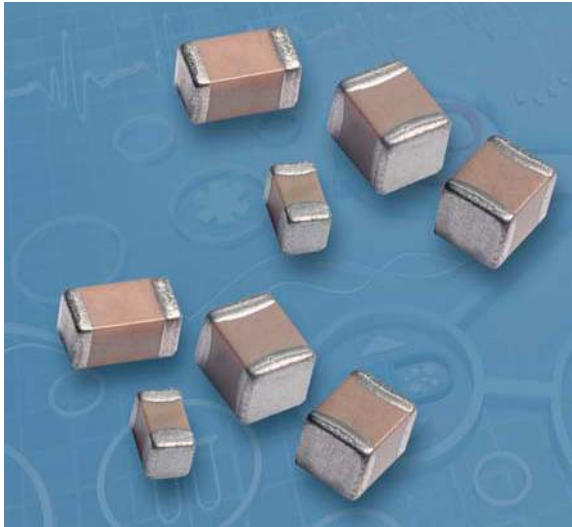


MQ Series – Medical Grade MLCC

General Specifications



GENERAL DESCRIPTION

AVX offers a wide variety of medically qualified passive components. Medical devices require the utmost reliability with respect to the components incorporated into the designs. Advanced design qualification requirements, in-process controls and requirements and lot acceptance testing are implemented to ensure these components will meet the superior reliability levels of a life supporting application. AVX medical MLCC reliability documents provide an advanced level of designing, manufacturing, testing and qualification that places AVX as the top supplier and industry leader of medically qualified MLCCs.

AVX MQ series of medically qualified ceramic capacitors are available in EIA case sizes ranging from 0402 to 2225, at typical voltage ratings between 4 – 200 Vdc with various termination options including Sn, SnPb solder, and Au.

APPLICATIONS

- Implantable cardioverter-defibrillator (ICD)
- Pacemakers
- Neuromodulation

FEATURES

- 0402 to 2225 case sizes
- Voltage range from 4v to 100v
- Capacitance up to 100 μ F
- Class I & II dielectric materials
- Tight tolerances on Class I dielectric materials
- Various terminations
- Customer specific requirements, screening, & testing

HOW TO ORDER

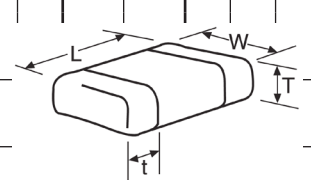
MQ02	Z	A	100	J	G	T	3	A
Size	Rated Voltage	Dielectric Code	Capacitance Code (In pF)	Capacitance Tolerance	Medical Grade	Termination Finish	Packaging	Special Code
MQ02 = 0402 MQ03 = 0603 MQ05 = 0805 MQ06 = 1206 MQ10 = 1210 MQ12 = 1812 MQ13 = 1825 MQ14 = 2225	4 = 4V 6 = 6.3V Z = 10V Y = 16v 3 = 25V 5 = 50V 1 = 100V	A = NP0 (C0G) C = X7R Z = X7S D = X5R	Capacitance Code (In pF) (2 significant digits + number of zeros) for values <10pF: letter R denotes decimal point. Example: 68pF = 680 8.2pF = 8R2	For Values < 10pF B = ± 0.1 pF C = ± 0.25 pF D = ± 0.5 pF For Values ≥ 10pF F = $\pm 1\%$ G = $\pm 2\%$ J = $\pm 5\%$ K = $\pm 10\%$ M = $\pm 20\%$ N = $\pm 30\%$		T = Plated Ni & Sn J = 60/40 Sn/Pb B = 5% min Pb Plated Solder 7 = Gold Plated	1 = 7" Reel 2 = 7" Reel (0402 only) 3 = 13" Reel 4 = 13" Reel (0402 only) 6 = Waffle	A = Standard Contact AVX for others

