



# THE DATASHEET OF SMBJ60A-HR



**SMBJ-HR Series**



**Agency Approvals**

Agency	Agency File Number
	E230531

**Maximum Ratings and Thermal Characteristics (T<sub>A</sub>=25°C unless otherwise noted)**

Parameter	Symbol	Value	Unit
Peak Pulse Power Dissipation at T <sub>A</sub> =25°C by 10/1000µs Waveform (Fig.2)(Note 1), (Note 2)	P <sub>PPM</sub>	600	W
Power Dissipation on Infinite Heat Sink at T <sub>A</sub> =50°C	P <sub>M(AV)</sub>	5.0	W
Peak Forward Surge Current, 8.3ms Single Half Sine Wave (Note 3)	I <sub>FSM</sub>	100	A
Maximum Instantaneous Forward Voltage at 50A for Unidirectional Only	V <sub>F</sub>	3.5V	V
Operating Junction and Storage Temperature Range	T <sub>J</sub> , T <sub>STG</sub>	-65 to 150	°C
Typical Thermal Resistance Junction to Lead	R <sub>θJL</sub>	20	°C/W
Typical Thermal Resistance Junction to Ambient	R <sub>θJA</sub>	100	°C/W

- Notes:**  
 1. Non-repetitive current pulse per Fig. 4 and derated above T<sub>A</sub> = 25°C per Fig. 3.  
 2. Mounted on copper pad area of 0.2x0.2" (5.0 x 5.0mm) to each terminal.  
 3. Measured on 8.3ms single half sine wave or equivalent square wave for unidirectional device only, duty cycle=4 per minute maximum.

**Functional Diagram**



**Description**

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

**Features**

- 600W peak pulse power capability at 10/1000µs waveform, repetition rate (duty cycles):0.01%
- Excellent clamping capability
- Low incremental surge resistance
- Typical I<sub>R</sub> less than 1µA above 12V
- For surface mounted applications to optimize board space
- Low profile package
- 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
- IEC 61000-4-2 ESD 15kV(Air), 8kV (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
- Built-in strain relief
- Fast response time: typically less than 1.0ps from 0V to BV min
- V<sub>BR</sub> @ T<sub>J</sub> = V<sub>BR</sub> @ 25°C x (1 + αT x (T<sub>J</sub> - 25)) (αT: Temperature Coefficient, typical value is 0.1%)
- Glass passivated chip junction
- High temperature soldering guaranteed: 260°C/40 seconds at terminals
- Plastic package is flammability rated V-0 per UL 94
- Meet MSL level1, per J-STD-020, LF maximum peak of 260°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)
- UL Recognized to ANSI/UL 497B: Protectors for Data Communications and Fire-Alarm Circuits.

**Applications**

TVS Components are ideal for the protection of I/O Interfaces, V<sub>CC</sub> bus and other vulnerable circuits used in Telecom, Computer, Industrial and Consumer electronic applications.

