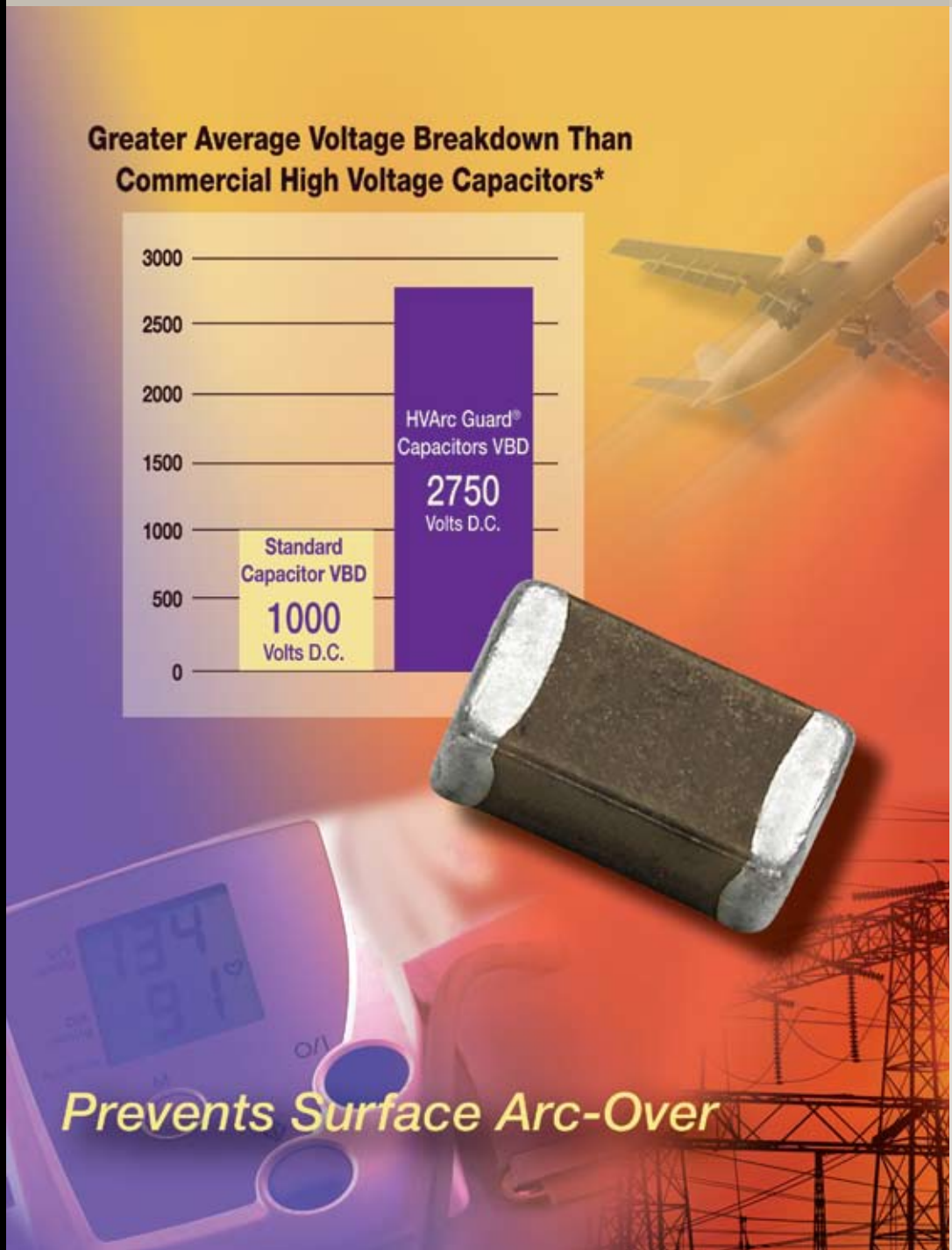
VISHAY INTERTECHNOLOGY, INC.

