TVS Diodes

Transient Voltage Suppression Diodes

A5.0SMD Series

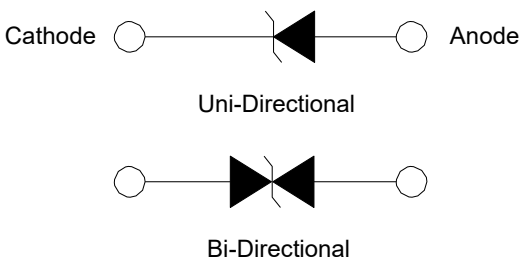
Description

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
- Surge Protection

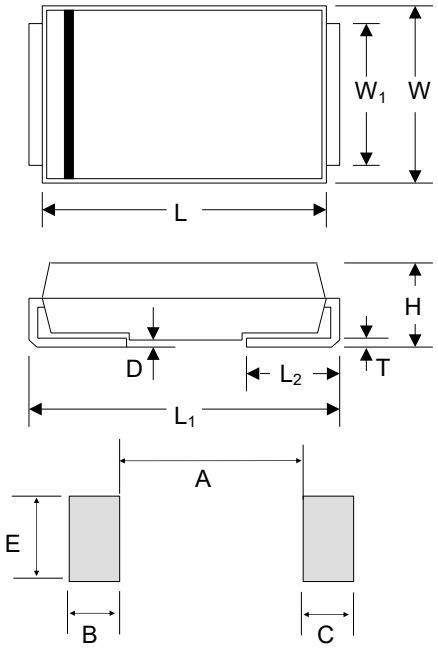
Functional Diagram



Features

- AEC-Q101 Qualified
- Low incremental surge resistance
- Excellent clamping capability
- Low profile package with built-in strain relief
- Typical I_R less than 5.0 μA above 22 V
- 5000 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/40sec
- 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)

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	-

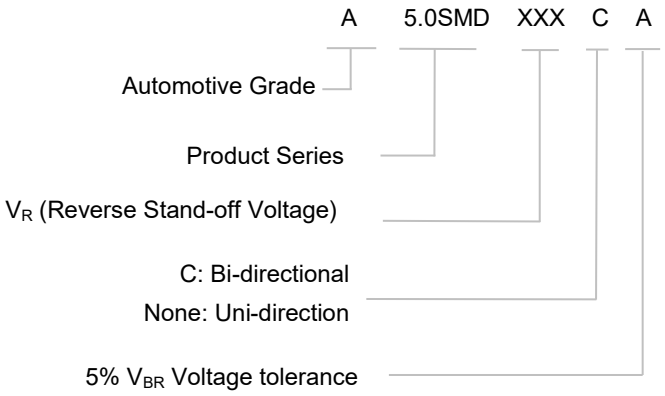
Maximum Ratings and Characteristics

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

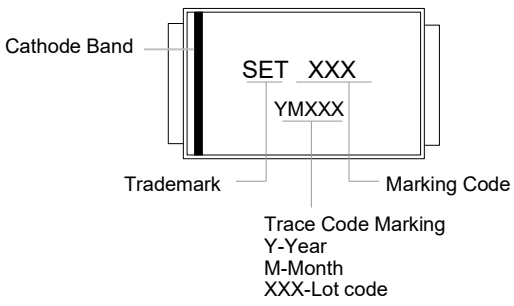
Parameter	Symbol	Value	Unit
Peak Power Dissipation at T_L=25 °C by 10/1000 μs waveform(1)(2)(Fig.2)	P_{PPM}	5000	W
Peak Power Dissipation on Infinite Heat Sink at T_L=50 °C	P_D	6.5	W
Peak Forward Surge Current,8.3 ms single half sinewave superimposed on rated load (JEDEC Method)(3)	I_{FSM}	300	A
Maximum Instantaneous Forward Voltage at 100 A for Unidirectional Only	V_F	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

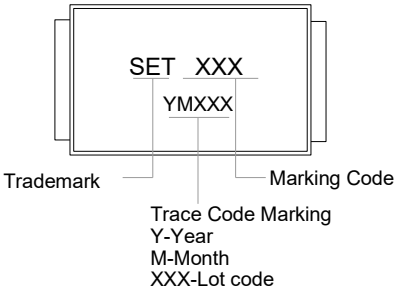
Notes:
1. Non-repetitive current pulse, per Fig. 4 and derated above T_J(initial)=25 °C per Fig. 3.
2. Mounted on 8.0 mm^2 land areas.
3. Measured of 8.3 ms single half sine-wave or equivalent square wave, duty cycle=4 pulses per minute maximum.

