

P6KE6.8A Series

600 Watt Peak Power Surmetic™ -40 Transient Voltage Suppressors Unidirectional*

The P6KE6.8A series is designed to protect voltage sensitive components from high voltage, high energy transients. They have excellent clamping capability, high surge capability and fast response time. These devices are ON Semiconductor's exclusive, cost-effective, highly reliable Surmetic™ axial leaded package and is ideally-suited for use in communication systems, numerical controls, process controls, medical equipment, business machines, power supplies and many other industrial/consumer applications.

Features:

- Working Peak Reverse Voltage Range – 5.8 to 171 V
- Peak Power – 600 W @ 1 ms
- ESD Rating of Class 3 (>16 KV) per Human Body Model
- Maximum Clamp Voltage @ Peak Pulse Current
- Low Leakage < 5 μ A above 10 V
- Maximum Temperature Coefficient Specified
- UL 497B for Isolated Loop Circuit Protection
- Response Time is Typically < 1 ns
- Pb-Free Packages are Available*

Mechanical Characteristics:

CASE: Void-free, Transfer-molded, Thermosetting plastic

FINISH: All external surfaces are corrosion resistant and leads are readily solderable

MAXIMUM LEAD TEMPERATURE FOR SOLDERING:

260°C, 1/16" from the case for 10 seconds

POLARITY: Cathode indicated by polarity band

MOUNTING POSITION: Any

MAXIMUM RATINGS

| Rating | Symbol | Value | Unit |
|--|-----------------|-----------------|-------|
| Peak Power Dissipation (Note 1) @ $T_L \leq 25^\circ\text{C}$ | P_{PK} | 600 | W |
| Steady State Power Dissipation @ $T_L \leq 25^\circ\text{C}$, Lead Length = 3/8 in Derated above $T_L = 50^\circ\text{C}$ | P_D | 5.0 | W |
| | | 50 | mW/°C |
| Thermal Resistance, Junction-to-Lead | $R_{\theta JL}$ | 20 | °C/W |
| Forward Surge Current (Note 2) @ $T_A = 25^\circ\text{C}$ | I_{FSM} | 100 | A |
| Operating and Storage Temperature Range | T_J, T_{stg} | - 55 to +150 | °C |

Stresses exceeding Maximum Ratings may damage the device. Maximum Ratings are stress ratings only. Functional operation above the Recommended Operating Conditions is not implied. Extended exposure to stresses above the Recommended Operating Conditions may affect device reliability.

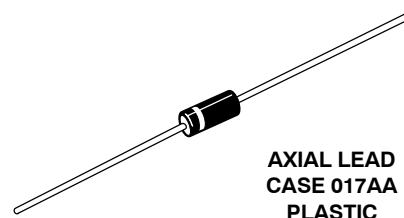
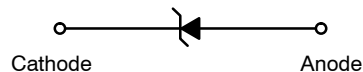
1. Nonrepetitive current pulse per Figure 4 and derated above $T_A = 25^\circ\text{C}$ per Figure 2.
2. 1/2 sine wave (or equivalent square wave), PW = 8.3 ms, duty cycle = 4 pulses per minute maximum.

*For additional information on our Pb-Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.



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MARKING DIAGRAM



A = Assembly Location
P6KExxxA = Device Number
YY = Year
WW = Work Week
■ = Pb-Free Package
(Note: Microdot may be in either location)

ORDERING INFORMATION

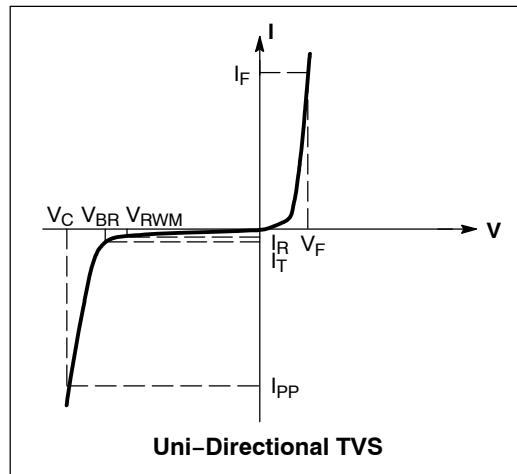
| Device | Package | Shipping† |
|-------------|-------------------------|------------------|
| P6KExxxA | Axial Lead | 1000 Units / Box |
| P6KExxxAG | Axial Lead (Pb-Free) | 1000 Units / Box |
| P6KExxxARL | Axial Lead | 4000/Tape & Reel |
| P6KExxxARLG | Axial Lead (Pb-Free) | 4000/Tape & Reel |

