SM36KPA-HR Series

Surface Mount – 36 kW

Description

The SM36KPA-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

- 36 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
- Low incremental surge resistance
- Excellent clamping capability
- Typical failure mode is short from over-specified voltage or current
- 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} min > 66.7 V
- Fast response time: typically less than 1.0 ps from 0 volts to V_{BR} min
- High temperature to reflow soldering guaranteed: 245 °C/10 sec
- V_{BR} @ T_J = V_{BR} @ 25 °C x (1+αT x (T_J -25))(αT:Temperature Coefficient, typical value is 0.1%)
- Meet MSL level 1, per J-STD-020, LF maximum peak of 245 °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)

Maximum Ratings and Thermal Characteristics (T_A = 25 °C unless otherwise noted)

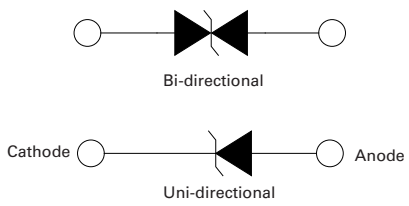
Parameter	Symbol	Value	Unit
Peak Pulse Power Dissipation (I_{PP} x V_C) by 10/1000 µs Test Waveform (Fig.2) (Note 1)	P_{PPM}	36	kW
Steady State Power Dissipation on Infinite Heat Sink at T_L = 100 °C (Fig. 6)	P_D	50	W
Peak Forward Surge Current, 8.3 ms Single Half Sine Wave Unidirectional Only (Note 2)	I_{FSM}	2500	A
Maximum Instantaneous Forward Voltage at 500 A for Unidirectional Only	V_F	3.5	A
Operating Junction and Storage Temperature Range	T_J, T_{STG}	-55 to 150	°C
Typical Thermal Resistance Junction to Case	$R_{\theta JC}$	1.0	°C/W
Typical Thermal Resistance Junction to Ambient	$R_{\theta JA}$	20	°C/W

Notes:
1. Non-repetitive current pulse per Fig. 4 and derated above T_J (initial) = 25 °C per Fig. 3.
2. Measured on 8.3 ms single half sine wave or equivalent square wave, duty cycle = 4 per minute maximum.
3. Case temperature controlled on heat sink as specified.