MQ Series – Medical Grade MLCC

NP0 (C0G) – Capacitance & Voltage Range

PREFERRED SIZES ARE SHADED

SIZE	0402			0603				0805				1206			1210			1812			1825		2225					
Soldering	Reflow Only			Reflow/Wave				Reflow/Wave				Reflow/Wave			Reflow Only			Reflow Only			Reflow Only		Reflow Only					
Packaging	All Paper			All Embossed				All Embossed				All Embossed			All Embossed			All Embossed			All Embossed		All Embossed					
(L) Length	mm	1.00 ± 0.10		1.60 ± 0.15		2.01 ± 0.20		3.20 ± 0.20		3.20 ± 0.20		4.50 ± 0.30		4.50 ± 0.30		5.72 ± 0.25												
	(in.)	(0.040 ± 0.004)		(0.063 ± 0.006)		(0.079 ± 0.008)		(0.126 ± 0.008)		(0.126 ± 0.008)		(0.177 ± 0.012)		(0.177 ± 0.012)		(0.225 ± 0.010)												
(W) Width	mm	0.50 ± 0.10		0.81 ± 0.15		1.25 ± 0.20		1.60 ± 0.20		2.50 ± 0.20		3.20 ± 0.20		6.40 ± 0.40		6.35 ± 0.25												
	(in.)	(0.020 ± 0.004)		(0.032 ± 0.006)		(0.049 ± 0.008)		(0.063 ± 0.008)		(0.098 ± 0.008)		(0.126 ± 0.008)		(0.252 ± 0.016)		(0.250 ± 0.010)												
(t) Terminal	mm	0.25 ± 0.15		0.35 ± 0.15		0.50 ± 0.25		0.50 ± 0.25		0.50 ± 0.25		0.61 ± 0.36		0.61 ± 0.36		0.64 ± 0.39												
	(in.)	(0.010 ± 0.006)		(0.037)		(0.020 ± 0.010)		(0.020 ± 0.010)		(0.020 ± 0.010)		(0.024 ± 0.014)		(0.024 ± 0.014)		(0.025 ± 0.015)												
Maximum Thickness	mm	0.56		0.94		1.52		1.78		1.78		2.79		2.79		2.79												
	(in.)	(0.022)		(0.014 ± 0.006)		(0.060)		(0.070)		(0.070)		(0.110)		(0.110)		(0.110)												
WVDC		16	25	50	6.3	16	25	50	100	16	25	50	100	16	25	50	100	25	50	100	25	50	100	50	100	25	50	100
Cap (pF)	0.5	Shaded																										
	1.0	Shaded																										
	1.2	Shaded																										
	1.5	Shaded																										
	1.8	Shaded																										
	2.2	Shaded																										
	2.7	Shaded																										
	3.3	Shaded																										
	3.9	Shaded																										
	4.7	Shaded																										
	5.6	Shaded																										
	6.8	Shaded																										
	8.2	Shaded																										
	10	Shaded																										
	12	Shaded																										
	15	Shaded																										
	18	Shaded																										
	22	Shaded																										
	27	Shaded																										
	33	Shaded																										
	39	Shaded																										
	47	Shaded																										
	56	Shaded																										
	68	Shaded																										
	82	Shaded																										
	100	Shaded																										
	120	Shaded																										
	150	Shaded																										
	180	Shaded																										
	220	Shaded																										
	270	Shaded																										
	330	Shaded																										
	390	Shaded																										
	470	Shaded																										
	560	Shaded																										
	680	Shaded																										
	820	Shaded																										
	1000	Shaded																										
	1200	Shaded																										
	1500	Shaded																										
	1800	Shaded																										
	2200	Shaded																										
	2700	Shaded																										
	3300	Shaded																										
	3900	Shaded																										
	4700	Shaded																										
	5600	Shaded																										
	6800	Shaded																										
	8200	Shaded																										
	10000	Shaded																										
WVDC		16	25	50	6.3	16	25	50	100	16	25	50	100	16	25	50	100	25	50	100	25	50	100	50	100	25	50	100
SIZE	0402			0603				0805				1206			1210			1812			1825		2225					