CAPACITORS

HVArc GUARD® SURFACE MOUNT MLCCs

Multilayer Ceramic Chip Capacitors

PRODUCT OVERVIEW



www.vishay.com

SEMICONDUCTORS

RECTIFIERS
- Schottky (single, dual)
- Standard, Fast, and Ultra-Fast Recovery (single, dual)
- Bridge
- Superectifier®
- Sinterglass Avalanche Diodes

HIGH-POWER DIODES AND THYRISTORS
- High-Power Fast-Recovery Diodes
- Phase-Control Thyristors
- Fast Thyristors

SMALL-SIGNAL DIODES
- Schottky and Switching (single, dual)
- Tuner/Capacitance (single, dual)
- Bandswitching
- PIN

ZENER AND SUPPRESSOR DIODES
- Zener (single, dual)
- TVS (TRANSZORB®, Automotive, ESD, Arrays)

FETs
- Low-Voltage TrenchFET® Power MOSFETs
- High-Voltage TrenchFET® Power MOSFETs
- High-Voltage Planar MOSFETs
- JFETs

OPTOELECTRONICS
- IR Emitters and Detectors, and IR Receiver Modules
- Optocouplers and Solid-State Relays
- Optical Sensors
- LEDs and 7-Segment Displays
- Infrared Data Transceiver Modules
- Custom Products

ICs
- Power ICs
- Analog Switches
- RF Transmitter and Receiver Modules
- ICs for Optoelectronics

MODULES
- Power Modules (contain power diodes, thyristors, MOSFETs, IGBTs)
- DC/DC Converters

PASSIVE COMPONENTS

RESISTIVE PRODUCTS
- Foil Resistors
- Film Resistors
  - Metal Film Resistors
  - Thin Film Resistors
  - Thick Film Resistors
  - Metal Oxide Film Resistors
  - Carbon Film Resistors
- Wirewound Resistors
- Power Metal Strip® Resistors
- Chip Fuses
- Variable Resistors
  - Cermet Variable Resistors
  - Wirewound Variable Resistors
  - Conductive Plastic Variable Resistors
- Networks/Arrays
- Non-Linear Resistors
  - NTC Thermistors
  - PTC Thermistors
  - Varistors

MAGNETICS
- Inductors
- Transformers

CAPACITORS
- Tantalum Capacitors
  - Molded Chip Tantalum Capacitors
  - Coated Chip Tantalum Capacitors
  - Solid Through-Hole Tantalum Capacitors
  - Wet Tantalum Capacitors
- Ceramic Capacitors
  - Multilayer Chip Capacitors
  - Disc Capacitors
- Film Capacitors
- Power Capacitors
- Heavy-Current Capacitors
- Aluminum Capacitors
- Silicon RF Capacitors

STRAIN GAGE TRANSDUCERS AND STRESS ANALYSIS SYSTEMS
- PhotoStress®
- Strain Gages
- Load Cells
- Force Transducers
- Instruments
- Weighing Systems
- Specialized Strain Gage Systems

HVArc Guard® Surface Mount MLCCs

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INTRODUCTION

Vishay was founded in 1962 to manufacture and market foil resistors, an invention of physicist Dr. Felix Zandman, Chairman of the Board and founder. The Company began operations with foil resistors and strain gages as its initial product offerings. In 1985, having grown from a start-up into the world's leading manufacturer of these original products, Vishay began an ongoing series of strategic acquisitions to broaden its product portfolio.

Broad-Line Manufacturer, Global Presence

Today, Vishay is a broad-line manufacturer with a global presence. It is one of the world's largest manufacturers of discrete semiconductors and passive electronic components. Vishay's acquisitions include the infrared component business of Infineon and such top names as Siliconix, Dale, Draloric, Sprague, Vitramon, and BCcomponents (the former passive components business of Philips Electronics and Beyschlag).

Innovations in Technology

Over the years, Vishay's R&D efforts have led to a steady stream of technological breakthroughs and innovative products. These include packageless power MOSFETs, the industry's first silicon-based RF capacitors, dc-to-dc converter modules with all the active and passive components required for a complete power conversion solution, high-current IHLP inductors, Power Metal Strip® resistors, and many more.

Leading Industry Rankings

Vishay's global footprint includes manufacturing facilities in China and other Asian countries, Israel, Europe, and the Americas, as well as sales offices around the world. Vishay has market shares ranging from substantial to number-one for each of its products.

Discrete Semiconductors

Number 1 worldwide in low-voltage power MOSFETs
Number 1 worldwide in rectifiers
Number 1 worldwide in glass diodes
Number 1 worldwide in infrared components
...and others

Passive Components

Number 1 worldwide in wirewound and other power resistors
Number 1 worldwide in foil, SMD thin film, and leaded film resistors
Number 1 worldwide in wet tantalum capacitors
Number 1 worldwide in strain gage sensors and load cells
...and others

"One-Stop Shop" Service

With Vishay's "one-stop shop" service, customers can send their bills of materials (BOMs) to Vishay and ask the Company to cross-reference Vishay products in all categories. This enables customers to order multiple components from one source—Vishay. In addition, Vishay's product sample service for design engineers provides free product samples worldwide. Quick turnaround time and a complete range of Vishay samples enable customers to rely on Vishay for discrete electronic component solutions. For more information about Vishay samples, please visit us on the Web at www.vishay.com or contact a local Vishay sales representative or office.