Applications

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

Functional Diagram



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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 (µA)
		Uni	Bi		Min	Max				
SM36KPA28A-HR	SM36KPA28CA-HR	36028A	36028C	28	31.1	34.4	5	46.4	776	10
SM36KPA30A-HR	SM36KPA30CA-HR	36030A	36030C	30	33.3	36.8	5	48.8	738	10
SM36KPA33A-HR	SM36KPA33CA-HR	36033A	36033C	33	36.7	40.6	5	53.3	676	10
SM36KPA36A-HR	SM36KPA36CA-HR	36036A	36036C	36	40.0	44.2	5	58.1	620	10
SM36KPA40A-HR	SM36KPA40CA-HR	36040A	36040C	40	44.4	49.1	5	64.5	559	5
SM36KPA43A-HR	SM36KPA43CA-HR	36043A	36043C	43	47.8	52.8	5	69.4	519	5
SM36KPA45A-HR	SM36KPA45CA-HR	36045A	36045C	45	50.0	55.3	5	72.7	496	5
SM36KPA48A-HR	SM36KPA48CA-HR	36048A	36048C	48	53.3	58.9	5	77.4	466	5
SM36KPA51A-HR	SM36KPA51CA-HR	36051A	36051C	51	56.7	62.7	5	82.4	437	5
SM36KPA54A-HR	SM36KPA54CA-HR	36054A	36054C	54	60.0	66.3	5	87.1	414	5
SM36KPA58A-HR	SM36KPA58CA-HR	36058A	36058C	58	64.4	71.2	5	93.6	385	5
SM36KPA60A-HR	SM36KPA60CA-HR	36060A	36060C	60	66.7	73.7	5	96.8	372	2
SM36KPA64A-HR	SM36KPA64CA-HR	36064A	36064C	64	71.1	78.6	5	103.0	350	2
SM36KPA70A-HR	SM36KPA70CA-HR	36070A	36070C	70	77.8	86.0	5	113.0	319	2
SM36KPA75A-HR	SM36KPA75CA-HR	36075A	36075C	75	83.3	92.1	5	121.0	298	2
SM36KPA78A-HR	SM36KPA78CA-HR	36078A	36078C	78	86.7	95.8	5	126.0	286	2
SM36KPA85A-HR	SM36KPA85CA-HR	36085A	36085C	85	94.4	104.0	5	137.0	263	2
SM36KPA90A-HR	SM36KPA90CA-HR	36090A	36090C	90	100.0	111.0	5	146.0	247	2
SM36KPA100A-HR	SM36KPA100CA-HR	36100A	36100C	100	111.0	123.0	5	162.0	223	2
SM36KPA110A-HR	SM36KPA110CA-HR	36110A	36110C	110	122.0	135.0	5	177.0	204	2
SM36KPA120A-HR	SM36KPA120CA-HR	36120A	36120C	120	133.0	147.0	5	193.0	187	2
SM36KPA130A-HR	SM36KPA130CA-HR	36130A	36130C	130	144.0	159.0	5	209.0	173	2
SM36KPA150A-HR	SM36KPA150CA-HR	36150A	36150C	150	167.0	185.0	5	243.0	149	2
SM36KPA160A-HR	SM36KPA160CA-HR	36160A	36160C	160	178.0	197.0	5	259.0	139	2
SM36KPA170A-HR	SM36KPA170CA-HR	36170A	36170C	170	189.0	209.0	5	275.0	131	2
SM36KPA180A-HR	SM36KPA180CA-HR	36180A	36180C	180	200.0	221.0	5	291.0	124	2
SM36KPA200A-HR	SM36KPA200CA-HR	36200A	36200C	200	222.0	245.0	5	322.0	112	2
SM36KPA220A-HR	SM36KPA220CA-HR	36220A	36220C	220	245.0	271.0	5	356.0	102	2
SM36KPA260A-HR	SM36KPA260CA-HR	36260A	36260C	260	289.0	320.0	5	419.0	86	2
SM36KPA280A-HR	SM36KPA280CA-HR	36280A	36280C	280	311.0	345.0	5	451.0	80	2
SM36KPA300A-HR	SM36KPA300CA-HR	36300A	36300C	300	333.0	369.0	5	483.0	75	2
SM36KPA350A-HR	SM36KPA350CA-HR	36350A	36350C	350	389.0	431.0	5	564.0	64	2
SM36KPA400A-HR	SM36KPA400CA-HR	36400A	36400C	400	444.0	492.0	5	644.0	56	2

Note:
Each lot of parts will pass group B test requirement.

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Screen Process

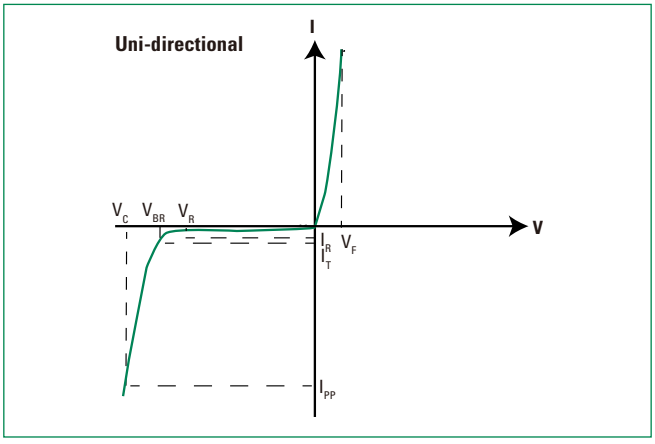
100 % Vision Inspection	MIL-STD-750 method 2074
100 % High Temperature Storage Life (168 hrs,150 °C)	MIL-STD-750 method 1031
100 % X-RAY Inspection	MIL-STD-750 method 2076
100 % Temperature Cycle Test (-55 to150 °C, 20 cycles, dwell time 15 min)	MIL-STD-750 method 1051
100 % Surge Test (2x)	MIL-STD-750 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

