

# High-Reliability TVS Diodes Upscreening and Sorting Solutions

## Overview

Littelfuse, a global leader in circuit protection products, offers a wide portfolio of discrete TVS Diode devices ranging from 200 watts to 30 kW including ultra-high-power AK families up to 15 kA. Our dedicated design team, with an AS9100-certified facility, provides specialized upscreening services based on Specification MIL-PRF-19500 for robust Hi-Rel TVS Diodes, which are a suitable selection for applications that require higher reliability performance under harsh conditions.

## Features

- Specification MIL-PRF-19500 screening processes flow.
- Flexible selection on high-reliability sortings flow can be customized by requests.
- Standard voltage range and power rating are offered for energy absorption capability.
- Long history of use in the Avionics industry.

## Customized Sorting Steps Available

- Visual Monitor in Process
- Single Wafer Lot Source
- High Temperature Storage Life
- X-Ray Inspection
- 3 Sigma & Dynamic Test
- Temperature Cycle Test
- Reflow (2X)
- Customized Vbr/Ir
- Additional Sorting
- HTRB
- H3TRB
- Labeling

## Benefits

- Ensures high-reliability performance and low infant mortality to meet the requirements of Avionics, industrial, and medical applications.
- Provides the flexibility to address a variety of applications.
- Allows for easy design-in, in compliance with the RTCA / DO-160 Standard (Environmental Conditions and Test Procedures for Airborne Equipment).
- Ensures market-proven results.

## Applications

- Airplane, eVTOL, Helicopter and Drone Application
- Industrial Application
- Harsh Environment Application
- AC/DC Power Line Protection
- Data Line Protection

### DO-160 Test Results Available (example, more data by request)

| 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   |
| SMDJ5.0CA-HR     | pass   | pass | pass              | pass | pass               | pass | pass   | pass | pass              | pass | pass               | pass | pass   | pass | pass              | pass | pass               | pass |
| SMDJ6.0CA-HR     | pass   | pass | pass              | pass | pass               | pass | pass   | pass | pass              | pass | pass               | pass | pass   | pass | pass              | pass | pass               | pass |
| SMDJ6.5CA-HR     | pass   | pass | pass              | pass | pass               | pass | pass   | pass | pass              | pass | pass               | pass | pass   | pass | pass              | pass | pass               | -    |
| SMDJ7.0CA-HR     | pass   | pass | pass              | pass | pass               | pass | pass   | pass | pass              | pass | pass               | pass | pass   | pass | pass              | pass | pass               | -    |
| SMDJ7.5CA-HR     | pass   | pass | pass              | pass | pass               | pass | pass   | pass | pass              | pass | pass               | pass | pass   | pass | pass              | pass | pass               | -    |
| SMDJ8.0CA-HR     | pass   | pass | pass              | pass | pass               | pass | pass   | pass | pass              | pass | pass               | pass | pass   | pass | pass              | pass | pass               | -    |
| SMDJ8.5CA-HR     | pass   | pass | pass              | pass | pass               | pass | pass   | pass | pass              | pass | pass               | pass | pass   | pass | pass              | pass | pass               | -    |
| SMDJ9.0CA-HR     | pass   | pass | pass              | pass | pass               | pass | pass   | pass | pass              | pass | pass               | pass | pass   | pass | pass              | pass | pass               | -    |
| SMDJ10CA-HR      | pass   | pass | pass              | pass | pass               | pass | pass   | pass | pass              | pass | pass               | pass | pass   | pass | pass              | pass | pass               | -    |
| SMDJ11CA-HR      | pass   | pass | pass              | pass | pass               | -    | pass   | pass | pass              | pass | pass               | pass | pass   | pass | pass              | pass | pass               | -    |
| SMDJ12CA-HR      | pass   | pass | pass              | pass | pass               | -    | pass   | pass | pass              | pass | pass               | pass | pass   | pass | pass              | pass | pass               | -    |
| SMDJ13CA-HR      | pass   | pass | pass              | pass | pass               | -    | pass   | pass | pass              | pass | pass               | pass | pass   | pass | pass              | pass | pass               | -    |
| SMDJ14CA-HR      | pass   | pass | pass              | pass | pass               | -    | pass   | pass | pass              | pass | pass               | pass | pass   | pass | pass              | pass | pass               | -    |
| SMDJ15CA-HR      | pass   | pass | pass              | pass | pass               | -    | pass   | pass | pass              | pass | pass               | pass | pass   | pass | pass              | pass | pass               | -    |
| SMDJ16CA-HR      | pass   | pass | pass              | pass | pass               | -    | pass   | pass | pass              | pass | pass               | pass | pass   | pass | pass              | pass | pass               | -    |

