# Surface-Mount 36,000 W Transient Voltage Suppressor

## 1 Product Overview

These high-power, 36 kW–rated transient voltage suppressors in a surface-mount package are provided with design features to minimize thermal resistance and cumulative heating. Typical applications include lightning 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 14 V to 400 V in either unidirectional or bidirectional construction.

### 1.1 Features

The following are key features of the MPLAD36KP14A—MPLAD36KP400CA devices:

- 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 Hirel Non-Hermetic Product Portfolio brochure on our website for more details on the screening options.
- Suppresses transients up to 36,000 W at 10/1000 µs (see Figure 1 (see page 6))
- Moisture classification is Level 1 with no dry pack required per IPC/JEDEC J-STD-020D.1
- RoHS-compliant versions are available
- 3σ lot norm screening performed on standby current ($I_D$)
- AEC-Q101 qualified

### 1.2 Applications and Benefits

The following are benefits of the MPLAD36KP14A—MPLAD36KP400CA devices:

- Protection from switching transients and induced RFI
- 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 Ω source impedance:
  - Class 1, 2, 3, 4, 5: MPLAD36KP14A to 400CA
  - Class 5: MPLAD36KP14A to 400CA (short distance)
  - Class 5: MPLAD36KP14A to 260CA (long distance)
- Secondary lightning protection per IEC 61000-4-5 with 12 Ω source impedance:
  - Class 1, 2, 3: MPLAD36KP14A to 400CA
  - Class 4: MPLAD36KP14A to 280CA
- Secondary lightning protection per IEC 61000-4-5 with 2 Ω source impedance:
  - Class 2: MPLAD36KP10A to 400CA
  - Class 3: MPLAD36KP14A to 260CA
  - Class 4: MPLAD36KP14A to 130CA
- Pin injection protection per RTCA/DO-160G for Waveform 4 (6.4/69 µs at 25 °C)[1]:
  - Level 4: MPLAD36KP14A to 400CA
  - Level 5: MPLAD36KP14A to 300CA
- Pin injection protection per RTCA/DO-160G for Waveform 5A (40/120 µs at 25 °C)[1]:
  - Level 4: MPLAD36KP14A to 78CA
  - Level 5: MPLAD36KP14A to 38CA

**Note**:

1. See MicroNote 132 for further temperature derating selection.

## 1.3 Part Nomenclature

The following table shows the part nomenclature for the MPLAD36KP14A—MPLAD36KP400CA devices.

**Table 1 • MPLAD36KP14A Part Nomenclature**

| | | |
|---|---|---|
| **M** | Reliability level* | M MA MX MXL *(see Hirel Non-Hermetic Product Portfolio) |
| **PLAD** | Package designation | |
| **36K** | $P_{PP}$ rating (36 kW) | |
| **P** | Plastic | |
| **14** | Reverse standoff voltage | |
| **CA** | polarity | A = Unidirectional |
| | | CA = Bidirectional |
| **e3** | RoHS compliance | e3 = RoHS compliant |
| | | blank = non-RoHS compliant |

## 1.4 Symbols and Definitions

The following table shows the symbols and definitions used for the MPLAD36KP14A—MPLAD36KP400CA devices.

**Table 2 • Symbols and Definitions**

| Symbol | Value | Definition |
|---|---|---|
| $I_{(BR)}$ | Breakdown current | The current used for measuring breakdown voltage $V_{(BR)}$. |
| $I_D$ | Standby current | The current through the device at rated stand-off voltage. |
| $I_{PP}$ | Peak Impulse current | The maximum-rated random recurring peak impulse current or nonrepetitive peak impulse current that may be applied to a device. A random recurring or nonrepetitive transient current is usually due to an external cause, and it is assumed that its effect will have completely disappeared before the next transient arrives. |
| $V_{(BR)}$ | Breakdown voltage | The voltage across the device at a specified current $I_{(BR)}$ in the breakdown region. |
| $V_C$ | Clamping voltage | The voltage across the device in a region of low differential resistance during the application of an impulse current ($I_{PP}$) for a specified waveform. |
| $V_{WM}$ | Working standoff voltage | The maximum-rated value of dc or repetitive peak positive cathode-to-anode voltage that may be continuously applied over the standard operating temperature. |
| $\alpha_{V(BR)}$ | Temperature coefficient of breakdown voltage | The change in breakdown voltage divided by the change in temperature that caused it expressed in %/°C or mV/°C. |

# 2 Electrical Specifications

This section details the electrical specifications for the MPLAD36KP14A—MPLAD36KP400CA devices.

