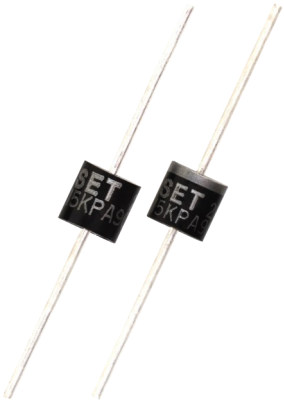
TVS Diodes

Transient Voltage Suppression Diodes

15KPA Series



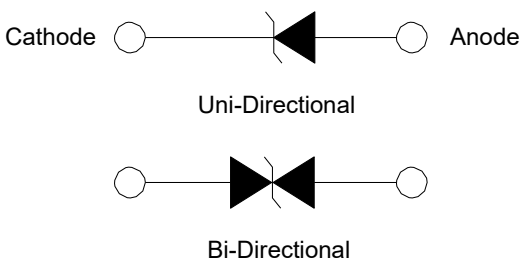
Description

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



Features

- Excellent clamping capability
- Low profile package
- Glass passivated chip junction in P600 package
- Typical I_R less than 2.0 μA above 36 V
- 15 kW peak pulse power capability with a 10/1000 μS Waveform, repetition rate (duty cycle): 0.01%
- 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
- High temperature to reflow soldering guaranteed: 260 °C / 40 sec / 0.375”, (9.5 mm) lead length, 5 lbs., (2.3 kg) tension
- 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

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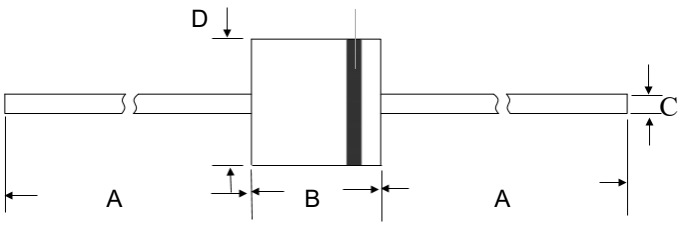
Package Outline Dimensions (P600)

Cathode Band
(for uni-directional products only)



P600

Symbol	Millimeters		Inches	
	Min.	Max.	Min.	Max.
A	25.40	-	1.000	-
B	8.60	9.10	0.340	0.360
C	1.22	1.36	0.048	0.054
D	8.60	9.10	0.340	0.360

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)	P_{PPM}	15	kW
Peak Power Dissipation on Infinite Heat Sink at T_L=75 °C	P_D	8.0	W
Peak Forward Surge Current,8.3 ms single half sinewave unidirectional only(2)	I_{FSM}	400	A
Operating Temperature Range	T_J	-55 to 175	°C
Storage Temperature Range	T_{STG}	-55 to 175	°C
Typical Thermal Resistance Junction to Lead	$R_{\theta JL}$	8.0	°C/W
Typical Thermal Resistance Junction to Ambient	$R_{\theta JA}$	40	°C/W

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

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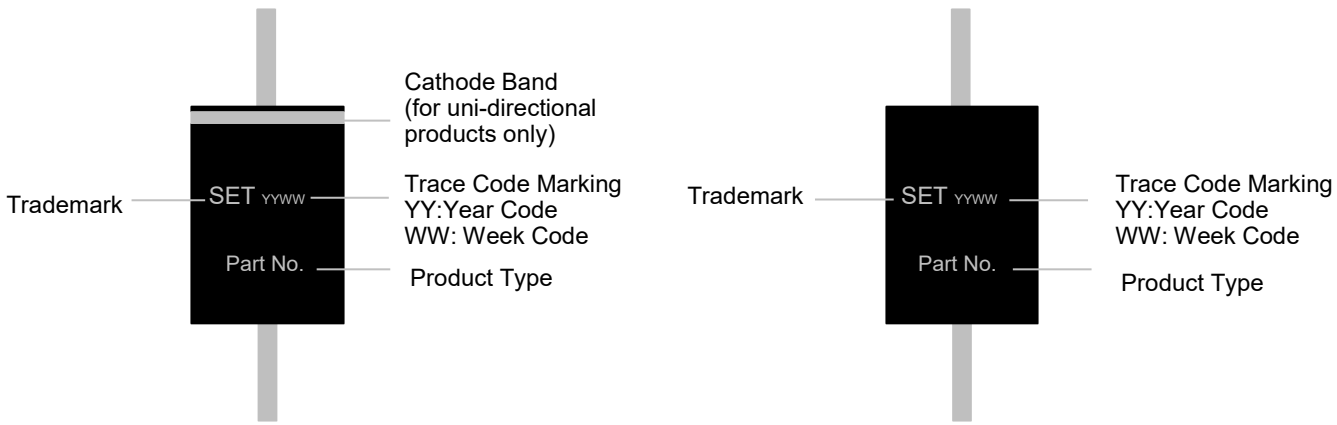
Part Numbering System

