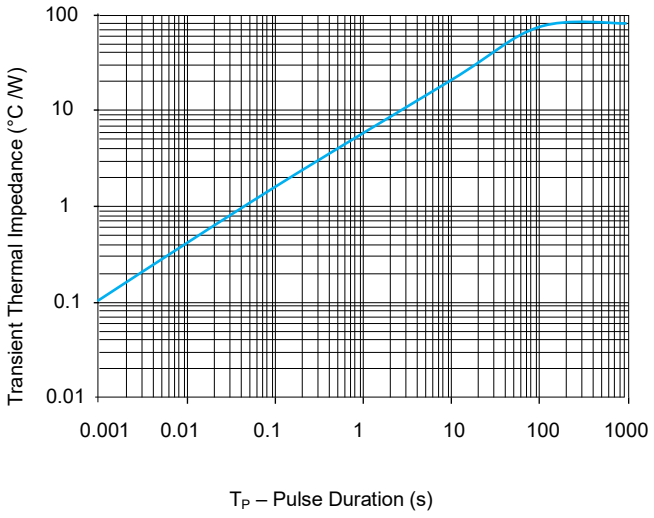


FIGURE 6 Typical Transient Thermal Impedance

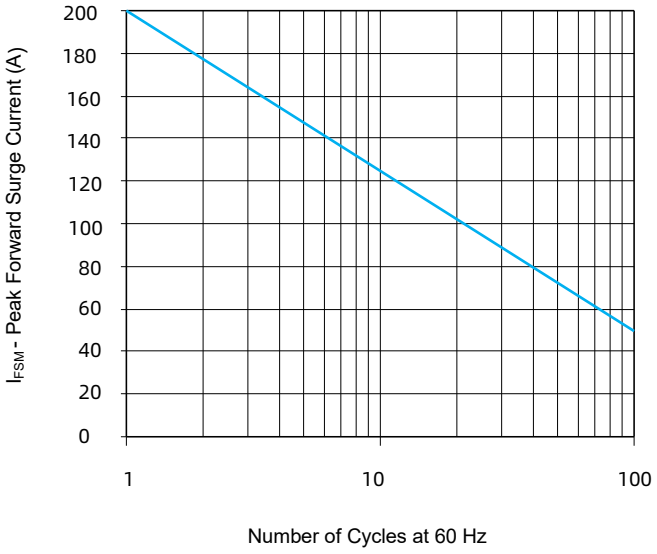


FIGURE 7 Maximum Non-Repetitive Forward Surge Current Uni-Directional only

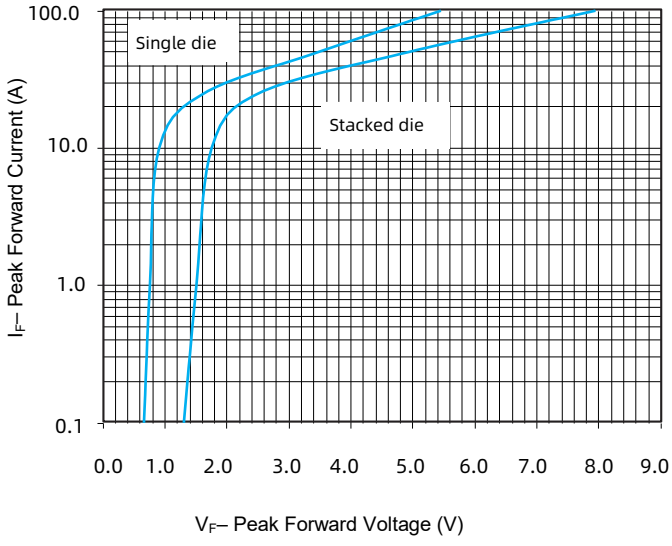


FIGURE 8 Peak Forward Drop vs Peak Forward Current (Typical Values)

