



# 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.

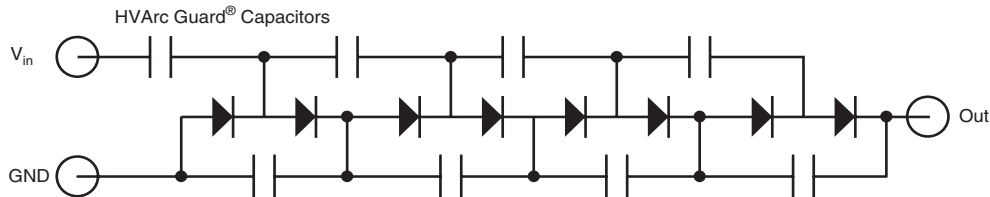


Figure 1. Series Multiplier for HV Applications

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.

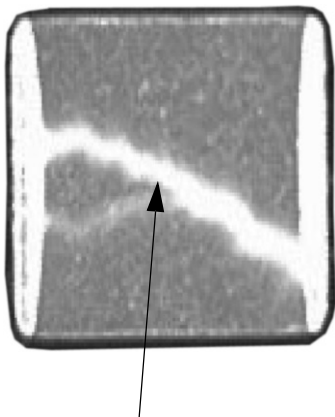


Figure 1. Standard High Voltage MLCC with voltage applied causing surface arc-over between terminations

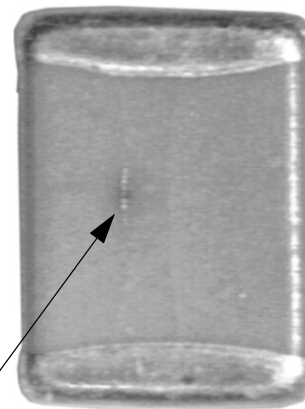


Figure 2. Standard High Voltage MLCC surface typical arc-over failure site

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

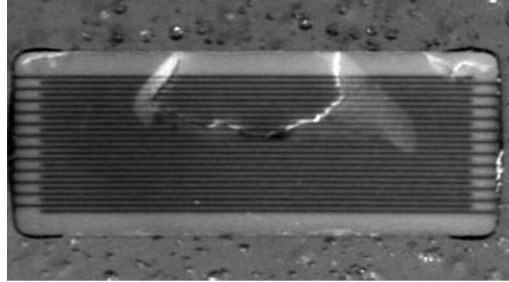


Figure 3. Example of typical surface arc-over failure site in an 1812-case-size X7R, 100 nF, 500 V<sub>DC</sub> rated MLCC and a post-test cross section showing surface cracking

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.

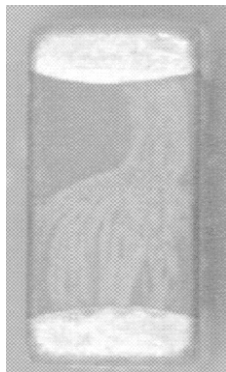


Figure 4. Carbon traces from surface arc-over on a typical Standard High Voltage MLCC

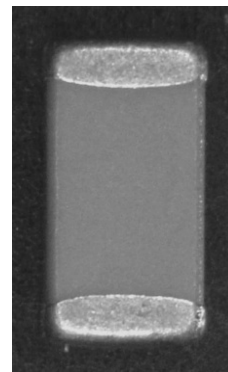


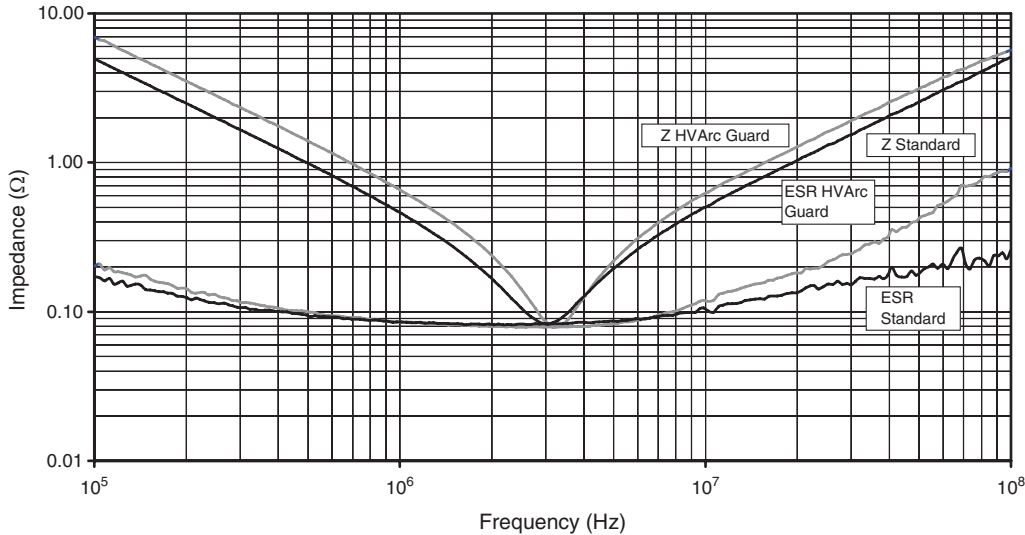
Figure 5. Vishay HVArc Guard without surface arc-over

