

# 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 upscrewing 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  $\mu$ s (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
- 3 $\sigma$  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  $\Omega$  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  $\Omega$  source impedance:
  - Class 1, 2, 3: MPLAD36KP14A to 400CA
  - Class 4: MPLAD36KP14A to 280CA
- Secondary lightning protection per IEC 61000-4-5 with 2  $\Omega$  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  $\mu$ s at 25  $^{\circ}$ C)<sup>1</sup>:
  - Level 4: MPLAD36KP14A to 400CA
  - Level 5: MPLAD36KP14A to 300CA
- Pin injection protection per RTCA/DO-160G for Waveform 5A (40/120  $\mu$ s at 25  $^{\circ}$ C)<sup>1</sup>:
  - 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**

<b>M</b>	Reliability level*	M MA MX MXL *(see <a href="#">Hirel Non-Hermetic Product Portfolio</a> )
<b>PLAD</b>	Package designation	
<b>36K</b>	P <sub>PP</sub> rating (36 kW)	
<b>P</b>	Plastic	
<b>14</b>	Reverse standoff voltage	
<b>CA</b>	polarity	A = Unidirectional CA = Bidirectional
<b>e3</b>	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 <sup>1</sup>	$R_{\theta JA}$	50	°C/W
Thermal resistance junction-to-case	$R_{\theta JC}$	1.0	°C/W
Peak pulse power at 10/1000 $\mu s^2$	$P_{PP}$	36,000	W
$t_{CLAMPING}$ (0 V to $V_{(BR)}$ min)	Unidirectional	<100	ps
	Bidirectional	<5	ns
Forward clamping voltage at 500 A <sup>3</sup>	$V_{FS}$	4.0	V
Forward surge current <sup>3</sup>	$I_{FSM}$	1500	A
Solder temperature at 10 seconds	$T_{SP}$	260	°C
Steady-state power dissipation <sup>5</sup>	$T_A = 25\text{ °C}$	$P_D$ 2.5 <sup>1</sup>	W
	$T_C = 100\text{ °C}$	50 <sup>4</sup>	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 <sub>WM</sub> Working Standoff Voltage <sup>1</sup>	V <sub>BR</sub> Breakdown Voltage at I <sub>BR</sub>	I <sub>BR</sub> Test Current	V <sub>c</sub> Max Clamping Voltage at I <sub>PP</sub>	I <sub>D</sub> Max Stand-by Current at V <sub>WM</sub>	I <sub>PP</sub> Max Peak Pulse Current <sup>3</sup>	α <sub>V(BR)</sub> 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 <sup>2</sup>	10
MPLAD36KP15A	15	16.7 – 18.5	5	25.8	750	1396 <sup>2</sup>	12
MPLAD36KP16A	16	17.8 – 19.7	5	27.2	450	1324 <sup>2</sup>	12
MPLAD36KP17A	17	18.9 – 20.9	5	28.8	150	1250 <sup>2</sup>	14
MPLAD36KP18A	18	20.0 – 22.1	5	30.8	60	1169 <sup>2</sup>	16
MPLAD36KP20A	20	22.2 – 24.5	5	34.0	45	1059 <sup>2</sup>	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 <sub>WM</sub> Working Standoff Voltage <sup>1</sup>	V <sub>BR</sub> Breakdown Voltage at I <sub>BR</sub>	I <sub>BR</sub> Test Current	V <sub>C</sub> Max Clamping Voltage at I <sub>PP</sub>	I <sub>D</sub> Max Stand-by Current at V <sub>WM</sub>	I <sub>PP</sub> Max Peak Pulse Current <sup>3</sup>	α <sub>V(BR)</sub> 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

