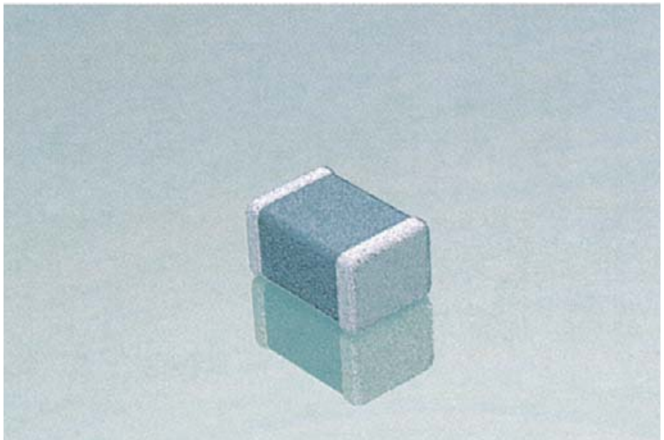
C0G (NP0) Dielectric

General Specifications



C0G (NP0) is the most popular formulation of the “temperature-compensating,” EIA Class I ceramic materials. Modern C0G (NP0) formulations contain neodymium, samarium and other rare earth oxides.

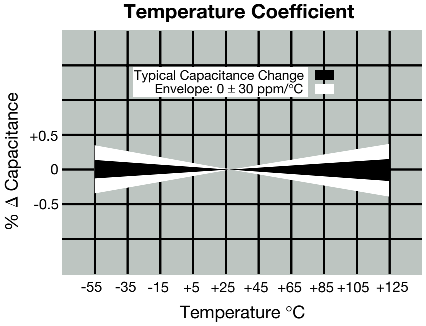
C0G (NP0) ceramics offer one of the most stable capacitor dielectrics available. Capacitance change with temperature is 0 ±30ppm/°C which is less than ±0.3% Δ C from -55°C to +125°C. Capacitance drift or hysteresis for C0G (NP0) ceramics is negligible at less than ±0.05% versus up to ±2% for films. Typical capacitance change with life is less than ±0.1% for C0G (NP0), one-fifth that shown by most other dielectrics. C0G (NP0) formulations show no aging characteristics.

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

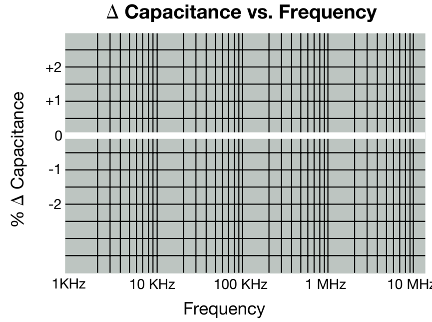
0805	5	A	101	J	A	T	2	A
Size (L" x W")	**Voltage** 6.3V = 6 10V = Z 16V = Y 25V = 3 50V = 5 100V = 1 200V = 2 500V = 7	**Dielectric** C0G (NP0) = A	**Capacitance Code (In pF)** 2 Sig. Digits + Number of Zeros	**Capacitance Tolerance** B = ±.10 pF (<10pF) C = ±.25 pF (<10pF) D = ±.50 pF (<10pF) F = ±1% (≥ 10 pF) G = ±2% (≥ 10 pF) J = ±5% K = ±10%	**Failure Rate** A = Not Applicable	**Terminations** T = Plated Ni and Sn 7 = Gold Plated **Contact Factory For 1 = Pd/Ag Term**	**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.

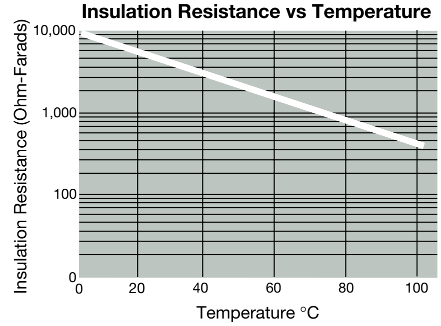
Temperature Coefficient



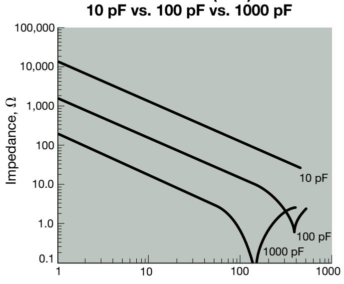
Δ Capacitance vs. Frequency



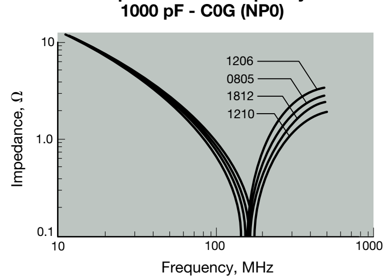
Insulation Resistance vs Temperature



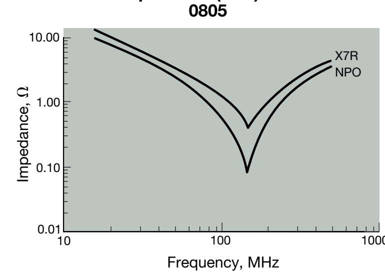
Variation of Impedance with Cap Value
Impedance vs. Frequency
0805 - C0G (NP0)
10 pF vs. 100 pF vs. 1000 pF



