3000-W , SMCJ Transient voltage suppressor diodes

1. Product Profile

1-1.General description

The 3.0SMCJ Series has been designed to protect sensitive equipment against electro-static discharges according to IEC 61000-4 -2, MIL STD 883 method 3015, and electrical over stress such as IEC 61000-4-4 and 5. They are generally for surges below 3000 W (10/1000μs). This technology makes it compatible with high-end equipment and SMPS where low leakage current and high junction temperature are required to provide reliability and stability over time. Their low clamping voltages provide a better safety margin to protect sensitive circuits with extended life time expectancy. packaged in SMCJ,this minimizes PCB space consumption.

SMCJ

3D Models

1-2. Features

- High density technology
- ESD protection : Level 4
- Low clamping voltage
- 3000 Watts peak pulse power per line (tp = 10/1000uS)
- Low clamping voltage
- Excellent surge capability makes it ideal for protecting sensitive devices against transient over voltages Optimizes the use of circuit board space. Also, due to its small size, it is good for designing into portable devices/hard drives,notebooks, V_{CC} busses, POS terminals, SSDs, power supplies, monitors and other consumer applications

1-3. Applications

- SMCJ Devices are ideal for the protection of I/O V_{CC} bus and other vulnerable circuit used in portable devices, business machines, power supplies and other consumer applications.

1-4. IEC Compatibility

- ESD / Transient protection according to:
  - IEC61000-4-2(ESD) : ±30KV(Contact) / ±30KV(Air)
  - IEC61000-4-5(Surge) : 3000W (10/1000us)

1-5. Mechanical characteristics

- Molded SMCJ package
- Packing : tape and reel
- Flammability rating UL 94V-0
- Halogen free
- Moisture sensitivity levels (MSL): Level 1
- UL Listed: E538773

CERTIFIED SAFETY US E538773

2. Maximum ratings

Parameter	Symbol	Condition	Value	Units
Peak pulse power	P_{PP}	(tp=8/20us)	21000	Watts
		(tp=10/1000us)	3000	
Power dissipation	P_D	on infinite heat sink at T_L=50°C	6.5	
Peak forward surge current	I_{FSM}	8.3ms single half sine wave	300	A
Maximum instantaneous forward voltage	V_F	at 50A for unidirectional only	3.5	V
Operating temperature	T_J	-	-55~150	°C
Storage temperature	T_{STG}	-		
Thermal resistance from junction to ambient	$R_{th(j-a)}$	-	15	°C/W
Thermal resistance from junction to lead	$R_{th(j-l)}$	-	75	

Table 1. maximum ratings

3. Electrical characteristics

Part number		Reverse stand-off voltage	Breakdown voltage		Test current	Reverse leakage	Max. clamp voltage	Peak pulse current	Marking	
		V_{RWM}	V_{BR} @ I_T Min	V_{BR} @ I_T Max	I_T	I_R @ V_{RWM}	V_C @ I_{PP}	$I_{PP(10/1000uS)}$		
Uni	Bi	V	V	V	mA	µA	V	A	Uni	Bi
3000 W surface mount transient voltage suppressors 3.0SMCJ series										
3.0SMCJ5.0A	3.0SMCJ5.0CA	5.0	6.40	7.07	10.0	200.0	9.2	326.0	HDE	IDE
3.0SMCJ6.0A	3.0SMCJ6.0CA	6.0	6.67	7.37	10.0	200.0	10.3	291.3	HDG	IDG
3.0SMCJ6.5A	3.0SMCJ6.5CA	6.5	7.22	7.98	10.0	100.0	11.2	267.9	HDK	IDK
3.0SMCJ7.0A	3.0SMCJ7.0CA	7.0	7.78	8.60	10.0	100.0	12.0	250.0	HDM	IDM
3.0SMCJ7.5A	3.0SMCJ7.5CA	7.5	8.33	9.21	1.0	100.0	12.9	232.6	HDP	IDP
3.0SMCJ8.0A	3.0SMCJ8.0CA	8.0	8.89	9.83	1.0	100.0	13.6	220.6	HDR	IDR
3.0SMCJ8.5A	3.0SMCJ8.5CA	8.5	9.44	10.40	1.0	20.0	14.4	208.4	HDT	IDT
3.0SMCJ9.0A	3.0SMCJ9.0CA	9.0	10.00	11.10	1.0	10.0	15.4	194.8	HDV	IDV
3.0SMCJ10A	3.0SMCJ10CA	10.0	11.10	12.30	1.0	10.0	17.0	176.4	HDX	IDX
3.0SMCJ11A	3.0SMCJ11CA	11.0	12.20	13.50	1.0	1.0	18.2	184.8	HDZ	IDZ
3.0SMCJ12A	3.0SMCJ12CA	12.0	13.30	14.70	1.0	1.0	19.9	150.6	HEE	IEE
3.0SMCJ13A	3.0SMCJ13CA	13.0	14.40	15.90	1.0	1.0	21.5	139.4	HEG	IEG
3.0SMCJ14A	3.0SMCJ14CA	14.0	15.60	17.20	1.0	1.0	23.2	129.4	HEK	IEK
3.0SMCJ15A	3.0SMCJ15CA	15.0	16.70	18.50	1.0	1.0	24.4	123.0	HEM	IEM

