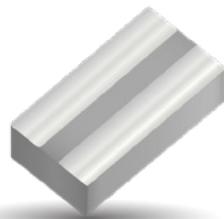
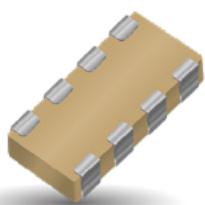
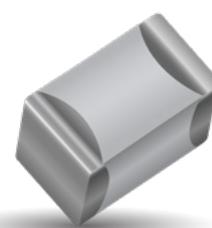
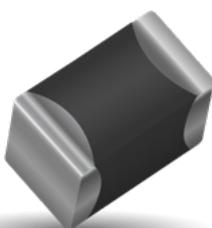
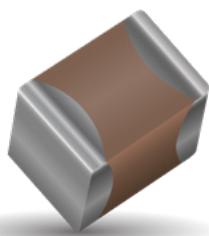




# Surface Mount Ceramic Capacitor Products



## IMPORTANT INFORMATION/DISCLAIMER

All product specifications, statements, information and data (collectively, the "Information") in this datasheet or made available on the website are subject to change. The customer is responsible for checking and verifying the extent to which the Information contained in this publication is applicable to an order at the time the order is placed. All Information given herein is believed to be accurate and reliable, but it is presented without guarantee, warranty, or responsibility of any kind, expressed or implied.

Statements of suitability for certain applications are based on KYOCERA AVX's knowledge of typical operating conditions for such applications, but are not intended to constitute and KYOCERA AVX specifically disclaims any warranty concerning suitability for a specific customer application or use.

**ANY USE OF PRODUCT OUTSIDE OF SPECIFICATIONS OR ANY STORAGE OR INSTALLATION INCONSISTENT WITH PRODUCT GUIDANCE VOIDS ANY WARRANTY.**

The Information is intended for use only by customers who have the requisite experience and capability to determine the correct products for their application. Any technical advice inferred from this Information or otherwise provided by KYOCERA AVX with reference to the use of KYOCERA AVX's products is given without regard, and KYOCERA AVX assumes no obligation or liability for the advice given or results obtained.

Although KYOCERA AVX designs and manufactures its products to the most stringent quality and safety standards, given the current state of the art, isolated component failures may still occur. Accordingly, customer applications which require a high degree of reliability or safety should employ suitable designs or other safeguards (such as installation of protective circuitry or redundancies) in order to ensure that the failure of an electrical component does not result in a risk of personal injury or property damage.

Unless specifically agreed to in writing, KYOCERA AVX has not tested or certified its products, services or deliverables for use in high risk applications including medical life support, medical device, direct physical patient contact, water treatment, nuclear facilities, weapon systems, mass and air transportation control, flammable environments, or any other potentially life critical uses. Customer understands and agrees that KYOCERA AVX makes no assurances that the products, services or deliverables are suitable for any high-risk uses. Under no circumstances does KYOCERA AVX warrant or guarantee suitability for any customer design or manufacturing process.

Although all product-related warnings, cautions and notes must be observed, the customer should not assume that all safety measures are indicated or that other measures may not be required.

# Surface Mount Ceramic Capacitor Products



## Table of Contents

### How to Order

Part Number Explanation..... 1

### COG (NP0) Dielectric

General Specifications ..... 3

Specifications and Test Methods ..... 4

Capacitance Range ..... 5

### U Dielectric

RF/Microwave C0G (NP0) Capacitors (RoHS)

RF/Microwave C0G (NP0) Capacitors (Sn/Pb)

RF/Microwave Automotive C0G (NP0) Capacitors (RoHS)

    AEC Q200 Qualified Ultra Low ESR ..... 13

Designer Kits ..... 15

### X8R/X8L Dielectric

General Specifications ..... 16

Specifications and Test Methods ..... 18

### X7R Dielectric

General Specifications ..... 19

Specifications and Test Methods ..... 20

Capacitance Range ..... 21

### X7S Dielectric

General Specifications ..... 23

Specifications and Test Methods ..... 24

Capacitance Range ..... 25

### X5R Dielectric

General Specifications ..... 26

Specifications and Test Methods ..... 27

Capacitance Range ..... 28

### Y5V Dielectric

General Specifications ..... 30

Specifications and Test Methods ..... 31

Capacitance Range ..... 32

### MLCC Gold Termination – AU Series

General Specifications ..... 33

Capacitance Range ..... 34

### MLCC Tin/Lead Termination "B" (LD Series)

C0G (NP0) – General Specifications ..... 40

    Specifications and Test Methods ..... 41

    Capacitance Range ..... 42

X8R    General Specifications ..... 44

    Specifications and Test Methods ..... 45

    Capacitance Range ..... 46

X7R    General Specifications ..... 47

    Specifications and Test Methods ..... 48

    Capacitance Range ..... 49

X5R    General Specifications ..... 51

    Specifications and Test Methods ..... 52

    Capacitance Range ..... 53

### Automotive MLCC

General Specifications ..... 54

Capacitance Range ..... 56

### APS for COTS+ High Reliability Applications

General Specifications ..... 59

Capacitance Range ..... 60

### MLCC with FLEXITERM®

General Specifications ..... 63

Specifications and Test Methods ..... 64

Capacitance Range ..... 66

### FLEXISAFE MLC Chips

General Specifications and Capacitance Range ..... 68

### Capacitor Array

Capacitor Array (IPC) ..... 69

Automotive Capacitor Array (IPC) ..... 73

Part & Pad Layout Dimensions ..... 74

### Low Inductance Capacitors

Introduction ..... 75

LICC® (Low Inductance Chip Capacitors)Capacitors ..... 77

LICC® (Low Inductance Chip Capacitors)Capacitors ..... 78

IDC (InterDigitated Capacitors) ..... 81

LGA Low Inductance Capacitors ..... 85

### High Temperature MLCCs

AT Series – 200°C & 250°C Rated ..... 88

### High Voltage MLC Chips

For 600V to 5000V Applications ..... 94

Tin/Lead Termination "B" - 600V to 5000V Applications ..... 99

FLEXITERM® - 600V to 5000V Applications ..... 101

For 600V to 3000V Automotive Applications - AEC-Q200 ..... 106

### MIL-PRF-55681/Chips

CDR01 thru CDR06 ..... 108

CDR31 thru CDR35 ..... 110

### MLCC Medical Applications

MM Series ..... 114

### Packaging of Chip Components

..... 119

### Embossed Carrier Configuration

..... 120

### Paper Carrier Configuration

..... 121

### Basic Capacitor Formulas

..... 122

### General Description

..... 123



The Important Information/Disclaimer is incorporated in the catalog where these specifications came from or available online at [www.kyocera-avx.com/disclaimer/](http://www.kyocera-avx.com/disclaimer/) by reference and should be reviewed in full before placing any order.

# How to Order

## Part Number Explanation

Commercial Surface Mount Chips

EXAMPLE: 0805A101JAT2A

0805	5	A	101	J*	A	T	2	A**
<b>Size</b> (L' x W'') 0101* 0201 0402 0603 0805 1206 1210 1812 1825 2220 2225	<b>Voltage</b> 4 = 4V 6 = 6.3V Z = 10V Y = 16V 3 = 25V D = 35V 5 = 50V 1 = 100V 2 = 200V 7 = 500V	<b>Dielectric</b> A = NPO(COG) C = X7R D = X5R F = X8R G = Y5V U = U Series W = X6S Z = X7S	<b>Capacitance</b> 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	<b>Tolerance</b> B = ±10 pF C = ±25 pF D = ±50 pF F = ±1% (≥ 10 pF) G = ±2% (≥ 10 pF) J = ±5% K = ±10% M = ±20% Z = +80%, -20% P = +100%, -0%	<b>Failure Rate</b> A = N/A 4 = Automotive	<b>Terminations</b> T = Plated Ni and Sn 7 = Gold Plated U = Conductive Epoxy for Hybrid Applications Z = FLEXITERM® *X = FLEXITERM® with 5% min lead (X7R & X8R only)	<b>Packaging</b> Available 2 = 7" Reel 4 = 13" Reel U = 4mm TR (01005)	<b>Special Code</b> A = Std K = 30K (0603 2mm pitch) 22K (0805/1206 <0.030" / 0.76mm) H = 18K (0603/0805/1206 <0.037" / 0.94mm) J = 15K (0805/1206 <0.050" / 1.27mm) 1 = 12K (0805/1206 <0.055 / 1.4mm)
<b>Contact Factory for Special Voltages</b>								
*EIA 01005 F = 63V E = 150V V = 250V								
For values below 10 pF, use "R" in place of Decimal point, e.g., 9.1 pF = 9R1.								

\* 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.

NOTE: Contact factory for availability of Termination and Tolerance Options for Specific Part Numbers.

For Tin/Lead Terminations, please refer to LD Series

### High Voltage MLC Chips

EXAMPLE: 1808AA271KAT2A

1808	A	A	271	K	A	T	2	A
<b>Style</b> 0805 1206 1210 1808 1812 1825 2220 2225 3640	<b>Voltage</b> C = 600V/630V A = 1000V S = 1500V G = 2000V W = 2500V H = 3000V J = 4000V K = 5000V	<b>Temperature Coefficient</b> A = COG C = X7R	<b>Capacitance Code</b> (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	<b>Capacitance Tolerance</b> COG: J = ±5% K = ±10% X7R: M = ±20% K = ±10% M = ±20% Z = +80%, -20%	<b>Failure Rate</b> A=Not Applicable	<b>Termination</b> 1 = Pd/Ag T = Plated Ni and Sn B = 5% Min Pb Z = FLEXITERM® *X = FLEXITERM® with 5% min lead (X7R only)	<b>Packaging/ Marking</b> 2 = 7" Reel 4 = 13" Reel	<b>Special Code</b> A = Standard

NOTE: Contact factory for availability of Termination and Tolerance Options for Specific Part Numbers.

For Tin/Lead Terminations, please refer to LD Series

\* Not RoHS Compliant



For RoHS compliant products,  
please select correct termination style.

# How to Order

## Part Number Explanation

### Capacitor Array

#### EXAMPLE: W2A43C103MAT2A

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

NOTE: Contact factory for availability of Termination and Tolerance Options for Specific Part Numbers.

### Low Inductance Capacitors (LICC®)

#### EXAMPLE: 0612ZD105MAT2A

0612	Z	D	105	M	A	T	2	A
Size 0306 0508 0612 *LD16 *LD17 *LD18	Voltage 6 = 6.3V Z = 10V Y = 16V 3 = 25V 5 = 50V	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 *B = 5% min lead	Packaging Available 2 = 7" Reel 4 = 13" Reel	Thickness See Page 97 for Codes

NOTE: Contact factory for availability of Termination and Tolerance Options for Specific Part Numbers.

### Interdigitated Capacitors (IDC)

#### EXAMPLE: W3L16D225MAT3A

W	3	L	1	6	D	225	M	A	T	3	A
Style W = RoHS L = SnPb	Case Size 2 = 0508 3 = 0612	Low Inductance ESL = 50pH ESL = 60pH	Number of Terminals 1 = 8 Terminals	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 M = ±20	Failure Rate A = N/A	Termination T = Plated Ni and Sn *B = 5% min lead	Packaging Available 1=7" Reel 3=13" Reel	Thickness Max. Thickness mm(in) A=0.95 (0.037) S=0.55 (0.022)

NOTE: Contact factory for availability of Termination and Tolerance Options for Specific Part Numbers.

### Low Inductance Decoupling Capacitor Arrays (LICA)

#### EXAMPLE: LICA3T183M3FC4AA

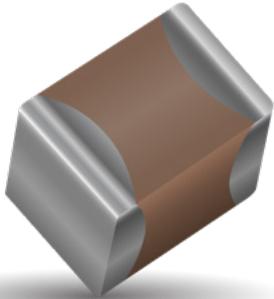
LICA	3	T	102	M	3	F	C	4	A	A
Style & Size 5V = 9 10V = Z 25V = 3	Voltage D = X5R T = T55T S = High K T55T	Dielectric C = X7R	Cap/Section (EIA Code) 102 = 1000 pF 103 = 10 nF 104 = 100 nF	Capacitance Tolerance M = ±20%	Height Code 6 = 0.500mm P = GMV 1 = 0.650mm 5 = 1.075mm 7 = 1.100mm 1 = 1.600mm N = Cr-Ni-Au X = None	Termination *F = C4 Solder H = C4 Solder P = GMV 1 = 0.650mm 5 = 1.075mm 7 = 1.100mm N = Cr-Ni-Au X = None	Reel Packaging M = 7" Reel Balls-97Pb/3Sn 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 D = Triangle

\* Not RoHS Compliant



NOTE: Contact factory for availability of Termination and Tolerance Options for Specific Part Numbers.

# COG (NP0) Dielectric General Specifications



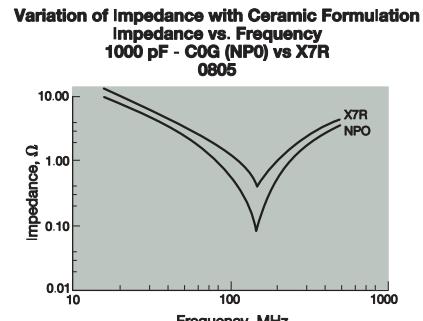
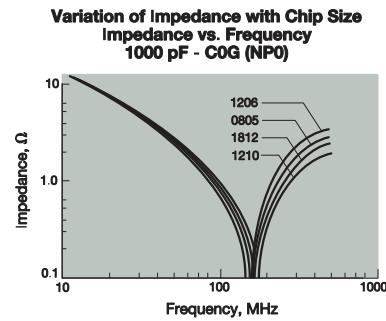
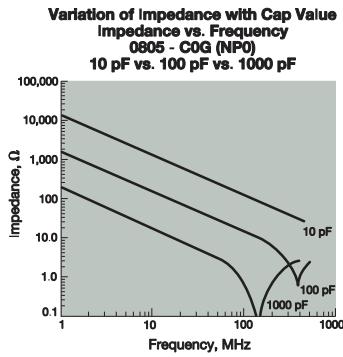
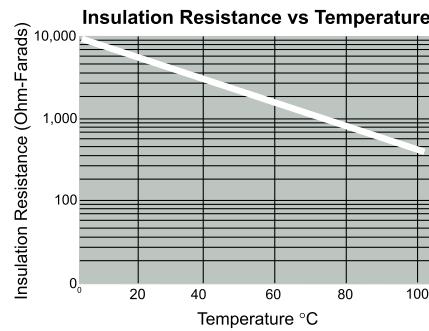
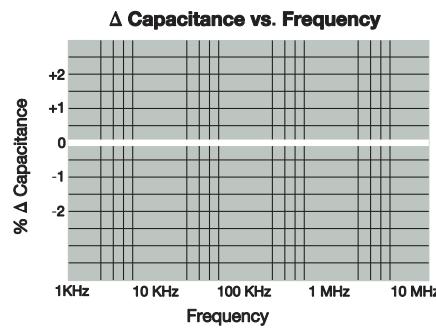
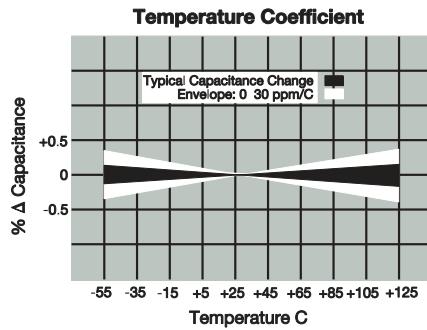
COG (NP0) is the most popular formulation of the "temperature-compensating," EIA Class I ceramic materials. Modern COG (NP0) formulations contain neodymium, samarium and other rare earth oxides.

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

## PART NUMBER (SEE PAGE 4 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 250V = V 500V = 7	Dielectric COG (NP0) = A	Capacitance Code (In pF) 2 Sig. Digits + Number of Zeros	Capacitance Tolerance B = $\pm 10\text{ pF}$ ( $< 10\text{ pF}$ ) C = $\pm 25\text{ pF}$ ( $< 10\text{ pF}$ ) D = $\pm 50\text{ pF}$ ( $< 10\text{ pF}$ ) F = $\pm 1\%$ ( $\geq 10\text{ pF}$ ) G = $\pm 2\%$ ( $\geq 10\text{ pF}$ ) J = $\pm 5\%$ K = $\pm 10\%$	Failure Rate A = Not Applicable	Terminations T = Plated Ni and Sn	Packaging 2 = 7" Reel 4 = 13" Reel U = 4mm TR (01005)	Special Code A = Std. Product
						Contact Factory For 1 = Pd/Ag Term 7 = Gold Plated <b>NOT RoHS COMPLIANT</b>		
							Contact Factory For Multiples	

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



# COG (NP0) Dielectric Specifications and Test Methods

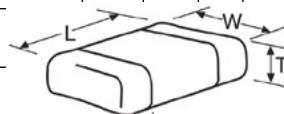
Parameter/Test	NP0 Specification Limits		Measuring Conditions	
Operating Temperature Range	-55°C to +125°C		Temperature Cycle Chamber	
Capacitance	Within specified tolerance <30 pF: $Q \geq 400 + 20 \times \text{Cap Value}$ $\geq 30 \text{ pF: } Q \geq 1000$		Freq.: 1.0 MHz $\pm 10\%$ for cap $\leq 1000 \text{ pF}$ 1.0 kHz $\pm 10\%$ for cap $> 1000 \text{ pF}$ Voltage: 1.0Vrms $\pm .2\text{V}$	
Insulation Resistance	10,000MΩ or 500MΩ - $\mu\text{F}$ , whichever is less		Charge device with rated voltage for 60 $\pm 5$ secs @ room temp/humidity	
Dielectric Strength	No breakdown or visual defects		Charge device with 250% 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		
	Capacitance Variation	$\pm 5\%$ or $\pm .5 \text{ pF}$ , whichever is greater		
	Q	Meets Initial Values (As Above)		
	Insulation Resistance	$\geq \text{Initial Value} \times 0.3$		
Solderability	$\geq 95\%$ of each terminal should be covered with fresh solder		Dip device in eutectic solder at $230 \pm 5^\circ\text{C}$ for $5.0 \pm 0.5$ seconds	
Resistance to Solder Heat	Appearance	No defects, <25% leaching of either end terminal		
	Capacitance Variation	$\leq \pm 2.5\%$ or $\pm .25 \text{ pF}$ , 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: $-55^\circ\text{C} \pm 2^\circ$ $30 \pm 3$ minutes	
	Capacitance Variation	$\leq \pm 2.5\%$ or $\pm .25 \text{ pF}$ , whichever is greater	Step 2: Room Temp $\leq 3$ minutes	
	Q	Meets Initial Values (As Above)	Step 3: $+125^\circ\text{C} \pm 2^\circ$ $30 \pm 3$ 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	Charge device with twice rated voltage in test chamber set at $125^\circ\text{C} \pm 2^\circ\text{C}$ for 1000 hours (+48, -0).  Remove from test chamber and stabilize at room temperature for 24 hours before measuring.	
	Capacitance Variation	$\leq \pm 3.0\%$ or $\pm .3 \text{ pF}$ , whichever is greater		
	Q (C=Nominal Cap)	$\geq 30 \text{ pF: } Q \geq 350$ $\geq 10 \text{ pF, } <30 \text{ pF: } Q \geq 275 + 5\text{C}/2$ $<10 \text{ pF: } Q \geq 200 + 10\text{C}$		
	Insulation Resistance	$\geq \text{Initial Value} \times 0.3$ (See Above)		
	Dielectric Strength	Meets Initial Values (As Above)		
Load Humidity	Appearance	No visual defects	Store in a test chamber set at $85^\circ\text{C} \pm 2^\circ\text{C} / 85\% \pm 5\%$ relative humidity for 1000 hours (+48, -0) with rated voltage applied.  Remove from chamber and stabilize at room temperature for 24 $\pm 2$ hours before measuring.	
	Capacitance Variation	$\leq \pm 5.0\%$ or $\pm .5 \text{ pF}$ , whichever is greater		
	Q	$\geq 30 \text{ pF: } Q \geq 350$ $\geq 10 \text{ pF, } <30 \text{ pF: } Q \geq 275 + 5\text{C}/2$ $<10 \text{ pF: } Q \geq 200 + 10\text{C}$		
	Insulation Resistance	$\geq \text{Initial Value} \times 0.3$ (See Above)		
	Dielectric Strength	Meets Initial Values (As Above)		

# COG (NP0) 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	All Paper	All Paper	All Paper	All Paper	Paper/Embossed	Paper/Embossed
(L) Length (in.)	0.40 ± 0.02 (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 (in.)	0.20 ± 0.02 (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 (in.)	0.10 ± 0.04 (0.004 ± 0.0016)	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	16	25	50	16	25	50
Cap (pF)	0.5	A	A	C	C	G
	1.0	B	A	C	C	G
	1.2	B	A	C	C	G
	1.5	B	A	C	C	G
	1.8	B	A	C	C	G
	2.2	B	A	C	C	G
	2.7	B	A	C	C	G
	3.3	B	A	C	C	G
	3.9	B	A	C	C	G
	4.7	B	A	C	C	G
	5.6	B	A	C	C	G
	6.8	B	A	C	C	G
	8.2	B	A	C	C	G
	10	B	A	C	C	G
	12	B	A	C	C	G
	15	B	A	C	C	G
	18	B	A	C	C	G
	22	B	A	C	C	G
	27	B	A	C	C	G
	33	B	A	C	C	G
	39	B	A	C	C	G
	47	B	A	C	C	G
	56	B	A	C	C	G
	68	B	A	C	C	G
	82	B	A	C	C	G
	100	B	A	C	C	G
	120			C	C	G
	150			C	C	G
	180			C	C	G
	220			C	C	G
	270			C	C	G
	330			C	C	G
	390			C	C	G
	470			C	C	G
	560			C	C	G
	680			C	C	G
	750			C	C	G
	820			C	C	G
	1000			C	C	G
	1200			G	G	G
	1500			G	G	G
	1800			G	G	G
	2200			G	G	G
	2700			G	G	G
	3300			G	G	G
	3900			G	G	G
	4700			G	G	G
	5600					
	6800					
	8200					
Cap ( $\mu$ F)	0.010				P	P
	0.012				P	P
	0.015				P	P
	0.018					
	0.022					
	0.027					
	0.033					
	0.039					
	0.047					
	0.068					
	0.082					
	0.1					
WVDC	16	25	50	16	25	50
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							EMBOSS							



The Important Information/Disclaimer is incorporated in the catalog where these specifications came from or available online at [www.kyocera-avx.com/disclaimer/](http://www.kyocera-avx.com/disclaimer/) by reference and should be reviewed in full before placing any order.

# COG (NP0) Dielectric Capacitance Range



PREFERRED SIZES ARE SHADED



SIZE	1210					1812					1825					2220					2225					
	Reflow Only					Reflow Only					Reflow Only					Reflow Only					Reflow Only					
Soldering	Reflow Only					All Embossed					All Embossed					All Embossed					All Embossed					
Packaging	Paper/Embossed					All Embossed					All Embossed					All Embossed					All Embossed					
(L) Length (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 (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 (in.)	0.50 ± 0.25 (0.020 ± 0.010)					0.61 ± 0.36 (0.024 ± 0.014)					0.64 ± 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	50	100	200	50	100	200	
Cap (pF)	3.9																									
	4.7																									
	5.6																									
	6.8																									
	8.2																									
10	M	M	M	M	M	P	P	P	P	P																
12	M	M	M	M	M	P	P	P	P	P																
15	M	M	M	M	M	P	P	P	P	P																
18	M	M	M	M	M	P	P	P	P	P																
22	M	M	M	M	M	P	P	P	P	P																
27	M	M	M	M	M	P	P	P	P	P																
33	M	M	M	M	M	P	P	P	P	P																
39	M	M	M	M	M	P	P	P	P	P																
47	P	P	P	P	P	P	P	P	P	P																
56	P	P	P	P	P	P	P	P	P	P																
68	P	P	P	P	P	P	P	P	P	P																
82	P	P	P	P	P	P	P	P	P	P																
100	P	P	P	P	P	P	P	P	P	P																
120	P	P	P	P	P	P	P	P	P	P																
150	P	P	P	P	P	P	P	P	P	P																
180	P	P	P	P	P	P	P	P	P	P																
220	P	P	P	P	P	P	P	P	P	P																
270	P	P	P	P	P	P	P	P	P	P																
330	P	P	P	P	P	P	P	P	P	P																
390	P	P	P	P	P	P	P	P	P	P																
470	P	P	P	P	P	P	P	P	P	P																
560	P	P	P	P	P	P	P	P	P	P																
680	P	P	P	P	P	P	P	P	P	P																
820	P	P	P	P	P	P	P	P	P	P																
1000	P	P	P	P	P	P	P	P	P	P						M	M	M					M	M	P	
1200	P	P	P	P	P	P	P	P	P	P						M	M	M					M	M	P	
1500	P	P	P	P	P	P	P	P	P	P						M	M	M					M	M	P	
1800	P	P	P	P	P	P	P	P	P	P						M	M	M					M	M	P	
2200	P	P	P	P	P	P	P	P	P	P						X	X	X					M	M	P	
2700	P	P	P	P	P	P	P	P	P	P						X	X	X					M	M	P	
3300	P	P	P	P	P	P	P	P	P	P						X	X	X					X	M	P	
3900	P	P	P	P	P	P	P	P	P	P						X	X	X					X	M	P	
4700	P	P	P	P	P	P	P	P	P	P						X	X	X					X	M	P	
5600	P	P	P	P	P	P	P	P	P	P						X	X	X					X	M	P	
6800	P	P	P	P	P	P	P	P	P	P						X	X	X					X	M	P	
8200	P	P	P	P	P	P	P	P	P	P						X	X	X					X	M	P	
Cap (pF)	0.010	P	P	X	X	P	P	Q	Q	Y						X	X	X					M	M	P	
	0.012	X	X	X	X	P	P	Q	Q	Y						X	X	X					M	Y	Y	
	0.015	X	X	X	Z	P	P	Q	X	Y						X	X	X					P	Y	Y	
	0.018	X	X	Z	Z	P	P	X	X	Y						X	X	X					M	Y	Y	
	0.022	X	X	Z	Z	P	P	X	X	Y						X	X	X					M	Y	Y	
	0.027	X	Z	Z	Z	Q	X	X	Z	X						X	X	Y					P	Y	Y	
	0.033	X	Z	Z	Z	Q	X	X	Z	Z						X	X						X	Y	Y	
	0.039	Z	Z	Z	Z	X	X	Z	Z	Z						X	X						X	Y	Y	
	0.047	Z	Z	Z	Z	X	X	Z	Z	Z						X	X						X	Z	Z	
	0.068					Z	Z	Z	Z	Z													Z	Z	Z	
	0.082					Z	Z	Z	Z	Z													Z	Z	Z	
	0.1					Z	Z	Z	Z	Z													Z	Z	Z	
WVDC	25	50	100	200	500	25	50	100	200	500	50	100	200	50	100	200	50	100	200	50	100	200	50	100	200	
SIZE	1210					1812					1825					2220					2225					

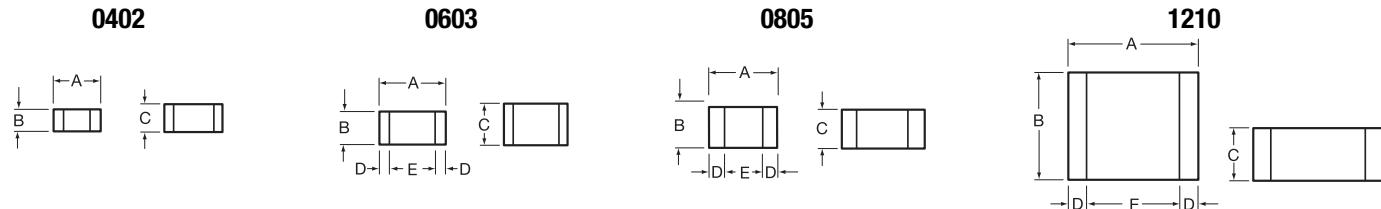
## PAPER

## EMBOSSED

## GENERAL INFORMATION

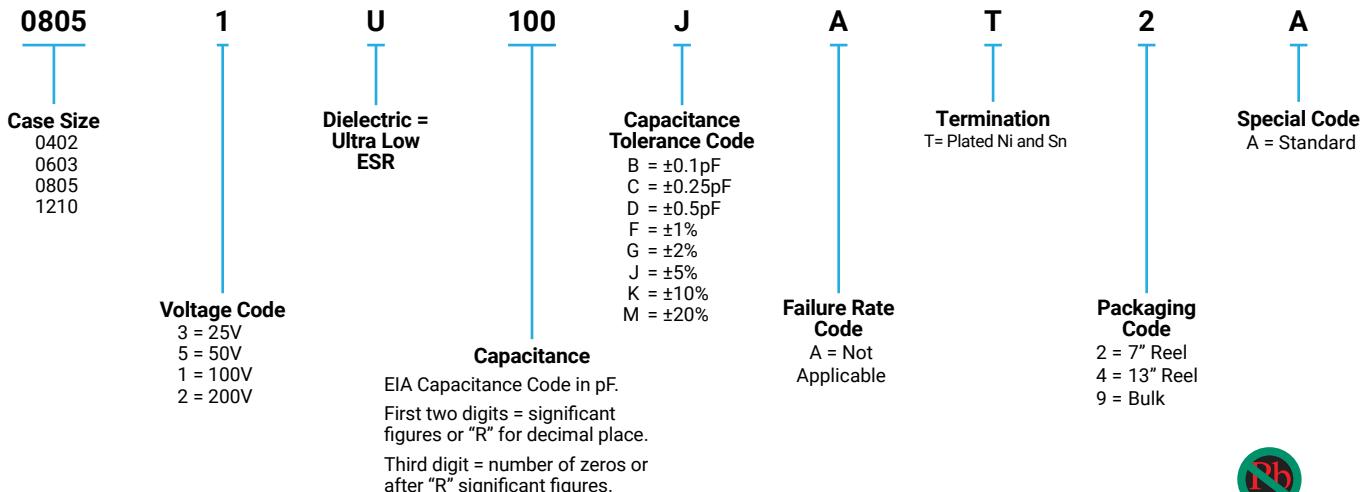
"U" Series capacitors are COG (NP0) chip capacitors specially designed for "Ultra" low ESR for applications in the communications market. Max ESR and effective capacitance are met on each value producing lot to lot uniformity. Sizes available are EIA chip sizes 0603, 0805, and 1210.

## DIMENSIONS: inches (millimeters)



Size	A	B	C	D	E
0402	0.039±0.004 (1.00±0.1)	0.020±0.004 (0.50±0.1)	0.024 (0.6) max	0.010 ± 0.006 (0.25 ± 0.15)	0.014 (0.36) min
0603	0.060±0.010 (1.52±0.25)	0.030±0.010 (0.76±0.25)	0.036 (0.91) max	0.010 ± 0.005 (0.25 ± 0.13)	0.030 (0.76) min
0805	0.079±0.008 (2.01±0.2)	0.049±0.008 (1.25±0.2)	0.045 (1.15mm) max	0.020 ± 0.010 (0.51 ± 0.254)	0.020 (0.51) min
1210	0.126±0.008 (3.2±0.2)	0.098±0.008 (2.49±0.2)	0.055 (1.40mm) max	0.025 ± 0.015 (0.635 ± 0.381)	0.040 (1.02) min

## HOW TO ORDER



## ELECTRICAL CHARACTERISTICS

## Capacitance Values and Tolerances:

Size 0402 - 0.2 pF to 22 pF @ 1 MHz

Size 0603 - 1.0 pF to 100 pF @ 1 MHz

Size 0805 - 1.6 pF to 160 pF @ 1 MHz

Size 1210 - 2.4 pF to 1000 pF @ 1 MHz

## Temperature Coefficient of Capacitance (TC):

0±30 ppm/°C (-55° to +125°C)

## Insulation Resistance (IR):

10<sup>12</sup> Ω min. @ 25°C and rated WVDC

10<sup>11</sup> Ω min. @ 125°C and rated WVDC

## Working Voltage (WVDC):

Size Working Voltage

0402 - 50, 25 WVDC

0603 - 200, 100, 50 WVDC

0805 - 200, 100 WVDC

1210 - 200, 100 WVDC

## Dielectric Working Voltage (DWV):

250% of rated WVDC

## Equivalent Series Resistance Typical (ESR):

0402 - See Performance Curve, page 300

0603 - See Performance Curve, page 300

0805 - See Performance Curve, page 300

1210 - See Performance Curve, page 300

## Marking

Laser marking EIA J marking standard (except 0603) (capacitance code and tolerance upon request).

## MILITARY SPECIFICATIONS

Meets or exceeds the requirements of MIL-C-55681



# U Dielectric

## RF/Microwave COG (NP0) Capacitors (RoHS)

### Ultra Low ESR, "U" Series, COG (NP0) Chip Capacitors



#### CAPACITANCE RANGE

Cap (pF)	Available Tolerance	Size			
		0402	0603	0805	1210
0.2	B,C	50V	N/A	N/A	N/A
0.3					
0.4	B,C				
0.5					
0.6	B,C,D				
0.7					
0.8	B,C,D				
0.9					

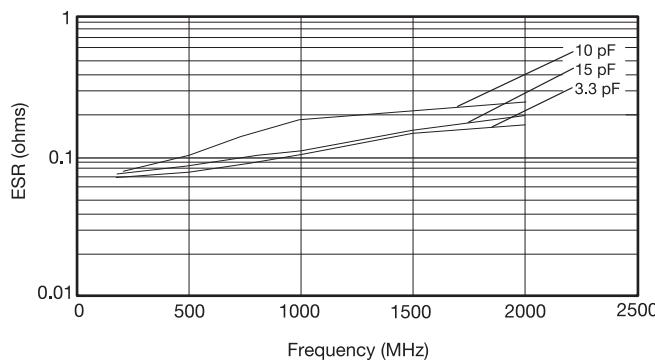
Cap (pF)	Available Tolerance	Size			
		0402	0603	0805	1210
1.0	B,C,D	50V	200V	200V	200V
1.1					
1.2					
1.3					
1.4					
1.5					
1.6					
1.7					
1.8					
1.9					
2.0					
2.1					
2.2					
2.4					
2.7					
3.0					
3.3					
3.6					
3.9					
4.3					
4.7					
5.1					
5.6					
6.2	B,C,D				
6.8	B,C,J,K,M				

Cap (pF)	Available Tolerance	Size			
		0402	0603	0805	1210
7.5	B,C,J,K,M	50V	200V	200V	200V
8.2					
9.1	B,C,J,K,M				
10	F,G,J,K,M				
11					
12					
13					
15					
18					
20					
22					
24					
27					
30					
33					
36					
39					
43					
47					
51					
56					
68					
75					
82					
91					

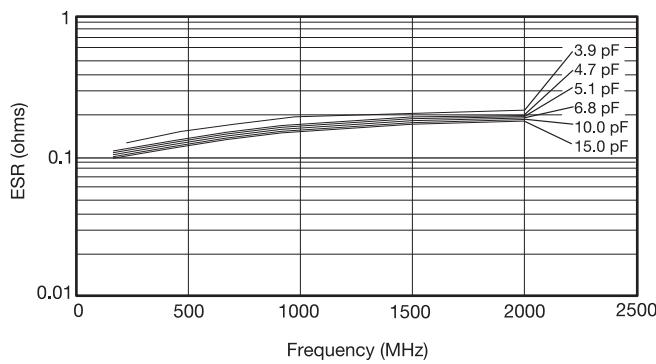
Cap (pF)	Available Tolerance	Size			
		0402	0603	0805	1210
100	F,G,J,K,M	N/A	100V	200V	200V
110			50V	50V	
120			N/A	200V	100V
130				100V	N/A
140					
150					
160					
180					
200					
220					
270					
300					
330					
360					
390					
430					
470					
510					
560					
620					
680					
750					
820					
910					
1000	F,G,J,K,M				

#### ULTRA LOW ESR, "U" SERIES

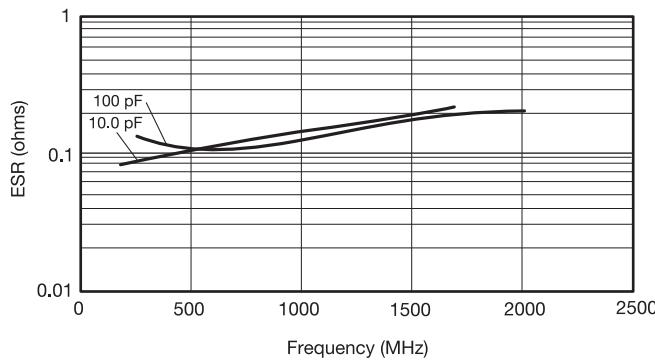
TYPICAL ESR vs. FREQUENCY  
0402 "U" SERIES



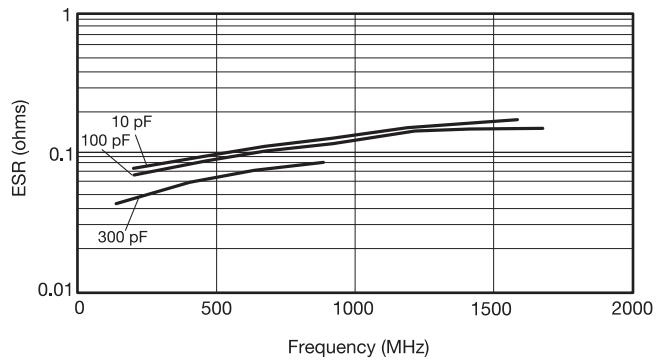
TYPICAL ESR vs. FREQUENCY  
0603 "U" SERIES



TYPICAL ESR vs. FREQUENCY  
0805 "U" SERIES



TYPICAL ESR vs. FREQUENCY  
1210 "U" SERIES

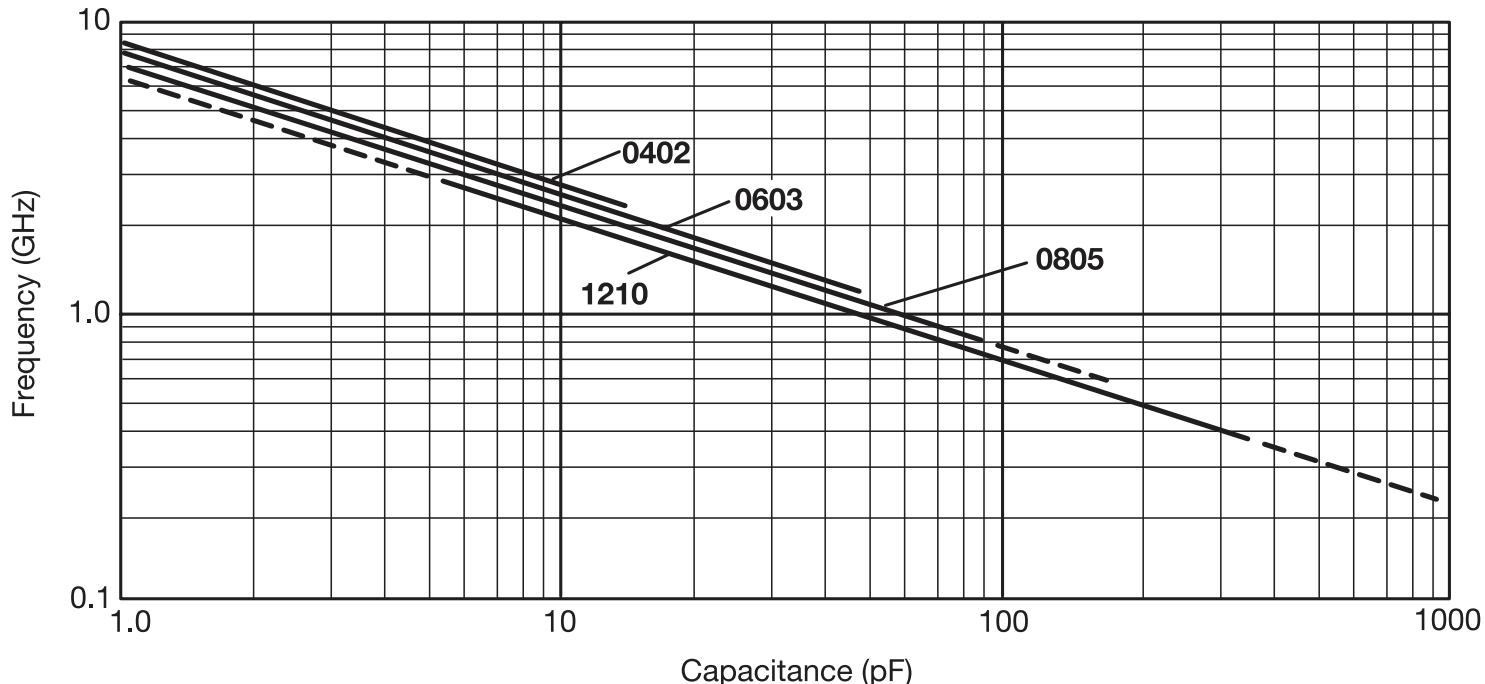


ESR Measured on the Boonton 34A



The Important Information/Disclaimer is incorporated in the catalog where these specifications came from or available online at [www.kyocera-avx.com/disclaimer/](http://www.kyocera-avx.com/disclaimer/) by reference and should be reviewed in full before placing any order.

**TYPICAL  
SERIES RESONANT FREQUENCY  
"U" SERIES CHIP**



# U Dielectric

## RF/Microwave COG (NP0) Capacitors (Sn/Pb)

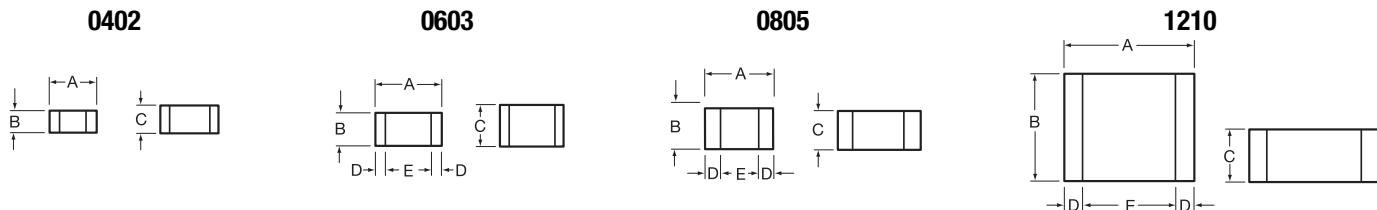
### Ultra Low ESR, "U" Series, COG (NP0) Chip Capacitors



#### GENERAL INFORMATION

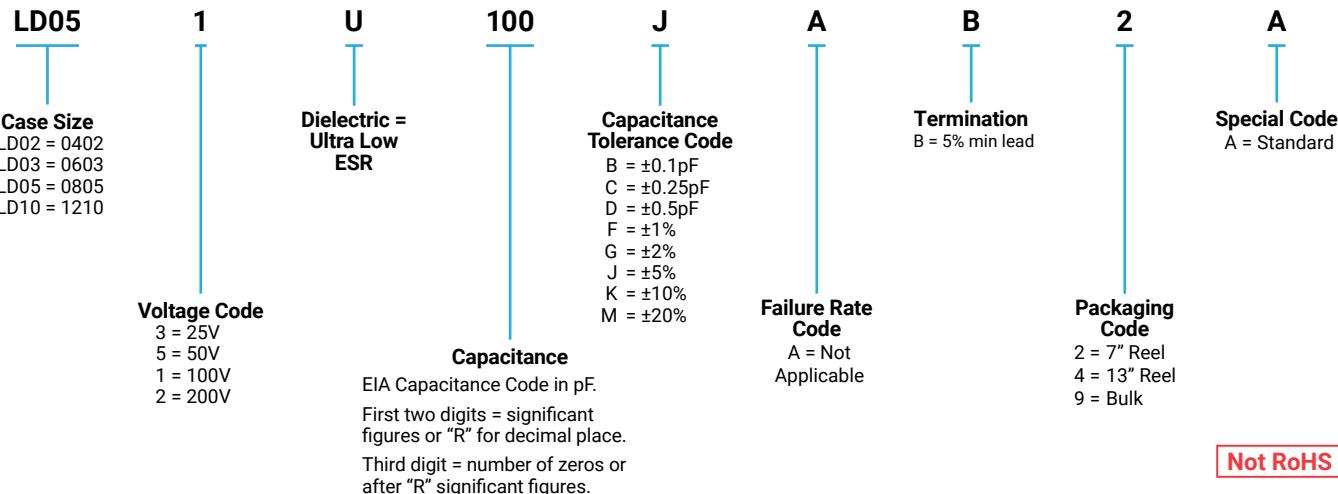
"U" Series capacitors are COG (NP0) chip capacitors specially designed for "Ultra" low ESR for applications in the communications market. Max ESR and effective capacitance are met on each value producing lot to lot uniformity. Sizes available are EIA chip sizes 0402, 0805, and 1210.