## 2.1 Maximum Ratings

The following table shows the absolute maximum ratings for the MPLAD36KP14A—MPLAD36KP400CA devices.

**Table 3 • Absolute Maximum Ratings**

| Parameter/Test Conditions | | Symbol | Value | Unit |
|---|---|---|---|---|
| Junction and storage temperature | | $T_J$ and $T_{STG}$ | –55 to +150 | °C |
| Thermal resistance junction-to-ambient[1] | | $R_{\theta JA}$ | 50 | °C/W |
| Thermal resistance junction-to-case | | $R_{\theta JC}$ | 1.0 | °C/W |
| Peak pulse power at 10/1000 µs[2] | | $P_{PP}$ | 36,000 | W |
| $t_{CLAMPING}$ (0 V to $V_{(BR)}$ min) | Unidirectional | | <100 | ps |
| | Bidirectional | | <5 | ns |
| Forward clamping voltage at 500 A[3] | | $V_{FS}$ | 4.0 | V |
| Forward surge current[3] | | $I_{FSM}$ | 1500 | A |
| Solder temperature at 10 seconds | | $T_{SP}$ | 260 | °C |
| Steady-state power dissipation[5] | $T_A$ = 25 °C | $P_D$ | 2.5[1] | W |
| | $T_C$ = 100 °C | | 50[4] | W |

**Notes**:

1. When mounted on FR4 PC board (1oz Cu) with recommended mounting pad (see pad layout).
2. Also, see Figure 1 (see page 6) and Figure 2 (see page ). 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 the heat sink as specified.
5. See MicroNote 134 for derating $P_{PP}$ when also applying steady-state power.

## 2.2 Electrical Characteristics

The following table shows the electrical characteristics of the MPLAD36KP14A—MPLAD36KP400CA devices at 25 °C unless otherwise specified. Bidirectional part numbers have a "CA" suffix instead of an "A" suffix.