Table 2. Electrical characteristics

3. Electrical characteristics

Part number		Reverse stand-off voltage	Breakdown voltage		Test current	Reverse leakage	Max. clamp voltage	Peak pulse current	Marking	
		V_{RWM}	V_{BR} @ I_T Min	V_{BR} @ I_T Max	I_T	I_R @ V_{RWM}	V_C @ I_{PP}	$I_{PP(10/1000uS)}$		
Uni	Bi	V	V	V	mA	μA	V	A	Uni	Bi
3000 W surface mount transient voltage suppressors 3.0SMCJ series										
3.0SMCJ16A	3.0SMCJ16CA	16.0	17.80	19.70	1.0	1.0	26.0	115.4	HEP	IEP
3.0SMCJ17A	3.0SMCJ17CA	17.0	18.90	20.90	1.0	1.0	27.6	106.6	HER	IER
3.0SMCJ18A	3.0SMCJ18CA	18.0	20.00	22.10	1.0	1.0	29.2	102.8	HET	IET
3.0SMCJ20A	3.0SMCJ20CA	20.0	22.20	24.50	1.0	1.0	32.4	92.6	HEV	IEV
3.0SMCJ22A	3.0SMCJ22CA	22.0	24.40	26.90	1.0	1.0	35.5	84.4	HEX	IEX
3.0SMCJ24A	3.0SMCJ24CA	24.0	26.70	29.50	1.0	1.0	38.9	77.2	HEZ	IEZ
3.0SMCJ26A	3.0SMCJ26CA	26.0	28.90	31.90	1.0	1.0	42.1	71.2	HFE	IFE
3.0SMCJ28A	3.0SMCJ28CA	28.0	31.10	34.40	1.0	1.0	45.4	66.0	HFG	IFG
3.0SMCJ30A	3.0SMCJ30CA	30.0	33.30	36.80	1.0	1.0	48.4	62.0	HFK	IFK
3.0SMCJ33A	3.0SMCJ33CA	33.0	36.70	40.60	1.0	1.0	53.3	56.2	HFM	IFM
3.0SMCJ36A	3.0SMCJ36CA	36.0	40.00	44.20	1.0	1.0	58.1	51.6	HFP	IFP
3.0SMCJ40A	3.0SMCJ40CA	40.0	44.40	49.10	1.0	1.0	64.5	46.4	HFR	IFR
3.0SMCJ43A	3.0SMCJ43CA	43.0	47.80	52.80	1.0	1.0	69.4	43.2	HFT	IFT
3.0SMCJ45A	3.0SMCJ45CA	45.0	50.00	55.30	1.0	1.0	72.7	41.2	HFV	IFV
3.0SMCJ48A	3.0SMCJ48CA	48.0	53.30	58.90	1.0	1.0	77.4	38.8	HFX	IFX
3.0SMCJ51A	3.0SMCJ51CA	51.0	56.70	62.70	1.0	1.0	82.4	36.4	HFZ	IFZ
3.0SMCJ54A	3.0SMCJ54CA	54.0	60.00	66.30	1.0	1.0	87.1	34.4	HGE	IGE
3.0SMCJ58A	3.0SMCJ58CA	58.0	64.40	71.20	1.0	1.0	93.0	32.0	HGG	IGG
3.0SMCJ60A	3.0SMCJ60CA	60.0	66.70	73.70	1.0	1.0	96.0	31.0	HGK	IGK
3.0SMCJ64A	3.0SMCJ64CA	64.0	71.10	78.60	1.0	1.0	103.0	29.2	HGM	IGM
3.0SMCJ70A	3.0SMCJ70CA	70.0	77.80	86.00	1.0	1.0	113.0	26.6	HGP	IGP
3.0SMCJ75A	3.0SMCJ75CA	75.0	83.30	92.10	1.0	1.0	121.0	24.8	HGR	IGR
3.0SMCJ78A	3.0SMCJ78CA	78.0	86.70	95.80	1.0	1.0	126.0	22.8	HGT	IGT
3.0SMCJ85A	3.0SMCJ85CA	85.0	94.40	104.00	1.0	1.0	137.0	20.8	HGV	IGV
3.0SMCJ90A	3.0SMCJ90CA	90.0	100.00	111.00	1.0	1.0	146.0	20.6	HGX	IGX
3.0SMCJ100A	3.0SMCJ100CA	100.0	111.00	123.00	1.0	1.0	162.0	18.6	HGZ	IGZ
3.0SMCJ110A	3.0SMCJ110CA	110.0	122.00	135.00	1.0	1.0	177.0	16.8	HHE	IHE
3.0SMCJ120A	3.0SMCJ120CA	120.0	133.00	147.00	1.0	1.0	193.0	15.6	HHG	IHG
3.0SMCJ130A	3.0SMCJ130CA	130.0	144.00	159.00	1.0	1.0	209.0	14.4	HHK	IHK
3.0SMCJ150A	3.0SMCJ150CA	150.0	167.00	185.00	1.0	1.0	243.0	12.4	HHM	IHM
3.0SMCJ160A	3.0SMCJ160CA	160.0	178.00	197.00	1.0	1.0	259.0	11.6	HHP	IHP
3.0SMCJ170A	3.0SMCJ170CA	170.0	189.00	209.00	1.0	1.0	275.0	11.0	HHR	IHR
3.0SMCJ180A	3.0SMCJ180CA	180	200	220	1.0	1.0	291.6	10.3	HHT	IHT
3.0SMCJ190A	3.0SMCJ190CA	190	211	232	1.0	1.0	307.8	9.8	HHV	IHV

