

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

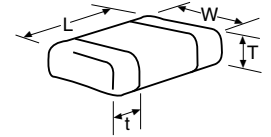
MQ02	Z	A	100	J	G	T	3	A
Size	Rated Voltage	Dielectric Code	Capacitance Code (In pF)	Capacitance Tolerance	Medical Grade	Termination Finish	Packaging	Special Code
MQ02 = 0402 MQ03 = 0603 MQ05 = 0805 MQ06 = 1206 MQ10 = 1210 MQ12 = 1812 MQ13 = 1825 MQ14 = 2225	4 = 4V 6 = 6.3V Z = 10V Y = 16V 3 = 25V 5 = 50V 1 = 100V	A = NP0 (C0G) C = X7R Z = X7S D = X5R	(2 significant digits + number of zeros) for values <10pF: letter R denotes decimal point. Example: 68pF = 680 8.2pF = 8R2	B = ± 0.1 pF C = ± 0.25 pF D = ± 0.5 pF F = $\pm 1\%$ (≥ 10 pF) G = $\pm 2\%$ (≥ 10 pF) 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 (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	mm	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	mm	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	mm	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		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																											
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	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					

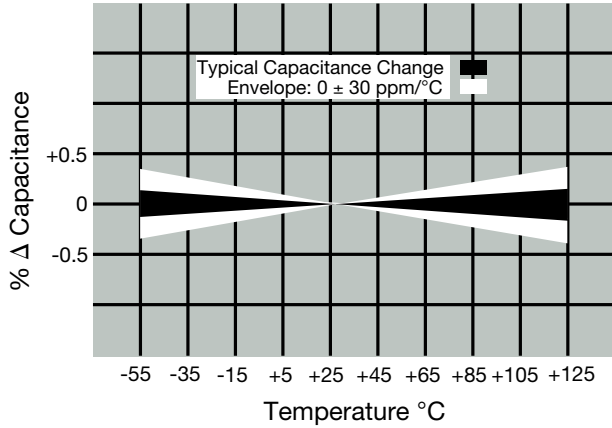


MQ Series – Medical Grade MLCC

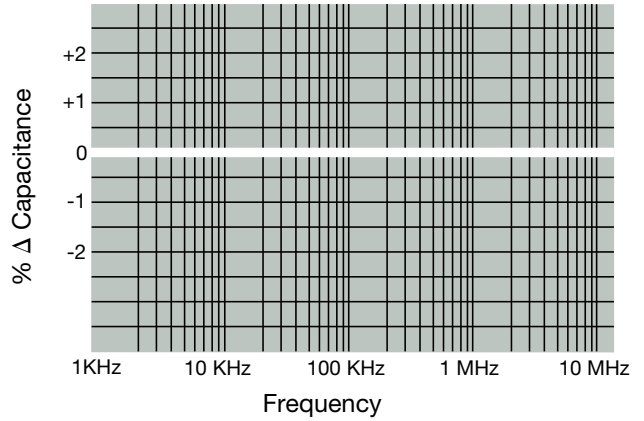
NP0 (C0G) – General Specifications

TYPICAL ELECTRICAL CHARACTERISTICS

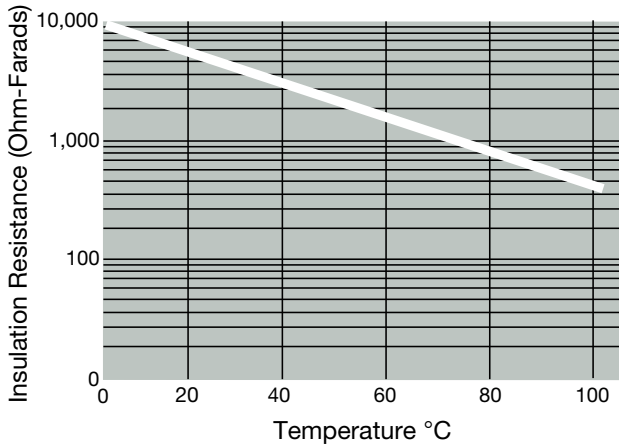
Temperature Coefficient



Δ Capacitance vs. Frequency



Insulation Resistance vs. Temperature

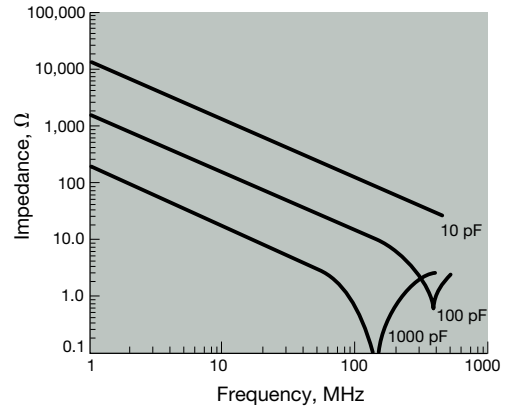


Variation of Impedance with Cap Value

Impedance vs. Frequency

0805 - C0G (NP0)

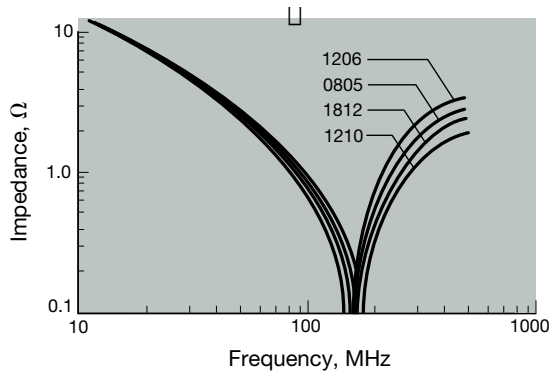
10 pF vs. 100 pF vs. 1000 pF



Variation of Impedance with Chip Size

Impedance vs. Frequency

1000 pF - C0G (NP0)

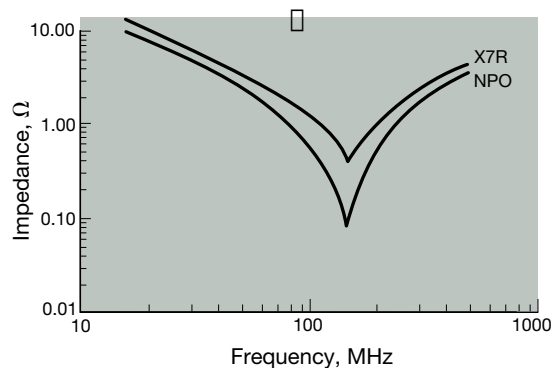


Variation of Impedance with Ceramic Formulation

Impedance vs. Frequency

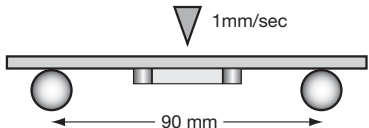
1000 pF - C0G (NP0) vs. X7R

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.	