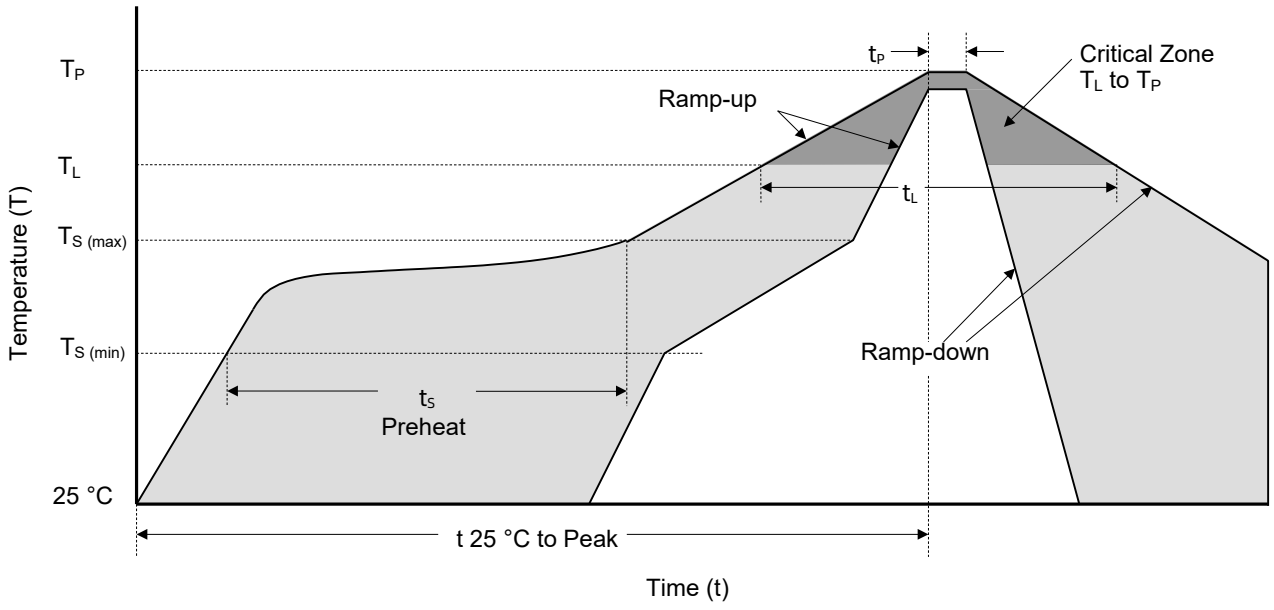
Environmental Specifications

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

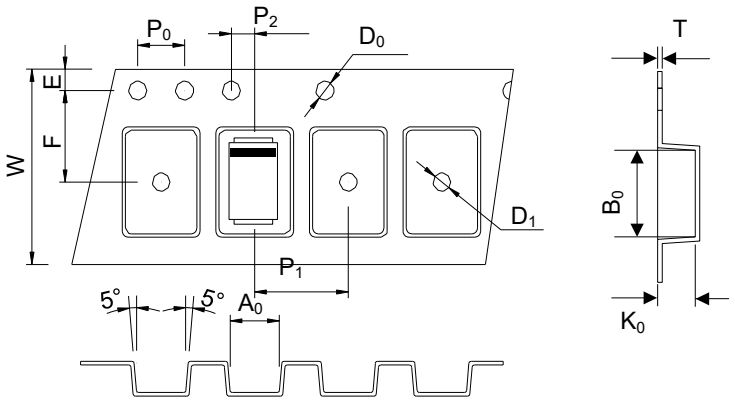
Soldering Parameters

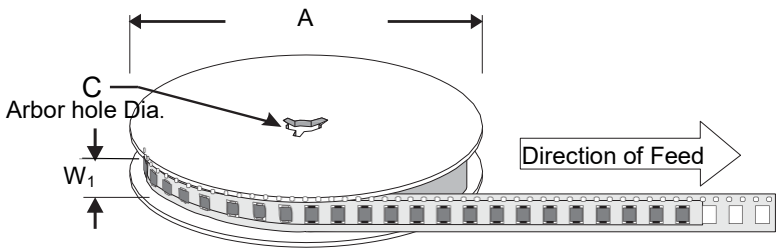


Reflowing Condition

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
1.5SMCxxx	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.