Part Numbering System



Marking





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

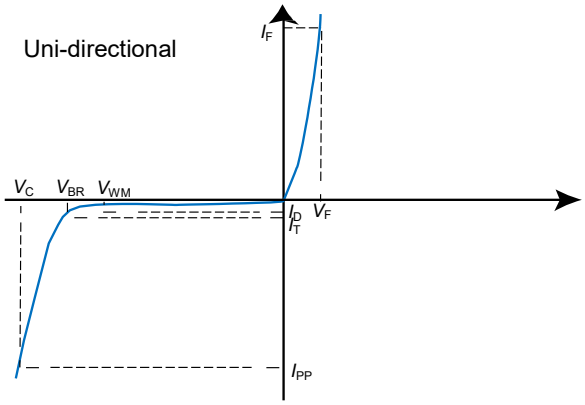
Part Number		Device Marking Code		Breakdown Voltage $V_{BR}@I_T$		Test Current I_T	Reverse Stand-off Voltage V_R	Max. Reverse Leakage $I_R@V_R$	Max. Peak Pulse Current I_{PPM} (10/1000 μs)	Max. Clamping Voltage $V_C@I_{PPM}$ (10/1000 μs)
				Min	Max					
Uni	Bi	Uni	Bi	(V)		(mA)	(V)	(μA)	(A)	(V)
A5.0SMD12A	A5.0SMD12CA	APEP	ABEP	13.30	14.70	10	12.00	800.00	252.00	19.90
A5.0SMD13A	A5.0SMD13CA	APEQ	ABEQ	14.40	15.90	10	13.00	500.00	233.00	21.50
A5.0SMD14A	A5.0SMD14CA	APER	ABER	15.60	17.20	10	14.00	200.00	216.00	23.20
A5.0SMD15A	A5.0SMD15CA	APES	ABES	16.70	18.50	1	15.00	100.00	205.00	24.40
A5.0SMD16A	A5.0SMD16CA	APET	ABET	17.80	19.70	1	16.00	50.00	193.00	26.00
A5.0SMD17A	A5.0SMD17CA	APEU	ABEU	18.90	20.90	1	17.00	20.00	181.00	27.60
A5.0SMD18A	A5.0SMD18CA	APEV	ABEV	20.00	22.10	1	18.00	10.00	172.00	29.20
A5.0SMD20A	A5.0SMD20CA	APEW	ABEW	22.20	24.50	1	20.00	5.00	155.00	32.40
A5.0SMD22A	A5.0SMD22CA	APEX	ABEX	24.40	26.90	1	22.00	5.00	141.00	35.50
A5.0SMD24A	A5.0SMD24CA	APEZ	ABEZ	26.70	29.50	1	24.00	5.00	129.00	38.90
A5.0SMD26A	A5.0SMD26CA	APFE	ABFE	28.90	31.90	1	26.00	5.00	119.00	42.10
A5.0SMD28A	A5.0SMD28CA	APFG	ABFG	31.10	34.40	1	28.00	5.00	110.00	45.40
A5.0SMD30A	A5.0SMD30CA	APFK	ABFK	33.30	36.80	1	30.00	5.00	103.00	48.40
A5.0SMD33A	A5.0SMD33CA	APFM	ABFM	36.70	40.60	1	33.00	5.00	93.90	53.30
A5.0SMD36A	A5.0SMD36CA	APFP	ABFP	40.00	44.20	1	36.00	5.00	86.10	58.10
A5.0SMD40A	A5.0SMD40CA	APFR	ABFR	44.40	49.10	1	40.00	5.00	77.60	64.50
A5.0SMD43A	A5.0SMD43CA	APFT	ABFT	47.80	52.80	1	43.00	5.00	72.10	69.40
A5.0SMD45A	A5.0SMD45CA	APFV	ABFV	50.00	55.30	1	45.00	5.00	68.80	72.70
A5.0SMD48A	A5.0SMD48CA	APFX	ABFX	53.30	58.90	1	48.00	5.00	64.70	77.40
A5.0SMD51A	A5.0SMD51CA	APFZ	ABFZ	56.70	62.70	1	51.00	5.00	60.70	82.40
A5.0SMD54A	A5.0SMD54CA	APGE	ABGE	60.00	66.30	1	54.00	5.00	57.50	87.10

