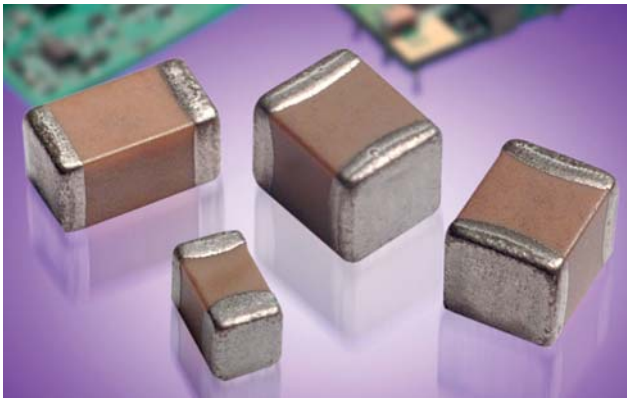
X7R Dielectric

General Specifications



X7R formulations are called “temperature stable” ceramics and fall into EIA Class II materials. X7R is the most popular of these intermediate dielectric constant materials. Its temperature variation of capacitance is within ±15% from -55°C to +125°C. This capacitance change is non-linear.

Capacitance for X7R varies under the influence of electrical operating conditions such as voltage and frequency.

X7R dielectric chip usage covers the broad spectrum of industrial applications where known changes in capacitance due to applied voltages are acceptable.

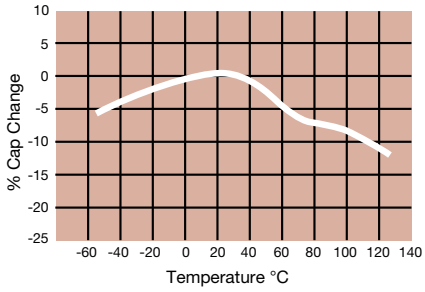
RoHS COMPLIANT

PART NUMBER (see page 2 for complete part number explanation)

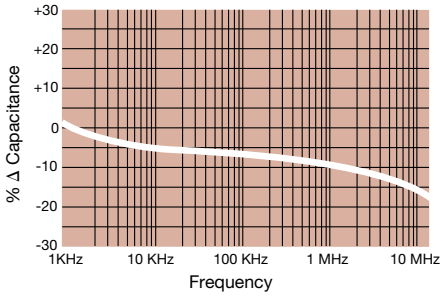
0805	5	C	103	M	A	T	2	A
Size (L" x W")	**Voltage** 4V = 4 6.3V = 6 10V = Z 16V = Y 25V = 3 50V = 5 100V = 1 200V = 2 500V = 7	**Dielectric** X7R = C	**Capacitance Code (In pF)** 2 Sig. Digits + Number of Zeros	**Capacitance Tolerance** J = ± 5%* K = ±10% M = ± 20% *≤1µF only, contact factory for additional values	**Failure Rate** A = Not Applicable	**Terminations** T = Plated Ni and Sn 7 = Gold Plated* Z = FLEXITERM®** *Optional termination **See FLEXITERM® X7R section	**Packaging** 2 = 7" Reel 4 = 13" Reel 7 = Bulk Cass. 9 = Bulk **Contact Factory For Multiples**	**Special Code** A = Std. Product

NOTE: Contact factory for availability of Termination and Tolerance Options for Specific Part Numbers. Contact factory for non-specified capacitance values.

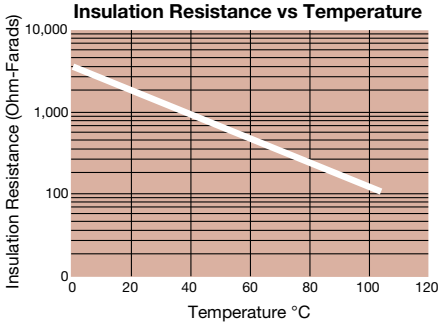
X7R Dielectric
Typical Temperature Coefficient