15KPA XXX C A — X

- Product Series: 15KPA
- Breakdown Voltage: XXX
- C: Bi-directional; None: uni-direction: C
- A: 5% V_{BR} Voltage tolerance; None: 10% V_{BR} Voltage tolerance: A
- Package Code: X
  - None: Reel Tape
  - B: Bulk Packaging

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)

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

Part Number		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}	Maxi. Clamping Voltage $V_C@I_{PPM}$
		Min	Max					
Uni	Bi	(V)		(mA)	(V)	(μA)	(A)	(V)
15KPA17A	15KPA17CA	18.99	20.79	50	17	5000	515.4	29.3
15KPA18A	15KPA18CA	20.11	22.01	50	18	5000	488.7	30.9
15KPA20A	15KPA20CA	22.34	24.46	20	20	1500	440.2	34.3
15KPA22A	15KPA22CA	24.57	26.91	10	22	500	407	37.1
15KPA24A	15KPA24CA	26.81	29.35	5	24	150	371	40.7
15KPA26A	15KPA26CA	29.04	31.8	5	26	50	343.2	44
15KPA28A	15KPA28CA	31.28	34.24	5	28	25	317.9	47.5
15KPA30A	15KPA30CA	33.51	36.7	5	30	15	297.8	50.7
15KPA33A	15KPA33CA	36.9	40.4	5	33	2	276.1	54.7
15KPA36A	15KPA36CA	40.2	44	5	36	2	252.5	59.8
15KPA40A	15KPA40CA	44.7	48.9	5	40	2	229.5	65.8
15KPA43A	15KPA43CA	48	52.6	5	43	2	216.3	69.8
15KPA45A	15KPA45CA	50.3	55	5	45	2	207.4	72.8
15KPA48A	15KPA48CA	53.6	58.7	5	48	2	194.3	77.7
15KPA51A	15KPA51CA	57	62.4	5	51	2	182.1	82.9
15KPA54A	15KPA54CA	60.3	66	5	54	2	172.2	87.7
15KPA58A	15KPA58CA	64.8	70.9	5	58	2	161	93.8
15KPA60A	15KPA60CA	67	73.4	5	60	2	155	97.4
15KPA64A	15KPA64CA	71.5	78.3	5	64	2	144.9	104.2
15KPA70A	15KPA70CA	78.2	85.6	5	70	2	132.9	113.6
15KPA75A	15KPA75CA	83.8	91.7	5	75	2	123.8	122
15KPA78A	15KPA78CA	87.1	95.4	5	78	2	119.7	126.1
15KPA85A	15KPA85CA	94.9	104	5	85	2	109.7	137.6
15KPA90A	15KPA90CA	100.5	110.1	5	90	2	103.7	145.6
15KPA100A	15KPA100CA	111.7	122.3	5	100	2	93.6	161.3
15KPA110A	15KPA110CA	122.9	134.5	5	110	2	84.5	178.6
15KPA120A	15KPA120CA	134	146.8	5	120	2	78.5	192.3
15KPA130A	15KPA130CA	145.2	159	5	130	2	72.5	208.3
15KPA150A	15KPA150CA	167.6	183.5	5	150	2	62.4	241.9
15KPA160A	15KPA160CA	178.7	195.7	5	160	2	58.4	258.6

TVS

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Part Number		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	(V)		(mA)	(V)	(μA)	(A)	(V)
15KPA170A	15KPA170CA	189.9	207.9	5	170	2	55.4	272.7
15KPA180A	15KPA180CA	201.1	220.1	5	180	2	52.3	288.5
15KPA200A	15KPA200CA	223.4	244.6	5	200	2	47.3	319.1
15KPA220A	15KPA220CA	245.7	269.1	5	220	2	42.4	356
15KPA240A	15KPA240CA	268.1	293.5	5	240	2	39.3	384.6
15KPA260A	15KPA260CA	290.4	318	5	260	2	36.2	416.7
15KPA280A	15KPA280CA	312.8	342.4	5	280	2	33.2	454.5

Notes:
1. Measured of 8.3 ms single half sine-wave or equivalent square wave, duty cycle=4 pulses per minute maximum.
2. V_F < 3.5 V for single die parts and V_F < 5.0 V for stacked-die parts.
3.For bidirectional type having V_R of 30 volts and less, the I_R should be doubled.