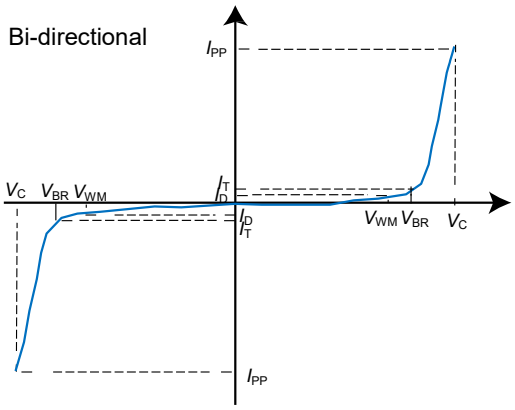
Electrical Characteristics (T_A=25 °C unless otherwise noted)Table 1

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)
				Min	Max					
Uni	Bi	Uni	Bi	(V)		(mA)	(V)	(μA)	(A)	(V)
A5.0SMD58A	A5.0SMD58CA	APGG	ABGG	64.40	71.20	1	58.00	5.00	53.50	93.60
A5.0SMD60A	A5.0SMD60CA	APGK	ABGK	66.70	73.70	1	60.00	5.00	51.70	96.80
A5.0SMD64A	A5.0SMD64CA	APGM	ABGM	71.10	78.60	1	64.00	5.00	48.60	103.00
A5.0SMD70A	A5.0SMD70CA	APGP	ABGB	77.80	86.00	1	70.00	5.00	44.30	113.00
A5.0SMD75A	A5.0SMD75CA	APGR	ABGR	83.30	92.10	1	75.00	5.00	41.40	121.00
A5.0SMD78A	A5.0SMD78CA	APGT	ABGT	86.70	95.80	1	78.00	5.00	39.70	126.00
A5.0SMD85A	A5.0SMD85CA	APGV	ABGV	94.40	104.00	1	85.00	5.00	36.50	137.00
A5.0SMD90A	A5.0SMD90CA	APGX	ABGX	100.00	111.00	1	90.00	5.00	34.30	146.00
A5.0SMD100A	A5.0SMD100CA	APGZ	ABGZ	111.00	123.00	1	100.00	5.00	30.90	162.00
A5.0SMD110A	A5.0SMD110CA	APHE	ABHE	122.00	135.00	1	110.00	5.00	28.30	177.00
A5.0SMD120A	A5.0SMD120CA	APHG	ABHG	133.00	147.00	1	120.00	5.00	26.00	193.00
A5.0SMD130A	A5.0SMD130CA	APHK	ABHK	144.00	159.00	1	130.00	5.00	24.00	209.00
A5.0SMD140A	A5.0SMD140CA	APHL	ABHL	156.00	172.00	1	140.00	5.00	22.20	226.00
A5.0SMD150A	A5.0SMD150CA	APHM	ABHM	167.00	185.00	1	150.00	5.00	20.60	243.00
A5.0SMD160A	A5.0SMD160CA	APHP	ABHB	178.00	197.00	1	160.00	5.00	19.30	259.00
A5.0SMD170A	A5.0SMD170CA	APHR	ABHR	189.00	209.00	1	170.00	5.00	18.20	275.00

Notes:
1. For bidirectional type having V_R of 20 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.

