TVS Diodes

Transient Voltage Suppression Diodes

SPCL15 Series (15 kA)

Description

The SPCL15 series of high power TVS diode is specially designed for meeting severe surge test environment of both AC and DC line protection applications. It features a very fast response and ultra low clamping characteristics over traditional metal oxide varistor (MOV) solutions. They can be connected in series and / or parallel to create a very high surge current protection solution.

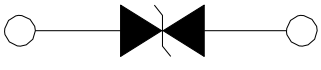
Applications

- Communication Equipment
- Security & Protection
- Industrial Control Equipment
- Power Supply
- Automotive Electronics
- New Energy
- Lightning Protection

Features

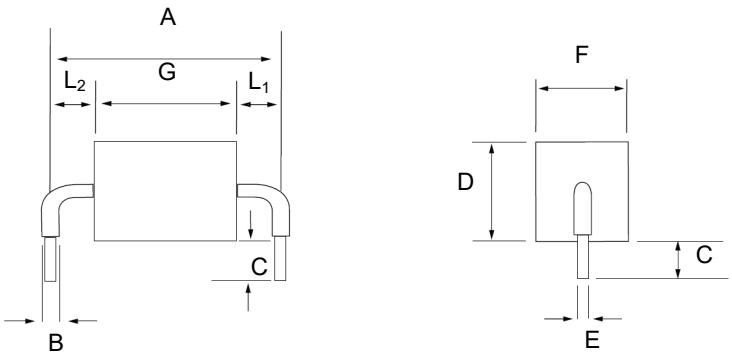
- Very low clamping voltage
- Sharp breakdown voltage
- Low slope resistance
- Bi-directional
- Snapback technology for superior clamping factor
- Symmetric in leads width for easier soldering during assembly.
- IEC-61000-4-2 ESD 30 kV (Air), 30 kV (Contact)
- ESD protection of data lines in accordance with IEC 61000-4-2
- EFT protection of data lines in accordance with IEC 61000-4-4
- Surge protection of lightning in accordance with IEC61000-4-5
- Halogen-free
- RoHS compliant
- Glass passivated junction
- Pb-free E4 means 2nd level interconnect is Pb-free and the terminal finish material is Silver

Functional Diagram



Bi-Directional

Package Outline Dimensions



Symbol	Millimeters	Inches
A	24.15 ± 0.8	0.95 ± 0.03
B	2.50 ± 0.70	0.100 ± 0.028
C	6.00 ± 1.00	0.236 ± 0.04
D	15.50 ± 1.40	0.611 ± 0.055
E	1.28 ± 0.05	0.051 ± 0.002
F	14.90 ± 1.40	0.587 ± 0.055
G - 015C	3.60 ± 1.00	0.142 ± 0.040
G - 030C	4.23 ± 1.00	0.167 ± 0.040
G - 058C / 066C / 076C	7.41 ± 1.20	0.292 ± 0.047
G - 066C / 076C - F	8.91 ± 1.20	0.351 ± 0.047
G - 190C	9.20 ± 1.20	0.362 ± 0.047
G - 380C	17.30 ± 1.20	0.681 ± 0.047
L_1 / L_2	$L_1 = L_2$ Tolerance ± 1.0 mm (0 .04 inch)	

Part Numbering System

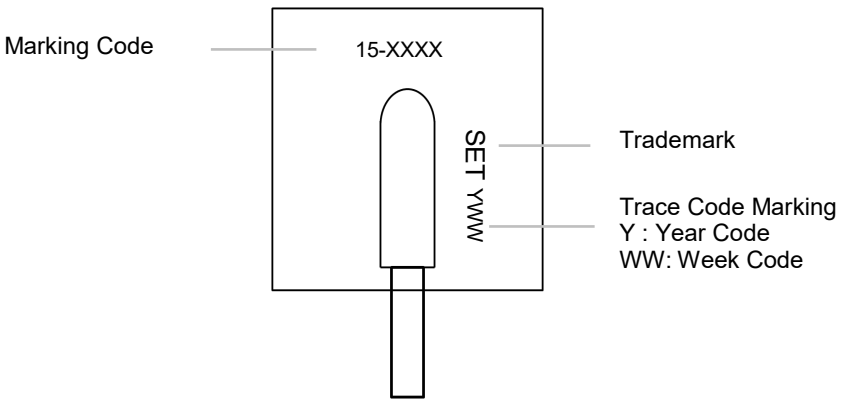
SPCL15 - XXXX

Series Type

V_R (Reverse Stand-off Voltage)