### Electrical Characteristics (T<sub>a</sub>=25°C unless otherwise noted)

Part Number (Uni)	Part Number (Bi)	Marking		Reverse Stand off Voltage V <sub>R</sub> (Volts)	Breakdown Voltage V <sub>BR</sub> (Volts) @ I <sub>T</sub>		Test Current I <sub>T</sub> (mA)	Maximum Clamping Voltage V <sub>C</sub> @ I <sub>PP</sub> (V)	Maximum Peak Pulse Current I <sub>PP</sub> (A)	Maximum Reverse Leakage I <sub>R</sub> @ V <sub>R</sub> (µA)	Agency Approval 
		UNI	BI		MIN	MAX					
SMBJ5.0A-HR	SMBJ5.0CA-HR	KE	AE	5.0	6.40	7.00	10	9.2	65.3	800	X
SMBJ6.0A-HR	SMBJ6.0CA-HR	KG	AG	6.0	6.67	7.37	10	10.3	58.3	800	X
SMBJ6.5A-HR	SMBJ6.5CA-HR	KK	AK	6.5	7.22	7.98	10	11.2	53.6	500	X
SMBJ7.0A-HR	SMBJ7.0CA-HR	KM	AM	7.0	7.78	8.60	10	12.0	50.0	200	X
SMBJ7.5A-HR	SMBJ7.5CA-HR	KP	AP	7.5	8.33	9.21	1	12.9	46.6	100	X
SMBJ8.0A-HR	SMBJ8.0CA-HR	KR	AR	8.0	8.89	9.83	1	13.6	44.2	50	X
SMBJ8.5A-HR	SMBJ8.5CA-HR	KT	AT	8.5	9.44	10.40	1	14.4	41.7	20	X
SMBJ9.0A-HR	SMBJ9.0CA-HR	KV	AV	9.0	10.00	11.10	1	15.4	39.0	10	X
SMBJ10A-HR	SMBJ10CA-HR	KX	AX	10.0	11.10	12.30	1	17.0	35.3	5	X
SMBJ11A-HR	SMBJ11CA-HR	KZ	AZ	11.0	12.20	13.50	1	18.2	33.0	1	X
SMBJ12A-HR	SMBJ12CA-HR	LE	BE	12.0	13.30	14.70	1	19.9	30.2	1	X
SMBJ13A-HR	SMBJ13CA-HR	LG	BG	13.0	14.40	15.90	1	21.5	28.0	1	X
SMBJ14A-HR	SMBJ14CA-HR	LK	BK	14.0	15.60	17.20	1	23.2	25.9	1	X
SMBJ15A-HR	SMBJ15CA-HR	LM	BM	15.0	16.70	18.50	1	24.4	24.6	1	X
SMBJ16A-HR	SMBJ16CA-HR	LP	BP	16.0	17.80	19.70	1	26.0	23.1	1	X
SMBJ17A-HR	SMBJ17CA-HR	LR	BR	17.0	18.90	20.90	1	27.6	21.8	1	X
SMBJ18A-HR	SMBJ18CA-HR	LT	BT	18.0	20.00	22.10	1	29.2	20.6	1	X
SMBJ20A-HR	SMBJ20CA-HR	LV	BV	20.0	22.20	24.50	1	32.4	18.6	1	X
SMBJ22A-HR	SMBJ22CA-HR	LX	BX	22.0	24.40	26.90	1	35.5	16.9	1	X
SMBJ24A-HR	SMBJ24CA-HR	LZ	BZ	24.0	26.70	29.50	1	38.9	15.5	1	X
SMBJ26A-HR	SMBJ26CA-HR	ME	CE	26.0	28.90	31.90	1	42.1	14.3	1	X
SMBJ28A-HR	SMBJ28CA-HR	MG	CG	28.0	31.10	34.40	1	45.4	13.3	1	X
SMBJ30A-HR	SMBJ30CA-HR	MK	CK	30.0	33.30	36.80	1	48.4	12.4	1	X
SMBJ33A-HR	SMBJ33CA-HR	MM	CM	33.0	36.70	40.60	1	53.3	11.3	1	X
SMBJ36A-HR	SMBJ36CA-HR	MP	CP	36.0	40.00	44.20	1	58.1	10.4	1	X
SMBJ40A-HR	SMBJ40CA-HR	MR	CR	40.0	44.40	49.10	1	64.5	9.3	1	X
SMBJ43A-HR	SMBJ43CA-HR	MT	CT	43.0	47.80	52.80	1	69.4	8.7	1	X
SMBJ45A-HR	SMBJ45CA-HR	MV	CV	45.0	50.00	55.30	1	72.7	8.3	1	X
SMBJ48A-HR	SMBJ48CA-HR	MX	CX	48.0	53.30	58.90	1	77.4	7.8	1	X
SMBJ51A-HR	SMBJ51CA-HR	MZ	CZ	51.0	56.70	62.70	1	82.4	7.3	1	X
SMBJ54A-HR	SMBJ54CA-HR	NE	DE	54.0	60.00	66.30	1	87.1	6.9	1	X
SMBJ58A-HR	SMBJ58CA-HR	NG	DG	58.0	64.40	71.20	1	93.6	6.5	1	X
SMBJ60A-HR	SMBJ60CA-HR	NK	DK	60.0	66.70	73.70	1	96.8	6.2	1	X
SMBJ64A-HR	SMBJ64CA-HR	NM	DM	64.0	71.10	78.60	1	103.0	5.9	1	X
SMBJ70A-HR	SMBJ70CA-HR	NP	DP	70.0	77.80	86.00	1	113.0	5.3	1	X
SMBJ75A-HR	SMBJ75CA-HR	NR	DR	75.0	83.30	92.10	1	121.0	5.0	1	X
SMBJ78A-HR	SMBJ78CA-HR	NT	DT	78.0	86.70	95.80	1	126.0	4.8	1	X
SMBJ85A-HR	SMBJ85CA-HR	NV	DV	85.0	94.40	104.00	1	137.0	4.4	1	X
-	SMBJ90CA-HR	-	DX	90.0	100.00	111.00	1	146.0	4.1	1	X
-	SMBJ100CA-HR	-	DZ	100.0	111.00	123.00	1	162.0	3.7	1	X
-	SMBJ110CA-HR	-	EE	110.0	122.00	135.00	1	177.0	3.4	1	X
-	SMBJ120CA-HR	-	EG	120.0	133.00	147.00	1	193.0	3.1	1	X
-	SMBJ130CA-HR	-	EK	130.0	144.00	159.00	1	209.0	2.9	1	X
-	SMBJ150CA-HR	-	EM	150.0	167.00	185.00	1	243.0	2.5	1	X
-	SMBJ160CA-HR	-	EP	160.0	178.00	197.00	1	259.0	2.3	1	X
-	SMBJ170CA-HR	-	ER	170.0	189.00	209.00	1	275.0	2.2	1	X

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

### 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 to150°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 Requirement

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**

**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 Dissipation Derating Curve**



**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>	0.003 ounce, 0.093 grams
<b>Case</b>	JEDEC DO214AA. Molded plastic body over glass passivated junction
<b>Polarity</b>	Color band denotes 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>Temperature Cycling</b>	JESD22-A104
<b>MSL</b>	JEDEC-J-STD-020, Level 1
<b>H3TRB</b>	JESD22-A101
<b>RSH</b>	JESD22-A111

### Dimensions



Dimensions	Inches		Millimeters	
	Min	Max	Min	Max
A	0.077	0.086	1.950	2.200
B	0.160	0.180	4.060	4.570
C	0.130	0.155	3.300	3.940
D	0.084	0.096	2.130	2.440
E	0.030	0.060	0.760	1.520
F	-	0.008	-	0.203
G	0.205	0.220	5.210	5.590
H	0.006	0.012	0.152	0.305
I	0.089	-	2.260	-
J	0.085	-	2.160	-
K	-	0.107	-	2.740
L	0.085	-	2.160	-

### Part Numbering System



### Part Marking System



### Packaging

Part number	Component Package	Quantity	Packaging Option	Packaging Specification
SMBJxxxXX-HR	DO-214AA	3000	Tape & Reel - 12mm tape/13" reel	EIA STD RS-481

### Tape and Reel Specification



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