Figure 1. Packages Overview

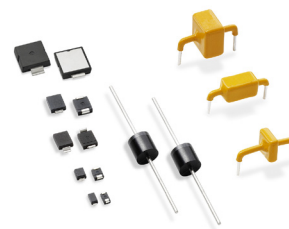
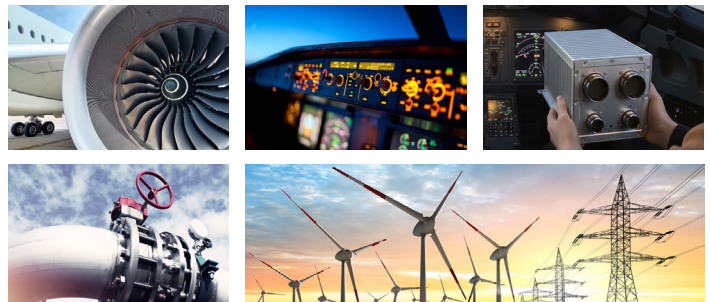


Figure 2. Application Examples



# Available Upscreened Hi-REL TVS Series

Table 1. Series List Table

| Series                         | 100 % Screen Test Sorting | Group B Test Sorting | PeakPulse Power Rating |              | Reverse Stand Off Voltage (V <sub>R</sub> ) | Minimum Breakdown Voltage (V <sub>BR</sub> ) | Low Cap. @0V | SMD/ Axial Lead | Package    | Compliance and Protection |             |
|--------------------------------|---------------------------|----------------------|------------------------|--------------|---|--|--------------|-----------------|------------|---------------------------|-------------|
|                                |                           |                      | 10/1000 μS (W)         | 8/20 μS (kA) | (V)   | (V)  | (pF)         |                 |            | DO-160 / DC Protection    | MIL-STD-704 |
| <a href="#">SMAJ-HR</a>        | Yes                       | Yes                  | 400                    |              | 6.0 - 45.0                                  | 6.67 - 50                                    | -            | SMD             | DO-214AC   | Yes                       | -           |
| <a href="#">SMAJ-HRA</a>       | Yes                       | -                    | 400                    |              | 6.0 - 45.0                                  | 6.67 - 50                                    | -            | SMD             | DO-214AC   | Yes                       | -           |
| <a href="#">SMBJ-HR</a>        | Yes                       | Yes                  | 600                    |              | 5.0 - 170                                   | 6.4 - 189                                    | -            | SMD             | DO-214AA   | Yes                       | -           |
| <a href="#">SMBJ-HRA</a>       | Yes                       | -                    | 600                    |              | 5.0 - 170                                   | 6.4 - 189                                    | -            | SMD             | DO-214AA   | Yes                       | -           |
| <a href="#">SMBLCE-HR</a>      | Yes                       | Yes                  | 600                    |              | 6.5 - 70.0                                  | 7.22 - 77.8                                  | 50           | SMD             | DO-214AA   | Yes                       | -           |
| <a href="#">SMBLCE-HRA</a>     | Yes                       | -                    | 600                    |              | 6.5 - 70.0                                  | 7.22 - 77.8                                  | 50           | SMD             | DO-214AA   | Yes                       | -           |
| <a href="#">SMCG-HR</a>        | Yes                       | Yes                  | 1500                   |              | 5.0 - 130                                   | 6.4 - 133                                    | -            | SMD             | DO-215AB   | Yes                       | -           |
| <a href="#">SMCG-HRA</a>       | Yes                       | -                    | 1500                   |              | 5.0 - 130                                   | 6.4 - 144                                    | -            | SMD             | DO-215AB   | Yes                       | -           |
| <a href="#">SMCLCE-HR</a>      | Yes                       | Yes                  | 1500                   |              | 12.0 - 70.0                                 | 13.3 - 77.8                                  | 50           | SMD             | DO-214AB   | Yes                       | -           |
| <a href="#">SMCLCE-HRA</a>     | Yes                       | -                    | 1500                   |              | 12.0 - 70.0                                 | 13.3 - 77.8                                  | 50           | SMD             | DO-214AB   | Yes                       | -           |
| <a href="#">SMCJ-HR</a>        | Yes                       | Yes                  | 1500                   |              | 5.0 - 170                                   | 6.4 - 189                                    | -            | SMD             | DO-214AB   | Yes                       | -           |
| <a href="#">SMCJ-HRA</a>       | Yes                       | -                    | 1500                   |              | 5.0 - 170                                   | 6.4 - 189                                    | -            | SMD             | DO-214AB   | Yes                       | -           |
| <a href="#">SMDJ-HR</a>        | Yes                       | Yes                  | 3000                   |              | 5.0 - 200                                   | 6.4 - 224                                    | -            | SMD             | DO-214AB   | Yes                       | -           |
| <a href="#">SMDJ-HRA</a>       | Yes                       | -                    | 3000                   |              | 5.0 - 200                                   | 6.4 - 224                                    | -            | SMD             | DO-214AB   | Yes                       | -           |
| <a href="#">SMDLCE-HR</a>      | Yes                       | Yes                  | 3000                   |              | 12.0 - 70.0                                 | 13.3 - 77.8                                  | 50           | SMD             | DO-214AB   | Yes                       | -           |
| <a href="#">SMDLCE-HRA</a>     | Yes                       | -                    | 3000                   |              | 12.0 - 70.0                                 | 13.3 - 77.8                                  | 50           | SMD             | DO-214AB   | Yes                       | -           |
| <a href="#">5.0SMDJxxS-HR</a>  | Yes                       | Yes                  | 5000                   |              | 13.0  | 14.4   | -            | SMD             | DO-214AB   | Yes                       | -           |
| <a href="#">5.0SMDJxxS-HRA</a> | Yes                       | -                    | 5000                   |              | 6.0 - 60.0                                  | 6.67 - 66.7                                  | -            | SMD             | DO-214AB   | Yes                       | -           |
| <a href="#">SM15KPA-HR</a>     | Yes                       | Yes                  | 15000                  |              | 20.0 - 400.0                                | 22.3 - 444.0                                 | -            | SMD             | SPD4-1     | Yes                       | -           |
| <a href="#">SM15KPA-HRA</a>    | Yes                       | -                    | 15000                  |              | 20.0 - 400.0                                | 22.3 - 444.0                                 | -            | SMD             | SPD4-1     | Yes                       | -           |
| <a href="#">SM30KPA-HR</a>     | Yes                       | Yes                  | 30000                  |              | 28.0 - 400.0                                | 31.1 - 444.0                                 | -            | SMD             | SPD4-1     | Yes                       | -           |
| <a href="#">SM30KPA-HRA</a>    | Yes                       | -                    | 30000                  |              | 28.0 - 400.0                                | 31.1 - 444.0                                 | -            | SMD             | SPD4-1     | Yes                       | -           |
| <a href="#">TLP</a>            | Yes                       | Yes                  | 5000                   |              | 10.0 - 40.0                                 | 11.8 - 44.4                                  | -            | Axial Leaded    | P600       | Yes                       | Yes         |
| <a href="#">TLPA</a>           | Yes                       | -                    | 5000                   |              | 10.0 - 40.0                                 | 11.8 - 44.4                                  | -            | Axial Leaded    | P600       | Yes                       | Yes         |
| <a href="#">5KP-HR</a>         | Yes                       | Yes                  | 5000                   |              | 5.0 - 220                                   | 6.4 - 244                                    | -            | Axial Leaded    | P600       | Yes                       | -           |
| <a href="#">5KP-HRA</a>        | Yes                       | -                    | 5000                   |              | 5.0 - 220                                   | 6.4 - 244                                    | -            | Axial Leaded    | P600       | Yes                       | -           |
| <a href="#">15KPA-HR</a>       | Yes                       | Yes                  | 15000                  |              | 17.0 - 280                                  | 18.99 - 312.8                                | -            | Axial Leaded    | P600       | Yes                       | -           |
| <a href="#">15KPA-HRA</a>      | Yes                       | -                    | 15000                  |              | 17.0 - 280                                  | 18.99 - 312.8                                | -            | Axial Leaded    | P600       | Yes                       | -           |
| <a href="#">30KPA-HR</a>       | Yes                       | Yes                  | 30000                  |              | 28.0 - 345                                  | 31.28 - 384                                  | -            | Axial Leaded    | P600       | Yes                       | -           |
| <a href="#">30KPA-HRA</a>      | Yes                       | -                    | 30000                  |              | 28.0 - 345                                  | 31.28 - 384                                  | -            | Axial Leaded    | P600       | Yes                       | -           |
| <a href="#">AK-FL</a>          | Yes                       | -                    | -                      | 6/8/10       | see datasheet for details                   |  | -            | Axial Leaded    | AK Package | Yes                       | -           |