#### DIMENSIONS: inches (millimeters)



Size	A	B	C	D	E
0402	0.039±0.004 (1.00±0.1)	0.020±0.004 (0.50±0.1)	0.024 (0.6) max	0.010 ± 0.006 (0.25 ± 0.15)	0.014 (0.36) min
0603	0.060±0.010 (1.52±0.25)	0.030±0.010 (0.76±0.25)	0.036 (0.91) max	0.010±0.005 (0.25±0.13)	0.030 (0.76) min
0805	0.079±0.008 (2.01±0.2)	0.049±0.008 (1.25±0.2)	0.045 (1.15mm) max	0.020±0.010 (0.51±0.254)	0.020 (0.51) min
1210	0.126±0.008 (3.2±0.2)	0.098±0.008 (2.49±0.2)	0.055 (1.40mm) max	0.025±0.015 (0.635±0.381)	0.040 (1.02) min

#### HOW TO ORDER



#### ELECTRICAL CHARACTERISTICS

##### Capacitance Values and Tolerances:

Size 0402 - 0.2 pF to 22 pF @ 1 MHz

Size 0603 - 1.0 pF to 100 pF @ 1 MHz

Size 0805 - 1.6 pF to 160 pF @ 1 MHz

Size 1210 - 2.4 pF to 1000 pF @ 1 MHz

##### Temperature Coefficient of Capacitance (TC):

0±30 ppm/°C (-55° to +125°C)

##### Insulation Resistance (IR):

10<sup>12</sup> Ω min. @ 25°C and rated WVDC

10<sup>11</sup> Ω min. @ 125°C and rated WVDC

##### Working Voltage (WVDC):

Size Working Voltage

0402 - 50, 25 WVDC

0603 - 200, 100, 50 WVDC

0805 - 200, 100 WVDC

1210 - 200, 100 WVDC

##### Dielectric Working Voltage (DWV):

250% of rated WVDC

##### Equivalent Series Resistance Typical (ESR):

040 - See Performance Curve, page 306

0603 - See Performance Curve, page 306

0805 - See Performance Curve, page 306

1210 - See Performance Curve, page 306

##### Marking:

Laser marking EIA J marking standard (except 0603) (capacitance code and tolerance upon request).

##### Military Specifications

Meets or exceeds the requirements of MIL-C-55681

# U Dielectric

## RF/Microwave C0G (NP0) Capacitors (Sn/Pb)

### Ultra Low ESR, "U" Series, C0G (NP0) Chip Capacitors



#### CAPACITANCE RANGE

Cap (pF)	Available Tolerance	Size			
		LD02	LD03	LD05	LD10
0.2	B,C	50V	N/A	N/A	N/A
0.3					
0.4					
0.5	B,C				
0.6	B,C,D				
0.7					
0.8	B,C,D				
0.9					

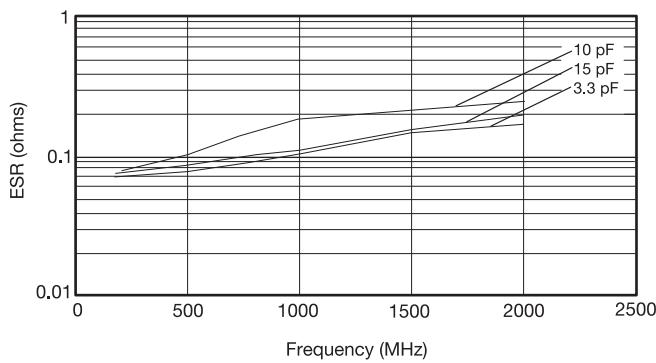
Cap (pF)	Available Tolerance	Size			
		LD02	LD03	LD05	LD10
1.0	B,C,D	50V	200V	200V	200V
1.1					
1.2					
1.3					
1.4					
1.5					
1.6					
1.7					
1.8					
1.9					
2.0					
2.1					
2.2					
2.4					
2.7					
3.0					
3.3					
3.6					
3.9					
4.3					
4.7					
5.1					
5.6					
6.2	B,C,D				
6.8	B,C,J,K,M				

Cap (pF)	Available Tolerance	Size			
		LD02	LD03	LD05	LD10
7.5	B,C,J,K,M	50V	200V	200V	200V
8.2					
9.1	B,C,J,K,M				
10	F,G,J,K,M				
11					
12					
13					
15					
18					
20					
22					
24					
27					
30					
33					
36					
39					
43					
47					
51					
56					
68					
75					
82					
91					

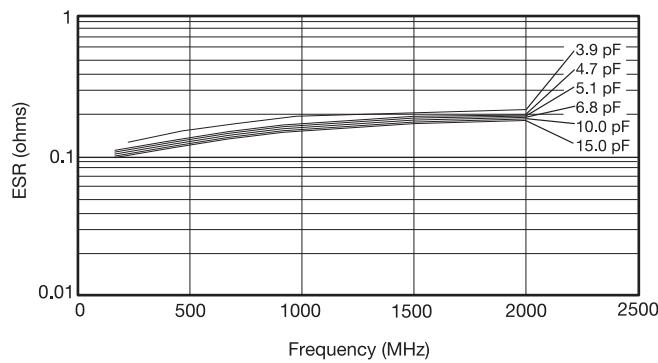
Cap (pF)	Available Tolerance	Size			
		LD02	LD03	LD05	LD10
100	F,G,J,K,M	N/A	100V	200V	200V
110			50V	50V	
120			N/A	200V	
130				100V	
140				N/A	
150					
160					
180					
200					
220					
270					
300					
330					
360					
390					
430					
470					
510					
560					
620					
680					
750					
820					
910					
1000	F,G,J,K,M				

#### ULTRA LOW ESR, "U" SERIES

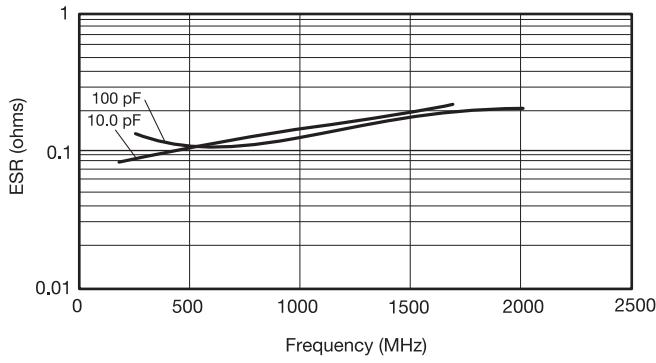
TYPICAL ESR vs. FREQUENCY  
0402 "U" SERIES



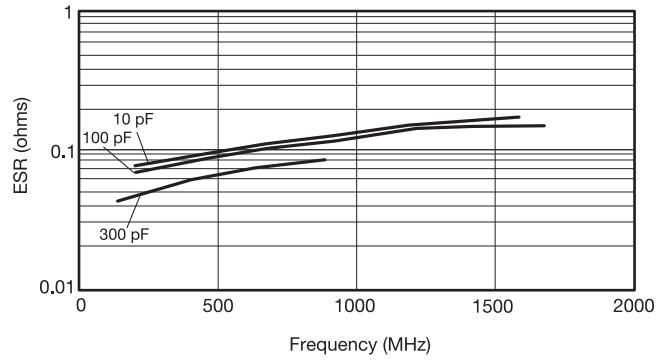
TYPICAL ESR vs. FREQUENCY  
0603 "U" SERIES



TYPICAL ESR vs. FREQUENCY  
0805 "U" SERIES



TYPICAL ESR vs. FREQUENCY  
1210 "U" SERIES

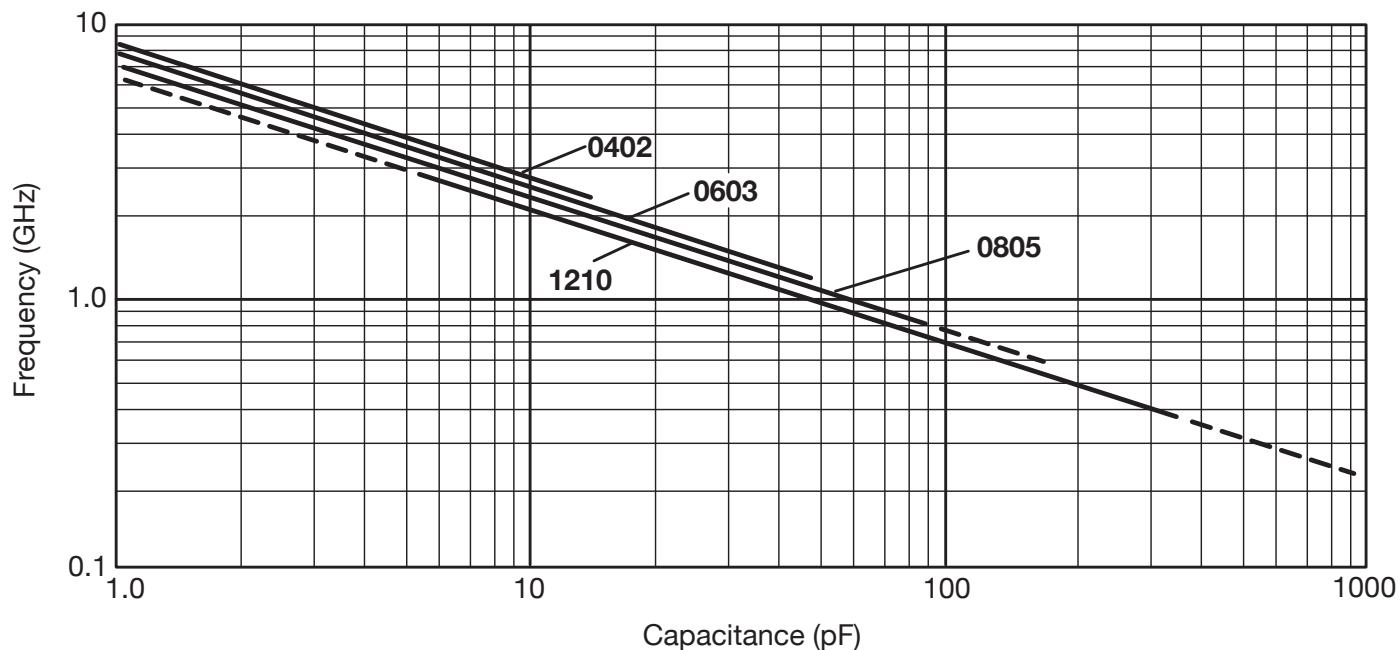


ESR Measured on the Boonton 34A



The Important Information/Disclaimer is incorporated in the catalog where these specifications came from or available online at [www.kyocera-avx.com/disclaimer/](http://www.kyocera-avx.com/disclaimer/) by reference and should be reviewed in full before placing any order.

**TYPICAL  
SERIES RESONANT FREQUENCY  
"U" SERIES CHIP**



# U Dielectric

## RF/Microwave Automotive C0G (NP0) Capacitors (RoHS)

### AEC Q200 Qualified Ultra Low ESR, "U" Series, C0G (NP0) Chip Capacitors

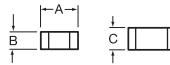


#### GENERAL INFORMATION

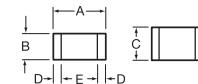
Automotive "U" Series capacitors are C0G (NP0) chip capacitors specially designed for "Ultra" low ESR for applications in the automotive market. Max ESR and effective capacitance are met on each value producing lot to lot uniformity. Sizes available are EIA chip sizes 0402 and 0603.

#### DIMENSIONS: inches (millimeters)

0402



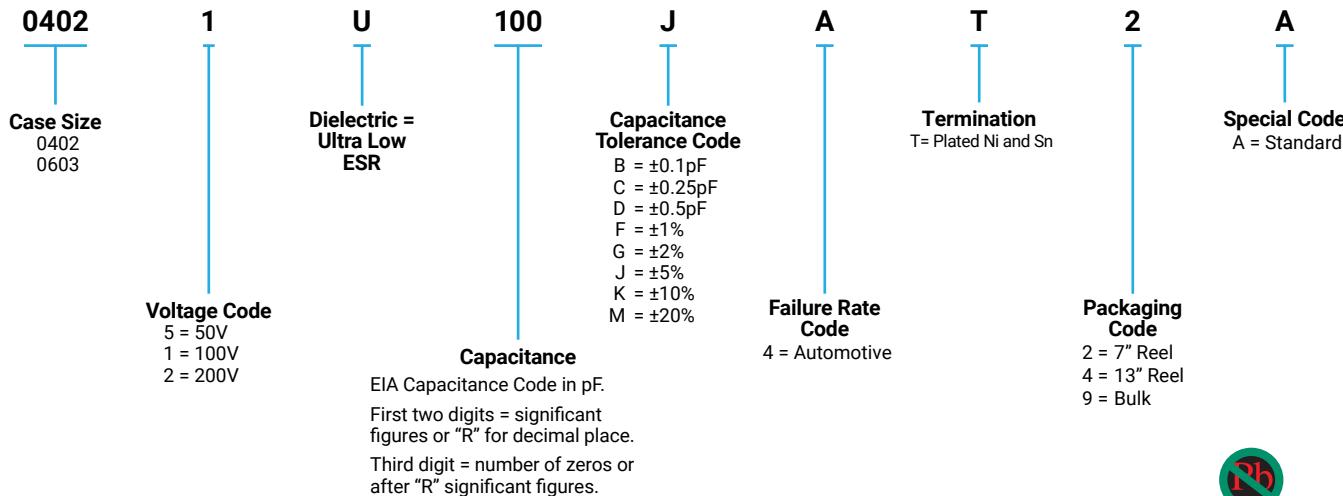
0603



inches (mm)

Size	A	B	C	D	E
0402	0.039±0.004 (1.00±0.1)	0.020±0.004 (0.50±0.1)	0.024 max (0.6)	N/A	N/A
0603	0.060±0.010 (1.52±0.25)	0.030±0.010 (0.76±0.25)	0.036 max (0.91)	0.010±0.005 (0.25±0.13)	0.030 min (0.76)

#### HOW TO ORDER



#### ELECTRICAL CHARACTERISTICS

##### Capacitance Values and Tolerances:

Size 0402 - 0.2 pF to 22 pF @ 1 MHz

Size 0603 - 1.0 pF to 100 pF @ 1 MHz

##### Temperature Coefficient of Capacitance (TC):

0±30 ppm/°C (-55° to +125°C)

##### Insulation Resistance (IR):

10<sup>12</sup> Ω min. @ 25°C and rated WVDC

10<sup>11</sup> Ω min. @ 125°C and rated WVDC

##### Working Voltage (WVDC):

Size Working Voltage

0402 - 100, 50, 25 WVDC

0603 - 200, 100, 50 WVDC

##### Dielectric Working Voltage (DWV):

250% of rated WVDC

##### Equivalent Series Resistance Typical (ESR):

0402 - See Performance Curve, page 303

0603 - See Performance Curve, page 303

##### Automotive Specifications

Meets or exceeds the requirements of AEC Q200



The Important Information/Disclaimer is incorporated in the catalog where these specifications came from or available online at [www.kyocera-avx.com/disclaimer/](http://www.kyocera-avx.com/disclaimer/) by reference and should be reviewed in full before placing any order.

## CAPACITANCE RANGE

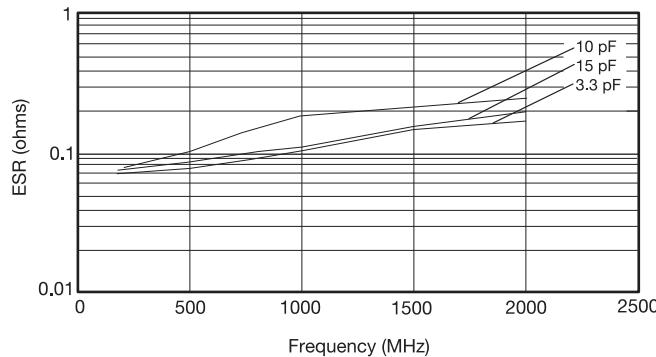
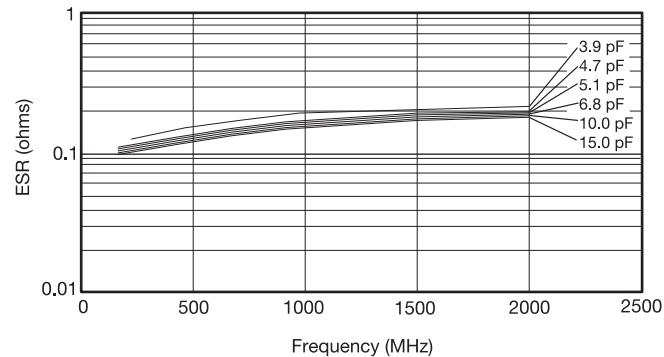
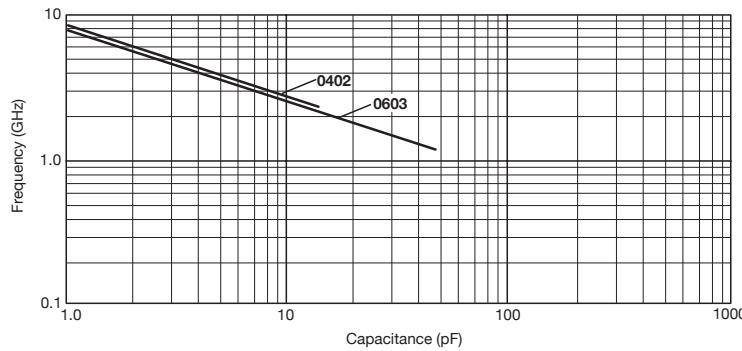
Cap (pF)	Available Tolerance	Size	
		0402	0603
0.2	B,C	50V	N/A
0.3			
0.4	↓		
0.5	B,C		
0.6	B,C,D		
0.7			
0.8	↓		
0.9	B,C,D		

Cap (pF)	Available Tolerance	Size	
		0402	0603
1.0	B,C,D	50V	200V
1.1			
1.2			
1.3			
1.4			
1.5			
1.6			
1.7			
1.8			
1.9			
2.0			
2.1			
2.2			
2.4			
2.7			
3.0			
3.3			
3.6			
3.9			
4.3			
4.7			
5.1			
5.6			
6.2	B,C,D		
6.8	B,C,J,K,M		

Cap (pF)	Available Tolerance	Size	
		0402	0603
7.5	B,C,J,K,M	50V	200V
8.2			
9.1	B,C,J,K,M		
10	F,G,J,K,M		
11			
12			
13			
15			
18			
20			
22			
24			
27			
30			
33			
36			
39			
43			
47			
51			
56			
68			
75			
82			
91			

Cap (pF)	Available Tolerance	Size	
		0402	0603
100	F,G,J,K,M	N/A	100V
110			50V
120			50V
130			N/A
140			
150			
160			
180			
200			
220			
270			
300			
330			
360			
390			
430			
470			
510			
560			
620			
680			
750			
820			
910			
1000	F,G,J,K,M		

## ULTRA LOW ESR, "U" SERIES

TYPICAL ESR vs. FREQUENCY  
0402 "U" SERIESTYPICAL ESR vs. FREQUENCY  
0603 "U" SERIESTYPICAL  
SERIES RESONANT FREQUENCY  
"U" SERIES CHIP

# U Dielectric Designer Kits

## Communication Kits "U" Series



**0402**

Kit 5000 UZ			
Cap. Value pF	Tolerance	Cap. Value pF	Tolerance
0.5	B ( $\pm 0.1\text{pF}$ )	4.7	B ( $\pm 0.1\text{pF}$ )
1.0		5.6	
1.5		6.8	
1.8		8.2	
2.2		10.0	J ( $\pm 5\%$ )
2.4		12.0	
3.0		15.0	
3.6			

\*\*\*25 each of 15 values

**0603**

Kit 4000 UZ			
Cap. Value pF	Tolerance	Cap. Value pF	Tolerance
1.0	B ( $\pm 0.1\text{pF}$ )	6.8	B ( $\pm 0.1\text{pF}$ )
1.2		7.5	
1.5		8.2	
1.8		10.0	
2.0		12.0	
2.4		15.0	
2.7		18.0	
3.0		22.0	
3.3		27.0	
3.9		33.0	
4.7		39.0	
5.6		47.0	

\*\*\*25 each of 24 values

**0805**

Kit 3000 UZ			
Cap. Value pF	Tolerance	Cap. Value pF	Tolerance
1.0	B ( $\pm 0.1\text{pF}$ )	15.0	J ( $\pm 5\%$ )
1.5		18.0	
2.2		22.0	
2.4		24.0	
2.7		27.0	
3.0		33.0	
3.3		36.0	
3.9		39.0	
4.7		47.0	
5.6		56.0	
7.5		68.0	
8.2		82.0	
10.0	J ( $\pm 5\%$ )	100.0	J ( $\pm 5\%$ )
12.0		130.0	

\*\*\*25 each of 30 values

**1210**

Kit 3500 UZ			
Cap. Value pF	Tolerance	Cap. Value pF	Tolerance
2.2	B ( $\pm 0.1\text{pF}$ )	36.0	J ( $\pm 5\%$ )
2.7		39.0	
4.7		47.0	
5.1		51.0	
6.8		56.0	
8.2		68.0	
9.1		82.0	
10.0	J ( $\pm 5\%$ )	100.0	
13.0		120.0	
15.0		130.0	
18.0		240.0	
20.0		300.0	
24.0		390.0	
27.0		470.0	
30.0		680.0	

\*\*\*25 each of 30 values



The Important Information/Disclaimer is incorporated in the catalog where these specifications came from or available online at [www.kyocera-avx.com/disclaimer/](http://www.kyocera-avx.com/disclaimer/) by reference and should be reviewed in full before placing any order.

# X8R/X8L Dielectric

## General Specifications



KYOCERA AVX has developed a range of multilayer ceramic capacitors designed for use in applications up to 150°C. These capacitors are manufactured with an X8R and an X8L dielectric material. X8R material has capacitance variation of  $\pm 15\%$  between -55°C and +150°C. The X8L material has capacitance variation of  $\pm 15\%$  between -55°C to 125°C to 125°C and  $\pm 15/40\%$  from +125°C to +150°C.

The need for X8R and X8L performance has been driven by customer requirements for parts that operate at elevated temperatures. They provide a highly reliable capacitor with low loss and stable capacitance over temperature.

They are ideal for automotive under the hood sensors, and various industrial applications. Typical industrial application would be drilling monitoring system. They can also be used as bulk capacitors for high temperature camera modules.

Both X8R and X8L dielectric capacitors are automotive AEC-Q200 qualified. Optional termination systems, tin, FLEXITERM® and conductive epoxy for hybrid applications are available. Providing this series with our FLEXITERM® termination system provides further advantage to customers by way of enhanced resistance to both, temperature cycling and mechanical damage.

0805	5	A	104	K	4	T	2	A
Size	Voltage	Dielectric	Capacitance Code (in pF)	Capacitance Tolerance	Failure Rate	Terminations	Packaging	Special Code
0402	10V = Z	X8R = F		J = $\pm 5\%$	4 = Automotive	T = Plated Ni and Sn	2 = 7" Reel	A = Std. Product
0603	16V = Y	X8L = L	2 Sig. Digits + Number of Zeros	K = $\pm 10\%$	A = Not Applicable	Z = FLEXITERM®**	4 = 13" Reel	
0805	25V = 3		e.g. 10 F = 106	M = $\pm 20\%$				
1206	50V = 5							
	100V = 1							

NOTE: Contact factory for availability of Termination and Tolerance Options for Specific Part Numbers.

### X8R

Style	0603			0805			1206		
	Soldering			Reflow/Wave			Reflow/Wave		
	WVDC	25V	50V	100V	25V	50V	100V	25V	50V
221	220			J	J	J			
271	270	G	G		J	J	J		
331 pF	330	G	G		J	J	J		
471	470	G	G	G	J	J	J		
681	680	G	G	G	J	J	J		
102	1000	G	G	G	J	J	J	J	J
152	1500	G	G	G	J	J	J	J	J
222	2200	G	G	G	J	J	J	J	J
332	3300	G	G	G	J	J	J	J	J
472	4700	G	G	G	J	J	J	J	J
682	6800	G	G	G	J	J	J	J	J
103 uF	0.01	G	G	G	J	J	J	J	J
153	0.015	G	G		J	J	N	J	J
223	0.022	G	G		J	J	N	J	J
333	0.033	G	G		J	J		J	J
473	0.047	G	G		J	J		J	J
683	0.068	G			N	N	M	M	
104	0.1				N	N	M	M	
154	0.15				N	N	M	M	
224	0.22				N		M	M	
334	0.33						M	M	
474	0.47						M	Q	
684	0.68						Q	Q	
105 uF	1						Q	Q	
	WVDC	25V	50V	100V	25V	50V	100V	25V	50V
Style	0603	0805			1206				

Size	0603			0805			1206			1210		
	Soldering			Reflow/Wave			Reflow/Wave			Reflow/Wave		
	WVDC	25V	50V	100V	25V	50V	100V	25V	50V	100V	10V	50V
271	Cap 270	G	G									
331	(pF) 330	G	G	G	J	J	J					
471	470	G	G	G	J	J	J					
681	680	G	G	G	J	J	J					
102	1000	G	G	G	J	J	J	J	J	J		
152	1500	G	G	G	J	J	J	J	J	J		
182	1800	G	G	G	J	J	J	J	J	J		
222	2200	G	G	G	J	J	J	J	J	J		
272	2700	G	G	G	J	J	J	J	J	J		
332	3300	G	G	G	J	J	J	J	J	J		
392	3900	G	G	G	J	J	J	J	J	J		
472	4700	G	G	G	J	J	J	J	J	J		
562	5600	G	G	G	J	J	J	J	J	J		
682	6800	G	G	G	J	J	J	J	J	J		
822	8200	G	G	G	J	J	J	J	J	J		
103	Cap 0.01	G	G	G	J	J	J	J	J	J		
123	( $\mu$ F) 0.012	G	G	G	J	J	J	J	J	J		
153	0.015	G	G		J	J	J	J	J	J		
183	0.018	G	G		J	J	J	J	J	J		
223	0.022	G	G		J	J	J	J	J	J		
273	0.027	G	G		J	J	J	J	J	J		
333	0.033	G	G		J	J	N	J	J	J		
393	0.039	G	G		J	J	N	J	J	J		
473	0.047	G	G		J	J	N	J	J	J		
563	0.056	G	G		J	J	N	J	J	J		
683	0.068	G	G		J	J	N	J	J	J		
823	0.082	G	G		J	J	N	J	J	J		
104	0.1	G	G		J	J	N	J	J	M		
124	0.12				J	N		J	J	M		
154	0.15				J	N		J	J	Q		
184	0.18				N	N		J	J	J	Q	
224	0.22				N	N		J	J	J	Q	
274	0.27				N			J	M	M	Q	
334	0.33				N			J	M	M	Q	
394	0.39				N			M	M	P	Q	
474	0.47				N			M	M	P	Q	
684	0.68				N			M	M	P	Q	
824	0.82				N			M	M	P	Q	
105	1				N			M	M	P	Q	
155	1.5							M	M			
225	2.2							M	M			
475										Z		
106		WVDC	25V	50V	100V	25V	50V	100V	16V	25V	50V	100V
		SIZE	0603	0805			1206			1210		

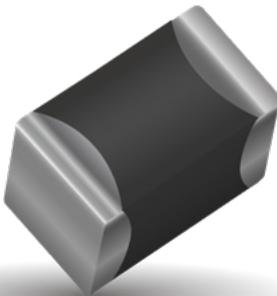
Letter	A	C	E	G	J	K	M	N	P	Q	X	Y	Z
Max. Thickness	0.33 (-0.013)	0.56 (-0.022)	0.71 (-0.028)	0.9 (-0.035)	0.94 (-0.037)	1.02 (-0.04)	1.27 (-0.05)	1.4 (-0.055)	1.52 (-0.06)	1.78 (-0.07)	2.29 (-0.09)	2.54 (-0.1)	2.79 (-0.11)
PAPER												EMBOSSSED	

# X8R/X8L Dielectric

## General Specifications

### APPLICATIONS FOR X8R AND X8L CAPACITORS

- All market sectors with a 150°C requirement
- Automotive on engine applications
- Oil exploration applications
- Hybrid automotive applications
  - Battery control
  - Inverter / converter circuits
  - Motor control applications
  - Water pump
- Hybrid commercial applications
  - Emergency circuits
  - Sensors
  - Temperature regulation



### ADVANTAGES OF X8R AND X8L MLC CAPACITORS

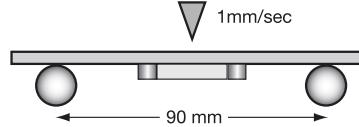
- Both ranges are qualified to the highest automotive AEC-Q200 standards
- Excellent reliability compared to other capacitor technologies
- RoHS compliant
- Low ESR / ESL compared to other technologies
- Tin solder finish
- FLEXITERM® available
- Epoxy termination for hybrid available
- 100V range available

### ENGINEERING TOOLS FOR HIGH VOLTAGE MLC CAPACITORS

- Samples
- Technical Articles
- Application Engineering
- Application Support

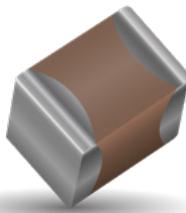


# X8R/X8L Dielectric Specifications and Test Methods

Parameter/Test	X8R/X8L Specification Limits		Measuring Conditions	
<b>Operating Temperature Range</b>	-55°C to +150°C		Temperature Cycle Chamber	
<b>Capacitance</b>	Within specified tolerance		Freq.: 1.0 kHz ± 10% Voltage: 1.0Vrms ± .2V	
<b>Dissipation Factor</b>	$\leq 2.5\%$ for $\geq 50V$ DC rating $\leq 3.5\%$ for 25V DC and 16V DC rating			
<b>Insulation Resistance</b>	100,000MΩ or 1000MΩ - $\mu$ 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 250% 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 1mm/sec 	
	Capacitance Variation	$\leq \pm 12\%$		
	Dissipation Factor	Meets Initial Values (As Above)		
	Insulation Resistance	$\geq$ Initial Value x 0.3		
<b>Solderability</b>	$\geq 95\%$ of each terminal should be covered with fresh solder		Dip device in eutectic solder at $230 \pm 5^\circ\text{C}$ 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 $260^\circ\text{C}$ 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: $-55^\circ\text{C} \pm 2^\circ$	$30 \pm 3$ minutes
	Capacitance Variation	$\leq \pm 7.5\%$	Step 2: Room Temp	$\leq 3$ minutes
	Dissipation Factor	Meets Initial Values (As Above)	Step 3: $+125^\circ\text{C} \pm 2^\circ$	$30 \pm 3$ 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 $150^\circ\text{C} \pm 2^\circ\text{C}$ 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)		
<b>Load Humidity</b>	Appearance	No visual defects	Store in a test chamber set at $85^\circ\text{C} \pm 2^\circ\text{C}$ / 85% ± 5% relative humidity for 1000 hours (+48, -0) with rated voltage applied. Remove from chamber and stabilize at room temperature and humidity for $24 \pm 2$ 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

## 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.

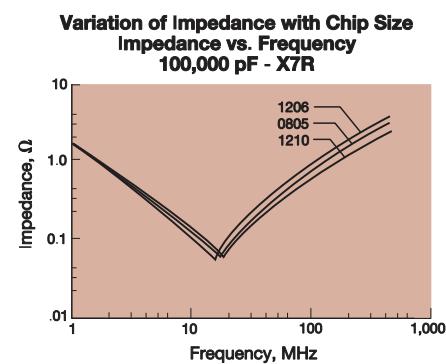
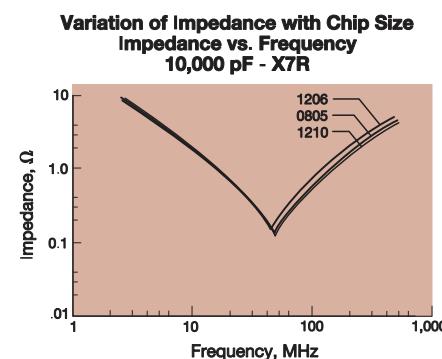
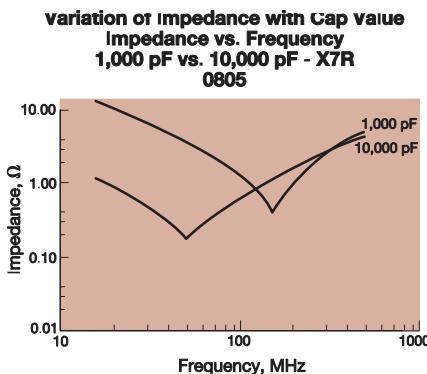
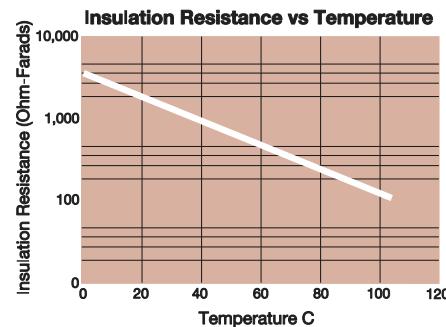
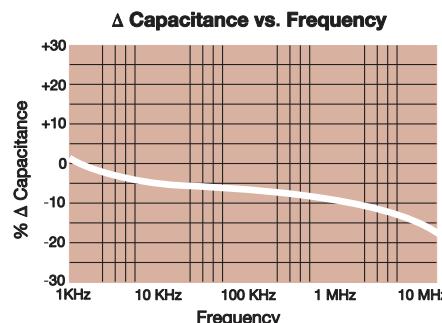
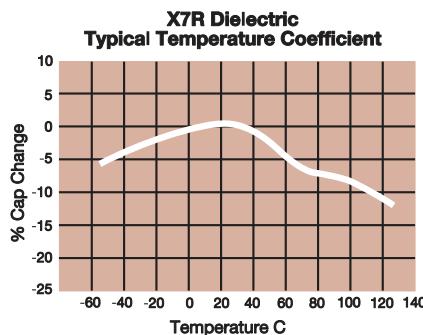
X7R dielectric chip usage covers the broad spectrum of industrial applications where known changes in capacitance due to applied voltages are acceptable.



### PART NUMBER (SEE PAGE 4 FOR COMPLETE PART NUMBER EXPLANATION)

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

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



# X7R Dielectric

## 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					
Dissipation Factor	≤ 10% for ≥ 50V DC ratings 12.5% for 25V DC rating ≤ 12.5% for 25V and 16V DC rating ≤ 12.5% for ≤ 10V DC rating Contact Factory for DF by PN		Freq.: 1.0 kHz ± 10% Voltage: 1.0Vrms ± .2V For Cap > 10µF, 0.5Vrm @ 120Hz			
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 250% 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				
	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 ± 5°C for 5.0 ± 0.5 seconds			
Resistance to Solder Heat	Appearance	No defects, <25% leaching of either end terminal				
	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				
	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)				
Load Life	Appearance	No visual defects				
	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				
	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 (in.)	0.40 ± 0.02 (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 ± 0.30 (0.126 ± 0.012)
W) Width (in.)	0.20 ± 0.02 (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 ± 0.30 (0.063 ± 0.012)
(t) Terminal (in.)	0.10 ± 0.04 (0.004 ± 0.0016)	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	16	6.3 10 16 25 50	6.3 10 16 25 50 100	6.3 10 16 25 50 100 200 250	6.3 10 16 25 50 100 200 250	6.3 10 16 25 50 100 200 250 500
Cap 100 101	B	A A A A A C C C C C G G G G G J J				G G G G G N N N
(pF) 150 151	B	A A A A A A C C C C C G G G G G J J				G G G G G N N N
220 221	B	A A A A A A C C C C C G G G G G J J E E E E E J P				
330 331	B	A A A A A A C C C C C G G G G G J N N P				
470 471	B	A A A A A A C C C C C G G G G G J N N P				
680 681	B	A A A A A A C C C C C G G G G G J N N P				
1000 102	B	A A A A A A C C C C C G G G G G J N N P				
1500 152		A A A A C C C C C C G G G G G J N N P				
2200 222		A A A A C C C C C C G G G G G J N N P				
3300 332		A A A A C C C C C C G G G G G J N N P				
3900 392		A A A A				
4700 472		A A A A C C C C C C G G G G G J N N P				
5600 562		A A A A				
6800 682		A A A A C C C C C C G G G G G J J J J J J J J J J J P P P J J J J J J J J J J N N P				
Cap 0.01 103		A A A A C C C C C C G G G G G J J J J J J J J J J J P P P J J J J J J J J N N P				
( $\mu$ F) 0.012 123						
0.015 153			C C C C C E G G G G G J J J J J J J J J P P P J J J J J N N Q			
0.018 183						
0.022 223		A A A C C C C C E G G G G G J J J J J J J J J P P P J J J J J J J P P Q				
0.027 273						
0.033 333			C C C C C E G G G G G J J J J J J J J P P P P J J J J J J J Q Q Q			
0.039 393						
0.047 473			C C C C C E G G G G G J J J J J J J J P P P P J J J J J J J Q Q Q			
0.068 683			C C C C C E G G G G G J J J J J J J J P P P J J J J J J J P Q Q			
0.082 823						
0.1 104	A	C C C C C E G G G G G J J J J J J J J P P P J J J J J P Q Q				
0.12 124						
0.15 154				G G G J J J N N N N P K K K K K Q Q Q		
0.22 224			C C C C C G G J J J N N N N P K K K K K Q Q Q			
0.33 334				J J J J J J P P P P K K K K N Q		
0.47 474			C C J J J J J P P P P M M M M X X			
0.68 684				J J J J J P P P P M M M M X X		
1.0 105		C J J J J K P P P P M M M M X X				
2.2 225				J J K P P P P M M M M X X		
4.7 475			K P P P P X X X X Z			
10 106				P P P P X X X X		
22 226					X X X X	
47 476						
100 107						
WVDC	16	6.3 10 16 25 50	6.3 10 16 25 50 100	6.3 10 16 25 50 100 200 250	6.3 10 16 25 50 100 200 250	6.3 10 16 25 50 100 200 250 500
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

\*\*Contact Factory for Specifications



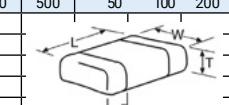
The Important Information/Disclaimer is incorporated in the catalog where these specifications came from or available online at [www.kyocera-avx.com/disclaimer/](http://www.kyocera-avx.com/disclaimer/) by reference and should be reviewed in full before placing any order.

# 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 (in.)	3.30 ± 0.4 (0.130 ± 0.016)						4.50 ± 0.40 (0.177 ± 0.016)						4.50 ± 0.40 (0.177 ± 0.016)						5.70 ± 0.50 (0.224 ± 0.020)						5.70 ± 0.40 (0.224 ± 0.016)															
(W) Width (in.)	2.50 ± 0.30 (0.098 ± 0.012)						3.20 ± 0.40 (0.126 ± 0.016)						6.40 ± 0.40 (0.252 ± 0.016)						5.00 ± 0.40 (0.197 ± 0.016)						6.30 ± 0.40 (0.248 ± 0.016)															
(t) Terminal (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	25	50	100	200	25	50	100	200								
Cap (pF)	100 101																																							
150 151																																								
220 221								K	K	K	M																													
330 331								K	K	K	M																													
470 471								K	K	K	M																													
680 681								K	K	K	M																													
1000 102	K	K	K	K	K	M		N	N	N	N	N	N	N	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X								
1500 152	K	K	K	K	K	M		N	N	N	N	N	N	N	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X								
2200 222	K	K	K	K	K	M		N	N	N	N	N	N	N	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X								
3300 332	K	K	K	K	K	P		N	N	N	N	N	N	N	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X								
4700 472	K	K	K	K	K	P		N	N	N	N	N	N	N	P	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X								
6800 682	K	K	K	K	K	P		N	N	N	N	N	N	N	P	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X								
Cap (μF)	0.01 103	K	K	K	K	K	P	N	N	N	N	N	N	N	P	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X								
0.015 153	K	K	K	K	K	P		N	N	N	N	N	N	N	P	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X								
0.022 223	K	K	K	K	K	P	Q	N	N	N	N	N	N	N	P	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X								
0.033 333	K	K	K	K	K	P	X	N	N	N	N	N	N	N	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X								
0.047 473	K	K	K	K	K	P	X	N	N	N	N	N	N	N	P	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X								
0.068 683	K	K	K	K	K	P	X	N	N	N	N	N	N	N	P	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X								
0.1 104	K	K	K	K	K	P	X	N	N	N	N	N	N	N	P	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X								
0.15 154	K	K	K	M	P	Z	Z	N	N	N	N	N	N	N	P	Z	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X								
0.22 224	K	K	M	P	Z			N	N	N	N	N	N	N	P	Q	Z	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X								
0.33 334	K	K	M	Q	Z			N	N	N	N	N	N	N	P	X	Z	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X								
0.47 474	M	M	M	P	Q	Z		N	N	N	N	N	N	N	Q	X	Z	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X								
0.68 684	M	M	P	X	X	Z		Q	Q	Q	Q	Q	Q	Q	Z		X	X	X	X	X	X	X	X	X	Z	X	X	X	X	X	X								
1.0 105	P	P	P	X	Z			Q	Q	Q	Q	Q	Q	Q	X	Z		X	X	X	X	X	X	X	X	7	X	X	X	X	X	X	X							
1.5 155	N	N	Z	Z	Z			Z	Z	Z	Z	Z	Z	Z		X	X	Z		X	X	Z																		
2.2 225	X	X	Z	Z	Z			Z	Z	Z	Z	Z	Z	Z		X	X	Z		X	X	Z																		
3.3 335	X	X	Z	Z	Z			Z	Z	Z	Z	Z	Z	Z		X	X	X		X	Z																			
4.7 475	Z	Z	Z	Z	Z			Z	Z	Z	Z	Z	Z	Z		X	X	X		Z	Z																			
10 106	Z	Z	Z	Z	Z			Z	Z	Z	Z	Z	Z	Z		Z	Z	Z		Z	Z	Z																		
22 226	Z	Z	Z	Z	Z																			Z																
47 476	Z	Z	Z	Z	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	25	50	100	200	50	100	200	25	50	100	200					
SIZE	1210						1812						1825						2220						2225															

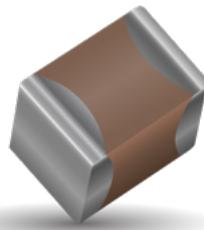


NOTE:

Contact factory for non-specified capacitance values

# X7S Dielectric

## General Specifications



### GENERAL DESCRIPTION

X7S formulations are called "temperature stable" ceramics and fall into EIA Class II materials. Its temperature variation of capacitances within  $\pm 22\%$  from  $-55^{\circ}\text{C}$  to  $+125^{\circ}\text{C}$ . This capacitance change is non-linear.

Capacitance for X7S varies under the influence of electrical operating conditions such as voltage and frequency.

X7S dielectric chip usage covers the broad spectrum of industrial applications where known changes in capacitance due to applied voltages are acceptable.

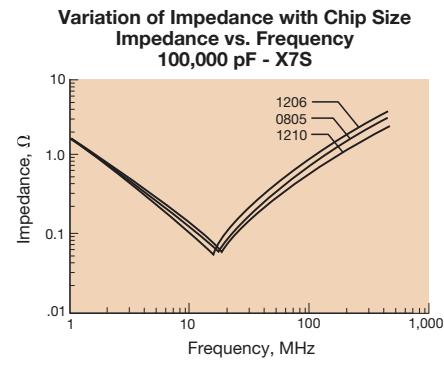
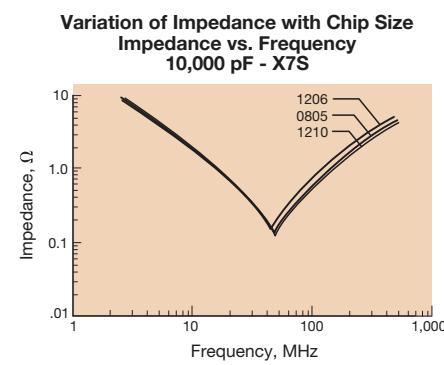
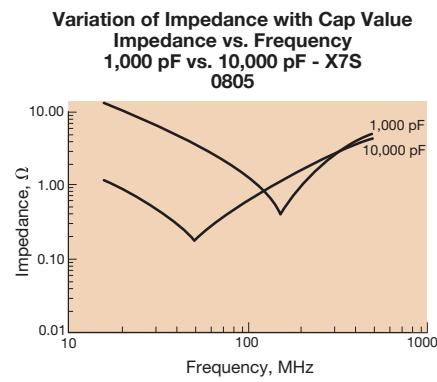
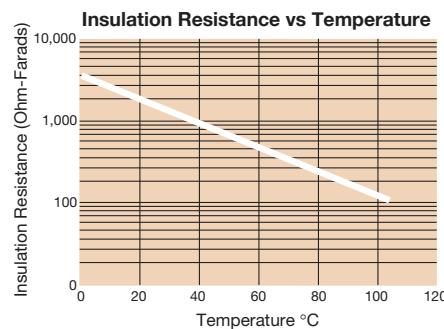
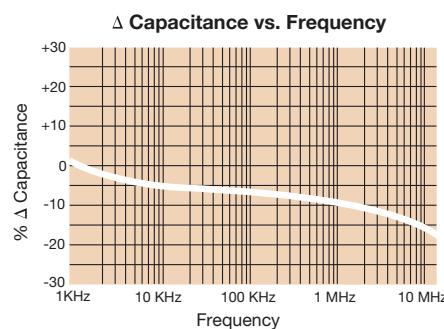
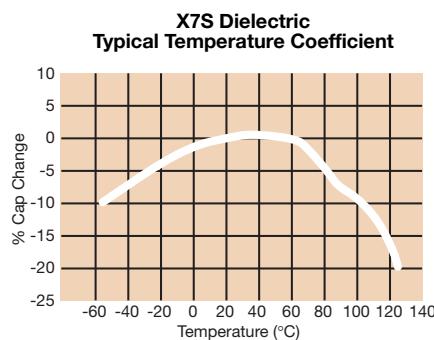
### PART NUMBER (SEE PAGE 4 FOR COMPLETE PART NUMBER EXPLANATION)

<b>1206</b>	<b>Z</b>	<b>Z</b>	<b>105</b>	<b>M</b>	<b>A</b>	<b>T</b>	<b>2</b>	<b>A</b>
Size (L" x W")	Voltage 4 = 4V 6 = 6.3V Z = 10V Y = 16V 3 = 25V 5 = 50V 1 = 100V 2 = 200V	Dielectric Z = X7S	Capacitance Code (In pF) 2 Sig. Digits + Number of Zeros	Capacitance Tolerance K = $\pm 10\%$ M = $\pm 20\%$	Failure Rate A = N/A	Terminations T = Plated Ni and Sn	Packaging 2 = 7" Reel 4 = 13" Reel	Special Code A = Std. Product

NOTE: Contact factory for availability of Tolerance Options for Specific Part Numbers.



