RoHS Available

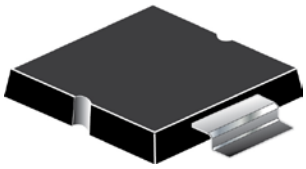
# 6.5 kW, Unidirectional and Bidirectional TVS Protection Device

*High-Reliability screening available in reference to MIL-PRF-19500*

## DESCRIPTION

These 6.5 kW rated transient voltage suppressors (TVS) in a surface mount PLAD package are provided with design features to minimize thermal resistance and cumulative heating. These devices have the ability to clamp dangerous high voltage, short term transients such as those produced by directed or radiated electrostatic discharge phenomena before entering sensitive component regions of a circuit design. Typical applications include lighting and automotive load dump protection. They are particularly effective at meeting the multi-stroke lightning standard RTCA DO-160, section 22 for aircraft design. This efficient low profile package design is offered in standoff voltage selections ($V_{WM}$) of 10 volt to 48 volts in either unidirectional or bidirectional construction. This product addition expands High reliable PLAD product portfolio. For more information on PLAD products, broad range of TVS devices please visit our website.

**Important:** For the latest information, visit our website http://www.microsemi.com.



mini-PLAD
(The cathode is the heatsink under the body of this device.)

## FEATURES

- Available in both unidirectional and bidirectional construction (bidirectional with CA suffix).
- High reliability with wafer fabrication and assembly lot traceability.
- All parts surge tested.
- Low profile surface mount package.
- Optional upscreening is available with various screening and conformance inspection options based on MIL-PRF-19500. Refer to Hi-Rel Non-Hermetic Products brochure on our web site for more details on the screening options.
- Suppresses transients up to 6,500 W @ 10/1000 µs (see figure 1).
- Moisture classification is Level 1 with no dry pack required per IPC/JEDEC J-STD-020.
- 3σ lot norm screening performed on standby current ($I_D$).
- RoHS compliant (2002/95/EC) devices available.
- Halogen free (IEC 61249-2-21)

## APPLICATIONS / BENEFITS

- Protection from switching transients and induced RF.
- Protection from ESD, and EFT per IEC 61000-4-2 and IEC 61000-4-4.
- Secondary lightning protection per IEC 61000-4-5 with 42 ohms source impedance:
  Class 1,2,3,4,5: MPLAD6.5KP10A to 48CA
- Secondary lightning protection per IEC 61000-4-5 with 12 ohms source impedance:
  Class 1,2,3,4: MPLAD6.5KP10A to 48CA
- Secondary lightning protection per IEC 61000-4-5 with 2 ohms source impedance:
  Class 2,3: MPLAD6.5KP10A to 48CA
  Class 4: MPLAD6.5KP10A to 22CA
- Pin injection protection per RTCA/DO-160F for Waveform 4 (6.4/69 µs at 25 ºC)*:
  Level 1,2,3,4: MPLAD6.5KP10A to 48CA
  Level 5: MPLAD6.5KP10A to 43CA
- Pin injection protection per RTCA/DO-160F for Waveform 5A (40/120 µs at 25 ºC)*:
  Level 1 and 2: MPLAD6.5KP10A to 48CA
  Level 3: MPLAD6.5KP10A to 36CA
  Level 4: MPLAD6.5KP10A to 12CA
- $I_{PP}$ rating of 40.1 amps to 383 amps.
- $V_{WM}$ rating of 10 volts to 48 volts.
- $V_{(BR)(min)}$ range of 11.1 volts to 53.3 volts.
- $V_{C(MAX)}$ rating of 17 volts to 77.4 volts

*See MicroNote 132 for further temperature derating selection.

**MSC – Lawrence**
6 Lake Street,
Lawrence, MA 01841
Tel: 1-800-446-1158 or
(978) 620-2600
Fax: (978) 689-0803

**MSC – Ireland**
Gort Road Business Park,
Ennis, Co. Clare, Ireland
Tel: +353 (0) 65 6840044
Fax: +353 (0) 65 6822298

**Website:**
www.microsemi.com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## MAXIMUM RATINGS @ 25 °C unless otherwise specified

