



## American Electronic Ceramics, Inc.

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# High Frequency Chip Capacitors (Multi-Layer & Single Layer)

## Company Features

American Electronic Ceramics, Inc. is staffed with engineers and scientists with over 35 years of experiences in capacitor manufacturing and materials. Located in Southern California, the company is equipped with the most advanced manufacturing equipment and quality control instruments. Our technology is devoted to making the most advanced MLCC, SLC and other ceramic components for radio frequency circuits, wireless and microwave communication applications. Our product line covers components made of NPO (COG), X7R, Z5U and Y5V dielectrics, useful at a variety of voltages. The features of our products are:

- Specializing in high frequency, high Q, high reliability ceramics
- Stringent quality control process meet ISO-9001 requirements
- Statistical Process Control (SPC) employed
- 0402 and 0201
- Electrical, Environmental and Mechanical tested
- Industrial tolerance standards followed
- Tape and reel packaging per EIA481-1
- 7" (178mm), 13" (330mm) reel packaging



## MLCC Applications/Devices

1. NPO (COG): Coupling, LC networks, High frequency EMI. Band pass, lowpass filter, cellular phone, High frequency amplifier, Thin film, Thick film, Hybrid circuits and module, LTCC,. Blue tooth circuit board
2. X7R: Decoupling, Low frequency EMI. Band pass filter, low pass filter, Cellular phone,. high frequency amplifier

## SLC Applications/Devices

1. NPO: Coupling, Microwave LC networks, Microwave filter, High frequency EMI, Band pass, Microwave, Low pass filter, amplifier, IC package, Thin film, Thick film, Hybrid RF circuits and module, LTCC, Blue tooth circuit board.
2. X7R: Decoupling low frequency EMI, Microwave filter, band pass, low pass filter, Microwave amplifier, IC package, Thin film, Thick film, Hybrid RF circuits and module, LTCC, Blue tooth circuit board.

# Ceramic Capacitors

## Company Products

### MLCC (Multi-Layer Ceramic Capacitors)

#### NPO (COG) Capacitors

Cap. (pf)	Working Voltage	D.F. ( $\times 10^{-4}$ )	I.R. ( $G\Omega$ )	TCC (-55-125°C)	Apply Fre. (Hz)
5.6	10,16,25,50	<5.0	1000	0±30ppm/C°	100K-2.4G
7.5	10,16,25,50	<5.0	1000	0±30ppm/C°	100K-2.4G
10	10,16,25,50	<5.0	1000	0±30ppm/C°	100K-2.4G
12	10,16,25,50	<5.0	1000	0±30ppm/C°	100K-2.4G
15	10,16,25,50	<5.0	1000	0±30ppm/C°	100K-2.4G

#### X7R Capacitors

Cap. (pf)	Working voltage	D.F. ( $\times 10^{-4}$ )	I.R. ( $G\Omega$ )	TCC (-55-125°C)	Apply Fre. (Hz)
100	10,16,25,50	<250	100	±15%	1K-100K
560	10,16,25,50	<250	100	±15%	1K-100K
820	10,16,25,50	<250	100	±15%	1K-100K
1000	10,16,25,50	<250	100	±15%	1K-100K
10000	10,16,25	<250	100	±15%	1K-100K

### SLC (Single Layer Capacitors)

#### NPO, size 0.010"~0.090"

Cap. (pf)	Working voltage	D.F. ( $\times 10^{-4}$ )	I.R. ( $G\Omega$ )	TCC (-55-125°C)	Apply Fre. (Hz)
0.1-9.1	50,100	<5.0	1000	0±30ppm/C°	100K-2.4G

#### X7R, size: 0.010"~0.090"

Cap. (pf)	Working voltage	D.F. ( $\times 10^{-4}$ )	I.R. ( $G\Omega$ )	TCC (-55-125°C)	Apply Fre. (Hz)
3.9~100	50,100	<250	100	±15%	1K-100K

## Product Range

### COG(NPO) High Frequency, High Q Multilayer Ceramic Capacitors

Cap.(pf)	Code	Cap. Tol.	Size	Voltage
0.1	0R1	C(±0.25pf)	0402 L: 0.04"±0.004"(1.0±0.1mm) W:0.020"±0.004"(0.5±0.1mm) T:0.020"±0.004"(0.5±0.1mm) High Q COG	25V
0.2	0R2			
0.3	0R3			
0.4	0R4			
0.5	0R5			
0.6	0R6			
0.7	0R7			
0.8	0R8			
0.9	0R9			
1.0	1R0			
1.1	1R1			
1.2	1R2			
1.5	1R5			
1.8	1R8			
2.2	2R2			
2.7	2R7			
3.3	3R3		D(±0.5pf)	
3.9	3R9			
4.7	4R7			
5.6	5R6	D(±0.5pf)		
6.8	6R8			
10	100	J(±5%)		
11	110			
12	120			
15	150			
18	180			
22	220			
27	270			