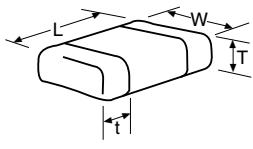
MQ Series – Medical Grade MLCC

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	mm 1.00 ± 0.10 (0.040 ± 0.004)				mm 1.60 ± 0.15 (0.063 ± 0.006)				mm 2.01 ± 0.20 (0.079 ± 0.008)				mm 3.20 ± 0.20 (0.126 ± 0.008)				mm 3.20 ± 0.20 (0.126 ± 0.008)				mm 4.50 ± 0.30 (0.177 ± 0.012)		mm 4.50 ± 0.30 (0.177 ± 0.012)		mm 5.72 ± 0.25 (0.225 ± 0.010)																																			
(W) Width	mm 0.50 ± 0.10 (0.020 ± 0.004)				mm 0.81 ± 0.15 (0.032 ± 0.006)				mm 1.25 ± 0.20 (0.049 ± 0.008)				mm 1.60 ± 0.20 (0.063 ± 0.008)				mm 2.50 ± 0.20 (0.098 ± 0.008)				mm 3.20 ± 0.20 (0.126 ± 0.008)		mm 6.40 ± 0.40 (0.252 ± 0.016)		mm 6.35 ± 0.25 (0.250 ± 0.010)																																			
(t) Terminal	mm 0.25 ± 0.15 (0.010 ± 0.006)				mm 0.35 ± 0.15 (0.037)				mm 0.50 ± 0.25 (0.020 ± 0.010)				mm 0.50 ± 0.25 (0.020 ± 0.010)				mm 0.50 ± 0.25 (0.020 ± 0.010)				mm 0.61 ± 0.36 (0.024 ± 0.014)		mm 0.61 ± 0.36 (0.024 ± 0.014)		mm 0.64 ± 0.39 (0.025 ± 0.015)																																			
Maximum Thickness	mm 0.56 (0.022)				mm 0.94 (0.014 ± 0.006)				mm 1.52 (0.060)				mm 1.78 (0.070)				mm 1.78 (0.070)				mm 2.79 (0.110)		mm 2.79 (0.110)		mm 2.79 (0.110)																																			
WDC	10	16	25	50	6.3	10	16	25	50	100	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	100																									
Cap (µF)	100				150				220				330				470				680				1000				1500				2200																											
Cap (µF)	3300				4700				6800				0.010				0.015				0.022				0.033				0.047				0.068				0.10				0.15				0.22				0.33				0.47				0.68			
Cap (µF)	1.0				1.5				2.2				3.3				4.7				10				WDC				10				16				25				50				100															
SIZE	0402				0603				0805				1206				1210				1812		1825		2225																																			