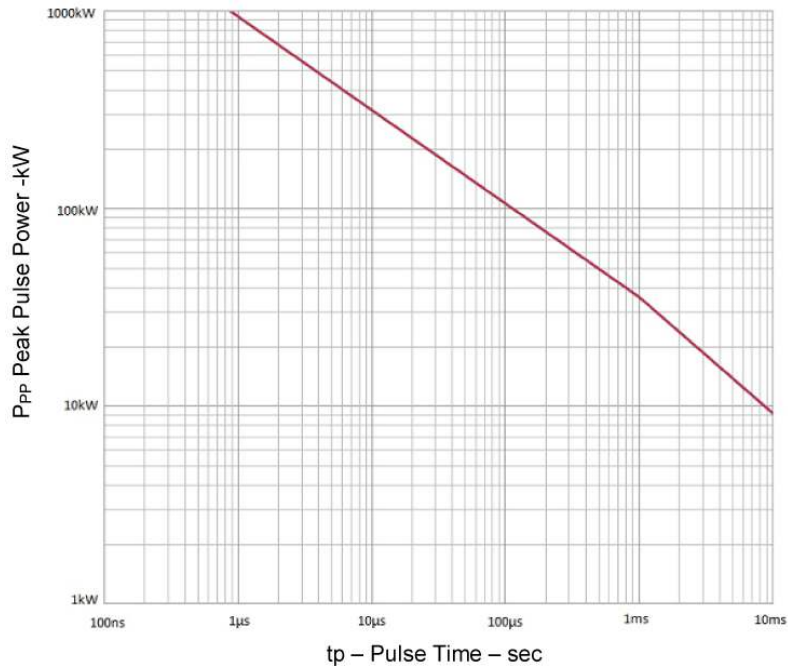
**Notes:**

1. Transient voltage suppressors are normally selected with reverse standoff voltage V<sub>WM</sub>, 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

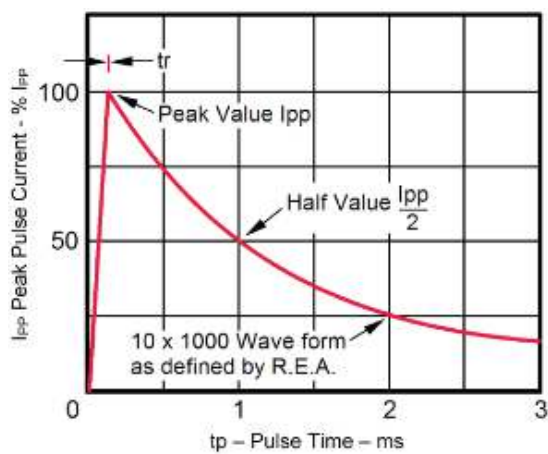
This section shows the typical performance curves of the MPLAD36KP14A—MPLAD36KP400CA device. The following graph shows peak pulse power versus pulse time (to 50% of exponentially decaying pulse).

Figure 1 • Peak Pulse Power vs. Pulse Time



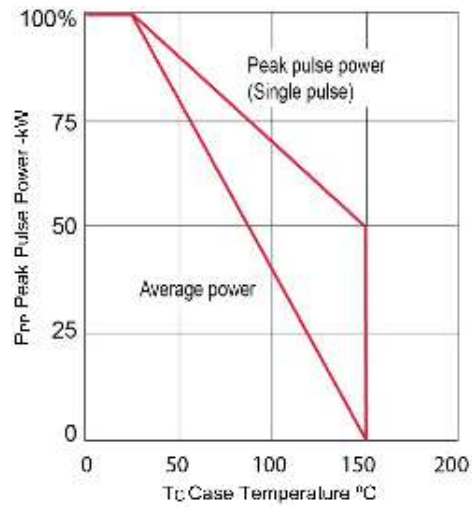
The following graph shows the pulse waveform with these parameters:  $t_r = 10 \mu s$  and  $t_p = 1000 \mu s$ .

