



# THE DATASHEET OF SMDJ28CA-HR



# SMDJ-HR Series

## Surface Mount – 3000W



### Additional Information



Resources



Accessories



Samples

### Agency Approvals

Agency	Agency File Number
	E230531

### Maximum Ratings and Thermal Characteristics

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

Parameter	Symbol	Value	Unit
Peak Pulse Power Dissipation by 10/1000 $\mu\text{s}$ waveform (Note 1), (Note 2)	$P_{PPM}$	3000	W
Power Dissipation on infinite heat sink at $T_L = 50^\circ\text{C}$	$P_D$	6.5	W
Peak Forward Surge Current, 8.3ms Single Half Sine Wave (Note 3)	$I_{FSM}$	300	A
Maximum Instantaneous Forward Voltage at 100A for Unidirectional only	$V_F$	3.5	V
Operating Junction and Storage Temperature Range	$T_J, T_{STG}$	-65 to 150	$^\circ\text{C}$
Typical Thermal Resistance Junction to Lead	$R_{\theta JL}$	15	$^\circ\text{C}/\text{W}$
Typical Thermal Resistance Junction to Ambient	$R_{\theta JA}$	75	$^\circ\text{C}/\text{W}$

#### Notes:

1. Non-repetitive current pulse per Fig. 2 and derated above  $T_A = 25^\circ\text{C}$  per Fig. 3.
2. Mounted on copper pad area of 0.31x0.31" (8.0 x 8.0mm) to each terminal.
3. Measured on 8.3ms single half sine wave or equivalent square wave for unidirectional component only, duty cycle=4 per minute maximum.

### Description

The SMDJ-HR High Reliability series is designed specifically to protect sensitive electronic equipment from voltage transients induced by lightning and other transient voltage events.

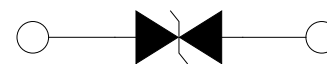
### Features

- 3000W peak pulse power capability at 10/1000 $\mu\text{s}$  waveform, repetition rate (duty cycles):0.01%
- For surface mounted applications in order to optimize board space
- Low profile package
- Built-in strain relief
- $V_{BR} @ T_J = V_{BR} @ 25^\circ\text{C} \times (1 + \alpha T \times (T_J - 25))$  ( $\alpha$ : Temperature Coefficient, typical value is 0.1%)
- Glass passivated chip junction
- Fast response time: typically less than 1.0ps from 0V to VBR min
- Excellent clamping capability
- Low incremental surge resistance
- Typical  $I_R \leq 2\mu\text{A}$  for  $V_R > 10\text{V}$
- Meet MSL level1, per J-STD-020, LF maximum peak of 260 $^\circ\text{C}$
- UL Recognized compound meeting flammability rating V-0.
- 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)

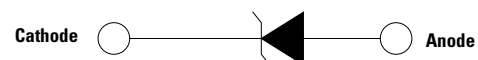
### Applications

TVS components are ideal for the protection of I/O Interfaces, VCC bus and other vulnerable circuits used in Telecom, Computer, Industrial and Consumer electronic applications.