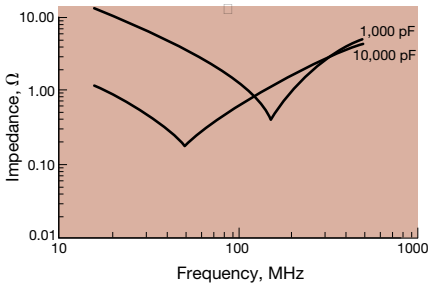
Δ Capacitance vs. Frequency



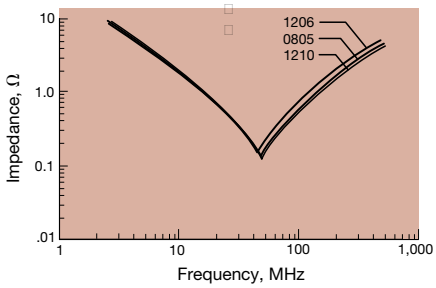
Insulation Resistance vs Temperature



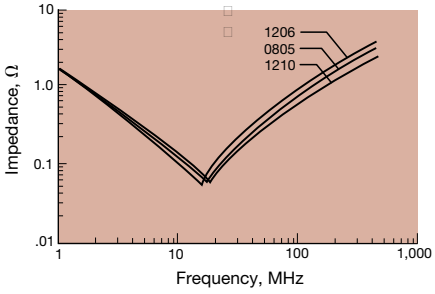
Variation of Impedance with Cap Value
Impedance vs. Frequency
1,000 pF vs. 10,000 pF - X7R
0805



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

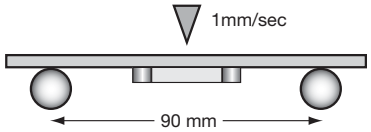


Variation of Impedance with Chip Size
Impedance vs. Frequency
100,000 pF - X7R



X7R Dielectric

Specifications and Test Methods

Parameter/Test		X7R Specification Limits	Measuring Conditions	
Operating Temperature Range		-55ºC to +125ºC	Temperature Cycle Chamber	
Capacitance		Within specified tolerance	Freq.: 1.0 kHz ± 10% Voltage: 1.0Vrms ± .2V	
Dissipation Factor		≤ 2.5% for ≥ 50V DC rating ≤ 3.0% for 25V DC rating ≤ 3.5% for 25V and 16V DC rating ≤ 5.0% for ≤ 10V DC rating		
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 300% of rated voltage for 1-5 seconds, w/charge and discharge current limited to 50 mA (max) Note: Charge device with 150% of rated voltage for 500V devices.	
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		≥ 95% of each terminal should be covered with fresh solder	Dip device in eutectic solder at 230 ± 5ºC for 5.0 ± 0.5 seconds	
Resistance to Solder Heat	Appearance	No defects, <25% leaching of either end terminal	Dip device in eutectic solder at 260ºC for 60 seconds. Store at room temperature for 24 ± 2 hours before measuring electrical properties.	
	Capacitance Variation	≤ ±7.5%		
	Dissipation Factor	Meets Initial Values (As Above)		
	Insulation Resistance	Meets Initial Values (As Above)		
	Dielectric Strength	Meets Initial Values (As Above)		
Thermal Shock	Appearance	No visual defects	Step 1: -55ºC ± 2º	30 ± 3 minutes
	Capacitance Variation	≤ ±7.5%	Step 2: Room Temp	≤ 3 minutes
	Dissipation Factor	Meets Initial Values (As Above)	Step 3: +125ºC ± 2º	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	Charge device with 1.5 rated voltage (≤ 10V) in test chamber set at 125ºC ± 2ºC for 1000 hours (+48, -0) Remove from test chamber and stabilize at room temperature for 24 ± 2 hours 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	Store in a test chamber set at 85ºC ± 2ºC/ 85% ± 5% relative humidity for 1000 hours (+48, -0) with rated voltage applied. Remove from chamber and stabilize at room temperature and humidity for 24 ± 2 hours 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)		

