

SM15KPA-HR Series

Surface Mount – 15 kW



Maximum Ratings and Thermal Characteristics ($T_A = 25\text{ }^\circ\text{C}$ unless otherwise noted)

Parameter	Symbol	Value	Unit
Peak Pulse Power Dissipation ($I_{PP} \times V_C$) by 10/1000 μs Test Waveform (Fig.2) (Note 1)	P_{PPM}	15	kW
Steady State Power Dissipation on Infinite Heat Sink at $T_L = 100\text{ }^\circ\text{C}$ (Fig. 6)	P_D	50	W
Peak Forward Surge Current, 8.3 ms Single Half Sine Wave Unidirectional Only (Note 2)	I_{FSM}	2500	A
Maximum Instantaneous Forward Voltage at 500 A for Unidirectional Only (Note 3)	V_F	2.0/3.5	A
Operating Junction and Storage Temperature Range	T_J, T_{STG}	-55 to 150	$^\circ\text{C}$
Typical Thermal Resistance Junction to Case	$R_{\theta JC}$	1.0	$^\circ\text{C/W}$
Typical Thermal Resistance Junction to Ambient	$R_{\theta JA}$	20	$^\circ\text{C/W}$

Notes:

- Non-repetitive current pulse per Fig. 4 and derated above T_J (initial) = $25\text{ }^\circ\text{C}$ per Fig. 3.
- Measured on 8.3 ms single half sine wave or equivalent square wave, duty cycle = 4 per minute maximum.
- $V_F < 2.0\text{ V}$ for single die parts and $V_F < 3.5\text{ V}$ for stacked-die parts.
- For stacked die component details, please refer to part numbers labeled by * in Electrical Characteristics.
- Case temperature controlled on heat sink as specified.

Description

The SM15KPA-HR high reliability series is designed specifically to protect sensitive electronic equipment from voltage transients induced by lightning and other transient voltage events.

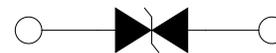
Features & Benefits

- 15 kW peak pulse capability at 10/1000 μs waveform, repetition rate (duty cycles):0.01 %
- Low profile package
- For surface mounted applications to optimize board space
- Typical failure mode is short from over-specified voltage or current
- Low incremental surge resistance
- Excellent clamping capability
- Whisker test is conducted based on JEDEC JESD201A per its table 4a and 4c
- ESD protection of data lines in accordance with IEC 61000-4-2, 30 kV(Air), 30 kV (Contact)
- EFT protection of data lines in accordance with IEC 61000-4-4
- Typical I_R less than 2 μA when $V_{BR\text{ min}} > 33.5\text{ V}$
- Fast response time: typically less than 1.0 ps from 0 volts to $V_{BR\text{ min}}$
- High temperature to reflow soldering guaranteed: 245 $^\circ\text{C}/10\text{ sec}$
- $V_{BR} @ T_J = V_{BR} @ 25\text{ }^\circ\text{C} \times (1 + \alpha T \times (T_J - 25))$ (α : Temperature Coefficient, typical value is 0.1%)
- Meet MSL level 1, per J-STD-020, LF maximum peak of 245 $^\circ\text{C}$
- 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)

Applications

TVS components are ideal for the protection of I/O interfaces, V_{CC} bus and other vulnerable circuits used in aviation and eVTOL applications.