### Functional Diagram



Bi-directional



Uni-directional

# SMDJ-HR Series

## Surface Mount – 3000W

### Electrical Characteristics

Part Number (Uni)	Part Number (Bi)	Marking		Reverse Stand off Voltage $V_R$ (Volts)	Breakdown Voltage $V_{BR}$ (Volts) @ $I_T$		Test Current $I_T$ (mA)	Maximum Clamping Voltage $V_C$ @ $I_{PP}$ (V)	Maximum Peak Pulse Current $I_{PP}$ (A)	Maximum Reverse Leakage $I_R$ @ $V_R$ ( $\mu$ A)	Agency Approval 
		Uni	Bi		Min	Max					
SMDJ5.0A-HR	SMDJ5.0CA-HR	RDE	DDE	5.0	6.40	7.00	10	9.2	326.1	800	X
SMDJ6.0A-HR	SMDJ6.0CA-HR	RDG	DDG	6.0	6.67	7.37	10	10.3	291.3	800	X
SMDJ6.5A-HR	SMDJ6.5CA-HR	RDK	DDK	6.5	7.22	7.98	10	11.2	267.9	500	X
SMDJ7.0A-HR	SMDJ7.0CA-HR	PDM	DDM	7.0	7.78	8.60	10	12.0	250.0	200	X
SMDJ7.5A-HR	SMDJ7.5CA-HR	PDP	DDP	7.5	8.33	9.21	1	12.9	232.6	100	X
SMDJ8.0A-HR	SMDJ8.0CA-HR	PDR	DDR	8.0	8.89	9.83	1	13.6	220.6	50	X
SMDJ8.5A-HR	SMDJ8.5CA-HR	PDT	DDT	8.5	9.44	10.40	1	14.4	208.3	20	X
SMDJ9.0A-HR	SMDJ9.0CA-HR	PDV	DDV	9.0	10.00	11.10	1	15.4	194.8	10	X
SMDJ10A-HR	SMDJ10CA-HR	PDX	DDX	10.0	11.10	12.30	1	17.0	176.5	5	X
SMDJ11A-HR	SMDJ11CA-HR	PDZ	DDZ	11.0	12.20	13.50	1	18.2	164.8	2	X
SMDJ12A-HR	SMDJ12CA-HR	PEE	DEE	12.0	13.30	14.70	1	19.9	150.8	2	X
SMDJ13A-HR	SMDJ13CA-HR	PEG	DEG	13.0	14.40	15.90	1	21.5	139.5	2	X
SMDJ14A-HR	SMDJ14CA-HR	PEK	DEK	14.0	15.60	17.20	1	23.2	129.3	2	X
SMDJ15A-HR	SMDJ15CA-HR	PEM	DEM	15.0	16.70	18.50	1	24.4	123.0	2	X
SMDJ16A-HR	SMDJ16CA-HR	PEP	DEP	16.0	17.80	19.70	1	26.0	115.4	2	X
SMDJ17A-HR	SMDJ17CA-HR	PER	DER	17.0	18.90	20.90	1	27.6	108.7	2	X
SMDJ18A-HR	SMDJ18CA-HR	PET	DET	18.0	20.00	22.10	1	29.2	102.7	2	X
SMDJ20A-HR	SMDJ20CA-HR	PEV	DEV	20.0	22.20	24.50	1	32.4	92.6	2	X
SMDJ22A-HR	SMDJ22CA-HR	PEX	DEX	22.0	24.40	26.90	1	35.5	84.5	2	X
SMDJ24A-HR	SMDJ24CA-HR	PEZ	DEZ	24.0	26.70	29.50	1	38.9	77.1	2	X
SMDJ26A-HR	SMDJ26CA-HR	PFE	DFE	26.0	28.90	31.90	1	42.1	71.3	2	X
SMDJ28A-HR	SMDJ28CA-HR	PFG	DFG	28.0	31.10	34.40	1	45.4	66.1	2	X
SMDJ30A-HR	SMDJ30CA-HR	PFK	DFK	30.0	33.30	36.80	1	48.4	62.0	2	X
SMDJ33A-HR	SMDJ33CA-HR	PFM	DFM	33.0	36.70	40.60	1	53.3	56.3	2	X
SMDJ36A-HR	SMDJ36CA-HR	PFP	DFP	36.0	40.00	44.20	1	58.1	51.6	2	X
SMDJ40A-HR	SMDJ40CA-HR	PFR	DFR	40.0	44.40	49.10	1	64.5	46.5	2	X
SMDJ43A-HR	SMDJ43CA-HR	PFT	DFT	43.0	47.80	52.80	1	69.4	43.2	2	X
SMDJ45A-HR	SMDJ45CA-HR	PFV	DFV	45.0	50.00	55.30	1	72.7	41.3	2	X
SMDJ48A-HR	SMDJ48CA-HR	PFX	DFX	48.0	53.30	58.90	1	77.4	38.8	2	X
SMDJ51A-HR	SMDJ51CA-HR	PFZ	DFZ	51.0	56.70	62.70	1	82.4	36.4	2	X
SMDJ54A-HR	SMDJ54CA-HR	RGE	DGE	54.0	60.00	66.30	1	87.1	34.4	2	X
SMDJ58A-HR	SMDJ58CA-HR	PGG	DGG	58.0	64.40	71.20	1	93.6	32.1	2	X
SMDJ60A-HR	SMDJ60CA-HR	PGK	DGK	60.0	66.70	73.70	1	96.8	31.0	2	X
SMDJ64A-HR	SMDJ64CA-HR	PGM	DGM	64.0	71.10	78.60	1	103.0	29.1	2	X
SMDJ70A-HR	SMDJ70CA-HR	PGP	DGP	70.0	77.80	86.00	1	113.0	26.5	2	X
SMDJ75A-HR	SMDJ75CA-HR	PGR	DGR	75.0	83.30	92.10	1	121.0	24.8	2	X
SMDJ78A-HR	SMDJ78CA-HR	PGT	DGT	78.0	86.70	95.80	1	126.0	23.8	2	X
SMDJ85A-HR	SMDJ85CA-HR	PGV	DGV	85.0	94.40	104.00	1	137.0	21.9	2	X
SMDJ90A-HR	SMDJ90CA-HR	PGX	DGX	90.0	100.00	111.00	1	146.0	20.5	2	X
SMDJ100A-HR	SMDJ100CA-HR	PGZ	DGZ	100.0	111.00	123.00	1	162.0	18.5	2	X
SMDJ110A-HR	SMDJ110CA-HR	PHE	DHE	110.0	122.00	135.00	1	177.0	16.9	2	X
SMDJ120A-HR	SMDJ120CA-HR	PHG	DHG	120.0	133.00	147.00	1	193.0	15.5	2	X
SMDJ130A-HR	SMDJ130CA-HR	PHK	DHK	130.0	144.00	159.00	1	209.0	14.4	2	X
SMDJ150A-HR	SMDJ150CA-HR	PHM	DHM	150.0	167.00	185.00	1	243.0	12.3	2	X
SMDJ170A-HR	SMDJ170CA-HR	PHR	DHR	170.0	189.00	209.00	1	275.0	10.9	2	X