**Table 4 • Typical Electrical Performance**

| Part Number | $V_{WM}$ Working Standoff Voltage[1] | $V_{BR}$ Breakdown Voltage at $I_{(BR)}$ | $I_{BR}$ Test Current | $V_C$ Max Clamping Voltage at $I_{PP}$ | $I_D$ Max Stand-by Current at $V_{WM}$ | $I_{PP}$ Max Peak Pulse Current[3] | $\alpha_{V(BR)}$ Max Temp Coefficient |
|---|---|---|---|---|---|---|---|
| **Unidirectional** | **(V)** | **Min – Max (V)** | **(mA)** | **(V)** | **(µA)** | **(A)** | **(mV/°C)** |
| MPLAD36KP14A | 14 | 15.6 – 17.2 | 150 | 24.0 | 3000 | 1500[2] | 10 |
| MPLAD36KP15A | 15 | 16.7 – 18.5 | 5 | 25.8 | 750 | 1396[2] | 12 |
| MPLAD36KP16A | 16 | 17.8 – 19.7 | 5 | 27.2 | 450 | 1324[2] | 12 |
| MPLAD36KP17A | 17 | 18.9 – 20.9 | 5 | 28.8 | 150 | 1250[2] | 14 |
| MPLAD36KP18A | 18 | 20.0 – 22.1 | 5 | 30.8 | 60 | 1169[2] | 16 |
| MPLAD36KP20A | 20 | 22.2 – 24.5 | 5 | 34.0 | 45 | 1059[2] | 18 |
| MPLAD36KP22A | 22 | 24.4 – 26.9 | 5 | 36.4 | 10 | 990 | 20 |
| MPLAD36KP24A | 24 | 26.7 – 29.5 | 5 | 39.8 | 10 | 905 | 22 |
| MPLAD36KP26A | 26 | 28.9 – 31.9 | 5 | 43.0 | 10 | 838 | 24 |
| MPLAD36KP28A | 28 | 31.1 – 34.4 | 5 | 46.4 | 10 | 776 | 26 |
| MPLAD36KP30A | 30 | 33.3 – 36.8 | 5 | 48.8 | 10 | 738 | 30 |
| MPLAD36KP33A | 33 | 36.7 – 40.6 | 5 | 53.3 | 10 | 676 | 35 |
| MPLAD36KP36A | 36 | 40.0 – 44.2 | 5 | 58.1 | 10 | 620 | 38 |
| MPLAD36KP40A | 40 | 44.4 – 49.1 | 5 | 64.5 | 10 | 559 | 44 |
| MPLAD36KP43A | 43 | 47.8 – 52.8 | 5 | 69.4 | 10 | 519 | 50 |
| MPLAD36KP45A | 45 | 50.0 – 55.3 | 5 | 72.7 | 10 | 496 | 51 |
| MPLAD36KP48A | 48 | 53.3 – 58.9 | 5 | 77.4 | 10 | 466 | 54 |
| MPLAD36KP51A | 51 | 56.7 – 62.7 | 5 | 82.4 | 10 | 437 | 58 |
| MPLAD36KP54A | 54 | 60.0 – 66.3 | 5 | 87.1 | 10 | 414 | 64 |
| MPLAD36KP58A | 58 | 64.4 – 71.2 | 5 | 93.6 | 10 | 385 | 70 |
| MPLAD36KP60A | 60 | 66.7 – 73.7 | 5 | 96.8 | 10 | 372 | 72 |
| MPLAD36KP64A | 64 | 71.1 – 78.6 | 5 | 103.0 | 10 | 350 | 75 |
| MPLAD36KP70A | 70 | 77.8 – 86.0 | 5 | 113 | 10 | 319 | 84 |
| MPLAD36KP75A | 75 | 83.3 – 92.1 | 5 | 121 | 10 | 298 | 98 |
| MPLAD36KP78A | 78 | 86.7 – 95.8 | 5 | 126 | 10 | 286 | 95 |
| MPLAD36KP85A | 85 | 94.4–104.0 | 5 | 137 | 10 | 263 | 104 |
| MPLAD36KP90A | 90 | 100 – 111 | 5 | 146 | 10 | 247 | 109 |
| MPLAD36KP100A | 100 | 111 – 123 | 5 | 162 | 10 | 223 | 122 |

| Part Number | $V_{WM}$ Working Standoff Voltage[1] | $V_{BR}$ Breakdown Voltage at $I_{(BR)}$ | $I_{BR}$ Test Current | $V_C$ Max Clamping Voltage at $I_{PP}$ | $I_D$ Max Stand-by Current at $V_{WM}$ | $I_{PP}$ Max Peak Pulse Current[3] | $\alpha_{V(BR)}$ Max Temp Coefficient |
|---|---|---|---|---|---|---|---|
| **Unidirectional** | **(V)** | **Min – Max (V)** | **(mA)** | **(V)** | **(µA)** | **(A)** | **(mV/°C)** |
| MPLAD36KP110A | 110 | 122 – 135 | 5 | 177 | 10 | 204 | 132 |
| MPLAD36KP120A | 120 | 133 – 147 | 5 | 193 | 10 | 187 | 145 |
| MPLAD36KP130A | 130 | 144 – 159 | 5 | 209 | 10 | 173 | 157 |
| MPLAD36KP150A | 150 | 167 – 185 | 5 | 243 | 10 | 149 | 183 |
| MPLAD36KP160A | 160 | 178 – 197 | 5 | 259 | 10 | 139 | 195 |
| MPLAD36KP170A | 170 | 189 – 209 | 5 | 275 | 10 | 131 | 207 |
| MPLAD36KP180A | 180 | 200 – 221 | 5 | 291 | 10 | 124 | 219 |
| MPLAD36KP200A | 200 | 222 – 245 | 5 | 322 | 10 | 112 | 243 |
| MPLAD36KP220A | 220 | 245 – 271 | 5 | 356 | 10 | 102 | 269 |
| MPLAD36KP260A | 260 | 289 – 320 | 5 | 419 | 10 | 86 | 318 |
| MPLAD36KP280A | 280 | 311 – 345 | 5 | 451 | 10 | 80 | 344 |
| MPLAD36KP300A | 300 | 333 – 369 | 5 | 483 | 10 | 75 | 368 |
| MPLAD36KP350A | 350 | 389 – 431 | 5 | 564 | 10 | 64 | 430 |
| MPLAD36KP400A | 400 | 444 – 492 | 5 | 644 | 10 | 56 | 493 |