TVS

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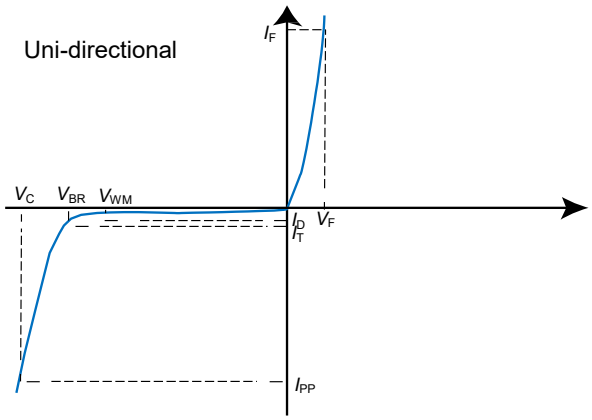
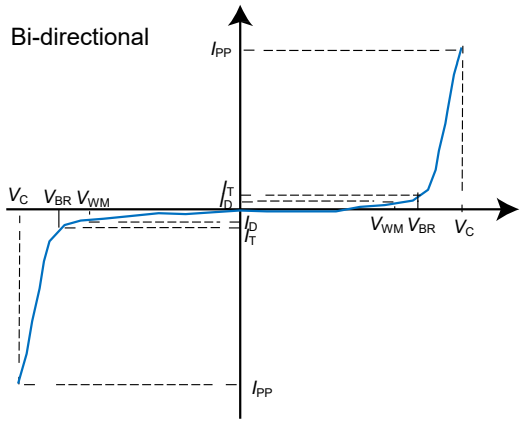
I-V Curve Characteristics