**Note:**

1. Each lot of parts will pass group B test requirements.

# SMDJ-HR Series

## Surface Mount – 3000W

### Screen Process

100% Vision Inspection	MIL-STD-750 method 2074
100% High Temperature Storage Life (168hrs,175°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% Reflow (2X)	JEDEC J-STD-020
100% Surge Test (2x)	MIL-STD-750 method 4066
100% HTRB 150°C Bias=VR(80% breakdown voltage, 96hrs, and each direction 96hrs 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 Requirements

Screen	Method	Condition	Requirement
Surge test	10/1000 $\mu$ 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 bi-direction 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** -- 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**

# SMDJ-HR Series

## Surface Mount – 3000W

### 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



**Figure 3 -**  
Pulse Derating Curve



**Figure 4 -**  
Pulse Waveform



**Figure 5 -**  
Typical Junction Capacitance



**Figure 6 -**  
Steady State Power Derating Curve



# SMDJ-HR Series

## Surface Mount – 3000W

**Figure 7 -**  
Maximum Non-Repetitive Peak Forward Surge Current  
Uni-Directional only



## Soldering Parameters

<b>Reflow Condition</b>	Lead-free assembly	
<b>Pre Heat</b>	- Temperature Min ( $T_{s(min)}$ )	150°C
	- Temperature Max ( $T_{s(max)}$ )	200°C
	- Time (min to max) ( $t_s$ )	60 – 180 secs
<b>Average ramp up rate (Liquidus Temp (<math>T_L</math>) to peak)</b>		3°C/second max
<b><math>T_{s(max)}</math> to <math>T_L</math> - Ramp-up Rate</b>		3°C/second max
<b>Reflow</b>	- Temperature ( $T_L$ ) (Liquidus)	217°C
	- Time (min to max) ( $t_s$ )	60 – 150 seconds
<b>Peak Temperature (<math>T_p</math>)</b>		260 <sup>+0/-5</sup> °C
<b>Time within 5°C of actual peak Temperature (<math>t_p</math>)</b>		20 – 40 seconds
<b>Ramp-down Rate</b>		6°C/second max
<b>Time 25°C to peak Temperature (<math>T_p</math>)</b>		8 minutes Max.
<b>Do not exceed</b>		260°C