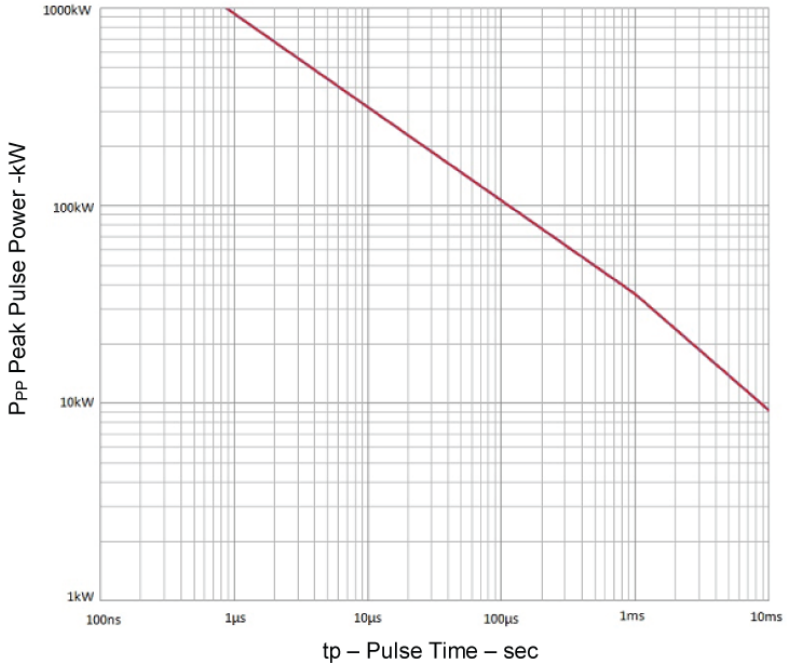
**Notes**:

1. Transient voltage suppressors are normally selected with reverse standoff voltage $V_{WM}$, which should be equal to or greater than the peak operating voltage.
2. Surge testing is performed to 1000 A due to equipment limitations.
3. See Figure 3 (see page 7).

## 2.3 Typical Performance Curves

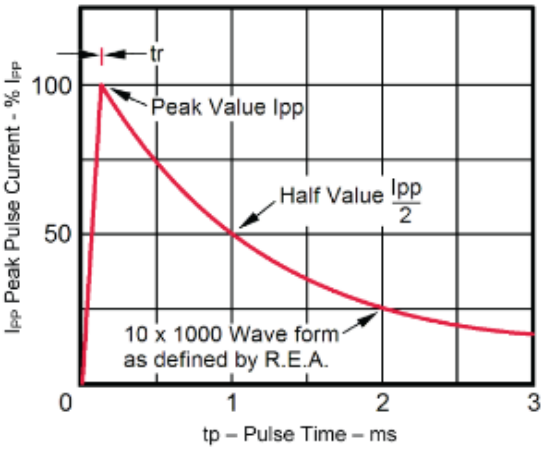
This section shows the typical performance curves of the MPLAD36KP14A—MPLAD36KP400CA device. The following graph shows peak pulse power versus pulse time (to 50% of exponentially decaying pulse).

