



# THE DATASHEET OF SMCJ51A-HR



## SMCJ-HR Series



### Agency Approvals

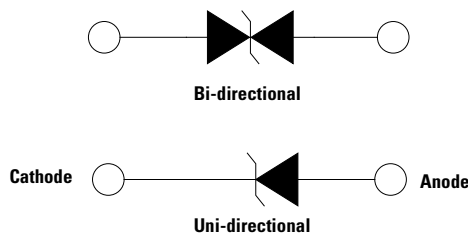
| Agency | Agency File Number |
|--------|--------------------|
|        | E230531            |

### 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. 1)(Note 1), (Note 2) | P <sub>PPM</sub>                  | 1500       | W    |
| Power Dissipation on infinite heat sink at T <sub>A</sub> = 50°C                                       | P <sub>M(AV)</sub>                | 6.5        | W    |
| Peak Forward Surge Current, 8.3ms Single Half Sine Wave (Note 3)                                       | I <sub>FSM</sub>                  | 200        | A    |
| Maximum Instantaneous Forward Voltage at 100A for Unidirectional only (Note 4)                         | V <sub>F</sub>                    | 3.5/5.0    | 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>wJL</sub>                  | 15         | °C/W |
| Typical Thermal Resistance Junction to Ambient   | R <sub>wJA</sub>                  | 75         | °C/W |

**Notes:**  
 1. Non-repetitive current pulse, per Fig. 3 and derated above T<sub>A</sub> = 25°C per Fig. 2.  
 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 device only, duty cycle=4 per minute maximum.

### Functional Diagram



### Description

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

### Features

- For surface mounted applications in order to optimize board space
- Low profile package
- Built-in strain relief
- 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)
- Glass passivated chip junction
- 1500W peak pulse power capability at 10/1000µs waveform, repetition rate (duty cycles): 0.01 %
- Fast response time: typically less than 1.0ps from 0V to BV min
- Excellent clamping capability
- Low incremental surge resistance
- Typical I<sub>R</sub> less than 1µA above 12V
- High Temperature soldering guaranteed: 260°C/40 seconds at terminals
- Plastic package has Underwriters laboratory flammability 94V-O
- Meet MSL level1, per J-STD-020, LF maximum peak of 260°C
- Matte tin lead-free plated
- Halogen free and RoHS compliant
- 2nd level interconnect is Pb-free per IPC/JEDEC J-STD-609A.01
- Recognized to UL 497B as an Isolated Loop Circuit Protector