### TYPICAL ELECTRICAL CHARACTERISTICS



# X7S Dielectric

## Specifications and Test Methods



Parameter/Test	X7S Specification Limits		Measuring Conditions		
Operating Temperature Range	-55°C to +125°C		Temperature Cycle Chamber		
Capacitance	Within specified tolerance				
Dissipation Factor	$\leq 5.0\%$ for $\geq 100V$ DC rating $\leq 5.0\%$ for $\geq 25V$ DC rating $\leq 10.0\%$ for $\geq 10V$ DC rating $\leq 10.0\%$ for $\leq 10V$ DC rating Contact Factory for DF by PN		Freq.: 1.0 kHz $\pm 10\%$ Voltage: 1.0Vrms $\pm .2V$ For Cap $> 10 \mu F$ , 0.5Vrms @ 120Hz		
Insulation Resistance	100,000MΩ or 1000MΩ - μF, 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 250% of rated voltage for 1-5 seconds, w/charge and discharge current limited to 50 mA (max)		
Resistance to Flexure Stresses	Appearance	No defects			
	Capacitance Variation	$\leq \pm 12\%$			
	Dissipation Factor	Meets Initial Values (As Above)			
	Insulation Resistance	$\geq$ Initial Value $\times 0.3$			
Solderability	$\geq 95\%$ of each terminal should be covered with fresh solder		Dip device in eutectic solder at $230 \pm 5^\circ C$ 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 $260^\circ C$ 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: $-55^\circ C \pm 2^\circ$ $30 \pm 3$ minutes	
	Capacitance Variation	$\leq \pm 7.5\%$		Step 2: Room Temp $\leq 3$ minutes	
	Dissipation Factor	Meets Initial Values (As Above)		Step 3: $+125^\circ C \pm 2^\circ$ $30 \pm 3$ 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	
Load Life	Appearance	No visual defects		Charge device with 1.5 rated voltage ( $\leq 10V$ ) in test chamber set at $125^\circ C \pm 2^\circ C$ for 1000 hours (+48, -0)	
	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)			
Load Humidity	Appearance	No visual defects		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)			



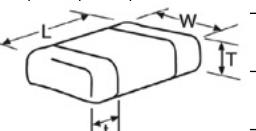
The Important Information/Disclaimer is incorporated in the catalog where these specifications came from or available online at [www.kyocera-avx.com/disclaimer/](http://www.kyocera-avx.com/disclaimer/) by reference and should be reviewed in full before placing any order.

# X7S Dielectric Capacitance Range



PREFERRED SIZES ARE SHADED

SIZE	0402	0603	0805	1206	1210
<b>Soldering</b>	<b>Reflow/Wave</b>	<b>Reflow/Wave</b>	<b>Reflow/Wave</b>	<b>Reflow/Wave</b>	<b>Reflow Only</b>
<b>Packaging</b>	<b>All Paper</b>	<b>All Paper</b>	<b>Paper/Embossed</b>	<b>Paper/Embossed</b>	<b>Paper/Embossed</b>
(L) Length mm (in.)	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)
(W) Width mm (in.)	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)
(t) Terminal mm (in.)	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)	0.50 ± 0.25 (0.020 ± 0.010)
WVDC	4	6.3	6.3	4	10 50 100 6.3
Cap (pF)	100 150 220				
	330 470 680				
	1000 1500 2200				
	3300 4700 6800				
Cap (μF)	0.010 0.015 0.022				
	0.033 0.047 0.068	C			
	0.10 0.15 0.22	C			
	0.33 0.47 0.68	G G G			
	1.0 1.5 2.2	E G	N N		Q
	3.3 4.7 10		N N	Q	
	22 47 100				Z
WVDC	4	6.3	6.3	4	10 50 100 6.3
SIZE	0402	0603	0805	1206	1210



Letter	A	C	E	G	J	K	M	N	P	Q	X	Y	Z
<b>Max. Thickness</b>	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					EMBOSSED								

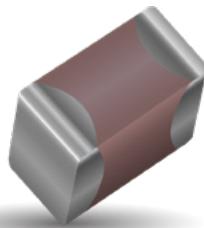
\*Contact Factory for Specifications



The Important Information/Disclaimer is incorporated in the catalog where these specifications came from or available online at [www.kyocera-avx.com/disclaimer/](http://www.kyocera-avx.com/disclaimer/) by reference and should be reviewed in full before placing any order.

# X5R Dielectric

## General Specifications



### GENERAL DESCRIPTION

- General Purpose Dielectric for Ceramic Capacitors
- EIA Class II Dielectric
- Temperature variation of capacitance is within  $\pm 15\%$  from  $-55^{\circ}\text{C}$  to  $+85^{\circ}\text{C}$
- Well suited for decoupling and filtering applications
- Available in High Capacitance values (up to  $100\mu\text{F}$ )

### PART NUMBER (SEE PAGE 4 FOR COMPLETE PART NUMBER EXPLANATION)

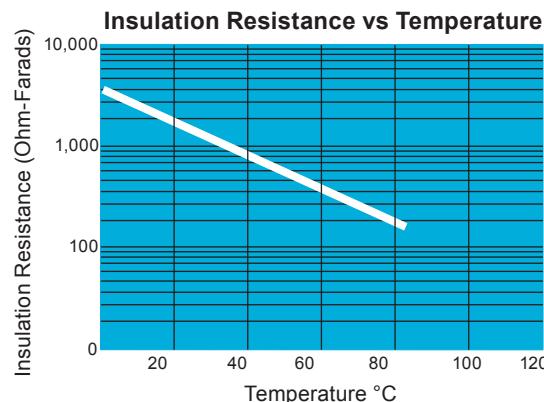
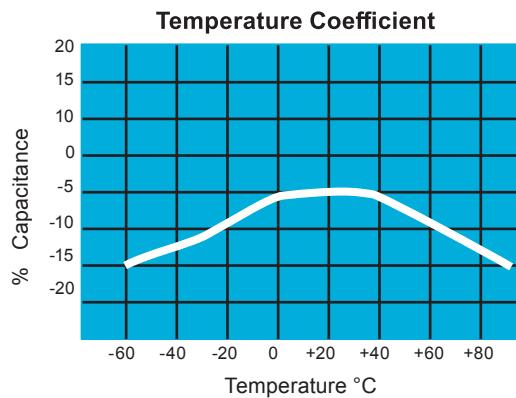
1210	4	D	107	M	A	T	2	A
<b>Size</b> (L" x W")	<b>Voltage</b>	<b>Dielectric</b>	<b>Capacitance Code (In pF)</b>	<b>Capacitance Tolerance</b>	<b>Failure Rate</b>	<b>Terminations</b>	<b>Packaging</b>	<b>Special Code</b>
0101**	4 = 4V	D = X5R	2 Sig. Digits + Number of Zeros	K = $\pm 10\%$ M = $\pm 20\%$	A = N/A	T = Plated Ni and Sn	2 = 7" Reel 4 = 13" Reel	A = Std.
0201	6 = 6.3V							
0402	Z = 10V							
0603	Y = 16V							
0805	3 = 25V							
1206	D = 35V							
1210	5 = 50V							
1812	1 = 100V							

\*\*EIA 01005



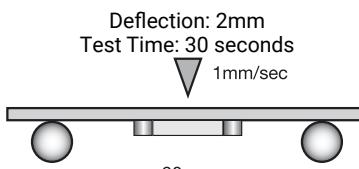
NOTE: Contact factory for availability of Tolerance Options for Specific Part Numbers.  
Contact factory for non-specified capacitance values.

### TYPICAL ELECTRICAL CHARACTERISTICS



# X5R Dielectric

## Specifications and Test Methods

Parameter/Test	X5R Specification Limits		Measuring Conditions		
Operating Temperature Range	-55°C to +85°C		Temperature Cycle Chamber		
Capacitance	Within specified tolerance				
Dissipation Factor	$\leq 2.5\%$ for $\geq 50V$ DC rating $\leq 12.5\%$ for 25V, 35V DC rating $\leq 12.5\%$ Max. for 16V DC rating and lower Contact Factory for DF by PN		Freq.: 1.0 kHz $\pm 10\%$ Voltage: 1.0Vrms $\pm 2V$ For Cap $> 10 \mu F$ , 0.5Vrms @ 120Hz		
Insulation Resistance	10,000MΩ or 500MΩ - $\mu F$ , 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 250% of rated voltage for 1-5 seconds, w/charge and discharge current limited to 50 mA (max)		
Resistance to Flexure Stresses	Appearance	No defects			
	Capacitance Variation	$\leq \pm 12\%$			
	Dissipation Factor	Meets Initial Values (As Above)			
	Insulation Resistance	$\geq$ Initial Value $\times 0.3$			
Solderability	$\geq 95\%$ of each terminal should be covered with fresh solder		Dip device in eutectic solder at $230 \pm 5^\circ C$ 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 $260^\circ C$ for 60seconds. 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: $-55^\circ C \pm 2^\circ$ $30 \pm 3$ minutes	
	Capacitance Variation	$\leq \pm 7.5\%$		Step 2: Room Temp $\leq 3$ minutes	
	Dissipation Factor	Meets Initial Values (As Above)		Step 3: $+85^\circ C \pm 2^\circ$ $30 \pm 3$ 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	
Load Life	Appearance	No visual defects		Charge device with 1.5X rated voltage in test chamber set at $85^\circ C \pm 2^\circ C$ for 1000 hours (+48, -0). Note: Contact factory for *optional specification part numbers that are tested at < 1.5X rated voltage. Remove from test chamber and stabilize at room temperature for $24 \pm 2$ hours	
	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)			
Load Humidity	Appearance	No visual defects		Store in a test chamber set at $85^\circ C \pm 2^\circ C / 85\% \pm 5\%$ 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)			

# X5R Dielectric

## Capacitance Range



### PREFERRED SIZES ARE SHADED

Case Size	0101*		0201				0402				0603				0805					
Soldering	Reflow Only		Reflow Only				Reflow/Wave				Reflow/Wfeve				Reflow/Wfeve					
Packaging	Paper/Embossed		All Paper				All Paper				All Paper				Paper/Embossed					
(L) Length (in.)	mm 0.40 ± 0.02 (0.016 ± 0.0008)				mm 0.60 ± 0.09 (0.024 ± 0.004)				mm 1.00 ± 0.20 (0.040 ± 0.008)				mm 1.60 ± 0.20 (0.063 ± 0.008)				mm 2.01 ± 0.20 (0.079 ± 0.008)			
W) Width (in.)	mm 0.20 ± 0.02 (0.008 ± 0.0008)				mm 0.30 ± 0.09 (0.011 ± 0.004)				mm 0.50 ± 0.20 (0.020 ± 0.008)				mm 0.80 ± 0.20 (0.031 ± 0.008)				mm 1.25 ± 0.20 (0.049 ± 0.008)			
(t) Terminal (in.)	mm 0.10 ± 0.04 (0.004 ± 0.0016)				mm 0.15 ± 0.05 (0.006 ± 0.002)				mm 0.25 ± 0.10 (0.010 ± 0.004)				mm 0.35 ± 0.15 (0.014 ± 0.006)				mm 0.50 ± 0.25 (0.020 ± 0.010)			
Voltage:	6.3	10	4	6.3	10	16	25	4	6.3	10	16	25	50	4	6.3	10	16	25	35	50
Cap (pF)	100	101		B				A												
	150	151		B				A												
	220	221		B				A					C							
	330	331		B				A					C							
	470	471		B				A					C							
	680	681		B				A					C							
	1000	102		B				A	A				C							
	1500	152	B	B				A	A	A			C							
	2200	222	B	B				A	A	A			C							
	3300	332	B	B				A	A	A			C							
	4700	472	B	B				A	A	A			C					G		
	6800	682	B	B				A	A	A			C					G		
Cap (μF)	0.01	103	B	B				A	A	A			C				G	G	G	
	0.015	150	B										C				G	G	G	
	0.022	223	B					A	A	A	A		C	C			G	G	G	N
	0.033	333	B										C				G	G	G	N
	0.047	473	B					A	A	A	A		C	C			G	G	G	N
	0.068	689	B										C				G		G	N
	0.1	104	B					A	A	A	A		C	C	C	C	G	G	G	N N N
	0.15	154															G			N N
	0.22	224	B					A	A	A			C	C	C	C	G	G	G	N N N
	0.33	334															G	G		N
	0.47	474	B					A	A				C	C	C	C	G	J		N P P
	0.68	684															G			N
	1.0	105						A	A	C	C		C	C	C	C	G	G	G	N N P P
	1.5	155																		
	2.2	225						C	C	C	C		C	C	C	C	G	G	J	N N P P P P
	3.3	335															J	J	J	N N
	4.7	475						C	C				E	E	E	E	J	J	J	N P J N N P P
	10	106											E	E	E	E	K	J	K	P P P P P P
	22	226											E	G			K	K	K	P P P P P P
	47	476															K	K		P P P P
	100	107																		
Voltage:	6.3	10	4	6.3	10	16	25	4	6.3	10	16	25	50	4	6.3	10	16	25	35	50
Case Size	0101*		0201				0402				0603				0805					

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													EMBOSS	

PAPER and EMBOSS available for 01005

NOTE: Contact factory for non-specified capacitance values

\*EIA 01005



The Important Information/Disclaimer is incorporated in the catalog where these specifications came from or available online at [www.kyocera-avx.com/disclaimer/](http://www.kyocera-avx.com/disclaimer/) by reference and should be reviewed in full before placing any order.

# X5R Dielectric

## Capacitance Range

PREFERRED SIZES ARE SHADED

Case Size	1206							1210							1812							
Soldering	Reflow/Wave							Reflow Only							Reflow Only							
Packaging	Paper/Embossed							Paper/Embossed							All Embossed							
(L) Length	mm (in.)	3.20 ± 0.40 (0.126 ± 0.016)							3.20 ± 0.40 (0.126 ± 0.016)							4.50 ± 0.30 (0.177 ± 0.012)						
W) Width	mm (in.)	1.60 ± 0.30 (0.063 ± 0.012)							2.50 ± 0.30 (0.098 ± 0.012)							3.20 ± 0.20 (0.126 ± 0.008)						
(t) Terminal	mm (in.)	0.50 ± 0.25 (0.020 ± 0.010)							0.50 ± 0.25 (0.020 ± 0.010)							0.61 ± 0.36 (0.024 ± 0.014)						
Voltage:	4	6.3	10	16	25	35	50	4	6.3	10	16	25	35	50	4	6.3	10	16	25	35	50	
Cap (pF)	100	101																				
	150	151																				
	220	221																				
	330	331																				
	470	471																				
	680	681																				
	1000	102																				
	1500	152																				
	2200	222																				
	3300	332																				
	4700	472																				
	6800	682																				
Cap (μF)	0.01	103																				
	0.015	150																				
	0.022	223																				
	0.033	333																				
	0.047	473																				
	0.068	689																				
	0.1	104																				
	0.15	154																				
	0.22	224																				
	0.33	334																				
	0.47	474																				
	0.68	684																				
	1.0	105																				
	1.5	155																				
	2.2	225																				
	3.3	335																				
	4.7	475	X	X	X	X	X	X	X							Z	Z	Z	Z	Z	Z	Z
	10	106	X	X	X	X	X	X	X							X	X	Z	Z	Z	Z	Z
	22	226	X	X	X	X	X									Z	Z	Z	Z	Z	Z	Z
	47	476	X	X	X	X										Z	Z	Z	Z	Z	Z	Z
	100	107	X	X												Z	Z					
Voltage:	4	6.3	10	16	25	35	50	4	6.3	10	16	25	35	50	4	6.3	10	16	25	35	50	
Case Size	1206							1210							1812							

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	

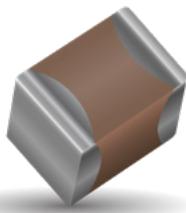
PAPER and EMBOSSED available for 01005

NOTE: Contact factory for non-specified capacitance values  
\*EIA 01005

# Y5V Dielectric General Specifications

**KYOCERA**

**AVX**



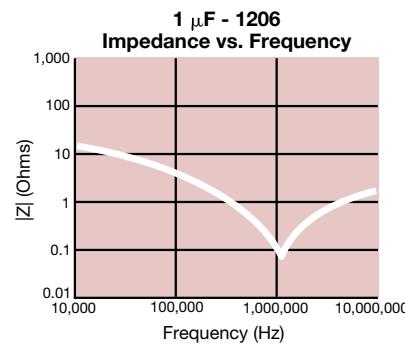
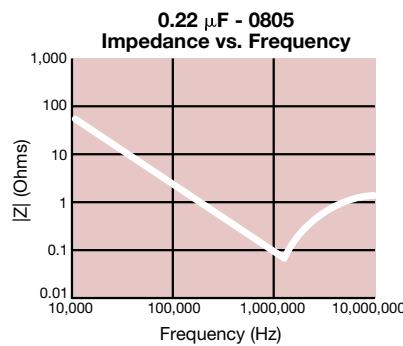
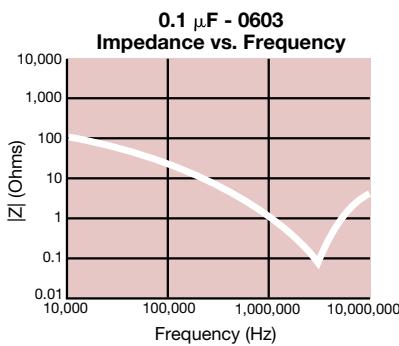
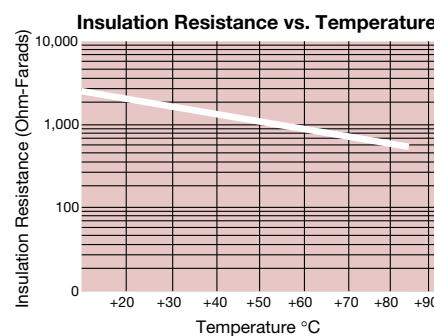
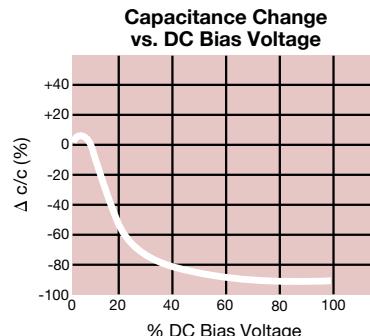
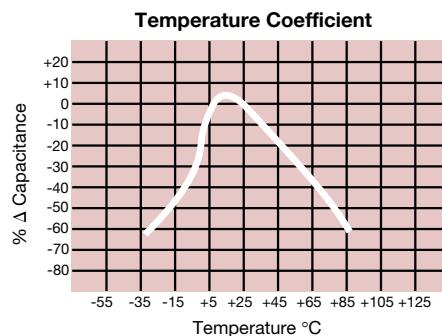
## GENERAL DESCRIPTION

Y5V formulations are for general-purpose use in a limited temperature range. They have a wide temperature characteristic of +22% –82% capacitance change over the operating temperature range of –30°C to +85°C. These characteristics make Y5V ideal for decoupling applications within limited temperature range.



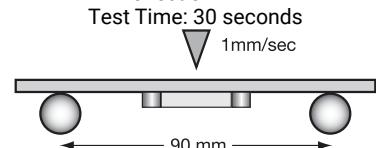
## PART NUMBER (SEE PAGE 4 FOR COMPLETE PART NUMBER EXPLANATION)

<b>0805</b>	<b>3</b>	<b>G</b>	<b>104</b>	<b>Z</b>	<b>A</b>	<b>T</b>	<b>2</b>	<b>A</b>
Size (L" x W")	Voltage 6.3V = 6 10V = Z 16V = Y 25V = 3 50V = 5	Dielectric Y5V = G	Capacitance Code (In pF) 2 Sig. Digits + Number of Zeros	Capacitance Tolerance Z = +80 –20%	Failure Rate A = Not Applicable	Terminations T = Plated Ni and Sn	Packaging 2 = 7" Reel 4 = 13" Reel	Special Code A = Std. Product



# Y5V Dielectric

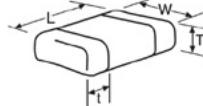
## Specifications and Test Methods

Parameter/Test	Y5V Specification Limits		Measuring Conditions		
Operating Temperature Range	-30°C to +85°C		Temperature Cycle Chamber		
Capacitance	Within specified tolerance				
Dissipation Factor	$\leq 5.0\%$ for $\geq 50V$ DC rating $\leq 7.0\%$ for $25V$ DC rating $\leq 9.0\%$ for $16V$ DC rating $\leq 12.5\%$ for $\leq 10V$ DC rating		Freq.: 1.0 kHz $\pm 10\%$ Voltage: 1.0Vrms $\pm .2V$ For Cap $> 10 \mu F$ , 0.5Vrms @ 120Hz		
Insulation Resistance	10,000MΩ or 500MΩ - $\mu F$ , 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 250% of rated voltage for 1-5 seconds, w/charge and discharge current limited to 50 mA (max)		
Resistance to Flexure Stresses	Appearance	No defects			
	Capacitance Variation	$\leq \pm 30\%$			
	Dissipation Factor	Meets Initial Values (As Above)			
	Insulation Resistance	$\geq$ Initial Value $\times 0.1$			
Solderability	$\geq 95\%$ of each terminal should be covered with fresh solder		Dip device in eutectic solder at $230 \pm 5^\circ C$ 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 $260^\circ C$ for 60 seconds. Store at room temperature for $24 \pm 2$ hours before measuring electrical properties.	
	Capacitance Variation	$\leq \pm 20\%$			
	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: $-30^\circ C \pm 2^\circ$ <span style="float: right;"><math>30 \pm 3</math> minutes</span>	
	Capacitance Variation	$\leq \pm 20\%$		Step 2: Room Temp <span style="float: right;"><math>\leq 3</math> minutes</span>	
	Dissipation Factor	Meets Initial Values (As Above)		Step 3: $+85^\circ C \pm 2^\circ$ <span style="float: right;"><math>30 \pm 3</math> minutes</span>	
	Insulation Resistance	Meets Initial Values (As Above)		Step 4: Room Temp <span style="float: right;"><math>\leq 3</math> minutes</span>	
	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 twice rated voltage in test chamber set at $85^\circ C \pm 2^\circ C$ for 1000 hours (+48, -0)	
	Capacitance Variation	$\leq \pm 30\%$			
	Dissipation Factor	$\leq$ Initial Value $\times 1.5$ (See Above)			
	Insulation Resistance	$\geq$ Initial Value $\times 0.1$ (See Above)			
	Dielectric Strength	Meets Initial Values (As Above)			
Load Humidity	Appearance	No visual defects		Remove from test chamber and stabilize at room temperature for $24 \pm 2$ hours before measuring.	
	Capacitance Variation	$\leq \pm 30\%$			
	Dissipation Factor	$\leq$ Initial Value $\times 1.5$ (See above)			
	Insulation Resistance	$\geq$ Initial Value $\times 0.1$ (See Above)			
	Dielectric Strength	Meets Initial Values (As Above)			

# Y5V Dielectric Capacitance Range

## PREFERRED SIZES ARE SHADED

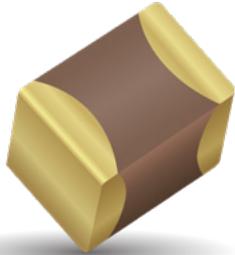
SIZE	0201		0402				0603				0805				1206				1210											
Soldering	Reflow Only		Reflow/Wave				Reflow/Wave				Reflow/Wave				ReflowMfeve				Reflow/Wave											
Packaging	All Paper		All Paper				All Paper				Paper/Embossed				Paper/Embossed				Paper/Embossed											
(L) Length (in.)	mm (0.024 ± 0.004)		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)											
W) Width (in.)	mm (0.011 ± 0.004)		0.50 ± 0.10 (0.020 ± 0.004)				.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)											
(t) Terminal (in.)	mm (0.006 ± 0.002)		0.15 ± 0.05 (0.010 ± 0.006)				0.25 ± 0.15 (0.014 ± 0.006)				0.35 ± 0.15 (0.020 ± 0.010)				0.50 ± 0.25 (0.020 ± 0.010)				.50 ± 0.25 (0.020 ± 0.010)											
WVDC	6.3		10		6		10		16		25		50		10		16		25		50		10		16		25		50	
Cap (pF)	820																													
1000			A																											
2200			A																											
4700			A																											
Cap (μF)	0.010		A		A																									
0.047			A																											
0.10			C		C												G		G								K			
0.22			C		C												G		G											
0.33			C														G		G											
0.47			C		C												G		G											
1.0			C		C												G		G								M			
2.2			C														J										N			
4.7																			N		N		N		P		Q			
10.0																			N		N		X		Z		Q			
22.0																			Q								X			
47.0																											Z			
WVDC	6.3		10		6		10		16		25		50		10		16		25		50		10		16		25		50	



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

# MLCC Gold Termination – AU Series

## General Specifications



KYOCERA AVX will support those customers for commercial and military Multilayer Ceramic Capacitors with a termination consisting of Gold. This termination is indicated by the use of a "7" or "G" in the 12th position of the KYOCERA AVX Catalog Part Number. This fulfills KYOCERA AVX's commitment to providing a full range of products to our customers. Please contact the factory if you require additional information on our MLCC Gold Termination.

### PART NUMBER

AU03	Y	G	104	K	A	7	2	A
<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</b>	<b>Special Code</b>
AU02 - 0402	6.3V = 6	COG (NP0) = A	2 Sig. Digits + Number of Zeros	B = $\pm .10$ pF (<10pF) C = $\pm .25$ pF (<10pF) D = $\pm .50$ pF (<10pF) F = $\pm 1\%$ ( $\geq 10$ pF) G = $\pm 2\%$ ( $\geq 10$ pF) J = $\pm 5\%$ K = $\pm 10\%$ M = $\pm 20\%$	A = Not Applicable	G* = $1.9 \mu$ " to $7.87 \mu$ " 7 = $100 \mu$ " minimum	2 = 7" Reel 4 = 13" Reel U = 4mm TR (01005)	A = Std. Product
AU03 - 0603	10V = Z	X7R = C						
AU05 - 0805	16V = Y	X5R = D						
AU06 - 1206	25V = 3							
AU10 - 1210	35V = D							
AU12 - 1812	50V = 5							
AU13 - 1825	100V = 1							
AU14 - 2225	200V = 2							
AU16 - 0306	500V = 7							
AU17 - 0508								
AU18 - 0612								
* Contact factory for availability.								
Contact Factory For Multiples*								

\* Contact factory for availability.

## MLCC Gold Termination – AU Series

 KYOCERA  
AVAX®

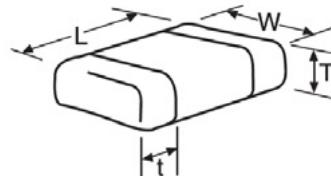
## Capacitance Range (NP0 Dielectric)

## PREFERRED SIZES ARE SHADED

SIZE	AU02			AU03			AU05					AU06						
Soldering	Reflow/Epoxy/ Wire Bond*			Reflow/Epoxy/ Wire Bond*			Reflow/Epoxy/ Wire Bond*					Reflow/Epoxy/ Wire Bond*						
Packaging	All Paper			All Paper			Paper/Embossed					Paper/Embossed						
(L) Length (in.)	mm (in.)	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 (in.)	mm (in.)	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 (in.)	mm (in.)	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	16	25	50	16	25	50	100	16	25	50	100	200	16	25	50	100	200	500
Cap (pF)	0.5	C	C	C	G	G	G	J	J	J	J	J	J	J	J	J	J	J
	1.0	C	C	C	G	G	G	J	J	J	J	J	J	J	J	J	J	J
	1.2	C	C	C	G	G	G	J	J	J	J	J	J	J	J	J	J	J
	1.5	C	C	C	G	G	G	J	J	J	J	J	J	J	J	J	J	J
	1.8	C	C	C	G	G	G	J	J	J	J	J	J	J	J	J	J	J
	2.2	C	C	C	G	G	G	J	J	J	J	J	J	J	J	J	J	J
	2.7	C	C	C	G	G	G	J	J	J	J	J	J	J	J	J	J	J
	3.3	C	C	C	G	G	G	J	J	J	J	J	J	J	J	J	J	J
	3.9	C	C	C	G	G	G	J	J	J	J	J	J	J	J	J	J	J
	4.7	C	C	C	G	G	G	J	J	J	J	J	J	J	J	J	J	J
	5.6	C	C	C	G	G	G	J	J	J	J	J	J	J	J	J	J	J
	6.8	C	C	C	G	G	G	J	J	J	J	J	J	J	J	J	J	J
	8.2	C	C	C	G	G	G	J	J	J	J	J	J	J	J	J	J	J
	10	C	C	C	G	G	G	J	J	J	J	J	J	J	J	J	J	J
	12	C	C	C	G	G	G	J	J	J	J	J	J	J	J	J	J	J
	15	C	C	C	G	G	G	J	J	J	J	J	J	J	J	J	J	J
	18	C	C	C	G	G	G	J	J	J	J	J	J	J	J	J	J	J
	22	C	C	C	G	G	G	J	J	J	J	J	J	J	J	J	J	J
	27	C	C	C	G	G	G	J	J	J	J	J	J	J	J	J	J	J
	33	C	C	C	G	G	G	J	J	J	J	J	J	J	J	J	J	J
	39	C	C	C	G	G	G	J	J	J	J	J	J	J	J	J	J	J
	47	C	C	C	G	G	G	J	J	J	J	J	J	J	J	J	J	J
	56	C	C	C	G	G	G	J	J	J	J	J	J	J	J	J	J	J
	68	C	C	C	G	G	G	J	J	J	J	J	J	J	J	J	J	J
	82	C	C	C	G	G	G	J	J	J	J	J	J	J	J	J	J	J
	100	C	C	C	G	G	G	J	J	J	J	J	J	J	J	J	J	J
	120	C	C	C	G	G	G	J	J	J	J	J	J	J	J	J	J	J
	150	C	C	C	G	G	G	J	J	J	J	J	J	J	J	J	J	J
	180	C	C	C	G	G	G	J	J	J	J	J	J	J	J	J	J	J
	220	C	C	C	G	G	G	J	J	J	J	J	J	J	J	J	J	M
	270	C	C	C	G	G	G	J	J	J	J	J	M	J	J	J	J	M
	330	C	C	C	G	G	G	J	J	J	J	J	M	J	J	J	J	M
	390	C	C	C	G	G	G	J	J	J	J	J	M	J	J	J	J	M
	470	C	C	C	G	G	G	J	J	J	J	J	M	J	J	J	J	M
	560				G	G	G	J	J	J	J	J	M	J	J	J	J	M
	680				G	G	G	J	J	J	J	J	M	J	J	J	J	P
	820				G	G	G	J	J	J	J	J	M	J	J	J	J	M
	1000				G	G	G	J	J	J	J	J	M	J	J	J	J	Q
	1200							J	J	J	J	J	M	J	J	J	J	Q
	1500							J	J	J	J	J	M	J	J	J	M	Q
	1800							J	J	N	N			J	J	M	M	
	2200							J	J	N	N			J	J	M	M	
	2700							J	J	N	N			J	J	M	M	
	3300							J	J					J	J	M	M	
	3900							J	J					J	J	M	M	
	4700							J	J					J	J	M	M	
	5600													J	J	M		
	6800													M	M			
	8200													M	M			
	0.010													M	M			
	0.012													M	M			
	0.015													M	M			
	0.018																	
	0.022																	
	0.027																	
	0.033																	
	0.039																	
	0.047																	
	0.068																	
	0.082																	
	0.1																	
SIZE	AU02			AU03			AU05					AU06						
WVDC	16	25	50	16	25	50	100	16	25	50	100	200	16	25	50	100	200	500

\* Contact Factory

Letter	A	C	E	G	J	K	M	N	P	Q	X	Y	Z
<b>Max. Thickness</b>	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)



kyocera  
awd

The Important Information/Disclaimer is incorporated in the catalog where these specifications came from or available online at [www.kyocera-avx.com/disclaimer/](http://www.kyocera-avx.com/disclaimer/) by reference and should be reviewed in full before placing any order.

# MLCC Gold Termination – AU Series

## Capacitance Range (NP0 Dielectric)

### PREFERRED SIZES ARE SHADED

SIZE	AU10					AU12					AU13					AU14				
Soldering	Reflow/Epoxy/ Wire Bond*					Reflow/Epoxy/ Wire Bond*					Reflow/Epoxy/ Wire Bond*					Reflow/Epoxy/ Wire Bond*				
Packaging	Paper/Embossed					All Embossed					All Embossed					All Embossed				
(L) Length (in.)	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 (in.)	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 (in.)	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)			
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																				
12																				
15																				
18																				
22																				
27																				
33																				
39																				
47																				
56																				
68																				
82																				
100																				
120																				
150																				
180																				
220																				
270																				
330																				
390																				
470																				
560	J	J	J	J	J	M														
680	J	J	J	J	J	M														
820	J	J	J	J	J	M														
1000	J	J	J	J	J	M	K	K	K	K	M	M	M	M	M	M	M	P		
1200	J	J	J	J	J	M	K	K	K	K	M	M	M	M	M	M	M	P		
1500	J	J	J	J	J	M	K	K	K	K	M	M	M	M	M	M	M	P		
1800	J	J	J	M			K	K	K	K	M	M	M	M	M	M	M	P		
2200	J	J	J	Q			K	K	K	K	P	M	M	M	M	M	M	P		
2700	J	J	J	Q			K	K	K	K	Q	M	M	M	M	M	M	P		
3300	J	J	J				K	K	K	K	P	Q	M	M	M	M	M	P		
3900	J	J	M				K	K	K	K	P	Q	M	M	M	M	M	P		
4700	J	J	M				K	K	K	K	P	Q	M	M	M	M	M	P		
5600	J	J					K	K	M	P	X		M	M	M	M	M	P		
6800	J	J					K	K	M	X		M	M	M	M	M	M	P		
8200	J	J					K	M	M			M	M	M	M	M	M	P		
0.010	J	J					K	M	M			M	M	M	M	M	M	P		
0.012	J	J					K	M	M			M	M	M	M	M	M	P		
0.015							M	M	M			M	M	M	M	M	M	P		
0.018							M	M	M			P	M				M	P		
0.022							M	M	M			P					M	Y		
0.027							M	M	M			P					M	Y		
0.033							M	M	M			P					P			
0.039							M	M	M			P					P			
0.047							M	M	M			P					P			
0.068							M	M	M								P			
0.082							M	M	M								Q			
0.1																				
WVDC	25	50	100	200	500	25	50	100	200	500	50	100	200	50	100	200	50	100	200	
SIZE	AU10					AU12					AU13					AU14				

\* Contact Factory

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													EMBOSSED

# MLCC Gold Termination – AU Series

## Capacitance Range (X7R Dielectric)

### PREFERRED SIZES ARE SHADED

SIZE	AU02				AU03					AU05					AU06											
Soldering	Reflow/Epoxy/ Wire Bond*				Reflow/Epoxy/ Wire Bond*					Reflow/Epoxy/ Wire Bond*					Reflow/Epoxy/ Wire Bond*											
Packaging	All Paper				All Paper					Paper/Embossed					Paper/Embossed											
(L) Length mm (in.)	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.)	0.50 ± 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.)	0.25 ± 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	50	63	10	16	25	50	100	200	63	10	16	25	50	100	200	63	10	16	25	50	100	200	500
Cap (pF)	100																									
150																										
220					C							G														
330						C						G	G	G			J	J	J	J	J	J	J	J	K	
470						C						G	G	G			J	J	J	J	J	J	J	J	K	
680						C						G	G	G			J	J	J	J	J	J	J	J	K	
1000							C					G	G	G			J	J	J	J	J	J	J	J	K	
1500							C					G	G	G			J	J	J	J	J	J	J	J	M	
2200							C					G	G	G			J	J	J	J	J	J	J	J	M	
3300						C	C	C			G	G	G			J	J	J	J	J	J	J	J	M		
4700						C	C	C			G	G	G			J	J	J	J	J	J	J	J	M		
6800						C	C	C			G	G	G			J	J	J	J	J	J	J	J	P		
Cap (μF)	0.010					C					G	G	G			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	M	
0.022		C				C					G	G	G			J	J	J	J	J	J	J	J	J	M	
0.033		C									G	G	G			J	J	J	J	N		J	J	J	M	
0.047											G	G	G			J	J	J	J	N		J	J	J	M	
0.068											G	G	G			J	J	J	J	N		J	J	J	P	
0.10											G	G	G			J	J	J	J	N		J	J	J	M	
0.15											G	G	G			J	J	J	N	N		J	J	J	Q	
0.22											G	G	G			J	J	J	N	N		J	J	J	Q	
0.33																N	N	N	N	N		J	J	M	Q	
0.47																N	N	N	N	N		M	M	P	Q	
0.68																N	N	N	N	N		M	M	Q	Q	
1.0																N	N	N	N	N		M	M	Q	Q	
1.5																						P*				
2.2																										
3.3																										
4.7																										
10																										
22																										
47																										
100																										
WVDC	10	16	25	50	63	10	16	25	50	100	200	63	10	16	25	50	100	200	63	10	16	25	50	100	200	500
SIZE	AU02				AU03					AU05					AU06											

\* Contact Factory

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												EMBOSS	

# MLCC Gold Termination – AU Series

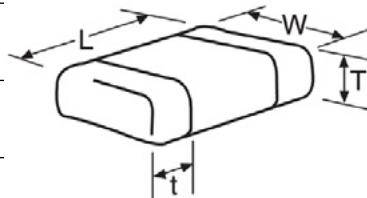
## Capacitance Range (X7R Dielectric)



### PREFERRED SIZES ARE SHADED

SIZE	AU10							AU12				AU13		AU14	
<b>Soldering</b>	Reflow/Epoxy/ Wire Bond*							Reflow/Epoxy/ Wire Bond*				Reflow/Epoxy/ Wire Bond*		Reflow/Epoxy/ Wire Bond*	
<b>Packaging</b>	Paper/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)		5.72 ± 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)		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)	
WVDC	10	16	25	50	100	200	500	50	100	200	500	50	100	50	100
Cap (pF)	100														
	150														
	220														
	330														
	470														
	680														
	1000														
Cap (pF)	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	P
	0.015	J	J	J	J	J	J	P	K	K	K	P	M	M	P
	0.022	J	J	J	J	J	J	Q	K	K	K	P	M	M	P
	0.033	J	J	J	J	J	J	Q	K	K	K	X	M	M	P
	0.047	J	J	J	J	J	J		K	K	K	Z	M	M	P
	0.068	J	J	J	J	J	M		K	K	K	Z	M	M	P
	0.10	J	J	J	J	J	M		K	K	K	Z	M	M	P
	0.15	J	J	J	J	J	Z		K	K	P		M	M	P
	0.22	J	J	J	J	P	Z		K	K	P		M	M	P
	0.33	J	J	J	J	Q			K	M	X		M	M	P
	0.47	M	M	M	M	Q			K	P			M	M	P
	0.68	M	M	P	X	X			M	Q			M	P	P
	1.0	N	N		X	Z			M	X			P	M	P
	1.5	N	N	Z	Z	Z			Z	Z			M	M	X
	2.2	X	X	Z	Z	Z			Z	Z					
	3.3	X	X	Z	Z	Z			Z						
	4.7	X	X	Z	Z	Z									
	10	Z	Z	Z											
	22														
	47														
	100														
WVDC	10	16	25	50	100	200	500	50	100	200	500	50	100	50	100
SIZE	AU10							AU12				AU13		AU14	

\* Contact Factory



Letter	A	C	E	G	J	K	M	N	P	Q	X	Y	Z
<b>Max. Thickness</b>	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							EMBOSSED						

## MLCC Gold Termination – AU Series



## Capacitance Range (X5R Dielectric)

## PREFERRED SIZES ARE SHADED

SIZE	AU02				AU03				AU05				AU06				AU10				AU12									
Soldering	Reflow/Epoxy Wire Bond*				Reflow/Epoxy Wire Bond*				Reflow/Epoxy Wire Bond*				Reflow/Epoxy Wire Bond*				Reflow/Epoxy Wire Bond*				Reflow/Epoxy Wire Bond*									
Packaging	All Paper				All Paper				Paper/Embossed				Paper/Embossed				Paper/Embossed				All Embossed									
(L) Length	mm (in.)	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 (in.)	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 (in.)	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)				0.50 ± 0.25 (0.020 ± 0.010)				0.61 ± 0.36 (0.024 ± 0.014)								
WVDC	4	6.3	10	16	25	50	4	6.3	10	16	25	35	50	6.3	10	16	25	35	50	4	6.3	10	16	25	35	50	6.3	10	25	50
Cap (pF)	100																													
	150																													
	220																													
	330						C																							
	470						C																							
	680						C																							
	1000						C																							
	1500						C																							
	2200						C																							
	3300						C																							
	4700						C																							
	6800						C																							
Cap (μF)	0.010						C																							
	0.015						C																							
	0.022						C																							
	0.033						C																							
	0.047						C																							
	0.068						C																							
	0.10		C				C																							
	0.15																													
	0.22		C*																											
	0.33																													
	0.47		C*																											
	0.68																													
	1.0																													
	1.5																													
	2.2		C*																											
	3.3																													
	4.7																													
	10																													
	22																													
	47																													
	100																													
WVDC	4	6.3	10	16	25	50	4	6.3	10	16	25	35	50	6.3	10	16	25	35	50	6.3	10	16	25	35	50	6.3	10	25	50	
SIZE	AU02				AU03				AU05				AU06				AU10				AU12									

\* Contact Factory

= \*Optional Specifications – Contact Factory

NOTE: Contact factory for non-specified capacitance values

# MLCC Gold Termination – AU Series

## AU16/AU17/AU18

SIZE		AU16 (0306)				AU17 (0508)				AU18 (0612)						
Packaging		Embossed				Embossed				Embossed						
Length	mm (in.)	0.81 ± 0.15 (0.032 ± 0.006)				1.27 ± 0.25 (0.050 ± 0.010)				1.60 ± 0.25 (0.063 ± 0.010)						
Width	mm (in.)	1.60 ± 0.15 (0.063 ± 0.006)				2.00 ± 0.25 (0.080 ± 0.010)				3.20 ± 0.25 (0.126 ± 0.010)						
Cap Code	WVDC	4	6.3	10	16	25	6.3	10	16	25	50	6.3	10	16	25	50
102	Cap 0.001	A	A	A	A	S	S	S	S	V	S	S	S	S	V	
222	(μF) .0022	A	A	A	A	S	S	S	S	V	S	S	S	S	V	
332	0.0033	A	A	A	A	S	S	S	S	V	S	S	S	S	V	
472	0.0047	A	A	A	A	S	S	S	S	V	S	S	S	S	V	
682	0.0068	A	A	A	A	S	S	S	S	V	S	S	S	S	V	
103	0.01	A	A	A	A	S	S	S	S	V	S	S	S	S	V	
153	0.015	A	A	A	A	S	S	S	S	V	S	S	S	S	W	
223	0.022	A	A	A	A	S	S	S	S	V	S	S	S	S	W	
333	0.033	A	A	A		S	S	S	V	V	S	S	S	S	W	
473	0.047	A	A	A		S	S	S	V	A	S	S	S	S	W	
683	0.068	A	A	A		S	S	S	A	A	S	S	S	V	W	
104	0.1	A	A	A		S	S	V	A	A	S	S	S	V	W	
154	0.15	A	A			S	S	V			S	S	S	W	W	
224	0.22	A	A			S	S	A			S	S	V	W		
334	0.33					V	V	A			S	S	V			
474	0.47					V	V	A			S	S	V			
684	0.68					A	A				V	V	W			
105	1	A				A	A				V	V	A			
155	1.5					A					W	W				
225	2.2										A	A				
335	3.3										A					
475	4.7															
685	6.8															
106	10															

Solid = X7R

= X5R

= X7S

mm (in.)

AU16 (0306)	
Code	Thickness
A	0.56 (0.022)

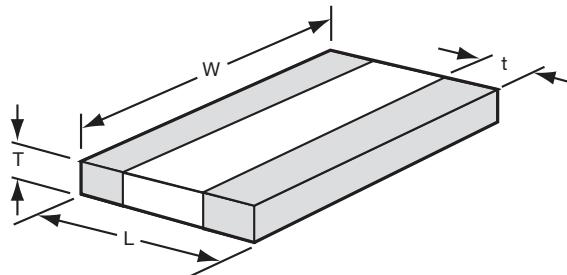
mm (in.)

AU16 (0508)	
Code	Thickness
S	0.56 (0.022)
V	0.76 (0.030)
A	1.02 (0.040)

mm (in.)