Table 2. Electrical characteristics

4. Terminology

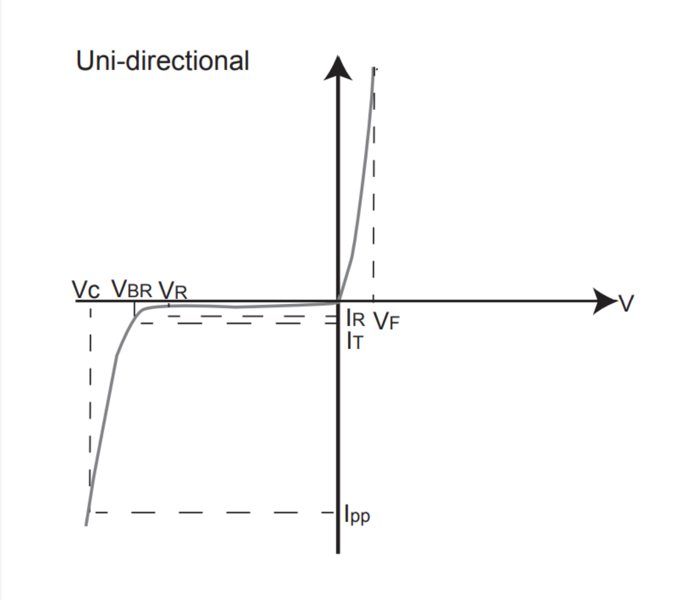
4.1 Basic Characteristics

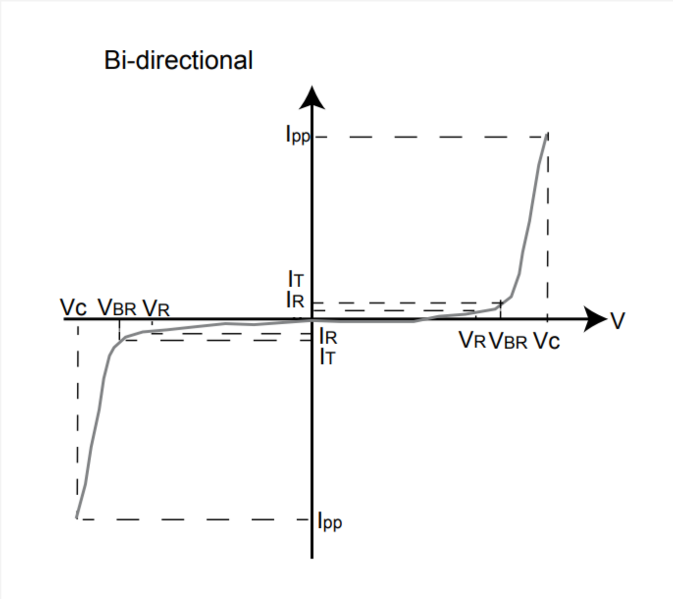
TVS diode, under the specified reverse application conditions, when subjected to a high-energy transient overvoltage pulse, due to it has a very fast response time (sub-nanosecond) and a very high surge absorption ability, its working impedance can be immediately reduced to a very low on value, allowing large currents to pass, and clamping the voltage to a predetermined level, thereby effectively protecting precision components in electronic circuits from damage. TVS can withstand instantaneous pulse power up to kilowatts, and its clamp response time is only 1ps (10-12S). The forward surge current allowed by TVS can reach 50 ~ 200A under the conditions of T_A = 250°C and T = 10ms.

TVS diodes work similarly to common Zener diodes. If the breakdown voltage is higher than the mark, the TVS diode will conduct. Compared with the Zener diode, the TVS diode has a higher current conduction capability. When the two poles of a TVS diode are subjected to reverse transient high-energy shocks, the high impedance between the two poles of the TVS diode becomes low at a speed of the order of 10 -12S, while absorbing surge power of up to several kilowatts. The clamped voltage between the two poles is at a safe value, which effectively protects precision components in electronic circuits from being damaged by surge pulses.

When the reverse voltage of the two poles of the TVS is greater than the maximum reverse voltage, it starts to conduct reversely; after the reverse voltage is greater than the breakdown voltage, it begins to be broken down, while the current starts to change suddenly; when the reverse voltage is greater than the maximum clamping voltage, the tube is in an avalanche breakdown state. At this time, the current flowing through the tube increases sharply, and the voltage difference across the tube does not change much (the voltage is clamped).

Under specified reverse application conditions, the TVS diode will provide a low-impedance path, and the instantaneous current flowing to the protected component will be shunted to the TVS diode through a large current method, while the voltage across the protected component will be limited to the clamping voltage of TVS. When the overvoltage condition disappears, the TVS diode returns to a high impedance state.





Parameter	Symbol
Reverse working voltage	V_{RWM}
Reverse leakage current	I_R
Reverse breakdown voltage	V_{BR}
Test current	I_T
Clamping voltage	V_C
Maximum peak pulse current	I_{PP}
Forward voltage	V_F

Table 3. V-I curve

4. Terminology

4-2 Main Parameters

1) Breakdown voltage $V_{(BR)}$

In the region where the device breaks down, the voltage across the device is measured at the specified test current $I_{(BR)}$, which is called the breakdown voltage. In this area, the TVS diode becomes a low impedance path.

2) Maximum reverse pulse peak current I_{PP}

In reverse operation, I_{PP} refers to the maximum pulse peak current allowed by the device under specified pulse conditions. The product of I_{PP} and the maximum clamping voltage V_C (max) is the maximum value of the transient pulse power.

The TVS should be properly selected during use, so that the rated transient pulse power P_{PK} is greater than the maximum transient surge power that may occur in the protected device or wires.

When the instantaneous pulse peak current appears, the TVS is broken down and its breakdown voltage value rises to the maximum clamping voltage value. As the pulse current decreases exponentially, the clamping voltage also decreases and returns to the original state. Therefore, TVS diode can suppress the impact of possible pulse power to effectively protect the electronic circuits.

The test waveform of the TVS peak current uses a standard wave (exponential waveform), which is determined by T_R / T_P.

Peak current rise time T_R: The time from when the current reaches 0.9 I_{PP} from 0.1 I_{PP}.

Half-peak current time T_P: The time after the current passes through the maximum peak from zero and then drops to 0.5 I_{PP}.

The T_R / T_P values of typical test waveforms are listed below:

A. EMP wave: 10ns / 1000ns

B. Lightning wave: 8μs / 20μs

C. Standard wave: 10μs / 1000μs

3) Maximum reverse working voltage V_{RWM}

When the device operates in reverse, the voltage across the device is called the maximum reverse operating voltage V_{RWM} under the specified I_R, usually V_{RWM} = (0.8 ~ 0.9) $V_{(BR)}$. At this voltage, the power consumption of the device is small. When used, V_{RWM} should not be lower than the normal working voltage of the protected device or circuits.

4) Maximum clamping current V_C(max)

The maximum voltage value across the device under the peak pulse current I_{PP} is called the maximum clamping voltage. When used, V_C (max) should not be higher than the maximum allowable safe voltage of the protected device. And the ratio of the maximum clamping voltage to the breakdown voltage is called the clamping coefficient.

Clamping coefficient = V_C(max) / $V_{(BR)}$, the general clamping coefficient is about 1.3.

5) Reverse pulse peak power P_{PK}

The P_{PK} of TVS depends on the pulse peak current I_{PP} and the maximum clamping voltage V_C (max). In addition, it is also related to the pulse waveform, pulse time and ambient temperature.

