Space-Saving HVArc Guard® Capacitors for Passive Snubber Applications

A wide range of passive devices can be used to make a passive snubber that absorbs energy from the reactance in a power switching circuit. Snubbers can be used to clamp ringing noise or reduce power dissipation during turn-off; another application is to reduce peak switching voltages. They are a critical circuit for improving the efficiency of most switching semiconductor circuits.

There are several different passive component options for snubber design. For example, film polypropylene capacitors are often used as a snubber to control the voltage rate of rise (dV/dt) in high pulse applications. High-voltage, standard MLCCs are likewise used as a snubber to clamp the voltage to a fixed level during device turn-on. They can also be used to clamp harmful transient voltages on semiconductor switching devices such as bipolar or MOS transistors.

The disadvantage with these solutions is their size. Film capacitors are leaded, through-hole devices that require significant board space. High-voltage, 390 pF, 1 kV MLCCs have until now been available only in the 1812 size.

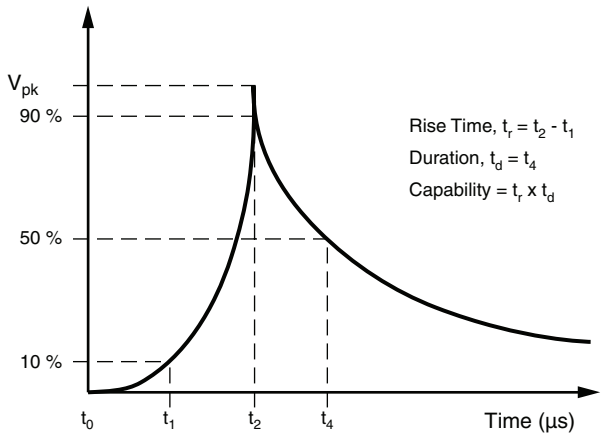
New HVArc Guard® high-voltage MLCCs remove these limitations. They combine high breakdown voltages, low impedance, and a wide operating frequency range in case sizes as small as 0805. Designers can thus save on board space while maintaining the same capacitance and voltage ratings for a wide range of medium- to high-voltage snubber applications.

Small Size Advantages

The small dimensions of HVArc Guard surface-mount MLCCs make them ideal for snubber circuits. Their high voltage breakdown performance is particularly useful in applications requiring snubber capacitors or capacitors in the high-voltage inverter section. In fact, the breakdown voltage of HVArc Guard MLCCs is more than twice that of the comparable standard commercial high-voltage capacitor.

Good Surge Capability

Vishay has conducted various surge tests on HVArc Guard capacitors. The basic surge waveform is shown below. Pulse rise times as fast as 1.2 µs were tested on HVArc Guard devices.



The results of surge testing on both the X7R and NP0 HVArc Guard capacitors are shown in the follwing table:

Waveform	C0G (N0P) HVArc Guard	X7R HVArc Guard
1.2 µs x 50 µs	1650 V	500 V
10 µs x 700 µs	1800 V	1200 V
10 µs x 160 µs	> 1500 V	1200 V

APPLICATION NOTE

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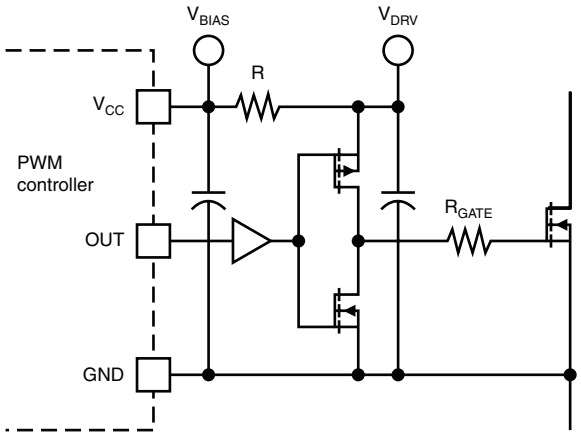
Designing Snubbers with HVArc Guard

A simple passive R-C snubber is used in power circuitry to dissipate energy and clamp voltages during turn-on and turn-off cycles. For example, in an application where high-voltage MOSFETs are used as the switching device, rapid changes occur as the drain-to-source voltage steps up during MOSFET operation. These changes create voltage transient noise on the gate of the MOSFET. A capacitor snubber is used on source-drain as a bypass cap for the harmful switching noise.

Used in these applications, HVArc Guard MLCCs will typically require significantly less space than standard high-voltage capacitors. Shown below is an example of a snubber used in a totem pole configured MOSFET circuit.



HVArc Guard Capacitors Ordering Information

HVArc-Guard MLCCs are available in both C0G (NPO) and X7R dielectrics and in a variety of popular surface mount EIA standard case sizes. Ordering is easy using the codes below.

HVArc Guard C0G (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

APPLICATION NOTE

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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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