## Physical Specifications

<b>Weight</b>	0.007 ounce, 0.21 grams
<b>Case</b>	JEDEC DO214AB. Molded plastic body over glass passivated junction
<b>Polarity</b>	Color band denotes positive end (cathode) except Bidirectional.
<b>Terminal</b>	Matte Tin-plated leads, Solderable per JESD22-B102

## Environmental Specifications

<b>High Temp. Storage</b>	JESD22-A103
<b>HTRB</b>	JESD22-A108
<b>Thermal Shock</b>	JESD22-A106
<b>MSL</b>	JEDEC-J-STD-020, Level 1
<b>H3TRB</b>	JESD22-A101
<b>RSH</b>	JESD22-A111

# SMDJ-HR Series

## Surface Mount – 3000W

### Part Numbering System



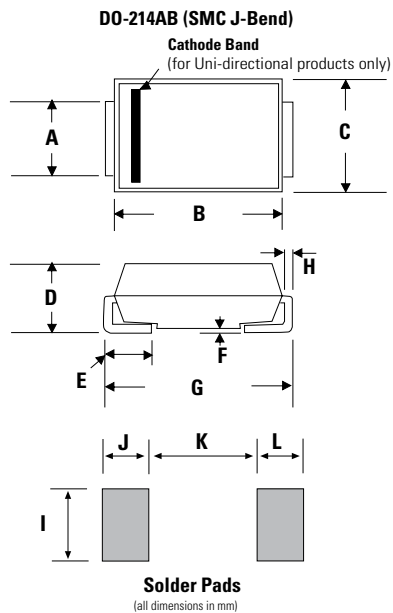
### Part Marking System



### Packaging

Part number	Component Package	Quantity	Packaging Option	Packaging Specification
SMDJxxxXX-HR	DO-214AB	500	Tape & Reel – 16mm tape/7" reel	EIA STD RS-481

### Dimensions



Dimensions	Inches		Millimeters	
	Min	Max	Min	Max
<b>A</b>	0.114	0.126	2.900	3.200
<b>B</b>	0.260	0.280	6.600	7.110
<b>C</b>	0.220	0.245	5.590	6.220
<b>D</b>	0.079	0.103	2.060	2.620
<b>E</b>	0.030	0.060	0.760	1.520
<b>F</b>	0.002	0.008	0.051	0.203
<b>G</b>	0.305	0.320	7.750	8.130
<b>H</b>	0.006	0.012	0.152	0.305
<b>I</b>	0.129	-	3.300	-
<b>J</b>	0.094	-	2.400	-
<b>K</b>	-	0.165	-	4.200
<b>L</b>	0.094	-	2.400	-