When the pulse time Tp is constant, $P_{PK} = K1 \cdot K2 \cdot V_C\text{ (max)} \cdot I_{PP}$

(K1 is the power coefficient, and K2 is the temperature coefficient of the power) . The typical pulse duration tp is 1_{mS}. When the pulse time tp applied to the transient voltage suppression diode is shorter than the standard pulse time, its peak pulse power will increase as tp is shortened. TVS reverse pulse peak power P_{PK} is related to the pulse waveform subjected to surge, expressed by the power coefficient K1: $E=\int i(t) \cdot V(t)dt$. i (t) is the pulse current waveform, and V (t) is the clamping voltage waveform.

This rated energy value is not reproducible to TVS in a very short time. However, in practical applications, surges often occur repeatedly. In this case, even if the single pulse energy is much smaller than the pulse energy that the TVS device can withstand, if repeat, these single pulse energy will accumulated, in some cases, it will exceed the pulse energy that the TVS device can withstand. Therefore, the circuit design must carefully consider and select the TVS device, so that the accumulation of pulse energy repeatedly applied within the specified interval does not exceed the pulse energy rating of the TVS device.

6) Capacitance C_J

The capacitance of TVS is determined by the area of the silicon sheet and the bias voltage. In the case of zero bias, the capacitance value decreases with the increase of the bias voltage. The value of the capacitance will affect the response time of the TVS device.

7) Leakage current I_R

When the maximum reverse working voltage is applied to the TVS, the TVS tube has a leakage current IR. When the TVS is used in a high impedance circuit, the leakage current is an important parameter. In practice, especially in automotive electronics, this parameter affects static current.