### 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 <sup>1)</sup>	MARKING	PACKAGING	PROCESS CODE
0805 1206 1210	A = COG	Expressed in picofarads (pF). The first two digits are significant, the third is a multiplier. <b>Examples:</b> 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<sup>®</sup> 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 <sup>1)</sup>	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. <b>Examples:</b> 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

**NOTICE** Specifications of the products displayed herein are subject to change without notice. Vishay Intertechnology, Inc., or anyone on its behalf, assumes no responsibility or liability for any errors or inaccuracies. Information contained herein is intended to provide a product description only. No license, express or implied, by estoppel or otherwise, to any intellectual property rights is granted by this document. Except as provided in Vishay's terms and conditions of sale for such products, Vishay assumes no liability whatsoever, and disclaims any express or implied warranty, relating to sale and/or use of Vishay products including liability or warranties relating to fitness for a particular purpose, merchantability, or infringement of any patent, copyright, or other intellectual property right. The products shown herein are not designed for use in medical, life-saving, or life-sustaining applications. Customers using or selling these products for use in such applications do so at their own risk and agree to fully indemnify Vishay for any damages resulting from such improper use or sale.

APPLICATION NOTE  
WORLDWIDE SALES AND TECHNICAL SUPPORT

### THE AMERICAS

#### UNITED STATES

VISHAY INTERTECHNOLOGY, INC.  
63 LANCASTER AVE.  
MALVERN, PA 19355  
UNITED STATES  
PH: +1-610-407-4800  
FAX: +1-610-640-9081

#### ASIA

#### SINGAPORE

VISHAY INTERTECHNOLOGY  
ASIA PTE LTD.  
25 TAMPINES STREET 92  
KEPPEL BUILDING #02-00  
SINGAPORE 528877  
PH: +65-6788-6668  
FAX: +65-6788-0988

#### P.R.C.

VISHAY INTERTECHNOLOGY  
ASIA PTE LTD.  
(SHANGHAI REPRESENTATIVE OFFICE)  
ROOM D, 15F, SUN TONG INFOPORT PLAZA  
55 HUAI HAI WEST ROAD  
200030 SHANGHAI  
P.R.C.  
PH: +86-21-6283-1036  
FAX: +86-21-6283-1039

### JAPAN

VISHAY JAPAN CO., LTD.  
GE EDISON BUILDING, SHIBUYA 3F  
3-5-16 SHIBUYA  
SHIBUYA-KU  
TOKYO 150-0002  
JAPAN  
PH: +81-3-5464-6411  
FAX: +81-3-5464-6433

### EUROPE

#### GERMANY

VISHAY EUROPE SALES GMBH  
GEHEIMRAT-ROSENTHAL-STR. 100  
95100 SELB  
GERMANY  
PH: +49-9287-71-0  
FAX: +49-9287-70435

#### FRANCE

VISHAY S.A.  
199, BLVD DE LA MADELEINE  
06003 NICE, CEDEX 1  
FRANCE  
PH: +33-4-9337-2920  
FAX: +33-4-9337-2997

### NETHERLANDS

VISHAY BCCOMPONENTS B.V.  
HURKESTRAAT 31  
P.O. BOX 8766  
5652 AH EINDHOVEN  
NETHERLANDS  
PH: +31-40-2590-700  
FAX: +31-40-2590-777

One of the World's Largest  
**Manufacturers**  
of Discrete Semiconductors and Passive Components