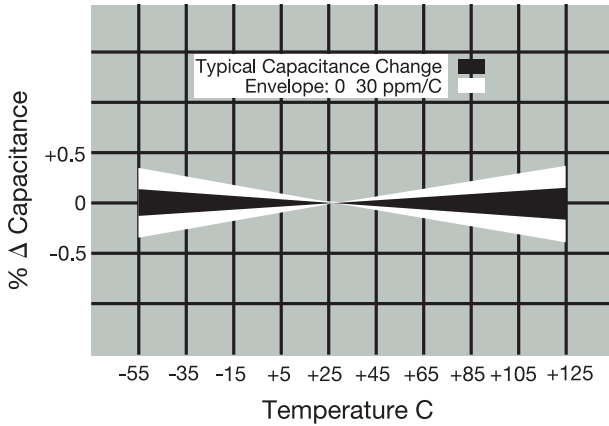


MQ Series – Medical Grade MLCC

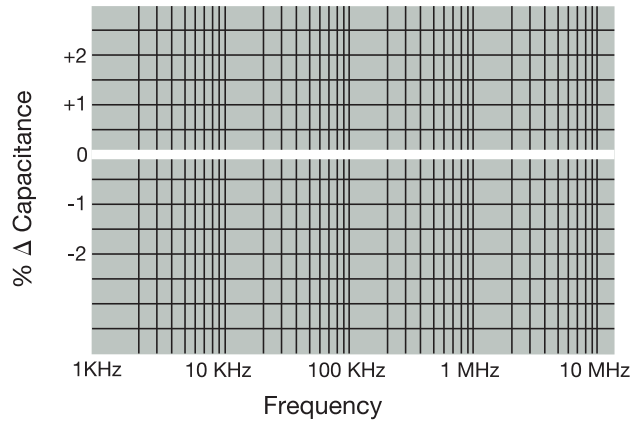
NP0 (C0G) – General Specifications

TYPICAL ELECTRICAL CHARACTERISTICS

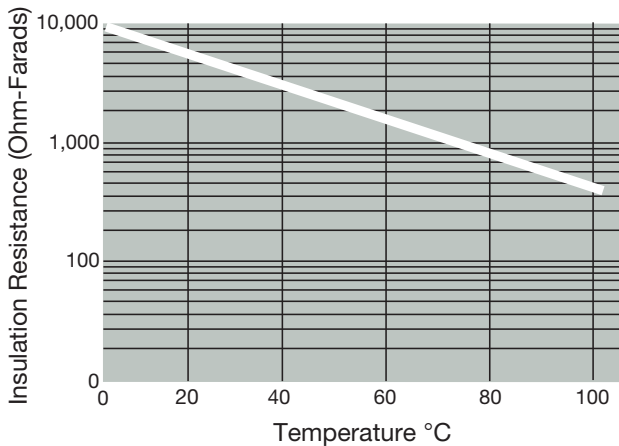
Temperature Coefficient



Δ Capacitance vs. Frequency



Insulation Resistance vs. Temperature

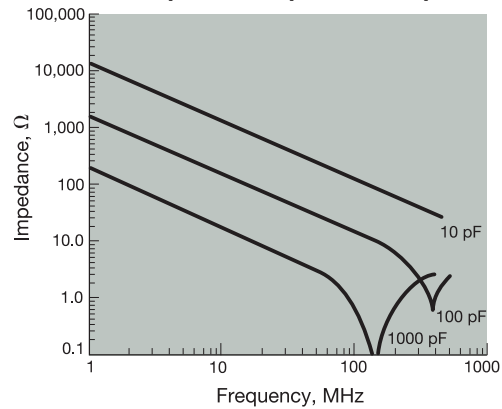


Variation of Impedance with Cap Value

Impedance vs. Frequency

0805 - C0G (NP0)

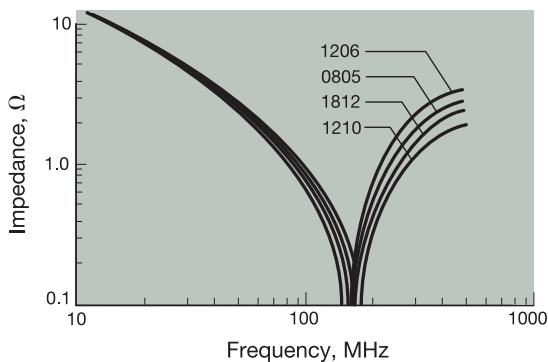
10 pF vs. 100 pF vs. 1000 pF



Variation of Impedance with Chip Size

Impedance vs. Frequency

1000 pF - C0G (NP0)