Variation of Impedance with Chip Size
Impedance vs. Frequency
1000 pF - C0G (NP0)

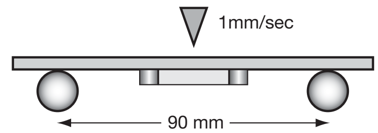


Variation of Impedance with Ceramic Formulation
Impedance vs. Frequency
1000 pF - C0G (NP0) vs X7R
0805



C0G (NP0) Dielectric

Specifications and Test Methods

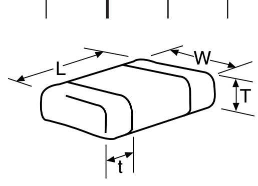
Parameter/Test		NP0 Specification Limits	Measuring Conditions	
Operating Temperature Range		-55ºC to +125ºC	Temperature Cycle Chamber	
Capacitance		Within specified tolerance	Freq.: 1.0 MHz ± 10% for cap ≤ 1000 pF 1.0 kHz ± 10% for cap > 1000 pF Voltage: 1.0Vrms ± .2V	
Q		<30 pF: Q≥ 400+20 x Cap Value ≥30 pF: Q≥ 1000		
Insulation Resistance		100,000MΩ or 1000MΩ - µF, whichever is less	Charge device with rated voltage for 60 ± 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	±5% or ±.5 pF, whichever is greater		
	Q	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	≤ ±2.5% or ±.25 pF, whichever is greater		
	Q	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	≤ ±2.5% or ±.25 pF, whichever is greater	Step 2: Room Temp	≤ 3 minutes
	Q	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 hours at room temperature	
Load Life	Appearance	No visual defects	Charge device with twice rated voltage in test chamber set at 125ºC ± 2ºC for 1000 hours (+48, -0). Remove from test chamber and stabilize at room temperature for 24 hours before measuring.	
	Capacitance Variation	≤ ±3.0% or ± .3 pF, whichever is greater		
	Q (C=Nominal Cap)	≥ 30 pF: Q≥ 350 ≥10 pF, <30 pF: Q≥ 275 +5C/2 <10 pF: Q≥ 200 +10C		
	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 for 24 ± 2 hours before measuring.	
	Capacitance Variation	≤ ±5.0% or ± .5 pF, whichever is greater		
	Q	≥ 30 pF: Q≥ 350 ≥10 pF, <30 pF: Q≥ 275 +5C/2 <10 pF: Q≥ 200 +10C		
	Insulation Resistance	≥ Initial Value x 0.3 (See Above)		
	Dielectric Strength	Meets Initial Values (As Above)		