AU16 (0612)	
Code	Thickness
S	0.56 (0.022)
V	0.76 (0.030)
W	1.02 (0.040)
A	1.27 (0.050)

## PHYSICAL DIMENSIONS AND PAD LAYOUT



## PHYSICAL DIMENSIONS

MM (IN.)

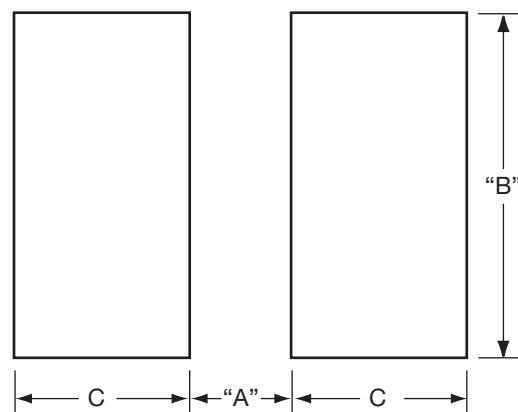
	L	W	t
AU16 (0306)	0.81 ± 0.15 (0.032 ± 0.006)	1.60 ± 0.15 (0.063 ± 0.006)	0.13 min. (0.005 min.)
AU17 (0508)	1.27 ± 0.25 (0.050 ± 0.010)	2.00 ± 0.25 (0.080 ± 0.010)	0.13 min. (0.005 min.)
AU18 (0612)	1.60 ± 0.25 (0.063 ± 0.010)	3.20 ± 0.25 (0.126 ± 0.010)	0.13 min. (0.005 min.)

T - See Range Chart for Thickness and Codes

## PAD LAYOUT DIMENSIONS

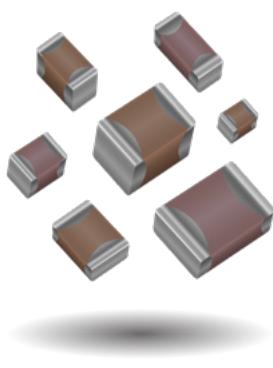
MM (IN.)

	A	B	C
AU16 (0306)	0.31 (0.012)	1.52 (0.060)	0.51 (0.020)
AU17 (0508)	0.51 (0.020)	2.03 (0.080)	0.51 (0.020)
AU18 (0612)	0.76 (0.030)	3.05 (0.120)	0.635 (0.025)



# MLCC Tin/Lead Termination "B" (LD Series)

## COG (NP0) – General Specifications



KYOCERA AVX will support those customers for commercial and military Multilayer Ceramic Capacitors with a termination consisting of 5% minimum lead. This termination is indicated by the use of a "B" in the 12th position of the KYOCERA AVX Catalog Part Number. This fulfills KYOCERA AVX's commitment to providing a full range of products to our customers. KYOCERA AVX has provided in the following pages a full range of values that we are currently offering in this special "B" termination. Please contact the factory if you require additional information on our MLCC Tin/Lead Termination "B" products.

### PART NUMBER (SEE PAGE 4 FOR COMPLETE PART NUMBER EXPLANATION)

**Not RoHS Compliant**

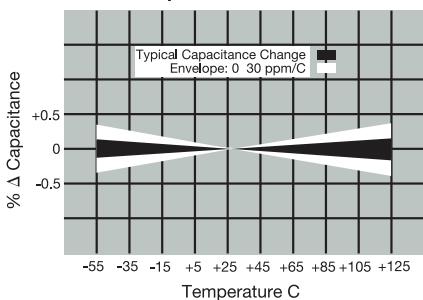
LD05	5	A	101	J	A	B	2	A
<b>Size</b>	<b>Voltage</b>	<b>Dielectric</b>	<b>Capacitance Code (In pF)</b>	<b>Capacitance Tolerance</b>	<b>Failure Rate</b>	<b>Terminations</b>	<b>Packaging</b>	<b>Special Code</b>
LD02 - 0402	6.3V = 6	COG (NP0) = A	2 Sig. Digits + Number of Zeros	B = $\pm 10\text{ pF}$ ( $<10\text{ pF}$ ) C = $\pm 25\text{ pF}$ ( $<10\text{ pF}$ ) D = $\pm 50\text{ pF}$ ( $<10\text{ pF}$ ) F = $\pm 1\%$ ( $\geq 10\text{ pF}$ ) G = $\pm 2\%$ ( $\geq 10\text{ pF}$ ) J = $\pm 5\%$ K = $\pm 10\%$ M = $\pm 20\%$	A = Not Applicable 4 = Automotive	B = 5% min lead X = FLEXITERM® with 5% min lead**	2 = 7" Reel 4 = 13" Reel	A = Std. Product
LD03 - 0603	10V = Z	X7R = C						
LD04 - 0504*	16V = Y	X5R = D						
LD05 - 0805	25V = 3	X8R = F						
LD06 - 1206	35V = D							
LD10 - 1210	50V = 5							
LD12 - 1812	100V = 1							
LD13 - 1825	200V = 2							
LD14 - 2225	500V = 7							
LD20 - 2220								

\*LD04 has the same CV ranges as LD03.

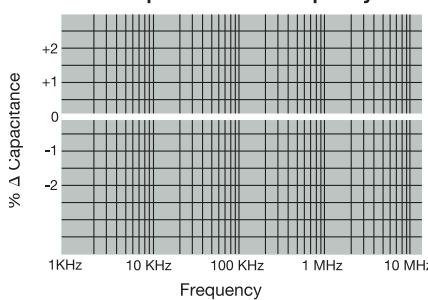
See FLEXITERM® section for CV options

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

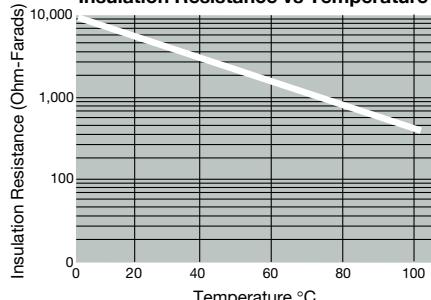
Temperature Coefficient



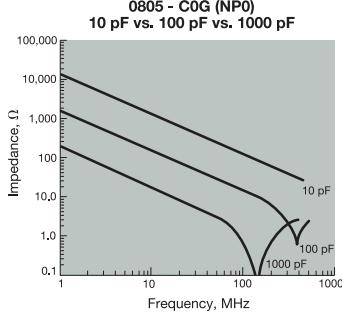
Δ Capacitance vs. Frequency



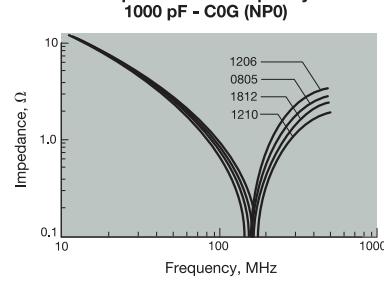
Insulation Resistance vs Temperature



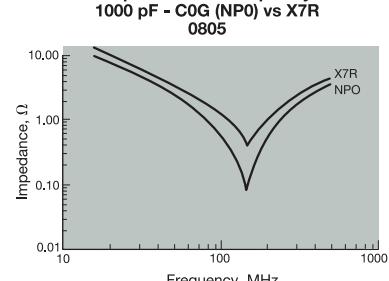
Variation of Impedance with Cap Value  
Impedance vs. Frequency  
0805 - COG (NP0)



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

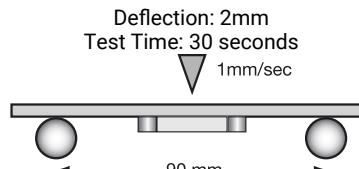


Variation of Impedance with Ceramic Formulation  
Impedance vs. Frequency  
1000 pF - COG (NP0) vs X7R  
0805



# MLCC Tin/Lead Termination "B"

## COG (NP0) – Specifications and 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: $Q \geq 400 + 20 \times$ Cap Value $\geq 30$ pF: $Q \geq 1000$			
Insulation Resistance	100,000MΩ or 1000MΩ - $\mu$ F, whichever is less		Charge device with rated voltage for 60 $\pm$ 5 secs @ room temp/humidity	
Dielectric Strength	No breakdown or visual defects		Charge device with 250% 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		
	Capacitance Variation	$\pm 5\%$ or $\pm .5$ pF, whichever is greater		
	Q	Meets Initial Values (As Above)		
	Insulation Resistance	$\geq$ Initial Value $\times 0.3$		
Solderability	$\geq 95\%$ of each terminal should be covered with fresh solder		Dip device in eutectic solder at $230 \pm 5^\circ\text{C}$ 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 $260^\circ\text{C}$ for 60 seconds. Store at room temperature for $24 \pm 2$ hours before measuring electrical properties.	
	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)		
	Dielectric Strength	Meets Initial Values (As Above)		
Thermal Shock	Appearance	No visual defects	Step 1: $-55^\circ\text{C} \pm 2^\circ$ $30 \pm 3$ minutes	
	Capacitance Variation	$\leq \pm 2.5\%$ or $\pm .25$ pF, whichever is greater	Step 2: Room Temp $\leq 3$ minutes	
	Q	Meets Initial Values (As Above)	Step 3: $+125^\circ\text{C} \pm 2^\circ$ $30 \pm 3$ 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	Charge device with twice rated voltage in test chamber set at $125^\circ\text{C} \pm 2^\circ$ for 1000 hours (+48, -0).  Remove from test chamber and stabilize at room temperature for 24 hours before measuring.	
	Capacitance Variation	$\leq \pm 3.0\%$ or $\pm .3$ 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 $\times 0.3$ (See Above)		
	Dielectric Strength	Meets Initial Values (As Above)		
Load Humidity	Appearance	No visual defects	Store in a test chamber set at $85^\circ\text{C} \pm 2^\circ\text{C}$ / $85\% \pm 5\%$ relative humidity for 1000 hours (+48, -0) with rated voltage applied.  Remove from chamber and stabilize at room temperature for $24 \pm 2$ hours before measuring.	
	Capacitance Variation	$\leq \pm 5.0\%$ or $\pm .5$ 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 $\times 0.3$ (See Above)		
	Dielectric Strength	Meets Initial Values (As Above)		

# MLCC Tin/Lead Termination "B"

## COG (NP0) – Capacitance Range



PREFERRED SIZES ARE SHADED

SIZE	LD02			LD03			LD05			LD06			
	Reflow/Wave			Reflow/Wave			Reflow/Wave			Reflow/Wave			
	All Paper			All Paper			Paper/Embossed			Paper/Embossed			
(L) Length (in.)	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 (in.)	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 (in.)	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	16	25	50	16	25	50	100	16	25	50	100	200	500
Cap (pF)													
0.5	C	C	C	G	G	G	J	J	J	J	J	J	J
1.0	C	C	C	G	G	G	J	J	J	J	J	J	J
1.2	C	C	C	G	G	G	J	J	J	J	J	J	J
1.5	C	C	C	G	G	G	J	J	J	J	J	J	J
1.8	C	C	C	G	G	G	J	J	J	J	J	J	J
2.2	C	C	C	G	G	G	J	J	J	J	J	J	J
2.7	C	C	C	G	G	G	J	J	J	J	J	J	J
3.3	C	C	C	G	G	G	J	J	J	J	J	J	J
3.9	C	C	C	G	G	G	J	J	J	J	J	J	J
4.7	C	C	C	G	G	G	J	J	J	J	J	J	J
5.6	C	C	C	G	G	G	J	J	J	J	J	J	J
6.8	C	C	C	G	G	G	J	J	J	J	J	J	J
8.2	C	C	C	G	G	G	J	J	J	J	J	J	J
10	C	C	C	G	G	G	J	J	J	J	J	J	J
12	C	C	C	G	G	G	J	J	J	J	J	J	J
15	C	C	C	G	G	G	J	J	J	J	J	J	J
18	C	C	C	G	G	G	J	J	J	J	J	J	J
22	C	C	C	G	G	G	J	J	J	J	J	J	J
27	C	C	C	G	G	G	J	J	J	J	J	J	J
33	C	C	C	G	G	G	J	J	J	J	J	J	J
39	C	C	C	G	G	G	J	J	J	J	J	J	J
47	C	C	C	G	G	G	J	J	J	J	J	J	J
56	C	C	C	G	G	G	J	J	J	J	J	J	J
68	C	C	C	G	G	G	J	J	J	J	J	J	J
82	C	C	C	G	G	G	J	J	J	J	J	J	J
100	C	C	C	G	G	G	J	J	J	J	J	J	J
120	C	C	C	G	G	G	J	J	J	J	J	J	J
150	C	C	C	G	G	G	J	J	J	J	J	J	J
180	C	C	C	G	G	G	J	J	J	J	J	J	J
220	C	C	C	G	G	G	J	J	J	J	J	J	M
270	C	C	C	G	G	G	J	J	J	J	J	J	M
330	C	C	C	G	G	G	J	J	J	J	M	J	M
390	C	C	C	G	G	G	J	J	J	J	M	J	M
470	C	C	C	G	G	G	J	J	J	J	M	J	M
560				G	G	G	J	J	J	J	M	J	M
680				G	G	G	J	J	J	J	M	J	P
820				G	G	G	J	J	J	J	M	J	
1000				G	G	G	J	J	J	J		J	Q
1200				G	G	G	J	J	J	J		J	Q
1500				G	G	G	J	J	J	J		J	M
1800							J	J	J	J		M	M
2200							J	J	N	J		M	P
2700							J	N		J		M	P
3300							J	J		J		M	P
3900							J	J		J		M	P
4700							J	J		J		M	P
5600										J	J	M	
6800										M	M		
8200										M	M		
Cap (pF)	0.010												
0.012													
0.015													
0.018													
0.022													
0.027													
0.033													
0.039													
0.047													
0.068													
0.082													
0.1													
WVDC	16	25	50	16	25	50	100	16	25	50	100	200	500
SIZE	LD02			LD03			LD05			LD06			



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													
EMBORESSED													



The Important Information/Disclaimer is incorporated in the catalog where these specifications came from or available online at [www.kyocera-avx.com/disclaimer/](http://www.kyocera-avx.com/disclaimer/) by reference and should be reviewed in full before placing any order.

# MLCC Tin/Lead Termination "B"

## COG (NP0) – Capacitance Range



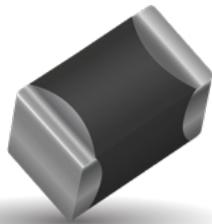
PREFERRED SIZES ARE SHADED

SIZE	LD10					LD12					LD13					LD14					
<b>Soldering</b>	Reflow Only					Reflow Only					Reflow Only					Reflow Only					
<b>Packaging</b>	Paper/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)				5.72 ± 0.25 (0.225 ± 0.010)				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)				6.35 ± 0.25 (0.250 ± 0.010)				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																					
12																					
15																					
18																					
22																					
27																					
33																					
39																					
47																					
56																					
68																					
82																					
100																					
120																					
150																					
180																					
220																					
270																					
330																					
390																					
470																					
560	J	J	J	J	J	M	K	K	K	K	M	M	M	M	M	M	M	M	P		
680	J	J	J	J	J	M	M	K	K	K	M	M	M	M	M	M	M	M	P		
820	J	J	J	J	J	M	M	K	K	K	M	M	M	M	M	M	M	M	P		
1000	J	J	J	J	J	M	K	K	K	K	M	M	M	M	M	M	M	M	P		
1200	J	J	J	M	J	M	K	K	K	K	M	M	M	M	M	M	M	M	P		
1500	J	J	J	M	J	M	K	K	K	K	M	M	M	M	M	M	M	M	P		
1800	J	J	J	M	Q	K	K	K	K	K	M	M	M	M	M	M	M	M	P		
2200	J	J	J	Q	Q	K	K	K	K	K	P	M	M	M	M	M	M	M	P		
2700	J	J	J	Q	Q	P	P	P	P	P	Q	M	M	M	M	M	M	M	P		
3300	J	J	J	M	M	P	P	P	P	P	Q	M	M	M	M	M	M	M	P		
3900	J	J	M	M	M	P	P	P	P	P	Y	M	M	M	M	M	M	M	P		
4700	J	J	M	M	M	P	P	P	P	P	Y	M	M	M	M	M	M	M	P		
5600	J	J				P	P	P	P	P	Y	M	M	M	M	M	M	M	P		
6800	J	J				P	P	P	P	P	Y	M	M	M	M	M	M	M	P		
8200	J	J				P	P	P	P	P	Y	M	M	M	M	M	M	M	P		
Cap (pF)	0.010	J	J			P	P	Q	Q	Y	Y	M	M			M	M	M	P		
0.012	J	J				P	P	Q	X	Y	Y	M	M			M	M	M	P		
0.015						P	P	Q	X	Y	Y	M	M			M	M	M	Y		
0.018						P	P	X	X	Y	Y	P	M			M	M	M	Y		
0.022						P	P	X	X	Z	Z	P				M	Y	Y	Y		
0.027						Q	X	X	Z	Z	Z	P				P	Y	Y	Y		
0.033						Q	X	X	Z	Z	Z	P				P					
0.039						X	X	Z	Z	Z	Z	P				P					
0.047						X	X	Z	Z	Z	Z	P				P					
0.068						Z	Z	Z	Z	Z	Z					P					
0.082						Z	Z	Z	Z	Z	Z					Q					
0.1						Z	Z	Z	Z	Z	Z					Q					
	WVDC	25	50	100	200	500	25	50	100	200	500	50	100	200	50	100	200	50	100	200	
<b>SIZE</b>	LD10					LD12					LD13					LD14					

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												EMBOSSED	

# MLCC Tin/Lead Termination "B"

## X8R – General Specifications



KYOCERA AVX will support those customers for commercial and military Multilayer Ceramic Capacitors with a termination consisting of 5% minimum lead. This termination is indicated by the use of a "B" in the 12th position of the KYOCERA AVX Catalog Part Number. This fulfills KYOCERA AVX's commitment to providing a full range of products to our customers. KYOCERA AVX has provided in the following pages a full range of values that we are currently offering in this special "B" termination. Please contact the factory if you require additional information on our MLCC Tin/Lead Termination "B" products.

**Not RoHS Compliant**

### PART NUMBER (SEE PAGE 4 FOR COMPLETE PART NUMBER EXPLANATION)

LD05	5	F	101	J	A	B	2	A
<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</b>	<b>Special Code</b>
LD02 - 0402	6.3V = 6	X8R = F	2 Sig. Digits + Number of Zeros	B = $\pm .10$ pF ( $<10$ pF)	A = Not Applicable	B = 5% min lead	2 = 7" Reel	A = Std. Product
LD03 - 0603	10V = Z			C = $\pm .25$ pF ( $<10$ pF)		X = FLEXITERM® with 5% min lead**	4 = 13" Reel	
LD04 - 0504*	16V = Y			D = $\pm .50$ pF ( $<10$ pF)				
LD05 - 0805	25V = 3			F = $\pm 1\%$ ( $\geq 10$ pF)				
LD06 - 1206	35V = D			G = $\pm 2\%$ ( $\geq 10$ pF)				
LD10 - 1210	50V = 5			J = $\pm 5\%$				
LD12 - 1812	100V = 1			K = $\pm 10\%$				
LD13 - 1825	200V = 2			M = $\pm 20\%$				
LD20 - 2220	500V = 7							

LD04 has the same CV ranges as LD03.

See FLEXITERM® section for CV options

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

# MLCC Tin/Lead Termination "B"

## X8R – Specifications and Test Methods

Parameter/Test	X8R Specification Limits		Measuring Conditions	
Operating Temperature Range	-55°C to +150°C		Temperature Cycle Chamber	
Capacitance	Within specified tolerance			
Dissipation Factor	$\leq 2.5\%$ for $\geq 50V$ DC rating $\leq 3.5\%$ for 25V DC and 16V DC rating		Freq.: 1.0 kHz $\pm 10\%$ Voltage: 1.0Vrms $\pm .2V$	
Insulation Resistance	100,000MΩ or 1000MΩ - $\mu$ 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 250% 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		
	Capacitance Variation	$\leq \pm 12\%$		
	Dissipation Factor	Meets Initial Values (As Above)		
	Insulation Resistance	$\geq$ Initial Value $\times 0.3$		
Solderability	$\geq 95\%$ of each terminal should be covered with fresh solder		Dip device in eutectic solder at 230 $\pm 5^\circ$ C for 5.0 $\pm 0.5$ seconds	
Resistance to Solder Heat	Appearance	No defects, <25% leaching of either end terminal		
	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 $\pm 2^\circ$ 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 $\pm 2^\circ$ 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	
Load Life	Appearance	No visual defects	Charge device with 1.5 rated voltage ( $\leq 10V$ ) in test chamber set at 150°C $\pm 2^\circ$ 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)		
Load Humidity	Appearance	No visual defects	Store in a test chamber set at 85°C $\pm 2^\circ$ / 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)		

# MLCC Tin/Lead Termination "B"

## X8R – Capacitance Range

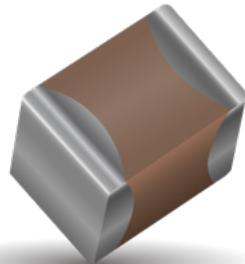


SIZE		LD03		LD05		LD06	
	WVDC	25V	50V	25V	50V	25V	50V
271	Cap 270	G	G				
331	(pF) 330	G	G	J	J		
471	470	G	G	J	J		
681	680	G	G	J	J		
102	1000	G	G	J	J	J	J
152	1500	G	G	J	J	J	J
182	1800	G	G	J	J	J	J
222	2200	G	G	J	J	J	J
272	2700	G	G	J	J	J	J
332	3300	G	G	J	J	J	J
392	3900	G	G	J	J	J	J
472	4700	G	G	J	J	J	J
562	5600	G	G	J	J	J	J
682	6800	G	G	J	J	J	J
822	Cap 8200	G	G	J	J	J	J
103	( $\mu$ F) 0.01	G	G	J	J	J	J
123	0.012	G	G	J	J	J	J
153	0.015	G	G	J	J	J	J
183	0.018	G	G	J	J	J	J
223	0.022	G	G	J	J	J	J
273	0.027	G	G	J	J	J	J
333	0.033	G	G	J	J	J	J
393	0.039	G	G	J	J	J	J
473	0.047	G	G	J	J	J	J
563	0.056	G		N	N	M	M
683	0.068	G		N	N	M	M
823	0.082			N	N	M	M
104	0.1			N	N	M	M
124	0.12			N	N	M	M
154	0.15			N	N	M	M
184	0.18			N		M	M
224	0.22			N		M	M
274	0.27					M	M
334	0.33					M	M
394	0.39					M	
474	0.47					M	
684	0.68						
824	0.82						
105	1						
	WVDC	25V	50V	25V	50V	25V	50V
SIZE		LD03		LD05		LD06	

Letter	A	C	E	G	J	K	M	N	P	Q	X	Y	Z
<b>Max. Thickness</b>	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					EMBOSSED								

# MLCC Tin/Lead Termination "B"

## X7R – General Specifications



KYOCERA AVX will support those customers for commercial and military Multilayer Ceramic Capacitors with a termination consisting of 5% minimum lead. This termination is indicated by the use of a "B" in the 12th position of the KYOCERA AVX Catalog Part Number. This fulfills KYOCERA AVX's commitment to providing a full range of products to our customers. KYOCERA AVX has provided in the following pages a full range of values that we are currently offering in this special "B" termination. Please contact the factory if you require additional information on our MLCC Tin/Lead Termination "B" products.

**Not RoHS Compliant**

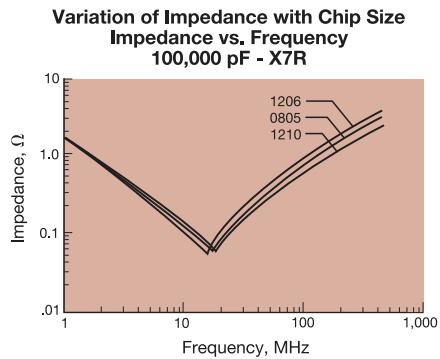
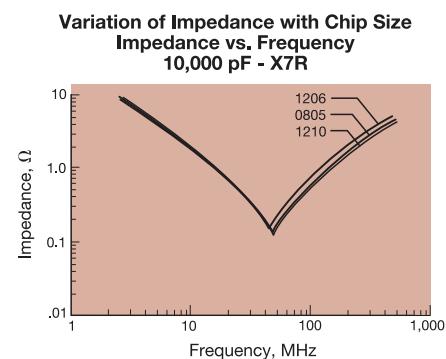
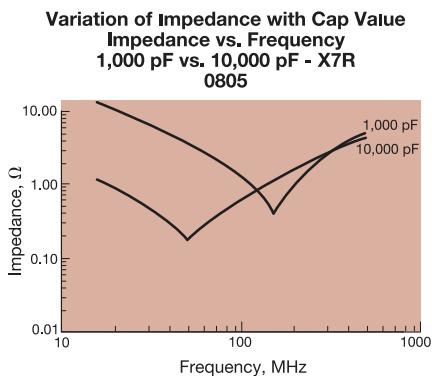
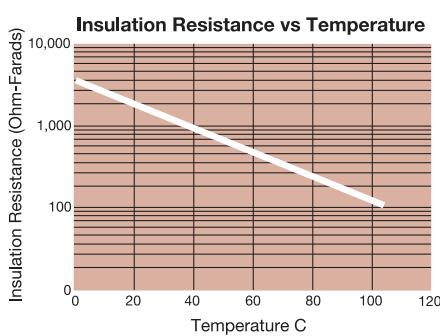
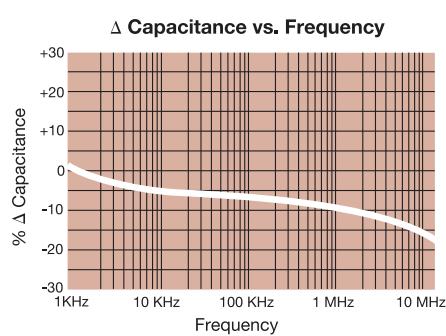
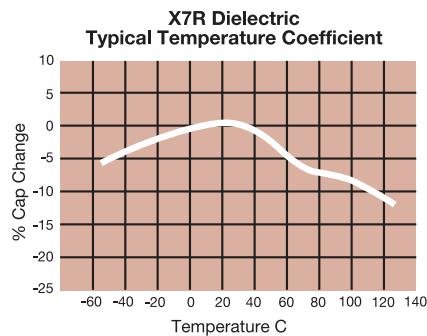
### PART NUMBER (SEE PAGE 4 FOR COMPLETE PART NUMBER EXPLANATION)

LD05	5	C	101	J	A	B	2	A
<b>Size</b> LD03 - 0603	<b>Voltage</b> 6.3V = 6	<b>Dielectric</b> X7R = C	<b>Capacitance Code (In pF)</b> 2 Sig. Digits + Number of Zeros	<b>Capacitance Tolerance</b> B = $\pm 0.10$ pF (<10pF) C = $\pm 0.25$ pF (<10pF) D = $\pm 0.50$ pF (<10pF) F = $\pm 1\%$ ( $\geq 10$ pF) G = $\pm 2\%$ ( $\geq 10$ pF) J = $\pm 5\%$ K = $\pm 10\%$ M = $\pm 20\%$	<b>Failure Rate</b> A = Not Applicable	<b>Terminations</b> B = 5% min lead X = FLEXITERM® with 5% min lead** **X7R only	<b>Packaging</b> 2 = 7" Reel 4 = 13" Reel	<b>Special Code</b> A = Std. Product
LD04 - 0504*	10V = Z							
LD05 - 0805	16V = Y							
LD06 - 1206	25V = 3							
LD10 - 1210	35V = D							
LD12 - 1812	50V = 5							
LD13 - 1825	100V = 1							
LD14 - 2225	200V = 2							
LD20 - 2220	500V = 7							

\*LD04 has the same CV ranges as LD03.

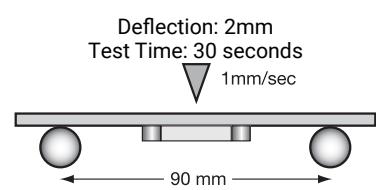
See FLEXITERM® section for CV options

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



# MLCC Tin/Lead Termination "B"

## X7R – 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		
Dissipation Factor	$\leq 10\%$ for $\geq 50V$ DC rating $\leq 12.5\%$ for $25V$ DC rating $\leq 12.5\%$ for $25V$ and $16V$ DC rating $\leq 12.5\%$ for $\leq 10V$ DC rating		Freq.: 1.0 kHz $\pm 10\%$ Voltage: 1.0Vrms $\pm .2V$
Insulation Resistance	100,000MΩ or 1000MΩ - μF, 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 250% 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	
	Capacitance Variation	$\leq \pm 12\%$	
	Dissipation Factor	Meets Initial Values (As Above)	
	Insulation Resistance	$\geq$ Initial Value $\times 0.3$	
Solderability	$\geq 95\%$ of each terminal should be covered with fresh solder		Dip device in eutectic solder at $230 \pm 5^\circ C$ 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 $260^\circ C$ 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: $-55^\circ C \pm 2^\circ$ $30 \pm 3$ minutes
	Capacitance Variation	$\leq \pm 7.5\%$	Step 2: Room Temp $\leq 3$ minutes
	Dissipation Factor	Meets Initial Values (As Above)	Step 3: $+125^\circ C \pm 2^\circ$ $30 \pm 3$ 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
Load Life	Appearance	No visual defects	Charge device with $1.5$ rated voltage ( $\leq 10V$ ) in test chamber set at $125^\circ C \pm 2^\circ C$ 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)	
Load Humidity	Appearance	No visual defects	Store in a test chamber set at $85^\circ C \pm 2^\circ C$ / $85\% \pm 5\%$ 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)	

# MLCC Tin/Lead Termination "B"

## X7R – Capacitance Range



PREFERRED SIZES ARE SHADED

SIZE	LD02					LD03					LD05					LD06										
	Reflow/Wave			Reflow/Wave		Reflow/Wave			Reflow/Wave		Reflow/Wave			Reflow/Wave		Reflow/Wave			Reflow/Wave							
Soldering	All Paper					All Paper					Paper/Embossed					Paper/Embossed										
Packaging	Reflow/Wave		Reflow/Wave		Reflow/Wave		Reflow/Wave		Reflow/Wave		Reflow/Wave		Reflow/Wave		Reflow/Wave		Reflow/Wave		Reflow/Wave							
(L) Length	(mm) 1.00 ± 0.10 (in.) (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 (in.)		W (in.)		W (in.)		W (in.)		W (in.)		W (in.)							
(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)		(t) Terminal		(t) Terminal		(t) Terminal		(t) Terminal		(t) Terminal		(t) Terminal							
(t) Terminal	(mm) 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		WVDC		WVDC		WVDC		WVDC		WVDC							
	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																									
150																										
220			C																							
330			C						G	G	G		J	J	J	J	J	J						K		
470			C						G	G	G		J	J	J	J	J	J						K		
680			C						G	G	G		J	J	J	J	J	J						K		
1000			C						G	G	G		J	J	J	J	J	J						K		
1500			C						G	G	G		J	J	J	J	J	J						M		
2200			C						G	G	G		J	J	J	J	J	J						M		
3300		C	C						G	G	G		J	J	J	J	J	J						M		
4700		C	C	C					G	G	G		J	J	J	J	J	J						M		
6800	C	C							G	G	G		J	J	J	J	J	J						P		
Cap (μF)	0.010	C	C						G	G	G		J	J	J	J	J	J						J		
0.015	C								G	G	G		J	J	J	J	J	J						M		
0.022	C								G	G	G		J	J	J	J	J	J						M		
0.033	C								G	G	G		J	J	J	J	N							M		
0.047									G	G	G		J	J	J	J	N							M		
0.068									G	G	G		J	J	J	J	N							P		
0.10		C*							G	G	G		J	J	J	J	N							P		
0.15			G	G					G	G	G		J	J	J	J	N							Q		
0.22			G	G	G				G	G	G		J	J	J	J	N							Q		
0.33									J*				N	N	N	N	N							P		
0.47													N	N	N	N	N								Q	
0.68													N	N	N	N	N								Q	
1.0									J*	J*			N	N	N*										Q	
1.5													P*													Q
2.2																										Q
3.3																										Q
4.7																										Q
10																										Q
22																										Q
47																										Q
100																										Q
WVDC	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	LD02					LD03					LD05					LD06					LD06					

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												EMBOSSED

= Under Development

# MLCC Tin/Lead Termination "B"

## X7R – Capacitance Range



PREFERRED SIZES ARE SHADED

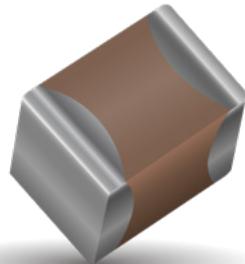


SIZE		LD10						LD12				LD13			LD20			LD14	
Soldering		Reflow Only						Reflow Only				Reflow Only			Reflow Only			Reflow Only	
Packaging		Paper/Embossed						All Embossed				All Embossed			All Embossed			All Embossed	
(L) Length	mm (in.)	3.20 ± 0.20 (0.126 ± 0.008)						4.50 ± 0.30 (0.177 ± 0.012)				4.50 ± 0.30 (0.177 ± 0.012)			5.70 ± 0.50 (0.224 ± 0.020)			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
	0.015	J	J	J	J	J	J	P	K	K	K	P	M	M		X	X	X	M
	0.022	J	J	J	J	J	J	Q	K	K	K	P	M	M		X	X	X	M
	0.033	J	J	J	J	J	J	Q	K	K	K	X	M	M		X	X	X	M
	0.047	J	J	J	J	J	J		K	K	K	Z	M	M		X	X	X	M
	0.068	J	J	J	J	J	M		K	K	K	Z	M	M		X	X	X	M
	0.10	J	J	J	J	J	M		K	K	K	Z	M	M		X	X	X	M
	0.15	J	J	J	J	M	Z		K	K	P		M	M		X	X	X	M
	0.22	J	J	J	J	P	Z		K	K	P		M	M		X	X	X	M
	0.33	J	J	J	J	Q			K	M	X		M	M		X	X	X	M
	0.47	M	M	M	M	Q			K	P			M	M		X	X	X	M
	0.68	M	M	P	X	X			M	Q			M	P		X	X	X	M
	1.0	N	N	P	X	Z			M	X			M	P		X	X		M
	1.5	N	N	Z	Z	Z			Z	Z			M			X	X		M
	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	Z						X	Z		
	10	Z	Z	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
SIZE	LD10						LD12				LD13			LD20			LD14		

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												EMBOSSED	

# MLCC Tin/Lead Termination "B"

## X5R – General Specifications



KYOCERA AVX will support those customers for commercial and military Multilayer Ceramic Capacitors with a termination consisting of 5% minimum lead. This termination is indicated by the use of a "B" in the 12th position of the KYOCERA AVX Catalog Part Number. This fulfills KYOCERA AVX's commitment to providing a full range of products to our customers. KYOCERA AVX has provided in the following pages a full range of values that we are currently offering in this special "B" termination. Please contact the factory if you require additional information on our MLCC Tin/Lead Termination "B" products.

**Not RoHS Compliant**

### PART NUMBER (SEE PAGE 4 FOR COMPLETE PART NUMBER EXPLANATION)

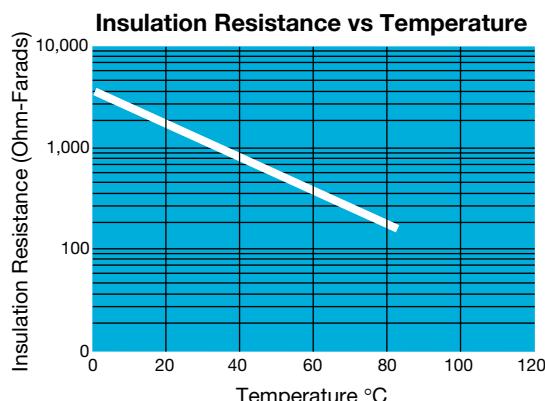
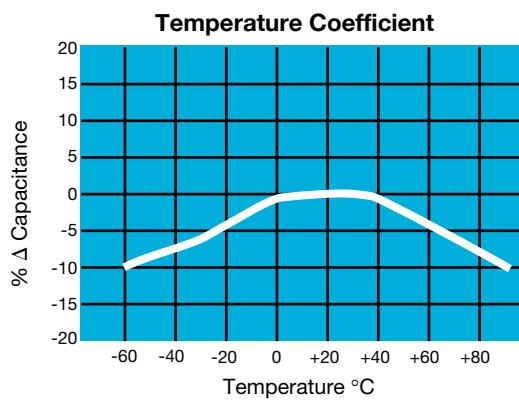
LD05	5	D	101	J	A	B	2	A
<b>Size</b>	<b>Voltage</b>	<b>Dielectric</b>	<b>Capacitance Code (In pF)</b>	<b>Capacitance Tolerance</b>	<b>Failure Rate</b>	<b>Terminations</b>	<b>Packaging</b>	<b>Special Code</b>
LD02 - 0402	6.3V = 6	X5R = D	2 Sig. Digits + Number of Zeros	B = $\pm 10\text{ pF}$ ( $<10\text{ pF}$ )	A = Not Applicable	B = 5% min lead	2 = 7" Reel	A = Std. Product
LD03 - 0603	10V = Z			C = $\pm 25\text{ pF}$ ( $<10\text{ pF}$ )		X = FLEXITERM® with 5% min lead**	4 = 13" Reel	
LD04 - 0504*	16V = Y			D = $\pm 50\text{ pF}$ ( $<10\text{ pF}$ )				
LD05 - 0805	25V = 3			F = $\pm 1\%$ ( $\geq 10\text{ pF}$ )				
LD06 - 1206	35V = D			G = $\pm 2\%$ ( $\geq 10\text{ pF}$ )				
LD10 - 1210	35V = D			J = $\pm 5\%$				
LD12 - 1812	50V = 5			K = $\pm 10\%$				
LD13 - 1825	100V = 1			M = $\pm 20\%$				
LD14 - 2225	200V = 2							
LD20 - 2220	500V = 7							

\*LD04 has the same CV ranges as LD03.

See FLEXITERM® section for CV options

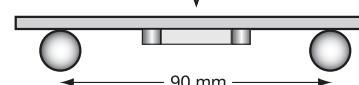
NOTE: Contact factory for availability of Tolerance Options for Specific Part Numbers.  
Contact factory for non-specified capacitance values.

### TYPICAL ELECTRICAL CHARACTERISTICS



# MLCC Tin/Lead Termination "B"

## X5R – Specifications and Test Methods

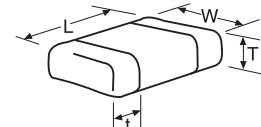
Parameter/Test	X5R Specification Limits		Measuring Conditions		
Operating Temperature Range	-55°C to +85°C		Temperature Cycle Chamber		
Capacitance	Within specified tolerance				
Dissipation Factor	$\leq 2.5\%$ for $\geq 50V$ DC rating $\leq 3.0\%$ for 25V, 35V DC rating $\leq 12.5\%$ Max. for 16V DC rating and lower Contact Factory for DF by PN		Freq.: 1.0 kHz $\pm 10\%$ Voltage: 1.0Vrms $\pm .2V$ For Cap $> 10 \mu F$ , 0.5Vrms @ 120Hz		
Insulation Resistance	10,000MΩ or 500MΩ - $\mu F$ , 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 250% of rated voltage for 1-5 seconds, w/charge and discharge current limited to 50 mA (max)		
Resistance to Flexure Stresses	Appearance	No defects			
	Capacitance Variation	$\leq \pm 12\%$			
	Dissipation Factor	Meets Initial Values (As Above)			
	Insulation Resistance	$\geq$ Initial Value $\times 0.3$			
Solderability	$\geq 95\%$ of each terminal should be covered with fresh solder		Dip device in eutectic solder at $230 \pm 5^\circ C$ 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 $260^\circ C$ 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: $-55^\circ C \pm 2^\circ$ <span style="float: right;"><math>30 \pm 3</math> minutes</span>	
	Capacitance Variation	$\leq \pm 7.5\%$		Step 2: Room Temp <span style="float: right;"><math>\leq 3</math> minutes</span>	
	Dissipation Factor	Meets Initial Values (As Above)		Step 3: $+85^\circ C \pm 2^\circ$ <span style="float: right;"><math>30 \pm 3</math> minutes</span>	
	Insulation Resistance	Meets Initial Values (As Above)		Step 4: Room Temp <span style="float: right;"><math>\leq 3</math> minutes</span>	
	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 1.5X rated voltage in test chamber set at $85^\circ C \pm 2^\circ C$ for 1000 hours (+48, -0). Note: Contact factory for *optional specification part numbers that are tested at $< 1.5X$ rated voltage.	
	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)			
Load Humidity	Appearance	No visual defects		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)			

## MLCC Tin/Lead Termination "B"



## X5R – Capacitance Range

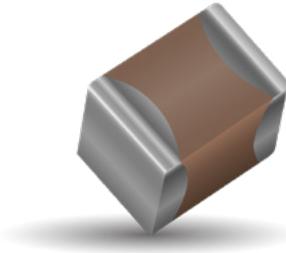
## PREFERRED SIZES ARE SHAPED



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												EMBOSSED	

**\*Optional Specifications – Contact factory**

NOTE: Contact factory for non-specified capacitance values



## GENERAL DESCRIPTION

KYOCERA AVX has supported the Automotive Industry requirements for Multilayer Ceramic Capacitors consistently for more than 25 years. Products have been developed and tested specifically for automotive applications and all manufacturing facilities are QS9000 and VDA 6.4 approved.

KYOCERA AVX is using AECQ200 as the qualification vehicle for this transition. A detailed qualification package is available on request and contains results on a range of part numbers.

## HOW TO ORDER

Contact factory for availability of Tolerance Options for Specific Part Numbers.

NOTE: Contact factory for non-specified capacitance values.  
0402 case size available in T termination only.

\*NPO only

## COMMERCIAL VS AUTOMOTIVE MLCC PROCESS COMPARISON

	<b>Commercial</b>	<b>Automotive</b>
<b>Administrative</b>	Standard Part Numbers. No restriction on who purchases these parts.	Specific Automotive Part Number. used to control supply of product to Automotive customers.
<b>Lot Qualification (Destructive Physical Analysis - DPA)</b>	As per EIA RS469	Increased sample plan stricter criteria.
<b>Visual/Cosmetic Quality</b>	Standard process and inspection	100% inspection
<b>Application Robustness</b>	Standard sampling for accelerated wave solder on X7R dielectrics	Increased sampling for accelerated wave solder on X7R and NP0 followed by lot by lot reliability testing.