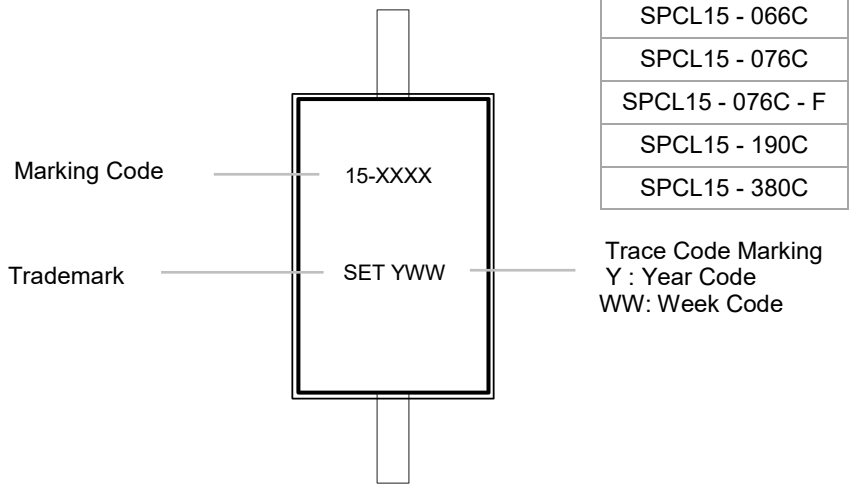
Marking

Apply to P/N
SPCL15-015C
SPCL15-030C



Type 1 - Side View

Apply to P/N
SPCL15 - 058C
SPCL15 - 066C-F
SPCL15 - 066C
SPCL15 - 076C
SPCL15 - 076C - F
SPCL15 - 190C
SPCL15 - 380C



Type 2 - Top View

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

Part Number	Device Marking Code	Breakdown Voltage V_{BR}@I_T		Test Current I_T	Stand-off Voltage V_R	Max. Reverse Leakage I_R@V_R	Typical I_R @85°C	Max. Clamping Voltage V_{CL}@ I_{pp} Peak Pulse Current (I_{PP})			Max. Temp Coefficient OF V_{BR}	Typ. Capacitance 0 Bias 10kHz
		Min	Max					I_{PP} (8/20 μs) (A)	I_{PP} (10/350 μs) (A)	V_{CL} (V)		
		(V)		(mA)	(V)	(μA)	(μA)				(%/°C)	(nF)
SPCL15 - 015C	15-015C	16.0	19.0	10	15	10	15	15000	2000	28	0.1	50.4
SPCL15 - 030C	15-030C	32.0	37.0	10	30	10	15	15000	2000	58	0.1	25.5
SPCL15 - 058C	15 - 058C	64.0	70.0	10	58	10	15	15000	2000	110	0.1	16
SPCL15 - 066C	15 - 066C	72.0	80.0	10	66	10	15	15000	2000	120	0.1	12
SPCL15 - 066C - F	15 - 066C - F	72.0	80.0	10	66	10	15	15000	2000	120	0.1	12
SPCL15 - 076C	15 - 076C	85.0	95.0	10	76	10	15	15000	2000	150	0.1	12
SPCL15 - 076C - F	15 - 076C - F	85.0	95.0	10	76	10	15	15000	2000	150	0.1	12
SPCL15 - 190C	15 - 190C	200.0	245.0	10	190	10	15	15000	1500	290	0.1	5
SPCL15 - 380C	15 - 380C	401.0	443.0	10	380	10	15	15000	1100	520	0.1	4

Note :
Using 8/20 μs wave shape as defined in IEC 61000-4-5.