X7R Dielectric

Capacitance Range

PREFERRED SIZES ARE SHADED

SIZE			0101*	0201				0402					0603							0805							1206						
Soldering			Reflow Only	Reflow Only				Reflow/Wave					Reflow/Wave							Reflow/Wave							Reflow/Wave						
Packaging			Paper/Embossed	All Paper				All Paper					All Paper							Paper/Embossed							Paper/Embossed						
(L) Length		mm	0.40 ± 0.02	0.60 ± 0.03				1.00 ± 0.10					1.60 ± 0.15							2.01 ± 0.20							3.20 ± 0.20						
		(in.)	(0.016 ± 0.0008)	(0.024 ± 0.001)				(0.040 ± 0.004)					(0.063 ± 0.006)							(0.079 ± 0.008)							(0.126 ± 0.008)						
(W) Width		mm	0.20 ± 0.02	0.30 ± 0.03				0.50 ± 0.10					0.81 ± 0.15							1.25 ± 0.20							1.60 ± 0.20						
		(in.)	(0.008 ± 0.0008)	(0.011 ± 0.001)				(0.020 ± 0.004)					(0.032 ± 0.006)							(0.049 ± 0.008)							(0.063 ± 0.008)						
(t) Terminal		mm	0.20 ± 0.02	0.15 ± 0.05				0.25 ± 0.15					0.35 ± 0.15							0.50 ± 0.25							0.50 ± 0.25						
		(in.)	(0.008 ± 0.0008)	(0.006 ± 0.002)				(0.010 ± 0.006)					(0.014 ± 0.006)							(0.020 ± 0.010)							(0.020 ± 0.010)						
		WVDC	10	10	16	25	50	6.3	10	16	25	50	6.3	10	16	25	50	100	200	6.3	10	16	25	50	100	200	6.3	10	16	25	50	100	200	500
Cap	100	101	A	A	A	A	A			C	C						G	G	G														
(pF)	150	151	A	A	A	A	A			C	C						G	G	G														
	220	221	A	A	A	A	A			C	C						G	G	G														
	330	331	A	A	A	A	A			C	C						G	G	G		J	J	J	J	J	J							K
	470	471	A	A	A	A	A			C	C						G	G	G		J	J	J	J	J	J							K
	680	681	A	A	A	A				C	C						G	G	G		J	J	J	J	J	J							K
	1000	102	A	A	A	A			C	C	C						G	G	G		J	J	J	J	J	J							K
	1500	152		A	A				C	C	C						G	G			J	J	J	J	J	J		J	J	J	J	J	J	M
	2200	222		A	A				C	C	C						G	G			J	J	J	J	J	J		J	J	J	J	J	J	M
	3300	332		A	A				C	C	C						G	G			J	J	J	J	J	J		J	J	J	J	J	J	M
	4700	472		A	A				C	C	C						G	G			J	J	J	J	J	J		J	J	J	J	J	J	M
	6800	682		A	A				C	C	C						G	G			J	J	J	J	J	J		J	J	J	J	J	J	P
Cap	0.01	103		A	A				C	C	C					G	G	G			J	J	J	J	J	J		J	J	J	J	J	J	P
(µF)	0.015	153							C	C	C					G	G	G			J	J	J	J	J	J		J	J	J	J	J	M	
	0.022	223							C	C	C					G	G	G			J	J	J	J	J	N		J	J	J	J	J	M	
	0.033	333							C	C	C					G	G				J	J	J	J	N			J	J	J	J	J	M	
	0.047	473							C	C	C				G	G	G				J	J	J	J	N			J	J	J	J	J	M	
	0.068	683							C	C	C				G	G	G				J	J	J	J	N			J	J	J	J	J	P	
	0.1	104							C	C	C			G	G	G	G				J	J	J	J	N			J	J	J	J	M	P	
	0.15	154											G	G	G	G					J	J	J	N	N			J	J	J	J	Q		
	0.22	224											G	G	J	J					J	J	N	N	N			J	J	J	J	Q		
	0.33	334											J	J	J	J					N	N	N	N	N			J	J	M	P	Q		
	0.47	474											J	J	J	J					N	N	N	N	N			M	M	M	P	Q		
	0.68	684											J	J	J						N	N	N					M	M	Q	Q	Q		
	1.0	105						C					J	J	J	J					N	N	N	N				M	M	Q	Q	Q		
	2.2	225											J	J							P	P	P	P				Q	Q	Q	Q	Q		
	4.7	475																			P	P	P					Q	Q	Q	Q			
	10	106																		P	P							Q	Q	Q				
	22	226																									Q	Q						
	47	476																																
	100	107																																
		WVDC	10	10	16	25	50	6.3	10	16	25	50	6.3	10	16	25	50	100	200	6.3	10	16	25	50	100	200	6.3	10	16	25	50	100	200	500
		SIZE	0101	0201				0402					0603							0805							1206						

Letter	A	B	C	E	G	J	K	M	N	P	Q	X	Y	Z
Max. Thickness	0.33 (0.013)	0.22 (0.009)	0.56 (0.022)	0.71 (0.028)	0.90 (0.035)	0.94 (0.037)	1.02 (0.040)	1.27 (0.050)	1.40 (0.055)	1.52 (0.060)	1.78 (0.070)	2.29 (0.090)	2.54 (0.100)	2.79 (0.110)
	PAPER						EMBOSSED							

