HVArc Guard® Surface-Mount Capacitors for Low-Power Voltage Multiplier Applications

Voltage multipliers can generate very high voltages due to an inverter circuit that feeds a step-up transformer, which is connected to the multiplier circuit. An example of a typical voltage multiplier, which is simply a circuit comprised of capacitors and diodes that charge and discharge in alternating half cycles of the applied AC voltage, is shown in the diagram below.

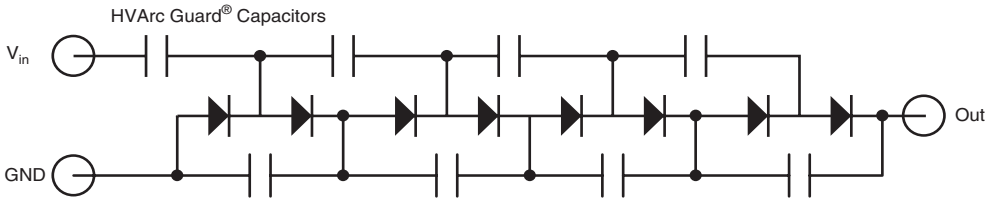

Figure 1. Series Multiplier for HV Applications

Cascading voltage doubler cells, as shown in the circuit, result in a high-voltage output. Applications for voltage multipliers include flyback converters, where a high voltage is produced from a low battery or supply voltage in medical X-ray systems, air ionizers, and oscilloscopes, and instrumentation requiring a high-voltage power supply.

Surface Arc-Over Problems in High-Voltage Applications

When a high voltage potential is applied at > 1000 V, an arc-over between the terminals, or from terminal to case, will occur. To eliminate any arc-over, an overcoating can be applied to the board, or additional board layout spacing can be added to isolate the high-voltage section from other sections of the board. Although coatings add cost to the process and the design, they are required in some applications to meet electrical safety standards.

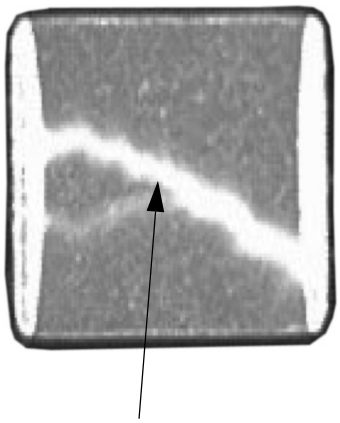

Figure 1. Standard High Voltage MLCC with voltage applied causing surface arc-over between terminations

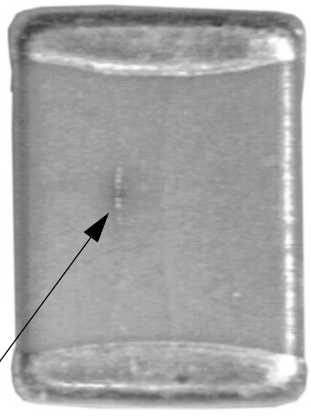

Figure 2. Standard High Voltage MLCC surface typical arc-over failure site

APPLICATION NOTE

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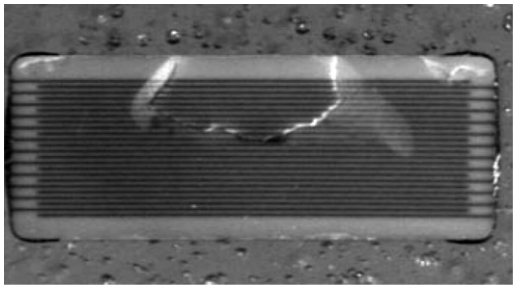


Figure 3. Example of typical surface arc-over failure site in an 1812-case-size X7R, 100 nF, 500 V_{DC} rated MLCC and a post-test cross section showing surface cracking

To avoid having to overcoat the components, coated disk capacitors or conformal coated leaded through-hole capacitors are commonly used in voltage multiplier sections, but they take up a large amount of board space.

HVArc Guard surface-mount capacitors offer designers a space-saving alternative. Because of their special worldwide-patent-pending internal construction technology, Vishay's HVArc Guard surface-mount capacitors eliminate the need to conformal coat the part or over-coat the circuit board to prevent surface arc-over. In addition, HVArc Guard surface-mount capacitors offer cost savings by eliminating the costly manual insertion processes associated with through-hole devices.

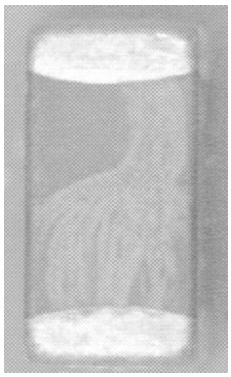


Figure 4. Carbon traces from surface arc-over on a typical Standard High Voltage MLCC