# SMDJ-HR Series

## Surface Mount – 3000W

### Tape and Reel Specification



### RTCA/DO-160G Wave 3



### RTCA/DO-160G Wave 4



### RTCA/DO-160G Wave 5



# SMDJ-HR Series

## Surface Mount – 3000W

### Pin Injection Protection Per RTCA/DO-160G

Part Number (Uni)	Part Number (Bi)	25C						70C						120C								
		Wave 3	Wave 4 (6.4/69us)				Wave 5a (40/120us)		Wave 3	Wave 4 (6.4/69us)				Wave 5a (40/120us)		Wave 3	Wave 4 (6.4/69us)				Wave 5a (40/120us)	
			L5	L3	L4	L5	L3	L4		L5	L3	L4	L5	L3	L4		L5	L3	L4	L5	L3	L4
			128A	60A	150A	320A	300A	750A		128A	60A	150A	320A	300A	750A		128A	60A	150A	320A	300A	750A
SMDJ5.0A-HR	SMDJ5.0CA-HR	pass	pass	pass	pass	pass	pass	pass	pass	pass	pass	pass	pass	pass	pass	pass	pass	pass	pass	pass	pass	
SMDJ6.0A-HR	SMDJ6.0CA-HR	pass	pass	pass	pass	pass	pass	pass	pass	pass	pass	pass	pass	pass	pass	pass	pass	pass	pass	pass	pass	
SMDJ6.5A-HR	SMDJ6.5CA-HR	pass	pass	pass	pass	pass	pass	pass	pass	pass	pass	pass	pass	pass	pass	pass	pass	pass	pass	pass	pass	
SMDJ7.0A-HR	SMDJ7.0CA-HR	pass	pass	pass	pass	pass	pass	pass	pass	pass	pass	pass	pass	-	pass	pass	pass	pass	pass	pass	-	
SMDJ7.5A-HR	SMDJ7.5CA-HR	pass	pass	pass	pass	pass	pass	pass	pass	pass	pass	pass	pass	-	pass	pass	pass	pass	pass	pass	-	
SMDJ8.0A-HR	SMDJ8.0CA-HR	pass	pass	pass	pass	pass	pass	pass	pass	pass	pass	pass	pass	-	pass	pass	pass	pass	pass	pass	-	
SMDJ8.5A-HR	SMDJ8.5CA-HR	pass	pass	pass	pass	pass	pass	pass	pass	pass	pass	pass	pass	-	pass	pass	pass	pass	pass	pass	-	
SMDJ9.0A-HR	SMDJ9.0CA-HR	pass	pass	pass	pass	pass	pass	pass	pass	pass	pass	pass	pass	-	pass	pass	pass	pass	pass	pass	-	
SMDJ10A-HR	SMDJ10CA-HR	pass	pass	pass	pass	pass	pass	pass	pass	pass	pass	pass	pass	-	pass	pass	pass	pass	pass	pass	-	
SMDJ11A-HR	SMDJ11CA-HR	pass	pass	pass	pass	pass	-	pass	pass	pass	pass	pass	pass	-	pass	pass	pass	pass	-	-	-	
SMDJ12A-HR	SMDJ12CA-HR	pass	pass	pass	pass	pass	-	pass	pass	pass	pass	pass	pass	-	pass	pass	pass	pass	-	-	-	
SMDJ13A-HR	SMDJ13CA-HR	pass	pass	pass	pass	pass	-	pass	pass	pass	pass	pass	pass	-	pass	pass	pass	pass	-	-	-	
SMDJ14A-HR	SMDJ14CA-HR	pass	pass	pass	pass	pass	-	pass	pass	pass	pass	pass	pass	-	pass	pass	pass	pass	-	-	-	
SMDJ15A-HR	SMDJ15CA-HR	pass	pass	pass	pass	pass	-	pass	pass	pass	pass	pass	pass	-	pass	pass	pass	pass	-	-	-	
SMDJ16A-HR	SMDJ16CA-HR	pass	pass	pass	pass	pass	-	pass	pass	pass	pass	pass	-	-	pass	pass	pass	pass	-	-	-	
SMDJ17A-HR	SMDJ17CA-HR	pass	pass	pass	pass	pass	-	pass	pass	pass	pass	pass	-	-	pass	pass	pass	pass	-	-	-	
SMDJ18A-HR	SMDJ18CA-HR	pass	pass	pass	pass	pass	-	pass	pass	pass	pass	pass	-	-	pass	pass	pass	pass	-	-	-	