Maximum Ratings and Characteristics

(T_A = 25 °C unless otherwise specified.)

Parameter	Symbol	Value	Unit
Operating Storage Temperature Range	T_{STG}	-55 to 150	°C
Operating Junction Temperature Range	T_J	-55 to 125	°C
Current Rating (Note 1)	I_{pp}	15	kA

Note:
Rated I_{PP} measured with 8/20 μs pulse.

Ratings and Characteristic Curves (T_A = 25 °C unless otherwise noted)

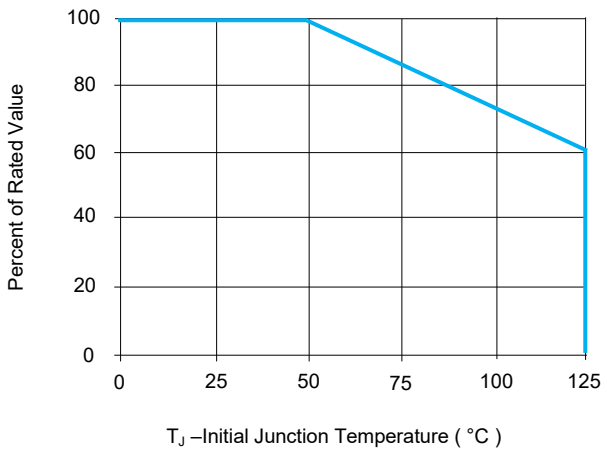


FIGURE 1 Peak Pulse Power Derating Curve

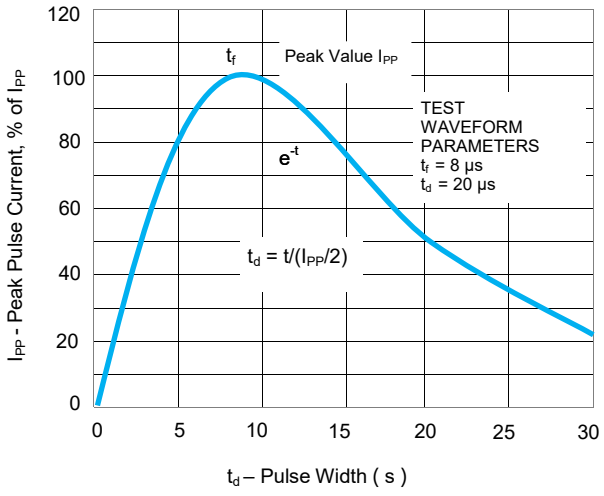


FIGURE 2 Pulse Waveform