| Parameters/Test Conditions | Symbol | Value | Unit |
|---|---|---|---|
| Junction and Storage Temperature | $T_J$ and $T_{STG}$ | -55 to +150 | ºC/W |
| Thermal Resistance Junction-to-Ambient (1) | $R_{\Theta JA}$ | 50 | ºC/W |
| Thermal Resistance Junction-to-Case | $R_{\Theta JC}$ | 1.5 | ºC/W |
| Peak Pulse Power @ 10/1000 µs (2) | $P_{PP}$ | 6,500 | W |
| $t_{clamping}$ (0 volts to $V_{(BR)}$ min) Unidirectional<br>Bidirectional | | <100<br><5 | ps<br>ns |
| Forward Clamping Voltage @ 300 Amps (3) | $V_{FS}$ | 2.5 | V |
| Forward Surge Current (3) | $I_{FSM}$ | 400 | A |
| Solder Temperature @ 10 s | $T_{SP}$ | 260 | ºC |
| Rated Average Power dissipation (5) $T_A$ = 25 °C<br>$T_C$ = 100 °C | $P_{M(AV)}$ | 2.5 (1)<br>33.3 (4) | W<br>W |

**Notes:**
1. When mounted on FR4 PC board with recommended mounting pad (see pad layout).
2. Also see figures 1 and 2. With impulse repetition rate (duty factor) of 0.05% or less.
3. At 8.3 ms half-sine wave (unidirectional devices only).
4. Case temperature controlled on heat sink as specified.
5. See MicroNote 134 for derating $P_{PP}$ when also applying steady-state power.

## MECHANICAL and PACKAGING

- CASE: Epoxy, meets UL94V-0.
- TERMINALS: Tin/lead or matte-tin (fully RoHS compliant) plating.
- MARKING: Part number.
- DELIVERY option: Tape and reel (13 inch).
- See Package Dimensions on last page.

## PART NOMENCLATURE

**M PLAD 6.5K P 7.0 CA (e3)**

**Reliability Level***
M
MA
MX
MXL
*(see Hi-Rel Non-Hermetic Product Portfolio)

**Package Designation**

**$P_{PP}$ Rating (W)**

**RoHS Compliance**
e3 = RoHS compliant
Blank = non-RoHS compliant

**Polarity**
A = Unidirectional
CA = Bidirectional

**Reverse Standoff Voltage**

**Plastic**


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| SYMBOLS & DEFINITIONS | |
|---|---|
| **Symbol** | **Definition** |
| $I_{(BR)}$ | Breakdown Current: The current used for measuring breakdown voltage $V_{(BR)}$. |
| $I_D$ | Standby Current: The current at the rated standoff voltage $V_{WM}$. |
| $I_{PP}$ | Peak Impulse Current: The peak current during the impulse. |
| $V_{(BR)}$ | Breakdown Voltage: The minimum voltage the device will exhibit at a specified current. |
| $V_C$ | Clamping Voltage: Clamping voltage at $I_{PP}$ (peak pulse current) at the specified pulse conditions (typically shown as maximum value). |
| $V_{WM}$ | Rated Working Standoff Voltage: The maximum peak voltage that can be applied over the operating temperature range. |
| $\alpha_{V(BR)}$ | Temperature Coefficient of Breakdown Voltage: The change in breakdown voltage divided by change in temperature. |