I-V Curve Characteristics





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

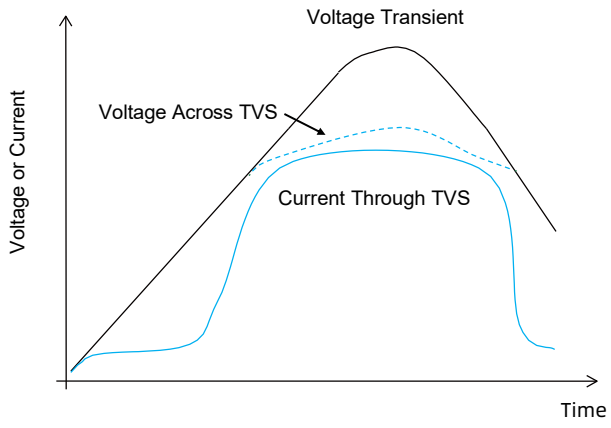


FIGURE 1 TVS Transients Clamping Waveform

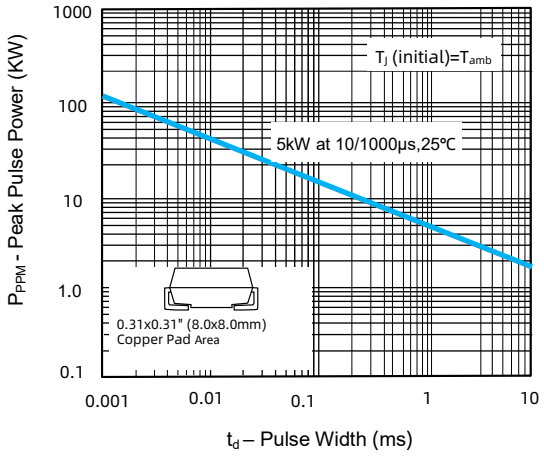


FIGURE 2 Peak Pulse Power Rating Curve

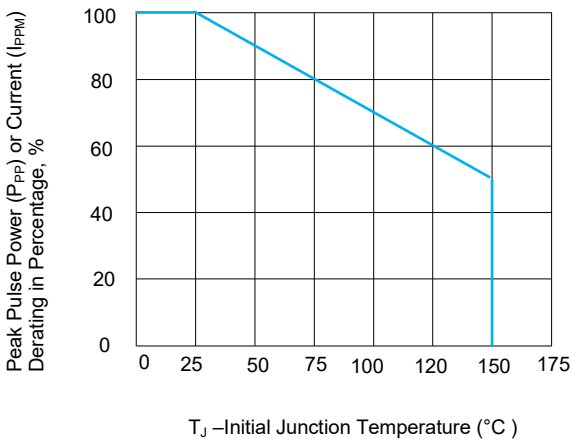


FIGURE 3 Peak Pulse Power Derating Curve

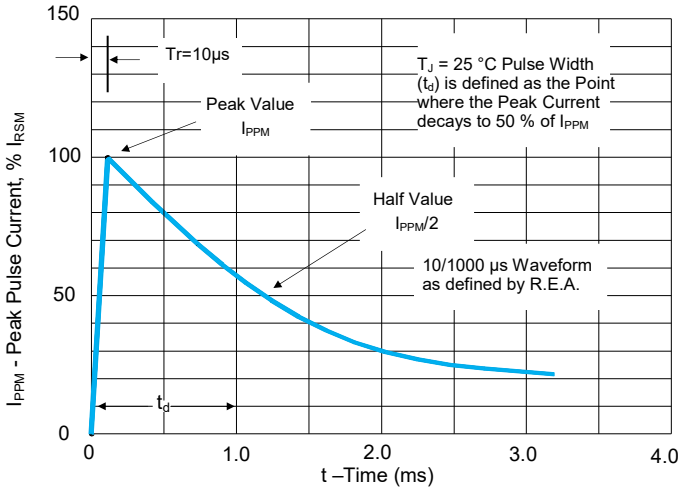


FIGURE 4 Pulse Waveform