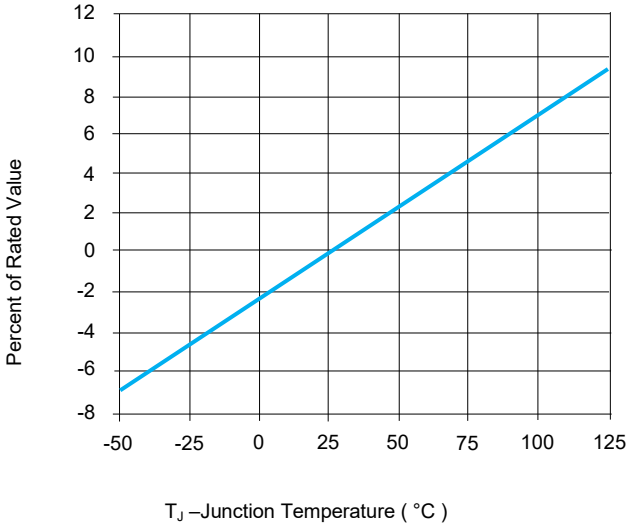


FIGURE 3 Typical V_{BR} Vs Junction Temperature

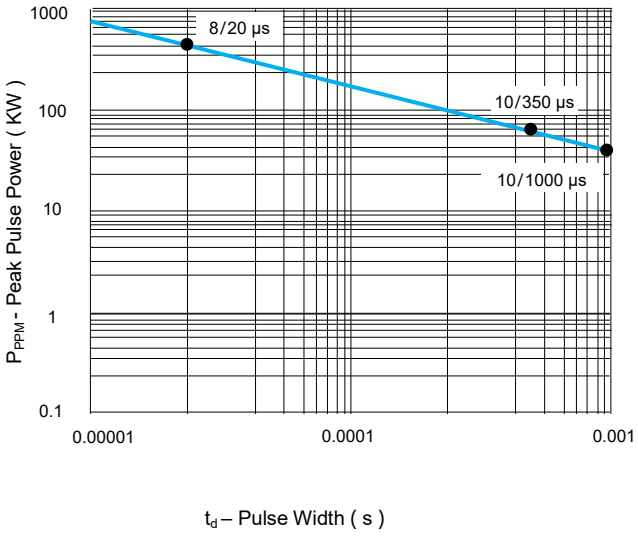
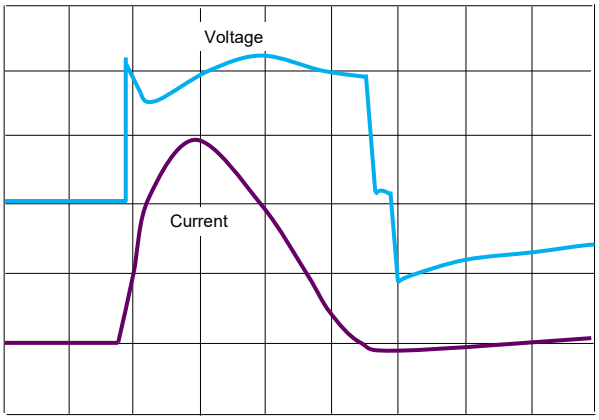


FIGURE 4Peak Pulse Power Rating Curve



Note: The power dissipation causes a change in avalanche voltage during the surge and the avalanche voltage eventually returns to the original value when the transient has passed.

FIGURE 5 Surge Response (8/20 Surge current waveform)

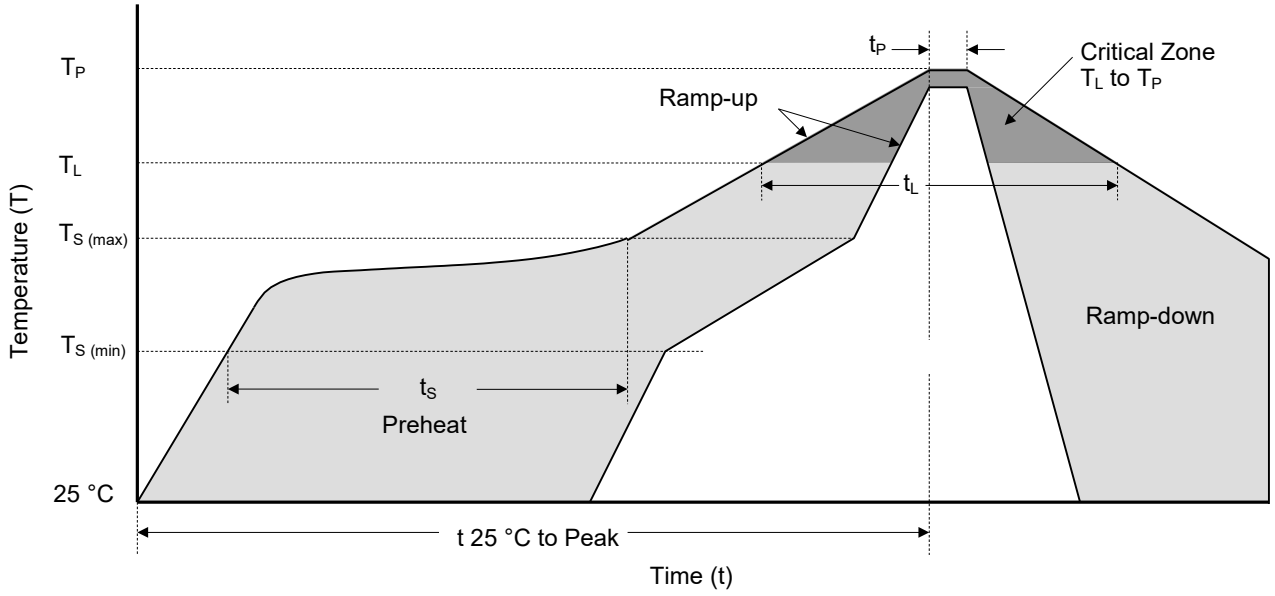
Flow/Wave Soldering (Solder Dipping)