Temperature coefficient:: 0±30ppm/°C,-55 to125°C  
 Q (at 1 MHz): > 2500  
 Insulation Resistance: >1000GΩ @25°C, 125°C  
 Dielectric Withstanding Voltage: >2.5XWVDC, 25°C.  
 Test condition: 1 MHz ±50KHz, 1.0±0.2V, 25°C

### X7R Multilayer Ceramic Capacitors

Cap.(pf)	Code	Cap. Tol.	Size	Voltage
150	151	J.K.M	0402 L: 0.04"±0.004"(1.0±0.1mm) W:0.020"±0.004"(0.5±0.1mm) T:0.020"±0.004"(0.5±0.1mm) X7R	25
180	181			
220	221			
270	271			
330	331			
390	391			
470	471			
560	561			
680	681			
820	821			
1000	102			
1200	122			
1500	152			
1800	182			
2200	222			
2700	272			
3300	332			

Temperature coefficient: ±15%, -55 to 125°C

Dissipation factor: For 25 Volts <2.5%

Aging: 2.5% /decade

Insulation resistance: 1000ΩF or 100G, which is less at 25°C, WVDC

Dielectric Withstanding Voltage: >2.5XWVDC, 25°C.

Test condition: 1KHz±50Hz, 1.0±0.2 VRMS at 25°C

## Mechanical and Environmental Characteristics

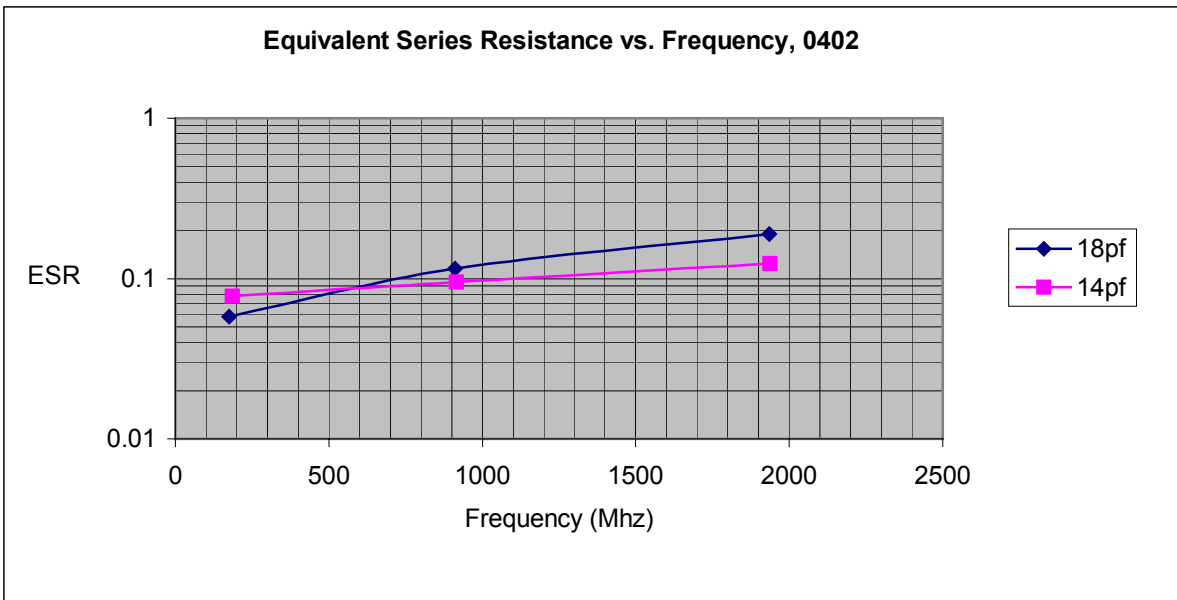