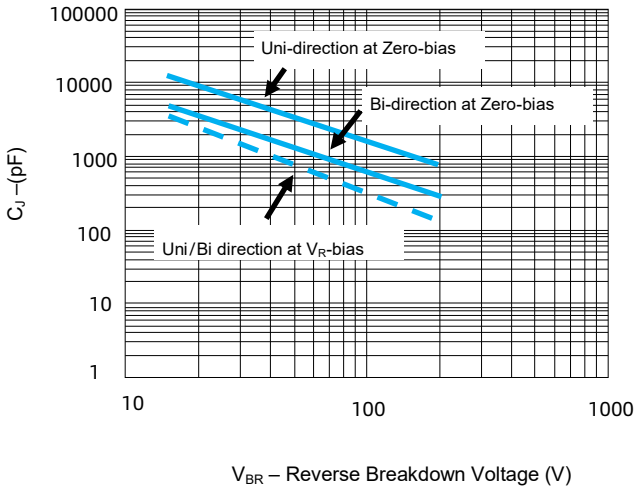


FIGURE 5 Typical Junction Capacitance

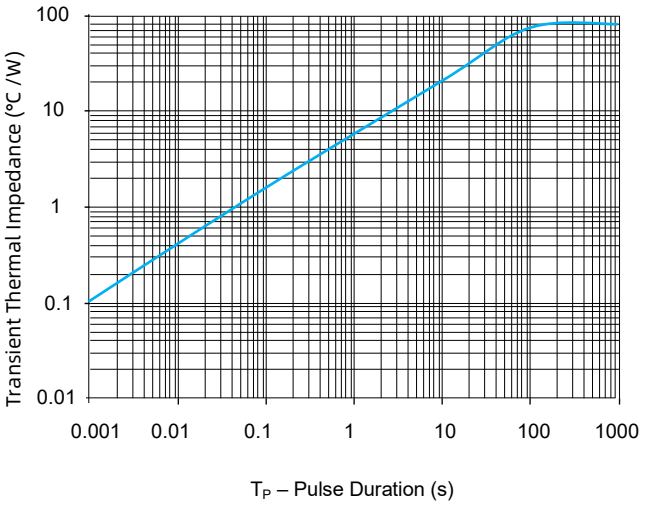


FIGURE 6 Typical Transient Thermal Impedance

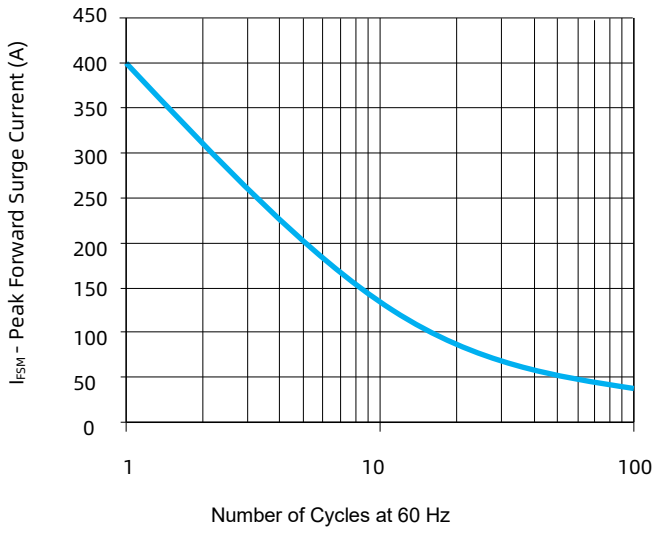


FIGURE 7 Maximum Non-Repetitive Forward Surge Current Uni-Directional only

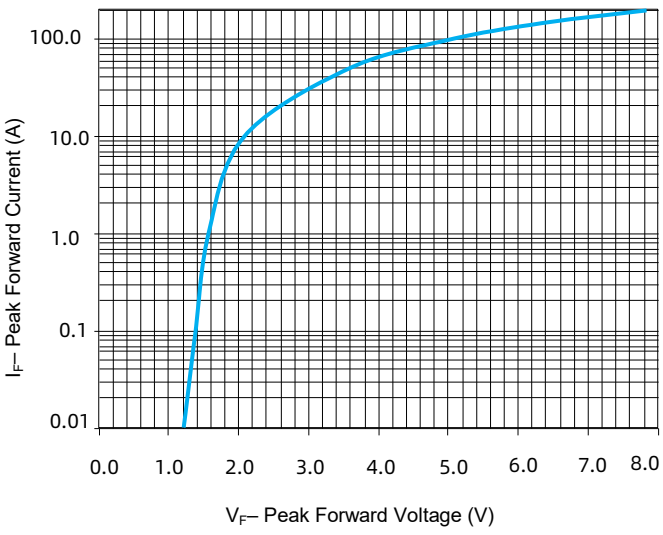


FIGURE 8 Peak Forward Drop vs Peak Forward Current (Typical Values)