Multilayer Ceramic Chip Capacitors Prevent Surface Arc-Over and Reduce Component Space Requirements in High-Voltage Applications

Features

- Offer capacitance ranges of 10 pF to 0.27 µF
- Offered in 0805, 1206, 1210, 1808, 1812, 2220 and 2225 case sizes
- Available with NP0 (C0G) and X7R dielectrics
- High capacitances and small case sizes save board space (compared to standard high-voltage MLCCs)
- Excellent reliability and high-voltage performance: rated for 250 VDC to 2500 VDC
- Eliminate the need to encapsulate capacitors with a conformal coating
- Average voltage breakdown (VBD) is typically twice that of standard commercial-grade products
- Replace wire-leaded, through-hole capacitors

Applications

- High-voltage applications
- Medical equipment and instrumentation
- Electronic transmissions
- DC electric motors
- Construction and mining equipment
- Lighting
- Power supplies

Introducing HVArc Guard® MLCCs

High-voltage applications require capacitors with a high breakdown voltage capability and protection from high-voltage arc-over, which can damage the capacitor when a high voltage potential is applied.

Leaded through–hole capacitors have traditionally been the preferred choice for high-voltage applications such as buck and boost dc-to-dc converters, voltage multipliers for flyback converters, lighting ballast circuits, and power supplies for medical, computer, motor control, and telecommunications applications. Unfortunately, these capacitors require a large amount of board space and increase design and assembly costs.

To eliminate any surface arc-over, circuit boards can be conformally coated, or the components are arranged such as to isolate the high-voltage section from other sections of the board. But as with leaded through-hole capacitors, this approach utilizes a great amount of board space and increases design and assembly costs. Encapsulating compounds and conformal coating may make it more difficult to repair, recycle, or discard the circuit board.

To address this problem, Vishay has developed an innovative series of high-voltage HVArc Guard® MLCCs that are the industry's first C0G and X7R surface mount MLCCs designed to prevent surface arc-over.

The HVArc Guard® devices provide maximum capacitance in high-voltage ratings and an increased capacitor voltage breakdown through a unique and world wide patented internal design structure that prevents surface arc-

over at high voltages. This design facilitates the use of smaller case sizes in high-voltage products, allowing for device miniaturization and reducing component cost.

HVArc Guard® capacitors eliminate the need for conformal coating, and are particularly significant as an alternative to leaded through-hole capacitors since they provide double the voltage breakdown capability while requiring much less space. The devices offer voltage ratings from 250 VDC to 2500 VDC, and a capacitance range of 10 pF to 27,000 pF. In fact, the HVArc Guard® 27,000-pF MLCC has the highest capacitance value currently available in a surface mount 1206 case size with a X7R dielectric and 1,000-V rating. The next closest capacitance value is 10,000 pF.

Vishay has conducted various surge tests on HVArc Guard® capacitors. The basic surge waveform is shown in Figure 1. Pulse rise times as fast as 1.2 µs were tested on HVArc Guard® devices.