Functional Diagram



Bi-directional



Uni-directional

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Electrical Characteristics

Part Number (Uni)	Part Number (Bi)	Marking		Reverse Stand off Voltage V_R (V)	Breakdown Voltage $V_{BR} @ I_T$ (V)		Test Current I_T (mA)	Maximum Clamping Voltage $V_C @ I_{PP}$ (V)	Maximum Peak Pulse Current I_{PP} (A)	Maximum Reverse Leakage $I_R @ V_R$ (μ A)
					Uni	Bi				
		Uni	Bi		Min	Max				
SM15KPA20A-HR	SM15KPA20CA-HR	15020A	15020C	20	22.34	24.46	5	34.3	440.2	5
SM15KPA22A-HR	SM15KPA22CA-HR	15022A	15022C	22	24.57	26.91	5	37.1	407.0	5
SM15KPA24A-HR	SM15KPA24CA-HR	15024A	15024C	24	26.81	29.35	5	40.7	371.0	5
SM15KPA26A-HR	SM15KPA26CA-HR	15026A	15026C	26	29.04	31.80	5	44.0	343.2	5
SM15KPA28A-HR	SM15KPA28CA-HR	15028A	15028C	28	31.28	34.24	5	47.5	317.9	5
SM15KPA30A-HR	SM15KPA30CA-HR	15030A	15030C	30	33.51	36.70	5	50.7	297.8	2
SM15KPA33A-HR	SM15KPA33CA-HR	15033A	15033C	33	36.90	40.40	5	54.7	276.1	2
SM15KPA36A-HR	SM15KPA36CA-HR	15036A	15036C	36	40.20	44.00	5	59.8	252.5	2
SM15KPA40A-HR	SM15KPA40CA-HR	15040A	15040C	40	44.70	48.90	5	65.8	229.5	2
SM15KPA43A-HR	SM15KPA43CA-HR	15043A	15043C	43	48.00	52.60	5	69.8	216.3	2
SM15KPA45A-HR	SM15KPA45CA-HR	15045A	15045C	45	50.30	55.00	5	72.8	207.4	2
SM15KPA48A-HR	SM15KPA48CA-HR	15048A	15048C	48	53.60	58.70	5	77.7	194.3	2
SM15KPA51A-HR	SM15KPA51CA-HR	15051A	15051C	51	57.00	62.40	5	82.9	182.1	2
SM15KPA54A-HR	SM15KPA54CA-HR	15054A	15054C	54	60.30	66.00	5	87.7	172.2	2
SM15KPA58A-HR	SM15KPA58CA-HR	15058A	15058C	58	64.80	70.90	5	93.8	161.0	2
SM15KPA60A-HR	SM15KPA60CA-HR	15060A	15060C	60	67.00	73.40	5	97.4	155.0	2
SM15KPA64A-HR	SM15KPA64CA-HR	15064A	15064C	64	71.50	78.30	5	104.2	144.9	2
SM15KPA70A-HR	SM15KPA70CA-HR	15070A	15070C	70	78.20	85.60	5	113.6	132.9	2
SM15KPA75A-HR	SM15KPA75CA-HR	15075A	15075C	75	83.80	91.70	5	122.0	123.8	2
SM15KPA78A-HR	SM15KPA78CA-HR	15078A	15078C	78	87.10	95.40	5	126.1	119.7	2
SM15KPA85A-HR	SM15KPA85CA-HR	15085A	15085C	85	94.90	104.00	5	137.6	109.7	2
SM15KPA90A-HR	SM15KPA90CA-HR	15090A	15090C	90	100.50	110.10	5	145.6	103.7	2
SM15KPA100A-HR	SM15KPA100CA-HR	15100A	15100C	100	111.70	122.30	5	161.3	93.6	2
SM15KPA110A-HR	SM15KPA110CA-HR	15110A	15110C	110	122.90	134.50	5	178.6	84.5	2
SM15KPA120A-HR	SM15KPA120CA-HR	15120A	15120C	120	134.00	146.80	5	192.3	78.5	2
SM15KPA130A-HR	SM15KPA130CA-HR	15130A	15130C	130	145.20	159.00	5	208.3	72.5	2
SM15KPA150A-HR	SM15KPA150CA-HR	15150A	15150C	150	167.60	183.50	5	241.9	62.4	2
SM15KPA160A-HR	SM15KPA160CA-HR	15160A	15160C	160	178.70	195.70	5	258.6	58.4	2
SM15KPA170A-HR	SM15KPA170CA-HR	15170A	15170C	170	189.90	207.90	5	272.7	55.4	2
SM15KPA180A-HR	SM15KPA180CA-HR	15180A	15180C	180	201.10	220.10	5	288.5	52.3	2
SM15KPA200A-HR	SM15KPA200CA-HR	15200A	15200C	200	223.40	244.60	5	319.1	47.3	2
SM15KPA220A-HR	SM15KPA220CA-HR	15220A	15220C	220	245.70	269.10	5	356.0	42.4	2
SM15KPA240A-HR	SM15KPA240CA-HR	15240A	15240C	240	268.10	293.50	5	384.6	39.3	2
SM15KPA260A-HR*	SM15KPA260CA-HR*	15260A	15260C	260	290.40	318.00	5	416.7	36.2	2
SM15KPA280A-HR*	SM15KPA280CA-HR*	15280A	15280C	280	311.00	345.00	5	451.8	33.2	2
SM15KPA300A-HR*	SM15KPA300CA-HR*	15300A	15300C	300	333.00	369.00	5	482.3	31.1	2
SM15KPA350A-HR*	SM15KPA350CA-HR*	15350A	15350C	350	389.00	431.00	5	563.9	26.6	2
SM15KPA400A-HR*	SM15KPA400CA-HR*	15400A	15400C	400	444.00	492.00	5	643.8	23.3	2

Note:

1. Each lot of parts will pass group B test requirement.
2. For stack-die parts, use * to label the part number.

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Screen Process

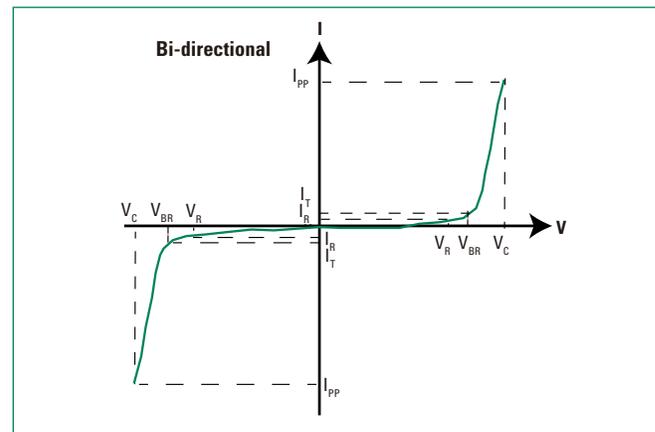
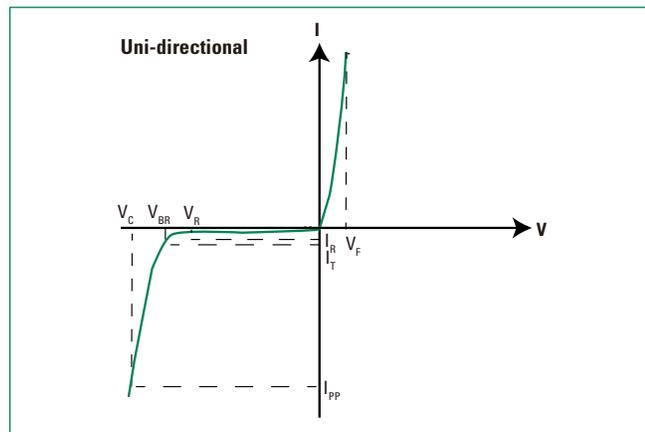
100 % Vision Inspection	MIL-STD-750 method 2074
100 % High Temperature Storage Life (168 hrs, 150 °C)	MIL-STD-750 method 1031
100 % X-RAY Inspection	MIL-STD-750 method 2076
100 % Temperature Cycle Test (-55 to 150 °C, 20 cycles, dwell time 15 min)	MIL-STD-750 method 1051
100 % Surge Test (2x)	MIL-STD-750 method 4066
100 % HTRB 150 °C Bias = V_R (80 % breakdown voltage, 96 hrs, and each direction at 96 hrs for Bi-directional products)	MIL-STD-750 method 1038
Final Electrical Test (100 % 3 sigma limit, 100% dynamic test and PAT limit)	MIL-STD-750 method 4016.4021.4011

Note: Up-screen program can be specified by customer's request via contacting Littelfuse service

Group B Test Requirement

Screen	Method	Condition	Requirement
Surge Test	10/1000 μ s Peak Pulse Waveform	Maximum Clamping Voltage (V_C) @ Peak Pulse Current (I_{PP})	Sample size 45 perform 10x Accept 0 failures
Burn - In (HTRB)	MIL -STD-750, Method 1038.5	Applied Voltage 100 % V_R @ 150 °C	Sample size 45 340 hours (680 hours for bidirection products, each direction 340 hours) Accept 0 failures
Electrical Test	-	I_R @ V_R , V_{BR} @ I_T	Sample size 45 Accept 0 failures

I-V Curve Characteristics



- P_{PPM} Peak Pulse Power Dissipation ($I_{PP} \times V_C$)** – Max power dissipation
 V_R Stand-off Voltage – Maximum voltage that can be applied to the TVS without operation
 V_{BR} Breakdown Voltage – Maximum voltage that flows through the TVS at a specified test current (I_T)
 V_C Clamping Voltage – Peak voltage measured across the suppressor at a specified I_{PPM} (peak impulse current)
 I_R Reverse Leakage Current – Current measured at V_R
 V_F Forward Voltage Drop for Uni-directional

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Ratings and Characteristic Curves ($T_A = 25^\circ\text{C}$ unless otherwise noted)