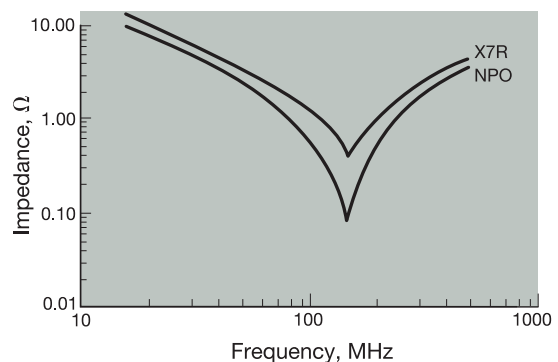


Variation of Impedance with Ceramic Formulation

Impedance vs. Frequency

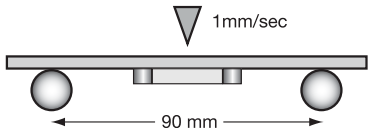
1000 pF - C0G (NP0) vs. X7R

0805



MQ Series – Medical Grade MLCC

NP0 (C0G) – Specifications & Test Methods

Parameter/Test		NP0 Specification Limits	Measuring Conditions	
Operating Temperature Range		-55°C to +125°C	Temperature Cycle Chamber	
Capacitance		Within specified tolerance	Freq.: 1.0 MHz \pm 10% for cap \leq 1000 pF 1.0 kHz \pm 10% for cap > 1000 pF Voltage: 1.0Vrms \pm .2V	
Q		<30 pF: Q \geq 400+20 x Cap Value \geq 30 pF: Q \geq 1000	Charge device with rated voltage for 120 \pm 5 secs @ room temp/humidity	
Insulation Resistance		100,000M Ω or 1000M Ω - μ F, whichever is less	Charge device with 250% of rated voltage for 1-5 seconds, with charge and discharge current limited to 50 mA (max)	
Dielectric Strength		No breakdown or visual defects	Deflection: 2mm Test Time: 30 seconds	
Resistance to Flexure Stresses	Appearance	No defects		
	Capacitance Variation	\pm 5% or \pm .5 pF, whichever is greater		
	Q	Meets Initial Values (As Above)		
	Insulation Resistance	\geq Initial Value x 0.3		
Solderability		\geq 85% of each terminal should be covered with fresh solder	Dip device in eutectic solder at 245 \pm 5°C for 5.0 \pm 0.5 seconds	
Resistance to Solder Heat	Appearance	No defects, <25% leaching of either end terminal	MIL-STD-202 / Method 210 / Condition J (Reflow Mounting plus 1 Reflow Cycle @ 235°C \pm 5°C)	
	Capacitance Variation	\leq \pm 2.5% or \pm .25 pF, whichever is greater		
	Q	Meets Initial Values (As Above)		
	Insulation Resistance	Meets Initial Values (As Above)		
Thermal Shock	Appearance	No visual defects	Step 1: -55°C \pm 2°	30 \pm 3 minutes
	Capacitance Variation	\leq \pm 3.0% or \pm .0.3 pF, whichever is greater	Step 2: Room Temp	\leq 3 minutes
	Q	Meets Initial Values (As Above)	Step 3: +125°C \pm 2°	30 \pm 3 minutes
	Insulation Resistance	Meets Initial Values (As Above)	Step 4: Room Temp	\leq 3 minutes
	Dielectric Strength	Meets Initial Values (As Above)	Repeat for 5 cycles and measure after 24 hours at room temperature	
Load Life	Appearance	No visual defects	Load in test chamber set at 125°C \pm 2°C for 1000 hours (+48, -0) with twice rated voltage applied. Remove from test chamber and stabilize at room temperature before measuring.	
	Capacitance Variation	\leq \pm 3.0% or \pm 0.3 pF, whichever is greater		
	Q	\geq 30 pF: Q \geq 350 \geq 10 pF, <30 pF: Q \geq 275 +5C/2 <10 pF: Q \geq 200 +10C		
	Insulation Resistance	\geq Initial Value x 0.3 (See Above)		
	Dielectric Strength	Meets Initial Values (As Above)		
Load Humidity	Appearance	No visual defects	Load in a test chamber set at 85°C \pm 2°C/85% \pm 5% relative humidity for 1000 hours (+48, -0) with rated voltage applied.	
	Insulation Resistance	\geq Initial Value x 0.3 (See Above)	Remove from chamber and stabilize at room temperature before measuring.	

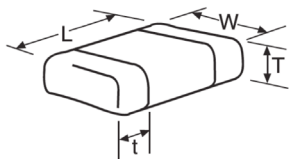
MQ Series – Medical Grade MLCC

X7R/X7S – General Specifications



PREFERRED SIZES ARE SHADED

SIZE	0402				0603				0805					1206					1210				1812		1825		2225						
Soldering	Reflow Only				Reflow/Wave				Reflow/Wave					Reflow/Wave					Reflow Only				Reflow Only		Reflow Only		Reflow Only						
Packaging	All Paper				All Embossed				All Embossed					All Embossed					All Embossed				All Embossed		All Embossed		All Embossed						
(L) Length	1.00 ± 0.10 (0.040 ± 0.004)				1.60 ± 0.15 (0.063 ± 0.006)				2.01 ± 0.20 (0.079 ± 0.008)					3.20 ± 0.20 (0.126 ± 0.008)					3.20 ± 0.20 (0.126 ± 0.008)				4.50 ± 0.30 (0.177 ± 0.012)		4.50 ± 0.30 (0.177 ± 0.012)		5.72 ± 0.25 (0.225 ± 0.010)						
(W) Width	0.50 ± 0.10 (0.020 ± 0.004)				0.81 ± 0.15 (0.032 ± 0.006)				1.25 ± 0.20 (0.049 ± 0.008)					1.60 ± 0.20 (0.063 ± 0.008)					2.50 ± 0.20 (0.098 ± 0.008)				3.20 ± 0.20 (0.126 ± 0.008)		6.40 ± 0.40 (0.252 ± 0.016)		6.35 ± 0.25 (0.250 ± 0.010)						
(t) Terminal	0.25 ± 0.15 (0.010 ± 0.006)				0.35 ± 0.15 (0.037)				0.50 ± 0.25 (0.020 ± 0.010)					0.50 ± 0.25 (0.020 ± 0.010)					0.50 ± 0.25 (0.020 ± 0.010)				0.61 ± 0.36 (0.024 ± 0.014)		0.61 ± 0.36 (0.024 ± 0.014)		0.64 ± 0.39 (0.025 ± 0.015)						
Maximum Thickness	0.56 (0.022)				0.94 (0.014 ± 0.006)				1.52 (0.060)					1.78 (0.070)					1.78 (0.070)				2.79 (0.110)		2.79 (0.110)		2.79 (0.110)						
WVDC	10	16	25	50	6.3	10	16	25	50	6.3	10	16	25	50	100	6.3	10	16	25	50	100	10	16	25	50	100	50	100	50	100	16	25	50
Cap (pF)	100																																
	150																																
	220																																
	330																																
	470																																
	680																																
	1000																																
	1500																																
	2200																																
	3300																																
	4700																																
	6800																																
Cap (µF)	0.010																																
	0.015																																
	0.022																																
	0.033																																
	0.047																																
	0.068																																
	0.10																																
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WVDC	10	16	25	50	6.3	10	16	25	50	6.3	10	16	25	50	100	6.3	10	16	25	50	100	10	16	25	50	100	50	100	50	100	16	25	50
SIZE	0402				0603				0805					1206					1210				1812		1825		2225						