†For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, BRD8011/D.

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ELECTRICAL CHARACTERISTICS ($T_A = 25^\circ\text{C}$ unless otherwise noted, $V_F = 3.5\text{ V Max.}$ @ I_F (Note 6) = 50 A)

| Symbol | Parameter |
|-------------------|---|
| I_{PP} | Maximum Reverse Peak Pulse Current |
| V_C | Clamping Voltage @ I_{PP} |
| V_{RWM} | Working Peak Reverse Voltage |
| I_R | Maximum Reverse Leakage Current @ V_{RWM} |
| V_{BR} | Breakdown Voltage @ I_T |
| I_T | Test Current |
| $\Theta_{V_{BR}}$ | Maximum Temperature Coefficient of V_{BR} |
| I_F | Forward Current |
| V_F | Forward Voltage @ I_F |



ELECTRICAL CHARACTERISTICS ($T_A = 25^\circ\text{C}$ unless otherwise noted, $V_F = 3.5\text{ V Max.}$ @ I_F (Note 6) = 50 A)

| Device* | Device Marking | V_{RWM} (Note 3) V | I_R @ V_{RWM} μA | Breakdown Voltage | | | V_C @ I_{PP} (Note 5) | | $\Theta_{V_{BR}}$ %/°C | |
|-------------|----------------|----------------------------|------------------------------------|-----------------------|-------|------|---------------------------|-------|---------------------------|----------|
| | | | | V_{BR} (Note 4) (V) | | | I_T | V_C | | I_{PP} |
| | | | | Min | Nom | Max | mA | V | | A |
| P6KE6.8A, G | P6KE6.8A | 5.8 | 1000 | 6.45 | 6.80 | 7.14 | 10 | 10.5 | 57 | 0.057 |
| P6KE7.5ARLG | P6KE7.5A | 6.4 | 500 | 7.13 | 7.51 | 7.88 | 10 | 11.3 | 53 | 0.061 |
| P6KE10AG | P6KE10A | 8.55 | 10 | 9.5 | 10 | 10.5 | 1 | 14.5 | 41 | 0.073 |
| P6KE12A, G | P6KE12A | 10.2 | 5 | 11.4 | 12 | 12.6 | 1 | 16.7 | 36 | 0.078 |
| P6KE13AG | P6KE13A | 11.1 | 5 | 12.4 | 13.05 | 13.7 | 1 | 18.2 | 33 | 0.081 |
| P6KE15AG | P6KE15A | 12.8 | 5 | 14.3 | 15.05 | 15.8 | 1 | 21.2 | 28 | 0.084 |
| P6KE16A, G | P6KE16A | 13.6 | 5 | 15.2 | 16 | 16.8 | 1 | 22.5 | 27 | 0.086 |
| P6KE18AG | P6KE18A | 15.3 | 5 | 17.1 | 18 | 18.9 | 1 | 25.2 | 24 | 0.088 |
| P6KE20ARLG | P6KE20A | 17.1 | 5 | 19 | 20 | 21 | 1 | 27.7 | 22 | 0.09 |
| P6KE22ARLG | P6KE22A | 18.8 | 5 | 20.9 | 22 | 23.1 | 1 | 30.6 | 20 | 0.092 |
| P6KE24ARLG | P6KE24A | 20.5 | 5 | 22.8 | 24 | 25.2 | 1 | 33.2 | 18 | 0.094 |