C0G (NP0) Dielectric

Capacitance Range

PREFERRED SIZES ARE SHADED

SIZE	0201			0402			0603				0805					1206					
Soldering	Reflow Only			Reflow Only			Reflow Only				Reflow/Wave					Reflow/Wave					
Packaging	All Paper			All Paper			All Paper				Paper/Embossed					Paper/Embossed					
(L) Length MM (in.)	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 (in.)	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 (in.)	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	16	25	16	25	50	6.3	25	50	100	16	25	50	100	200	16	25	50	100	200	500
Cap (pF) 0.5			A	C	C	C	G	G	G	G	J	J	J	J	J	J	J	J	J	J	J
1.0			A	C	C	C	G	G	G	G	J	J	J	J	J	J	J	J	J	J	J
1.2			A	C	C	C	G	G	G	G	J	J	J	J	J	J	J	J	J	J	J
1.5	A	A	A	C	C	C	G	G	G	G	J	J	J	J	J	J	J	J	J	J	J
1.8	A	A	A	C	C	C	G	G	G	G	J	J	J	J	J	J	J	J	J	J	J
2.2	A	A	A	C	C	C	G	G	G	G	J	J	J	J	J	J	J	J	J	J	J
2.7	A	A	A	C	C	C	G	G	G	G	J	J	J	J	J	J	J	J	J	J	J
3.3	A	A	A	C	C	C	G	G	G	G	J	J	J	J	J	J	J	J	J	J	J
3.9	A	A	A	C	C	C	G	G	G	G	J	J	J	J	J	J	J	J	J	J	J
4.7	A	A	A	C	C	C	G	G	G	G	J	J	J	J	J	J	J	J	J	J	J
5.6	A	A	A	C	C	C	G	G	G	G	J	J	J	J	J	J	J	J	J	J	J
6.8	A	A	A	C	C	C	G	G	G	G	J	J	J	J	J	J	J	J	J	J	J
8.2	A	A	A	C	C	C	G	G	G	G	J	J	J	J	J	J	J	J	J	J	J
10	A	A	A	C	C	C	G	G	G	G	J	J	J	J	J	J	J	J	J	J	J
12	A	A	A	C	C	C	G	G	G	G	J	J	J	J	J	J	J	J	J	J	J
15	A	A	A	C	C	C	G	G	G	G	J	J	J	J	J	J	J	J	J	J	J
18	A	A	A	C	C	C	G	G	G	G	J	J	J	J	J	J	J	J	J	J	J
22	A	A	A	C	C	C	G	G	G	G	J	J	J	J	J	J	J	J	J	J	J
27	A	A	A	C	C	C	G	G	G	G	J	J	J	J	J	J	J	J	J	J	J
33	A	A	A	C	C	C	G	G	G	G	J	J	J	J	J	J	J	J	J	J	J
39	A	A	A	C	C	C	G	G	G	G	J	J	J	J	J	J	J	J	J	J	J
47	A	A	A	C	C	C	G	G	G	G	J	J	J	J	J	J	J	J	J	J	J
56	A	A	A	C	C	C	G	G	G	G	J	J	J	J	J	J	J	J	J	J	J
68	A	A	A	C	C	C	G	G	G	G	J	J	J	J	J	J	J	J	J	J	J
82	A	A	A	C	C	C	G	G	G	G	J	J	J	J	J	J	J	J	J	J	J
100	A	A	A	C	C	C	G	G	G	G	J	J	J	J	J	J	J	J	J	J	J
120				C	C	C	G	G	G	G	J	J	J	J	J	J	J	J	J	J	J
150				C	C	C	G	G	G	G	J	J	J	J	J	J	J	J	J	J	J
180				C	C	C	G	G	G	G	J	J	J	J	J	J	J	J	J	J	J
220				C	C	C	G	G	G	G	J	J	J	J	J	J	J	J	J	J	M
270							G	G	G	G	J	J	J	J	M	J	J	J	J	J	M
330							G	G	G	G	J	J	J	J	M	J	J	J	J	J	M
390							G	G	G		J	J	J	J	M	J	J	J	J	J	M
470							G	G	G		J	J	J	J	M	J	J	J	J	J	M
560							G	G	G		J	J	J	J	M	J	J	J	J	J	M
680							G	G	G		J	J	J	J		J	J	J	J	J	P
820							G	G	G		J	J	J	J		J	J	J	J	M	
1000							G	G	G		J	J	J	J		J	J	J	J	Q	
1200											J	J	J			J	J	J	J	Q	
1500											J	J	J			J	J	J	M	Q	
1800											J	J	J			J	J	M	M		
2200											J	J	M			J	J	M	P		
2700											J	J	M			J	J	M	P		
3300																J	J	M	P		
3900																J	J	M	P		
4700																J	J	M	P		
5600																J	J	M			
6800																M	M				
8200																M	M				
Cap (μF) 0.010																M	M				
0.012																					
0.015																					
0.018																					
0.022																					
0.027																					
0.033																					
0.039																					
0.047																					
0.068																					
0.082																					
0.1																					
WVDC	10	16	25	16	25	50	6.3	25	50	100	16	25	50	100	200	16	25	50	100	200	500
SIZE	0201			0402			0603				0805					1206					



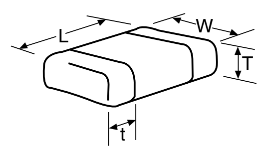
Letter	A	C	E	G	J	K	M	N	P	Q	X	Y	Z
Max. Thickness	0.33 (0.013)	0.56 (0.022)	0.71 (0.028)	0.86 (0.034)	0.94 (0.037)	1.02 (0.040)	1.27 (0.050)	1.40 (0.055)	1.52 (0.060)	1.78 (0.070)	2.29 (0.090)	2.54 (0.100)	2.79 (0.110)
	PAPER					EMBOSSED							

