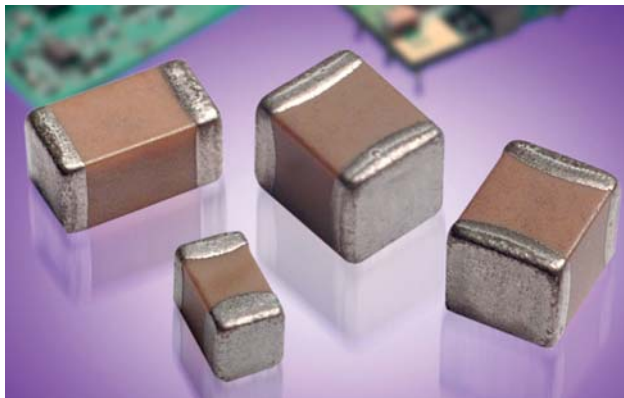


# X7R Dielectric

## 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  $-55^{\circ}\text{C}$  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.

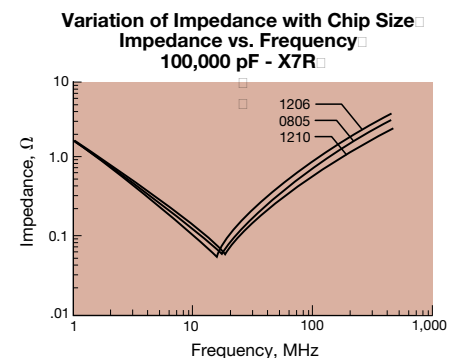
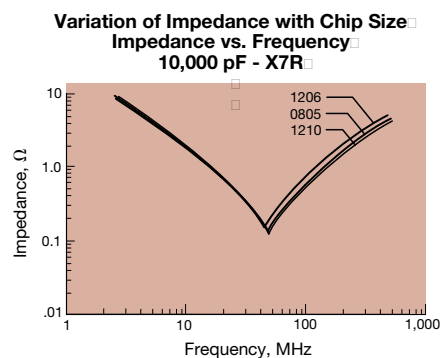
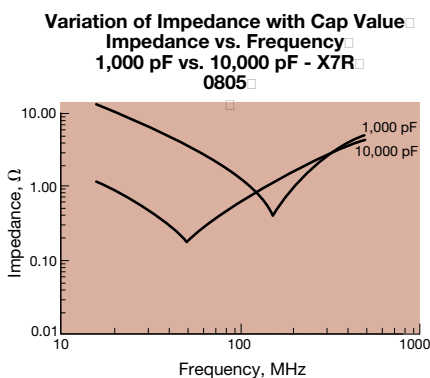
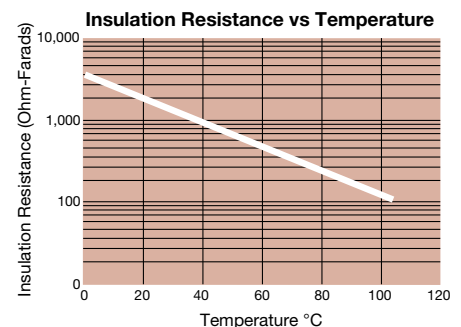
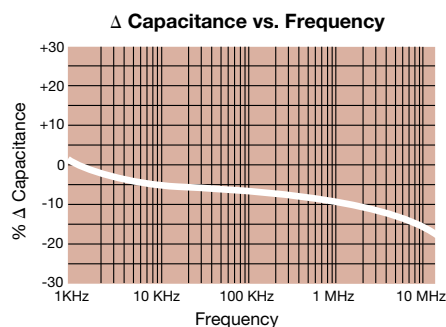
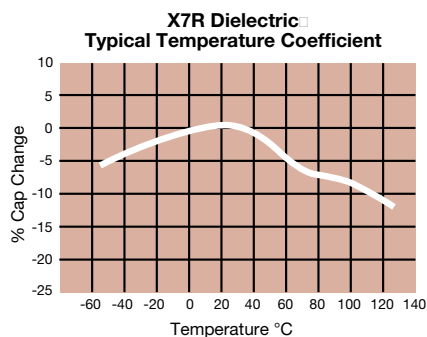
X7R dielectric chip usage covers the broad spectrum of industrial applications where known changes in capacitance due to applied voltages are acceptable.