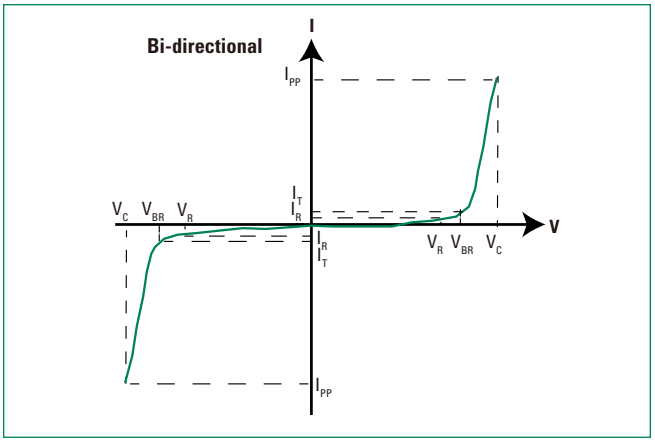
Note: Up-screen program can be specified by customer's request via contacting Littelfuse service

Group B Test Requirement

Screen	Method	Condition	Requirement
Surge Test	10/1000 µs 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} x 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 though the TVS at a specified test current (I_T)
V_C Clamping Voltage – Peak voltage measured across the suppressor at a specified Ippm (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 °C unless otherwise noted)