Figure 2 • Pulse Waveform



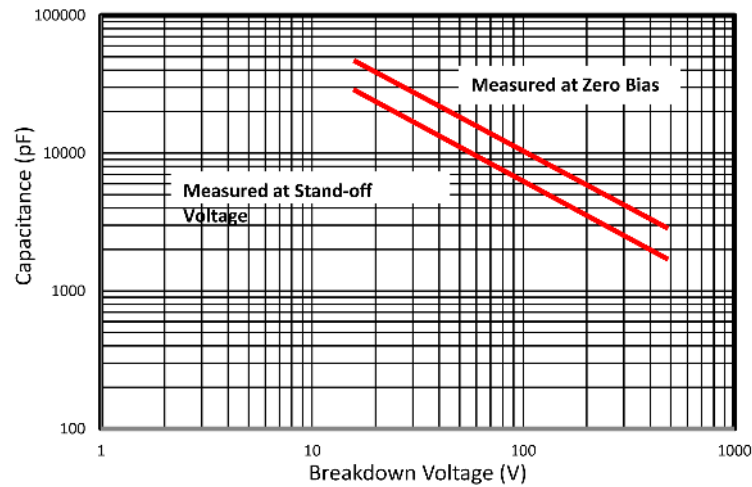
The following graph shows the derating curve.

**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**

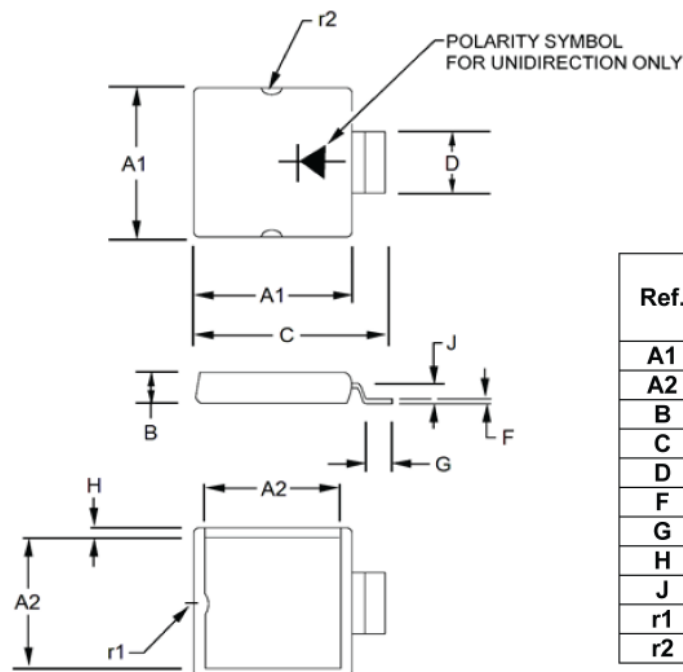
Component	Description
Case	Void-free transfer molded thermosetting epoxy body meeting UL94V-0
Terminals	Tin-lead or RoHS-compliant annealed matte-tin plating readily solderable per MIL-STD-750, method 2026.
Marking	Body marked with part number
Polarity	For unidirectional devices, the cathode is on the 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 <a href="#">Package Dimensions</a> on last page.	



### 3.1 Package Dimensions

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

Figure 6 • Package Outline Drawing

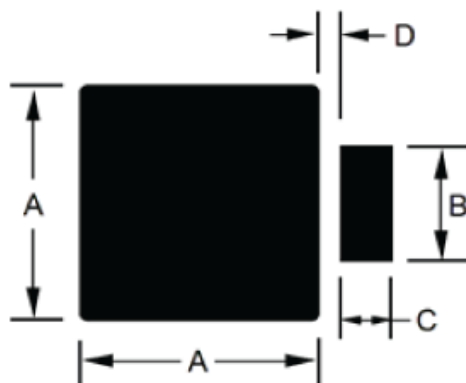


Ref.	Dimensions			
	Inch		Millimeters	
	Min	Max	Min	Max
A1	0.485	0.495	12.32	12.57
A2	0.415	0.425	10.54	10.80
B	0.145	0.155	3.68	3.94
C	0.585	0.595	14.86	15.11
D	0.200	0.210	5.08	5.33
F	0.008	0.013	0.20	0.33
G	0.045	0.055	1.14	1.40
H	0.015	0.025	0.38	0.64
J	0.062 TYP		1.57 TYP	
r1	0.030 TYP		0.76 TYP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