Figure 1 - TVS Transients Clamping Waveform

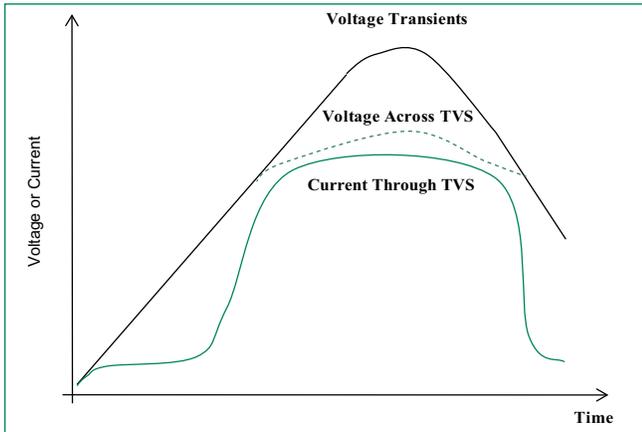


Figure 2 - Peak Pulse Power Rating Curve

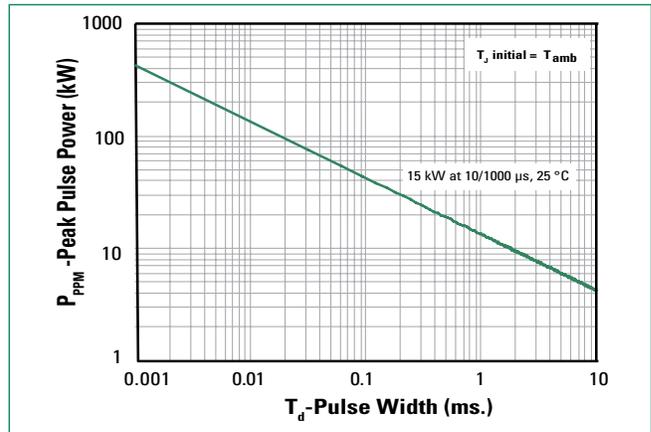


Figure 3 - Peak Pulse Power Derating Curve

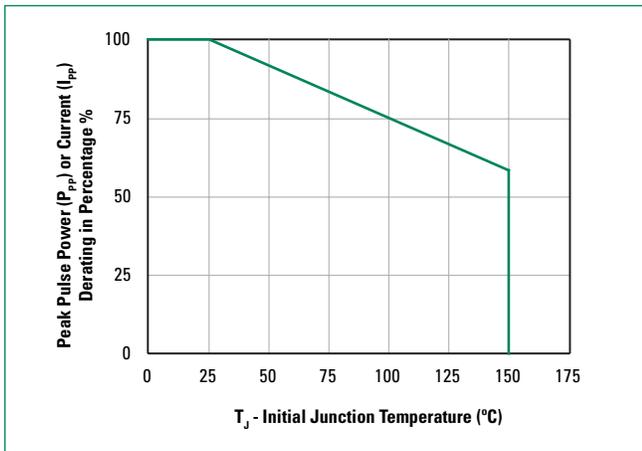


Figure 4 - Test Pulse Waveform

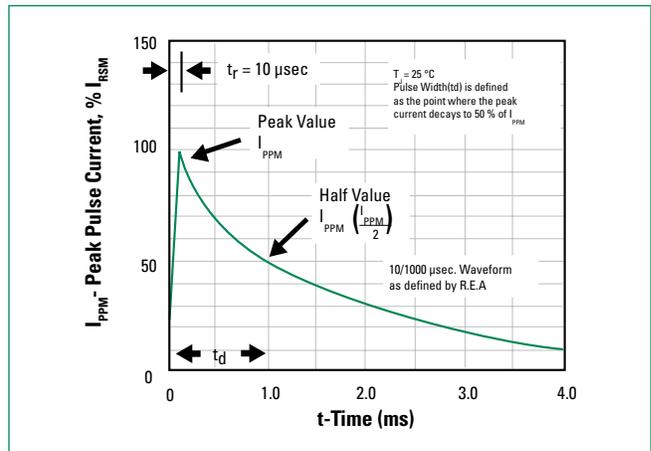


Figure 5 - Typical Junction Capacitance

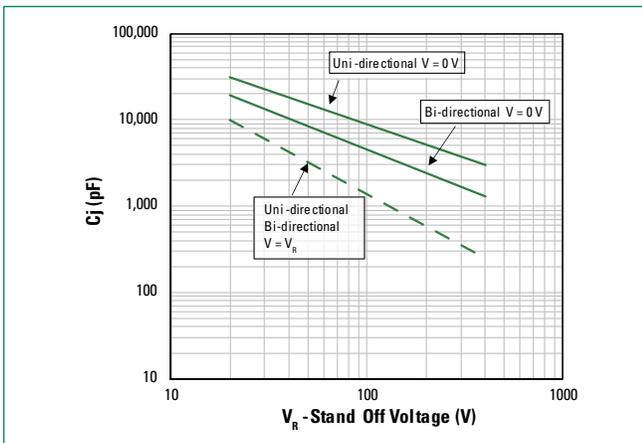
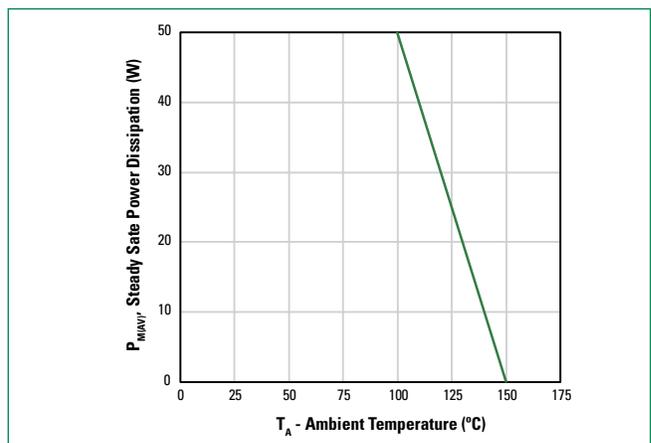