Figure 1

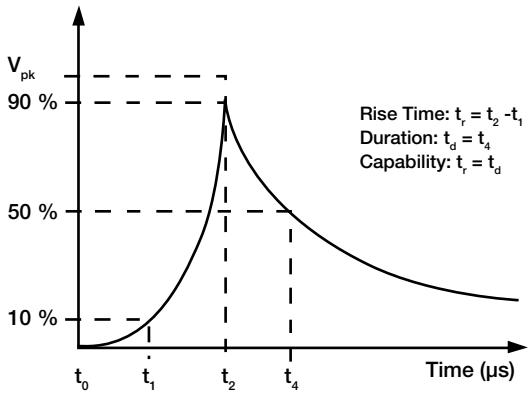


Figure 2

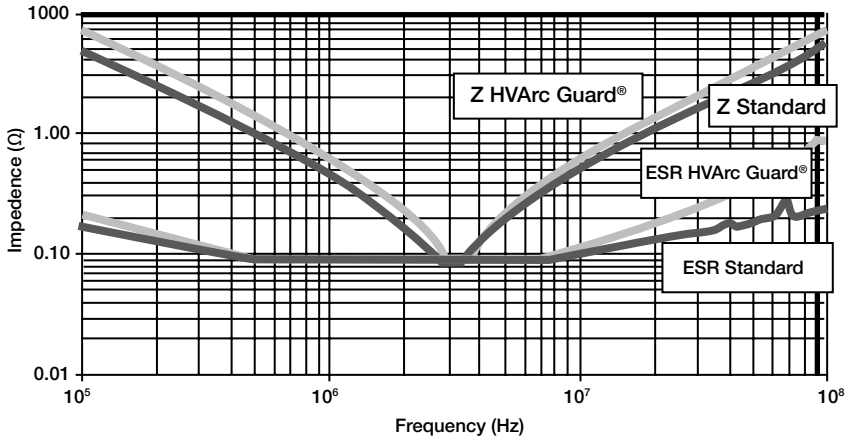


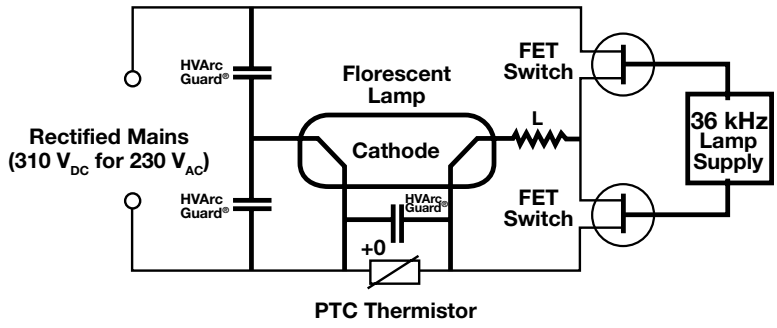
Figure 2 compares the impedance vs. frequency, ESR, and impedance of a standard commercial 500 V, X7R capacitor in the 1206 case and an HVArc Guard® surface-mount capacitor with the same ratings. As demonstrated in the graph, the impedance of the HVArc Guard® is similar to standard high-voltage surface-mount capacitors. Specific details regarding the impedance of specific HVArc Guard® surface-mount capacitors are available upon request through your local Vishay sales office.

Application Examples

Lighting Ballast Circuits

MLCCs used in lighting ballast circuits can be exposed to high voltages, over 1000 VDC in air. A block diagram of typical lighting ballast is shown in Figure 3. The capacitors are prone to both surface arc-over and internal breakdown. In either event, failure may result when surface arc-over causes the circuit to be de-stabilized, which may in turn cause damage to surrounding components even if the capacitor remains temporarily functional. The unique HVArc Guard® capacitor design prevents arc-over while allowing the use of smaller case sizes in lighting ballast applications.

Figure 3



Until now, surface mount MLCCs in the larger 1210, 1808 and 1812 cases have been used in high-voltage lighting ballast applications. New HVArc Guard® high-voltage MLCCs can replace many of these standard high voltage capacitors in ballast circuits, allowing more compact designs while reducing component cost.

Figure 4

Improved Voltage Breakdown Capability with HVArc Guard® Capacitors

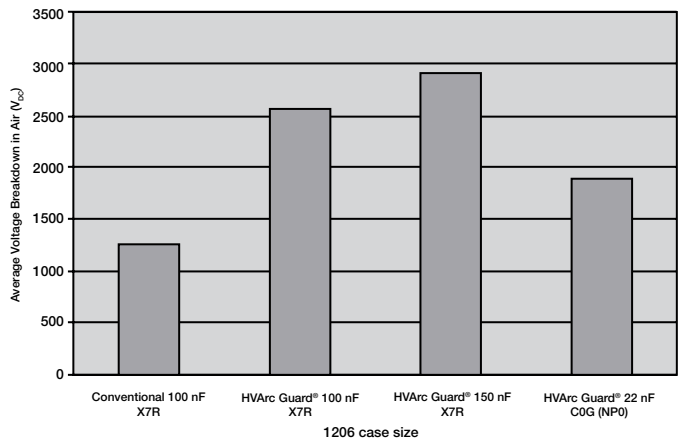


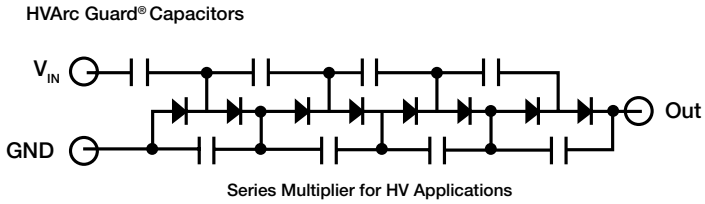
Figure 4 compares standard surface mount high-voltage MLCCs and the HVArc Guard® replacements for lighting ballast applications. For example, a common 630 V MLCC in a 1206 case (0.126 in. by 0.063 in.) can be replaced with a HVArc Guard® MLCC in the 0805 case (0.079 in. by 0.049 in.). Using HVArc Guard® can provide board space savings of 50 % or more.