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

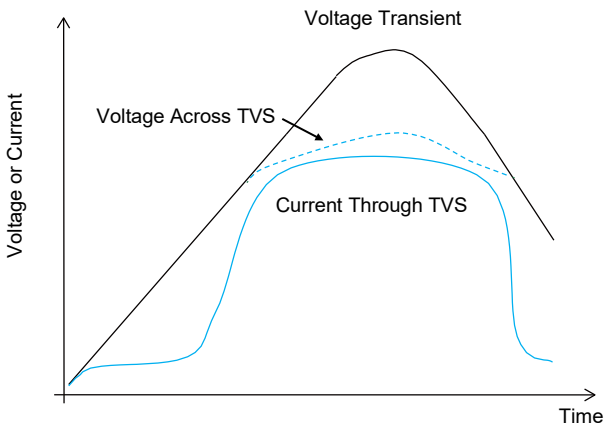


FIGURE 1 TVS Transients Clamping Waveform

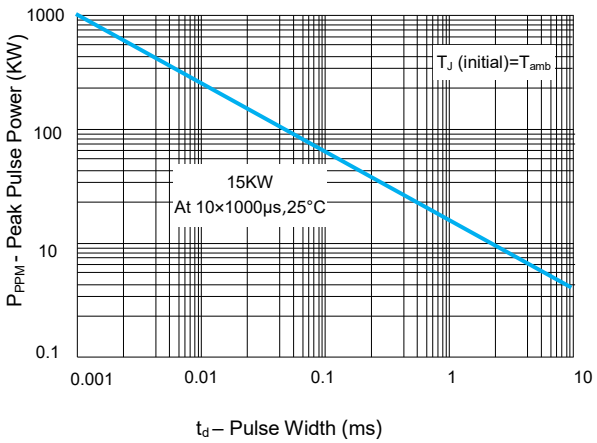


FIGURE 2 Peak Pulse Power Rating Curve

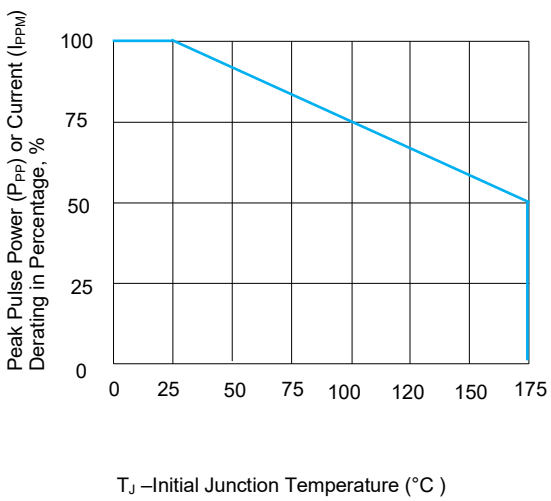


FIGURE 3 Peak Pulse Power Derating Curve

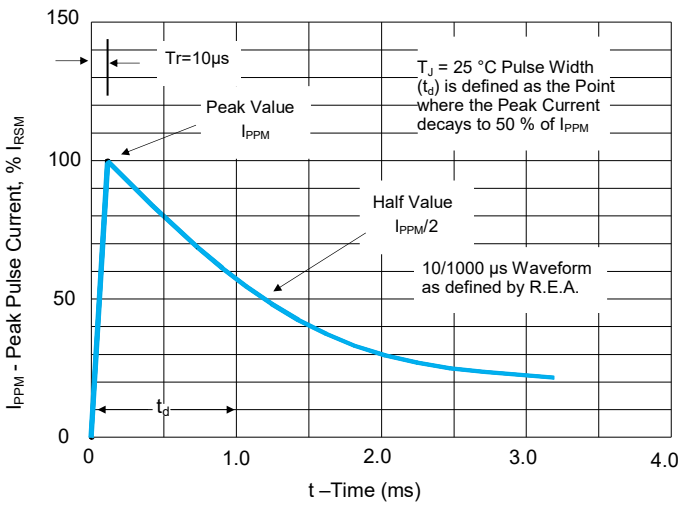


FIGURE 4 Pulse Waveform

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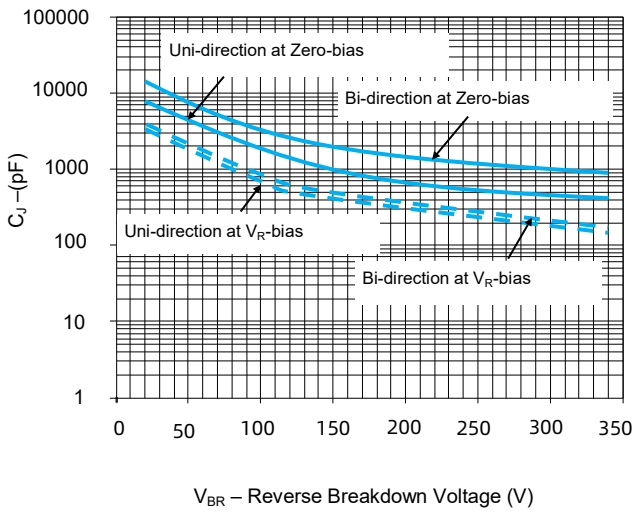