Figure 1 - TVS Transients Clamping Waveform

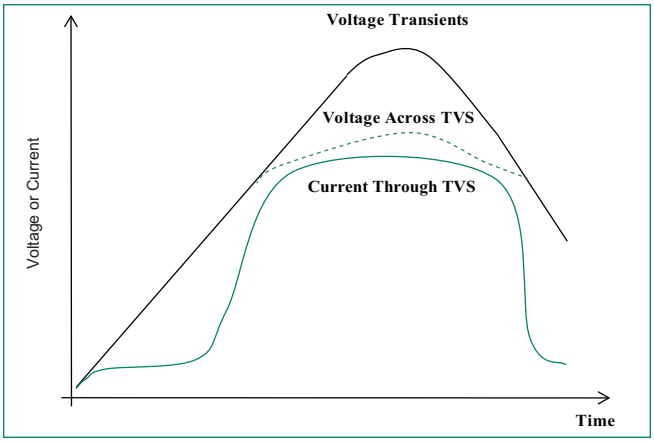


Figure 2 - Peak Pulse Power Rating Curve

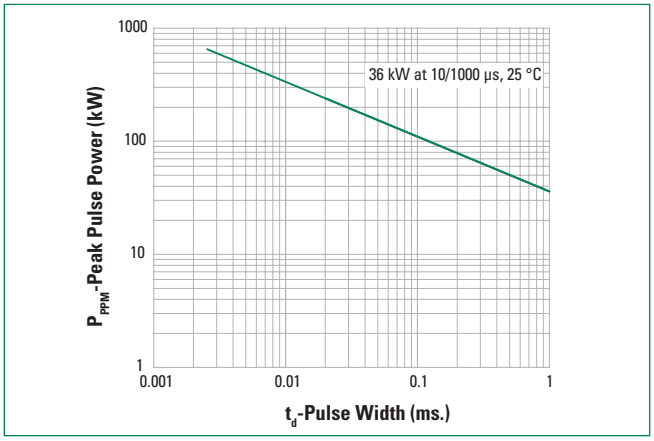


Figure 3 - Peak Pulse Power Derating Curve

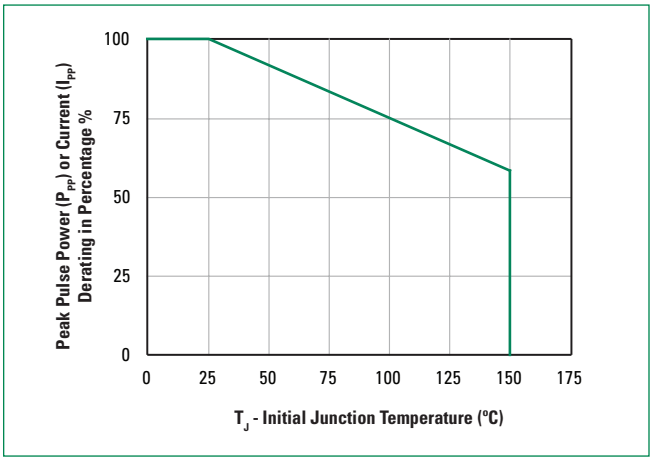


Figure 4 - Test Pulse Waveform

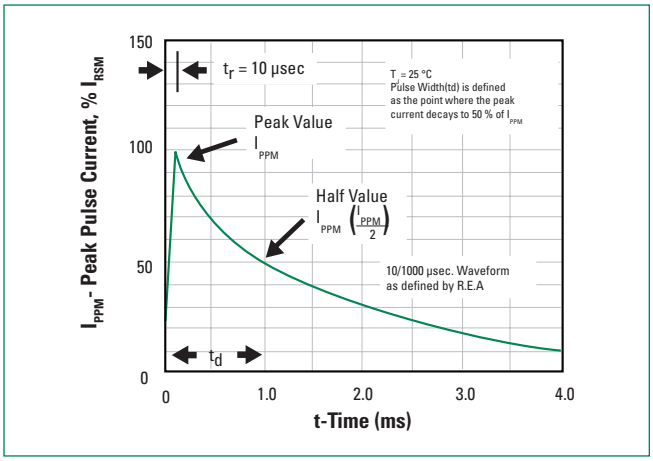


Figure 5 - Typical Junction Capacitance

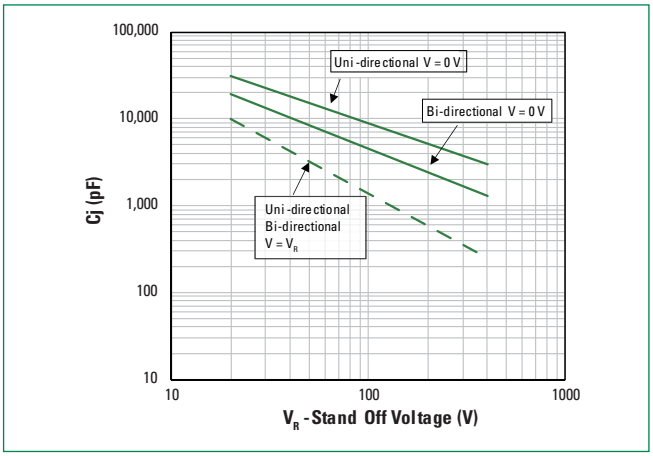
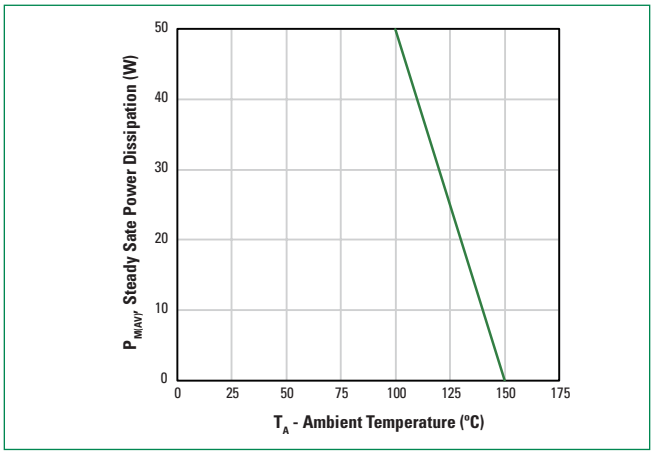


Figure 6 - Steady State Power Derating Curve



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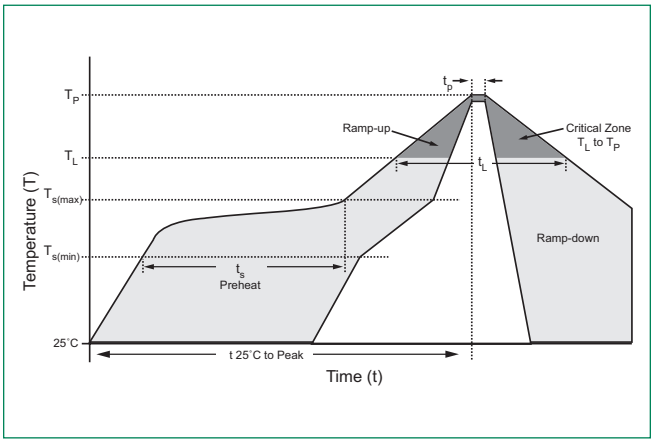
Soldering Parameters