Figure 6 - Steady State Power Derating Curve

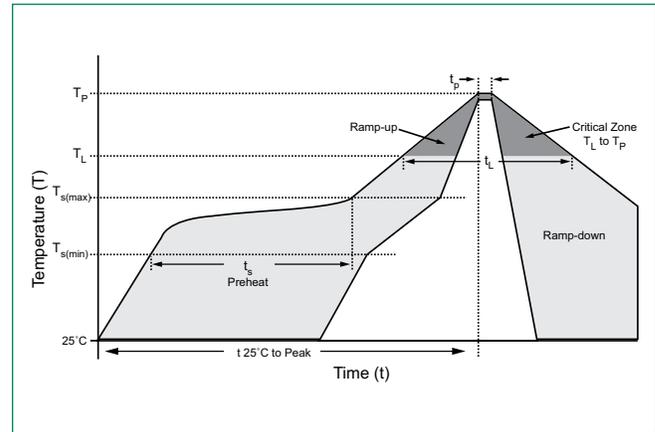


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Soldering Parameters

Reflow Condition		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 (T_L) 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_s)	60 – 150 seconds
Peak Temperature (T_p)		245 ^{+0/-5} °C
Time Within 5 °C of Actual Peak Temperature (t_p)		30 seconds max
Ramp-down Rate		6°C/second max
Time 25°C to Peak Temperature (T_p)		8 minutes max
Do Not Exceed		245 °C



Physical Specifications

Weight	0.092 ounce, 2.6 grams
Case	Molded plastic body over glass passivated junction
Polarity	Color band denotes positive end (cathode) except bidirectional.
Terminal	Matte tin-plated leads, solderable per JESD22-B102

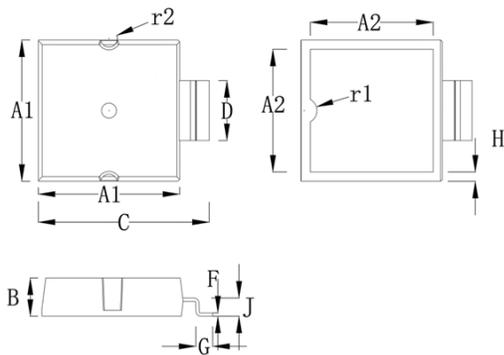
Environmental Specifications

High Temperature Storage	JESD22-A103
HTRB	JESD22-A108
Temperature Cycling	JESD22-A104
MSL	JEDEC-J-STD-020, Level 1
H3TRB	JESD22-A101
RSH	JESD22-A111

Packaging

Part number	Component Package	Quantity	Packaging Option	Packaging Specification
SM15KPAxxxXX-HR	SPD4-1	500	Tape & Reel - 28 mm tape/ 7" reel	EIA STD RS-481

Dimensions

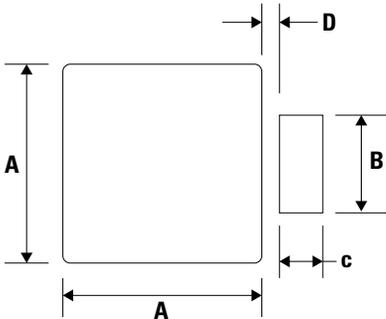


Dimensions	Inches		Millimeters	
	Min	Max	Min	Max
A1	0.488	0.498	12.40	12.66
A2	0.414	0.442	10.52	11.22
B	0.128	0.144	3.24	3.66
C	0.587	0.610	14.90	15.50
D	0.208	0.214	5.28	5.43
F	0.009	0.014	0.23	0.35
G	0.054	0.066	1.37	1.67
J	0.057	0.069	1.45	1.75
H	0.032 TYP		0.83 TYP	
r1	0.045 TYP		1.14 TYP	
r2	0.027 TYP		0.70 TYP	

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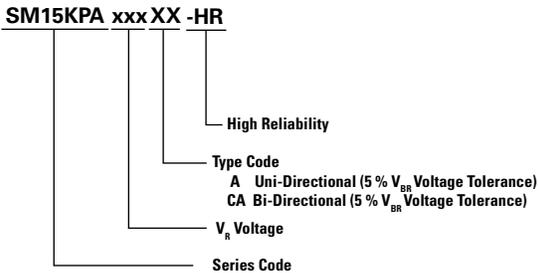
Surface Mount – 15 kW

Pad Layout

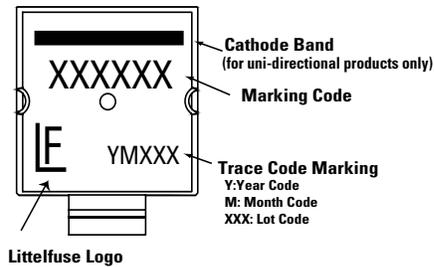


Dimensions	Inches		Millimeters	
	Min	Max	Min	Max
A	0.465	0.475	11.81	12.07
B	0.225	0.235	5.72	5.97
C	0.095	0.105	2.41	2.67
D	0.04	0.05	1.02	1.27

