HVArc Guard® Multilayer Ceramic Capacitors: High-Voltage Capacitor Solutions

HVArc Guard® MLCCs have been developed with a worldwide patent-pending design by Vishay to prevent surface arc-over. This development has allowed Vishay to significantly extend the range and capability of high-voltage class 2 X7R and class 1 NP0 MLCCs. To help designers select the best HVArc Guard MLCC for their application, their typical properties are compared in this document.

X7R Comparison With C0G (NP0)

The advantages of HVArc Guard MLCCs made with these two different dielectric systems are compared in the following table: The voltage capability tests are shown in the following tables for X7R and NP0:

PROPERTY	COMPARATIVE ADVANTAGE
Initial Capacitance	X7R: Much higher than C0G (NP0)
Voltage Coefficient of Capacitance (TCC)	C0G (NP0): Has no change X7R: Capacitance can drop by > 70 % for 1000 VDC rated products
Temperature Coefficient of Capacitance (TCC)	C0G (NP0): ± 30 ppm/°C from - 55 °C to + 125 °C X7R: ± 15 % from - 55 °C to + 125 °C, with 0 VDC applied
Dissipation Factor (Power Loss)	C0G (NP0): 10 x lower than X7R
AC Voltage	C0G (NP0): Less prone to self heating than X7R
Surge Resistance (High DV/DT)	C0G (NP0): Can withstand higher surge
Equivalent Series Resistance (ESR)	C0G (NP0): Lower ESR than X7R
Aging Rate	C0G (NP0): Does not age X7R: 1 % maximum per decade

Voltage Rating

The voltage rating is assigned based on the ability of the design to sustain this DC voltage or higher for 1000 hours at + 125 ºC. This rating does not describe the level of DC voltage that can be applied at different rise times, the effect of reversing polarity, or the AC voltage capability. For these reasons, Vishay developed a series of tests to determine the capabilities that are described below.

Voltage Capability Testing

- Voltage Breakdown (DC)
  The average voltage breakdown when applying 500VDC/s.
- Voltage Breakdown (AC)
  The average voltage breakdown when applying 500 $V_{rms/s}$ at 60 Hz.
- HiPot Voltage (DC)
  The maximum voltage the MLCC can sustain for a one- to five-second period when the charge/discharge current does not exceed 50 mA. The typical rise time to this voltage is 50 ms.
- HiPot Reverse Polarity (DC)
  The voltage the MLCC can withstand when successive HiPots are applied and the polarity is reversed with further HiPots being applied. This is an important parameter for applications where voltage spikes may occur in both directions.
- Alternating Current Voltage (AC)
  The maximum 60-Hz voltage level the MLCCs can withstand with successive power cycling.
- Surge Capability (DC)

TECH NOTE

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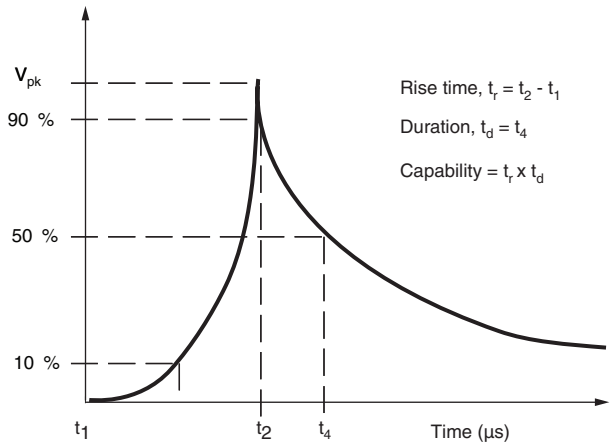

Figure 1. The surge voltage the MLCC can withstand when applied per the wave shape shown above: two different waveforms were tested: 1.2 µs x 50 µs, and 10 µs x 160 µs.

The voltage capability tests are shown in the following tables for X7R and NP0:

TYPICAL X7R VOLTAGE PERFORMANCE

PART NUMBER	CAP. (µF)	VOLTAGE RATING (VDC)	VOLTAGE BREAKDOWN (DC)	VOLTAGE BREAKDOWN (AC, V_{rms})	HiPOT VOLTAGE (DC)	HiPOT VOLTAGE REVERSE POLARITY (DC)	ALTERNATING CURRENT VOLTAGE (AC, V_{rms})	SURGE CAPABILITY (V_{pk} DC)	
								1.2 µs x 50 µs	10 µs x 160 µs
VJ1812Y274KXPAT5Z	0.27	250	2012	550	1100	800	400	350	700
VJ1206Y473KXEAT5Z	0.047	500	2811	500	1200	800	230	400	650
VJ1812Y104KXLAT5Z	0.10	630	2385	700	2100	1400	350	350	1000
VJ0805Y822KXGAT5Z	0.0082	1000	2949	700	1700	1000	345	550	950
VJ1206Y563KXGAT5Z	0.056	1000	2517	650	1400	1000	300	400	800
VJ1210Y563KXGAT5Z	0.056	1000	2822	650	2000	1200	350	400	1000
VJ1812Y154KXGAT5Z	0.15	1000	2396	700	1300	1200	380	400	1000

TYPICAL C0G (NP0) VOLTAGE PERFORMANCE

PART NUMBER	CAP. (pF)	VOLTAGE RATING (VDC)	VOLTAGE BREAKDOWN (DC)	VOLTAGE BREAKDOWN (AC, V_{rms})	HiPOT VOLTAGE (DC)	HiPOT VOLTAGE REVERSE POLARITY (DC)	ALTERNATING CURRENT VOLTAGE (AC, V_{rms})	SURGE CAPABILITY (V_{pk} DC)	
								1.2 µs x 50 µs	10 µs x 160 µs
VJ0805A391MXGAT5Z	390	1000	2712	1150	2000	1800	500	1600	1500
VJ1210A272KXGAT5Z	2700	1000	2812	1600	2300	2300	1000	1750	2200
VJ1812A272KXGAT5Z	2700	1000	3367	1300	2200	1700	800	1600	1700
VJ1812A822KXGAT5Z	8200	1000	2812	1500	2300	2300	1000	1400	2100
VJ1206A102KXRAT5Z	1000	1500	2860	1300	2000	1900	800	1700	1700
VJ1206A152KXRAT5Z	1500	1500	2590	1350	2000	1800	750	1600	1600
VJ1808A322KXRAT5Z	3300	1500	3394	1300	2300	2000	800	1500	1800