| P6KE27ARLG | P6KE27A | 23.1 | 5 | 25.7 | 27.05 | 28.4 | 1 | 37.5 | 16 | 0.096 |
| P6KE30ARLG | P6KE30A | 25.6 | 5 | 28.5 | 30 | 31.5 | 1 | 41.4 | 14.4 | 0.097 |
| P6KE33AG | P6KE33A | 28.2 | 5 | 31.4 | 33.05 | 34.7 | 1 | 45.7 | 13.2 | 0.098 |
| P6KE36AG | P6KE36A | 30.8 | 5 | 34.2 | 36 | 37.8 | 1 | 49.9 | 12 | 0.099 |
| P6KE39AG | P6KE39A | 33.3 | 5 | 37.1 | 39.05 | 41 | 1 | 53.9 | 11.2 | 0.1 |
| P6KE43AG | P6KE43A | 36.8 | 5 | 40.9 | 43.05 | 45.2 | 1 | 59.3 | 10.1 | 0.101 |
| P6KE47AG | P6KE47A | 40.2 | 5 | 44.7 | 47.05 | 49.4 | 1 | 64.8 | 9.3 | 0.101 |
| P6KE51AG | P6KE51A | 43.6 | 5 | 48.5 | 51.05 | 53.6 | 1 | 70.1 | 8.6 | 0.102 |
| P6KE56AG | P6KE56A | 47.8 | 5 | 53.2 | 56 | 58.8 | 1 | 77 | 7.8 | 0.103 |
| P6KE62ARLG | P6KE62A | 53 | 5 | 58.9 | 62 | 65.1 | 1 | 85 | 7.1 | 0.104 |
| P6KE68AG | P6KE68A | 58.1 | 5 | 64.6 | 68 | 71.4 | 1 | 92 | 6.5 | 0.104 |
| P6KE75ARLG | P6KE75A | 64.1 | 5 | 71.3 | 75.05 | 78.8 | 1 | 103 | 5.8 | 0.105 |
| P6KE82ARLG | P6KE82A | 70.1 | 5 | 77.9 | 82 | 86.1 | 1 | 113 | 5.3 | 0.105 |
| P6KE91ARLG | P6KE91A | 77.8 | 5 | 86.5 | 91 | 95.5 | 1 | 125 | 4.8 | 0.106 |
| P6KE100ARLG | P6KE100A | 85.5 | 5 | 95 | 100 | 105 | 1 | 137 | 4.4 | 0.106 |
| P6KE120ARLG | P6KE120A | 102 | 5 | 114 | 120 | 126 | 1 | 165 | 3.6 | 0.107 |
| P6KE130AG | P6KE130A | 111 | 5 | 124 | 130.5 | 137 | 1 | 179 | 3.3 | 0.107 |
| P6KE150AG | P6KE150A | 128 | 5 | 143 | 150.5 | 158 | 1 | 207 | 2.9 | 0.108 |
| P6KE160ARLG | P6KE160A | 136 | 5 | 152 | 160 | 168 | 1 | 219 | 2.7 | 0.108 |
| P6KE180ARLG | P6KE180A | 154 | 5 | 171 | 180 | 189 | 1 | 246 | 2.4 | 0.108 |
| P6KE200A, G | P6KE200A | 171 | 5 | 190 | 200 | 210 | 1 | 274 | 2.2 | 0.108 |

3. A transient suppressor is normally selected according to the maximum working peak reverse voltage (V_{RWM}), which should be equal to or greater than the dc or continuous peak operating voltage level.

4. V_{BR} measured at pulse test current I_T at an ambient temperature of 25°C

5. Surge current waveform per Figure 4 and derate per Figures 1 and 2.

6. 1/2 sine wave (or equivalent square wave), PW = 8.3 ms, duty cycle = 4 pulses per minute maximum.

*The "G" suffix indicates Pb-Free package or Pb-Free Packages are available.