FIGURE 5 Typical Junction Capacitance

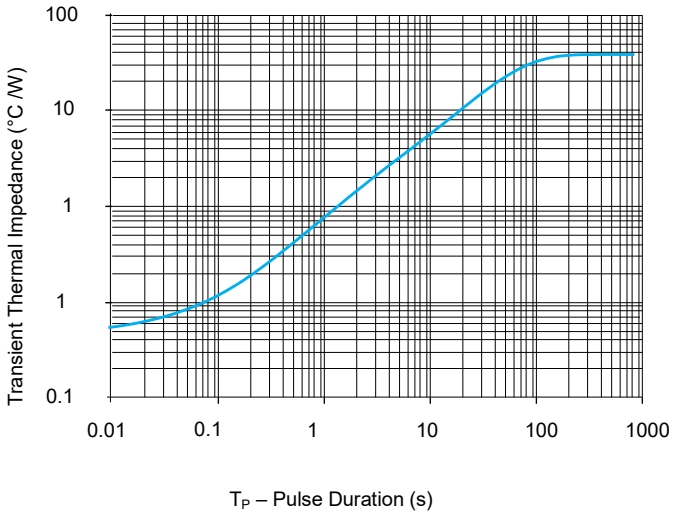

FIGURE 6 Typical Transient Thermal Impedance

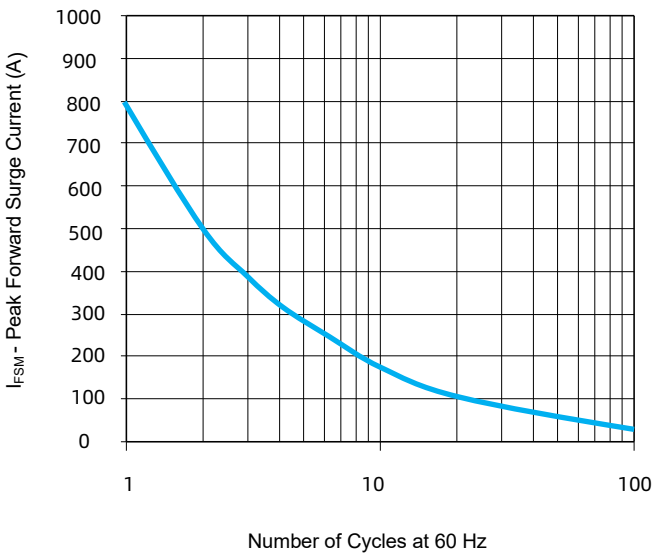

FIGURE 7 Maximum Non-Repetitive Forward Surge Current Uni-Directional only

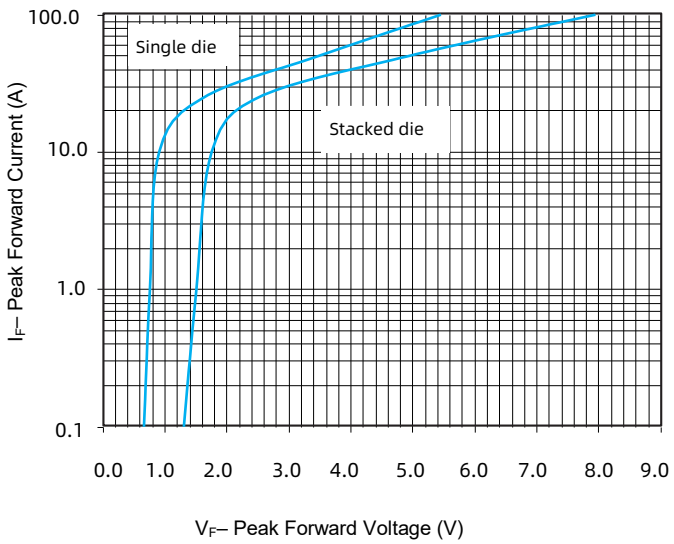

FIGURE 8 Peak Forward Drop vs Peak Forward Current (Typical Values)

Environmental Specifications

High Temp. Storage	JESD22-A103
HTRB	JESD22-A108
Temperature Cycling	JESD22-A104
H3TRB	JESD22-A101
RSH	JESD22-B106

Physical Specifications

Weight	0.07 ounce, 2.5 grams
Case	P600 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