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

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

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	
<b>Operating Temperature Range</b>		-55°C to +125°C	Temperature Cycle Chamber	
<b>Capacitance</b>		Within specified tolerance		
<b>Dissipation Factor</b>		$\leq 2.5\%$ 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	Freq.: 1.0 kHz $\pm$ 10% Voltage: 1.0Vrms $\pm$ .2V	
<b>Insulation Resistance</b>		100,000M $\Omega$ or 1000M $\Omega$ - $\mu$ F, whichever is less	Charge device with rated voltage for 120 $\pm$ 5 secs @ room temp/humidity	
<b>Dielectric Strength</b>		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.	
<b>Resistance to Flexure Stresses</b>	Appearance	No defects	Deflection: 2mm Test Time: 30 seconds 	
	Capacitance Variation	$\leq \pm 12\%$		
	Dissipation Factor	Meets Initial Values (As Above)		
	Insulation Resistance	$\geq$ Initial Value $\times$ 0.3		
<b>Solderability</b>		$\geq 95\%$ 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	
<b>Resistance to Solder Heat</b>	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)		
<b>Thermal Shock</b>	Appearance	No visual defects	Step 1: -55°C $\pm$ 2°	30 $\pm$ 3 minutes
	Capacitance Variation	$\leq \pm 7.5\%$	Step 2: Room Temp	$\leq 3$ 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	$\leq 3$ minutes
	Dielectric Strength	Meets Initial Values (As Above)	Repeat for 5 cycles and measure after 24 $\pm$ 2 hours at room temperature	
<b>Load Life</b>	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 $\times$ 2.0 (See Above)		
	Insulation Resistance	$\geq$ Initial Value $\times$ 0.3 (See Above)		
	Dielectric Strength	Meets Initial Values (As Above)		
<b>Load Humidity</b>	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 $\times$ 2.0 (See Above)		
	Insulation Resistance	$\geq$ Initial Value $\times$ 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 (0.016 ± 0.0008)	0.60 ± 0.03 (0.024 ± 0.001)			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)													
(W) Width	mm (0.008 ± 0.0008)	0.30 ± 0.03 (0.011 ± 0.001)			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)													
(t) Terminal	mm (0.008 ± 0.0008)	0.15 ± 0.05 (0.006 ± 0.002)			0.25 ± 0.15 (0.010 ± 0.006)			0.35 ± 0.15 (0.014 ± 0.006)				0.50 ± 0.25 (0.020 ± 0.010)				0.50 ± 0.25 (0.020 ± 0.010)													
WVDC	10	10	16	25	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 (pF)	100	A	A	A	A																								
	150	A	A	A	A																								
	220	A	A	A	A		C																						
	330	A	A	A	A		C					G	G	G	J	J	J	J	J	J	J								K
	470	A	A	A	A		C					G	G	G	J	J	J	J	J	J	J								K
	680	A	A	A	A		C					G	G	G	J	J	J	J	J	J	J								K
	1000	A	A	A			C					G	G	G	J	J	J	J	J	J	J								M
	1500		A				C					G	G	G	J	J	J	J	J	J	J		J	J	J	J	J	J	M
	2200		A				C					G	G	G	J	J	J	J	J	J	J		J	J	J	J	J	J	M
	3300		A				C					G	G	G	J	J	J	J	J	J	J		J	J	J	J	J	J	M
	4700		A				C					G	G	G	J	J	J	J	J	J	J		J	J	J	J	J	J	M
	6800		A				C					G	G	G	J	J	J	J	J	J	J		J	J	J	J	J	J	P
Cap (µF)	0.010		A				C					G	G	G	J	J	J	J	J	J	J		J	J	J	J	J	J	P
	0.015						C					G	G	G	J	J	J	J	J	J	J		J	J	J	J	J	J	M
	0.022						C					G	G	G	J	J	J	J	J	J	J		J	J	J	J	J	J	M
	0.033						C					G	G	G	J	J	J	J	J	N			J	J	J	J	J	M	
	0.047						C					G	G	G	J	J	J	J	J	N			J	J	J	J	J	M	
	0.068						C					G	G	G	J	J	J	J	J	N			J	J	J	J	J	P	
	0.10						C					G	G	G	J	J	J	J	J	N			J	J	J	J	M	P	
	0.15											G	G		J	J	J	J	N				J	J	J	J	Q		
	0.22											G			J	J	J	N	N				J	J	J	J	Q		
	0.33														N	N	N	N	N				J	J	M	P	Q		
	0.47														N	N	N	N	N				M	M	M	P	Q		
	0.68														N	N	N	N	N				M	M	Q	Q	Q		
	1.0														N	N	N	N					M	M	Q	Q	Q		
	1.5														N	N	N	N					P	Q	Q	Q			
	2.2														J*								Q	Q	Q		Q*		
	3.3																												
	4.7																												
	10														P*	P*	P*												
	22																												
	47																												
	100																												
WVDC	10	10	16	25	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