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

Physical Specifications

Weight	Contact manufacturer
Case	Epoxy encapsulated
Terminal	Silver plated leads, solderability per MIL-STD-750 Method 2026

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

Part Number	Package	Quantity	Packaging Option
SPCL15-XXXX	SPCL Package	56 PCS / Box	Bulk
SPCL15-XXXX-12	SPCL Package	12PCS / Box	Bulk

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

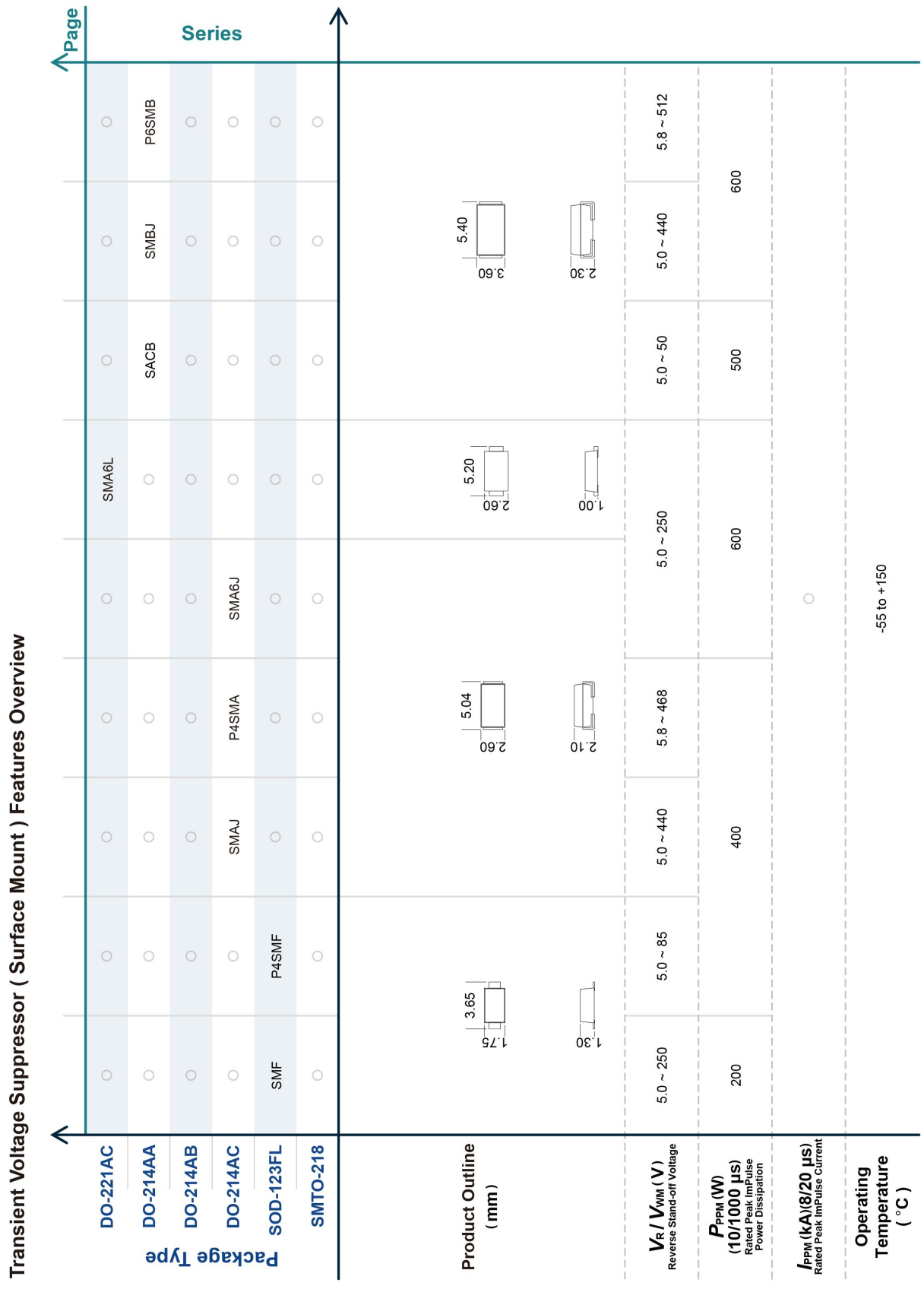
1. TVS should not be exposed to the open air, nor direct sunshine.
2. TVS should avoid rain, water vapor or other condition of high temp. and high humidity.
3. TVS should avoid sand dust, salt mist, or other harmful gases.