SMDJ20A-HR	SMDJ20CA-HR	pass	pass	pass	pass	pass	-	pass	pass	pass	pass	pass	-	-	pass	pass	pass	pass	-	-	-	
SMDJ22A-HR	SMDJ22CA-HR	pass	pass	pass	-	-	-	pass	pass	pass	-	-	-	pass	pass	pass	pass	-	-	-	-	
SMDJ24A-HR	SMDJ24CA-HR	pass	pass	pass	-	-	-	pass	pass	pass	-	-	-	pass	pass	pass	pass	-	-	-	-	
SMDJ26A-HR	SMDJ26CA-HR	pass	pass	pass	-	-	-	pass	pass	pass	-	-	-	pass	pass	pass	pass	-	-	-	-	
SMDJ28A-HR	SMDJ28CA-HR	pass	pass	pass	-	-	-	pass	pass	pass	-	-	-	pass	pass	pass	pass	-	-	-	-	
SMDJ30A-HR	SMDJ30CA-HR	pass	pass	pass	-	-	-	pass	pass	pass	-	-	-	pass	pass	pass	pass	-	-	-	-	
SMDJ33A-HR	SMDJ33CA-HR	pass	pass	pass	-	-	-	pass	pass	pass	-	-	-	pass	pass	pass	pass	-	-	-	-	
SMDJ36A-HR	SMDJ36CA-HR	pass	pass	pass	-	-	-	pass	pass	pass	-	-	-	pass	pass	pass	pass	-	-	-	-	
SMDJ40A-HR	SMDJ40CA-HR	pass	pass	pass	-	-	-	pass	pass	pass	-	-	-	pass	pass	pass	pass	-	-	-	-	
SMDJ43A-HR	SMDJ43CA-HR	pass	pass	pass	-	-	-	pass	pass	pass	-	-	-	pass	pass	pass	pass	-	-	-	-	
SMDJ45A-HR	SMDJ45CA-HR	pass	pass	pass	-	-	-	pass	pass	-	-	-	-	pass	pass	pass	pass	-	-	-	-	
SMDJ48A-HR	SMDJ48CA-HR	pass	pass	pass	-	-	-	pass	pass	-	-	-	-	pass	pass	pass	pass	-	-	-	-	
SMDJ51A-HR	SMDJ51CA-HR	pass	pass	pass	-	-	-	pass	pass	-	-	-	-	pass	pass	pass	pass	-	-	-	-	
SMDJ54A-HR	SMDJ54CA-HR	pass	pass	pass	-	-	-	pass	pass	-	-	-	-	pass	pass	pass	pass	-	-	-	-	
SMDJ58A-HR	-	pass	pass	-	-	-	-	pass	pass	-	-	-	-	pass	pass	pass	pass	-	-	-	-	
SMDJ60A-HR	-	pass	pass	-	-	-	-	pass	pass	-	-	-	-	pass	pass	pass	pass	-	-	-	-	
SMDJ64A-HR	-	pass	pass	-	-	-	-	pass	pass	-	-	-	-	pass	-	-	-	-	-	-	-	
SMDJ70A-HR	-	pass	pass	-	-	-	-	pass	pass	-	-	-	-	pass	-	-	-	-	-	-	-	
SMDJ75A-HR	-	pass	pass	-	-	-	-	pass	pass	-	-	-	-	pass	-	-	-	-	-	-	-	
SMDJ78A-HR	-	pass	pass	-	-	-	-	pass	pass	-	-	-	-	pass	-	-	-	-	-	-	-	
SMDJ85A-HR	-	pass	pass	-	-	-	-	pass	pass	-	-	-	-	pass	-	-	-	-	-	-	-	
SMDJ90A-HR	-	pass	pass	-	-	-	-	pass	-	-	-	-	-	pass	-	-	-	-	-	-	-	
SMDJ100A-HR	-	pass	pass	-	-	-	-	pass	-	-	-	-	-	pass	-	-	-	-	-	-	-	
SMDJ110A-HR	-	pass	pass	-	-	-	-	pass	-	-	-	-	-	pass	-	-	-	-	-	-	-	
SMDJ120A-HR	-	pass	pass	-	-	-	-	pass	-	-	-	-	-	pass	-	-	-	-	-	-	-	
SMDJ130A-HR	-	pass	pass	-	-	-	-	pass	-	-	-	-	-	pass	-	-	-	-	-	-	-	
SMDJ150A-HR	-	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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## Optimize Your Supply Chain with WIN SOURCE Solutions

-  Global Sourcing Solution
-  Obsolete Management
-  Cost Control Management
-  Shortage Management
-  Alternative Solution
-  Excess Inventory Management