All Tests have Accept/Reject Criteria 0/1

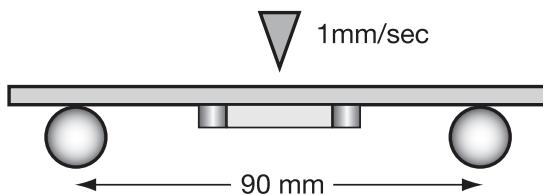
# Automotive MLCC

## NP0/X7R Dielectric

### FLEXITERM FEATURES

#### a) Bend Test

The capacitor is soldered to the PC Board as shown:



Typical bend test results are shown below:

Style	Conventional	Soft Term
0603	>2mm	>5
0805	>2mm	>5
1206	>2mm	>5

#### a) Temperature Cycle testing

FLEXITERM® has the ability to withstand at least 1000 cycles between -55°C and +125°C

# Automotive MLCC-NP0

## Capacitance Range



Case Size		0402			0603			0805						1206						1210											
Length (L) mm (in.)	mm (in.)	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)											
Width (W) mm (in.)	mm (in.)	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)											
Terminal (t) mm (in.)	mm (in.)	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)						0.50 ± 0.25 (0.020 ± 0.010)											
CAP CAP Code	Code	25	50	100	25	50	100	200	250	25	50	100	200	250	500	630	25	50	100	200	250	500	630	1000	50	100	200	250	500	630	1000
0.5	0R5	C	C	C	G	G	G	G	G	J	J	J	J	J	J	J	J	J	J	J	J	Q	Q	J	J	J	J	J	J	J	
1	1R0	C	C	C	G	G	G	G	G	J	J	J	J	J	J	J	J	J	J	J	J	Q	Q	J	J	J	J	J	J	J	
5	5R0	C	C	C	G	G	G	G	G	J	J	J	J	J	J	J	J	J	J	J	J	Q	Q	J	J	J	J	J	J	J	
10	100	C	C	C	G	G	G	G	G	J	J	J	J	J	J	J	J	J	J	J	J	Q	Q	J	J	J	J	J	J	J	
12	120	C	C	C	G	G	G	G	G	J	J	J	J	J	J	J	J	J	J	J	J	Q	Q	J	J	J	J	J	J	J	
15	150	C	C	C	G	G	G	G	G	J	J	J	J	J	J	J	J	J	J	J	J	Q	Q	J	J	J	J	J	J	J	
18	180	C	C	C	G	G	G	G	G	J	J	J	J	J	J	J	J	J	J	J	J	Q	Q	J	J	J	J	J	J	J	
22	220	C	C	C	G	G	G	G	G	J	J	J	J	J	J	J	J	J	J	J	J	Q	Q	J	J	J	J	J	J	J	
27	270	C	C	C	G	G	G	G	G	J	J	J	J	J	J	J	J	J	J	J	J	Q	Q	J	J	J	J	J	J	J	
33	330	C	C	C	G	G	G	G	G	J	J	J	J	J	J	J	J	J	J	J	J	Q	Q	J	J	J	J	J	J	J	
39	390	C	C	C	G	G	G	G	G	J	J	J	J	J	J	J	J	J	J	J	J	Q	Q	J	J	J	J	J	J	J	
47	470	C	C		G	G	G	G	G	J	J	J	J	J	J	J	J	J	J	J	J	Q	Q	J	J	J	J	J	J	J	
56	560	C	C		G	G	G	G	G	J	J	J	J	J	N	J	J	J	J	J	J	Q	Q	J	J	J	J	J	J	J	
68	680	C	C		G	G	G	G	G	J	J	J	J	J	N	J	J	J	J	J	J	Q	Q	J	J	J	J	J	J	J	
82	820	C	C		G	G	G	G	G	J	J	J	J	J	N	J	J	J	J	J	J	Q	Q	N	N	N	N	N	N	N	
100	101	C	C		G	G	G	G	G	J	J	J	J	J	N	J	J	J	J	J	J	Q	Q	N	N	N	N	N	N	N	
120	121				G	G	G	G	G	J	J	J	J	J	N	J	J	J	J	J	J	Q	Q	N	N	N	P	P	P	X	
150	151				G	G	G	G	G	J	J	J	J	J	N	J	J	J	J	J	J	Q	Q	N	N	N	P	P	P	X	
180	181				G	G	G	G	G	J	J	J	J	J	N	J	J	J	J	J	J	Q	Q	N	N	N	P	P	P	X	
220	221				G	G	G	G	G	J	J	J	J	J	N	J	J	J	J	J	J	Q	Q	N	N	N	P	P	P	X	
270	271				G	G	G	G	G	J	J	J	J	J	N	J	J	J	J	J	J	Q	Q	N	N	N	P	P	P	X	
330	331				G	G	G	G	G	J	J	J	J	J	N	J	J	J	J	J	J	Q	Q	N	N	N	P	P	P	X	
390	391				G	G	G	G	G	J	J	J	J	J	N	J	J	J	J	J	J	Q	Q	N	N	N	P	P	P	X	
430	431				G	G				J	J	J	J	J		J	J	J	J	J	J	Q	Q	N	N	N	P	P	P	P	X
470	471				G	G				J	J	J	J	J		J	J	J	J	J	J	Q	Q	N	N	N	P	P	P	P	X
560	561				G	G				J	J	J				J	J	J	M	Q	Q	N	N	N	P	P	P	P			
680	681				G	G				J	J	J				J	J	J	M	Q	Q	N	N	N	P	P	P	P			
1,000	102				G	G				J	J	J				J	J	J	M	Q	Q	N	N	N	P	P	P	P	X		
1,200	122				G	G				J	J	J				N	N	N	N			N	N	N	P	P	P	P			
1,500	152				G	G				J	J	J				N	N	N	N			N	N	N	P	P	P	P			
2,200	222				G					J	J	J				M	M	M	M	M	M	N	N	N	N	P	K	K			
2,700	272				G											M	M	M	M	M	M						K	K			
3,300	332				G											M	M	M	M	M	M						K	K			
3,900	392				G											P	P	P	P	P	P						M	M			
4,700	472				G											P	P	P	P	P	P						M	M			
5,600	562				G																								M	M	
6,800	682				G																								N	N	
8,200	822				G																								P	P	
10,000	103				G																								X	X	X
12,000	123																														
15,000	153																														
18,000	183																														
22,000	223																														
27,000	273																														
33,000	333																														
39,000	393																														
47,000	473																														
56,000	563																														
68,000	683																														
82,000	823																														
100,000	104																														
CAP CAP Code	Code	25	50	100	25	50	100	200	250	25	50	100	200	250	500	630	25	50	100	200	250	500	630	1000	50	100	200	250	500	630	1000
Case Size		0402			0603			0805						1206						1210						1210					

# Automotive MLCC - X7R

## Capacitance Range



Size		0402				0603				0805				1206				1210				1812				2220			
Soldering		Reflow/Wave				Reflow/Wave				Reflow/Wave				Reflow/Wave				Reflow Only				Reflow Only				Reflow Only			
(L) Length (mm) (in.)	mm (in.)	1 ± 0.1 (0.04 ± 0.004)				1.6 ± 0.15 (0.063 ± 0.006)				2.01 ± 0.2 (0.079 ± 0.008)				3.2 ± 0.2 (0.126 ± 0.008)				3.2 ± 0.2 (0.126 ± 0.008)				4.5 ± 0.3 (0.177 ± 0.012)				5.7 ± 0.5 (0.224 ± 0.02)			
(W) Width (mm) (in.)	mm (in.)	0.5 ± 0.1 (0.02 ± 0.004)				0.9 ± 0.15 (0.032 ± 0.006)				1.25 ± 0.2 (0.049 ± 0.008)				1.6 ± 0.2 (0.063 ± 0.008)				2.5 ± 0.2 (0.098 ± 0.008)				3.2 ± 0.2 (0.126 ± 0.008)				5 ± 0.4 (0.197 ± 0.016)			
(T) Terminal mm (in.)	mm (in.)	0.25 ± 0.15 (0.01 ± 0.006)				0.35 ± 0.15 (0.014 ± 0.006)				0.5 ± 0.25 (0.02 ± 0.01)				0.5 ± 0.25 (0.02 ± 0.01)				0.5 ± 0.25 (0.02 ± 0.01)				0.61 ± 0.36 (0.024 ± 0.014)				0.64 ± 0.39 (0.025 ± 0.015)			
WVDC	6.3V	16V	25V	50V	10V	16V	25V	50V	100V	200V	250V	6.3V	10V	16V	25V	50V	100V	200V	250V	500V	16V	25V	50V	100V	200V	250V	500V		
101	100																					M	Q						
221	220	C	C	C	G	G	G	G	G	G	G											M	Q						
271	270	C	C	C	G	G	G	G	G	G	G											M	Q						
331	330	C	C	C	G	G	G	G	G	G	G											M	Q						
391	390	C	C	C	G	G	G	G	G	G	G											M	Q						
471	470	C	C	C	G	G	G	G	G	G	G											M	Q						
561	560	C	C	C	G	G	G	G	G	G	G											M	Q						
681	680	C	C	C	G	G	G	G	G	G	G											M	Q						
821	820	C	C	C	G	G	G	G	G	G	G											M	Q						
102	1000	C	C	C	G	G	G	G	G	G	G	J	J	J	J	J	J	J	J	J	K	K	K	K	M	Q	K	K	
122	1220	C	C	C	G	G	G	G	G	G	G	J	J	J	J	J	J	J	J	J	K	K	K	K	M	Q	K	K	
152	1500	C	C	C	G	G	G	G	G	G	G	J	J	J	J	J	J	J	J	J	K	K	K	K	M	Q	K	K	
182	1800	C	C	C	G	G	G	G	G	G	G	J	J	J	J	J	J	J	J	J	K	K	K	K	M	Q	K	K	
222	2200	C	C	C	G	G	G	G	G	G	G	J	J	J	J	J	J	J	J	J	K	K	K	K	M	Q	K	K	
272	2700	C	C	C	G	G	G	G	G	G	G	J	J	J	J	J	J	J	J	J	K	K	K	K	M	Q	K	K	
332	3300	C	C	C	G	G	G	G	G	G	G	J	J	J	J	J	J	J	J	J	K	K	K	K	M	Q	K	K	
392	3900	C	C	C	G	G	G	G	G	G	G	J	J	J	J	J	J	J	J	J	K	K	K	K	M	Q	K	K	
472	4700	C	C	C	G	G	G	G	G	G	G	J	J	J	J	J	J	J	J	J	K	K	K	K	M	Q	K	K	
562	5600	C	C	C	G	G	G	G	G	G	G	J	J	J	J	J	J	J	J	J	K	K	K	K	M	Q	K	K	
682	6800	C	C	C	G	G	G	G	G	G	G	J	J	J	J	J	J	J	J	J	K	K	K	K	M	Q	K	K	
822	8200	C	C	C	G	G	G	G	G	G	G	J	J	J	J	J	J	J	J	J	K	K	K	K	M	Q	K	K	
103	Cap. 0.01	C	C	C	G	G	G	G	G	G	G	J	J	J	J	J	J	J	J	J	K	K	K	K	M	Q	K	K	
123	0.012	C			G	G	G	G	G	G	G	J	J	J	N	N	N	J	J	J	K	K	K	K	M	Q	K	K	
153	0.015	C			G	G	G	G	G	G	G	J	J	N	N	N	N	J	J	J	K	K	K	K	M	Q	K	K	
183	0.018	C			G	G	G	G	G	G	G	J	J	N	N	N	N	J	J	J	K	K	K	K	M	Q	K	K	
223	0.022	C			G	G	G	G	G	G	G	J	J	N	N	N	N	J	J	Q	K	K	K	K	M	Q	K	K	
273	0.027	C			G	G	G	G	G	G	G	J	J	N	N	N	N	J	J	Q	K	K	K	K	M	Q	K	K	
333	0.033	C			G	G	G	G	G	G	G	J	J	N	N	N	N	J	J	Q	K	K	K	K	M	Q	K	K	
393	0.039				G	G	G	G	G	G	G	J	J	N	N	N	N	J	J	Q	K	K	K	K	M	Q	K	K	
473	0.047				G	G	G	G	G	G	G	J	J	N	N	N	N	J	J	Q	K	K	K	K	M	Q	K	K	
563	0.056				G	G	G	G	G	G	G	J	J	N	N	N	N	J	J	Q	K	K	K	K	M	Q	K	K	
683	0.068				G	G	G	G	G	G	G	J	J	N	N	N	N	J	J	Q	K	K	K	K	M	Q	K	K	
823	0.082				G	G	G	G	G	G	G	J	J	N	N	N	N	J	J	Q	K	K	K	K	M	Q	K	K	
104	0.1				G	G	G	G	G	G	G	J	J	N	N	N	N	J	J	Q	K	K	K	K	M	Q	K	K	
124	0.12				G	J	J					J	J	N	N	N	N	J	J	Q	K	K	K	P	Q	Q	K	K	
154	0.15				G	J	J					M	N	N	N	N	N	J	J	Q	K	K	K	P	Q	Q	K	K	
224	0.22				G	J	J					M	N	N	N	N	N	J	M	Q	K	M	M	P	Q	Q	M	M	
334	0.33											N	N	N	N	N	N	J	M	P	Q	P	P	P	O	Z	Z	X	X
474	0.47											N	N	N	N	N	N	M	M	P	Q	P	P	P	O	Z	Z	X	X
684	0.68											N	N	N	N	N	N	M	Q	Q	Q	P	P	P	O	Z	Z	X	X
105	1	C										N	N	N	N	N	N	M	Q	Q	Q	P	P	Q	Z	X	X	Z	Z
155	1.5											N	N	N	N	N	N	Q	Q	Q	Q	P	P	Q	Z	Z	Z	Z	Z
225	2.2											N	N	N	N	N	N	Q	Q	Q	Q	Z	Z	Z	Z	Z	Z	Z	Z
335	3.3																	Q	Q	Q	Q	X	Z	Z	Z	Z	Z	Z	Z
475	4.7																	Q	Q	Q	Q	X	Z	Z	Z	Z	Z	Z	Z
106	10																	P	P	Q	Q	P	P	P	O	Z	Z	Z	Z
226	22																	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z

Letter A C E G J K M N P Q X Y Z

Max. Thickness 0.33 0.56 0.71 0.90 0.94 1.02 1.27 1.40 1.52 1.78 2.29 2.54 2.79 (0.013) (0.022) (0.028) (0.035) (0.037) (0.04) (0.05) (0.055) (0.060) (0.07) (0.09) (0.1) (0.11)

PAPER

EMBOSSED

# Automotive MLCC - X8R

## Capacitance Range

SIZE		0603			0805			1206	
Soldering		Reflow/Wave			Reflow/Wave			Reflow/Wave	
WVDC	WVDC	25V	50V	100V	25V	50V	100V	25V	50V
472	pF	4700	G	G	G	J	J	J	J
562		5600	G	G	G	J	J	J	J
682		6800	G	G	G	J	J	J	J
822		8200	G	G	G	J	J	J	J
103	uF	0.01	G	G	G	J	J	J	J
123		0.012	G	G		J	J	N	J
153		0.015	G	G		J	J	N	J
183		0.018	G	G		J	J	N	J
223		0.022	G	G		J	J	N	J
273		0.027	G	G		J	J		J
333		0.033	G	G		J	J		J
393		0.039	G	G		J	J		J
473		0.047	G	G		J	J		J
563		0.056	G			N	N		M
683		0.068	G			N	N		M
823		0.082				N	N		M
104		0.1				N	N		M
124		0.12				N	N		M
154		0.15				N	N		M
184		0.18				N			M
224		0.22				N			M
274		0.27							M
334		0.33							M
394		0.39							M
474		0.47							Q
684		0.68							Q
824		0.82							Q
105		1							Q
WVDC	WVDC	25V	50V	100V	25V	50V	100V	25V	50V
SIZE		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)	0.90 (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								

# APS for COTS+ High Reliability Applications

## General Specifications Surface Mount NP0, X7R and X8R/L MLCCs



KYOCERA AVX's APS COTS+ series of multilayer ceramic capacitors offers the customer a high reliability solution with an ultralow failure rate, <1ppb, in a variety of case sizes and voltages. The APS range encompasses a wide range of dielectric types to meet the customer's requirements from low temperature/voltage capacitance change dielectric, NP0, to high preforming capacitance voltage X7R to high temperature reliability dielectrics, X8R/L.

APS capacitors have a wider capacitance range than MIL spec parts that satisfies the need for higher CV demands and board space saving requirements. Each production lot is extensively tested and removes the requirement for customer specific drawings. The testing regime uses many of the MIL-STD test methods as per MIL-PRF-55681 and has a field failure rate of less than 1 ppb. The APS testing series uses KYOCERA AVX's unique in-house maverick testing detection system that eliminates infant mortality failures.

Applications suitable for APS include Industrial, Telecommunications, Aviation, and Military. The APS is available with a range of different termination finishes, Flexitem®, Nickel / Tin and Tin with Pb1. Flexitem® technology delivers improved thermo-mechanical stress resistance.

### APS RELIABILITY TEST SUMMARY

- 100% Visual Inspection
- DPA
- IR, DF, Cap, DWV
- Maverick Lot Review
- Thermal Shock
- 85/85 Testing
- Additional Life Testing
- C of C with every Order
- Quarterly Data Package

### FEATURES

- The APS range has been extensively reliability tested as standard resulting in an ultralow failure rate, <1ppb
- The APS range is available with Flexitem® that deliver's high thermo-mechanical stress resistance.
- High CV range enabling board space saving requirements.

Dielectric	Temperature/Percentage Cap Change
NP0	-30ppm +30ppm from -55°C + 125°C
X7R	-15% +15% from -55°C to + 125°C
X8R	-15% +15% from -55°C to + 150°C
X8L	-15% +40% from -55°C to + 150°C

### HOW TO ORDER

AP03	5	A	104	K	Q	T	2	A
Size	Voltage	Dielectric	Capacitance Code (In pF)	Capacitance Tolerance	Failure Rate	Terminations	Packaging	Special Code
AP03=0603	10V = Z	NP0 = A	2 Sig. Digits + Number of Zeros e.g. 10 F = 106	J = ±5% K = ±10% M = ±20%	Q = APS	T = Plated Ni and Sn Z = FLEXITEM®** B = 10% min lead X = FLEXITEM® with 10% min lead	2 = 7" Reel 4 = 13" Reel	A = Std.Product
AP05=0805	16V = Y	X7R = C				Z, X for X7R only		
AP06=1206	25V = 3	X8R = F				**RoHS compliant		
AP10=1210	50V = 5	X8L = L						
AP12=1812	100V = 1							
AP20=2220	200V = 2							
	250V = V							
	500V = 7							

NOTE: Contact factory for availability of Termination and Tolerance Options for Specific Part Number.

# APS COTS+ NP0 Series

## Capacitance Range



Size	AP03 = 0603			AP05 = 0805			AP06 = 1206					AP10 = 1210			
	25V	50V	100V	25V	50V	100V	25V	50V	100V	200V	500V	25V	50V	100V	200V
100 10pF	G	G	G	J	J	J	J	J	J	J	J				
120 12	G	G	G	J	J	J	J	J	J	J	J				
150 15	G	G	G	J	J	J	J	J	J	J	J				
180 18	G	G	G	J	J	J	J	J	J	J	J				
220 22	G	G	G	J	J	J	J	J	J	J	J				
270 27	G	G	G	J	J	J	J	J	J	J	J				
330 33	G	G	G	J	J	J	J	J	J	J	J				
390 39	G	G	G	J	J	J	J	J	J	J	J				
470 47	G	G	G	J	J	J	J	J	J	J	J				
510 51	G	G	G	J	J	J	J	J	J	J	J				
560 56	G	G	G	J	J	J	J	J	J	J	J				
680 68	G	G	G	J	J	J	J	J	J	J	J				
820 82	G	G	G	J	J	J	J	J	J	J	J				
101 100	G	G	G	J	J	J	J	J	J	J	J				
121 120	G	G	G	J	J	J	J	J	J	J	J				
151 150	G	G	G	J	J	J	J	J	J	J	J				
181 180	G	G	G	J	J	J	J	J	J	J	J				
221 220	G	G	G	J	J	J	J	J	J	J	J				
271 270	G	G	G	J	J	J	J	J	J	J	J				
331 330	G	G	G	J	J	J	J	J	J	J	J				
391 390	G	G		J	J	J	J	J	J	J	J				
471 470	G	G		J	J	J	J	J	J	J	J				
561 560				J	J	J	J	J	J	J	J				
681 680				J	J	J	J	J	J	J	J				
821 820				J	J	J	J	J	J	J	J				
102 1000				J	J	J	J	J	J	J	J	J	J	J	J
122 1200												J	J	M	M
152 1500												J	J	M	M
182 1800												J	J	M	M
222 2200												J	J	M	M
272 2700															
332 3300															
392 3900															
472 4700															
103 10nF															
WVDC	25V	50V	100V	25V	50V	100V	25V	50V	100V	200V	500V	25V	50V	100V	200V
Size	AP03 = 0603			AP05 = 0805			AP06 = 1206					AP10 = 1210			



Letter	A	C	E	G	J	K	M	N	P	Q	X	Y	Z
<b>Max. Thickness</b>	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						EMBOSSED							

TS 16949, ISO 9001 Certified

# APS COTS+ X7R Series

## Capacitance Range



Size		AP03 = 0603					AP05 = 0805					AP06 = 1206					AP10 = 1210				AP12 = 1812		AP20 = 2220				
WVDC		16V	25V	50V	100V	200V	16V	25V	50V	100V	200V	16V	25V	50V	100V	200V	500V	16V	25V	50V	100V	50V	100V	25V	50V	100V	
102	Cap 1000	G	G	G	G	G	J	J	J	J	J	J	J	J	J	J	K	K	K	K	K	K					
182	(pF) 1800	G	G	G	G	G	J	J	J	J	J	J	J	J	J	J	K	K	K	K	K	K					
222	2200	G	G	G	G	G	J	J	J	J	J	J	J	J	J	J	K	K	K	K	K	K					
332	3300	G	G	G	G	G	J	J	J	J	J	J	J	J	J	J	K	K	K	K	K	K					
472	4700	G	G	G	G	G	J	J	J	J	J	J	J	J	J	J	K	K	K	K	K	K					
103	0.01	G	G	G	G	G	J	J	J	J	J	J	J	J	J	J	K	K	K	K	K	K					
123	0.012	G	G	G	G	G	J	J	J	M	M	J	J	J	J	J	K	K	K	K	K	K					
153	0.015	G	G	G	G	G	J	J	J	M	M	J	J	J	J	J	K	K	K	K	K	K					
183	0.018	G	G	G	G	G	J	J	J	M	M	J	J	J	J	J	K	K	K	K	K	K					
223	0.022	G	G	G	G	G	J	J	J	M	M	J	J	J	J	J	K	K	K	K	K	K					
273	0.027	G	G	G	G	G	J	J	J	M	M	J	J	J	J	J	K	K	K	K	K	K					
333	0.033	G	G	G	G	G	J	J	J	M	M	J	J	J	J	J	K	K	K	K	K	K					
473	0.047	G	G	G	G	G	J	J	J	M	M	J	J	J	M	J	K	K	K	K	K	K					
563	0.056	G	G	G	G	G	J	J	J	M	M	J	J	J	M	J	K	K	K	M	K	K					
683	0.068	G	G	G	G	G	J	J	J	M	M	J	J	J	M	J	K	K	K	M	K	K					
823	0.082	G	G	G	G	G	J	J	J	M	M	J	J	J	M	J	K	K	K	M	K	K					
104	0.1	G	G	G	G	G	J	J	M	M	M	J	J	J	M	J	K	K	K	M	K	K					
124	0.12						J	J	M	N	N	J	J	M	M	M	K	K	K	P	K	K					
154	0.15						M	N	M	N	N	J	J	M	M	M	K	K	K	P	K	K					
224	0.22						M	N	M	N	N	J	M	M	Q	Q	M	M	M	P	M	M					
334	0.33						N	N	M	N	N	J	M	P	Q	Q	P	P	P	Q	X	X					
474	0.47						N	N	M	N	N	M	M	P	Q	Q	P	P	P	Q	X	X					
684	0.68						N	N	N	N	N	M	Q	Q	Q	Q	P	P	P	Q	X	X					
105	Cap 1.0						N	N	N	N*	N*	M	Q	Q	Q	Q*	P	Q	Q	Z*	X	X					
155	(μF) 1.5											Q	Q	Q	Q	Q	P	Q	Z	Z	X	X					
225	2.2											Q	Q	Q	Q	Q	Z	Z	Z	Z*	Z	Z					
335	3.3											Q					X	Z	Z	Z	Z	Z					
475	4.7											Q					X	Z	Z	Z	Z	Z*					
106	10																Z	Z*					Z	Z*			
226	22																							Z	Z*		
WVDC		16V	25V	50V	100V	200V	16V	25V	50V	100V	200V	16V	25V	50V	100V	200V	500V	16V	25V	50V	100V	50V	100V	25V	50V	100V	
Size		AP03 = 0603					AP05 = 0805					AP06 = 1206					AP10 = 1210				AP12 = 1812		AP20 = 2220				

\*Not currently available with lead plating finish, contact plant for further information.

Letter	A	C	E	G	J	K	M	N	P	Q	X	Y	Z
<b>Max. Thickness</b>	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												EMBOSSED	

TS 16949, ISO 9001 Certified

# APS COTS+ X8R/L Series

## Capacitance Range



### X8R

SIZE		AP03 = 0603		AP05 = 0805		AP06 = 1206	
WVDC		25V	50V	25V	50V	25V	50V
331	Cap 330	G	G	J	J		
471	(pF) 470	G	G	J	J		
681	680	G	G	J	J		
102	1000	G	G	J	J	J	J
152	1500	G	G	J	J	J	J
222	2200	G	G	J	J	J	J
332	3300	G	G	J	J	J	J
472	4700	G	G	J	J	J	J
682	6800	G	G	J	J	J	J
103	Cap 0.01	G	G	J	J	J	J
153	( $\mu$ F) 0.015	G	G	J	J	J	J
223	0.022	G	G	J	J	J	J
333	0.033	G	G	J	J	J	J
473	0.047	G	G	J	J	J	J
683	0.068	G		N	N	M	M
104	0.1			N	N	M	M
154	0.15			N	N	M	M
224	0.22			N		M	M
334	0.33					M	M
474	0.47					M	
684	0.68						
105	1						
WVDC		25V	50V	25V	50V	25V	50V
SIZE		0603		0805		1206	

### X8L

SIZE		AP03 = 0603			AP05 = 0805			AP06 = 1206			
WVDC		25V	50V	100V	25V	50V	100V	16V	25V	50V	100V
331	Cap 330		G	G		J	J				
471	(pF) 470		G	G		J	J				
681	680	G	G		J	J					
102	1000	G	G		J	J					
152	1500	G	G		J	J		J	J		
222	2200	G	G		J	J		J	J		
332	3300	G	G		J	J		J	J		
472	4700	G	G		J	J		J	J		
682	6800	G	G		J	J		J	J		
103	Cap 0.01	G	G		J	J		J	J		
153	( $\mu$ F) 0.015	G	G		J	J	J	J	J	J	
223	0.022	G	G		J	J		J	J	J	
333	0.033	G	G		J	J	N	J	J	J	
473	0.047	G	G		J	J	N	J	J	J	
683	0.068	G	G		J	J		J	J	J	
104	0.1	G	G		J	J		J	J	M	
154	0.15				J	N		J	J	J	Q
224	0.22				N	N		J	J	J	Q
334	0.33				N			J	M	P	Q
474	0.47				N			M	M	P	
684	0.68						M				
105	1						M				
WVDC		25V	50V	100V	25V	50V	100V	16V	25V	50V	100V
SIZE		0603		0805		1206					



Letter	A	C	E	G	J	K	M	N	P	Q	X	Y	Z
<b>Max. Thickness</b>	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					EMBORESSED								

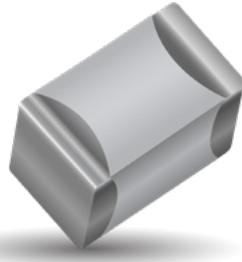
TS 16949, ISO 9001 Certified



The Important Information/Disclaimer is incorporated in the catalog where these specifications came from or available online at [www.kyocera-avx.com/disclaimer/](http://www.kyocera-avx.com/disclaimer/) by reference and should be reviewed in full before placing any order.

# MLCC with FLEXITERM®

## General Specifications



### GENERAL DESCRIPTION

With increased requirements from the automotive industry for additional component robustness, KYOCERA AVX recognized the need to produce a MLCC with enhanced mechanical strength. It was noted that many components may be subject to severe flexing and vibration when used in various under the hood automotive and other harsh environment applications.

To satisfy the requirement for enhanced mechanical strength, KYOCERA AVX had to find a way of ensuring electrical integrity is maintained whilst external forces are being applied to the component. It was found that the structure of the termination needed to be flexible and after much research and development, KYOCERA AVX launched FLEXITERM®. FLEXITERM® is designed to enhance the mechanical flexure and temperature cycling performance of a standard ceramic capacitor with an X7R dielectric. The industry standard for flexure is 2mm minimum. Using FLEXITERM®, KYOCERA AVX provides up to 5mm of flexure without internal cracks. Beyond 5mm, the capacitor will generally fail "open".

As well as for automotive applications FLEXITERM® will provide Design Engineers with a satisfactory solution when designing PCB's which may be subject to high levels of board flexure.

### PRODUCT ADVANTAGES

- High mechanical performance able to withstand, 5mm bend test guaranteed
- Increased temperature cycling performance, 3000 cycles and beyond
- Flexible termination system
- Reduction in circuit board flex failures
- Base metal electrode system
- Automotive or commercial grade products available
- AECQ200 Qualified
- Approved to VW 80808 Specification

### APPLICATIONS

#### High Flexure Stress Circuit Boards

- e.g. Depanelization: Components near edges of board.

#### Variable Temperature Applications

- Soft termination offers improved reliability performance in applications where there is temperature variation.
- e.g. All kind of engine sensors: Direct connection to battery rail.

#### Automotive Applications

- Improved reliability.
- Excellent mechanical performance and thermo mechanical performance.

### HOW TO ORDER

0805	5	C	104	K	A	Z	2	A
Style	Voltage	Dielectric	Capacitance Code (In pF)	Capacitance Tolerance	Failure Rate	Terminations	Packaging	Special Code
0603	6 = 6.3V	C = X7R	2 Sig Digits +	J = $\pm 5\%$ *	A=Commercial	Z=FLEXITERM®	2 = 7" Reel	A = Std. Product
0805	Z = 10V	F = X8R	Number of Zeros	K = $\pm 10\%$	4 = Automotive	For FLEXITERM® with Tin/Lead termination see LD Series	4 = 13" Reel	
1206	Y = 16V		e.g., 104 = 100nF	M = $\pm 20\%$				
1210	3 = 25V							
1812	5 = 50V							
2220	1 = 100V							
	2 = 200V							
				* $\leq 1\mu F$ only				



NOTE: Contact factory for availability of Tolerance Options for Specific Part Numbers.

### PERFORMANCE TESTING

#### AEC-Q200 Qualification:

- Created by the Automotive Electronics Council
- Specification defining stress test qualification for passive components



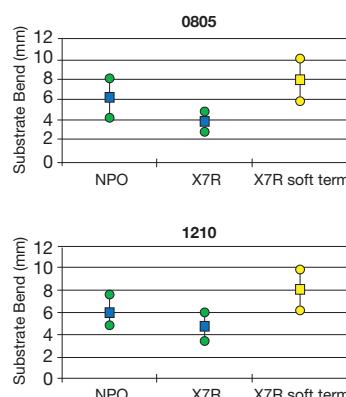
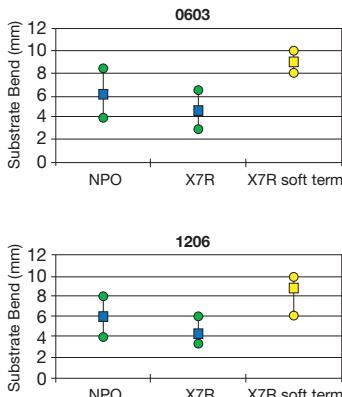
#### Testing:

Key tests used to compare soft termination to AEC-Q200 qualification:

- Bend Test
- Temperature Cycle Test

### BOARD BEND TEST RESULTS

AEC-Q200 Vrs FLEXITERM® Bend Test



### TABLE SUMMARY

Typical bend test results are shown below:

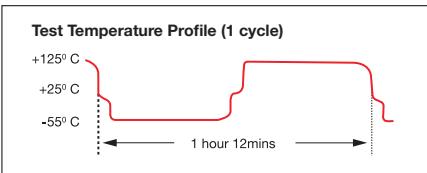
Style	Conventional Termination	FLEXITERM®
0603	>2mm	>5mm
0805	>2mm	>5mm
1206	>2mm	>5mm

### TEMPERATURE CYCLE TEST PROCEDURE

Test Procedure as per AEC-Q200:

The test is conducted to determine the resistance of the component when it is exposed to extremes of alternating high and low temperatures.

- Sample lot size quantity 77 pieces
- TC chamber cycle from -55°C to +125°C for 1000 cycles
- Interim electrical measurements at 250, 500, 1000 cycles
- Measure parameter capacitance dissipation factor, insulation resistance



### BOARD BEND TEST PROCEDURE

According to AEC-Q200

Test Procedure as per AEC-Q200:  
Sample size: 20 components  
Span: 90mm Minimum deflection spec: 2 mm

- Components soldered onto FR4 PCB (Figure 1)
- Board connected electrically to the test equipment (Figure 2)

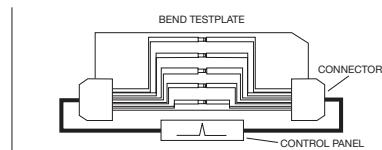


Fig 1 - PCB layout with electrical connections

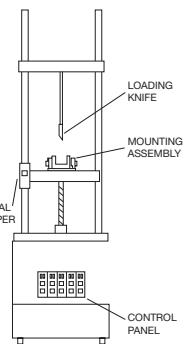
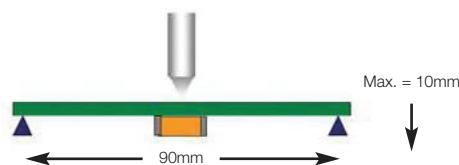


Fig 2 - Board Bend test equipment

### ENHANCED SOFT TERMINATION BEND TEST PROCEDURE

#### Bend Test

The capacitor is soldered to the printed circuit board as shown and is bent up to 10mm at 1mm per second:

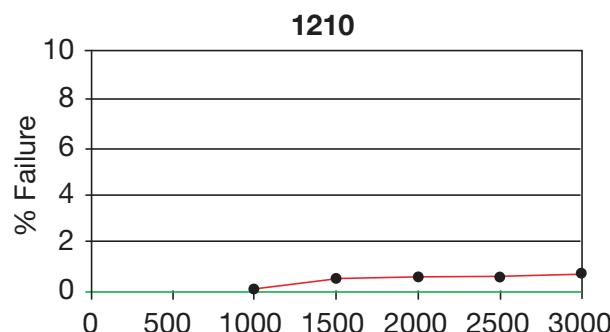
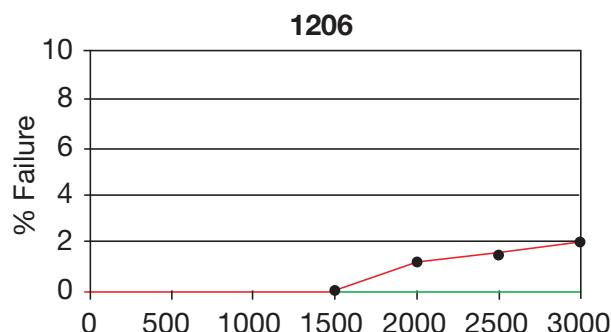
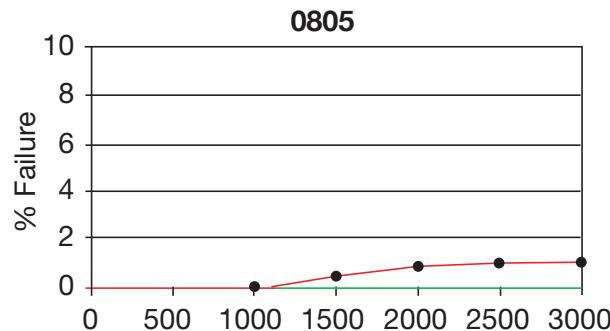
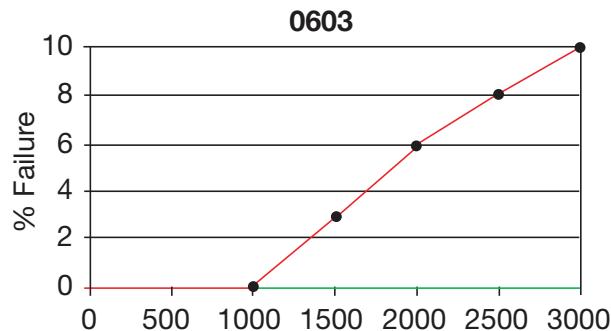


- The board is placed on 2 supports 90mm apart (capacitor side down)
- The row of capacitors is aligned with the load stressing knife



- The load is applied and the deflection where the part starts to crack is recorded (Note: Equipment detects the start of the crack using a highly sensitive current detection circuit)
- The maximum deflection capability is 10mm

### BEYOND 1000 CYCLES: TEMPERATURE CYCLE TEST RESULTS



Green = Soft Term MLCC (Flexiterm)  
Red = Standard MLCC

### Soft Term - No Defects up to 3000 cycles

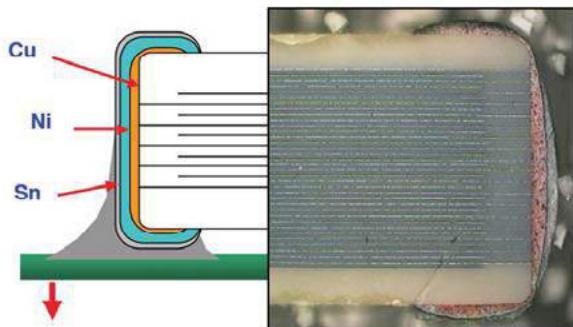
AEC-Q200 specification states 1000 cycles compared to 3000 temperature cycles.

### FLEXITERM® TEST SUMMARY

- Qualified to AEC-Q200 test/specification with the exception of using 3000 temperature cycles (up to +150°C bend test guaranteed greater than 5mm).
- FLEXITERM® provides improved performance compared to standard termination systems.

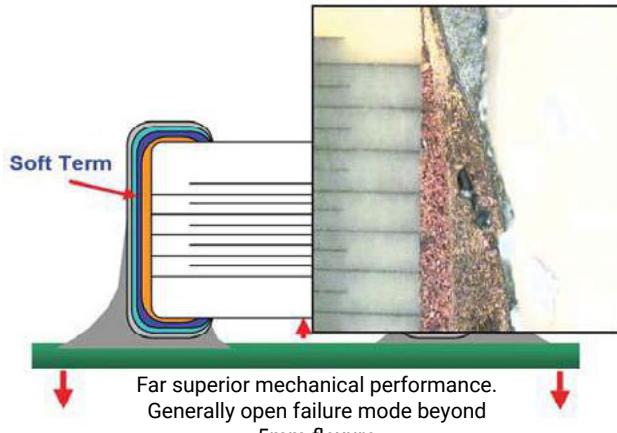
- Board bend test improvement by a factor of 2 to 4 times.
- Temperature Cycling:
  - 0% Failure up to 3000 cycles
  - No ESR change up to 3000 cycle

### WITHOUT SOFT TERMINATION



Major fear is of latent board flex failures.

### WITH SOFT TERMINATION



Far superior mechanical performance.  
Generally open failure mode beyond  
5mm flexure

SIZE	0603		0805		1206	
Soldering	Reflow/Wave		Reflow/Wave		Reflow/Wave	
WVDC	25V	50V	25V	50V	25V	50V
271 Cap (pF) 270	G	G				
331 330	G	G	J	J		
471 470	G	G	J	J		
681 680	G	G	J	J		
102 1000	G	G	J	J	J	J
152 1500	G	G	J	J	J	J
182 1800	G	G	J	J	J	J
222 2200	G	G	J	J	J	J
272 2700	G	G	J	J	J	J
332 3300	G	G	J	J	J	J
392 3900	G	G	J	J	J	J
472 4700	G	G	J	J	J	J
562 5600	G	G	J	J	J	J
682 6800	G	G	J	J	J	J
822 8200	G	G	J	J	J	J
103 Cap (μF) 0.01	G	G	J	J	J	J
123 0.012	G	G	J	J	J	J
153 0.015	G	G	J	J	J	J
183 0.018	G	G	J	J	J	J
223 0.022	G	G	J	J	J	J
273 0.027	G	G	J	J	J	J
333 0.033	G	G	J	J	J	J
393 0.039	G	G	J	J	J	J
473 0.047	G	G	J	J	J	J
563 0.056	G		N	N	M	M
683 0.068	G		N	N	M	M
823 0.082			N	N	M	M
104 0.1			N	N	M	M
124 0.12			N	N	M	M
154 0.15			N	N	M	M
184 0.18			N		M	M
224 0.22			N		M	M
274 0.27					M	M
334 0.33					M	M
394 0.39					M	
474 0.47					M	
684 0.68						
824 0.82						
105 1						
WVDC	25V	50V	25V	50V	25V	50V
SIZE	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)	0.90 (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	

TS 16949, ISO 9001 Certified

# MLCC with FLEXITERM®

## Capacitance Range X7R Dielectric



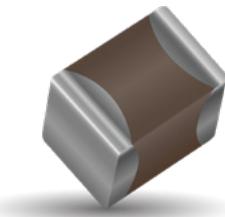
Size		0402			0603					0805					1206					1210			1812			2220							
Soldering		Reflow/ Wave			Reflow/Wave					Reflow/Wave					Reflow/Wave					Reflow Only			Reflow Only			Reflow Only							
WVDC		16V	25V	50V	10V	16V	25V	50V	100V	200V	250V	16V	25V	50V	100V	200V	250V	16V	25V	50V	100V	200V	250V	500V	16V	25V	50V	100V	50V	100V	25V	50V	100V
221	Cap	220	C	C	C																												
271	(pF)	270	C	C	C																												
331		330	C	C	C																												
391		390	C	C	C																												
471		470	C	C	C																												
561		560	C	C	C																												
681		680	C	C	C																												
821		820	C	C	C																												
102		1000	C	C	C	G	G	G	G	G	G	J	J	J	J	J	J	J	J	J	J	J	J	J	K	K	K	K	N	N			
182		1800	C	C	C	G	G	G	G	G	G	J	J	J	J	J	J	J	J	J	J	J	J	J	K	K	K	K	N	N			
222		2200	C	C	C	G	G	G	G	G	G	J	J	J	J	J	J	J	J	J	J	J	J	J	K	K	K	N	N				
332		3300	C	C	C	G	G	G	G	G	G	J	J	J	J	J	J	J	J	J	J	J	J	J	K	K	K	K	N	N			
472		4700	C	C	C	G	G	G	G	G	G	J	J	J	J	J	J	J	J	J	J	J	J	J	K	K	K	K	N	N			
103	Cap	0.01	C			G	G	G	G	G	G	J	J	J	J	J	J	J	J	J	J	J	J	J	K	K	K	K	N	N			
123	(μF)	0.012	C			G	G	G				J	J	J	N	N	N	J	J	J	J	J	J	J	J	K	K	K	K	N	N		
153		0.015	C			G	G	G				J	J	J	N	N	N	J	J	J	J	J	J	J	J	K	K	K	K	N	N		
183		0.018	C			G	G	G				J	J	J	N	N	N	J	J	J	J	J	J	J	J	K	K	K	K	N	N		
223		0.022	C			G	G	G				J	J	J	N	N	N	J	J	J	J	J	J	J	J	K	K	K	K	N	N		
273		0.027	C			G	G	G				J	J	J	N	N	N	J	J	J	J	J	J	J	J	K	K	K	K	N	N		
333		0.033	C			G	G	G				J	J	J	N	N	N	J	J	J	J	J	J	J	J	K	K	K	K	N	N		
473		0.047				G	G	G				J	J	J	N	N	N	J	J	J	M	J	J	J	J	K	K	K	K	N	N		
563		0.056				G	G	G				J	J	J	N	N	N	J	J	J	M	J	J	J	J	K	K	M	N	N			
683		0.068				G	G	G				J	J	J	N	N	N	J	J	J	M	J	J	J	J	K	K	K	M	N	N		
823		0.082				G	G	G				J	J	J	N	N	N	J	J	J	M	J	J	J	J	K	K	K	M	N	N		
104		0.1	C			G	G	G				J	J	J	N	N	N	J	J	J	M	J	J	J	J	K	K	K	M	N	N		
124		0.12										J	J	J	N	N	N	J	J	M	M	M	M	M	M	K	K	K	P	N	N		
154		0.15										M	N	N	N	N	N	J	J	M	M	M	M	M	M	K	K	K	P	N	N		
224		0.22				G	J	J	J	J	J	M	N	N	N	N	N	J	M	M	Q	M	M	M	P	N	N	N	N				
334		0.33										N	N	N	N	N	N	J	M	P	Q	P	P	P	P	Q	X	X	X	X			
474		0.47				J	J	J	J	J	J	N	N	N	N	N	N	M	M	P	Q	P	P	P	P	Q	X	X	X				
684		0.68										N	N	N	N	N	N	M	Q	Q	Q	P	P	P	P	Q	X	X	X				
105		1										N	N	N	N	N	N	M	Q	Q	Q	P	Q	Q	Z	X	X	X					
155		1.5										N	N	N	N	N	N	Q	Q	Q	Q	P	Q	Z	Z	X	X	Z					
225		2.2										N	N	N	N	N	N	Q	Q	Q	Q	X	Z	Z	Z	Z	Z	Z					
335		3.3																Q	Q	Q	Q	X	Z	Z	Z	Z	Z	Z					
475		4.7																Q	Q	Q	Q	X	Z	Z	Z	Z	Z	Z					
106		10																				Z	Z	Z	Z	Z	Z	Z	Z				
226		22																															
WVDC		16V	25V	50V	10V	16V	25V	50V	100V	200V	250V	16V	25V	50V	100V	200V	250V	16V	25V	50V	100V	200V	250V	500V	16V	25V	50V	100V	50V	100V	25V	50V	100V
Size		0402			0603					0805					1206					1210			1812			2220							

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)

EMBOSSED

# FLEXISAFE MLC Chips

## General Specifications and Capacitance Range For Ultra Safety Critical Applications



KYOCERA AVX have developed a range of components specifically for safety critical applications.

Utilizing the award-winning FLEXITERM™ layer in conjunction with the cascade design previously used for high voltage MLCCs, a range of ceramic capacitors is now available for customers who require components designed with an industry leading set of safety features.

The FLEXITERM™ layer protects the component from any damage to the ceramic resulting from mechanical stress during PCB assembly or use with end customers. Board flexure type mechanical damage accounts for the majority of MLCC failures. The addition of the cascade structure protects the component from low insulation resistance failure resulting from other common causes for failure; thermal stress damage, repetitive strike ESD damage and placement damage. With the inclusion of the cascade design structure to complement the FLEXITERM™ layer, the FLEXISAFE range of capacitors has unbeatable safety features. Flexisafe capacitors are qualified in accordance with AEC-Q200 standard. AEC-Q200 detailed qualification data is available on request.