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.



Transient Voltage Suppressor (Surface Mount) Features Overview

Package Type	Page	Series									
DO-221AC		SMCJ	1.5SMC	3.0SMCJ	SMDJ	5.0SMDJ	SPC1	SPC3	SPC6	SPC10
DO-214AA		SMCJ	1.5SMC	3.0SMCJ	SMDJ	5.0SMDJ	SPC1	SPC3	SPC6	SPC10
DO-214AB		SMCJ	1.5SMC	3.0SMCJ	SMDJ	5.0SMDJ	SPC1	SPC3	SPC6	SPC10
DO-214AC		SMCJ	1.5SMC	3.0SMCJ	SMDJ	5.0SMDJ	SPC1	SPC3	SPC6	SPC10
SOD-123FL		SMCJ	1.5SMC	3.0SMCJ	SMDJ	5.0SMDJ	SPC1	SPC3	SPC6	SPC10
SMTO-218		SMCJ	1.5SMC	3.0SMCJ	SMDJ	5.0SMDJ	SPC1	SPC3	SPC6	SPC10
Product Outline (mm)		5.90 / 7.94			2.34			14.26 / 18.27	7.09	
V_R / V_{WM} (V) Reverse Stand-off Voltage		5.0 ~ 440	5.8 ~ 512	5.0 ~ 440		12 ~ 170	380 / 430	66	58 ~ 76	58 ~ 86
P_{PPM} (W) (10/1000 µs) Rated Peak ImPulse Power Dissipation		1500		3000		5000		○		
I_{PPM} (kA)(8/20 µs) Rated Peak ImPulse Current				○			1	3	6	10
Operating Temperature (°C)		-55 to +150					-55 to +125			

Transient Voltage Suppressor (Axial Lead) Features Overview

Package Type	Page	Series	Product Outline (mm)	V_R / V_{WM} (V) Reverse Stand-off Voltage	P_{PPM} (W) (10/1000 μs) Rated Peak ImPulse Power Dissipation	I_{PPM} (kA)(8/20 μs) Rated Peak ImPulse Current	Operating Temperature (°C)
DO-201		1.5KE		5.8 ~ 468	400	1	-55 to +150
		LCE		5.0 ~ 50	500		
DO-41		P4KE		5.8 ~ 512	600	3	
				6.5 ~ 90	1500		
DO-15		SAC		5.0 ~ 250	5000	6	
		P6KE		5.8 ~ 512			
P600		5KP		17 ~ 280	15000	10	-55 to +125
		15KPA		20 ~ 300	20000		
		20KPA		28 ~ 360	30000	15	
		30KPA		76			
Radial lead		SPCL1		15 ~ 430		20	
		SPCL3		30 ~ 430			
		SPCL6		15 ~ 530			
		SPCL10		58 ~ 380			
		SPCL15		16 ~ 76			
		SPCL20					