5. Rating and characteristics curve

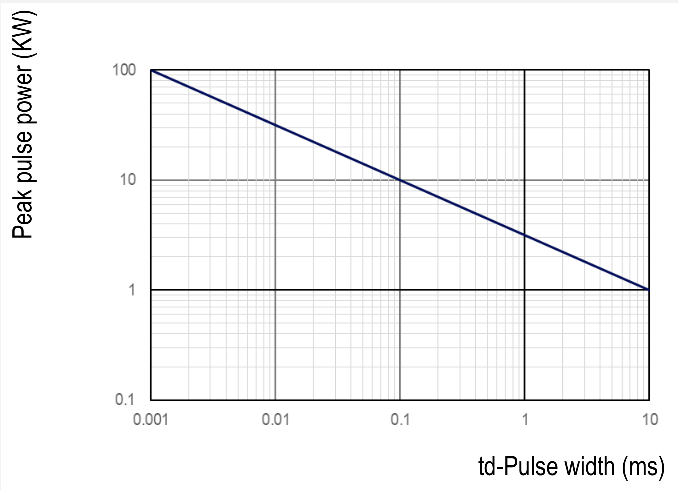


Figure 1. Non-repetitive peak pulse power vs. pulse time

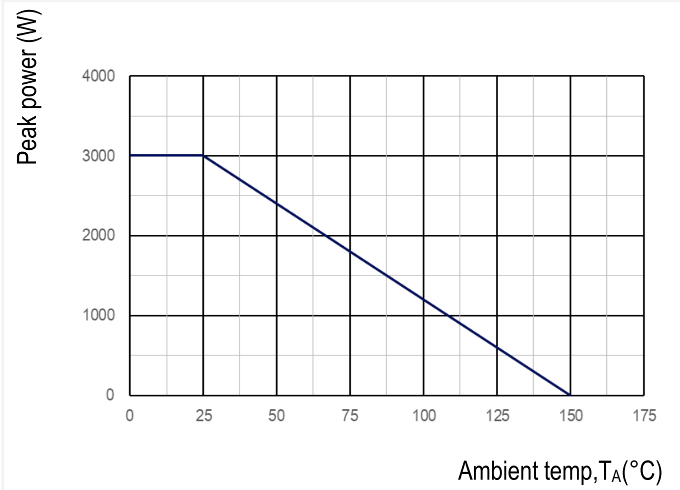


Figure 2. Power derating curve

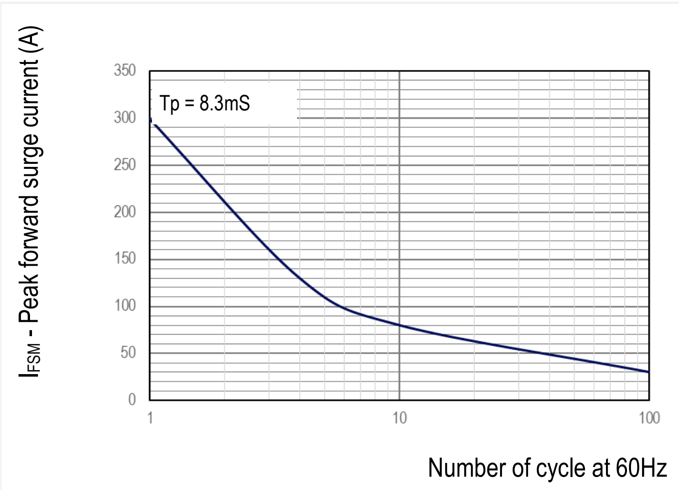


Figure 3. Maximum non-repetitive peak forward surge current uni-directional only

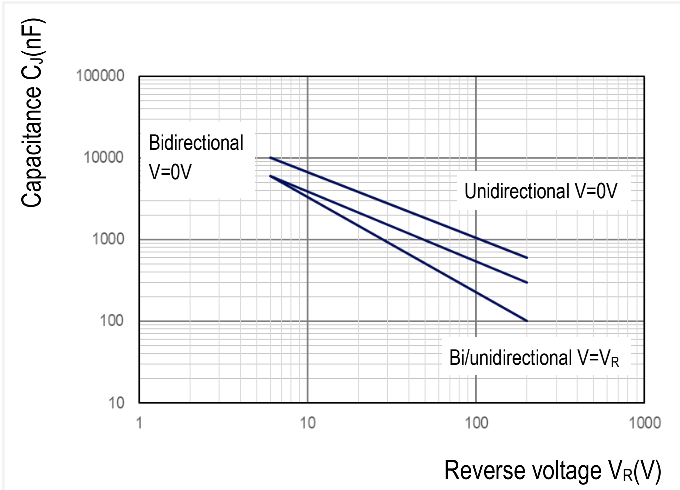


Figure 4. Normalized capacitance vs. reverse voltage

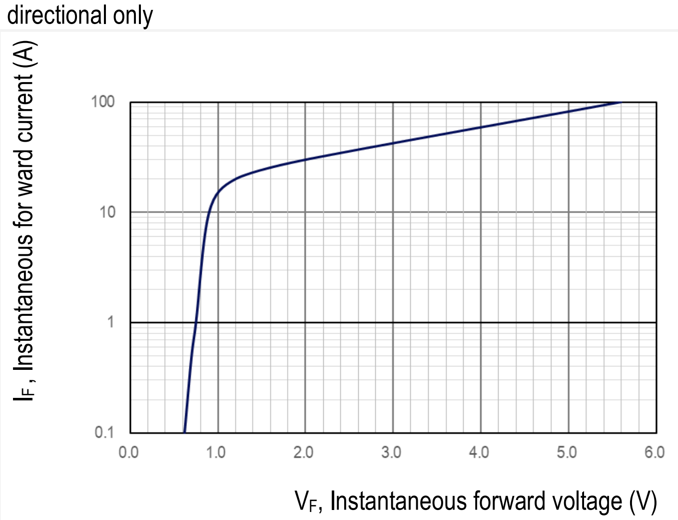


Figure 5. Typical instantaneous forward characteristics

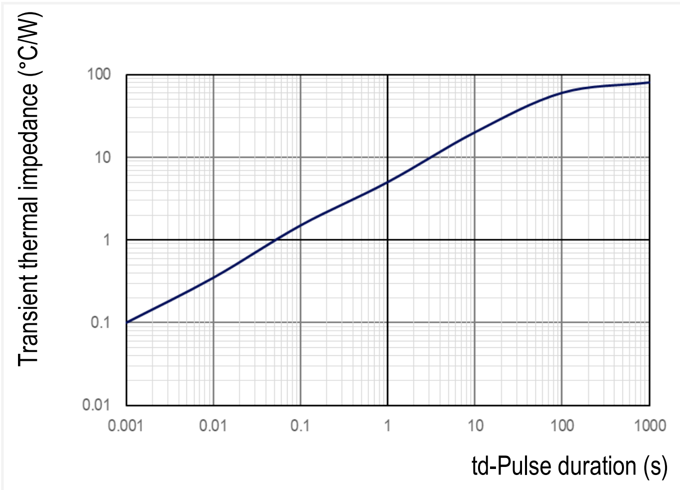


Figure 6. Typical transient thermal impedance

6. Application examples

6.1 Lighting protection

In thunderstorm-prone areas, lightning-induced voltage often breaks down some of the integrated circuits in a computer network. The reason is that cables are damaged due to transient high voltage caused by lightning induction, by installing tvs diodes in the microcomputer, it is useful to reduce damages and commercial loss. And the result shows that it is very practical, and it can improve the reliability of the whole machine application.

TVS also have many other applications, for example, for VMOS high power transistors, the tvs diodes between the gate and the source and the machine can prevent gate breakdown and improve the reliability of the VMOS power tube application.

6.2 Transistor protection

Various transient voltages can cause damage to the EB junction or CE junction of the transistor. Especially when the collector of the transistor has an inductive load (coil, transformer, motor), a high-voltage back-EMF can be generated, which often causes the transistor to be damaged. It is necessary to use a tvs diode as a protector.

6.3 Electric relay protection

Relay contacts often use large currents to switch on and off high-current inductive loads such as motors, and the inductor has a high back electromotive force when switching, and has a large amount of energy. What's more, the contacts are burned or broken to produce an arc, and the surge current generated by the arc is very large. To protect the contacts by suppressing the occurrence of arcs to protect the relays, adding a tvs diode is more effective. In the past, a capacitor or a capacitor series resistor, a diode or a diode series resistor and other suppression methods were used.

6.4 Silicon control protection

The thyristor may has wrong trigger and cause malfunction. The control electrode current cannot be too large and the voltage cannot be too high, in order to do it, TVS can be used for protection.

6.5 Integrated circuit (IC) protection

As integrated circuits become more integrated, their withstand voltages are getting lower and lower, and they are easily damaged by transient voltages. Protective measures must be taken, for example, adding TVS diode in the circuit, the CMOS circuit has a protection network at its input and output ends.

6.6 Integrated Op Amp protection

Integrated op amps are very sensitive to external electrical stress. In the process of using op amps, if having excessive voltage or current due to operating errors or abnormal working conditions, especially surges and electrostatic pulses, it is easy to damage the op amp. In the integrating circuit, if the capacitor is charged and discharged to a high potential, and then the power supply voltage is cut off, a transient voltage will be generated at the input terminal, and a large discharge current will occur, resulting in damage to the operational amplifier. At this time, tvs protection method adopted at the input terminal of op amp to avoid device damage. If the capacitance value is large (such as greater than 0.1μF), the protecting effect will be very significant.

6.7 Microcomputer system protection

In a typical microcomputer system, various interference or transient voltages entering through the power line, input line, and output line may cause the microcomputer to malfunction and fail, especially from the switching power supply. The on-off motor near the microcomputer, voltage surges and transients of AC power, electrostatic discharges, etc. may cause the system to fail, and in severe cases may damage the device. Connecting the TVS diode to the input and output lines of the power supply of the microcomputer can prevent the transient voltage from entering the "microcomputer" bus, strengthen the microcomputer's resistance to external interference, ensure the normal operation, and improve its reliability.

6.8 DC Regulated power supply protection

A DC regulated power supply with a transistor that expands the current output, adding a TVS diode to its regulated output can protect the equipment, and can also absorb peak voltage from the collector to the emitter in the circuit to protect the transistor. In a word, adding a tvs diode at the output end of each voltage stabilization source can greatly improve the reliability of the whole operation.

6.9 Suppression of electromagnetic pulse interference

A nuclear explosion will cause a strong electromagnetic pulse, which causes induced voltage in the wire. If the induced voltage exceeds the breakdown voltage of the device, it may cause the breakdown of the component, especially for long-term transmission, it is more easily to cause high voltage.TVS diodes are connected in parallel to the signal and power lines, which can absorb the induced voltage caused by electromagnetic pulses, ensure the reliability of the system, and avoid radiation damage to components.