Letter	A	C	E	G	J	K	M	N	P	Q	X	Y	Z
Max. Thickness	0.33 (0.013)	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					EMBOSSSED							

\*Optional Specifications – Contact factory

# X7R Dielectric

## Capacitance Range

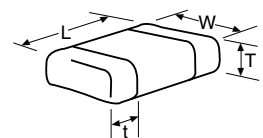


### PREFERRED SIZES ARE SHADED

SIZE	1210							1812				1825		2220				2225		
	Reflow Only							Reflow Only				Reflow Only		Reflow Only				Reflow Only		
Soldering	Paper/Embossed							All Embossed				All Embossed		All Embossed				All Embossed		
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	50	100	200	500	50	100	25	50	100	200	50	100	
Cap (pF)	100																			
	150																			
	220																			
	330																			
	470																			
	680																			
	1000																			
	1500	J	J	J	J	J	J	M												
	2200	J	J	J	J	J	J	M												
	3300	J	J	J	J	J	J	M												
	4700	J	J	J	J	J	J	M												
	6800	J	J	J	J	J	J	M												
Cap (µF)	0.010	J	J	J	J	J	J	M	K	K	K	K	M	M		X	X	X	M	P
	0.015	J	J	J	J	J	J	M	K	K	K	P	M	M		X	X	X	M	P
	0.022	J	J	J	J	J	J	M	K	K	K	P	M	M		X	X	X	M	P
	0.033	J	J	J	J	J	J	Q	K	K	K	X	M	M		X	X	X	M	P
	0.047	J	J	J	J	J	J		K	K	K	Z	M	M		X	X	X	M	P
	0.068	J	J	J	J	J	M		K	K	K	Z	M	M		X	X	X	M	P
	0.10	J	J	J	J	J	M		K	K	K	Z	M	M		X	X	X	M	P
	0.15	J	J	J	J	M	Z		K	K	P		M	M		X	X	X	M	P
	0.22	J	J	J	J	P	Z		K	K	P		M	M		X	X	X	M	P
	0.33	J	J	J	J	Q			K	M	X		M	M		X	X	X	M	P
	0.47	M	M	M	M	Q			K	P			M	M		X	X	X	M	P
	0.68	M	M	P	X	X			M	Q			M	P		X	X		M	P
	1.0	N	N	P	X	Z			M	X			M	P		X	X		M	P
	1.5	N	N	Z	Z	Z			Z	Z			M			X	X		M	X
	2.2	X	X	Z	Z	Z			Z	Z						X	X		M	
	3.3	X	X	Z	Z				Z							X	Z			
	4.7	X	X	Z	Z				Z							X	Z			
	10	Z	Z	Z*												Z				
	22	Z*	Z*																	
	47																			
	100																			
WVDC	10	16	25	50	100	200	500	50	100	200	500	50	100	25	50	100	200	50	100	

Letter	A	C	E	G	J	K	M	N	P	Q	X	Y	Z
Max. Thickness	0.33 (0.013)	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					EMBOSSSED							