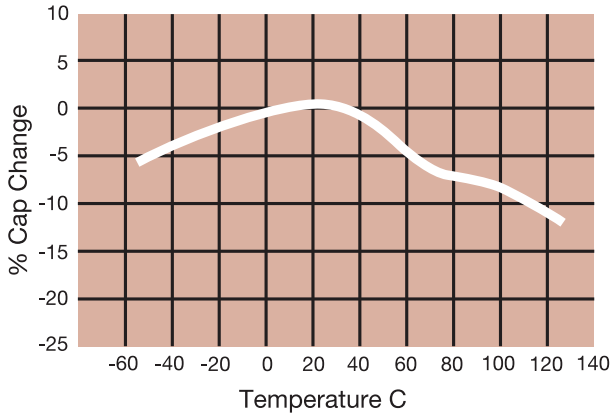


MQ Series – Medical Grade MLCC

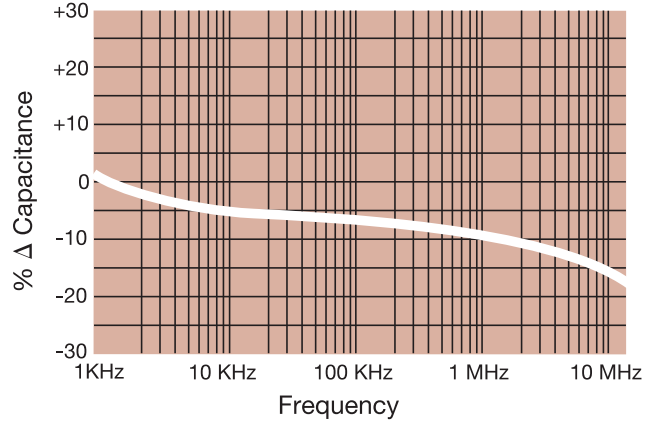
X7R/X7S – General Specifications

TYPICAL ELECTRICAL CHARACTERISTICS

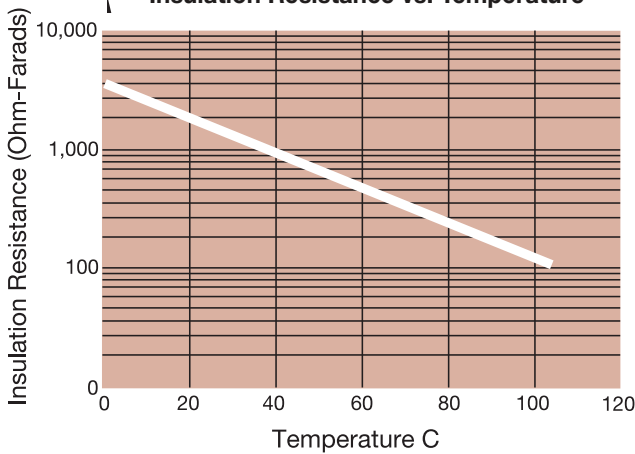
**X7R Dielectric
Typical Temperature Coefficient**