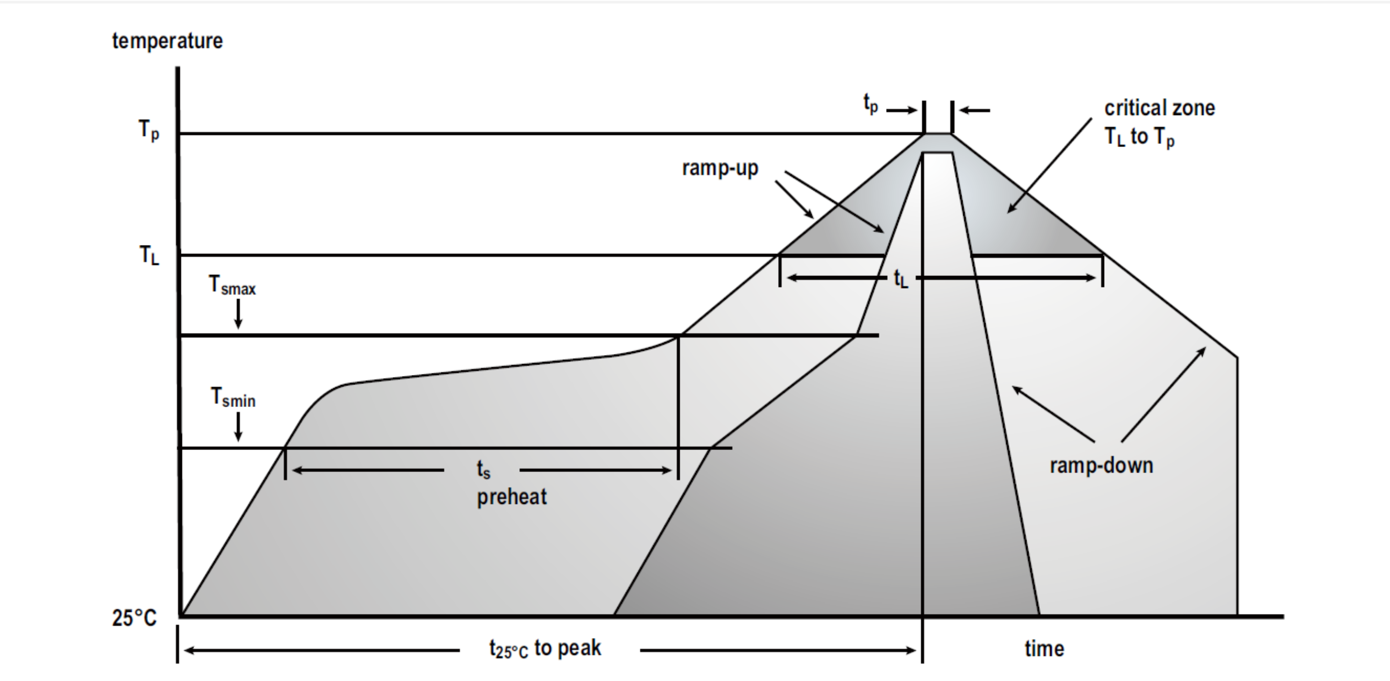
7. Recommended reflow soldering profile

7-1. Limiting value

The below temperature profile for moisture sensitivity characterization is based on the IPC/JEDEC joint industry standard: J-STD-020D-01.

Profile Feature	SnPb eutectic assembly	Pb-free assembly
Average ramp-up rate (Tsmax to Tp)	3˚C/s maximum	3˚C/s maximum
Preheat Temperature minimum (Tsmin) Temperature maximum (Tsmax) Time (tsmin to tsmax)	100˚C 150˚C 60 s to 120 s	150˚C 200˚C 60 s to 180 s
Time maintained above Temperature (TL) Time (tL)	183˚C 60 s to 150 s	217˚C 60 s to 150 s
Peak/classificationtemperature(T)	235˚C	260˚C
Number of allowed reflow cycles	3	3
Time within 5˚C of actual peak temperature (tp)	10 s to 30 s	20 s to 40 s
Ramp-down rate	6˚C/s maximum	6˚C/s maximum
Time 25˚C to peak temperature	6 minutes maximum	8 minutes maximum

7-2. Reflow soldering profile



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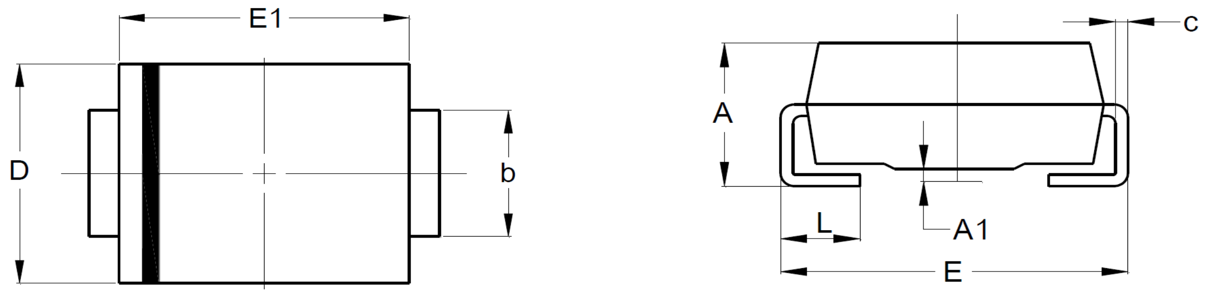
8. Package information