NOTE: Contact factory for non-specified capacitance values

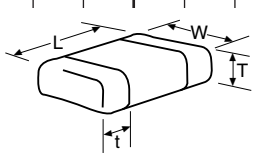
*EIA 01005

X7R Dielectric

Capacitance Range

PREFERRED SIZES ARE SHADED

SIZE			1210							1812						1825			2220					2225		
Soldering			Reflow Only							Reflow Only						Reflow Only			Reflow Only					Reflow Only		
Packaging			Paper/Embossed							All Embossed						All Embossed			All Embossed					All Embossed		
(L) Length		mm (in.)	3.20 ± 0.20 (0.126 ± 0.008)							4.50 ± 0.30 (0.177 ± 0.012)						4.50 ± 0.30 (0.177 ± 0.012)			5.70 ± 0.40 (0.225 ± 0.016)					5.72 ± 0.25 (0.225 ± 0.010)		
(W) Width		mm (in.)	2.50 ± 0.20 (0.098 ± 0.008)							3.20 ± 0.20 (0.126 ± 0.008)						6.40 ± 0.40 (0.252 ± 0.016)			5.00 ± 0.40 (0.197 ± 0.016)					6.35 ± 0.25 (0.250 ± 0.010)		
(t) Terminal		mm (in.)	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)					0.64 ± 0.39 (0.025 ± 0.015)		
		WVDC	10	16	25	50	100	200	500	16	25	50	100	200	500	50	100	200	25	50	100	200	500	50	100	200
Cap	100	101																								
(pF)	150	151																								
	220	221																								
	330	331																								
	470	471																								
	680	681																								
	1000	102																								
	1500	152	J	J	J	J	J	J	M																	
	2200	222	J	J	J	J	J	J	M																	
	3300	332	J	J	J	J	J	J	M																	
	4700	472	J	J	J	J	J	J	M																	
	6800	682	J	J	J	J	J	J	M																	
Cap	0.01	103	J	J	J	J	J	J	M		K	K	K	K	K	M	M	M		X	X	X	X	M	P	P
(µF)	0.015	153	J	J	J	J	J	J	P		K	K	K	K	P	M	M	M		X	X	X	X	M	P	P
	0.022	223	J	J	J	J	J	J	Q		K	K	K	K	P	M	M	M		X	X	X	X	M	P	P
	0.033	333	J	J	J	J	J	J	Q		K	K	K	K	X	M	M	M		X	X	X	X	M	P	P
	0.047	473	J	J	J	J	J	J	Q		K	K	K	K	Z	M	M	M		X	X	X	X	M	P	P
	0.068	683	J	J	J	J	J	M	Q		K	K	K	K	Z	M	M	M		X	X	X	X	M	P	P
	0.1	104	J	J	J	J	J	M			K	K	K	K	Z	M	M	M		X	X	X	X	M	P	P
	0.15	154	J	J	J	J	M	Z			K	K	K	P	Z	M	M	M		X	X	X	X	M	P	X
	0.22	224	J	J	J	J	P	Z			K	K	K	P		M	M	M		X	X	X	X	M	P	X
	0.33	334	J	J	J	J	Q				K	K	M	X		M	M			X	X	X	X	M	P	X
	0.47	474	M	M	M	M	Q				K	K	P			M	M			X	X	X	X	M	P	X
	0.68	684	M	M	P	X	X				M	M	Q			M	P			X	X			M	P	X
	1.0	105	N	N	P	X	Z				M	M	X	Z		M	P			X	X			M	P	X
	1.5	155	N	N	Z	Z	Z				Z	Z	Z			M				X	X			M	X	
	2.2	225	X	X	Z	Z	Z				Z	Z	Z							X	X			M	X	
	3.3	335	X	X	Z	Z					Z	Z	Z							X	Z					
	4.7	475	X	X	Z	Z					Z	Z								X	Z					
	10	106	Z	Z	Z	Z				Z										Z	Z					
	22	226	Z	Z	Z														Z							
	47	476	Z																							
	100	107																								
		WVDC	10	16	25	50	100	200	500	16	25	50	100	200	500	50	100	200	25	50	100	200	500	50	100	200
SIZE			1210							1812						1825			2220					2225		



Letter	A	B	C	E	G	J	K	M	N	P	Q	X	Y	Z
Max. Thickness	0.33 (0.013)	0.22 (0.009)	0.56 (0.022)	0.71 (0.028)	0.90 (0.035)	0.94 (0.037)	1.02 (0.040)	1.27 (0.050)	1.40 (0.055)	1.52 (0.060)	1.78 (0.070)	2.29 (0.090)	2.54 (0.100)	2.79 (0.110)
	PAPER						EMBOSSED							

NOTE: Contact factory for non-specified capacitance values