P6KE6.8A Series

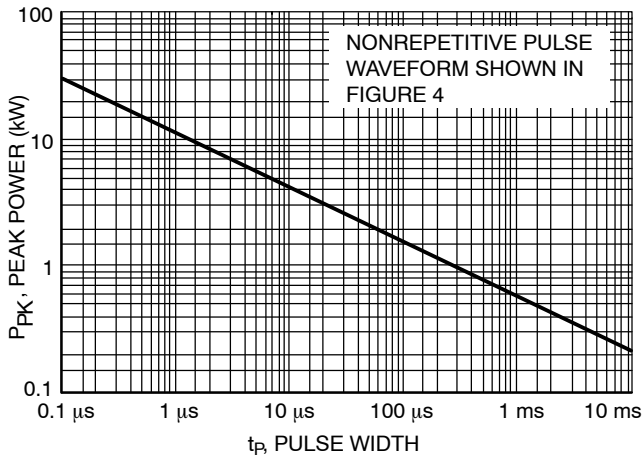


Figure 1. Pulse Rating Curve

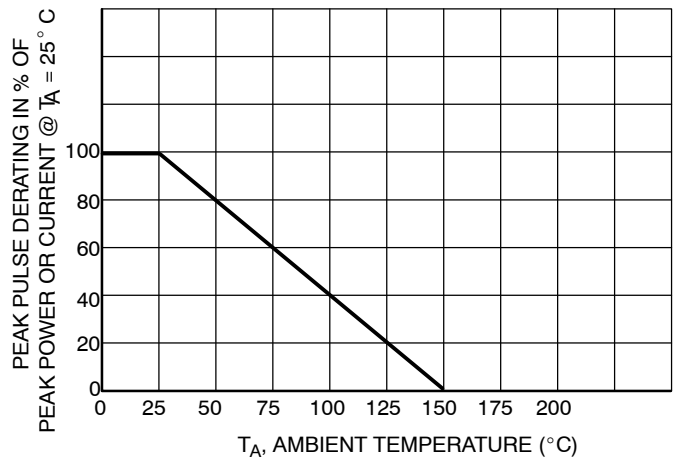


Figure 2. Pulse Derating Curve

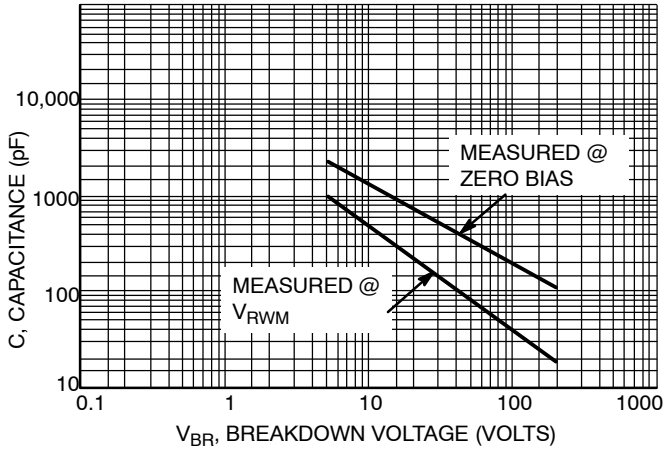


Figure 3. Capacitance versus Breakdown Voltage

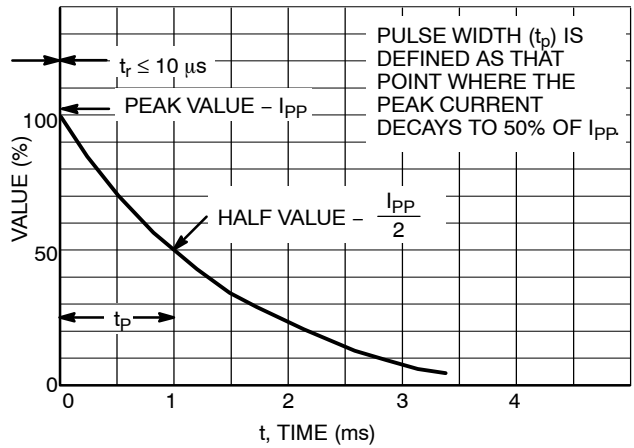


Figure 4. Pulse Waveform

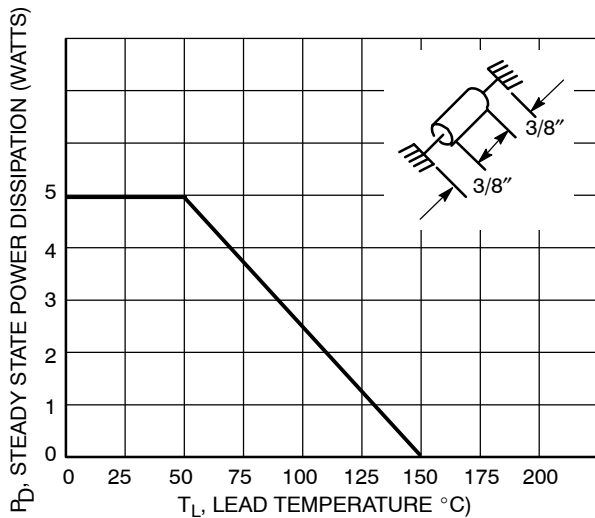


Figure 5. Steady State Power Derating

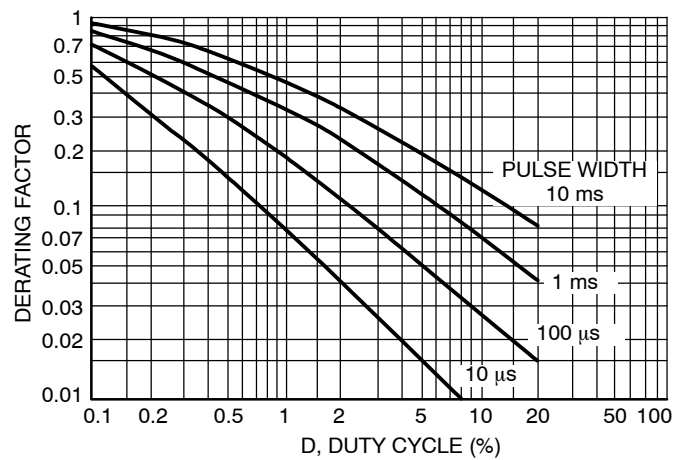


Figure 6. Typical Derating Factor for Duty Cycle

P6KE6.8A Series

APPLICATION NOTES

RESPONSE TIME

In most applications, the transient suppressor device is placed in parallel with the equipment or component to be protected. In this situation, there is a time delay associated with the capacitance of the device and an overshoot condition associated with the inductance of the device and the inductance of the connection method. The capacitance effect is of minor importance in the parallel protection scheme because it only produces a time delay in the transition from the operating voltage to the clamp voltage as shown in Figure 7.

The inductive effects in the device are due to actual turn-on time (time required for the device to go from zero current to full current) and lead inductance. This inductive effect produces an overshoot in the voltage across the equipment or component being protected as shown in Figure 8. Minimizing this overshoot is very important in the application, since the main purpose for adding a transient suppressor is to clamp voltage spikes. The P6KE6.8A series has very good response time, typically < 1 ns and negligible inductance. However, external inductive effects could produce unacceptable overshoot. Proper circuit layout, minimum lead lengths and placing the

suppressor device as close as possible to the equipment or components to be protected will minimize this overshoot.

Some input impedance represented by Z_{in} is essential to prevent overstress of the protection device. This impedance should be as high as possible, without restricting the circuit operation.

DUTY CYCLE DERATING

The data of Figure 1 applies for non-repetitive conditions and at a lead temperature of 25°C. If the duty cycle increases, the peak power must be reduced as indicated by the curves of Figure 6. Average power must be derated as the lead or ambient temperature rises above 25°C. The average power derating curve normally given on data sheets may be normalized and used for this purpose.

At first glance the derating curves of Figure 6 appear to be in error as the 10 ms pulse has a higher derating factor than the 10 μ s pulse. However, when the derating factor for a given pulse of Figure 6 is multiplied by the peak power value of Figure 1 for the same pulse, the results follow the expected trend.