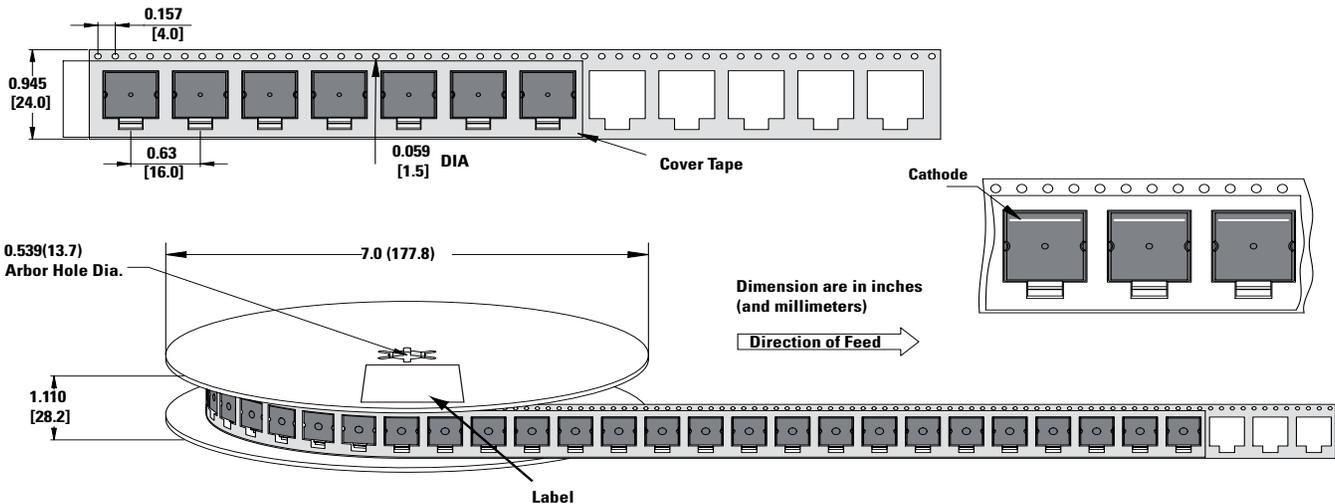
Part Numbering System



Part Marking System



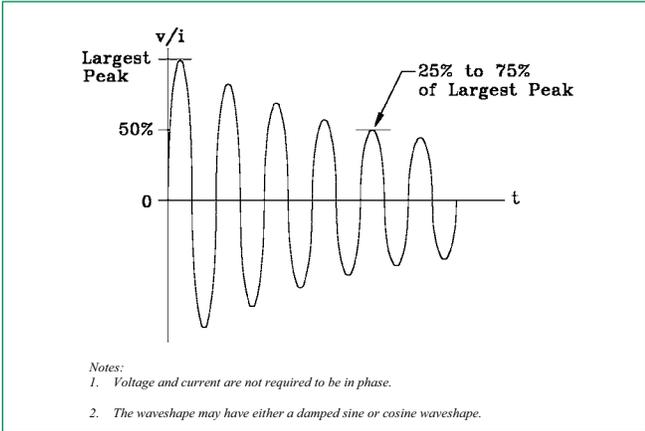
Tape and Reel Specification



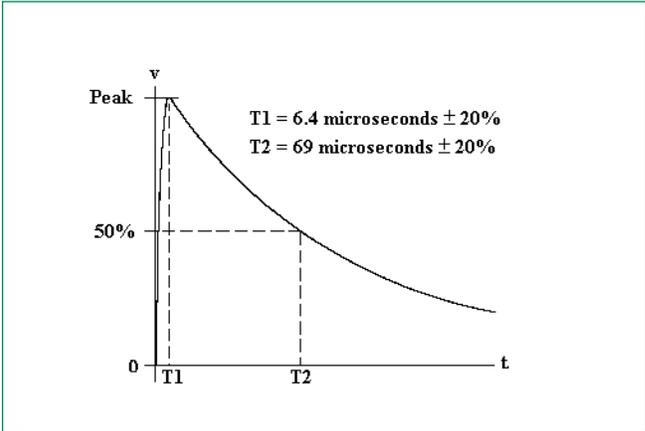
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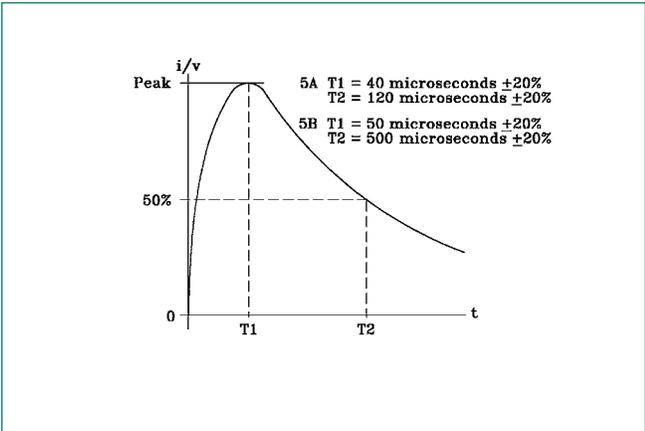
RTCA/DO-160G Wave 3