### Applications

TVS devices 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

| 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    |                         |   |   |  |   |
| SMCJ5.0A-HR       | SMCJ5.0CA-HR     | GDE     | BDE | 5.0                                     | 6.40                                       | 7.00   | 10                      | 9.2   | 163.0                                   | 800  | X   |
| SMCJ6.0A-HR       | SMCJ6.0CA-HR     | GDG     | BDG | 6.0                                     | 6.67                                       | 7.37   | 10                      | 10.3  | 145.7                                   | 800  | X   |
| SMCJ6.5A-HR       | SMCJ6.5CA-HR     | GDK     | BDK | 6.5                                     | 7.22                                       | 7.98   | 10                      | 11.2  | 134.0                                   | 500  | X   |
| SMCJ7.0A-HR       | SMCJ7.0CA-HR     | GDM     | BDM | 7.0                                     | 7.78                                       | 8.60   | 10                      | 12.0  | 125.0                                   | 200  | X   |
| SMCJ7.5A-HR       | SMCJ7.5CA-HR     | GDP     | BDP | 7.5                                     | 8.33                                       | 9.21   | 1                       | 12.9  | 116.3                                   | 100  | X   |
| SMCJ8.0A-HR       | SMCJ8.0CA-HR     | GDR     | BDR | 8.0                                     | 8.89                                       | 9.83   | 1                       | 13.6  | 110.3                                   | 50   | X   |
| SMCJ8.5A-HR       | SMCJ8.5CA-HR     | GDT     | BDT | 8.5                                     | 9.44                                       | 10.40  | 1                       | 14.4  | 104.2                                   | 20   | X   |
| SMCJ9.0A-HR       | SMCJ9.0CA-HR     | GDV     | BDV | 9.0                                     | 10.00                                      | 11.10  | 1                       | 15.4  | 97.4                                    | 10   | X   |
| SMCJ10A-HR        | SMCJ10CA-HR      | GDX     | BDX | 10.0                                    | 11.10                                      | 12.30  | 1                       | 17.0  | 88.3                                    | 5  | X   |
| SMCJ11A-HR        | SMCJ11CA-HR      | GDZ     | BDZ | 11.0                                    | 12.20                                      | 13.50  | 1                       | 18.2  | 82.5                                    | 1  | X   |
| SMCJ12A-HR        | SMCJ12CA-HR      | GEE     | BEE | 12.0                                    | 13.30                                      | 14.70  | 1                       | 19.9  | 75.4                                    | 1  | X   |
| SMCJ13A-HR        | SMCJ13CA-HR      | GEG     | BEG | 13.0                                    | 14.40                                      | 15.90  | 1                       | 21.5  | 69.8                                    | 1  | X   |
| SMCJ14A-HR        | SMCJ14CA-HR      | GEK     | BEK | 14.0                                    | 15.60                                      | 17.20  | 1                       | 23.2  | 64.7                                    | 1  | X   |
| SMCJ15A-HR        | SMCJ15CA-HR      | GEM     | BEM | 15.0                                    | 16.70                                      | 18.50  | 1                       | 24.4  | 61.5                                    | 1  | X   |
| SMCJ16A-HR        | SMCJ16CA-HR      | GEP     | BEP | 16.0                                    | 17.80                                      | 19.70  | 1                       | 26.0  | 57.7                                    | 1  | X   |
| SMCJ17A-HR        | SMCJ17CA-HR      | GER     | BER | 17.0                                    | 18.90                                      | 20.90  | 1                       | 27.6  | 54.4                                    | 1  | X   |
| SMCJ18A-HR        | SMCJ18CA-HR      | GET     | BET | 18.0                                    | 20.00                                      | 22.10  | 1                       | 29.2  | 51.4                                    | 1  | X   |
| SMCJ20A-HR        | SMCJ20CA-HR      | GEV     | BEV | 20.0                                    | 22.20                                      | 24.50  | 1                       | 32.4  | 46.3                                    | 1  | X   |
| SMCJ22A-HR        | SMCJ22CA-HR      | GEX     | BEX | 22.0                                    | 24.40                                      | 26.90  | 1                       | 35.5  | 42.3                                    | 1  | X   |
| SMCJ24A-HR        | SMCJ24CA-HR      | GEZ     | BEZ | 24.0                                    | 26.70                                      | 29.50  | 1                       | 38.9  | 38.6                                    | 1  | X   |
| SMCJ26A-HR        | SMCJ26CA-HR      | GFE     | BFE | 26.0                                    | 28.90                                      | 31.90  | 1                       | 42.1  | 35.7                                    | 1  | X   |
| SMCJ28A-HR        | SMCJ28CA-HR      | GFG     | BFG | 28.0                                    | 31.10                                      | 34.40  | 1                       | 45.4  | 33.1                                    | 1  | X   |
| SMCJ30A-HR        | SMCJ30CA-HR      | GFK     | BFK | 30.0                                    | 33.30                                      | 36.80  | 1                       | 48.4  | 31.0                                    | 1  | X   |