TYPICAL PROTECTION CIRCUIT

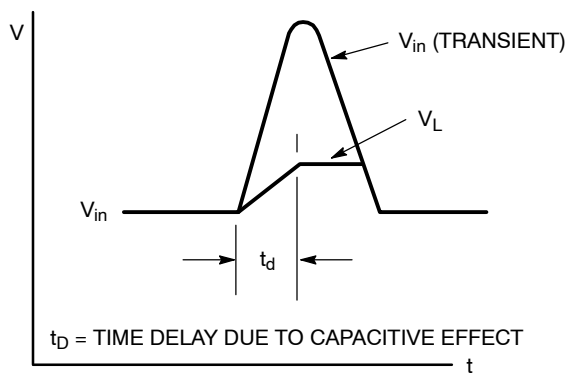
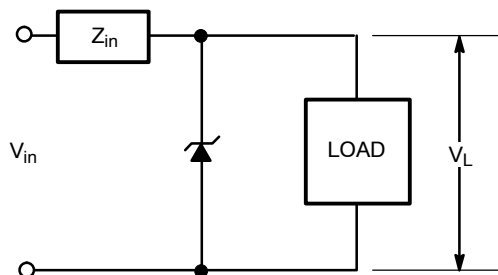


Figure 7.

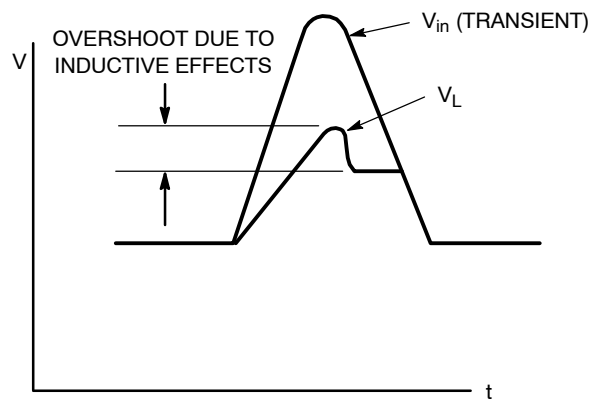


Figure 8.

UL RECOGNITION*

The entire series including the bidirectional CA suffix has *Underwriters Laboratory Recognition* for the classification of protectors (QVGQ2) under the UL standard for safety 497B and File #E210057. Many competitors only have one or two devices recognized or have recognition in a non-protective category. Some competitors have no recognition at all. With the UL497B recognition, our parts successfully passed several

tests including Strike Voltage Breakdown test, Endurance Conditioning, Temperature test, Dielectric Voltage-Withstand test, Discharge test and several more.

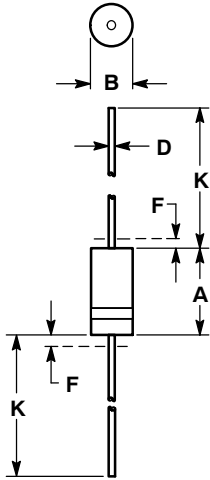
Whereas, some competitors have only passed a flammability test for the package material, we have been recognized for much more to be included in their protector category.

*Applies to P6KE6.8A – P6KE200A.

P6KE6.8A Series

PACKAGE DIMENSIONS

SURMETIC 40, AXIAL LEAD CASE 017AA-01 ISSUE O




NOTES:

1. CONTROLLING DIMENSION: INCH
2. LEAD DIAMETER AND FINISH NOT CONTROLLED WITHIN DIMENSION F.
3. CATHODE BAND INDICATES POLARITY

| DIM | INCHES | | MILLIMETERS | |
|-----|--------|-------|-------------|-------|
| | MIN | MAX | MIN | MAX |
| A | 0.330 | 0.350 | 8.38 | 8.89 |
| B | 0.130 | 0.145 | 3.30 | 3.68 |
| D | 0.037 | 0.043 | 0.94 | 1.09 |
| F | --- | 0.050 | --- | 1.27 |
| K | 1.000 | 1.250 | 25.40 | 31.75 |

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