8-1. Dimension

Plastic surface-mounted package ; 2 Leads



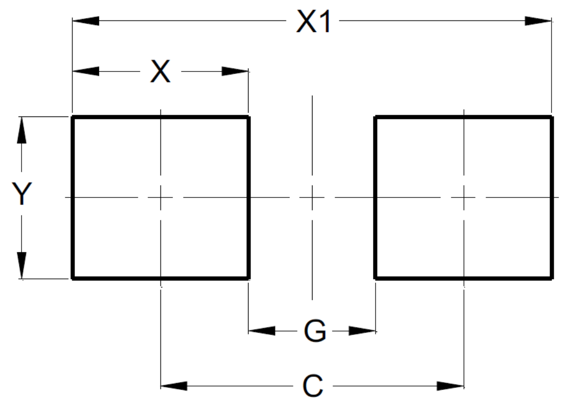
Dimension in mm

Dim	A	A1	b	c	D	E	E1	L
Min	2.05	0.05	2.80	0.10	5.65	7.65	6.75	0.90
Typ	-	-	-	-	-	-	-	-
Max	2.95	0.16	3.10	0.20	6.15	8.15	7.05	1.60

Table 4. Package summary

8-2. PCB Pad layout recommendation

Reflow soldering footprint for SMCJ



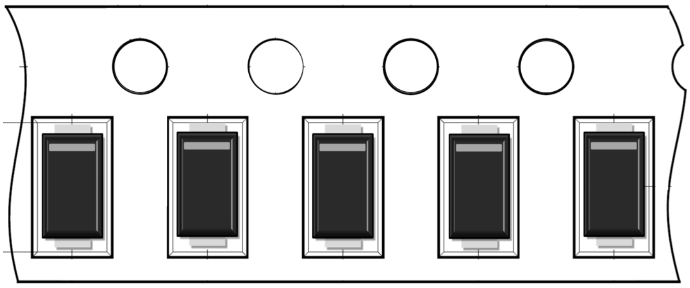
Dimension in mm

Dim	C	G	X	X1	Y
Value	6.90	4.40	2.50	9.40	3.30

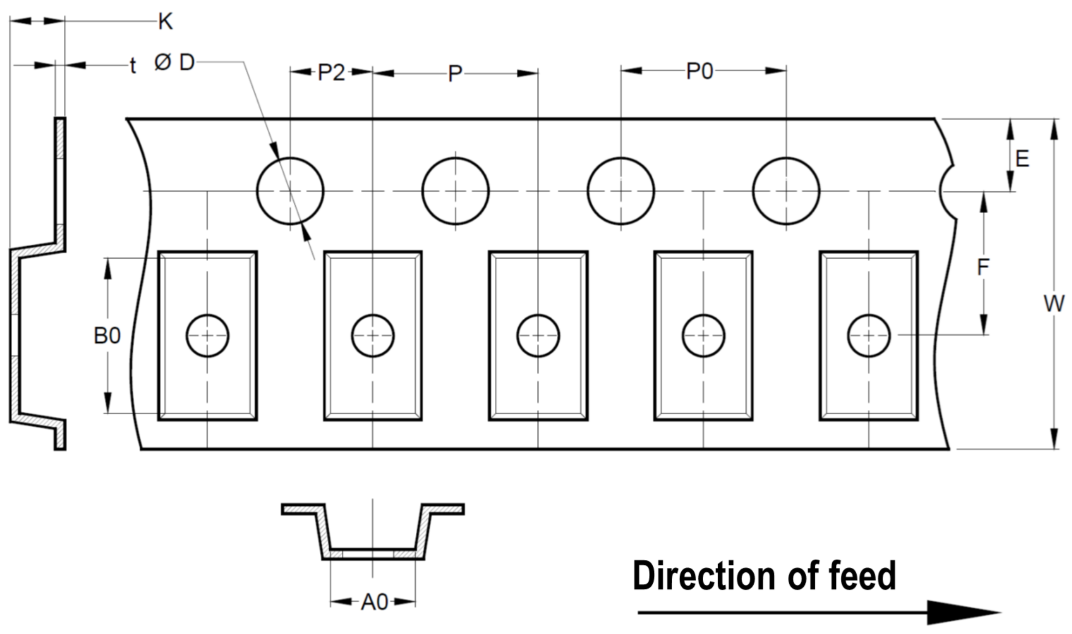
Table 5. Layout summary

9. Packing

9-1. Taping and reel specification

Taping width	Tape orientation
12 mm	

9-2. Embossed carrier tape specification



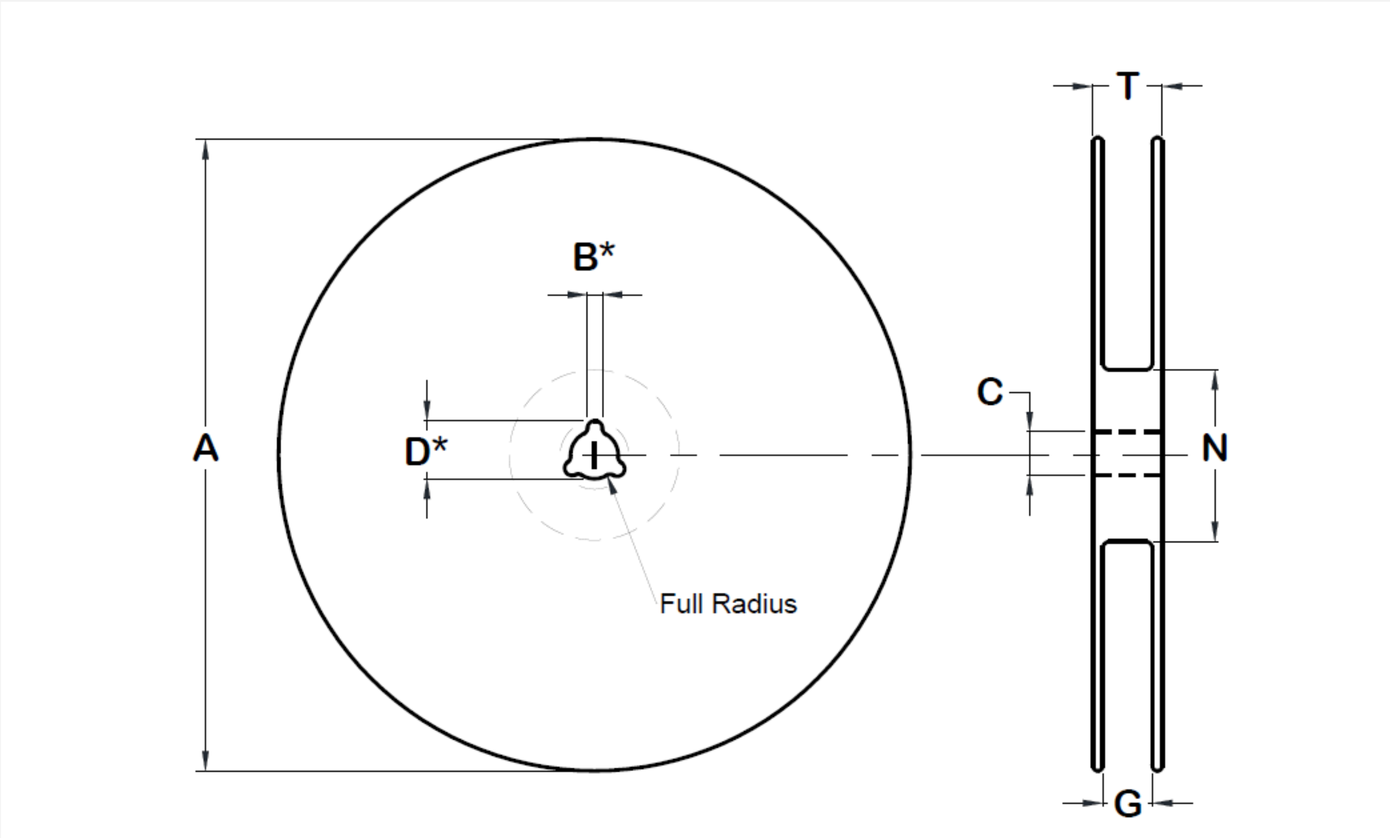
Unit : mm

Dimension	W	D	D1	E	F	K	P	P0	P2	t
Value	16 mm	1.5 ±0.10	1.5 mm	1.75 ±0.10	7.5 ±0.05	3.7 max.	8.0 ±0.10	4.0 ±0.05	2.0 ±0.05	0.4 max.
A0 / B0 / K0	Determined by component size. The clearance between the component and the cavity must comply to the rotational and lateral movement requirement provided in figures in the “maximum component movement in tape pocket” section.									

Table 6. Carrier tape summary

10. Surface mount reel specification

10-1. Reel specification

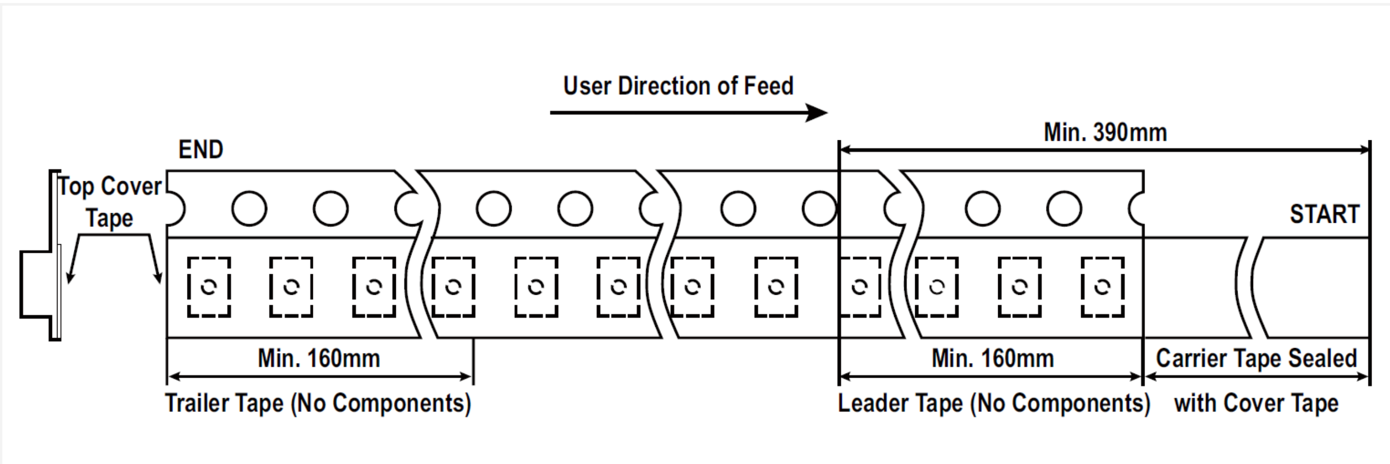


Unit : mm

Dimension	Tape width	Reel size	A	B	C	D	N	G	T
Value	16 mm	13"	330 ±2.0	2.0 ±0.5	13 ±0.5	20.5 ±0.3	100 ±5.0	16.4 +2.3/ -0.0	22.4 +0/ -2.0