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

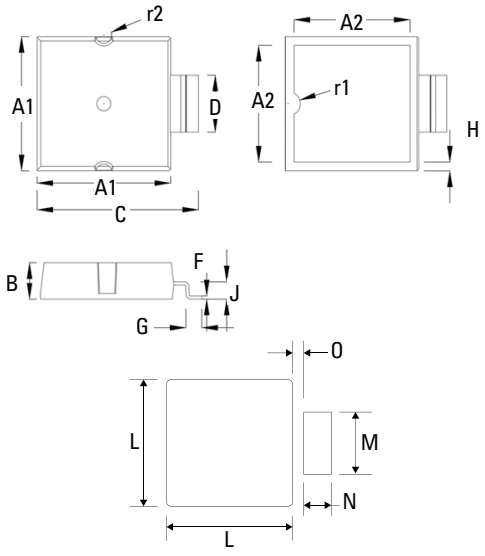
Environmental Specifications

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
SM36KPAxxxXX-HR	SPD4-1	500	Tape & Reel - 24 mm tape/ 7" reel	EIA STD RS-481

Dimensions



Recommended Soldering Pad Layout

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	
L	0.465	0.475	11.81	12.07
M	0.225	0.235	5.72	5.97
N	0.095	0.105	2.41	2.67
O	0.040	0.050	1.02	1.27

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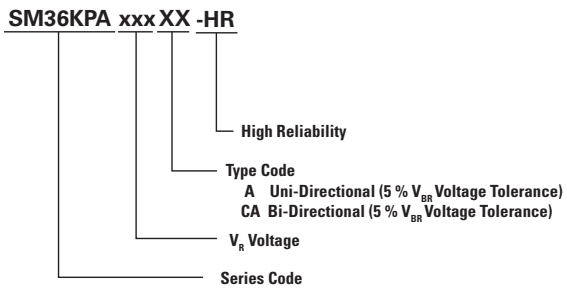
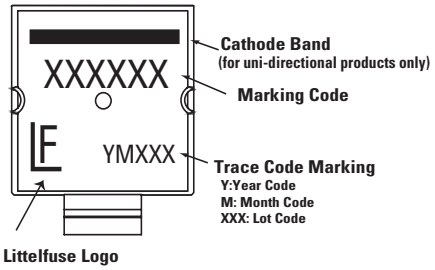
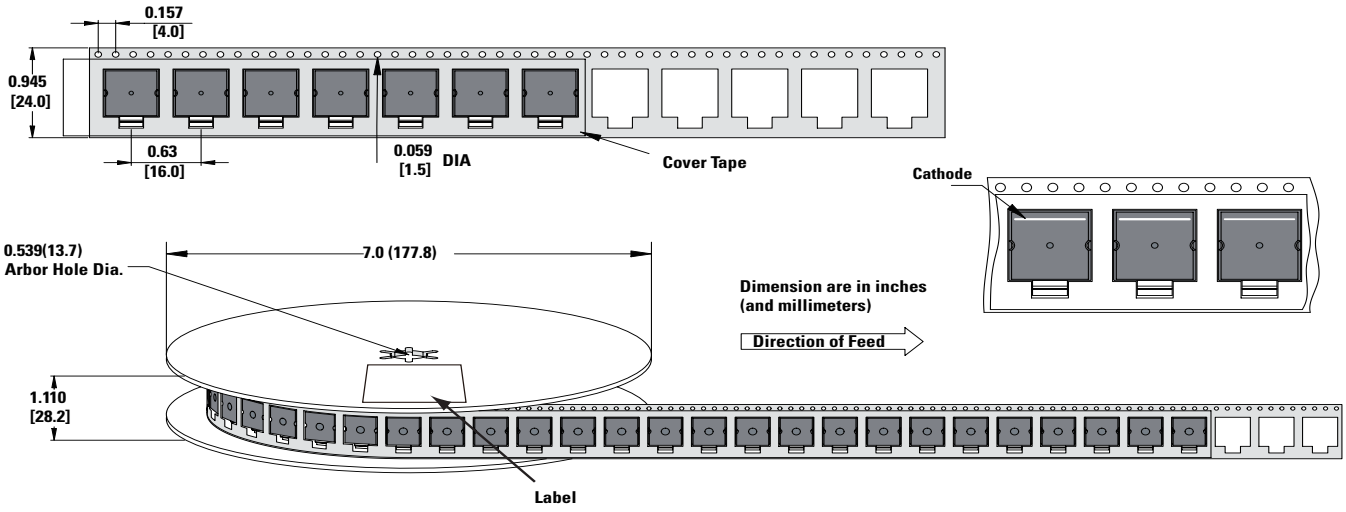
Part Numbering System