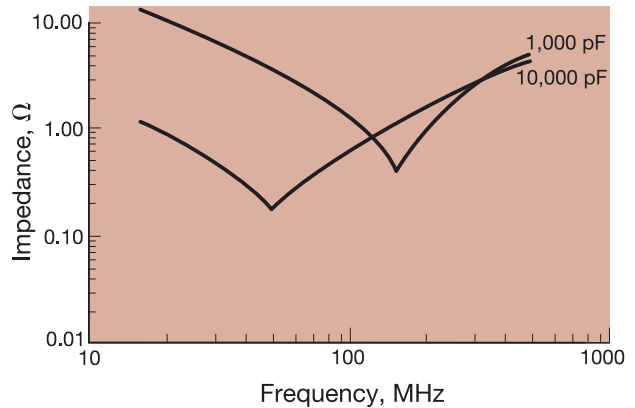
Δ Capacitance vs. Frequency



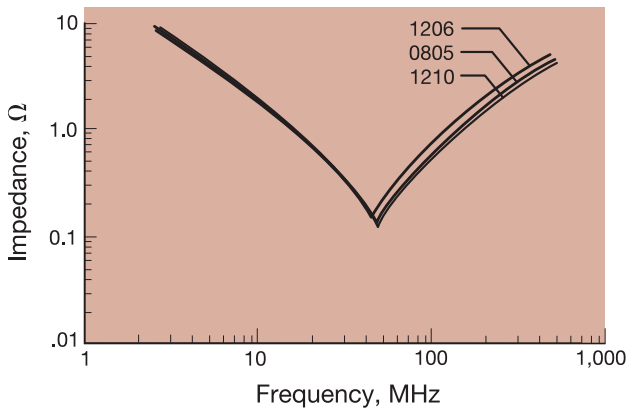
Insulation Resistance vs. Temperature



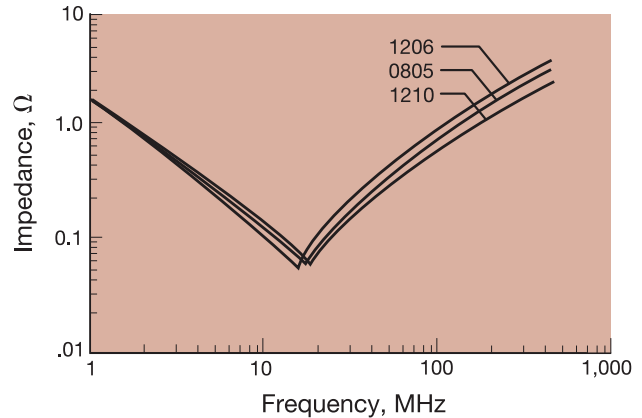
**Variation of Impedance with Cap Value
Impedance vs. Frequency
1,000 pF vs. 10,000 pF - X7R
0805**



**Variation of Impedance with Chip Size
Impedance vs. Frequency
10,000 pF - X7R**

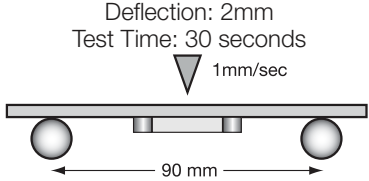


**Variation of Impedance with Chip Size
Impedance vs. Frequency
100,000 pF - X7R**



MQ Series – Medical Grade MLCC

X7R/X7S – Specifications & Test Methods

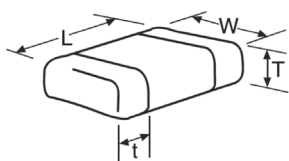
Parameter/Test		NPO Specification Limits	Measuring Conditions	
Operating Temperature Range		-55°C to +125°C	Temperature Cycle Chamber	
Capacitance		Within specified tolerance	Frequency: 1.0kHz ± 10% Voltage: 1.0Vrms ± 0.2V	
Dissipation Factor		≤ 2.5% for ≥ 50V DC rating ≤ 3.0% for 25V & 35V DC rating ≤ 12.5% for 16V DC rating and lower Contact factory for DF by PN		
Insulation Resistance		100,000MΩ or 1000MΩ - μF, whichever is less	Charge device with rated voltage for 120 ± 5 secs @ room temp/humidity	
Dielectric Strength		No breakdown or visual defects	Charge device with 250% of rated voltage for 1-5 seconds, with charge and discharge current limited to 50 mA (max)	
Resistance to Flexure Stresses	Appearance	No defects	Deflection: 2mm Test Time: 30 seconds 	
	Capacitance Variation	≤ ±12%		
	Dissipation Factor	Meets Initial Values (As Above)		
	Insulation Resistance	≥ Initial Value x 0.3		
Solderability		≥ 85% of each terminal should be covered with fresh solder	Dip device in eutectic solder at 245 ± 5°C for 5.0 ± 0.5 seconds	
Resistance to Solder Heat	Appearance	No defects, <25% leaching of either end terminal	MIL-STD-202 / Method 210 / Condition J (Reflow Mounting plus 1 Reflow Cycle @ 235°C ± 5°C)	
	Capacitance Variation	≤ ±7.5%		
	Dissipation Factor	Meets Initial Values (As Above)		
	Insulation Resistance	Meets Initial Values (As Above)		
Thermal Shock	Appearance	No visual defects	Step 1: -55°C ± 2°	30 ± 3 minutes
	Capacitance Variation	≤ ±7.5%	Step 2: Room Temp	≤ 3 minutes
	Dissipation Factor	Meets Initial Values (As Above)	Step 3: +125°C ± 2°	30 ± 3 minutes
	Insulation Resistance	Meets Initial Values (As Above)	Step 4: Room Temp	≤ 3 minutes
	Dielectric Strength	Meets Initial Values (As Above)	Repeat for 5 cycles and measure after 24 hours at room temperature	
Load Life	Appearance	No visual defects	Load in test chamber set at 125°C ± 2°C for 1000 hours (+48, -0) with twice rated voltage applied. Remove from test chamber and stabilize at room temperature before measuring.	
	Capacitance Variation	≤ ±12.5%		
	Dissipation Factor	≤ initial value x 2.0 (see above)		
	Insulation Resistance	≥ Initial Value x 0.3 (See Above)		
	Dielectric Strength	Meets Initial Values (As Above)		
Load Humidity	Appearance	No visual defects	Load in a test chamber set at 85°C ± 2°C/85% ± 5% relative humidity for 1000 hours (+48, -0) with rated voltage applied. Remove from chamber and stabilize at room temperature before measuring.	
	Insulation Resistance	≥ Initial Value x 0.3 (See Above)		