Table 7. Reel information

10-2. Tape leader and trailer specification



11. Ordering information

Part number	Package name	Description	Packing
3.0SMCJ Series	SMCJ	Plastic surface-mounted package ; 2 leads	3,000 PCS / 13” Reel

Table 8. Ordering information

12. Marking information

Part number	Marking code
3.0SMCJ Series	Series marking

Table 9. Marking codes

13. Pinning information

13-1. uni-directional

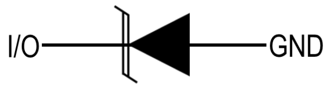
Pin	Symbol	Description	Simplified outline	Graphic symbol
1	K	Cathode		
2	A	Anode		

Table 10. Uni-directional Pinning information

13-2. Bi-directional

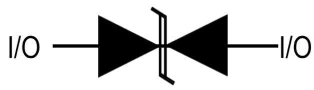
Pin	Symbol	Description	Simplified outline	Graphic symbol
1	A	Anode		
2	A	Anode		

Table 11. Bi-directional Pinning information

14. Legal information

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15. Revision history

Version	Document ID	Release date	Change notice	Basis
A	F118052	01-DEC-2017	New create	Market
B		30-JAN-2018	Outlook PCN	System
C		27-FEB-2019	Update company information	System
2.0		16-MAY-2021	Update version	System
2.1		19-JUL-2021	Update version	System
4.0		04-SEP-2023	Update version	System
5.0		06-JAN-2024	UL Listed	Engineer

Table 12. Revision history

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