

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 $\pm 15\%$ from -55°C to $+125^{\circ}\text{C}$. 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.



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 = $\pm 5\%$ * K = $\pm 10\%$ M = $\pm 20\%$ * $\leq 1\mu\text{F}$ 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.



Specifications and Test Methods

Parameter/Test		X7R Specification Limits	Measuring Conditions	
Operating Temperature Range		-55°C to +125°C	Temperature Cycle Chamber	
Capacitance		Within specified tolerance	Freq.: 1.0 kHz $\pm$ 10% Voltage: 1.0Vrms $\pm$.2V	
Dissipation Factor		$\leq 2.5\%$ for $\geq 50V$ DC rating $\leq 3.0\%$ for 25V DC rating $\leq 3.5\%$ for 25V and 16V DC rating $\leq 5.0\%$ for $\leq 10V$ DC rating		
Insulation Resistance		100,000M Ω or 1000M Ω - μ F, whichever is less	Charge device with rated voltage for 120 $\pm$ 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  1mm/sec 90 mm	
	Capacitance Variation	$\leq \pm 12\%$		
	Dissipation Factor	Meets Initial Values (As Above)		
	Insulation Resistance	$\geq$ Initial Value x 0.3		
Solderability		$\geq 95\%$ of each terminal should be covered with fresh solder	Dip device in eutectic solder at 230 $\pm$ 5°C for 5.0 $\pm$ 0.5 seconds	
Resistance to Solder Heat	Appearance	No defects, <25% leaching of either end terminal	Dip device in eutectic solder at 260°C for 60 seconds. Store at room temperature for 24 $\pm$ 2 hours before measuring electrical properties.	
	Capacitance Variation	$\leq \pm 7.5\%$		
	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: -55°C $\pm$ 2°	30 $\pm$ 3 minutes
	Capacitance Variation	$\leq \pm 7.5\%$	Step 2: Room Temp	≤ 3 minutes
	Dissipation Factor	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	≤ 3 minutes
	Dielectric Strength	Meets Initial Values (As Above)	Repeat for 5 cycles and measure after 24 $\pm$ 2 hours at room temperature	
Load Life	Appearance	No visual defects	Charge device with 1.5 rated voltage ($\leq 10V$) in test chamber set at 125°C $\pm$ 2°C for 1000 hours (+48, -0) Remove from test chamber and stabilize at room temperature for 24 $\pm$ 2 hours before measuring.	
	Capacitance Variation	$\leq \pm 12.5\%$		
	Dissipation Factor	$\leq$ Initial Value x 2.0 (See Above)		
	Insulation Resistance	$\geq$ 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 85°C $\pm$ 2°C/ 85% $\pm$ 5% relative humidity for 1000 hours (+48, -0) with rated voltage applied. Remove from chamber and stabilize at room temperature and humidity for 24 $\pm$ 2 hours before measuring.	
	Capacitance Variation	$\leq \pm 12.5\%$		
	Dissipation Factor	$\leq$ Initial Value x 2.0 (See Above)		
	Insulation Resistance	$\geq$ 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	500
Cap	100	101	A	A	A	A			C	C					G	G	G									
(pF)	150	151	A	A	A	A			C	C					G	G	G									
	220	221	A	A	A	A			C	C					G	G	G									
	330	331	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	M
	2200	222		A	A				C	C	C				G	G			J	J	J	J	J	J	J	M
	3300	332		A	A				C	C	C				G	G			J	J	J	J	J	J	J	M
	4700	472		A	A				C	C	C				G	G			J	J	J	J	J	J	J	M
	6800	682		A	A				C	C	C				G	G			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	P
(µF)	0.015	153							C	C	C				G	G	G		J	J	J	J	J	J		M
	0.022	223							C	C	C				G	G	G		J	J	J	J	J	J		M
	0.033	333							C	C	C				G	G			J	J	J	J	J	J		M
	0.047	473							C	C	C				G	G	G		J	J	J	J	J	N		M
	0.068	683							C	C	C				G	G	G		J	J	J	J	N			M
	0.1	104							C	C	C				G	G	G	G	J	J	J	J	N			P
	0.15	154										G	G	G	G				J	J	J	N	N			Q
	0.22	224										G	G	J	J				J	J	N	N	N	N		Q
	0.33	334										J	J	J	J				N	N	N	N	N	N		Q
	0.47	474										J	J	J	J				N	N	N	N	N	N		Q
	0.68	684										J	J	J	J				N	N	N	N				Q
	1.0	105										J	J	J	J				N	N	N	N				Q
	2.2	225										J	J	J					P	P	P	P				Q
	4.7	475																	P	P	P					Q
	10	106																	P	P						Q
	22	226																								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	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



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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																						
	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