Note: Hi-REL Series are also available for 3 kA/ 6 kA/10 kA/15 kA in AK packages, please contact Littelfuse sales for more details.

## 100% Screen Process

Table 2. Screen Process Description

| Description   | Standard                           |
|---|------------------------------------|
| 100 % Vision Inspection   | MIL-STD-750: Method 2074           |
| 100 % High Temperature Storage Life (168hrs)  | 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=V <sub>R</sub> (80 % breakdown voltage, 96hrs, 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 |

## Group B Test

Table 3. Group B Test Description

| Screen           | Method                         | Condition   | Requirement  |
|------------------|--------------------------------|---|--|
| Surge Test       | 10x1000 μS Peak Pulse Waveform | Maximum Clamping Voltage (V <sub>C</sub> ) @Peak Pulse Current (I <sub>PP</sub> ) | Sample Size 45, Perform 10x Accept 0 Failures  |
| Burn-In (HTRB)   | MIL-STD-750: Method 1038.5     | Applied Voltage 100 % V <sub>R</sub> @ 150 °C                                     | Sample Size 45, 340 Hours (680 hours for bi-directional products, each direction 340 hours). Accept 0 Failures |
| Electrical Tests | -                              | I <sub>R</sub> @V <sub>R</sub> V <sub>(BR)</sub> @ I <sub>T</sub>                 | Sample Size 45, Accept 0 Failures  |

Note: Please see our datasheets on website for more details.