MQ Series – Medical Grade MLCC

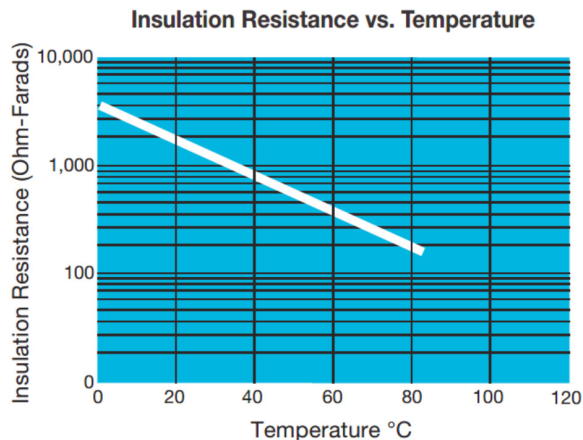
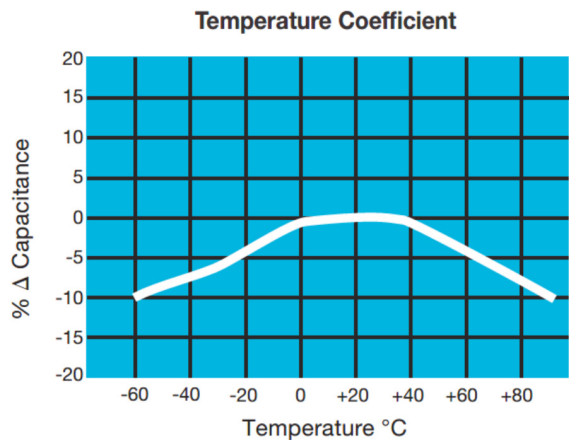
X5R – Capacitance & Voltage Range

PREFERRED SIZES ARE SHADED

SIZE		0402					0603					0805					1206				1210					1812											
Soldering		Reflow Only					Reflow/Wave					Reflow/Wave					Reflow/Wave				Reflow Only					Reflow Only											
Packaging		All Paper					All Embossed					All Embossed					All Embossed				All Embossed					All Embossed											
(L) Length	mm (in.)	1.00 ± 0.10 (0.040 ± 0.004)					1.60 ± 0.15 (0.063 ± 0.006)					2.01 ± 0.20 (0.079 ± 0.008)					3.20 ± 0.20 (0.126 ± 0.008)				3.20 ± 0.20 (0.126 ± 0.008)					4.50 ± 0.30 (0.177 ± 0.012)											
(W) Width	mm (in.)	0.50 ± 0.10 (0.020 ± 0.004)					0.81 ± 0.15 (0.032 ± 0.006)					1.25 ± 0.20 (0.049 ± 0.008)					1.60 ± 0.20 (0.063 ± 0.008)				2.50 ± 0.20 (0.098 ± 0.008)					3.20 ± 0.20 (0.126 ± 0.008)											
(t) Terminal	mm (in.)	0.25 ± 0.15 (0.010 ± 0.006)					0.35 ± 0.15 (0.037)					0.50 ± 0.25 (0.020 ± 0.010)					0.50 ± 0.25 (0.020 ± 0.010)				0.50 ± 0.25 (0.020 ± 0.010)					0.61 ± 0.36 (0.024 ± 0.014)											
Maximum Thickness	mm (in.)	0.56 (0.022)					0.94 (0.014 ± 0.006)					1.52 (0.060)					1.78 (0.070)				1.78 (0.070)					2.79 (0.110)											
WVDC		4	6.3	10	16	25	4	6.3	10	16	25	50	6.3	10	16	25	50	6.3	10	16	25	4	6.3	10	16	25	50	4	6.3	10	16	25	50	6.3	10	25	50
Cap (µF)	0.01	Shaded					Shaded					Shaded					Shaded				Shaded					Shaded											
	0.015	Shaded					Shaded					Shaded					Shaded				Shaded					Shaded											
	0.022	Shaded					Shaded					Shaded					Shaded				Shaded					Shaded											
	0.033	Shaded					Shaded					Shaded					Shaded				Shaded					Shaded											
	0.047	Shaded					Shaded					Shaded					Shaded				Shaded					Shaded											
0.1	0.1	Shaded					Shaded					Shaded					Shaded				Shaded					Shaded											
	0.15	Shaded					Shaded					Shaded					Shaded				Shaded					Shaded											
	0.22	Shaded					Shaded					Shaded					Shaded				Shaded					Shaded											
0.33	0.33	Shaded					Shaded					Shaded					Shaded				Shaded					Shaded											
	0.47	Shaded					Shaded					Shaded					Shaded				Shaded					Shaded											
	0.68	Shaded					Shaded					Shaded					Shaded				Shaded					Shaded											
1.0	1.0	Shaded					Shaded					Shaded					Shaded				Shaded					Shaded											
	1.5	Shaded					Shaded					Shaded					Shaded				Shaded					Shaded											
WVDC		4	6.3	10	16	25	4	6.3	10	16	25	50	6.3	10	16	25	50	6.3	10	16	25	4	6.3	10	16	25	50	4	6.3	10	16	25	50	6.3	10	25	50
SIZE		0402					0603					0805					1206				1210					1812											