Part Marking System



Tape and Reel Specification



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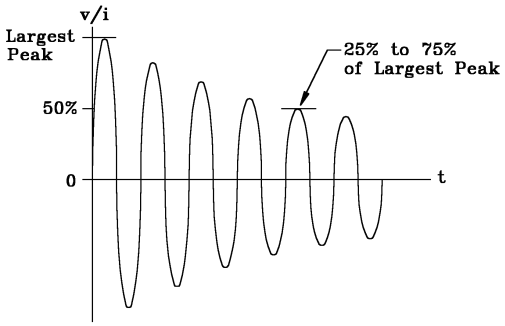
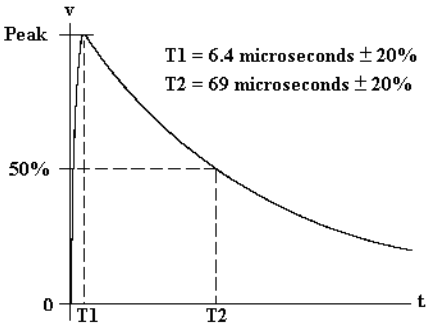
RTCA/DO-160G Wave 3

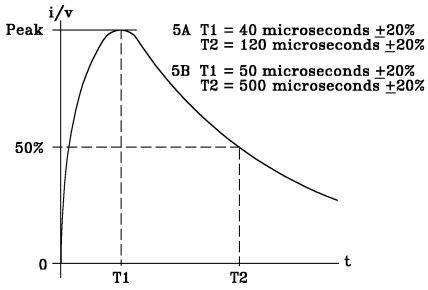


Notes:
1. *Voltage and current are not required to be in phase.*
2. *The waveshape may have either a damped sine or cosine waveshape.*