C0G (NP0) 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	25	50	100	200	500	25	50	100	200	500	50	100	200	50	100	200	50	100	200
Cap (pF)	0.5																			
	1.0																			
	1.2																			
	1.5																			
	1.8																			
	2.2																			
	2.7																			
	3.3																			
	3.9																			
	4.7																			
	5.6																			
	6.8																			
	8.2																			
	10					J														
	12					J														
	15					J														
	18					J														
	22					J														
	27					J														
	33					J														
	39					J														
	47					J														
	56					J														
	68					J														
	82					J														
	100					J														
	120					J														
	150					J														
	180					J														
	220					J														
	270					J														
	330					J														
	390					M														
	470					M														
	560	J	J	J	J	M														
	680	J	J	J	J	M														
	820	J	J	J	J	M														
	1000	J	J	J	J	M	K	K	K	K	M	M	M	M				M	M	P
	1200	J	J	J	M		K	K	K	K	M	M	M	M				M	M	P
	1500	J	J	J	M		K	K	K	K	M	M	M	M				M	M	P
	1800	J	J	J	M		K	K	K	K	M	M	M	M				M	M	P
	2200	J	J	J	Q		K	K	K	K	P	M	M	M				M	M	P
	2700	J	J	J	Q		K	K	K	P	Q	M	M	M				M	M	P
	3300	J	J	J			K	K	K	P	Q	M	M	M			X	M	M	P
	3900	J	J	M			K	K	K	P	Q	M	M	M			X	M	M	P
	4700	J	J	M			K	K	K	P	Q	M	M	M	X	X	X	M	M	P
	5600						K	K	M	P	X	M	M	M	X	X	X	M	M	P
	6800						K	K	M	X		M	M	M	X	X	X	M	M	P
	8200						K	M	M			M	M		X	X	X	M	M	P
Cap (µF)	0.010						K	M	M			M	M		X	X	X	M	M	P
	0.012						K	M				M	M		X	X	X	M	M	P
	0.015						M	M				M	M		X	X	X	M	M	Y
	0.018						M	M				P	M		X	X	X	M	M	Y
	0.022						M	M				P			X	X		M	Y	Y
	0.027														X	X		P	Y	Y
	0.033														X	X				
	0.039																			
	0.047																			
	0.068																			
	0.082																			
	0.1																			
	WVDC	25	50	100	200	500	25	50	100	200	500	50	100	200	50	100	200	50	100	200
	SIZE	1210					1812					1825			2200			2225		



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)	0.86 (0.034)	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							

How to Order

Part Number Explanation

Commercial Surface Mount Chips

EXAMPLE: 08055A101JAT2A

0805	5	A	101	J*	A	T	2	A
Size	**Voltage**	**Dielectric**	**Capacitance**	**Tolerance**	**Failure Rate**	**Terminations**	**Packaging**	**Special Code**

Size
(L" x W")
0201
0402
0603
0805
1206
1210
1812
1825
2220
2225

Voltage
4 = 4V
6 = 6.3V
Z = 10V
Y = 16V
3 = 25V
D = 35V
5 = 50V
1 = 100V
2 = 200V

Contact Factory for Special Voltages

F = 63V	9 = 300V
* = 75V	X = 350V
E = 150V	8 = 400V
V = 250V	

Dielectric
A = NP0(C0G)
C = X7R
D = X5R
G = Y5V
U = U Series
W = X6S
Z = X7S

Capacitance
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.

Tolerance
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%

Failure Rate
A = N/A

Terminations
T = Plated Ni and Sn
7 = Gold Plated

Contact Factory For 1 = Pd/Ag Term

Packaging
Available
2 = 7" Reel
4 = 13" Reel
7 = Bulk Cass.
9 = Bulk

Contact Factory For Multiples

Special Code
A = Std.

* 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
AVX Style	**Voltage**	**Temperature Coefficient**	**Capacitance Code**	**Capacitance Tolerance**	**Failure Rate**	**Termination**	**Packaging/Marking**

AVX Style
1206
1210
1808
1812
1825
2220
2225
3640

Voltage
7 = 500V
C = 600V
A = 1000V
S = 1500V
G = 2000V
W = 2500V
H = 3000V
J = 4000V
K = 5000V

Temperature Coefficient
A = C0G
C = X7R

Capacitance Code
(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

Capacitance Tolerance
C0G: J = ±5%
K = ±10%
M = ±20%
X7R: K = ±10%
M = ±20%
Z = +80%, -20%

Failure Rate
A=Not Applicable

Termination
1= Pd/Ag
T = Plated Ni and Sn

Packaging/Marking
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
Style	**Case Size**	**Voltage**	**Dielectric**	**Capacitance Code (In pF)**	**Capacitance Tolerance**	**Std.**	**Term**	**Packaging Code**	**Terminations Code (max.)**
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

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

Low Inductance Capacitors (LICC)

EXAMPLE: 0612ZD105MAT2A

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

Interdigitated Capacitors (IDC)

EXAMPLE: W3L16D225MAT3A

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

Decoupling Capacitor Arrays (LICA)

EXAMPLE: LICA3T183M3FC4AA

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