The small size dimensions and high-voltage breakdown performance of HVArc Guard® surface-mount MLCCs make these devices ideal for compact electronic fluorescent lighting ballasts, where they will be used in the high-voltage inverter section. Their breakdown voltage is in fact more than twice that of the comparable standard high-voltage capacitor.

Low-Power Voltage Multipliers

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 Figure 5.

Figure 5



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.

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.

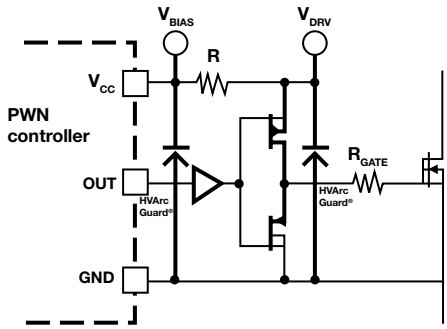
To avoid having to overcoat the components, coated disk capacitors or conformal coated leaded through-hole capacitors are commonly used in voltage multiplier sections, but they take up a large amount of board space. HVArc Guard® surface-mount capacitors offer designers a space-saving alternative. Because 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.

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.

Passive Snubbers

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. Figure 6 shows an example of a snubber used in a totem pole configured MOSFET circuit.

Figure 6



HVArc Guard® NP0 (C0G)

ORDERING INFORMATION

VJ0805	A	102	J	X	G	A	T	5Z (2)
CASE CODE	DIELECTRIC	CAPACITANCE NOMINAL CODE	CAPACITANCE TOLERANCE	TERMINATION	DC VOLTAGE RATING (1)	MARKING	PACKAGING	PROCESS CODE
0805 1206 1210 2220 2225	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 B = Polymer 100 % tin plated matte finish (3)	G = 1000 V R = 1500 V O = 2500 V	A = Unmarked	C = 7" reel/ paper tape T = 7" reel/ plastic tape P = 11 1/4" reel/ paper tape R = 11 1/4" reel/ plastic tape	5Z = HVArc Guard®

Notes:

(1) DC voltage rating should not be exceeded in application
(2) Process code with 2 digits has to be added
(3) Please contact factory for Polymer termination availability
- Polymer plus terminations, "B" termination part number code length dimensions positive tolerances (including bandwidth) above are allowed to increase by the following amounts: 1206 and smaller case sizes: Length 0.002" (0.05 mm)
  1210 and larger case sizes: Length 0.004" (0.1 mm)

HVArc Guard® X7R

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 (2)
0805 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 B = Polymer 100 % tin plated matte finish	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 R = 11 1/4" reel/ plastic tape	5Z = HVArc Guard®

Notes:

(1) DC voltage rating should not be exceeded in application
(2) Process code with 2 digits has to be added
- Polymer plus terminations, "B" termination part number code length dimensions positive tolerances (including band width) above are allowed to increase by the following amounts:
  1206 and smaller case sizes: Length 0.002" (0.05 mm)
  1210 and larger case sizes: Length 0.004" (0.1 mm)

In applications where circuit boards maybe handled in a negligent manner subjecting it to bending.

HVArc Guard® X7R dielectric product is available with polymer terminations for increase resistance to circuit board flex cracking of the ceramic body. This cracking of the ceramic body can cause the surface mount MLCC to fail and catastrophic damaging down stream components.

Contact the factory for availability of HVArc Guard® NP0 (C0G) product line with polymer terminations.

NOTES

NOTES

SEMICONDUCTORS:
Rectifiers • High-Power Diodes and Thyristors • Small-Signal Diodes • Zener and Suppressor Diodes • FETs • Optoelectronics • ICs • Modules

PASSIVE COMPONENTS:
Resistive Products • Magnetics • Capacitors • Strain Gage Transducers and Stress Analysis Systems

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

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