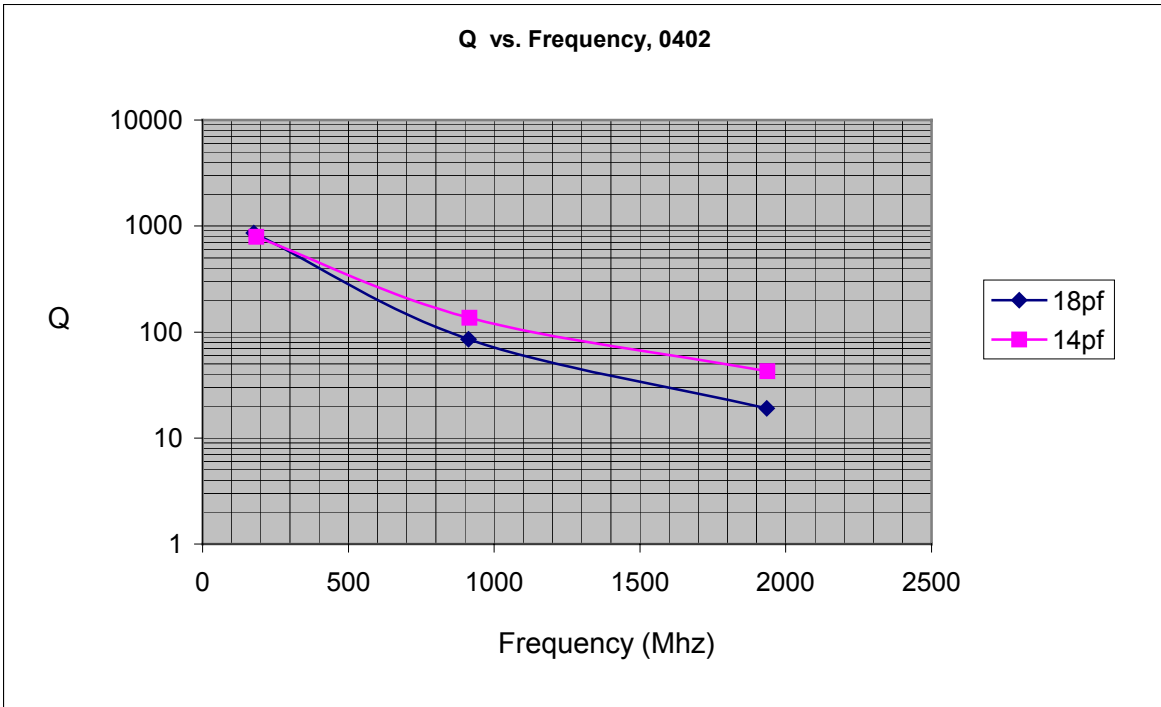
Solderability:	Solder coverage $\geq 90\%$ of metallized areas. 62Sn/36Pb/2Ag solder at $240\pm 5^{\circ}\text{C}$ , Dip time = $5\pm 1$ Sec.
Resistance to soldering heat:	Chip should not crack, Sold coverage $\geq 80\%$ , 62Sn/36Pb/2Ag solder at $260\pm 5^{\circ}\text{C}$ , dip time = $10\pm 1$ Sec.
Termination adhesion:	Termination should not pull off. Ceramic should remain undamaged. Termination strength $\geq 2.0$ lbs.
PCB deflection:	No mechanical damage. Glass epoxy PCB: 1mm deflection
Life test:	1000 hours, $125^{\circ}\text{C}$ , 2 X working voltage, Cap. Change 2% or 0.5pf max. I.R.=initial value
Thermal shock:	5 Cycles: $30\pm 3$ minutes at $-55^{\circ}\text{C}$ ; 3minutes at $25^{\circ}\text{C}$ ; $30\pm 3$ minues at $125^{\circ}\text{C}$ ; 3min. at $25^{\circ}\text{C}$ . Cap. Change 2%,or 0.5pf max. I.R.= 70% of initial value
Moisture resistance:	240 hours, 85% relative humidity, $85^{\circ}\text{C}$ , 1.5 VDC