| SMCJ33A-HR        | SMCJ33CA-HR      | GFM     | BFM | 33.0                                    | 36.70                                      | 40.60  | 1                       | 53.3  | 28.2                                    | 1  | X   |
| SMCJ36A-HR        | SMCJ36CA-HR      | GFP     | BFP | 36.0                                    | 40.00                                      | 44.20  | 1                       | 58.1  | 25.9                                    | 1  | X   |
| SMCJ40A-HR        | SMCJ40CA-HR      | GFR     | BFR | 40.0                                    | 44.40                                      | 49.10  | 1                       | 64.5  | 23.3                                    | 1  | X   |
| SMCJ43A-HR        | SMCJ43CA-HR      | GFT     | BFT | 43.0                                    | 47.80                                      | 52.80  | 1                       | 69.4  | 21.7                                    | 1  | X   |
| SMCJ45A-HR        | SMCJ45CA-HR      | GFV     | BFV | 45.0                                    | 50.00                                      | 55.30  | 1                       | 72.7  | 20.6                                    | 1  | X   |
| SMCJ48A-HR        | SMCJ48CA-HR      | GFX     | BFX | 48.0                                    | 53.30                                      | 58.90  | 1                       | 77.4  | 19.4                                    | 1  | X   |
| SMCJ51A-HR        | SMCJ51CA-HR      | GFZ     | BFZ | 51.0                                    | 56.70                                      | 62.70  | 1                       | 82.4  | 18.2                                    | 1  | X   |
| SMCJ54A-HR        | SMCJ54CA-HR      | GGE     | BGE | 54.0                                    | 60.00                                      | 66.30  | 1                       | 87.1  | 17.3                                    | 1  | X   |
| SMCJ58A-HR        | SMCJ58CA-HR      | GGG     | BGG | 58.0                                    | 64.40                                      | 71.20  | 1                       | 93.6  | 16.1                                    | 1  | X   |
| SMCJ60A-HR        | SMCJ60CA-HR      | GGK     | BGK | 60.0                                    | 66.70                                      | 73.70  | 1                       | 96.8  | 15.5                                    | 1  | X   |
| SMCJ64A-HR        | SMCJ64CA-HR      | GGM     | BGM | 64.0                                    | 71.10                                      | 78.60  | 1                       | 103.0   | 14.6                                    | 1  | X   |
| SMCJ70A-HR        | SMCJ70CA-HR      | GGP     | BGP | 70.0                                    | 77.80                                      | 86.00  | 1                       | 113.0   | 13.3                                    | 1  | X   |
| SMCJ75A-HR        | SMCJ75CA-HR      | GGR     | BGR | 75.0                                    | 83.30                                      | 92.10  | 1                       | 121.0   | 12.4                                    | 1  | X   |
| SMCJ78A-HR        | SMCJ78CA-HR      | GGT     | BGT | 78.0                                    | 86.70                                      | 95.80  | 1                       | 126.0   | 11.9                                    | 1  | X   |
| SMCJ85A-HR        | SMCJ85CA-HR      | GGV     | BGV | 85.0                                    | 94.40                                      | 104.00 | 1                       | 137.0   | 11.0                                    | 1  | X   |
| SMCJ90A-HR        | SMCJ90CA-HR      | GGX     | BGX | 90.0                                    | 100.00                                     | 111.00 | 1                       | 146.0   | 10.3                                    | 1  | X   |
| SMCJ100A-HR       | SMCJ100CA-HR     | GGZ     | BGZ | 100.0                                   | 111.00                                     | 123.00 | 1                       | 162.0   | 9.3                                     | 1  | X   |
| SMCJ110A-HR       | SMCJ110CA-HR     | GHE     | BHE | 110.0                                   | 122.00                                     | 135.00 | 1                       | 177.0   | 8.5                                     | 1  | X   |
| SMCJ120A-HR       | SMCJ120CA-HR     | GHG     | BHG | 120.0                                   | 133.00                                     | 147.00 | 1                       | 193.0   | 7.8                                     | 1  | X   |
| SMCJ130A-HR       | SMCJ130CA-HR     | GHK     | BHK | 130.0                                   | 144.00                                     | 159.00 | 1                       | 209.0   | 7.2                                     | 1  | X   |
| SMCJ150A-HR       | SMCJ150CA-HR     | GHM     | BHM | 150.0                                   | 167.00                                     | 185.00 | 1                       | 243.0   | 6.2                                     | 1  | X   |
| SMCJ154A-HR       | SMCJ154CA-HR     | GHN     | BHN | 154                                     | 172  | 190    | 1                       | 249   | 6.1                                     | 1  | -   |
| SMCJ160A-HR       | SMCJ160CA-HR     | GHP     | BHP | 160.0                                   | 178.00                                     | 197.00 | 1                       | 259.0   | 5.8                                     | 1  | X   |
| SMCJ170A-HR       | SMCJ170CA-HR     | GHR     | BHR | 170.0                                   | 189.00                                     | 209.00 | 1                       | 275.0   | 5.5                                     | 1  | X   |