\*Optional Specifications – Contact factory

# How to Order

## Part Number Explanation

### Commercial Surface Mount Chips

#### EXAMPLE: 08055A101JAT2A

0805	5	A	101	J*	A	T	2	A
<b>Size</b> (L" x W")	<b>Voltage</b>	<b>Dielectric</b>	<b>Capacitance</b>	<b>Tolerance</b>	<b>Failure Rate</b>	<b>Terminations</b>	<b>Packaging</b>	<b>Special Code</b>
0201 0402 0603 0805 1206 1210 1812 1825 2220 2225	4 = 4V 6 = 6.3V Z = 10V Y = 16V 3 = 25V D = 35V 5 = 50V 1 = 100V 2 = 200V	A = NP0(C0G) C = X7R D = X5R G = Y5V U = U Series W = X6S Z = X7S	2 Sig. Fig + No. of Zeros Examples: 100 = 10 pF 101 = 100 pF 102 = 1000 pF 223 = 22000 pF 224 = 220000 pF 105 = 1µF 106 = 10µF 107 = 100µF For values below 10 pF, use "R" in place of Decimal point, e.g., 9.1 pF = 9R1.	B = ±.10 pF C = ±.25 pF D = ±.50 pF F = ±1% (≥ 25 pF) G = ±2% (≥ 13 pF) J = ±5% K = ±10% M = ±20% Z = +80%, -20% P = +100%, -0%	A = N/A	T = Plated Ni and Sn 7 = Gold Plated	<u>Available</u> 2 = 7" Reel 4 = 13" Reel 7 = Bulk Cass. 9 = Bulk	A = Std.
	<b>Contact Factory for Special Voltages</b> F = 63V    9 = 300V * = 75V    X = 350V E = 150V    8 = 400V V = 250V					<b>Contact Factory For 1 = Pd/Ag Term</b>	<b>Contact Factory For Multiples</b>	
						* B, C & D tolerance for ≤10 pF values. Standard Tape and Reel material (Paper/Embossed) depends upon chip size and thickness. See individual part tables for tape material type for each capacitance value.		

### High Voltage Surface Mount Chips

#### EXAMPLE: 1808AA271KA11A

1808	A	A	271	K	A	1	1A
<b>AVX Style</b>	<b>Voltage</b>	<b>Temperature Coefficient</b>	<b>Capacitance Code</b>	<b>Capacitance Tolerance</b>	<b>Failure Rate</b>	<b>Termination</b>	<b>Packaging/Marking</b>
1206 1210 1808 1812 1825 2220 2225 3640	7 = 500V C = 600V A = 1000V S = 1500V G = 2000V W = 2500V H = 3000V J = 4000V K = 5000V	A = C0G C = X7R	(2 significant digits + no. of zeros) Examples: 10 pF = 100 100 pF = 101 1,000 pF = 102 22,000 pF = 223 220,000 pF = 224 1 µF = 105	C0G: J = ±5% K = ±10% M = ±20% X7R: K = ±10% M = ±20% Z = +80%, -20%	A=Not Applicable	1 = Pd/Ag T = Plated Ni and Sn	1A = 7" Reel Unmarked 3A = 13" Reel Unmarked 9A = Bulk/Unmarked

### Ultra Thin Surface Mount Chips

#### EXAMPLE: UT023C223MAT2A

UT	02	3	C	223	M	A	T	2	A
<b>Style</b>	<b>Case Size</b>	<b>Voltage</b>	<b>Dielectric</b>	<b>Capacitance Code (In pF)</b>	<b>Capacitance Tolerance</b>	<b>Std.</b>	<b>Term</b>	<b>Packaging Code</b>	<b>Terminations Code (max.)</b>
Ultrathin	01 = 0603 02 = 0805 03 = 1206	Y = 16Vdc 3 = 25Vdc 5 = 50Vdc	A = C0G C = X7R	2 Sig Digits + Number of Zeros			T = Plated Ni and Sn	2 = 7" reel	A = 0.50mm (0.020) B = 0.40mm (0.016) C = 0.35mm (0.014)

Please handle these products with due care as they are inherently more fragile than standard MLC capacitors because of their physical dimensions.