**ELECTRICAL CHARACTERISTICS** @ 25 ºC unless otherwise stated

| DEVICE* | REVERSE STAND-OFF VOLTAGE $V_{WM}$ | BREAKDOWN VOLTAGE $V_{(BR)}$ @ $I_{(BR)}$ | | MAXIMUM CLAMPING VOLTAGE $V_C$ @ $I_{PP}$ | MAXIMUM STANDBY CURRENT $I_D$ @ $V_{WM}$ | MAXIMUM PEAK PULSE CURRENT (FIG. 2) $I_{PP}$ | MAXIMUM TEMPERATURE COEFFICIENT OF $V_{(BR)}$ $\alpha_{V(BR)}$ |
|---|---|---|---|---|---|---|---|
| | Volts | Volts | mA | Volts | µA | Amps | mV/°C |
| MPLAD6.5KP10A(e3) | 10 | 11.1 - 12.3 | 5 | 17.0 | 15 | 383 | 9 |
| MPLAD6.5KP11A(e3) | 11 | 12.2 - 13.5 | 5 | 18.2 | 10 | 358 | 10 |
| MPLAD6.5KP12A(e3) | 12 | 13.3 - 14.7 | 5 | 19.9 | 10 | 327 | 11 |
| MPLAD6.5KP13A(e3) | 13 | 14.4 - 15.9 | 5 | 21.5 | 10 | 302 | 12 |
| MPLAD6.5KP14A(e3) | 14 | 15.6 - 17.2 | 5 | 23.2 | 10 | 280 | 13 |
| MPLAD6.5KP15A(e3) | 15 | 16.7 - 18.5 | 5 | 24.4 | 10 | 267 | 15 |
| MPLAD6.5KP16A(e3) | 16 | 17.8 - 19.7 | 5 | 26.0 | 10 | 250 | 16 |
| MPLAD6.5KP17A(e3) | 17 | 18.9 - 20.9 | 5 | 27.6 | 10 | 236 | 18 |
| MPLAD6.5KP18A(e3) | 18 | 20.0 - 22.1 | 5 | 29.2 | 10 | 223 | 19 |
| MPLAD6.5KP20A(e3) | 20 | 22.2 - 24.5 | 5 | 32.4 | 10 | 202 | 22 |
| MPLAD6.5KP22A(e3) | 22 | 24.4 - 26.9 | 5 | 35.5 | 10 | 183 | 24 |
| MPLAD6.5KP24A(e3) | 24 | 26.7 - 29.5 | 5 | 38.9 | 10 | 167 | 27 |
| MPLAD6.5KP26A(e3) | 26 | 28.9 - 31.9 | 5 | 42.1 | 10 | 154 | 29 |
| MPLAD6.5KP28A(e3) | 28 | 31.1 - 34.4 | 5 | 45.5 | 10 | 143 | 30 |
| MPLAD6.5KP30A(e3) | 30 | 33.3 - 36.8 | 5 | 48.4 | 10 | 135 | 35 |
| MPLAD6.5KP33A(e3) | 33 | 36.7 - 40.6 | 5 | 53.3 | 10 | 123 | 38 |
| MPLAD6.5KP36A(e3) | 36 | 40.0 - 44.2 | 5 | 58.1 | 10 | 111 | 40 |
| MPLAD6.5KP40A(e3) | 40 | 44.4 - 49.1 | 5 | 64.5 | 10 | 101 | 45 |
| MPLAD6.5KP43A(e3) | 43 | 47.8 - 52.8 | 5 | 69.4 | 10 | 93 | 49 |
| MPLAD6.5KP45A(e3) | 45 | 50.0 – 55.3 | 5 | 72.7 | 10 | 89 | 51 |
| MPLAD6.5KP48A(e3) | 48 | 53.3 – 58.9 | 5 | 77.4 | 10 | 85 | 54 |

* See part nomenclature for additional screening prefixes.