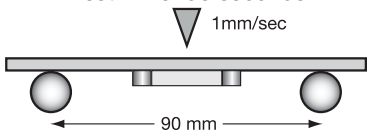


TYPICAL ELECTRICAL CHARACTERISTICS



MQ Series – Medical Grade MLCC

X5R – Specifications & Test Methods

Parameter/Test		X5R Specification Limits	Measuring Conditions	
Operating Temperature Range		-55°C to +85°C	Temperature Cycle Chamber	
Capacitance		Within specified tolerance	Freq.: 1.0 kHz ± 10% Voltage: 1.0Vrms ± .2V For Cap > 10 µF, 0.5Vrms @ 120Hz	
Dissipation Factor		≤ 2.5% for ≥ 50V DC rating ≤ 3.0% for 25V, 35V DC rating ≤ 12.5% Max. for 16V DC rating and lower Contact Factory for DF by PN		
Insulation Resistance		10,000MΩ or 500MΩ - µF, whichever is less	Charge device with rated voltage for 120 ± 5 secs @ room temp/humidity	
Dielectric Strength		No breakdown or visual defects	Charge device with 150% of rated voltage for 1-5 seconds, w/charge and discharge current limited to 50 mA (max)	
Resistance to Flexure Stresses	Appearance	No defects	Deflection: 2mm Test Time: 30 seconds 	
	Capacitance Variation	≤ ±12%		
	Dissipation Factor	Meets Initial Values (As Above)		
	Insulation Resistance	≥ Initial Value x 0.3		
Solderability		≥ 85% of each terminal should be covered with fresh solder	Dip device in eutectic solder at 245 ± 5°C for 5.0 ± 0.5 seconds	
Resistance to Solder Heat	Appearance	No defects, <25% leaching of either end terminal	MIL-STD-202 / Method 210 / Condition J (Reflow Mounting plus 1 Reflow Cycle @ 235°C ± 5°C)	
	Capacitance Variation	≤ ±7.5%		
	Dissipation Factor	Meets Initial Values (As Above)		
	Insulation Resistance	Meets Initial Values (As Above)		
Thermal Shock	Appearance	No visual defects	Step 1: -55°C ± 2°	30 ± 3 minutes
	Capacitance Variation	≤ ±7.5%	Step 2: Room Temp	≤ 3 minutes
	Dissipation Factor	Meets Initial Values (As Above)	Step 3: +85°C ± 2°	30 ± 3 minutes
	Insulation Resistance	Meets Initial Values (As Above)	Step 4: Room Temp	≤ 3 minutes
	Dielectric Strength	Meets Initial Values (As Above)	Repeat for 5 cycles and measure after 24 ± 2 hours at room temperature	
Load Life	Appearance	No visual defects	Load in test chamber set at 85°C ± 2°C for 1000 hours (+48, -0) with twice rated voltage applied. Remove from test chamber and stabilize at room temperature before measuring.	
	Capacitance Variation	≤ ±12.5%		
	Dissipation Factor	≤ Initial Value x 2.0 (See Above)		
	Insulation Resistance	≥ Initial Value x 0.3 (See Above)		
	Dielectric Strength	Meets Initial Values (As Above)		
Load Humidity	Appearance	No visual defects	Load in a test chamber set at 85°C ± 2°C/85% ± 5% relative humidity for 1000 hours (+48, -0) with rated voltage applied. Remove from chamber and stabilize at room temperature before measuring.	
	Insulation Resistance	≥ Initial Value x 0.3 (See Above)		