**Figure 1 • Peak Pulse Power vs. Pulse Time**



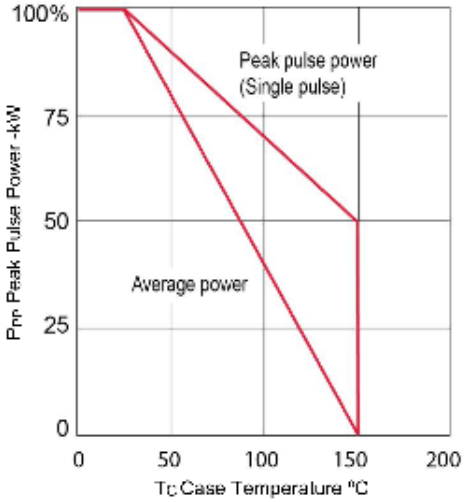

The following graph shows the pulse waveform with these parameters: tr = 10 µs and tp = 1000 µs.

**Figure 2 • Pulse Waveform**



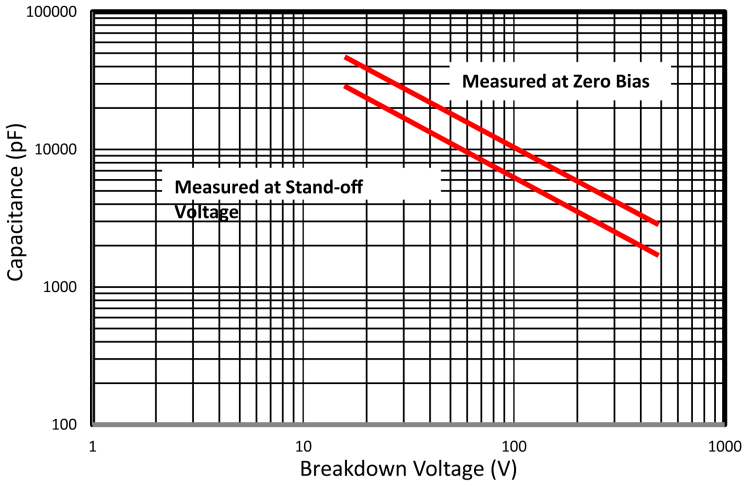
The following graph shows the derating curve.

**Figure 3 • Derating Curve**




The following graph shows the typical capacitance versus the breakdown voltage. Note that the bidirectional capacitance is half that shown at 0 V.

**Figure 4 • Typical Capacitance vs. Breakdown Voltage (Unidirectional Configuration)**

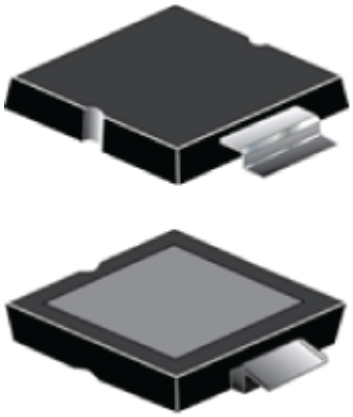


# 3 Package Specification

The following illustration is the MPLAD36KP14A—MPLAD36KP400CA package.

The cathode is the metal base under the body of this device.

**Figure 5 • PLAD Package**



The following table shows the mechanical and packaging information for the MPLAD36KP14A—MPLAD36KP400CA devices.