### HOW TO ORDER

FS05	5	C	104	K	Q	Z	2	A
Size	Voltage	Dielectric	Capacitance Code (In pF)	Capacitance Tolerance	Failure Rate	Terminations	Packaging	Special Code
FS03 = 0603	16V = Y	X7R = C	2 Sig. Digits + Number of Zeros e.g. 10µF = 106	J = ±5% K = ±10% M = ±20%	A = Commercial 4 = Automotive Q = APS	Z = FLEXITERM™ *X = FLEXITERM™ with 5% min lead *Not RoHS Compliant	2 = 7" Reel 4 = 13" Reel	A = Std. Product
FS05 = 0805	25V = 3							
FS06 = 1206	50V = 5							
FS10 = 1210	100V = 1							

### CAPACITANCE RANGE FLEXISAFE X7R

SIZE	FS03 = 0603				FS05 = 0805				FS06 = 1206			FS10 = 1210			
	WVDC	16	25	50	100	16	25	50	100	16	25	50	16	25	50
102 1000	G	G	G	G	J	J	J	J	J	J	J	J			
182 1800	G	G	G	G	J	J	J	J	J	J	J	J			
222 2200	G	G	G	G	J	J	J	J	J	J	J	J			
332 3300	G	G	G	G	J	J	J	J	J	J	J	J			
472 4700	G	G	G	G	J	J	J	J	J	J	J	J			
682 6800	G	G	G	G	J	J	J	J	J	J	J	J			
103 0.01	G	G	G	G	J	J	J	J	J	J	J	J			
123 0.012	G	G	G		J	J	J	J	J	J	J	J			
153 0.015	G	G	G		J	J	J	J	J	J	J	J			
183 0.018	G	G	G		J	J	J	J	J	J	J	J			
223 0.022	G	G	G		N	N	N	N	J	J	J	J			
273 0.027					N	N	N	N	J	J	J	J			
333 0.033					N	N	N	N	J	J	J	J			
473 0.047					N	N	N	N	M	M	M	M			
563 0.056					N	N	N	N	M	M	M	M			
683 0.068					N	N	N	N	M	M	M	M			
823 0.082					N	N	N	N	M	M	M	M			
104 0.1					N	N	N	N	M	M	M	M			
124 0.12									M	M	M				
154 0.15									M	M	M	Q	Q	Q	
224 0.22												Q	Q	Q	
334 0.33												Q	Q	Q	
474 0.47												Q	Q	Q	

Letter	G	J	M	N	Q
Max. Thickness	0.90 (0.035)	0.94 (0.037)	1.27 (0.050)	1.40 (0.055)	1.78 (0.070)
	PAPER				
	EMBOSS				



# Capacitor Array

## Capacitor Array (IPC)

### BENEFITS OF USING CAPACITOR ARRAYS

KYOCERA AVX capacitor arrays offer designers the opportunity to lower placement costs, increase assembly line output through lower component count per board and to reduce real estate requirements.

#### Reduced Costs

Placement costs are greatly reduced by effectively placing one device instead of four or two. This results in increased throughput and translates into savings on machine time. Inventory levels are lowered and further savings are made on solder materials, etc.

#### Space Saving

Space savings can be quite dramatic when compared to the use of discrete chip capacitors. As an example, the 0508 4-element array offers a space reduction of >40% vs. 4 x 0402 discrete capacitors and of >70% vs. 4 x 0603 discrete capacitors. (This calculation is dependent on the spacing of the discrete components.)

#### Increased Throughput

Assuming that there are 220 passive components placed in a mobile phone:

A reduction in the passive count to 200 (by replacing discrete components with arrays) results in an increase in throughput of approximately 9%.

A reduction of 40 placements increases throughput by 18%.

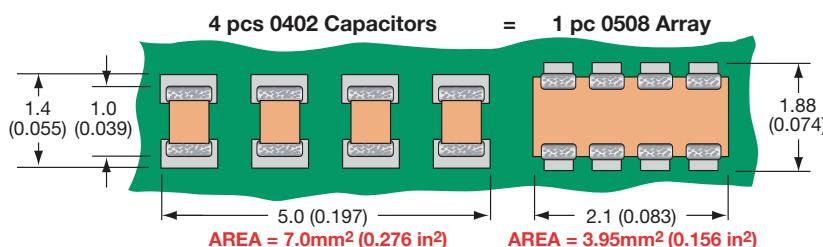
For high volume users of cap arrays using the very latest placement equipment capable of placing 10 components per second, the increase in throughput can be very significant and can have the overall effect of reducing the number of placement machines required to mount components:

If 120 million 2-element arrays or 40 million 4-element arrays were placed in a year, the requirement for placement equipment would be reduced by one machine.

During a 20Hr operational day a machine places 720K components. Over a working year of 167 days the machine can place approximately 120 million. If 2-element arrays are mounted instead of discrete components, then the number of placements is reduced by a factor of two and in the scenario where 120 million 2-element arrays are placed there is a saving of one pick and place machine.

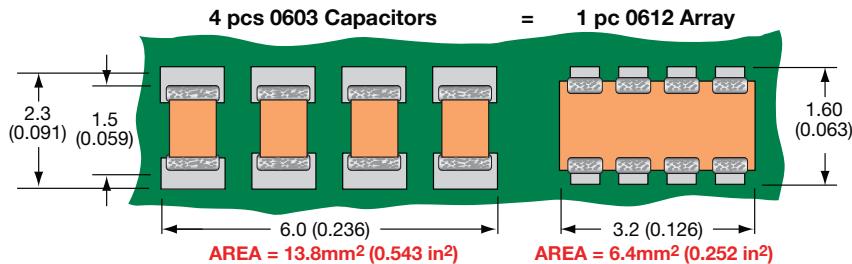
Smaller volume users can also benefit from replacing discrete components with arrays. The total number of placements is reduced thus creating spare capacity on placement machines. This in turn generates the opportunity to increase overall production output without further investment in new equipment.

### W2A (0508) Capacitor Arrays



The 0508 4-element capacitor array gives a PCB space saving of over 40% vs four 0402 discretes and over 70% vs four 0603 discrete capacitors.

### W3A (0612) Capacitor Arrays



The 0612 4-element capacitor array gives a PCB space saving of over 50% vs four 0603 discretes and over 70% vs four 0805 discrete capacitors.

# Capacitor Array

## Capacitor Array (IPC)



0508 - 2 Element



0508 - 4 Element



0612 - 4 Element

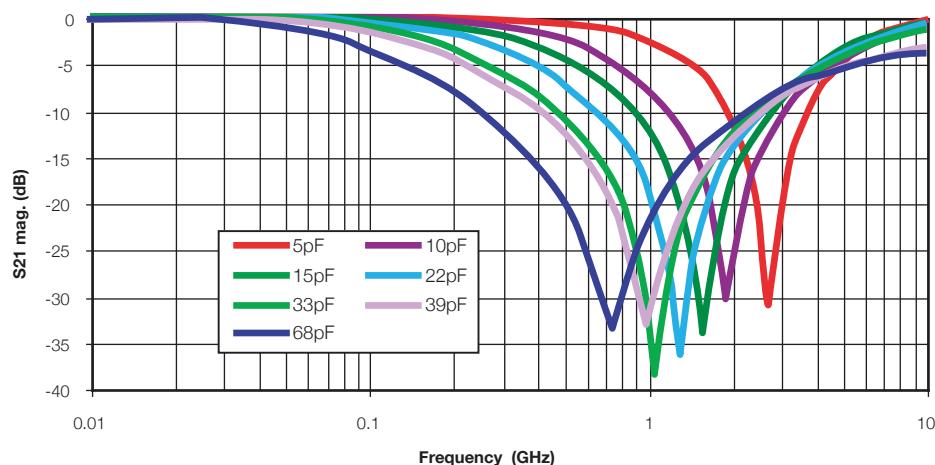
### GENERAL DESCRIPTION

KYOCERA AVX is the market leader in the development and manufacture of capacitor arrays. The array family of products also includes the 0612 4-element device as well as 0508 2-element and 4-element series, all of which have received widespread acceptance in the marketplace.

KYOCERA AVX capacitor arrays are available in X5R, X7R and NP0 (C0G) ceramic dielectrics to cover a broad range of capacitance values. Voltage ratings from 6.3 Volts up to 100 Volts are offered. KYOCERA AVX also now offers a range of automotive capacitor arrays qualified to AEC-Q200 (see separate table).

Key markets for capacitor arrays are Mobile and Cordless Phones, Digital Set Top Boxes, Computer Motherboards and Peripherals as well as Automotive applications, RF Modems, Networking Products, etc.

### AVX Capacitor Array - W2A41A\*\*\*K S21 Magnitude



### HOW TO ORDER

W	2	A	4	3	C	103	M	A	T	2A
Style W = RoHS L = SnPb	Case Size 2 = 0508 3 = 0612	Array 2 = 2 Element 4 = 4 Element	Number of Caps	Voltage 6 = 6V Z = 10V Y = 16V 3 = 25V 5 = 50V 1 = 100V	Dielectric A = NP0 C = X7R D = X5R	Capacitance Code 2 Sig. Digits + Number of Zeros	Capacitance Tolerance J = ±5% K = ±10% M = ±20%	Failure Rate A = Commercial 4 = Automotive	Termination Code *T = Plated Ni and Sn *Z = FLEXITERM® *B = 5% min lead *X = FLEXITERM® with 5% min lead	Packaging & Quantity Code 2A = 7" Reel 4A = 13" Reel 2F = 7" Reel (1000)

\*RoHS Compliant

\*Not RoHS Compliant



NOTE: Contact factory for availability of Termination and Tolerance Options for Specific Part Numbers.

# Capacitor Array

## Capacitance Range – NP0/C0G

SIZE	W2 = 0508			W3 = 0612		
# Elements	4			4		
Soldering	Reflow/Wave			Reflow/Wave		
Packaging	Paper/Embossed			Paper/Embossed		
Length mm (in.)	1.30 ± 0.15 (0.051 ± 0.006)			1.60 ± 0.150 (0.063 ± 0.006)		
Width mm (in.)	2.10 ± 0.15 (0.083 ± 0.006)			3.20 ± 0.20 (0.126 ± 0.008)		
Max. Thickness mm (in.)	0.94 (0.037)			1.35 (0.053)		
WVDC	16	25	50	16	25	50
1R0 Cap 1.0						
1R2 (pF) 1.2						
1R5 1.5						
1R8 1.8						
2R2 2.2						
2R7 2.7						
3R3 3.3						
3R9 3.9						
4R7 4.7						
5R6 5.6						
6R8 6.8						
8R2 8.2						
100 10						
120 12						
150 15						
180 18						
220 22						
270 27						
330 33						
390 39						
470 47						
560 56						
680 68						
820 82						
101 100						
121 120						
151 150						
181 180						
221 220						
271 270						
331 330						
391 390						
471 470						
561 560						
681 680						
821 820						
102 1000						
122 1200						
152 1500						
182 1800						
222 2200						
272 2700						
332 3300						
392 3900						
472 4700						
562 5600						
682 6800						
822 8200						

 = Supported Values

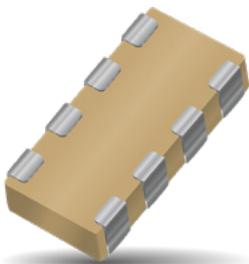
# Capacitor Array

## Capacitance Range – X7R

SIZE	W2 = 0508					W2 = 0508					W3 = 0612							
# Elements	2					4					4							
Soldering	Reflow/Wave					Reflow/Wave					Reflow/Wave							
Packaging	All Paper					Paper/Embossed					Paper/Embossed							
Length mm (in.)	1.30 ± 0.15 (0.051 ± 0.006)					1.30 ± 0.15 (0.051 ± 0.006)					1.60 ± 0.150 (0.063 ± 0.006)							
Width mm (in.)	2.10 ± 0.15 (0.083 ± 0.006)					2.10 ± 0.15 (0.083 ± 0.006)					3.20 ± 0.20 (0.126 ± 0.008)							
Max. Thickness mm (in.)	0.94 (0.037)					0.94 (0.037)					1.35 (0.053)							
WVDC	6	10	16	25	50	100	6	10	16	25	50	100	6	10	16	25	50	100
101 Cap 100																		
121 (PF) 120																		
151 150																		
181 180																		
221 220																		
271 270																		
331 330																		
391 390																		
471 470																		
561 560																		
681 680																		
821 820																		
102 1000																		
122 1200																		
152 1500																		
182 1800																		
222 2200																		
272 2700																		
332 3300																		
392 3900																		
472 4700																		
562 5600																		
682 6800																		
822 8200																		
103 Cap 0.010																		
123 (μF) 0.012																		
153 0.015																		
183 0.018																		
223 0.022																		
273 0.027																		
333 0.033																		
393 0.039																		
473 0.047																		
563 0.056																		
683 0.068																		
823 0.082																		
104 0.10																		
124 0.12																		
154 0.15																		
184 0.18																		
224 0.22																		
274 0.27																		
334 0.33																		
474 0.47																		
564 0.56																		
684 0.68																		
824 0.82																		
105 1.0																		
125 1.2																		
155 1.5																		
185 1.8																		
225 2.2																		
335 3.3																		
475 4.7																		
106 10																		
226 22																		
476 47																		
107 100																		

# Capacitor Array

## Automotive Capacitor Array (IPC)



As the market leader in the development and manufacture of capacitor arrays KYOCERA AVX is pleased to offer a range of AEC-Q200 qualified arrays to compliment our product offering to the Automotive industry. Both the KYOCERA AVX 0612 and 0508 4-element capacitor array styles are qualified to the AEC-Q200 automotive specifications.

AEC-Q200 is the Automotive Industry qualification standard and a detailed qualification package is available on request. All KYOCERA AVX automotive capacitor array production facilities are certified to ISO/TS 16949:2002.

### HOW TO ORDER

W	3	A	4	Y	C	104	K	4	T	2A	Packaging & Quantity Code
Style	Case Size	Array	Number of Caps	Voltage	Dielectric	Capacitance Code (In pF)	Capacitance Tolerance	Failure Rate	Terminations		
W = RoHS				Z = 10V	A = NP0	Significant Digits + Number of Zeros	*J = ±5%	4 = Automotive	*T = Plated Ni and Sn		
L = SnPb	2 = 0508			Y = 16V	C = X7R	e.g. 10μF=106	*K = ±10%		*Z = FLEXITERM®		
	3 = 0612			3 = 25V	F = X8R		*M = ±20%		B = 5% min lead		
				5 = 50V					X = FLEXITERM® with 5% min lead		
				1 = 100V						2A = 7" Reel	
										4A = 13" Reel	
										2F = 7" Reel (1000)	

\*RoHS Compliant

\*Contact factory for availability by part number for K = ±10% and J = ±5% tolerance.

### NP0/C0G

SIZE		W3 = 0612		
No. of Elements	Reflow/Wave	16	25	50
WVDC				
1R0	Cap 1.0 (pF)	1.0		
1R2		1.2		
1R5		1.5		
1R8		1.8		
2R2		2.2		
2R7		2.7		
3R3		3.3		
3R9		3.9		
4R7		4.7		
5R6		5.6		
6R8		6.8		
8R2		8.2		
100	10			
120	12			
150	15			
180	18			
220	22			
270	27			
330	33			
390	39			
470	47			
560	56			
680	68			
820	82			
101	100			
121	120			
151	150			
181	180			
221	220			
271	270			
331	330			
391	390			
471	470			
561	560			
681	680			
821	820			
102	1000			
122	1200			
152	1500			
182	1800			
222	2200			
272	2700			
332	3300			
392	3900			
472	4700			
562	5600			
682	6800			
822	8200			

 = NPO/C0G

SIZE		W2 = 0508				W3 = 0508				W3 = 0612				
No. of Elements	Reflow/Wave	2				4				4				
WVDC		16	25	50	100	16	25	50	100	10	16	25	50	100
101	Cap 100 (pF)	100												
121		120												
151		150												
181		180												
221		220												
271		270												
331		330												
391		390												
471		470												
561		560												
681		680												
821		820												
102		1000												
122		1200												
152		1500												
182		1800												
222		2200												
272		2700												
332		3300												
392		3900												
472		4700												
562		5600												
682		6800												
822		8200												

 = X7R

\*Not RoHS Compliant



LEAD-FREE  
LEAD-FREE COMPATIBLE  
COMPONENT



RoHS  
COMPLIANT

For RoHS compliant products,  
please select correct termination style.

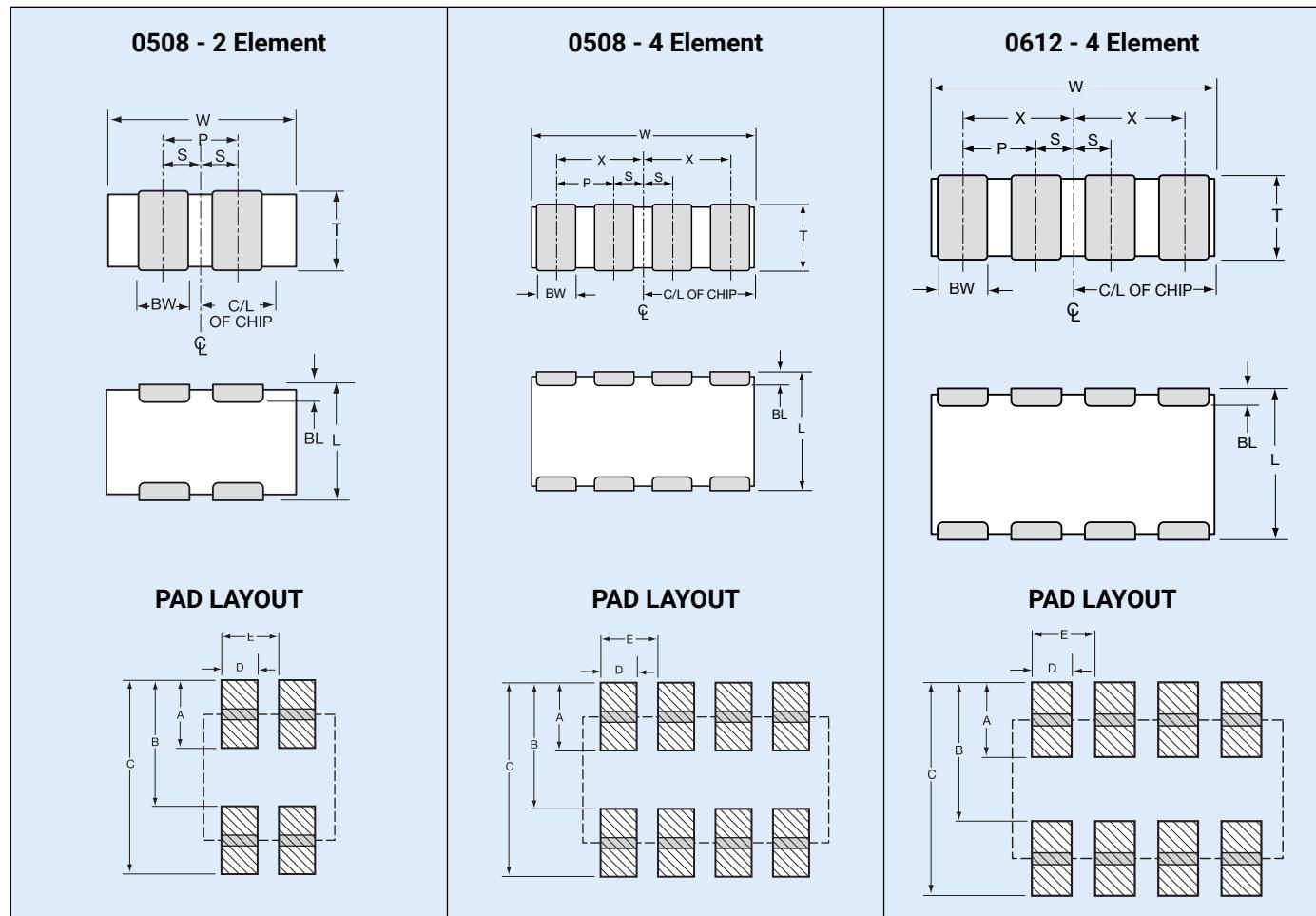


The Important Information/Disclaimer is incorporated in the catalog where these specifications came from or available online at [www.kyocera-avx.com/disclaimer/](http://www.kyocera-avx.com/disclaimer/) by reference and should be reviewed in full before placing any order.

# Capacitor Array

## Part & Pad Layout Dimensions

### PART & PAD LAYOUT DIMENSIONS



### PART DIMENSIONS

#### 0508 - 2 Element

L	W	T	BW	BL	P	S
$1.30 \pm 0.15$ ( $0.051 \pm 0.006$ )	$2.10 \pm 0.15$ ( $0.083 \pm 0.006$ )	0.94 MAX ( $0.037$ MAX)	$0.43 \pm 0.10$ ( $0.017 \pm 0.004$ )	$0.33 \pm 0.08$ ( $0.013 \pm 0.003$ )	1.00 REF ( $0.039$ REF)	$0.50 \pm 0.10$ ( $0.020 \pm 0.004$ )

#### 0508 - 4 Element

L	W	T	BW	BL	P	X	S
$1.30 \pm 0.15$ ( $0.051 \pm 0.006$ )	$2.10 \pm 0.15$ ( $0.083 \pm 0.006$ )	0.94 MAX ( $0.037$ MAX)	$0.25 \pm 0.06$ ( $0.010 \pm 0.003$ )	$0.20 \pm 0.08$ ( $0.008 \pm 0.003$ )	0.50 REF ( $0.020$ REF)	$0.75 \pm 0.10$ ( $0.030 \pm 0.004$ )	$0.25 \pm 0.10$ ( $0.010 \pm 0.004$ )

#### 0612 - 4 Element

L	W	T	BW	BL	P	X	S
$1.60 \pm 0.20$ ( $0.063 \pm 0.008$ )	$3.20 \pm 0.20$ ( $0.126 \pm 0.008$ )	1.35 MAX ( $0.053$ MAX)	$0.41 \pm 0.10$ ( $0.016 \pm 0.004$ )	$0.18^{+0.25}_{-0.08}$ ( $0.007^{+0.010}_{-0.003}$ )	0.76 REF ( $0.030$ REF)	$1.14 \pm 0.10$ ( $0.045 \pm 0.004$ )	$0.38 \pm 0.10$ ( $0.015 \pm 0.004$ )

### PAD LAYOUT DIMENSIONS

#### 0508 - 2 Element

A	B	C	D	E
0.68 (0.027)	1.32 (0.052)	2.00 (0.079)	0.46 (0.018)	1.00 (0.039)

#### 0508 - 4 Element

A	B	C	D	E
0.56 (0.022)	1.32 (0.052)	1.88 (0.074)	0.30 (0.012)	0.50 (0.020)

#### 0612 - 4 Element

A	B	C	D	E
0.89 (0.035)	1.65 (0.065)	2.54 (0.100)	0.46 (0.018)	0.76 (0.030)

# Low Inductance Capacitors

## Introduction

The signal integrity characteristics of a Power Delivery Network (PDN) are becoming critical aspects of board level and semiconductor package designs due to higher operating frequencies, larger power demands, and the ever shrinking lower and upper voltage limits around low operating voltages. These power system challenges are coming from mainstream designs with operating frequencies of 300MHz or greater, modest ICs with power demand of 15 watts or more, and operating voltages below 3 volts.

The classic PDN topology is comprised of a series of capacitor stages. Figure 1 is an example of this architecture with multiple capacitor stages.

An ideal capacitor can transfer all its stored energy to a load instantly. A real capacitor has parasitics that prevent instantaneous transfer of a capacitor's stored energy. The true nature of a capacitor can be modeled as an RLC equivalent circuit. For most simulation purposes, it is possible to model the characteristics of a real capacitor with one capacitor, one resistor, and one inductor. The RLC values in this model are commonly referred to as equivalent series capacitance (ESC), equivalent series resistance (ESR), and equivalent series inductance (ESL).

The ESL of a capacitor determines the speed of energy transfer to a load. The lower the ESL of a capacitor, the faster that energy can be transferred to a load. Historically, there has been a tradeoff between energy storage (capacitance) and inductance (speed of energy delivery). Low ESL devices typically have low capacitance. Likewise, higher capacitance devices typically have higher ESLs. This tradeoff between ESL (speed of energy delivery) and capacitance (energy storage) drives the PDN design topology that places the fastest low ESL capacitors as close to the load as possible. Low Inductance MLCCs are found on semiconductor packages and on boards as close as possible to the load.

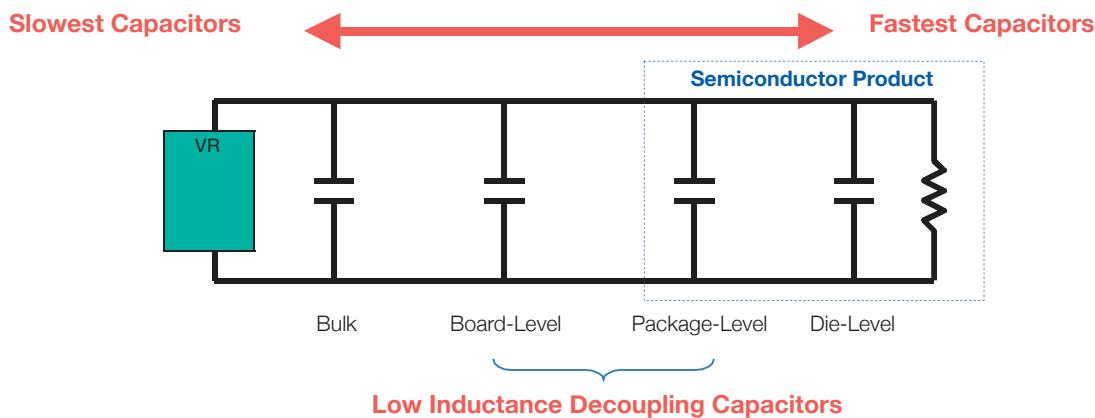


Figure 1 Classic Power Delivery Network (PDN) Architecture

## LOW INDUCTANCE CHIP CAPACITORS

The key physical characteristic determining equivalent series inductance (ESL) of a capacitor is the size of the current loop it creates. The smaller the current loop, the lower the ESL. A standard surface mount MLCC is rectangular in shape with electrical terminations on its shorter sides. A Low Inductance Chip Capacitor (LICC®) sometimes referred to as Reverse Geometry Capacitor (RGC) has its terminations on the longer side of its rectangular shape.

When the distance between terminations is reduced, the size of the current loop is reduced. Since the size of the current loop is the primary driver of inductance, an 0306 with a smaller current loop has significantly lower ESL than an 0603. The reduction in ESL varies by EIA size, however, ESL is typically reduced 60% or more with an LICC® versus a standard MLCC.

## INTERDIGITATED CAPACITORS

The size of a current loop has the greatest impact on the ESL characteristics of a surface mount capacitor. There is a secondary method for decreasing the ESL of a capacitor. This secondary method uses adjacent opposing current loops to reduce ESL. The InterDigitated Capacitor (IDC) utilizes both primary and secondary methods of reducing inductance. The IDC architecture shrinks the distance between terminations to minimize the current loop size, then further reduces inductance by creating adjacent opposing current loops.

An IDC is one single capacitor with an internal structure that has been optimized for low ESL. Similar to standard MLCC versus LICC®, the reduction in ESL varies by EIA case size. Typically, for the same EIA size, an IDC delivers an ESL that is at least 80% lower than an MLCC.

# Low Inductance Capacitors

## Introduction

### LAND GRID ARRAY (LGA) CAPACITORS

Land Grid Array (LGA) capacitors are based on the first Low ESL MLCC technology created to specifically address the design needs of current day Power Delivery Networks (PDNs). This is the 3rd low inductance capacitor technology developed by KYOCERA AVX. LGA technology provides engineers with new options. The LGA internal structure and manufacturing technology eliminates the historic need for a device to be physically small to create small current loops to minimize inductance.

The first family of LGA products are 2 terminal devices. A 2 terminal 0306 LGA delivers ESL performance that is equal to or better than an 0306 8 terminal IDC. The 2 terminal 0805 LGA delivers ESL performance that approaches the 0508 8 terminal IDC. New designs that would have used 8 terminal IDCs are moving to 2 terminal LGAs because the layout is easier for a 2 terminal device and manufacturing yield is better for a 2 terminal LGA versus an 8 terminal IDC.

LGA technology is also used in a 4 terminal family of products that KYOCERA AVX is sampling and will formerly introduce in 2008. Beyond 2008, there are new multi-terminal LGA product families that will provide even more attractive options for PDN designers.

### LOW INDUCTANCE CHIP ARRAYS (LICA®)

The LICA® product family is the result of a joint development effort between KYOCERA AVX and IBM to develop a high performance MLCC family of decoupling capacitors. LICA was introduced in the 1980s and remains the leading choice of designers in high performance semiconductor packages and high reliability board level decoupling applications.

LICA® products are used in 99.999% uptime semiconductor package applications on both ceramic and organic substrates. The C4 solder ball termination option is the perfect compliment to flip-chip packaging technology. Mainframe class CPUs, ultimate performance multi-chip modules, and communications systems that must have the reliability of 5 9's use LICA®.

LICA® products with either Sn/Pb or Pb-free solder balls are used for decoupling in high reliability military and aerospace applications. These LICA® devices are used for decoupling of large pin count FPGAs, ASICs, CPUs, and other high power ICs with low operating voltages.

When high reliability decoupling applications require the very lowest ESL capacitors, LICA® products are the best option.

### 470 nF 0306 Impedance Comparison

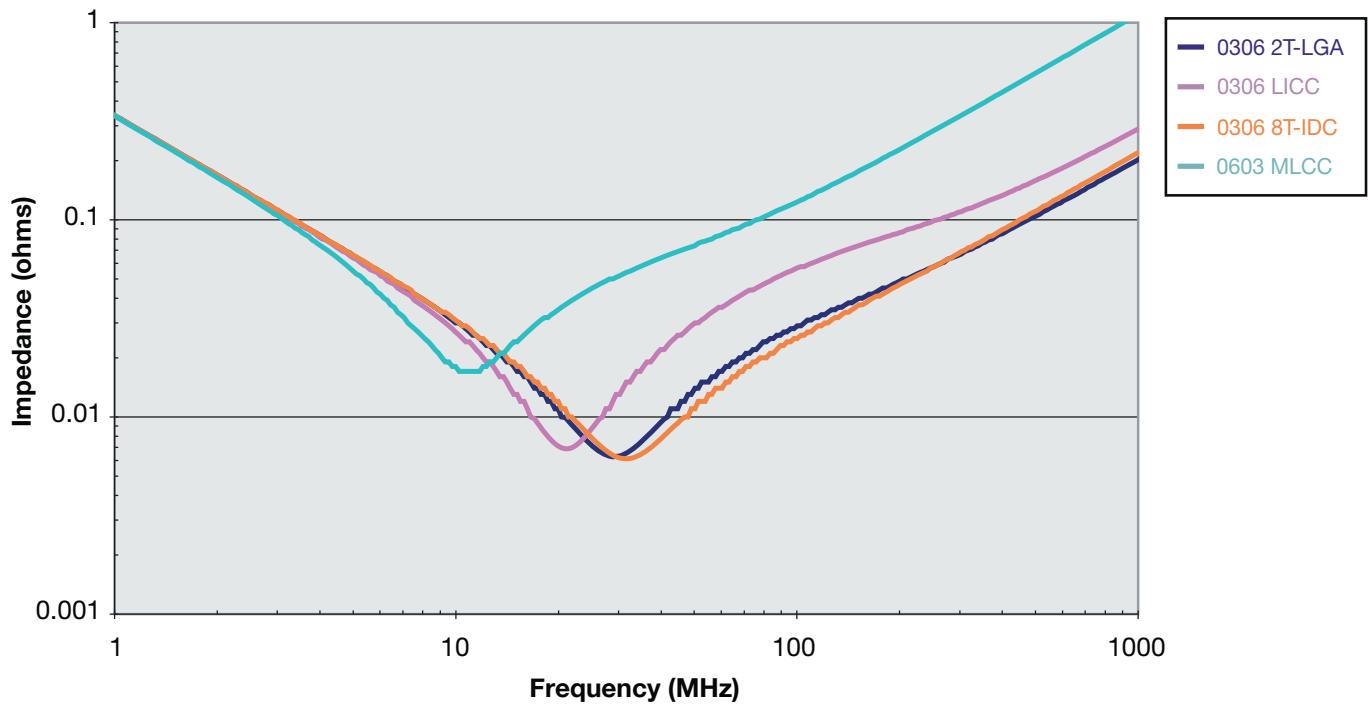


Figure 2 MLCC, LICC®, IDC, and LGA technologies deliver different levels of equivalent series inductance (ESL).

# Low Inductance Ceramic Capacitors

LICC® (Low Inductance Chip Capacitors) 0204/0306/0508/0612 RoHS Compliant

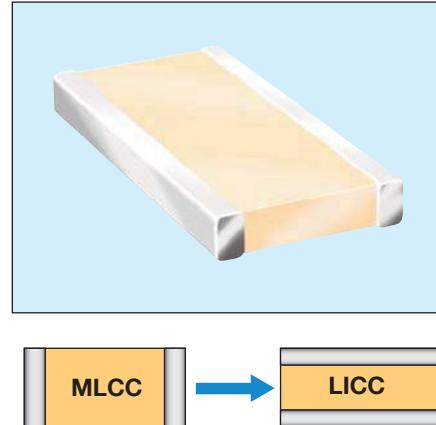
## GENERAL DESCRIPTION

The key physical characteristic determining equivalent series inductance (ESL) of a capacitor is the size of the current loop it creates. The smaller the current loop, the lower the ESL.

A standard surface mount MLCC is rectangular in shape with electrical terminations on its shorter sides. A Low Inductance Chip Capacitor (LICC®) sometimes referred to as Reverse Geometry Capacitor (RGC) has its terminations on the longer sides of its rectangular shape. The image on the right shows the termination differences between an MLCC and an LICC®.

When the distance between terminations is reduced, the size of the current loop is reduced. Since the size of the current loop is the primary driver of inductance, an 0306 with a smaller current loop has significantly lower ESL than an 0603. The reduction in ESL varies by EIA size, however, ESL is typically reduced 60% or more with an LICC® versus a standard MLCC.

KYOCERA AVX LICC® products are available with a lead-free finish of plated Nickel/Tin.



## PERFORMANCE CHARACTERISTICS

<b>Capacitance Tolerances</b>	$K = \pm 10\%$ , $M = \pm 20\%$
<b>Operation Temperature Range</b>	X7R = -55°C to +125°C X5R = -55°C to +85°C X7S = -55°C to +125°C
<b>Temperature Coefficient</b>	X7R, X5R = $\pm 15\%$ ; X7S = $\pm 22\%$
<b>Voltage Ratings</b>	4, 6.3, 10, 16, 25 VDC
<b>Dissipation Factor</b>	4V, 6.3V = 6.5% max; 10V = 5.0% max; 16V = 3.5% max; 25V = 3.0% max
<b>Insulation Resistance (@+25°C, RVDC)</b>	100,000MΩ min, or 1,000MΩ per $\mu$ F min., whichever is less

## HOW TO ORDER

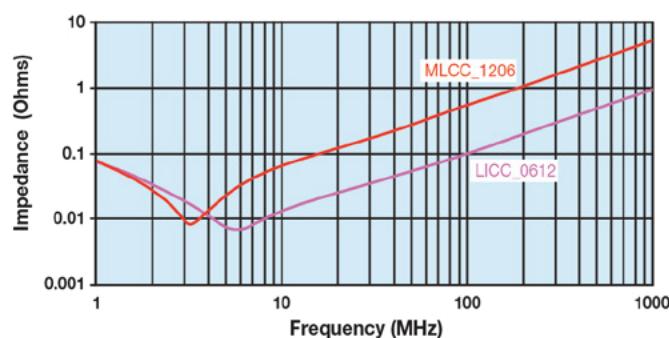
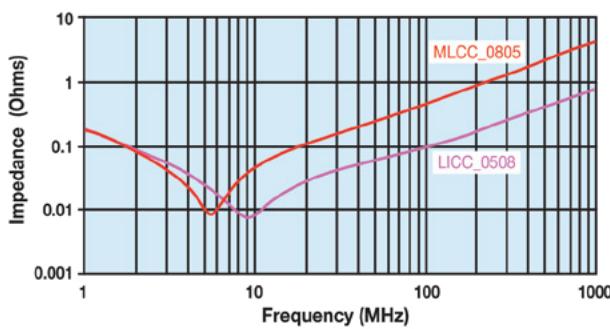
0612	Z	D	105	M	A	T	2	A*
<b>Size</b>								
0204								
0306	Voltage	Dielectric	Capacitance Code (In pF)	Capacitance Tolerance	Failure Rate	Terminations	Packaging Available	Thickness Thickness
0508	4 = 4V	C = X7R	2 Sig. Digits + Number of Zeros	$K = \pm 10\%$	A = N/A	Plated Ni and Sn	2 = 7" Reel	mm (in)
0612	6 = 6.3V	D = X5R		$M = \pm 20\%$	4 = Automotive**		4 = 13" Reel	0.56 (0.022)
	Z = 10V	W = X6S						0.76 (0.030)
	Y = 16V	Z = X7S						1.02 (0.040)
	3 = 25V							1.27 (0.050)
	5 = 50V							

\*See the thickness tables on the next page.

\*\*Select voltages for Automotive version, contact factory

NOTE: Contact factory for availability of Termination and Tolerance Options for Specific Part Numbers.

## TYPICAL IMPEDANCE CHARACTERISTICS



# Low Inductance Ceramic Capacitors

LICC® (Low Inductance Chip Capacitors) 0204/0306/0508/0612 RoHS Compliant

**KYOCERA**

**AVX**

SIZE		0204				0306				0508				0612				
Packaging		Paper				Paper				Paper/Embossed				Paper/Embossed				
Length		mm (in.)				0.50 ± 0.05 (0.020 ± 0.002)				0.81 ± 0.15 (0.032 ± 0.006)				1.27 ± 0.25 (0.050 ± 0.010)				
Width		mm (in.)				1.00 ± 0.05 (0.040 ± 0.002)				1.60 ± 0.15 (0.063 ± 0.006)				2.00 ± 0.25 (0.080 ± 0.010)				
Cap Code	WVDC	4	6.3	10	16	4	6.3	10	16	25	6.3	10	16	25	50	6.3	10	16
102	Cap 0.001					A	A	A	A	V	V	V	V	V	S	S	S	V
222	(μF) .0022					A	A	A	A	S	S	S	S	V	S	S	S	V
332	0.0033					A	A	A	A	S	S	S	S	V	S	S	S	V
472	0.0047					A	A	A	A	S	S	S	S	V	S	S	S	V
682	0.0068					A	A	A	A	S	S	S	S	V	S	S	S	V
103	0.01					A	A	A	A	S	S	S	S	V	S	S	S	V
153	0.015					A	A	A	A	S	S	S	S	V	S	S	S	W
223	0.022					A	A	A	A	S	S	S	S	V	S	S	S	W
333	0.033					A	A	A		S	S	S	S	V	S	S	S	W
473	0.047					A	A	A		S	S	S	V	A	S	S	S	W
683	0.068					A	A	A		S	S	S	A	A	S	S	S	V
104	0.1	b				A	A			S	S	V	A	A	S	S	S	V
154	0.15					A	A			S	S	V			S	S	S	W
224	0.22					A	A			S	S	A			S	S	V	W
334	0.33									V	V	A			S	S	V	
474	0.47									V	V	A			S	S	V	
684	0.68									A	A				V	V	W	
105	1									A	A				V	V	A	
155	1.5									A					W	W		
225	2.2														A	A		
335	3.3														A			
475	4.7																	
685	6.8																	
106	10																	

Solid = X7R

= X5R

= X7S

= X6S

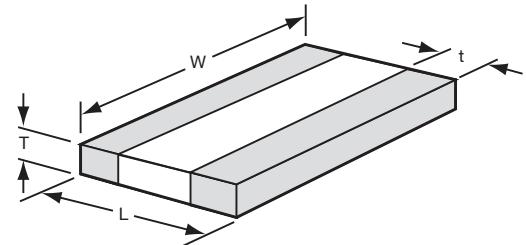
mm (in.)	
0204	
Code	Thickness
C	0.35 (0.014)

mm (in.)	
0306	
Code	Thickness
A	0.56 (0.022)

mm (in.)	
0508	
Code	Thickness
S	0.56 (0.022)
V	0.76 (0.030)
A	1.02 (0.040)

mm (in.)	
0612	
Code	Thickness
S	0.56 (0.022)
V	0.76 (0.030)
W	1.02 (0.040)
A	1.27 (0.050)

## PHYSICAL DIMENSIONS AND PAD LAYOUT



## PHYSICAL DIMENSIONS

MM (IN.)

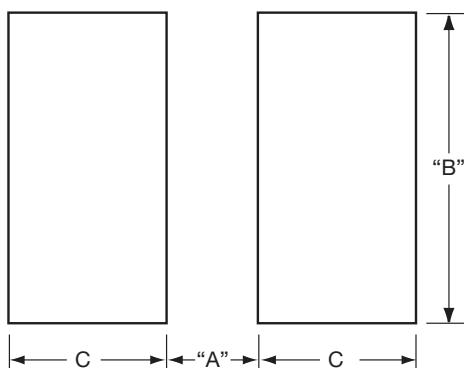
Size	L	W	t
0204	0.50 ± 0.05 (0.020 ± 0.002)	1.00 ± 0.05 (0.040 ± 0.002)	0.18 ± 0.08 (0.007 ± 0.003)
0306	0.81 ± 0.15 (0.032 ± 0.006)	1.60 ± 0.15 (0.063 ± 0.006)	0.13 min. (0.005 min.)
0508	1.27 ± 0.25 (0.050 ± 0.010)	2.00 ± 0.25 (0.080 ± 0.010)	0.13 min. (0.005 min.)
0612	1.60 ± 0.25 (0.063 ± 0.010)	3.20 ± 0.25 (0.126 ± 0.010)	0.13 min. (0.005 min.)

T - See Range Chart for Thickness and Codes

## PAD LAYOUT DIMENSIONS

MM (IN.)

Size	A	B	C
0306	0.31 (0.012)	1.52 (0.060)	0.51 (0.020)
0508	0.51 (0.020)	2.03 (0.080)	0.76 (0.030)
0612	0.76 (0.030)	3.05 (0.120)	0.635 (0.025)
0204			



# Low Inductance Capacitors with SnPb Terminations

## LD15/LD16/LD17/LD18 Tin-Lead Termination "B"



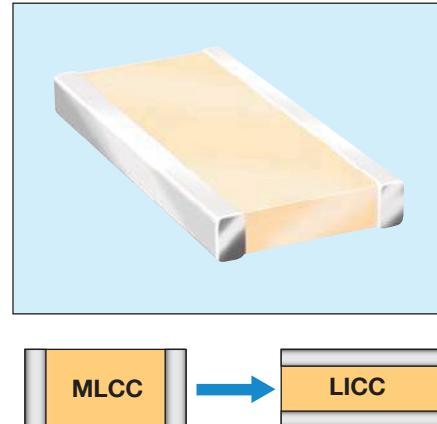
### GENERAL DESCRIPTION

The key physical characteristic determining equivalent series inductance (ESL) of a capacitor is the size of the current loop it creates. The smaller the current loop, the lower the ESL.

A standard surface mount MLCC is rectangular in shape with electrical terminations on its shorter sides. A Low Inductance Chip Capacitor (LICC®) sometimes referred to as Reverse Geometry Capacitor (RGC) has its terminations on the longer sides of its rectangular shape. The image on the right shows the termination differences between an MLCC and an LICC®.

When the distance between terminations is reduced, the size of the current loop is reduced. Since the size of the current loop is the primary driver of inductance, an 0306 with a smaller current loop has significantly lower ESL than an 0603. The reduction in ESL varies by EIA size, however, ESL is typically reduced 60% or more with an LICC® versus a standard MLCC.

AVX LICC® products are available with a lead termination for high reliability military and aerospace applications that must avoid tin whisker reliability issues.



**\*Not RoHS Compliant**

### PERFORMANCE CHARACTERISTICS

Capacitance Tolerances	K = $\pm 10\%$ ; M = $\pm 20\%$
Operation Temperature Range	X7R = -55°C to +125°C X5R = -55°C to +85°C X7S = -55°C to +125°C
Temperature Coefficient	X7R, X5R = $\pm 15\%$ ; X7S = $\pm 22\%$
Voltage Ratings	4, 6.3, 10, 16, 25 VDC
Dissipation Factor	4V, 6.3V = 6.5% max; 10V = 5.0% max; 16V = 3.5% max; 25V = 3.0% max
Insulation Resistance (@+25°C, RVDC)	100,000MΩ min, or 1,000MΩ per $\mu\text{F}$ min., whichever is less

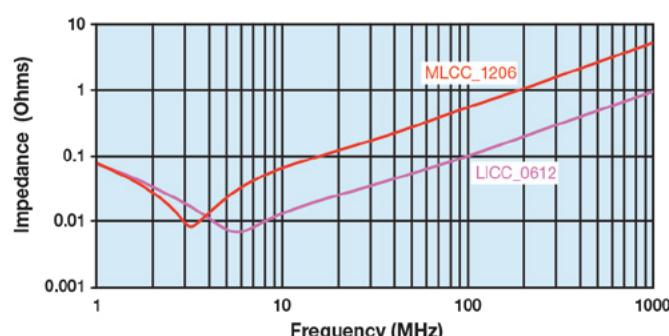
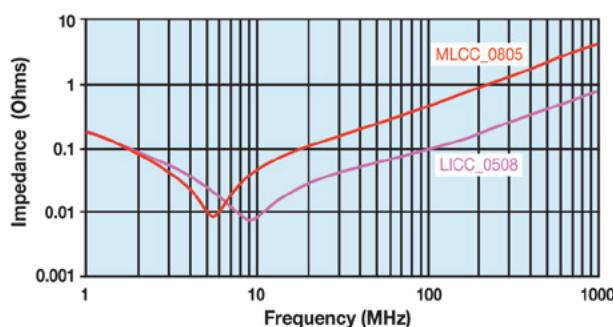
### HOW TO ORDER

LD18	Z	D	105	M	A	B	2	A*
Size	Voltage	Dielectric	Capacitance Code (In pF)	Capacitance Tolerance	Failure Rate	Terminations	Packaging Available	Thickness
LD15 = 0204	4 = 4V	C = X7R	2 Sig. Digits + Number of Zeros	K = $\pm 10\%$ M = $\pm 20\%$	A = N/A	B = 5% min lead	2 = 7" Reel 4 = 13" Reel	Thickness mm (in)
LD16 = 0306	6 = 6.3V	D = X5R						0.56 (0.022)
LD17 = 0508	Z = 10V	W = X6S						0.76 (0.030)
LD18 = 0612	Y = 16V	Z = X7S						1.02 (0.040)
	3 = 25V							1.27 (0.050)
	5 = 50V							

\*See the thickness tables on the next page.