RTCA/DO-160G Wave 4



RTCA/DO-160G Wave 5



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Pin Injection Protection Per RTCA/DO-160G

Part Number (Uni)	Part Number (Bi)	25 °C							70 °C							120 °C						
		Wave 3		Wave 4 (6.4/69 µs)			Wave 5 (40/120 µs)		Wave 3		Wave 4 (6.4/69 µs)			Wave 5 (40/120 µs)		Wave 3		Wave 4 (6.4/69 µs)			Wave 5 (40/120 µs)	
		L5	L3	L4	L5	L3	L4	L5	L5	L3	L4	L5	L3	L4	L5	L5	L3	L4	L5	L3	L4	L5
		128A	60A	150A	320A	300A	750A	1600A	128A	60A	150A	320A	300A	750A	1600A	128A	60A	150A	320A	300A	750A	1600A
SM15KPA20A-HR	SM15KPA20CA-HR	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass
SM15KPA22A-HR	SM15KPA22CA-HR	Pass	Pass	Pass	Pass	Pass	-	-	Pass	Pass	Pass	Pass	Pass	-	-	Pass	Pass	Pass	Pass	Pass	-	-
SM15KPA24A-HR	SM15KPA24CA-HR	Pass	Pass	Pass	Pass	Pass	-	-	Pass	Pass	Pass	Pass	Pass	-	-	Pass	Pass	Pass	Pass	Pass	-	-
SM15KPA26A-HR	SM15KPA26CA-HR	Pass	Pass	Pass	Pass	Pass	-	-	Pass	Pass	Pass	Pass	Pass	-	-	Pass	Pass	Pass	Pass	Pass	-	-
SM15KPA28A-HR	SM15KPA28CA-HR	Pass	Pass	Pass	Pass	Pass	-	-	Pass	Pass	Pass	Pass	Pass	-	-	Pass	Pass	Pass	Pass	Pass	-	-
SM15KPA30A-HR	SM15KPA30CA-HR	Pass	Pass	Pass	Pass	Pass	-	-	Pass	Pass	Pass	Pass	Pass	-	-	Pass	Pass	Pass	Pass	Pass	-	-
SM15KPA33A-HR	SM15KPA33CA-HR	Pass	Pass	Pass	Pass	Pass	-	-	Pass	Pass	Pass	Pass	Pass	-	-	Pass	Pass	Pass	Pass	Pass	-	-
SM15KPA36A-HR	SM15KPA36CA-HR	Pass	Pass	Pass	Pass	Pass	-	-	Pass	Pass	Pass	Pass	Pass	-	-	Pass	Pass	Pass	Pass	Pass	-	-
SM15KPA40A-HR	SM15KPA40CA-HR	Pass	Pass	Pass	Pass	Pass	-	-	Pass	Pass	Pass	Pass	Pass	-	-	Pass	Pass	Pass	Pass	Pass	-	-
SM15KPA43A-HR	SM15KPA43CA-HR	Pass	Pass	Pass	Pass	Pass	-	-	Pass	Pass	Pass	Pass	Pass	-	-	Pass	Pass	Pass	Pass	Pass	-	-
SM15KPA45A-HR	SM15KPA45CA-HR	Pass	Pass	Pass	Pass	Pass	-	-	Pass	Pass	Pass	Pass	Pass	-	-	Pass	Pass	Pass	Pass	Pass	-	-
SM15KPA48A-HR	SM15KPA48CA-HR	Pass	Pass	Pass	Pass	Pass	-	-	Pass	Pass	Pass	Pass	Pass	-	-	Pass	Pass	Pass	Pass	Pass	-	-
SM15KPA51A-HR	SM15KPA51CA-HR	Pass	Pass	Pass	Pass	Pass	-	-	Pass	Pass	Pass	Pass	Pass	-	-	Pass	Pass	Pass	Pass	Pass	-	-
SM15KPA54A-HR	SM15KPA54CA-HR	Pass	Pass	Pass	Pass	Pass	-	-	Pass	Pass	Pass	Pass	Pass	-	-	Pass	Pass	Pass	Pass	Pass	-	-
SM15KPA58A-HR	SM15KPA58CA-HR	Pass	Pass	Pass	Pass	Pass	-	-	Pass	Pass	Pass	Pass	Pass	-	-	Pass	Pass	Pass	Pass	Pass	-	-
SM15KPA60A-HR	SM15KPA60CA-HR	Pass	Pass	Pass	Pass	Pass	-	-	Pass	Pass	Pass	Pass	Pass	-	-	Pass	Pass	Pass	Pass	Pass	-	-