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## GRAPHS

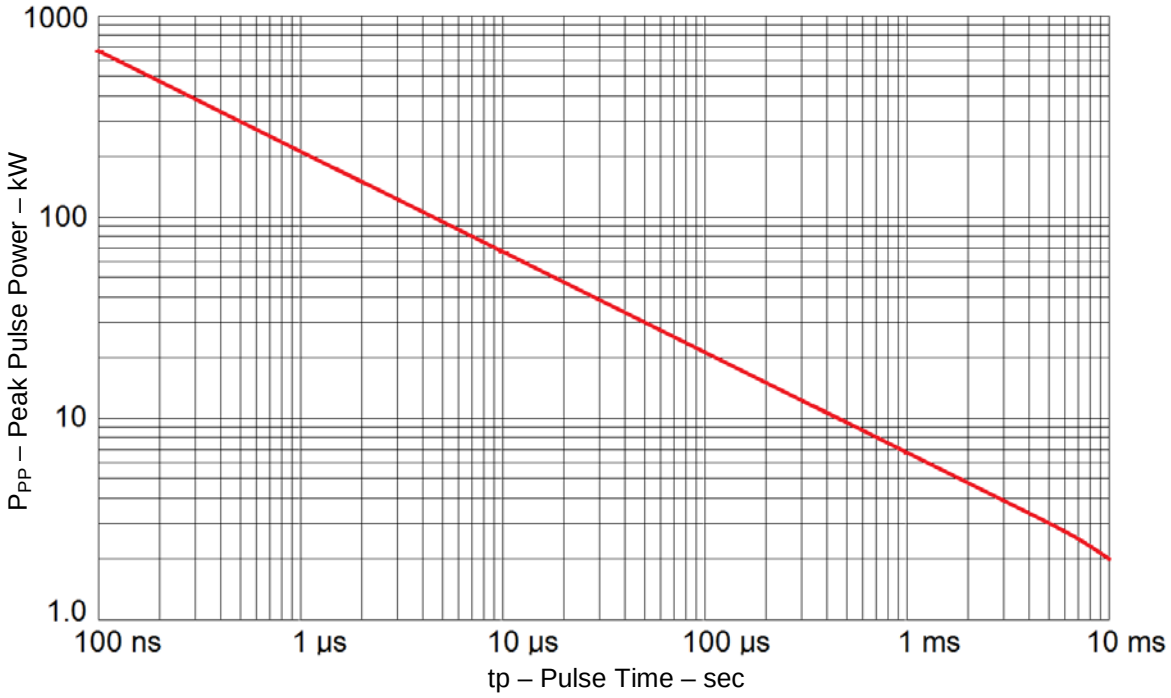
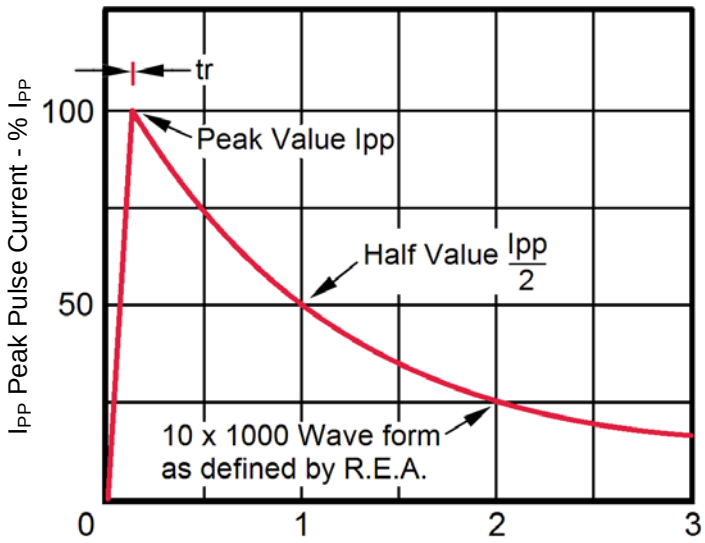