NOTE: Contact factory for availability of Termination and Tolerance Options for Specific Part Numbers.

### TYPICAL IMPEDANCE CHARACTERISTICS



The Important Information/Disclaimer is incorporated in the catalog where these specifications came from or available online at [www.kyocera-avx.com/disclaimer/](http://www.kyocera-avx.com/disclaimer/) by reference and should be reviewed in full before placing any order.

# Low Inductance Capacitors with SnPb Terminations

## LD15/LD16/LD17/LD18 Tin-Lead Termination "B"



SIZE		LD15 (0204)				LD16 (0306)				LD17 (0508)				LD18 (0612)						
Packaging		Paper				Paper				Paper/Embossed				Paper/Embossed						
mm (in.)		0.50 ± 0.05 (0.020 ± 0.002)				0.81 ± 0.15 (0.032 ± 0.006)				1.27 ± 0.25 (0.050 ± 0.010)				1.60 ± 0.25 (0.063 ± 0.010)						
Width mm (in.)		1.00 ± 0.05 (0.040 ± 0.002)				1.60 ± 0.15 (0.063 ± 0.006)				2.00 ± 0.25 (0.080 ± 0.010)				3.20 ± 0.25 (0.126 ± 0.010)						
Cap Code	WVDC	4	6.3	10	16	4	6.3	10	16	25	6.3	10	16	25	50	6.3	10	16	25	50
102	Cap 0.001					A	A	A	A	S	S	S	S	V	S	S	S	S	V	
222	( $\mu$ F) .0022					A	A	A	A	S	S	S	S	V	S	S	S	S	V	
332	0.0033					A	A	A	A	S	S	S	S	V	S	S	S	S	V	
472	0.0047					A	A	A	A	S	S	S	S	V	S	S	S	S	V	
682	0.0068					A	A	A	A	S	S	S	S	V	S	S	S	S	V	
103	0.01					A	A	A	A	S	S	S	S	V	S	S	S	S	V	
153	0.015					A	A	A	A	S	S	S	S	V	S	S	S	S	W	
223	0.022					A	A	A	A	S	S	S	S	V	S	S	S	S	W	
333	0.033					A	A	A		S	S	S	S	V	S	S	S	S	W	
473	0.047					A	A	A		S	S	S	S	V	A	S	S	S	W	
683	0.068					A	A	A		S	S	S	S	A	A	S	S	S	V	
104	0.1	C				A	A	A		S	S	V	A	A	S	S	S	V	W	
154	0.15					A	A			S	S	V			S	S	S	W	W	
224	0.22					A	A			S	S	A			S	S	V	W		
334	0.33									V	V	A			S	S	V			
474	0.47									V	V	A			S	S	V			
684	0.68									A	A				V	V	W			
105	1		A							A	A				V	V	A			
155	1.5									A					W	W				
225	2.2														A	A				
335	3.3														A					
475	4.7																			
685	6.8																			
106	10																			

Solid = X7R

= X5R

= X7S

= X6S

mm (in.)

LD15 (0204)	
Code	Thickness
C	0.35 (0.014)

mm (in.)

LD16 (0306)	
Code	Thickness
A	0.56 (0.022)

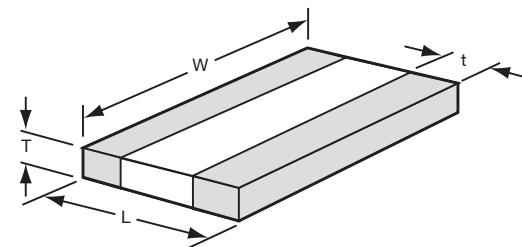
mm (in.)

LD17 (0508)	
Code	Thickness
S	0.56 (0.022)
V	0.76 (0.030)
A	1.02 (0.040)

mm (in.)

LD18 (0612)	
Code	Thickness
S	0.56 (0.022)
V	0.76 (0.030)
W	1.02 (0.040)
A	1.27 (0.050)

### PHYSICAL DIMENSIONS AND PAD LAYOUT



### PHYSICAL DIMENSIONS

MM (IN.)

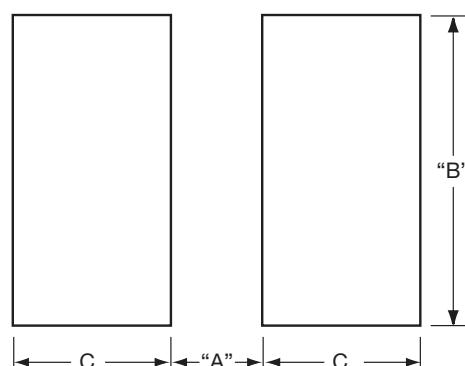
Size	L	W	t
LD15 (0204)	0.50 ± 0.05 (0.020 ± 0.002)	1.00 ± 0.05 (0.040 ± 0.002)	0.18 ± 0.08 (0.007 ± 0.003)
LD16 (0306)	0.81 ± 0.15 (0.032 ± 0.006)	1.60 ± 0.15 (0.063 ± 0.006)	0.13 min. (0.005 min.)
LD17 (0508)	1.27 ± 0.25 (0.050 ± 0.010)	2.00 ± 0.25 (0.080 ± 0.010)	0.13 min. (0.005 min.)
LD18 (0612)	1.60 ± 0.25 (0.063 ± 0.010)	3.20 ± 0.25 (0.126 ± 0.010)	0.13 min. (0.005 min.)

T - See Range Chart for Thickness and Codes

### PAD LAYOUT DIMENSIONS

MM (IN.)

Size	A	B	C
LD15 (0204)			
LD16 (0306)	0.31 (0.012)	1.52 (0.060)	0.51 (0.020)
LD17 (0508)	0.51 (0.020)	2.03 (0.080)	0.76 (0.030)
LD18 (0612)	0.76 (0.030)	3.05 (0.120)	0.635 (0.025)



The Important Information/Disclaimer is incorporated in the catalog where these specifications came from or available online at [www.kyocera-avx.com/disclaimer/](http://www.kyocera-avx.com/disclaimer/) by reference and should be reviewed in full before placing any order.

# IDC Low Inductance Capacitors (RoHS)

## IDC (InterDigitated Capacitors) 0306/0612/0508

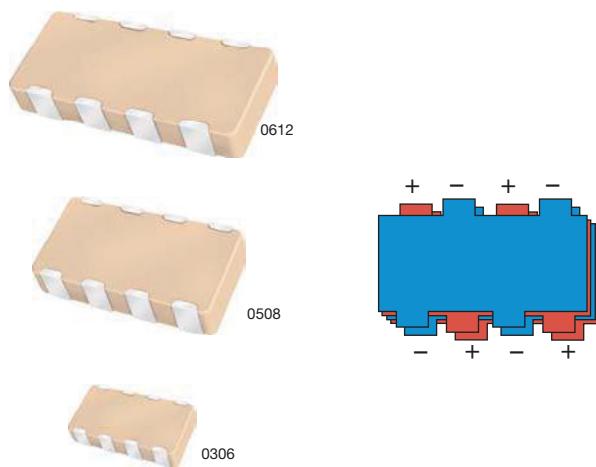
### GENERAL DESCRIPTION

Inter-Digitated Capacitors (IDCs) are used for both semiconductor package and board level decoupling. The equivalent series inductance (ESL) of a single capacitor or an array of capacitors in parallel determines the response time of a Power Delivery Network (PDN). The lower the ESL of a PDN, the faster the response time. A designer can use many standard MLCCs in parallel to reduce ESL or a low ESL Inter-Digitated Capacitor (IDC) device. These IDC devices are available in versions with a maximum height of 0.95mm or 0.55mm.

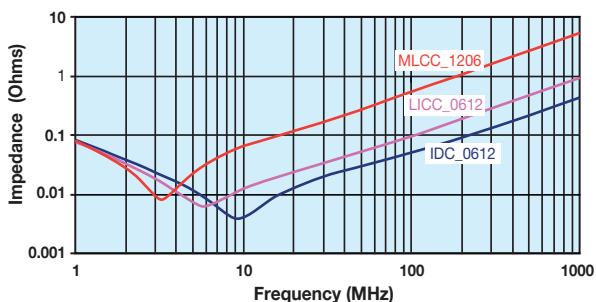
IDCs are typically used on packages of semiconductor products with power levels of 15 watts or greater. Inter-Digitated Capacitors are used on CPU, GPU, ASIC, and ASSP devices produced on 0.13 $\mu$ , 90nm, 65nm, and 45nm processes. IDC devices are used on both ceramic and organic package substrates. These low ESL surface mount capacitors can be placed on the bottom side or the top side of a package substrate. The low profile 0.55mm maximum height IDCs can easily be used on the bottom side of BGA packages or on the die side of packages under a heat spreader.

IDCs are used for board level decoupling of systems with speeds of 300MHz or greater. Low ESL IDCs free up valuable board space by reducing the number of capacitors required versus standard MLCCs. There are additional benefits to reducing the number of capacitors beyond saving board space including higher reliability from a reduction in the number of components and lower placement costs based on the need for fewer capacitors.

The Inter-Digitated Capacitor (IDC) technology was developed by KYOCERA AVX. This is the second family of Low Inductance MLCC products created by KYOCERA AVX. IDCs are a cost effective alternative to KYOCERA AVX's first generation low ESL family for high-reliability applications known as LICA (Low Inductance Chip Array). KYOCERA AVX IDC products are available with a lead-free finish of plated Nickel/Tin.



### TYPICAL IMPEDANCE



### HOW TO ORDER

W	3	L	1	6	D	225	M	A	T	3	A
Style	IDC Case Size	Low Inductance	Number of Terminals	Voltage	Dielectric	Capacitance Code (In pF)	Capacitance Tolerance	Failure Rate	Termination	Packaging Available	Thickness Max. Thickness
	2 = 0508 3 = 0612 4 = 0306		1 = 8 Terminals	4 = 4V 6 = 6.3V Z = 10V Y = 16V 3 = 25V	C = X7R D = X5R Z = X7S	2 Sig. Digits + Number of Zeros	M = $\pm 20\%$	A = N/A	T = Plated Ni and Sn	1 = 7" Reel 3 = 13" Reel	mm (in) A = Standard S = 0.55 (0.022)

NOTE: Contact factory for availability of Termination and Tolerance Options for Specific Part Numbers.

### PERFORMANCE CHARACTERISTICS

Capacitance Tolerance	$\pm 20\%$ Preferred
Operation Temperature Range	X7R = -55°C to +125°C X5R = -55°C to +85°C X7S = -55°C to +125°C
Temperature Coefficient	$\pm 15\%$ (0VDC), $\pm 22\%$ (X7S)
Voltage Ratings	4, 6.3, 10, 16, 25 VDC
Dissipation Factor	$\leq 6.3V = 6.5\%$ max; 10V = 5.0% max; $\geq 16V = 3.5\%$ max
Insulation Resistance (@+25°C, RVDC)	100,000M $\Omega$ min, or 1,000M $\Omega$ per $\mu$ F min., whichever is less

Dissipation Factor	No problems observed after 2.5 x RVDC for 5 seconds at 50mA max current
CTE (ppm/C)	12.0
Thermal Conductivity	4-5W/M K
Terminations Available	Plated Nickel and Solder

072522



# IDC Low Inductance Capacitors (RoHS)

## IDC (InterDigitated Capacitors) 0306/0612/0508

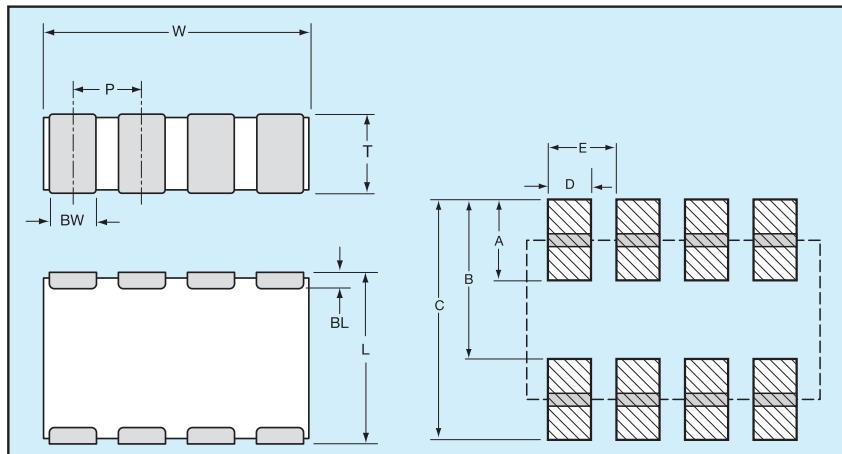


SIZE	W4 = 0306		W2 = Thin 0508				W2 = 0508				W3= Thin 0612				W3 = 0612				W3 = THICK 0612						
Max. Thickness (mm) (in.)	0.55 (0.022)		0.55. (0.022)				0.95 (0.037)				0.55 (0.022)				0.95 (0.037)				1.22 (0.048)						
WVDC	4	6.3	4	6.3	10	16	25	4	6.3	10	16	25	4	6.3	10	16	4	6.3	10	16	25	4	6.3	10	16
Cap (μF)	0.010																								
	0.022																								
	0.033																								
	0.047																								
	0.068																								
	0.10																								
	0.22																								
	0.33																								
	0.47																								
	0.68																								
	1.0																								
	1.5																								
	2.2																								
	3.3																								

### PHYSICAL DIMENSIONS AND PAD LAYOUT

Consult factory for additional requirements

- = X7R
- = X5R
- = X7S



### PHYSICAL CHIP DIMENSIONS

### MILLIMETERS (INCHES)

SIZE	W	L	BW	BL	P
0306	1.60 ± 0.20 (0.063 ± 0.008)	0.82 ± 0.10 (0.032 ± 0.006)	0.25 ± 0.10 (0.010 ± 0.004)	0.20 ± 0.10 (0.008 ± 0.004)	0.40 ± 0.05 (0.015 ± 0.002)
0508	2.03 ± 0.20 (0.080 ± 0.008)	1.27 ± 0.20 (0.050 ± 0.008)	0.30 ± 0.10 (0.012 ± 0.004)	0.25 ± 0.15 (0.010 ± 0.006)	0.50 ± 0.05 (0.020 ± 0.002)
0612	3.20 ± 0.20 (0.126 ± 0.008)	1.60 ± 0.20 (0.063 ± 0.008)	0.50 ± 0.10 (0.020 ± 0.004)	0.25 ± 0.15 (0.010 ± 0.006)	0.80 ± 0.10 (0.031 ± 0.004)

### PAD LAYOUT DIMENSIONS

SIZE	A	B	C	D	E
0306	0.38 (0.015)	0.89 (0.035)	1.27 (0.050)	0.20 (0.008)	0.40 (0.015)
0508	0.64 (0.025)	1.27 (0.050)	1.91 (0.075)	0.28 (0.011)	0.50 (0.020)
0612	0.89 (0.035)	1.65 (0.065)	2.54 (0.010)	0.45 (0.018)	0.80 (0.031)



The Important Information/Disclaimer is incorporated in the catalog where these specifications came from or available online at [www.kyocera-avx.com/disclaimer/](http://www.kyocera-avx.com/disclaimer/) by reference and should be reviewed in full before placing any order.

# IDC Low Inductance Capacitors (SnPb)

## IDC (InterDigitated Capacitors) 0306/0612/0508

### GENERAL DESCRIPTION

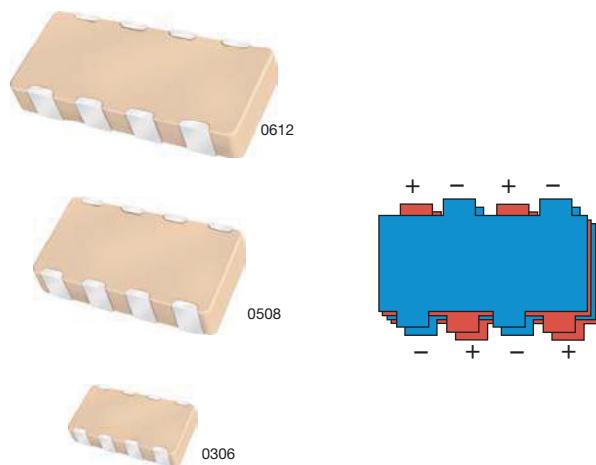
Inter-Digitated Capacitors (IDCs) are used for both semiconductor package and board level decoupling. The equivalent series inductance (ESL) of a single capacitor or an array of capacitors in parallel determines the response time of a Power Delivery Network (PDN). The lower the ESL of a PDN, the faster the response time. A designer can use many standard MLCCs in parallel to reduce ESL or a low ESL Inter-Digitated Capacitor (IDC) device. These IDC devices are available in versions with a maximum height of 0.95mm or 0.55mm.

IDCs are typically used on packages of semiconductor products with power levels of 15 watts or greater. Inter-Digitated Capacitors are used on CPU, GPU, ASIC, and ASSP devices produced on 0.13 $\mu$ , 90nm, 65nm, and 45nm processes. IDC devices are used on both ceramic and organic package substrates. These low ESL surface mount capacitors can be placed on the bottom side or the top side of a package substrate. The low profile 0.55mm maximum height IDCs can easily be used on the bottom side of BGA packages or on the die side of packages under a heat spreader.

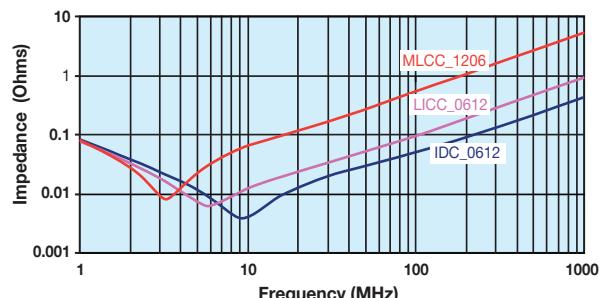
IDCs are used for board level decoupling of systems with speeds of 300MHz or greater. Low ESL IDCs free up valuable board space by reducing the number of capacitors required versus standard MLCCs. There are additional benefits to reducing the number of capacitors beyond saving board space including higher reliability from a reduction in the number of components and lower placement costs based on the need for fewer capacitors.

The Inter-Digitated Capacitor (IDC) technology was developed by KYOCERA AVX. This is the second family of Low Inductance MLCC products created by KYOCERA AVX. IDCs are a cost effective alternative to KYOCERA AVX's first generation low ESL family for high-reliability applications known as LICA (Low Inductance Chip Array).

KYOCERA AVX IDC products are available with a lead termination for high reliability military and aerospace applications that must avoid tin whisker reliability issues.



### TYPICAL IMPEDANCE



### HOW TO ORDER

L Style	3 IDC Case Size 2 = 0508 3 = 0612 4 = 0306	L Low Inductance	1 Number of Terminals 1 = 8 Termi- nals	6 Voltage 4 = 4V 6 = 6.3V Z = 10V Y = 16V 3 = 25V	D Dielectric C = X7R D = X5R Z = X7S	225 Capacitance Code (In pF) 2 Sig. Digits + Number of Zeros	M Capacitance Tolerance M = $\pm 20\%$	A Failure Rate A = N/A	B Termination B = 5% min. Lead	3 Packaging Available 1=7" Reel 3=13" Reel	A Thickness Max. Thickness mm (in) A=Standard S=0.55 (0.022)

NOTE: Contact factory for availability of Termination and Tolerance Options for Specific Part Numbers.

**\*Not RoHS Compliant**

### PERFORMANCE CHARACTERISTICS

Capacitance Tolerance	$\pm 20\%$ Preferred	Dissipation Factor	No problems observed after 2.5 x RVDC for 5 seconds at 50mA max current
Operation Temperature Range	X7R = -55°C to +125°C X5R = -55°C to +85°C X7S = -55°C to +125°C	CTE (ppm/C)	12.0
Temperature Coefficient	$\pm 15\%$ (0VDC), $\pm 22\%$ (X7S)	Thermal Conductivity	4-5W/M K
Voltage Ratings	4, 6.3, 10, 16, 25 VDC	Terminations Available	Plated Nickel and Solder
Dissipation Factor	$\leq 6.3V = 6.5\% \text{ max}$ $10V = 5.0\% \text{ max}$ $\geq 16V = 3.5\% \text{ max}$		
Insulation Resistance (@+25°C, RVDC)	100,000MΩ min, or 1,000MΩ per $\mu\text{F}$ min., whichever is less		

# IDC Low Inductance Capacitors (SnPb)

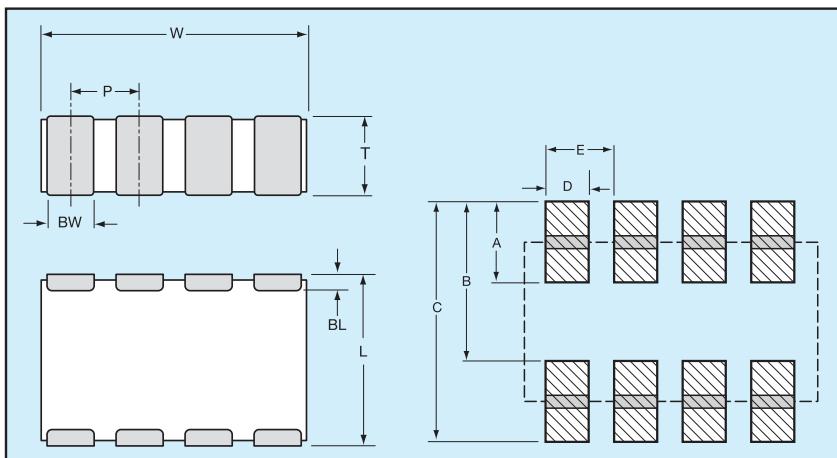
## IDC (InterDigitated Capacitors) with Sn/Pb Termination 0306/0612/0508



SIZE	W4 = 0306		W2 = Thin 0508				W2 = 0508				W3= Thin 0612				W3 = 0612				W3 = THICK 0612						
Max. Thickness mm (in.)	0.55 (0.022)		0.55 (0.022)				0.95 (0.037)				0.55 (0.022)				0.95 (0.037)				1.22 (0.048)						
WVDC	4	6.3	4	6.3	10	16	25	4	6.3	10	16	25	4	6.3	10	16	4	6.3	10	16	25	4	6.3	10	16
Cap (μF)	0.010																								
	0.022																								
	0.033																								
	0.047																								
	0.068																								
	0.10																								
	0.22																								
	0.33																								
	0.47																								
	0.68																								
	1.0																								
	1.5																								
	2.2																								
	3.3																								

### PHYSICAL DIMENSIONS AND PAD LAYOUT

Consult factory for additional requirements



= X7R  
 = X5R  
 = X7S

### PHYSICAL CHIP DIMENSIONS

### MILLIMETERS (INCHES)

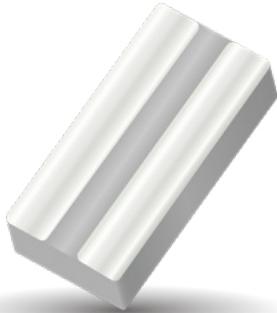
SIZE	W	L	BW	BL	P
0306	1.60 ± 0.20 (0.063 ± 0.008)	0.82 ± 0.10 (0.032 ± 0.006)	0.25 ± 0.10 (0.010 ± 0.004)	0.20 ± 0.10 (0.008 ± 0.004)	0.40 ± 0.05 (0.015 ± 0.002)
0508	2.03 ± 0.20 (0.080 ± 0.008)	1.27 ± 0.20 (0.050 ± 0.008)	0.30 ± 0.10 (0.012 ± 0.004)	0.25 ± 0.15 (0.010 ± 0.006)	0.50 ± 0.05 (0.020 ± 0.002)
0612	3.20 ± 0.20 (0.126 ± 0.008)	1.60 ± 0.20 (0.063 ± 0.008)	0.50 ± 0.10 (0.020 ± 0.004)	0.25 ± 0.15 (0.010 ± 0.006)	0.80 ± 0.10 (0.031 ± 0.004)

### PAD LAYOUT DIMENSIONS

SIZE	A	B	C	D	E
0306	0.38 (0.015)	0.89 (0.035)	1.27 (0.050)	0.20 (0.008)	0.40 (0.015)
0508	0.64 (0.025)	1.27 (0.050)	1.91 (0.075)	0.28 (0.011)	0.50 (0.020)
0612	0.89 (0.035)	1.65 (0.065)	2.54 (0.010)	0.45 (0.018)	0.80 (0.031)

# LGA Low Inductance Capacitors

## 0204/0306 Land Grid Array



Land Grid Array (LGA) capacitors are the latest family of low inductance MLCCs from KYOCERA AVX. These new LGA products are the third low inductance family developed by KYOCERA AVX. The innovative LGA technology sets a new standard for low inductance MLCC performance.

Our initial 2 terminal versions of LGA technology deliver the performance of an 8 terminal IDC low inductance MLCC with a number of advantages including:

- Simplified layout of 2 large solder pads compared to 8 small pads for IDCs
- Opportunity to reduce PCB or substrate contribution to system ESL by using multiple parallel vias in solder pads
- Advanced FCT manufacturing process used to create uniformly flat terminations on the capacitor that resist "tombstoning"
- Better solder joint reliability

### APPLICATIONS

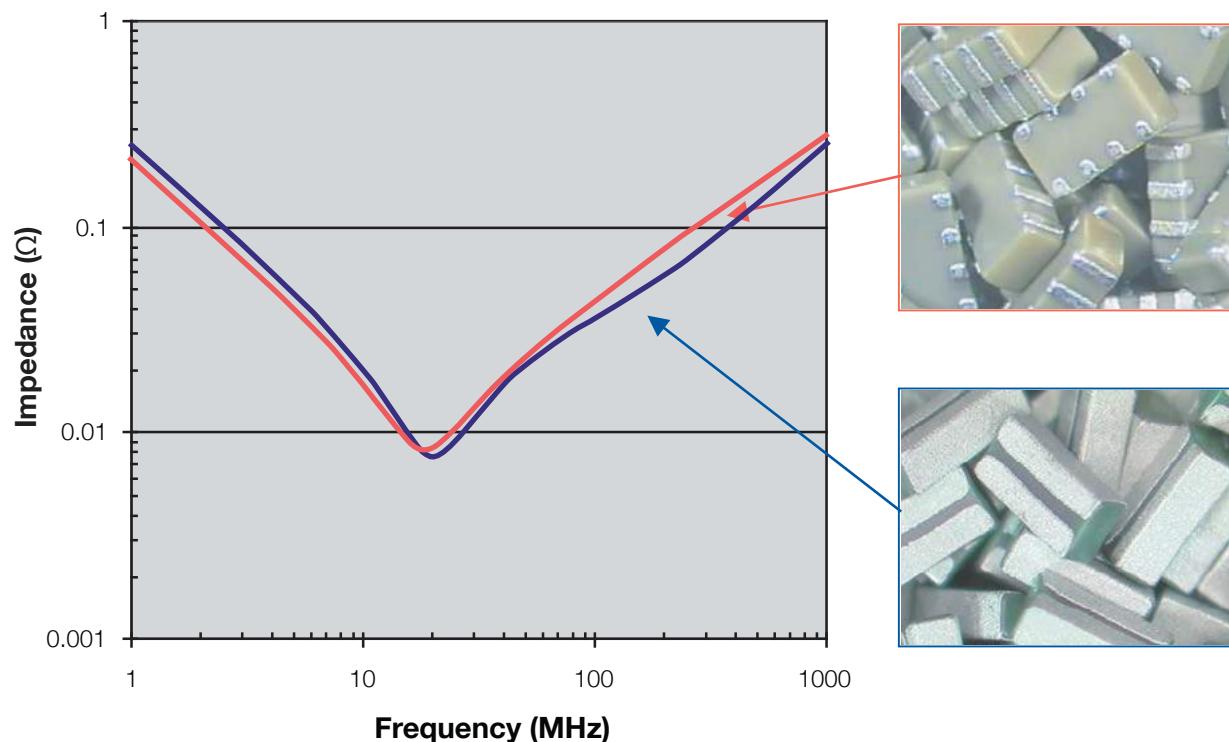
#### Semiconductor Packages

- Microprocessors/CPUs
- Graphics Processors/GPUs
- Chipsets
- FPGAs
- ASICs

#### Board Level Device Decoupling

- Frequencies of 300 MHz or more
- ICs drawing 15W or more
- Low voltages
- High speed buses

### 0306 2 TERMINAL LGA COMPARISON WITH 0306 8 TERMINAL IDC



# LGA Low Inductance Capacitors

## 0204/0306 Land Grid Array

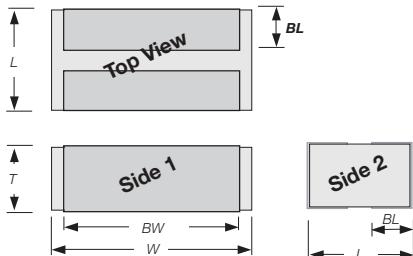
SIZE	LG12 (0204)					LG22 (0306)							
Length mm (in.)	0.50 (0.020)					0.76 (0.030)							
Width mm (in.)	1.00 (0.039)					1.60 (0.063)							
Temp. Char.	X5R (D)					X7R (C)					X5R (D)	X7S (Z)	
Working Voltage	6.3 (6)	4 (4)	6.3 (6)	4 (4)	6.3 (6)	4 (4)	10 (Z)	6.3 (6)	4 (4)	6.3 (6)	4 (4)	6.3 (6)	4 (4)
Cap (μF)	0.010 (103)												
	0.022 (223)												
	0.047 (473)												
	0.100 (104)												
	0.220 (224)												
	0.330 (334)												
	0.470 (474)												
	1.000 (105)												
	2.200 (225)												

= X7R      = X5R      = X7S      = X6S

### HOW TO ORDER

LG	1	2	6	Z	104	M	A	T	2	S	1
Style	Case Size	Number of Terminals	Working Voltage	Temperature Characteristic	Coded Cap	Cap Tolerance	Termination Style	Termination	Packaging Tape & Reel	Thickness	Number of Capacitors
1 = 0204	1	2	4=4V 6=6.3V Z=10V	C = X7R D = X5R Z = X7S W = X6S	104	M = ±20%	A = "U" Land	100% Sn*	2 = 7" Reel 4 = 13" Reel	S = 0.55mm max	1
2 = 0306								*Contact factory for other termination finishes			

### Reverse Geometry LGA LG12, LG22



### PART DIMENSIONS

Series	L	W	T	BW	BL
LG12 (0204)	$0.5 \pm 0.05$ ( $0.020 \pm 0.002$ )	$1.00 \pm 0.10$ ( $0.039 \pm 0.004$ )	$0.50 \pm 0.05$ ( $0.020 \pm 0.002$ )	$0.8 \pm 0.10$ ( $0.031 \pm 0.004$ )	$0.13 \pm 0.08$ ( $0.005 \pm 0.003$ )
LG22 (0306)	$0.76 \pm 0.10$ ( $0.030 \pm 0.004$ )	$1.60 \pm 0.10$ ( $0.063 \pm 0.004$ )	$0.50 \pm 0.05$ ( $0.020 \pm 0.002$ )	$1.50 \pm 0.10$ ( $0.059 \pm 0.004$ )	$0.28 \pm 0.08$ ( $0.011 \pm 0.003$ )



### RECOMMENDED SOLDER PAD DIMENSIONS

MM (INCHES)
Series
PL

Series	PL	PW1	G
LG12 (0204)	0.50 (0.020)	1.00 (0.039)	0.20 (0.008)
LG22 (0306)	0.65 (0.026)	1.50 (0.059)	0.20 (0.008)

# LGA Low Inductance Capacitors

## 0204/0306 Land Grid Array – Tin/Lead Termination “B”

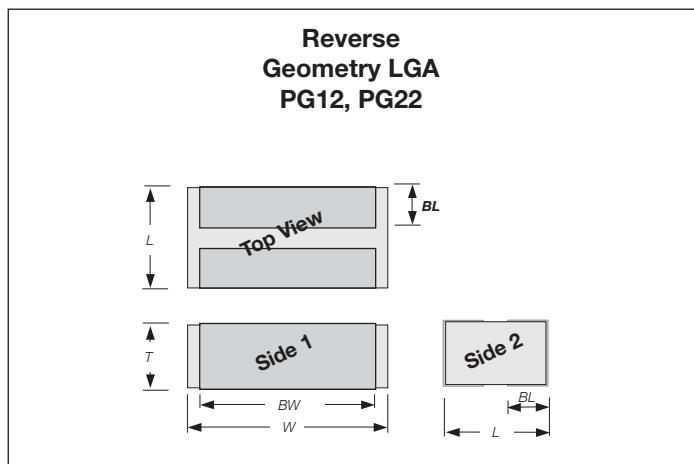
SIZE	PG12 (0204)				PG22 (0306)							
Length mm (in.)	0.50 (0.020)				0.76 (0.030)							
Width mm (in.)	1.00 (0.039)				1.60 (0.063)							
Temp. Char.	X5R (D)	X7S (Z)	X6S (W)		X7R (C)	X5R (D)	X7S (Z)	X6S (W)				
Working Voltage	6.3 (6) (4)	4 (6) (4)	6.3 (6) (4)	4 (6) (4)	10 (Z) (6) (4)	6.3 (6) (4)	4 (6) (4)	6.3 (6) (4)	4 (6) (4)	6.3 (6) (4)	4 (6) (4)	
Cap (μF)	0.010 (103)											
	0.022 (223)											
	0.047 (473)											
	0.100 (104)											
	0.220 (224)											
	0.330 (334)											
	0.470 (474)											
	1.000 (105)											
	2.200 (225)											

 = X7R    = X5R    = X7S    = X6S

### HOW TO ORDER

PG	1	2	6	Z	104	M	A	B	2	S	1
Style	Case Size	Number of Terminals	Working Voltage	Temperature Characteristic	Coded Cap	Cap Tolerance	Termination Style	Termination	Packaging	Thickness	Number of Capacitors
	1 = 0204 2 = 0306	2	4=4V 6=6.3V Z=10V	C = X7R D = X5R Z = X7S W = X6S	M = ±20%	A = "U" Land	5% Min Lead	5% Min Lead	2 = 7" Reel 4 = 13" Reel	S = 0.55mm max	

**\*Not RoHS Compliant**



### PART DIMENSIONS

### MM (INCHES)

Series	L	W	T	BW	BL
PG12 (0204)	0.5 ± 0.05 (0.020 ± 0.002)	1.00 ± 0.10 (0.039 ± 0.004)	0.50 ± 0.05 (0.020 ± 0.002)	0.8 ± 0.10 (0.031 ± 0.004)	0.13 ± 0.08 (0.005 ± 0.003)
PG22 (0306)	0.76 ± 0.10 (0.030 ± 0.004)	1.60 ± 0.10 (0.063 ± 0.004)	0.50 ± 0.05 (0.020 ± 0.002)	1.50 ± 0.10 (0.059 ± 0.004)	0.28 ± 0.08 (0.011 ± 0.003)

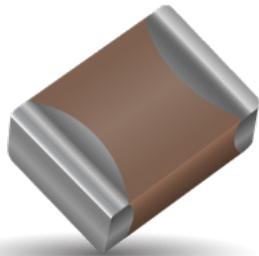
### RECOMMENDED SOLDER PAD DIMENSIONS

### MM (INCHES)

Series	PL	PW1	G
PG12 (0204)	0.50 (0.020)	1.00 (0.039)	0.20 (0.008)
PG22 (0306)	0.65 (0.026)	1.50 (0.059)	0.20 (0.008)

# High Temperature MLCCs

## AT Series – 200°C & 250°C Rated



Present military specifications, as well as a majority of commercial applications, require a maximum operating temperature of 125°C. However, the emerging market for high temperature electronics demands capacitors operating reliably at temperatures beyond 125°C. KYOCERA AVX's high temperature chip capacitor product line, has been extended with the BME COG chip. All AT chips have verified capabilities of long term operation up to 250°C for applications in both military and commercial businesses. These capacitors demonstrate high volumetric efficiency, high insulation resistance and low ESR/ESL for the most demanding applications, such as "down-hole" oil exploration and aerospace programs.

### HOW TO ORDER

AT10	3	T	104	K	A	T	2	A
Style	Voltage Code	Temperature Coefficient	Capacitance Code	Capacitance Tolerance	Test Level	Termination	Packaging	Special Code
AT03 = 0603		PME	(2 significant digits + no. of zeros)					
AT05 = 0805	16V = Y	COG 250°C = A	101 = 100pF	J = ±5%				
AT06 = 1206	25V = 3	COG 200°C = 2	102 = 1nF	K = ±10%				
AT10 = 1210	50V = 5	VHT 250°C = T	103 = 10nF	M = ±20%				
AT12 = 1812		VHT 200°C = 4	104 = 100nF					
AT14 = 2225		<b>BME</b>	105 = 1μF					
		COG 250°C = 5						
		COG 200°C = 3						

### ELECTRICAL SPECIFICATIONS

#### Temperature Coefficient

PME COG 0±30ppm/°C, -55C to 250°C  
BME COG 0±30ppm/°C, -55C to 200°C

See TCC Plot for +250°C

VHT: T ±15%, -55°C to +150°C  
See TCC Plot for +250°C

**Capacitance Test** (MIL-STD-202, Method 305)  
25°C, 1.0 ± 0.2 Vrms (open circuit voltage) @ 1kHz

**Dissipation factor 25°C**  
COG: 0.15% Max at 1.0 ± 0.2 Vrms (open circuit voltage) @ 1kHz  
VHT: 2.5% Max at 1.0 ± 0.2 Vrms (open circuit voltage) @ 1kHz

**Insulation Resistance 25°C** (MIL-STD-202, Method 302)  
100GΩ or 1000MΩ-μF (whichever is less)

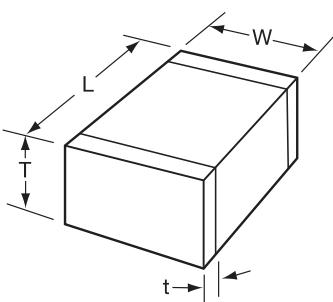
**Insulation Resistance 125°C** (MIL-STD-202, Method 302)  
10GΩ or 100MΩ-μF (whichever is less)

**Insulation Resistance 200°C** (MIL-STD-202, Method 302)  
1GΩ or 10MΩ-μF (whichever is less)

**Insulation Resistance 250°C** (MIL-STD-202, Method 302)  
100MΩ or 1MΩ-μF (whichever is less)

**Direct Withstanding Voltage 25°C** (Flash Test)  
250% rated voltage for 5 seconds with 50mA max charging current

### DIMENSIONS:



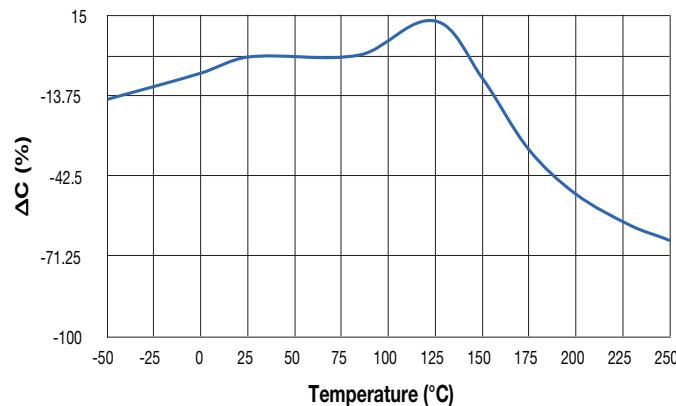
Size	AT03 = 0603	AT05 = 0805	AT06 = 1206	AT10 = 1210	AT12 = 1812	AT14 = 2225
(L) Length	1.60 ± 0.15 (0.063 ± 0.006)	2.01 ± 0.20 (0.079 ± 0.008)	3.20 ± 0.20 (0.126 ± 0.008)	3.20 ± 0.20 (0.126 ± 0.008)	4.50 ± 0.30 (0.177 ± 0.012)	5.72 ± 0.25 (0.225 ± 0.010)
(W) Width	0.81 ± 0.15 (0.032 ± 0.006)	1.25 ± 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)	6.35 ± 0.25 (0.250 ± 0.010)
(T) Thickness Max.	1.02 (0.040)	1.30 (0.051)	1.52 (0.060)	1.70 (0.067)	2.54 (0.100)	2.54 (0.100)
(t) terminal	min. 0.25 (0.010)	0.25 (0.010)	0.25 (0.010)	0.25 (0.010)	0.25 (0.010)	0.25 (0.010)
	max. 0.75 (0.030)	0.75 (0.030)	0.75 (0.030)	0.75 (0.030)	1.02 (0.040)	1.02 (0.040)

# High Temperature MLCC

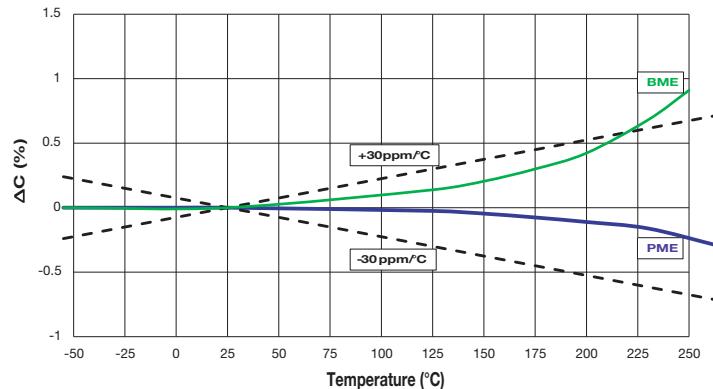
## AT Series – 200°C & 250°C Rated

### PERFORMANCE CHARACTERISTICS

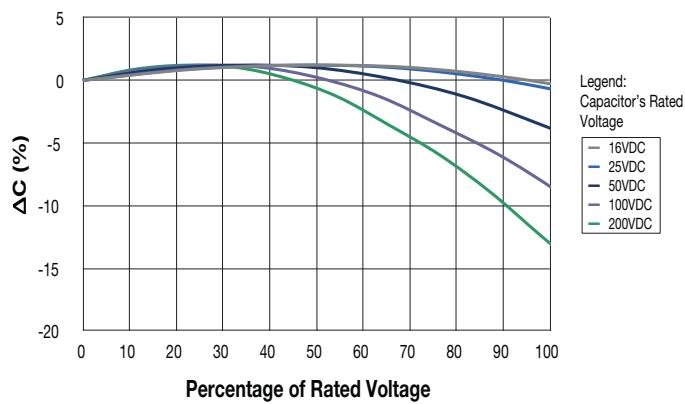
Typical Temperature Coefficient of Capacitance (VHT Dielectric)



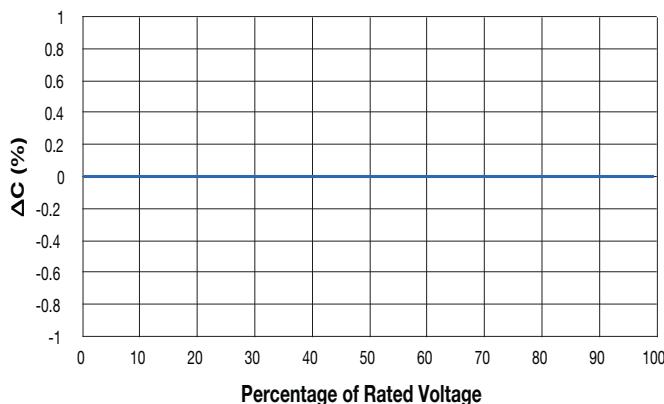
Typical Temperature Coefficient of Capacitance (COG Dielectric)



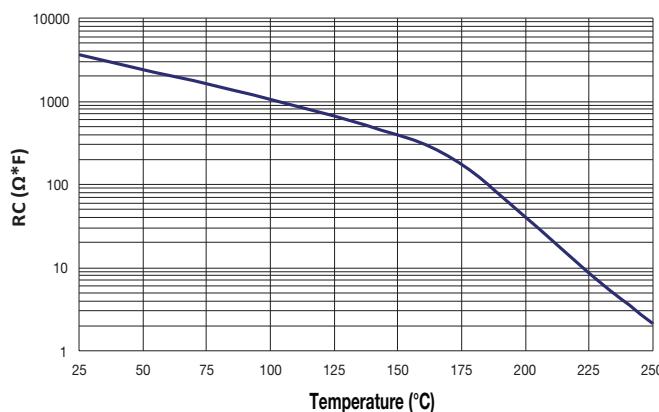
Typical Voltage Coefficient of Capacitance (VHT Dielectric)