SM15KPA64A-HR	SM15KPA64CA-HR	Pass	Pass	Pass	Pass	Pass	-	-	Pass	Pass	Pass	Pass	Pass	-	-	Pass	Pass	Pass	Pass	Pass	-	-
SM15KPA70A-HR	SM15KPA70CA-HR	Pass	Pass	Pass	Pass	Pass	-	-	Pass	Pass	Pass	Pass	Pass	-	-	Pass	Pass	Pass	Pass	Pass	-	-
SM15KPA75A-HR	SM15KPA75CA-HR	Pass	Pass	Pass	Pass	Pass	-	-	Pass	Pass	Pass	Pass	Pass	-	-	Pass	Pass	Pass	Pass	Pass	-	-
SM15KPA78A-HR	SM15KPA78CA-HR	Pass	Pass	Pass	Pass	Pass	-	-	Pass	Pass	Pass	Pass	Pass	-	-	Pass	Pass	Pass	Pass	Pass	-	-
SM15KPA85A-HR	SM15KPA85CA-HR	Pass	Pass	Pass	Pass	Pass	-	-	Pass	Pass	Pass	Pass	Pass	-	-	Pass	Pass	Pass	Pass	Pass	-	-
SM15KPA90A-HR	SM15KPA90CA-HR	Pass	Pass	Pass	Pass	-	-	-	Pass	Pass	Pass	Pass	-	-	-	Pass	Pass	Pass	-	-	-	-
SM15KPA100A-HR	SM15KPA100CA-HR	Pass	Pass	Pass	Pass	-	-	-	Pass	Pass	Pass	Pass	-	-	-	Pass	Pass	Pass	-	-	-	-
SM15KPA110A-HR	SM15KPA110CA-HR	Pass	Pass	Pass	Pass	-	-	-	Pass	Pass	Pass	Pass	-	-	-	Pass	Pass	Pass	-	-	-	-
SM15KPA120A-HR	SM15KPA120CA-HR	Pass	Pass	Pass	Pass	-	-	-	Pass	Pass	Pass	Pass	-	-	-	Pass	Pass	Pass	-	-	-	-
SM15KPA130A-HR	SM15KPA130CA-HR	Pass	Pass	Pass	Pass	-	-	-	Pass	Pass	Pass	Pass	-	-	-	Pass	Pass	Pass	-	-	-	-
SM15KPA150A-HR	SM15KPA150CA-HR	Pass	Pass	Pass	Pass	-	-	-	Pass	Pass	Pass	Pass	-	-	-	Pass	Pass	Pass	-	-	-	-
SM15KPA160A-HR	SM15KPA160CA-HR	Pass	Pass	Pass	Pass	-	-	-	Pass	Pass	Pass	Pass	-	-	-	Pass	Pass	Pass	-	-	-	-
SM15KPA170A-HR	SM15KPA170CA-HR	Pass	Pass	Pass	-	-	-	-	Pass	Pass	Pass	-	-	-	-	Pass	Pass	Pass	-	-	-	-
SM15KPA180A-HR	SM15KPA180CA-HR	Pass	Pass	Pass	-	-	-	-	Pass	Pass	Pass	-	-	-	-	Pass	Pass	Pass	-	-	-	-
SM15KPA200A-HR	SM15KPA200CA-HR	Pass	Pass	Pass	-	-	-	-	Pass	Pass	Pass	-	-	-	-	Pass	Pass	Pass	-	-	-	-
SM15KPA220A-HR	SM15KPA220CA-HR	Pass	Pass	Pass	-	-	-	-	Pass	Pass	Pass	-	-	-	-	Pass	Pass	Pass	-	-	-	-
SM15KPA240A-HR	SM15KPA240CA-HR	Pass	Pass	Pass	-	-	-	-	Pass	Pass	Pass	-	-	-	-	Pass	Pass	Pass	-	-	-	-
SM15KPA260A-HR	SM15KPA260CA-HR	Pass	Pass	Pass	-	-	-	-	Pass	Pass	Pass	-	-	-	-	Pass	Pass	Pass	-	-	-	-
SM15KPA280A-HR	SM15KPA280CA-HR	Pass	Pass	Pass	-	-	-	-	Pass	Pass	Pass	-	-	-	-	Pass	Pass	Pass	-	-	-	-
SM15KPA300A-HR	SM15KPA300CA-HR	Pass	Pass	Pass	-	-	-	-	Pass	Pass	Pass	-	-	-	-	Pass	Pass	Pass	-	-	-	-
SM15KPA350A-HR	SM15KPA350CA-HR	Pass	Pass	Pass	-	-	-	-	Pass	Pass	Pass	-	-	-	-	Pass	Pass	Pass	-	-	-	-
SM15KPA400A-HR	SM15KPA400CA-HR	Pass	Pass	Pass	-	-	-	-	Pass	Pass	Pass	-	-	-	-	Pass	Pass	Pass	-	-	-	-

Note:

1. L1 = Level 1, L2 = Level 2, L3 = Level 3, L4 = Level 4, L5 = Level 5

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