**FIGURE 1**
Peak Pulse Power vs. Pulse Time
(to 50% of exponentially decaying pulse)




Test waveform parameters: tr = 10 µs, tp = 1000 µs

**FIGURE 2**
Pulse Waveform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## GRAPHS (continued)

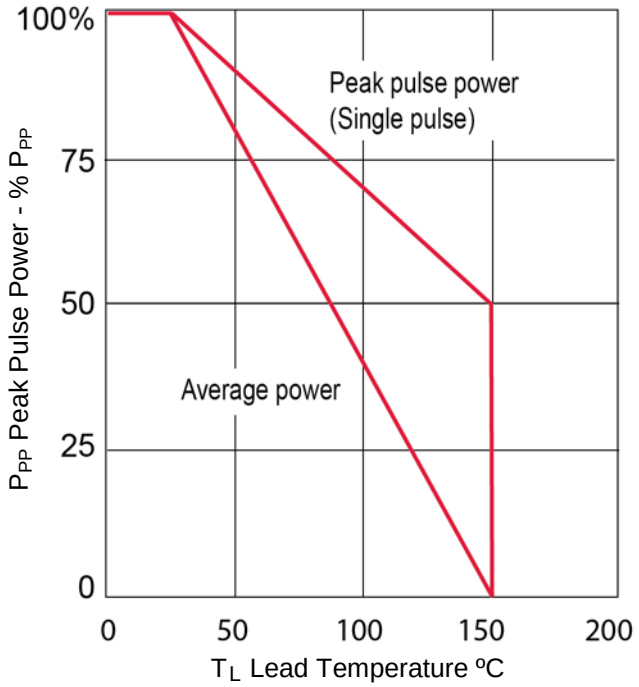


**FIGURE 3**
Derating Curve


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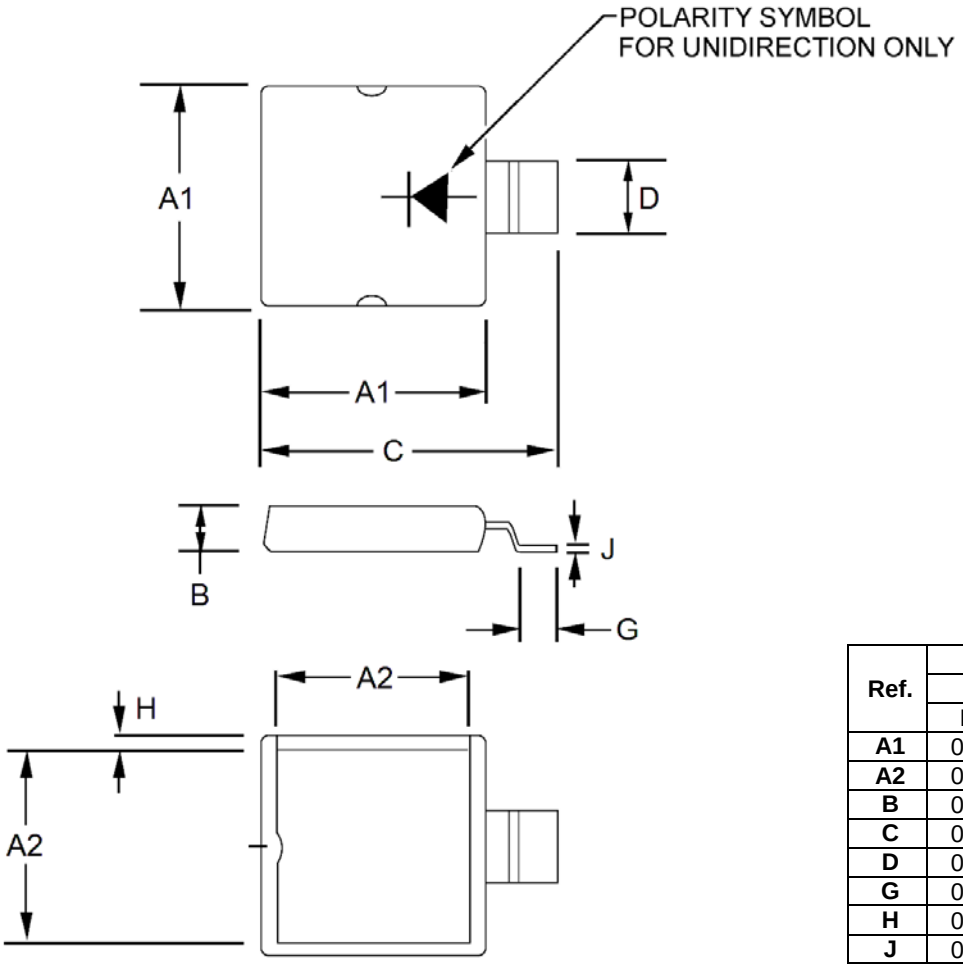
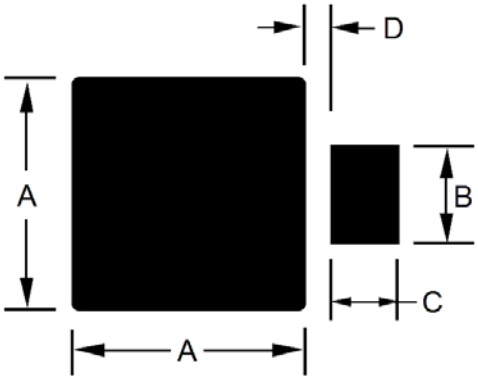
## PACKAGE DIMENSIONS




| Ref. | Dimensions | | | |
|---|---|---|---|---|
| | Inch | | Millimeters | |
| | Min | Max | Min | Max |
| A1 | 0.339 | 0.355 | 8.61 | 9.02 |
| A2 | 0.279 | 0.295 | 7.09 | 7.49 |
| B | 0.119 | 0.135 | 3.02 | 3.43 |
| C | 0.438 | 0.454 | 11.13 | 11.53 |
| D | 0.094 | 0.110 | 2.39 | 2.79 |
| G | 0.064 | 0.080 | 1.63 | 2.03 |
| H | 0.024 | 0.040 | 0.61 | 1.02 |
| J | 0.008 | 0.012 | 0.20 | 0.30 |

## PAD LAYOUT




| Ref. | Dimensions | |
|---|---|---|
| | Inch | Millimeters |
| | Typical | Typical |
| A | 0.357 | 9.08 |
| B | 0.117 | 2.97 |
| C | 0.080 | 2.03 |
| D | 0.033 | 0.84 |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