**Note:**

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

### Screen Process

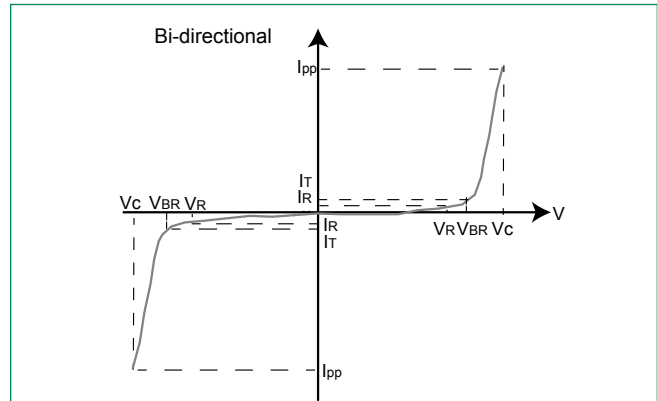
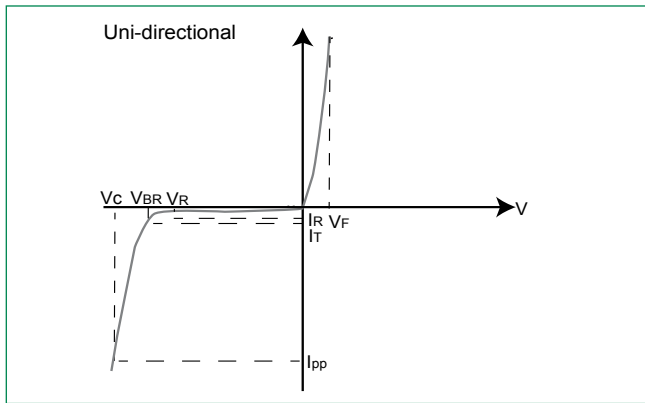
|   |                                   |
|---|-----------------------------------|
| 100% vision inspection  | MIL-STD-750 method 2074           |
| 100% High Temperature Storage Life (168hrs, 150C)   | MIL-STD-750 method 1031           |
| 100% X-RAY inspection   | MIL-STD-750 method 2076           |
| 100% Temperature cycle test (-55-150C, 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(150C, Bias=VR(80% breakdown voltage), 96hrs), for Bi-direction products, 96hrs for each direction | 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 Pluse Waveform | Maximum Clamping Voltage ( $V_C$ ) @ Peak Plus Current ( $I_{pp}$ ) | Sample size 45 perform 10x<br>Accept 0 failures   |
| Burn - In (HTRB) | MIL-STD-750, Method 1038.5          | Applied Voltage<br>100% $V_R$ @ 150°C                               | Sample size 45<br>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<br>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>   |                                    | 280°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**

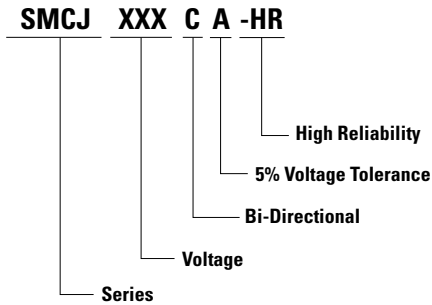
|                           |                          |
|---------------------------|--------------------------|
| <b>High Temp. Storage</b> | JESD22-A103              |
| <b>HTRB</b>               | JESD22-A108              |
| <b>Thermal Shock</b>      | JESD22-A106              |
| <b>MSL</b>                | JEDEC-J-STD-020, Level 1 |
| <b>H3TRB</b>              | JESD22-A101              |
| <b>RSH</b>                | JESD22-B106              |

### Dimensions



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

### Part Numbering System



### Part Marking System



### Packaging

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



### Tape and Reel Specification



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