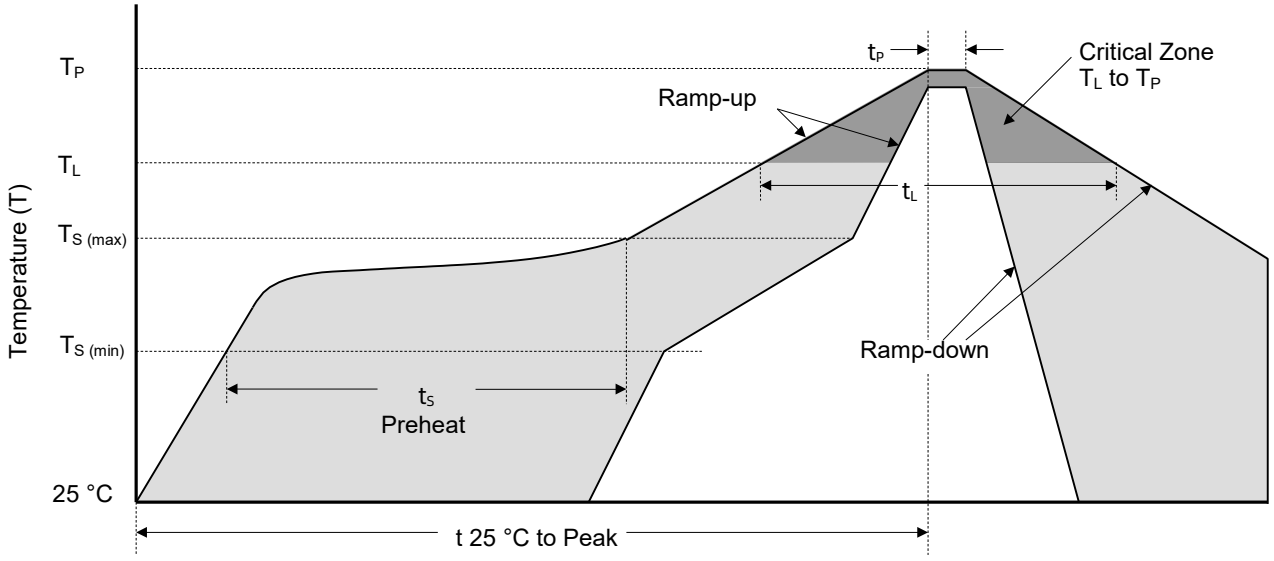
Environmental Specifications

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

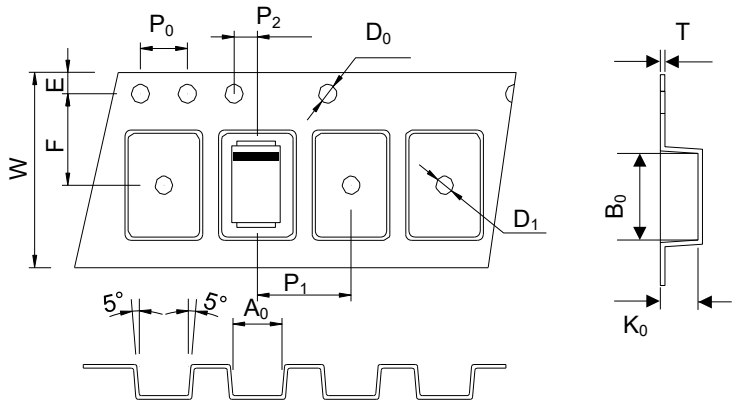
Soldering Parameters

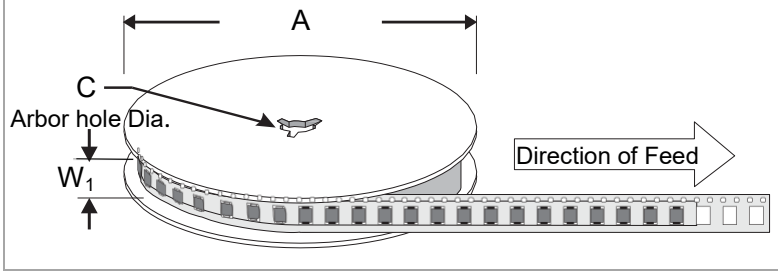


Reflowing Condition

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+0.30/-0.10
	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
A5.0SMDxxx	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.