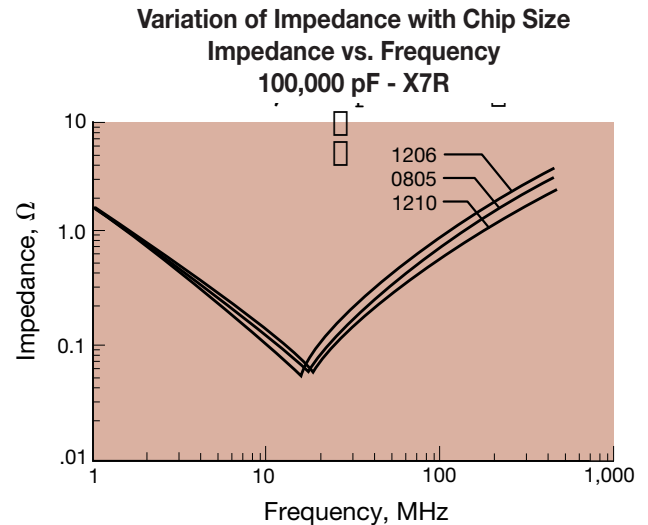
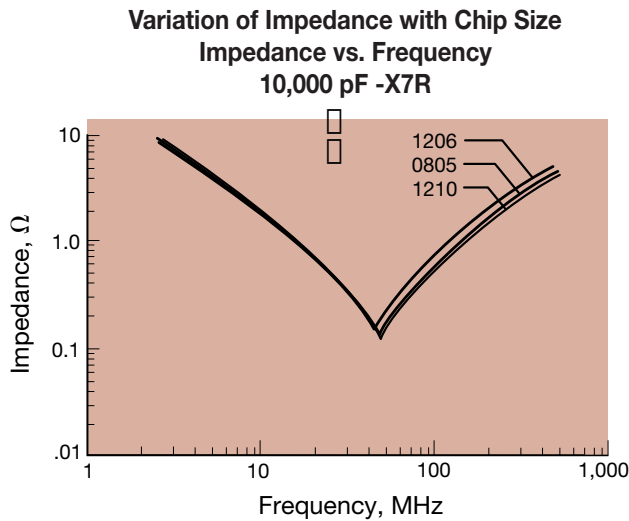
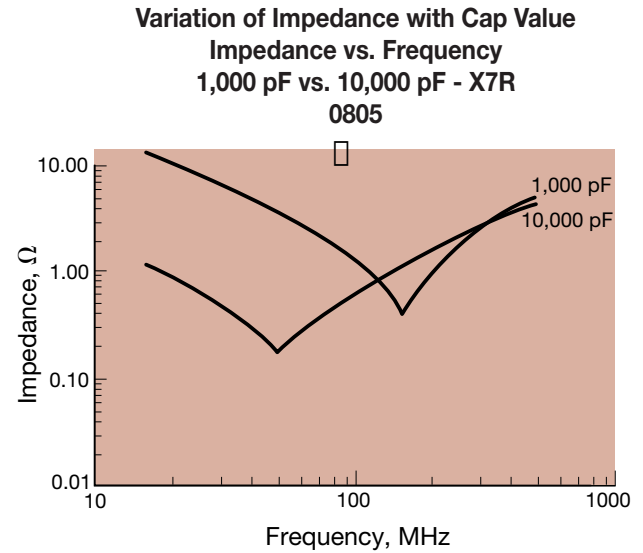
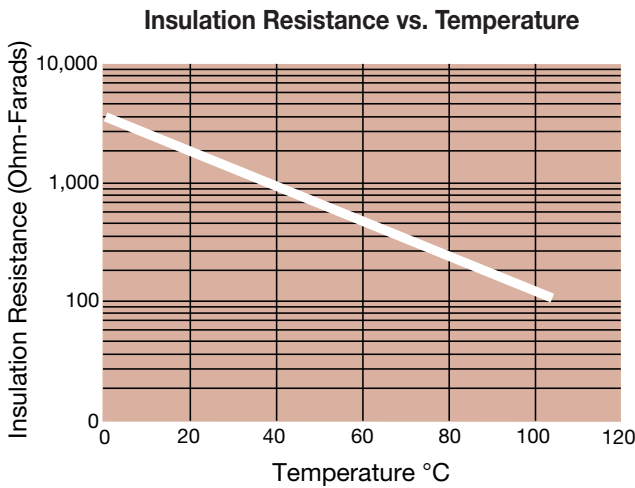
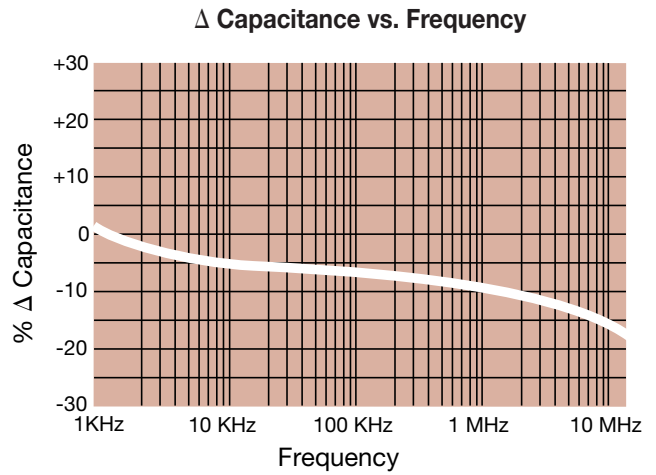
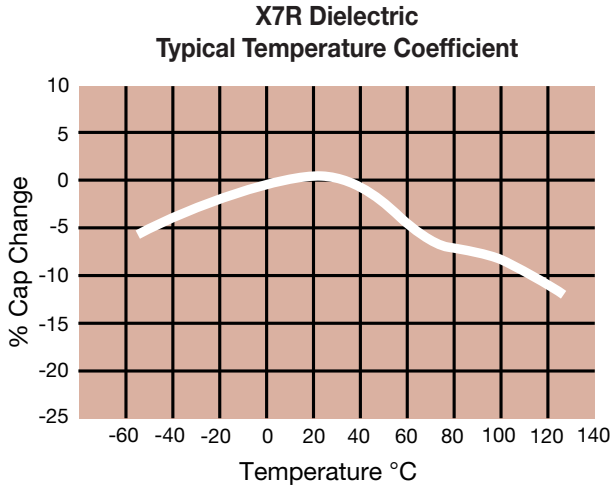
These values are produced with X7S temperature coefficient code