## Typical Properties for High Q 0402 COG MLCC

### Low ESR/High-Q MLCC Property Specifications

Material	<i>COG(NPO)</i>
Case Size	<b>0402 (1005)</b>
Length (L), inch, (mm)	<b><math>0.040 \pm 0.004</math> (<math>1.02 \pm 0.1</math>)</b>
Width – Thickness (W-T),inch,(mm)	<b><math>0.020 \pm 0.004</math> (<math>0.51 \pm 0.1</math>)</b>
Termination Band Width (B),inch, (mm)	<b><math>0.006 - 0.012</math> (<math>0.15 - 0.3</math>)</b>
Capacitance Range	<b>0.5 pF – 27 pF</b>
ESR @ 900MHz	<b>0.200 <math>\Omega</math> max</b>
Temperature Range	<b><math>-55^{\circ}\text{C}</math> to <math>+125^{\circ}\text{C}</math></b>
TCC	<b><math>0 \pm 30</math> PPM/<math>^{\circ}\text{C}</math></b>
Dissipation Factor	<b><math>5 \times 10^{-4}</math> max @ 1 MHz</b>
IR	<b><math>&gt; 10^{12}</math> <math>\Omega</math></b>
Rated Voltage (RV)	<b>25 V.</b>
Diele. Breakdown Withstanding voltage	<b>2.5 x RV</b>

RF Characteristics vs. Frequency  
High Frequency 0402 MLCC



## MLCC Property Definitions

### 1. Capacitance and Tolerance

A capacitance is the electric capacity of a capacitor, i.e. the amount of electrically charged carriers it can store. Tolerance is the permissible relative deviation of the capacitance from the rated value.

### 2. Dielectric Materials

The choice of dielectric material is usually determined by the required capacitance-temperature stability. Class I capacitors or temperature compensating capacitors have predictable temperature coefficients and in general do not have an aging characteristic. The most popular class I multilayer ceramic capacitors are COG (NP0) temperature compensating capacitors. EIA Class 2 capacitors typically are based on the chemistry of barium titanate and provide a wide range of capacitance values and temperature stability. The most commonly used Class 2 dielectrics are X7R and Y5V.

### 3. Working Voltage (WV)

The working voltage is the maximum continuous voltage that should be applied to a capacitor. The capacitor is designed for a particular working voltage, which it must stand up to without adverse effect during continuous operation. Rated voltages for DC and AC operation are usually not the same.

### 4. Temperature Coefficient (T.C.)

The temperature coefficient shows the fraction by which the capacitance changes with temperature expressed as parts per million per degree centigrade (PPM/C), or as a percent change over a specified temperature range. TC can be positive or negative.

### 5. Dissipation Factor (D.F.)

The dissipation factor loss tangent is the quotient of the active and reactive components of the impedance. DF is the measurement of dielectric losses and is dependent on temperature and frequency. Dielectric loss is the result of the changing polarization of the dielectric caused by alternating fields. They are transformed into oscillations and thus produce frictional heat.

### 6. Insulation Resistance (I.R.)

Insulation resistance is a measure of the resistance to a DC current flow through the capacitor under steady state conditions. Good insulation resistance is necessary for capacitors which are used to block off DC voltage and for storage capacitors in which a particular voltage rate has to remain unchanged for a longer period of time.

### 7. Equivalent Series Resistance (ESR)

ESR is a measure of all losses both series and parallel in a capacitor at a given frequency so that the equivalent circuit is reduced to a simple R-C series connection.

### 8. Dielectric Strength

Dielectric strength is an expression of the ability of a material to withstand an electrical stress. Although dielectric strength is usually expressed in volts, it is actually dependent on the thickness of the dielectric and thus is also a more generically a function of volts/mil.

## Ordering Information

### Parts:

<u>X</u> Ceramic	<u>XXXX</u> Case Size	<u>XXX</u> Capacitance (Pf)	<u>X</u> Cap. Tolerance	<u>X</u> Voltage (V)	<u>X</u> Termination
C= COG (NPO)	0402	First two digits are	A ( $\pm 0.05\text{pF}$ )	A (10)	S=Tin (Ag/Ni/Sn)
X= X7R	0201	significant. Last digit	B ( $\pm 0.1\text{pF}$ )	B (16)	G=Gold (Ag/Ni/Au)
Y= Y5V		is number of zeros.	C ( $\pm 0.25\text{pF}$ )	C (25)	
Z= Z5U		R=decimal point	D ( $\pm 0.5\text{pF}$ )	D (50)	
		i.e. 150=15pF	E ( $\pm 1\text{pF}$ )	E (100)	
		1R5=1.5pF	G ( $\pm 2\%$ )	G (200)	
			J ( $\pm 5\%$ )		
			K ( $\pm 10\%$ )		
			M ( $\pm 20\%$ )		

Example: C-0402-150-K-C-S means COG 0402 capacitor with 15pf capacitance,  $\pm 10\%$  of tolerance, working voltage of 25 volts and tin termination for soldering.

### Packaging:

7" (178mm), 13" (330mm) reel packaging

## How to Contact Us

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