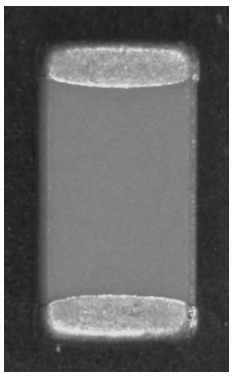


Figure 5. Vishay HVArc Guard without surface arc-over

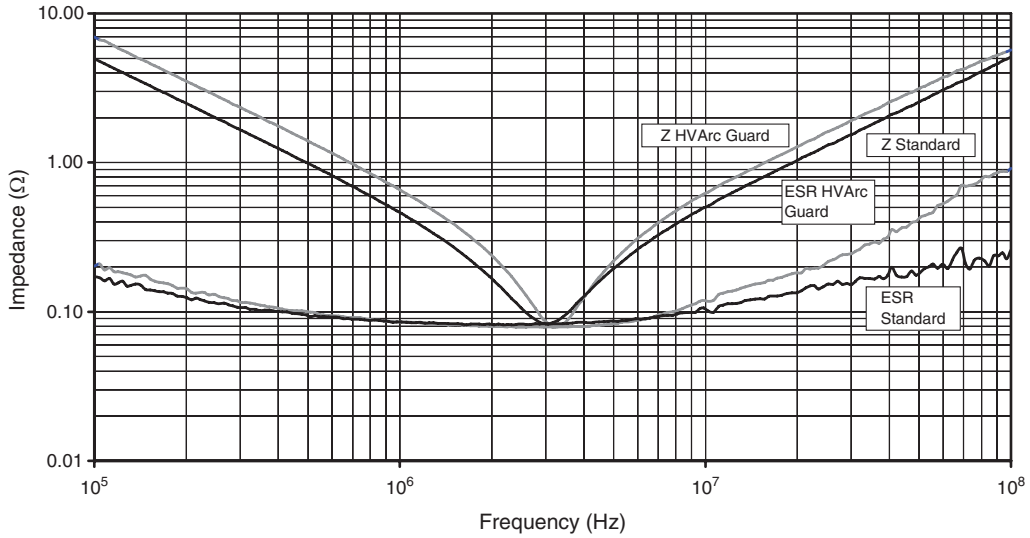
APPLICATION NOTE

Impedance of HVArc Guard Surface-Mount Capacitors for Voltage Multiplier Applications

The basic voltage multiplier is termed capacitive since the circuit can hold and store a charge. By series-connecting HVArc Guard surface-mount capacitors, low-power voltage multipliers can be designed so that the output voltage increases as the number of cascaded stages increases.

When selecting an HVArc Guard surface-mount component, careful attention must be paid to the voltage breakdown characteristics.

HVArc Guard® Surface-Mount Capacitors for Low-Power Voltage Multiplier Applications



The graph above compares the impedance vs. frequency, ESR, and impedance of a standard commercial 500 V, X7R capacitor in the 1206 case and an HVArc Guard surface-mount capacitor with the same ratings. As demonstrated in the graph, the impedance of the HVArc Guard is similar to standard high-voltage surface-mount capacitors.

Specific details regarding the impedance of specific HVArc Guard surface-mount capacitors are available upon request through your local Vishay sales office.

HVArc Guard Surface-Mount Capacitors Ordering Information

HVArc Guard surface-mount capacitors are available in both NP0 and X7R dielectrics, and in a variety of popular surface-mount EIA- standard case sizes.

HVArc Guard NP0 Dielectric Ordering Code

ORDERING INFORMATION

VJ0805	A	102	J	X	G	A	T	5Z
CASE CODE	DIELECTRIC	CAPACITANCE NOMINAL CODE	CAPACITANCE TOLERANCE	TERMINATION	DC VOLTAGE RATING [1]	MARKING	PACKAGING	PROCESS CODE
0805 1206 1210	A = C0G	Expressed in picofarads (pF). The first two digits are significant, the third is a multiplier. **Examples:** 102 = 1000 pF	J = ± 5 % K = ± 10 % M = ± 20 %	X = Ni barrier 100 % tin plated matte finish F = AgPd	G = 1000 V R = 1500 V	A = Unmarked	C = 7" reel/ paper tape T = 7" reel/ plastic tape P = 11 1/4" reel/ paper tape B = Bulk R = 11 1/4" reel/ plastic tape W = Waffle tray	5Z = HVArc Guard

Note:

1. DC voltage rating should not be exceeded in application

HVArc Guard® Surface-Mount Capacitors for Low-Power Voltage Multiplier Applications

HVArc Guard X7R Dielectric Ordering Code

ORDERING INFORMATION

VJ1812	Y	102	J	X	P	A	T	5Z
CASE CODE	DIELECTRIC	CAPACITANCE NOMINAL CODE	CAPACITANCE TOLERANCE	TERMINATION	DC VOLTAGE RATING 1)	MARKING	PACKAGING	PROCESS CODE
1206 1210 1808 1812	Y = X7R	Expressed in picofarads (pF). The first two digits are significant, the third is a multiplier. **Examples:** 223 = 22 000 pF	J = ± 5 % K = ± 10 % M = ± 20 %	X = Ni barrier 100 % tin plated F = AgPd	P = 250 V E = 500 V L = 630 V G = 1000 V	A = Unmarked	C = 7" reel/ paper tape T = 7" reel/ plastic tape P = 11 1/4" reel/ paper tape B = Bulk R = 11 1/4" reel/ plastic tape W = Waffle tray	5Z = HVArc Guard

Note:

1. DC voltage rating should not be exceeded in application

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