

# MLCCs – Multilayer Ceramic Chip Capacitors

## Characteristics of Class 1 and Class 2 Ceramic Capacitors

**Class 1 Ceramic Capacitors (i.e. NPO = COG)** are characterized by a small permittivity  $\epsilon_r$ , thus they have smaller capacities. Their dependencies of temperature and voltage are linear and their aging is minimal.

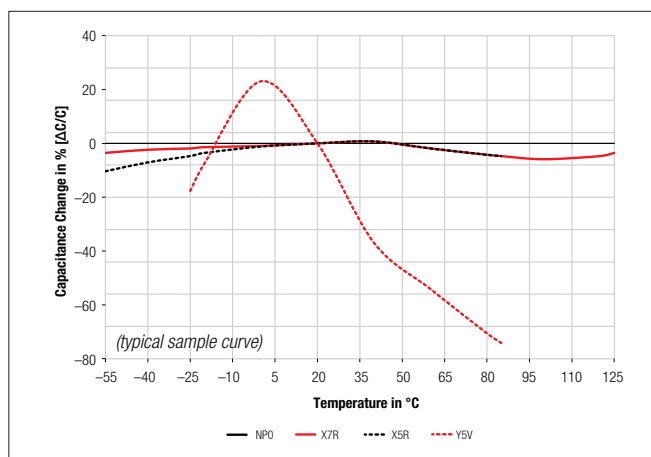
**Class 2 Ceramic Capacitors (i.e. X7R, X5R, Y5V)** own a higher permittivity  $\epsilon_r$ . That is why they provide higher capacities. Their dependencies of temperature and voltage are non-linear and they show aging behavior.

## Functions and applications Class 1 and Class 2 Ceramic Capacitors

**Class 1** Ceramic Capacitors provide **high stability and low losses** for example in resonant circuit, filter, temperature compensation and coupling applications.

**Class 2** Ceramic Capacitors provide **high volumetric capacity** for example in smoothing, coupling, decoupling and by-pass applications.

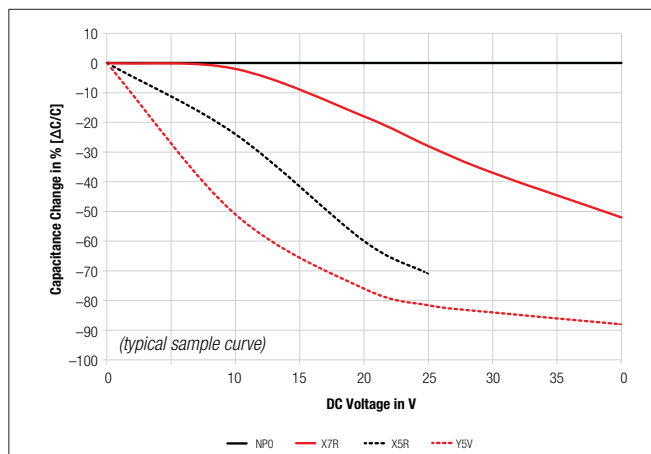
### Typical Capacitance Change vs. Temperature



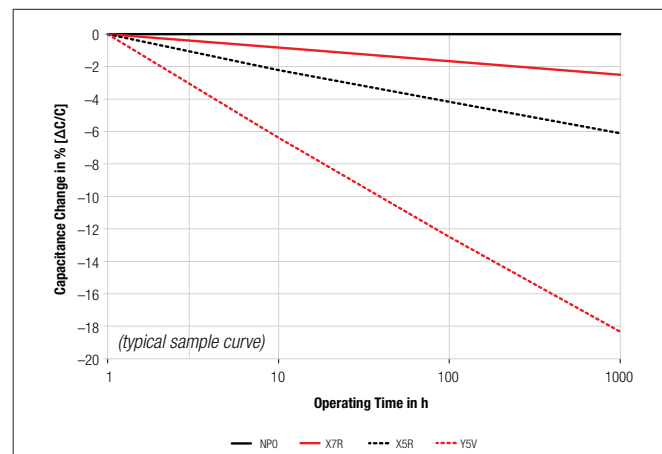
Temperature Characteristics	
Ceramic	Operating Temperature
NPO	-55 °C to + 125 °C
X7R	-55 °C to + 125 °C
X5R	-55 °C to + 85 °C
Y5V	-30 °C to + 85 °C

Capacitors

### Typical Capacitance Change vs. DC Voltage\*



### Typical Capacitance Change vs. Time



\*Typical characteristics for ceramic capacitors with a rated DC voltage of 25 V (X5R) and 50 V (NPO, X7R, Y5V)