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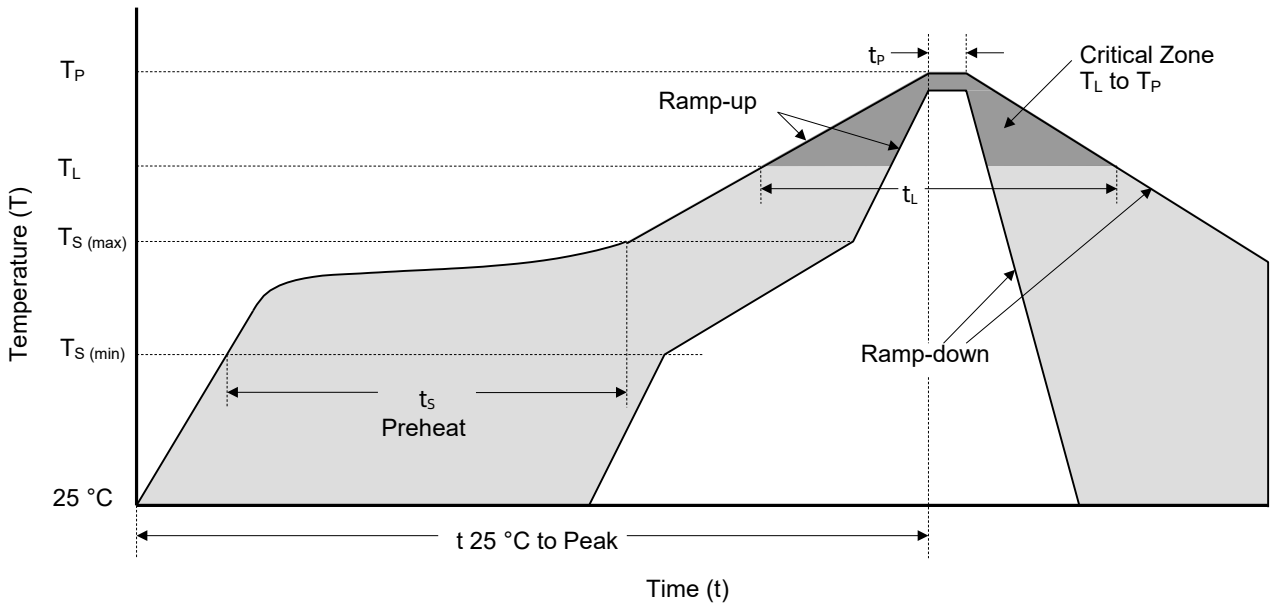
Soldering Parameters



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

Flow/Wave Soldering (Solder Dipping)

Peak Temperature	260 °C+0 /- 5 °C
Dipping Time	10 seconds
Soldering Number	1 time

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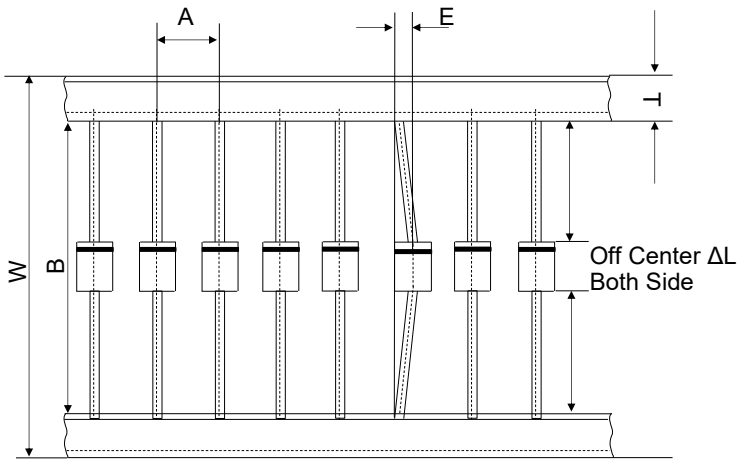
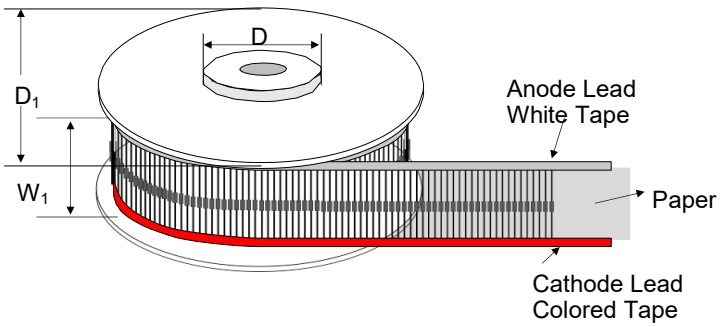
Packaging Information

Tape	Symbol	Millimeters	Inches
	A	10±0.5	0.394+/-0.020
	B	53.0+2.0/-1.0	2.063+0.079/-0.039
	E	1.2	0.047
	W	65.0	2.56
	T	6.0	0.236
	ΔL	0.7Max.	0.028Max.

Tape & Reel (T/R)	Symbol	Millimeters	Inches
	D	330	13.0
	D_1	76.2	3.0
	W_1	69.85	2.75

Part Number	Component Package	QTY's (Reel)	Package Option
15KPAxxxXX	P600	800 PCS	Tape & Reel
15KPAxxxXX-TB	P600	300 PCS	TB
15KPAxxxXX-B	P600	100 PCS	Bulk

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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.

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