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
SM36KPA28A-HR	SM36KPA28CA-HR	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass
SM36KPA30A-HR	SM36KPA30CA-HR	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass
SM36KPA33A-HR	SM36KPA33CA-HR	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass
SM36KPA36A-HR	SM36KPA36CA-HR	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass
SM36KPA40A-HR	SM36KPA40CA-HR	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass
SM36KPA43A-HR	SM36KPA43CA-HR	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass
SM36KPA45A-HR	SM36KPA45CA-HR	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass
SM36KPA48A-HR	SM36KPA48CA-HR	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass
SM36KPA51A-HR	SM36KPA51CA-HR	Pass	Pass	Pass	Pass	Pass	-	-	Pass	Pass	Pass	Pass	Pass	-	-	Pass	Pass	Pass	Pass	Pass	-	-
SM36KPA54A-HR	SM36KPA54CA-HR	Pass	Pass	Pass	Pass	Pass	-	-	Pass	Pass	Pass	Pass	Pass	-	-	Pass	Pass	Pass	Pass	Pass	-	-
SM36KPA58A-HR	SM36KPA58CA-HR	Pass	Pass	Pass	Pass	Pass	-	-	Pass	Pass	Pass	Pass	Pass	-	-	Pass	Pass	Pass	Pass	Pass	-	-
SM36KPA60A-HR	SM36KPA60CA-HR	Pass	Pass	Pass	Pass	Pass	-	-	Pass	Pass	Pass	Pass	Pass	-	-	Pass	Pass	Pass	Pass	Pass	-	-
SM36KPA64A-HR	SM36KPA64CA-HR	Pass	Pass	Pass	Pass	Pass	-	-	Pass	Pass	Pass	Pass	Pass	-	-	Pass	Pass	Pass	Pass	Pass	-	-
SM36KPA70A-HR	SM36KPA70CA-HR	Pass	Pass	Pass	Pass	Pass	-	-	Pass	Pass	Pass	Pass	Pass	-	-	Pass	Pass	Pass	Pass	Pass	-	-
SM36KPA75A-HR	SM36KPA75CA-HR	Pass	Pass	Pass	Pass	Pass	-	-	Pass	Pass	Pass	Pass	Pass	-	-	Pass	Pass	Pass	Pass	Pass	-	-
SM36KPA78A-HR	SM36KPA78CA-HR	Pass	Pass	Pass	Pass	Pass	-	-	Pass	Pass	Pass	Pass	Pass	-	-	Pass	Pass	Pass	Pass	Pass	-	-
SM36KPA85A-HR	SM36KPA85CA-HR	Pass	Pass	Pass	Pass	Pass	-	-	Pass	Pass	Pass	Pass	Pass	-	-	Pass	Pass	Pass	Pass	Pass	-	-
SM36KPA90A-HR	SM36KPA90CA-HR	Pass	Pass	Pass	Pass	Pass	-	-	Pass	Pass	Pass	Pass	Pass	-	-	Pass	Pass	Pass	Pass	Pass	-	-
SM36KPA100A-HR	SM36KPA100CA-HR	Pass	Pass	Pass	Pass	Pass	-	-	Pass	Pass	Pass	Pass	Pass	-	-	Pass	Pass	Pass	Pass	Pass	-	-
SM36KPA110A-HR	SM36KPA110CA-HR	Pass	Pass	Pass	Pass	Pass	-	-	Pass	Pass	Pass	Pass	Pass	-	-	Pass	Pass	Pass	Pass	Pass	-	-
SM36KPA120A-HR	SM36KPA120CA-HR	Pass	Pass	Pass	Pass	Pass	-	-	Pass	Pass	Pass	Pass	Pass	-	-	Pass	Pass	Pass	Pass	Pass	-	-
SM36KPA130A-HR	SM36KPA130CA-HR	Pass	Pass	Pass	Pass	Pass	-	-	Pass	Pass	Pass	Pass	Pass	-	-	Pass	Pass	Pass	Pass	Pass	-	-
SM36KPA150A-HR	SM36KPA150CA-HR	Pass	Pass	Pass	Pass	Pass	-	-	Pass	Pass	Pass	Pass	Pass	-	-	Pass	Pass	Pass	Pass	Pass	-	-
SM36KPA160A-HR	SM36KPA160CA-HR	Pass	Pass	Pass	Pass	Pass	-	-	Pass	Pass	Pass	Pass	Pass	-	-	Pass	Pass	Pass	Pass	Pass	-	-
SM36KPA170A-HR	SM36KPA170CA-HR	Pass	Pass	Pass	Pass	Pass	-	-	Pass	Pass	Pass	Pass	Pass	-	-	Pass	Pass	Pass	Pass	Pass	-	-
SM36KPA180A-HR	SM36KPA180CA-HR	Pass	Pass	Pass	Pass	-	-	-	Pass	Pass	Pass	Pass	-	-	-	Pass	Pass	Pass	-	-	-	-
SM36KPA200A-HR	SM36KPA200CA-HR	Pass	Pass	Pass	Pass	-	-	-	Pass	Pass	Pass	Pass	-	-	-	Pass	Pass	Pass	-	-	-	-
SM36KPA220A-HR	SM36KPA220CA-HR	Pass	Pass	Pass	Pass	-	-	-	Pass	Pass	Pass	Pass	-	-	-	Pass	Pass	Pass	-	-	-	-
SM36KPA260A-HR	SM36KPA260CA-HR	Pass	Pass	Pass	Pass	-	-	-	Pass	Pass	Pass	Pass	-	-	-	Pass	Pass	Pass	-	-	-	-
SM36KPA280A-HR	SM36KPA280CA-HR	Pass	Pass	Pass	Pass	-	-	-	Pass	Pass	Pass	Pass	-	-	-	Pass	Pass	Pass	-	-	-	-
SM36KPA300A-HR	SM36KPA300CA-HR	Pass	Pass	Pass	-	-	-	-	Pass	Pass	Pass	-	-	-	-	Pass	Pass	Pass	-	-	-	-
SM36KPA350A-HR	SM36KPA350CA-HR	Pass	Pass	Pass	-	-	-	-	Pass	Pass	Pass	-	-	-	-	Pass	Pass	Pass	-	-	-	-
SM36KPA400A-HR	SM36KPA400CA-HR	Pass	Pass	Pass	-	-	-	-	Pass	Pass	Pass	-	-	-	-	Pass	Pass	Pass	-	-	-	-

Note:
1. L1 = Level1, L2 = Level 2, L3 = Level 3, L4 = Level 4, L5 = Level 5