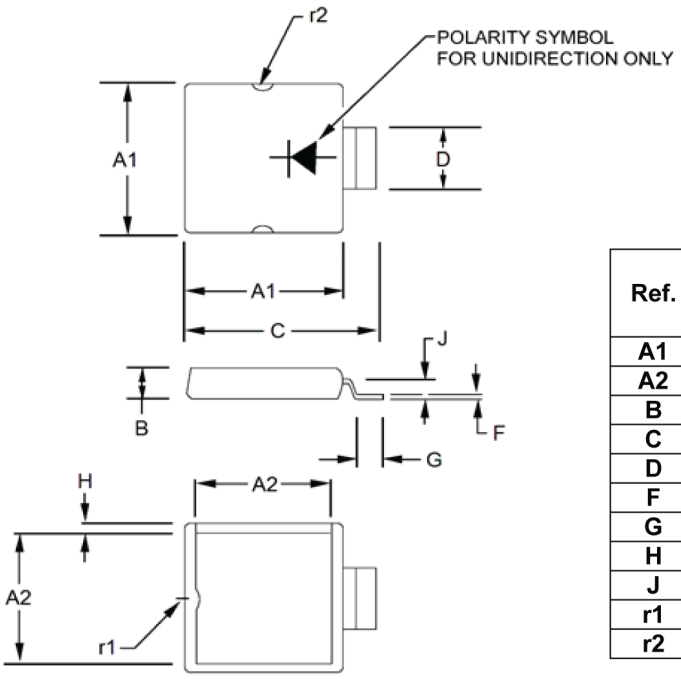
**Table 5 • Mechanical and Packaging**

| Component | Description |
|---|---|
| Case | Void-free transfer molded thermosetting epoxy body meeting UL94V-0 |
| Terminals | Tin-lead or RoHS-compliant annealed matte-tin plating readily solderable per MIL-STD-750, method 2026. |
| Marking | Body marked with part number |
| Polarity | For unidirectional devices, the cathode is on the metal backside (package bottom) |
| Packaging | Available in bulk or custom tape-and-reel packaging |
| Tape-and-Reel | Standard per EIA-481-B (add “TR” suffix to part number). Consult factory for quantities. |
| Weight | Approximately 1.7 g–2.0 g |
| See Package Dimensions on last page. | |

## 3.1 Package Dimensions

The following illustration shows the package dimensions for the MPLAD36KP14A–MPLAD36KP400CA devices.

**Figure 6 • Package Outline Drawing**

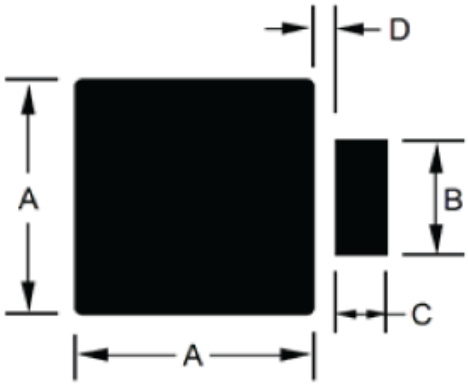



| Ref. | Dimensions | | | |
|---|---|---|---|---|
| | Inch | | Millimeters | |
| | Min | Max | Min | Max |
| A1 | 0.485 | 0.495 | 12.32 | 12.57 |
| A2 | 0.415 | 0.425 | 10.54 | 10.80 |
| B | 0.145 | 0.155 | 3.68 | 3.94 |
| C | 0.585 | 0.595 | 14.86 | 15.11 |
| D | 0.200 | 0.210 | 5.08 | 5.33 |
| F | 0.008 | 0.013 | 0.20 | 0.33 |
| G | 0.045 | 0.055 | 1.14 | 1.40 |
| H | 0.015 | 0.025 | 0.38 | 0.64 |
| J | 0.062 TYP | | 1.57 TYP | |
| r1 | 0.030 TYP | | 0.76 TYP | |
| r2 | 0.045 TYP | | 1.14 TYP | |

## 3.2 Pad Layout

The following illustration shows the pad layout for the MPLAD36KP14A—MPLAD36KP400CA devices

**Figure 7 • Pad Layout**




| Ref. | Dimensions | |
|---|---|---|
| | Inch | Millimeters |
| | Typical | Typical |
| A | 0.470 | 11.94 |
| B | 0.230 | 5.85 |
| C | 0.100 | 2.44 |
| D | 0.045 | 1.15 |

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