# How to Order

## Part Number Explanation



### Capacitor Array

#### EXAMPLE: W2A43C103MAT2A

<b>W</b>	<b>2</b>	<b>A</b>	<b>4</b>	<b>3</b>	<b>C</b>	<b>103</b>	<b>M</b>	<b>A</b>	<b>T</b>	<b>2A</b>
<b>Style</b>	<b>Case Size</b>	<b>Array</b>	<b>Number of Caps</b>	<b>Voltage</b>	<b>Dielectric</b>	<b>Capacitance Code (In pF)</b>	<b>Capacitance Tolerance</b>	<b>Failure Rate</b>	<b>Termination Code</b>	<b>Packaging &amp; Quantity Code</b>
	1 = 0405 2 = 0508 3 = 0612			6 = 6.3V Z = 10V Y = 16V 3 = 25V 5 = 50V 1 = 100V	A = NP0 C = X7R D = X5R	2 Sig Digits + Number of Zeros	J = ±5% K = ±10% M = ±20%		T = Plated Ni and Sn	2A = 7" Reel (4000) 4A = 13" Reel (10000) 2F = 7" Reel (1000)

### Low Inductance Capacitors (LICC)

#### EXAMPLE: 0612ZD105MAT2A

<b>0612</b>	<b>Z</b>	<b>D</b>	<b>105</b>	<b>M</b>	<b>A</b>	<b>T</b>	<b>2</b>	<b>A</b>
<b>Size</b>	<b>Voltage</b>	<b>Dielectric</b>	<b>Capacitance Code (In pF)</b>	<b>Capacitance Tolerance</b>	<b>Failure Rate</b>	<b>Terminations</b>	<b>Packaging Available</b>	<b>Thickness</b>
0306 0508 0612	6 = 6.3V Z = 10V Y = 16V 3 = 25V	C = X7R D = X5R	2 Sig. Digits + Number of Zeros	K = ±10% M = ±20%	A = N/A	T = Plated Ni and Sn	2 = 7" Reel 4 = 13" Reel	See Page 34 for Codes

### Interdigitated Capacitors (IDC)

#### EXAMPLE: W3L16D225MAT3A

<b>W</b>	<b>3</b>	<b>L</b>	<b>1</b>	<b>6</b>	<b>D</b>	<b>225</b>	<b>M</b>	<b>A</b>	<b>T</b>	<b>3</b>	<b>A</b>
<b>Style</b>	<b>Case Size</b>	<b>Low Inductance</b>	<b>Number of Caps</b>	<b>Voltage</b>	<b>Dielectric</b>	<b>Capacitance Code (In pF)</b>	<b>Capacitance Tolerance</b>	<b>Failure Rate</b>	<b>Termination</b>	<b>Packaging Available</b>	<b>Thickness</b>
	2 = 0508 3 = 0612	ESL = 95pH ESL = 120pH		4 = 4V 6 = 6.3V Z = 10V Y = 16V	C = X7R D = X5R	2 Sig. Digits + Number of Zeros	K = ±10% M = ±20%	A = N/A	T = Plated Ni and Sn	1=7" Reel 3=13" Reel	<u>Max. Thickness</u> mm (in.) A=0.95 (0.037) S=0.55 (0.022)

### Decoupling Capacitor Arrays (LICA)

#### EXAMPLE: LICA3T183M3FC4AA

<b>LICA</b>	<b>3</b>	<b>T</b>	<b>183</b>	<b>M</b>	<b>3</b>	<b>F</b>	<b>C</b>	<b>4</b>	<b>A</b>	<b>A</b>
<b>Style &amp; Size</b>	<b>Voltage</b>	<b>Dielectric</b>	<b>Cap/Section (EIA Code)</b>	<b>Capacitance Tolerance</b>	<b>Height Code</b>	<b>Termination</b>	<b>Reel Packaging</b>	<b># of Caps/Part</b>	<b>Inspection Code</b>	<b>Code Face</b>
	5V = 9 25V = 3 50V = 5	D = X5R T = T55T S = High K T55T		M = ±20% P = GMV	6 = 0.500mm 3 = 0.650mm 1 = 0.875mm 5 = 1.100mm 7 = 1.600mm	F = C4 Solder Balls- 97Pb/3Sn P = Cr-Cu-Au N = Cr-Ni-Au X = None	M = 7" Reel R = 13" Reel 6 = 2"x2" Waffle Pack 8 = 2"x2" Black Waffle Pack 7 = 2"x2" Waffle Pack w/ termination facing up A = 2"x2" Black Waffle Pack w/ termination facing up C = 4"x4" Waffle Pack w/ clear lid	1 = one 2 = two 4 = four	A = Standard B = Established Reliability Testing	A = Bar B = No Bar C = Dot, S55S Dielectrics