MQ Series – Medical Grade MLCC

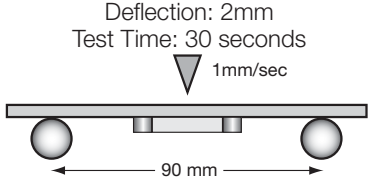
X7R/X7S – General Specifications

TYPICAL ELECTRICAL CHARACTERISTICS



MQ Series – Medical Grade MLCC

X7R/X7S – Specifications & Test Methods

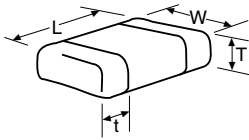
Parameter/Test		NPO Specification Limits	Measuring Conditions	
Operating Temperature Range		-55°C to +125°C	Temperature Cycle Chamber	
Capacitance		Within specified tolerance	Frequency: 1.0kHz ± 10% Voltage: 1.0Vrms ± 0.2V	
Dissipation Factor		≤ 2.5% for ≥ 50V DC rating ≤ 3.0% for 25V & 35V DC rating ≤ 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

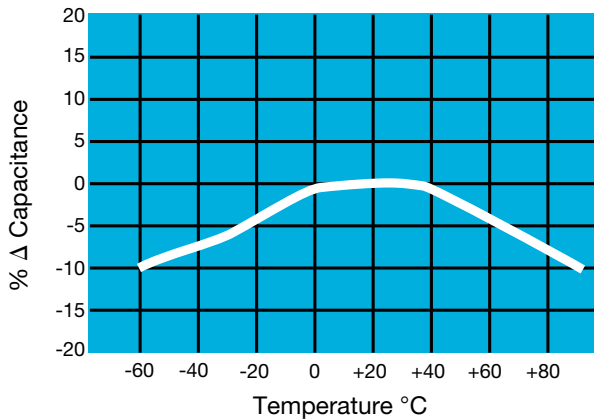
PREFERRED SIZES ARE SHADED

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)	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)	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)	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)	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	50	4	6.3	10	16	25	50	6.3	10	16	25	50	6.3	10	16	25	50	4	6.3	10	16	25	50	6.3	10	25	50																																																																									
Cap (µF)	0.01					0.015					0.022					0.033					0.047					0.068					0.1					0.15					0.22					0.33					0.47					0.68					1.0					1.5					2.2					3.3					4.7					10					22					47					100				
WVDC	4	6.3	10	16	25	50	4	6.3	10	16	25	50	6.3	10	16	25	50	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																																																																															

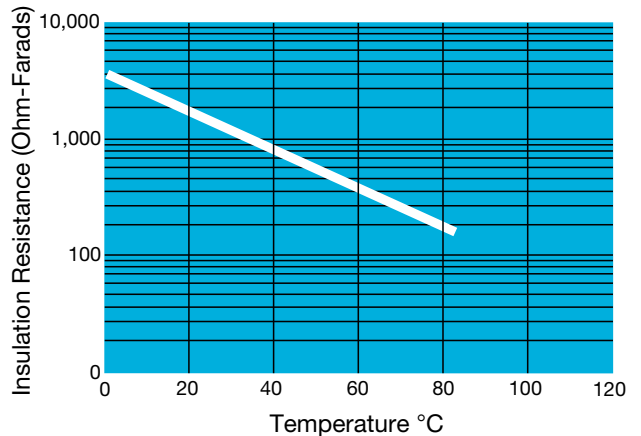


TYPICAL ELECTRICAL CHARACTERISTICS

Temperature Coefficient

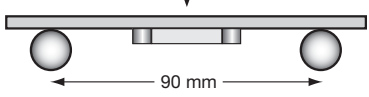


Insulation Resistance vs. Temperature



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)		