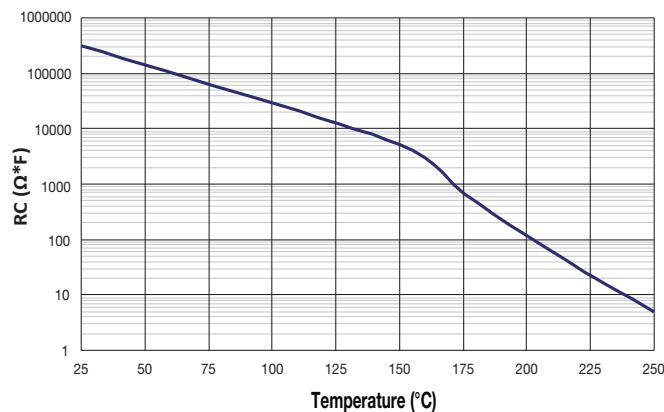
Typical Voltage Coefficient of Capacitance (COG Dielectric)



Typical RC vs Temperature (VHT Dielectric)



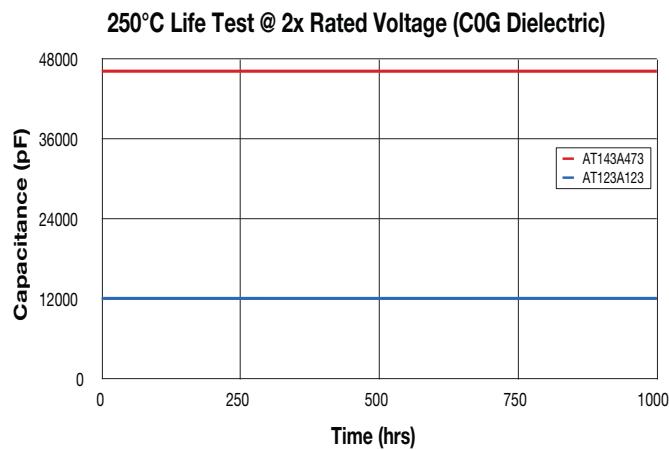
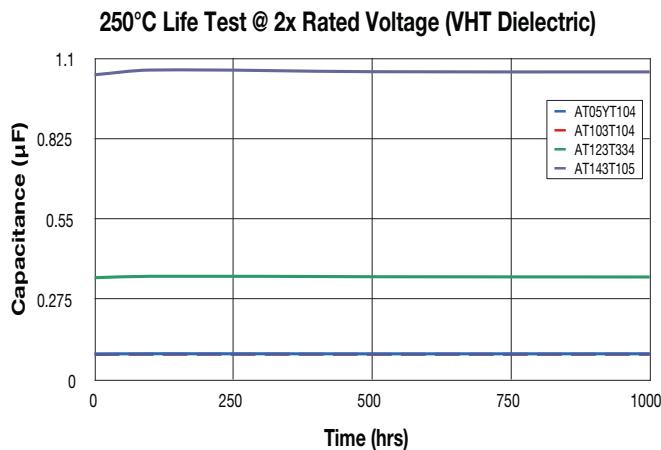
Typical RC vs Temperature (COG Dielectric)



# High Temperature MLCC

## AT Series – 200°C & 250°C Rated

### RELIABILITY



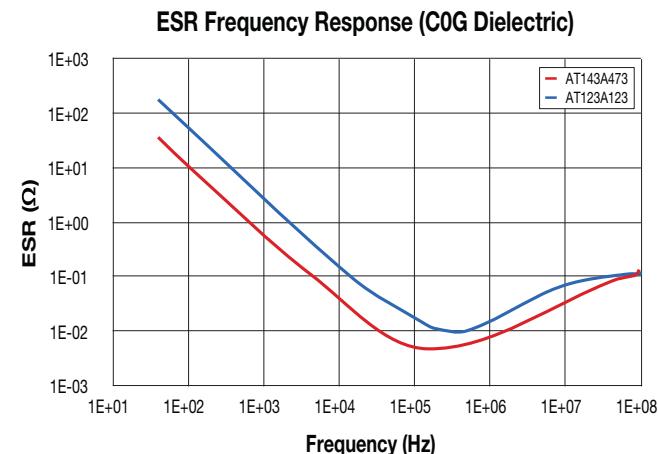
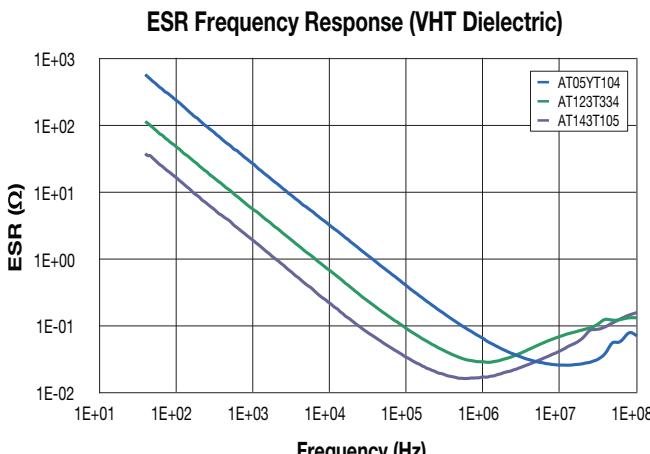
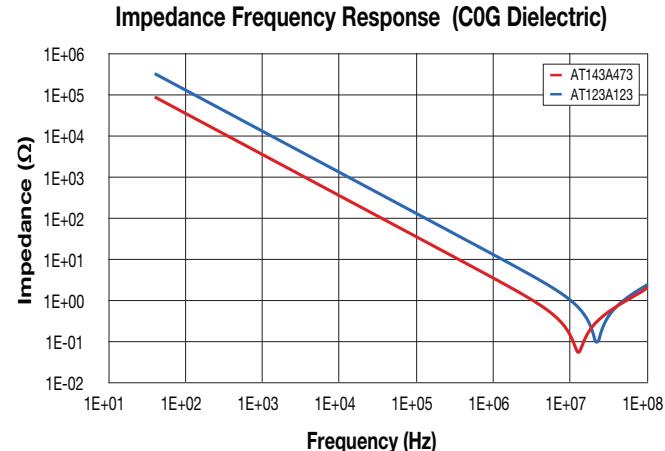
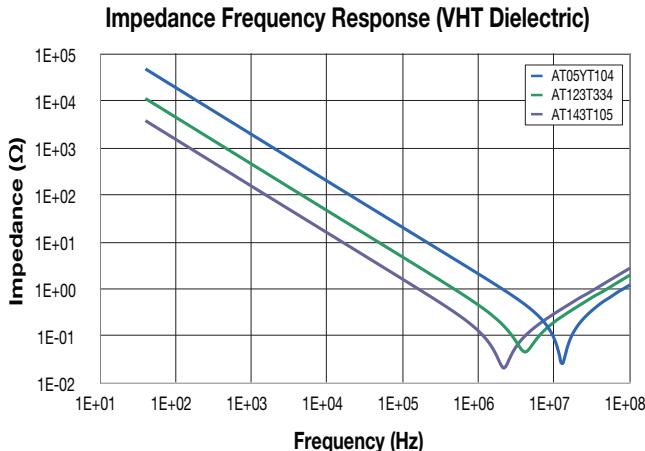
VHT - Failure Rate @ 90% Confidence Level (%/1000 hours)		
Temperature (°C)	50% Rated Voltage	100% Rated Voltage
200	0.002	0.017
250	0.026	0.210

\*Typical 1210, 1812, 2225 Failure Rate Analysis based on 250°C testing and voltage ratings specified on the following page.

COG - Failure Rate @ 90% Confidence Level (%/1000 hours)		
Temperature (°C)	50% Rated Voltage	100% Rated Voltage
200	0.006	0.047
250	0.074	0.590

\*Typical 1812 and 2225 Failure Rate Analysis based on 250°C testing and voltage ratings specified on the following page.

### FREQUENCY RESPONSE



# High Temperature MLCC

## AT Series – 200°C & 250°C Rated



**CAPACITANCE RANGE**  
**PREFERRED SIZES ARE SHADED**

**VHT** Temp. Coefficient: 4 200°C Rated

Case Size	AT03 = 0603	AT05 = 0805	AT06 = 1206	AT10 = 1210	AT12 = 1812	AT14 = 2225
<b>Soldering</b>	Reflow/Wave	Reflow/Wave	Reflow/Wave	Reflow Only	Reflow Only	Reflow Only
(L) Length	mm 1.60±0.15 (in.) (0.063±0.006)	2.01±0.20 (0.079±0.008)	3.20±0.20 (0.126±0.008)	4.50±0.30 (0.177±0.012)	5.72±0.25 (0.225±0.010)	
(W) Width	mm 0.81±0.15 (in.) (0.032±0.006)	1.25±0.20 (0.049±0.008)	2.50±0.20 (0.063±0.008)	3.20±0.20 (0.098±0.008)	6.35±0.25 (0.126±0.008)	6.35±0.25 (0.250±0.010)
(T) Thickness	mm 1.02 (in.) (0.040)	1.30 (0.051)	1.52 (0.060)	1.70 (0.067)	2.54 (0.100)	2.54
(t) Terminal	min 0.25(0.010)	0.25(0.010)	0.25(0.010)	0.25(0.010)	0.25(0.010)	0.25(0.010)
max	0.75(0.030)	0.75(0.030)	0.75(0.030)	0.75(0.030)	1.02(0.040)	1.02(0.040)
Rated Temp. (°C)	200	200	200	200	200	200
Temp. Coefficient	4	4	4	4	4	4
Voltage (V)	25	25 50	25 50	25 50	50	50
Cap (pF)	1000 102					
	1200 122					
	1500 152					
	1800 182					
	2200 222					
	2700 272					
	3300 332					
	3900 392					
	4700 472					
	5600 562					
	6800 682					
	8200 822					
Cap (pF)	0.010 103					
	0.012 123					
	0.015 153					
	0.018 183					
	0.022 223					
	0.027 273					
	0.033 333					
	0.039 393					
	0.047 473					
	0.056 563					
	0.068 683					
	0.082 823					
	0.100 104					
	0.120 124					
	0.150 154					
	0.180 184					
	0.220 224					
	0.270 274					
	0.330 334					
	0.390 394					
	0.470 474					
	0.560 564					
	0.680 684					
	0.820 824					
	1.000 105					
Voltage (V)	25	25 50	25 50	25 50	50	50
Rated Temp. (°C)	200	200	200	200	200	200
Case Size	AT03 = 0603	AT05 = 0805	AT06 = 1206	AT10 = 1210	AT12 = 1812	AT14 = 2225

**VHT** Temp. Coefficient: T 250°C Rated

Case Size	AT03 = 0603	AT05 = 0805	AT06 = 1206	AT10 = 1210	AT12 = 1812	AT14 = 2225
<b>Soldering</b>	Reflow/Wave	Reflow/Wave	Reflow/Wave	Reflow Only	Reflow Only	Reflow Only
(L) Length	mm 1.60±0.15 (in.) (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)	5.72±0.25 (0.225±0.010)
(W) Width	mm 0.81±0.15 (in.) (0.032±0.006)	1.25±0.20 (0.049±0.008)	2.50±0.20 (0.063±0.008)	3.20±0.20 (0.098±0.008)	6.35±0.25 (0.126±0.008)	6.35±0.25 (0.250±0.010)
(T) Thickness	mm 1.02 (in.) (0.040)	1.30 (0.051)	1.52 (0.060)	1.70 (0.067)	2.54 (0.100)	2.54
(t) Terminal	min 0.25(0.010)	0.25(0.010)	0.25(0.010)	0.25(0.010)	0.25(0.010)	0.25(0.010)
max	0.75(0.030)	0.75(0.030)	0.75(0.030)	1.02(0.040)	1.02(0.040)	1.02(0.040)
Rated Temp. (°C)	250	250	250	250	250	250
Temp. Coefficient	T	T	T	T	T	T
Voltage (V)	16	16 25	16 25	16 25	25	25
Cap (pF)	1000 102					
	1200 122					
	1500 152					
	1800 182					
	2200 222					
	2700 272					
	3300 332					
	3900 392					
	4700 472					
	5600 562					
	6800 682					
	8200 822					
Cap (pF)	0.010 103					
	0.012 123					
	0.015 153					
	0.018 183					
	0.022 223					
	0.027 273					
	0.033 333					
	0.039 393					
	0.047 473					
	0.056 563					
	0.068 683					
	0.082 823					
	0.100 104					
	0.120 124					
	0.150 154					
	0.180 184					
	0.220 224					
	0.270 274					
	0.330 334					
	0.390 394					
	0.470 474					
	0.560 564					
	0.680 684					
	0.820 824					
	1.000 105					
Voltage (V)	16	16 25	16 25	16 25	25	25
Rated Temp. (°C)	250	250	250	250	250	250
Case Size	AT03 = 0603	AT05 = 0805	AT06 = 1206	AT10 = 1210	AT12 = 1812	AT14 = 2225

Voltage rating per table. Capacitance values specified at 25°C, derate capacitance value based on TCC and VCC Plots on page 107.

NOTE: Contact factory for non-specified capacitance values.



The Important Information/Disclaimer is incorporated in the catalog where these specifications came from or available online at [www.kyocera-avx.com/disclaimer/](http://www.kyocera-avx.com/disclaimer/) by reference and should be reviewed in full before placing any order.

# High Temperature MLCC

## AT Series – 200°C & 250°C Rated



**CAPACITANCE RANGE**  
**PREFERRED SIZES ARE SHADED**

### BME COG Temp. Coefficient: 4 200°C Rated

Case Size	AT03=0603	AT05=0805	AT06=1206	
<b>Soldering</b>				
(L) Length (mm)	Reflow/Wave	Reflow/Wave	Reflow/Wave	
(L) Length (in.)	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)	0.81±0.15 (0.032±0.006)	1.25±0.20 (0.049±0.008)	1.60±0.20 (0.063±0.008)	
(T) Thickness (mm)	1.02 (0.040)	1.30 (0.051)	1.52 (0.060)	
(t) Terminal min	0.25(0.010)	0.25(0.010)	0.25(0.010)	
(t) Terminal max	0.75(0.030)	0.75(0.030)	0.75(0.030)	
Rated Temp. (°C)	200	200	200	
Temp. Coefficeint	3	3	3	
Voltage (V)	25	50	25	50
Cap (pF)	39 390			
	47 470			
	56 560			
	68 680			
	82 820			
	100 101			
	120 121			
	150 151			
	180 181			
	220 221			
	270 271			
	330 331			
	390 391			
	470 471			
	560 561			
	680 681			
	820 821			
	1000 102			
	1200 122			
	1500 152			
	1800 182			
	2200 222			
	2700 272			
	3300 332			
	3900 392			
	4700 472			
	5600 562			
	6800 682			
	8200 822			
Cap (μF)	0.010 103			
	0.012 123			
	0.015 153			
	0.018 183			
	0.022 223			
	0.027 273			
	0.033 333			
	0.039 393			
	0.047 473			
	0.056 563			
	0.068 683			
	0.082 823			
	0.100 104			
Voltage (V)	25	50	25	50
Rated Temp. (°C)	200	200	200	200
Case Size	AT03=0603	AT05=0805	AT06=1206	

### BME COG (Ni/Au) Temp. Coefficient: 5 250°C Rated

Case Size	AT03=0603	AT05=0805	AT06 = 1206
<b>Soldering</b>			
(L) Length (mm)	Reflow/Wave	Reflow/Wave	Reflow/Wave
(L) Length (in.)	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)	0.81±0.15 (0.032±0.006)	1.25±0.20 (0.049±0.008)	1.60±0.20 (0.063±0.008)
(T) Thickness (mm)	1.02 (0.040)	1.30 (0.051)	1.52 (0.060)
(t) Terminal min	0.25(0.010)	0.25(0.010)	0.25(0.010)
(t) Terminal max	0.75(0.030)	0.75(0.030)	0.75(0.030)
Rated Temp. (°C)	250	250	250
Temp. Coefficeint	5	5	5
Voltage (V)	25	25	25
Cap (pF)	39 390		
	47 470		
	56 560		
	68 680		
	82 820		
	100 101		
	120 121		
	150 151		
	180 181		
	220 221		
	270 271		
	330 331		
	390 391		
	470 471		
	560 561		
	680 681		
	820 821		
	1000 102		
	1200 122		
	1500 152		
	1800 182		
	2200 222		
	2700 272		
	3300 332		
	3900 392		
	4700 472		
	5600 562		
	6800 682		
	8200 822		
Cap (μF)	0.010 103		
	0.012 123		
	0.015 153		
	0.018 183		
	0.022 223		
	0.027 273		
	0.033 333		
	0.039 393		
	0.047 473		
	0.056 563		
	0.068 683		
	0.082 823		
	0.100 104		
Voltage (V)	25	25	25
Rated Temp. (°C)	250	250	250
Case Size	AT03=0603	AT05=0805	AT06=1206

Voltage rating per table. Capacitance values specified at 25°C, derate capacitance value based on TCC and VCC Plots on page 107.

NOTE: Contact factory for non-specified capacitance values.



The Important Information/Disclaimer is incorporated in the catalog where these specifications came from or available online at [www.kyocera-avx.com/disclaimer/](http://www.kyocera-avx.com/disclaimer/) by reference and should be reviewed in full before placing any order.

# High Temperature MLCC

## AT Series – 200°C & 250°C Rated

**CAPACITANCE RANGE**  
**PREFERRED SIZES ARE SHADED**

### PME COG Temp. Coefficient: 2 200°C Rated

Case Size	AT05 = 0805	AT06 = 1206	AT10 = 1210	AT12 = 1812	AT14 = 2225
<b>Soldering</b>	Reflow/Wave	Reflow/Wave	Reflow Only	Reflow Only	Reflow Only
(L) Length	mm (in.)	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 (in.)	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) Thickness	mm (in.)	1.30 (0.051)	1.52 (0.060)	1.70 (0.067)	2.54 (0.100)
(t) Terminal	min max	0.25 (0.010) 0.75 (0.030)	0.25 (0.010) 0.75 (0.030)	0.25 (0.010) 0.75 (0.030)	0.25 (0.010) 0.75 (0.030)
Rated Temp. (°C)	200	200	200	200	200
Temp. Coefficeint	2	2	2	2	2
Voltage (V)	50	50	50	50	50
100	101				
120	121				
150	151				
180	181				
220	221				
270	271				
330	331				
390	391				
470	471				
560	561				
680	681				
820	821				
1000	102				
1200	122				
1500	152				
1800	182				
2200	222				
2700	272				
3300	332				
3900	392				
4700	472				
5600	562				
6800	682				
8200	822				
0.010	103				
0.012	123				
0.015	153				
0.018	183				
0.022	223				
0.027	273				
0.033	333				
0.039	393				
0.047	473				
0.056	563				
0.068	683				
0.082	823				
0.100	104				
Voltage (V)	50	50	50	50	50
Rated Temp. (°C)	200	200	200	200	200
Case Size	AT05 = 0805	AT06 = 1206	AT10 = 1210	AT12 = 1812	AT14 = 2225

### PME COG Temp. Coefficient: A 250°C Rated

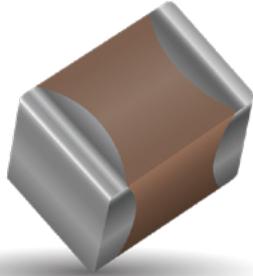
Case Size	AT05 = 0805	AT06 = 1206	AT10 = 1210	AT12 = 1812	AT14 = 2225
<b>Soldering</b>	Reflow/Wave	Reflow/Wave	Reflow Only	Reflow Only	Reflow Only
(L) Length	mm (in.)	2.01 ± 0.20 (0.079 ± 0.008)	3.20 ± 0.20 (0.126 ± 0.008)	3.20 ± 0.20 (0.126 ± 0.008)	4.50 ± 0.30 (0.177 ± 0.012)
(W) Width	mm (in.)	1.25 ± 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) Thickness	mm (in.)	1.30 (0.051)	1.52 (0.060)	1.70 (0.067)	2.54 (0.100)
(t) Terminal	min max	0.25 (0.010) 0.75 (0.030)	0.25 (0.010) 0.75 (0.030)	0.25 (0.010) 0.75 (0.030)	0.25 (0.010) 0.75 (0.030)
Rated Temp. (°C)	250	250	250	250	250
Temp. Coefficeint	A	A	A	A	A
Voltage (V)	25	25	25	25	25
100	101				
120	121				
150	151				
180	181				
220	221				
270	271				
330	331				
390	391				
470	471				
560	561				
680	681				
820	821				
1000	102				
1200	122				
1500	152				
1800	182				
2200	222				
2700	272				
3300	332				
3900	392				
4700	472				
5600	562				
6800	682				
8200	822				
0.010	103				
0.012	123				
0.015	153				
0.018	183				
0.022	223				
0.027	273				
0.033	333				
0.039	393				
0.047	473				
0.056	563				
0.068	683				
0.082	823				
0.100	104				
Voltage (V)	25	25	25	25	25
Rated Temp. (°C)	250	250	250	250	250
Case Size	AT05 = 0805	AT06 = 1206	AT10 = 1210	AT12 = 1812	AT14 = 2225

Voltage rating per table. Capacitance values specified at 25°C, derate capacitance value based on TCC and VCC Plots on page 107.

NOTE: Contact factory for non-specified capacitance values.

# High Voltage MLC Chips

## For 600V to 5000V Applications



High value, low leakage and small size are difficult parameters to obtain in capacitors for high voltage systems. KYOCERA AVX special high voltage MLC chip capacitors meet these performance characteristics and are designed for applications such as snubbers in high frequency power converters, resonators in SMPS, and high voltage coupling/dc blocking. These high voltage chip designs exhibit low ESRs at high frequencies.

Larger physical sizes than normally encountered chips are used to make high voltage MLC chip products. Special precautions must be taken in applying these chips in surface mount assemblies. The temperature gradient during heating or cooling cycles should not exceed 4°C per second. The preheat temperature must be within 50°C of the peak temperature reached by the ceramic bodies through the soldering process. Chip sizes 1210 and larger should be reflow soldered only. Capacitors may require protective surface coating to prevent external arcing.

For 1825, 2225 and 3640 sizes, KYOCERA AVX offers leaded version in either thru-hole or SMT configurations (for details see section on high voltage leaded MLC chips)

### NEW 630V RANGE

#### HOW TO ORDER

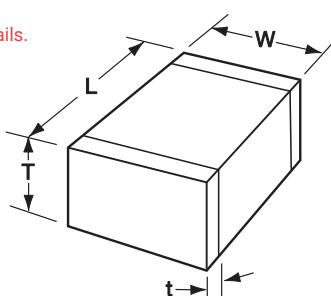
1808	A	A	271	M	A	T	2	A
Style	Voltage	Temperature Coefficient	Capacitance Code	Capacitance Tolerance	Test Level	Termination*	Packaging	Special Code
0805	C = 600V/630V	A = NPO (COG)	(2 significant digits + no. of zeros)	COG: J = ±5% K = ±10% M = ±20%	A = Standard	T = Plated Ni and Sn (RoHS Compliant)	2 = 7" Reel** 4 = 13" Reel** 6 = Tray (3640 Style)	A = Standard
1206	A = 1000V	C = X7R	Examples: 10 pF = 100 100 pF = 101 1,000 pF = 102 22,000 pF = 223 220,000 pF = 224 1 μF = 105	X7R: K = ±10% M = ±20% Z = +80%, -20%				
1210	S = 1500V							
1808	G = 2000V							
1812	W = 2500V							
1825	H = 3000V							
2220	J = 4000V							
2225	K = 5000V							
3640	***							

#### Notes:

1. Capacitors with X7R dielectrics are not intended for applications across AC supply mains or AC line filtering with polarity reversal. Contact plant for recommendations. Contact factory for availability of Termination and Tolerance options for Specific Part Numbers.
2. \*Terminations with 5% minimum lead (Pb) is available, see pages 100 and 101 for LD style. Leaded terminations are available, see pages 102-106.

\*\*The 3640 Style is not available on Reels.

\*\*\* KYOCERA AVX offers nonstandard chip sizes. Contact factory for details.



#### DIMENSIONS: millimeters (inches)

SIZE	0805	1206	1210*	1808*	1812*	1825*	2220*	2225*	3640*
(L) Length	2.10 ± 0.20 (0.083 ± 0.008)	3.30 ± 0.30 (0.130 ± 0.012)	3.30 ± 0.40 (0.130 ± 0.016)	4.60 ± 0.50 (0.181 ± 0.020)	4.60 ± 0.50 (0.181 ± 0.020)	4.60 ± 0.50 (0.181 ± 0.020)	5.70 ± 0.50 (0.224 ± 0.020)	5.70 ± 0.50 (0.224 ± 0.020)	9.14 ± 0.25 (0.360 ± 0.010)
(W) Width	1.25 ± 0.20 (0.049 ± 0.008)	1.60 ± 0.20 (0.063 ± 0.008)	2.50 ± 0.30 (0.098 ± 0.012)	2.00 ± 0.20 (0.079 ± 0.008)	3.20 ± 0.30 (0.126 ± 0.012)	6.30 ± 0.40 (0.248 ± 0.016)	5.00 ± 0.40 (0.197 ± 0.016)	6.30 ± 0.40 (0.248 ± 0.016)	10.2 ± 0.25 (0.400 ± 0.010)
(t) terminal min. max.	0.50 ± 0.20 (0.020 ± 0.008)	0.60 ± 0.20 (0.024 ± 0.008)	0.75 ± 0.35 (0.030 ± 0.014)	0.85 ± 0.35 (0.033 ± 0.014)	0.85 ± 0.35 (0.033 ± 0.014)	0.76 (0.030) 1.52 (0.060)			

\*Reflow Soldering Only

# High Voltage MLC Chips

## For 600V to 5000V Applications



### NPO (COG) DIELECTRIC – PERFORMANCE CHARACTERISTICS

Capacitance Range	10 pF to 0.100 µF (25°C, 1.0 ±0.2 Vrms at 1kHz, for ≤ 1000 pF use 1 MHz)
Capacitance Tolerances	±5%, ±10%, ±20%
Dissipation Factor	0.1% max. (425°C, 1.0 ±0.2 Vrms, 1kHz, for ≤ 1000 pF use 1 MHz)
Operating Temperature Range	-55°C to +125°C
Temperature Characteristic	0 ±30 ppm/°C (0 VDC)
Voltage Ratings	600, 630, 1000, 1500, 2000, 2500, 3000, 4000 & 5000 VDC (+125°C)
Insulation Resistance (+25°C, at 500 VDC)	100K MΩ min. or 1000 MΩ - µF min., whichever is less
Insulation Resistance (+125°C, at 500 VDC)	10K MΩ min. or 100 MΩ - µF min., whichever is less
Dielectric Strength	Minimum 120% rated voltage for 5 seconds at 50 mA max. current

### NPO (COG) CAPACITANCE RANGE – PREFERRED SIZES ARE SHADED

Case Size Soldering	0805	1206	1210	1808	1812
(L) Length mm (in.)	2.10 ± 0.20 (0.085 ± 0.008)	3.30 ± 0.30 (0.130 ± 0.012)	3.30 ± 0.40 (0.130 ± 0.016)	4.60 ± 0.50 (0.181 ± 0.020)	4.60 ± 0.50 (0.181 ± 0.020)
(W) Width mm (in.)	1.25 ± 0.20 (0.049 ± 0.008)	1.60 ± 0.30/-0.10 (0.063 ± 0.012/-0.004)	2.50 ± 0.30 (0.098 ± 0.012)	2.00 ± 0.20 (0.079 ± 0.008)	3.20 ± 0.30 (0.126 ± 0.012)
(t) Terminal mm (in.)	0.50 ± 0.20 (0.020 ± 0.008)	0.60 ± 0.20 (0.04 ± 0.008)	0.75 ± 0.35 (0.030 ± 0.014)	0.75 ± 0.35 (0.030 ± 0.014)	0.75 ± 0.35 (0.030 ± 0.014)
Voltage (V)	600 630 1000	600 630 1000 1500 2000	600 630 1000 1500 2000	600 630 1000 1500 2000 2500 3000 4000	600 630 1000 1500 2000 2500 3000 4000
Cap (pF)	.5 0R5	A C			
1.0 1R0	A C				
1.2 1R2	A C				
1.5 1R5	A A C X X X X X X				
1.8 1R8	A A C X X X X X X				
2.2 2R2	A A C X X X X X X				
2.7 2R7	A A C X X X X X X				
3.3 3R3	A A C X X X X X X				
3.9 3R9	A A C X X X X X X				
4.7 4R7	A A C X X X X X X				
5.6 5R6	A A C X X X X X X				
6.8 6R8	A A C X X X X X X				
8.2 8R2	A A C X X X X X X				
10 100	A A C C C C C C C C C	C C F C	C C C C C C C C C C	C C C C C C C C C C	C C C C C C C C C C
12 120	A A C C C C C C C C C	C C F C	C C C C C C C C C C	C C C C C C C C C C	C C C C C C C C C C
15 150	A A C C C C C C C C C	C C F C	C C C C C C C C C C	C C C C C C C C C C	C C C C C C C C C C
18 180	A A C C C C C C C C C	C C F C	C C C C C C C C C C	C C C C C C C C C C	C C C C C C C C C C
22 220	A A C C C C C C C C C	C C F C	C C C C C C C C C C	C C C C C C C C C C	C C C C C C C C C C
27 270	A A C C C C C C C C C	C C F C	C C C C C C C C C C	C C C C C C C C C C	C C C C C C C C C C
33 330	A A C C C C C C C C C	C C F C	C C C C C C C C C C	C C C C C C C C C C	C C C C C C C C C C
39 390	A A C C C C C C C C C	C C F C	C C C C C C C C C C	C C C C C C C C C C	C C C C C C C C C C
47 470	A A C C C C C C C C C	C C F C	C C C C C C C C C C	C C C C C C C C C C	C C C C C C C C C C
56 560	A A C C C C C C C C C	C C F C	C C C C C C C C C C	C C C C C C C C C C	C C C C C C C C C C
68 680	A A C C C C C C C C C	C C F C	C C C C C C C C C C	C C C C C C C C C C	C C C C C C C C C C
82 820	X X X C C C C C C C C	C C F C	C C C C C C C C C C	C C C C C C C C C C	C C C C C C C C C C
100 101	X X X C C C C C C C C	C C F C	C C C C C C C C C C	C C C C C C C C C C	C C C C C C C C C C
120 121	C C C C C C C C C C C	E E C C C C C C C C C	C C F C	C C C C C C C C C C	C C C C C C C C C C
150 151	C C C C C C C C C C C	E E C C C C C C C C C	C C F C	F F F F F F F F F F	C C C C C C C C C C
180 181	C C C C C C C C C C C	E E C C C C C C C C C	E E F C C C C C C C C	F F F F F F F F F F	C C C C C C C C C C
220 221	C C C C C C C C C C C	E E C C C C C C C C C	E E F C C C C C C C C	F F F F F F F F F F	C C C C C C C C C C
270 271	C C C C C C C C C C C	E E C C C C C C C C C	E E G C F C F F F	F F F F F F F F F F	C C C C C C C C C C
330 331	C C C C C C C C C C C	E E C C C C C C C C C	E E G C F C F F F	F F F F F F F F F F	C C C C F F F F F F
390 391	C C C C C C C C C C C	E E C C C C C C C C C	E E G C F C F F F	F F F F F F F F F F	C C C C E F F F F F F
470 471	C C C C C C C C C C C	E E C C C C C C C C C	E E G C F C F F F	F F F F F F F F F F	C C C F F F F F F F F
560 561	C C C C C C C C C C C	C C E E E E E E E E	C C F F F F F F F F	F F F F F F F F F F	C C F F F F F F F F
680 681	C C C C C C C C C C C	C C E E E E E E E E	C C F F F F F F F F	F F F F F F F F F F	C C F F F F F F F F
750 751	C C C C C C C C C C C	C C E E E E E E E E	C C F F F F F F F F	F F F F F F F F F F	C C F F F F G G
820 821	C C C C C C C C C C C	C C E E E E E E E E	C C F F F F F F F F	F F F F F F F F F F	C C F F F F G G
1000 102	C C C C C C C C C C C	C C E E E E E E E E	C C F F F F F F F F	F F F F F F F F F F	C C F F F F G G
1200 122	C C C C C C C C C C C	C C E E E E E E E E	C C F F F F F F F F	F F F F F F F F F F	C C F E E E G
1500 152	C C C C C C C C C C C	C C E E E E E E E E	C C F F F F F F F F	F F F F F F F F F F	C C F F F F G G
1800 182	C C C C C C C C C C C	C C E E E E E E E E	C C G G G G G G G G	E F F F F F F F F	C C F G F F
2200 222	C C C C C C C C C C C	E E E E E E E E E E	C C G G G G G G G G	E F F F F F F F F	C C E G G G
2700 272	C C C C C C C C C C C	E E E E E E E E E E	C C G G G G G G G G	E F F F F F F F F	C C E G G G
3300 332	C C C C C C C C C C C	E E E E E E E E E E	C C G G G G G G G G	E F F F F F F F F	C C F F F F G
3900 392	C C C C C C C C C C C	E E E E E E E E E E	C C G G G G G G G G	E F F F F F F F F	C C C F F F
4700 472	C C C C C C C C C C C	E E E E E E E E E E	C C G G G G G G G G	E F F F F F F F F	C C C G G G
5600 562	C C C C C C C C C C C	E E E E E E E E E E	C C G G G G G G G G	E F F F F F F F F	C C C G G G
6800 682	C C C C C C C C C C C	E E E E E E E E E E	C C G G G G G G G G	E F F F F F F F F	C C C G G G
8200 822	C C C C C C C C C C C	E E E E E E E E E E	C C G G G G G G G G	E F F F F F F F F	C C C G G G
Cap (pF)	0.010 103				
	0.012 123				
	0.015 153				
	0.018 183				
	0.022 223				
	0.027 273				
	0.033 333				
	0.047 473				
	0.056 563				
	0.068 683				
	0.100 104				
Voltage (V)	600 630 1000	600 630 1000 1500 2000	600 630 1000 1500 2000	600 630 1000 1500 2000 2500 3000 4000	600 630 1000 1500 2000 2500 3000 4000
Case Size	0805	1206	1210	1808	1812

NOTE: Contact factory for non-specified capacitance values

Letter	A	C	E	F	G	X	7
Max. Thickness	0.81 (0.032)	1.45 (0.057)	1.80 (0.071)	2.20 (0.087)	2.80 (0.110)	0.94 (0.037)	3.30 (0.130)



The Important Information/Disclaimer is incorporated in the catalog where these specifications came from or available online at [www.kyocera-avx.com/disclaimer/](http://www.kyocera-avx.com/disclaimer/) by reference and should be reviewed in full before placing any order.

# High Voltage MLC Chips

## For 600V to 5000V Applications



## NPO (COG) CAPACITANCE RANGE – PREFERRED SIZES ARE SHADED

Case Size	1825						2220						2225						3640								
Soldering	Reflow Only						Reflow Only						Reflow Only						Reflow Only								
(L) Length mm (in.)	4.60 ± 0.50 (0.181 ± 0.020)						5.70 ± 0.50 (0.224 ± 0.020)						5.70 ± 0.50 (0.224 ± 0.020)						9.14 ± 0.25 (0.360 ± 0.010)								
W) Width mm (in.)	6.30 ± 0.40 (0.248 ± 0.016)						(0.197 ± 0.016)						6.30 ± 0.40 (0.248 ± 0.016)						10.2 ± 0.25 (0.400 ± 0.010)								
(t) Terminal mm max	0.75 ± 0.35 (0.030 ± 0.014)						0.85 ± 0.35 (0.033 ± 0.014)						0.85 ± 0.35 (0.033 ± 0.014)						0.76 (0.030) 1.52 (0.060)								
Voltage (V)	600	630	1000	1500	2000	2500	3000	4000	600	630	1000	1500	2000	2500	3000	4000	5000	600	630	1000	1500	2000	2500	3000	4000	5000	
Cap (pF)	1.5	1R5																									
	1.8	1R8																									
	2.2	2R2																									
	2.7	2R7																									
	3.3	3R3																									
	3.9	3R9																									
	4.7	4R7																									
	5.6	5R6																									
	6.8	6R8																									
	8.2	8R2																									
10	100	E	E	G	E	F	E	F	F	E	E	E	E	E	E	E	E	E	E	E	E	E	F	F			
12	120	E	E	G	E	F	E	F	F	E	E	E	E	E	E	E	E	E	E	E	E	E	F	F			
15	150	E	E	G	E	F	E	F	F	E	E	E	E	E	E	E	E	E	E	E	E	E	F	F			
18	180	E	E	G	E	F	E	F	F	E	E	E	E	E	E	E	E	E	E	E	E	E	F	F			
22	220	E	E	G	E	F	E	F	F	E	E	E	E	E	E	E	E	E	E	E	E	E	F	F			
27	270	E	E	G	E	F	E	F	F	E	E	E	E	E	E	E	E	E	E	E	E	E	F	F			
33	330	E	E	G	E	F	E	F	F	E	E	E	E	E	E	E	E	E	E	E	E	E	F	F			
39	390	E	E	G	E	F	E	F	F	E	E	E	E	E	E	E	E	E	E	E	E	E	F	F			
47	470	E	E	G	E	F	E	F	F	E	E	E	E	E	E	E	E	E	E	E	E	E	F	G			
56	560	E	E	G	E	F	E	F	F	E	E	E	E	E	E	E	E	E	E	E	E	E	F	G			
68	680	E	E	G	E	F	E	F	F	E	E	E	E	E	E	E	E	E	E	E	E	E	F	G			
82	820	E	E	G	E	F	E	F	F	E	E	E	E	E	E	E	E	E	E	E	E	E	F	G			
100	101	E	E	G	E	F	E	F	F	E	E	E	E	E	E	E	E	E	E	E	E	E	G	G			
120	121	E	E	G	E	F	E	F	F	E	E	E	E	E	E	E	E	E	E	E	E	E	G	G			
150	151	E	E	G	E	F	E	F	F	E	E	E	E	E	E	E	E	E	E	E	E	E	G	G			
180	181	E	E	G	E	F	E	F	F	E	E	E	E	E	E	F	F	E	E	E	E	E	G	G			
220	221	E	E	G	E	F	E	F	F	E	E	E	E	E	E	F	F	E	E	E	E	E	G	G			
270	271	E	E	G	E	F	E	F	F	E	E	E	E	E	E	E	E	E	E	E	E	E	G	G			
330	331	E	E	G	E	F	E	F	F	E	E	E	E	E	E	E	E	E	E	E	E	E	G	G			
390	391	E	E	G	E	F	E	F	F	E	E	E	E	E	E	E	E	E	E	E	E	E	G	G			
470	471	E	E	G	E	F	E	F	F	E	E	E	E	E	E	E	E	E	E	E	E	E	G	G			
560	561	E	E	G	E	F	E	F	F	E	E	E	E	E	E	E	E	E	E	E	E	E	G	G			
680	681	E	E	G	E	F	F	G		E	E	E	E	E	F	F		E	E	E	E	E	E	G	G		
750	751	E	E	G	E	F	F	G		E	E	E	E	E	F	F		E	E	E	E	E	E	G	G		
820	821	E	E	G	E	F	F	G		E	E	E	E	E	F	F		E	E	E	F	F	E	G	G		
1000	102	E	E	G	E	F	G		E	E	E	E	E	F	F		E	E	E	E	E	E	G	G			
1200	122	E	E	G	E	F	G	G		E	E	E	E	E	G	G		E	E	E	F	F		G	G		
1500	152	E	E	G	F	G	G	G		E	E	E	F	F	G	G		E	E	E	F	F		G	G		
1800	182	E	E	G	F	G	G	G		E	E	E	F	F	G	G		E	E	E	G	G		G	G		
2200	222	E	E	G	G	G	G	G		E	E	E	G	G	G	G		E	E	E	E	E		G	G		
2700	272	E	E	G	G	G	G	G		E	E	E	G	G	G	G		E	E	E	F	F		G	G		
3300	332	E	E	G	G	G	G	G		E	E	E	G	G	G	G		E	E	E	F	F		G	G		
3900	392	E	E	G	G	G	G	G		E	E	E	G	G	G	G		E	E	E	G	G		G	G		
4700	472	E	E	G	G	G	G	G		E	E	E	G	G	G	G		F	F	F	G	G		G	G		
5600	562	F	F	G	G	G	G	G		F	F	F	F	F	G	G		F	F	F	G	G		G	G		
6800	682	F	F	G	G	G	G	G		F	F	F	F	F	G	G		F	F	F	G	G		G	G		
8200	822	F	F	G	G	G	G	G		G	G	G	G	G	G	G		G	G	G	G	G		G	G		
Cap (μF)	0.010	103	F	F	G				7	7	7							G	G	G				G	G		
	0.012	123	F	F	G													G	G	G				G	G		
	0.015	153	F	F														G	G	G				G	G		
	0.018	183	F	F														G	G	G				G	G		
	0.022	223	F	F														G	G	G				G	G		
	0.027	273	F	F																							
	0.033	333	F	F														G	G	G				G	G		
	0.039	393	G	G																							
	0.047	473	G	G														G	G	G				G	G		
	0.056	563	G	G														G	G	G				G	G		
	0.068	683	G	G														G	G	G				G	G		
	0.100	104																									
Voltage (V)	600	630	1000	1500	2000	2500	3000	4000	600	630	1000	1500	2000	2500	3000	4000	5000	600	630	1000	1500	2000	2500	3000	4000	5000	
Case Size	1825						2220						2225						3640								

Letter	A	C	E	F	G	X	7
Max.	0.81	1.45	1.80	2.20	2.80	0.94	3.30
Thickness	(0.032)	(0.057)	(0.071)	(0.087)	(0.110)	(0.037)	(0.130)

NOTE: Contact factory for non-specified capacitance values

# High Voltage MLC Chips

## For 600V to 5000V Applications



## X7R Dielectric Performance Characteristics

Capacitance Range	10 pF to 0.82 $\mu$ F (25°C, 1.0 $\pm$ 0.2 Vrms at 1kHz)
Capacitance Tolerances	$\pm$ 10%; $\pm$ 20%; +80%, -20%
Dissipation Factor	2.5% max. (+25°C, 1.0 $\pm$ 0.2 Vrms, 1kHz)
Operating Temperature Range	-55°C to +125°C
Temperature Characteristic	$\pm$ 15% (0 VDC)
Voltage Ratings	600, 630, 1000, 1500, 2000, 2500, 3000, 4000 & 5000 VDC (+125°C)
Insulation Resistance (+25°C, at 500 VDC)	100K M $\Omega$ min. or 1000 M $\Omega$ - $\mu$ F min., whichever is less
Insulation Resistance (+125°C, at 500 VDC)	10K M $\Omega$ min. or 100 M $\Omega$ - $\mu$ F min., whichever is less
Dielectric Strength	Minimum 120% rated voltage for 5 seconds at 50 mA max. current

## X7R CAPACITANCE RANGE – PREFERRED SIZES ARE SHADED

Case Size	0805			1206			1210			1808			1812												
Soldering	Reflow/Wave			Reflow/Wave			Reflow Only			Reflow Only			Reflow Only												
(L) Length mm (in.)	2.10 ± 0.20 (0.085 ± 0.008)			3.30 ± 0.30 (0.130 ± 0.012)			3.30 ± 0.40 (0.130 ± 0.016)			4.60 ± 0.50 (0.181 ± 0.020)			4.60 ± 0.50 (0.181 ± 0.020)												
W) Width mm (in.)	1.25 ± 0.20 (0.049 ± 0.008)			1.60 ± 0.30/-0.10 (0.063 ± 0.012/-0.004)			2.50 ± 0.30 (0.098 ± 0.012)			2.00 ± 0.20 (0.079 ± 0.008)			3.20 ± 0.30 (0.126 ± 0.012)												
(t) Terminal max mm max	0.50 ± 0.20 (0.020 ± 0.008)			0.60 ± 0.20 (0.024 ± 0.008)			0.75 ± 0.35 (0.030 ± 0.014)			0.75 ± 0.35 (0.030 ± 0.014)			0.75 ± 0.35 (0.030 ± 0.014)												
Voltage (V)	600	630	1000	600	630	1000	1500	2000	600	630	1000	1500	2000	2500	3000	4000	600	630	1000	1500	2000	2500	3000	4000	
Cap (pF)	100	101	X	X	C	C	C	E	E	E	E	E	E												
	120	121	X	X	C	C	C	E	E	E	E	E	E	E											
	150	151	X	X	C	C	C	E	E	E	E	E	E	E											
	180	181	X	X	C	C	C	E	E	E	E	E	E	E											
	220	221	X	X	C	C	C	E	E	E	E	E	E	E											
	270	271	X	X	C	C	C	E	E	E	E	E	E	E											
	330	331	X	X	C	C	C	E	E	E	E	E	E	E											
	390	391	X	X	C	C	C	E	E	E	E	E	E	E											
	470	471	X	X	C	C	C	E	E	E	E	E	E	E											
	560	561	X	X	C	C	C	E	E	E	E	E	E	E											
	680	681	X	X	C	C	C	E	E	E	E	E	E	E											
	750	751	X	X	C	C	C	E	E	E	E	E	E	E											
	820	821	X	X	C	C	C	E	E	E	E	E	E	E											
	1000	102	X	X	X	C	C	E	E	E	E	E	E	E											
	1200	122	X	X	X	C	C	E	E	E	E	E	E	E											
	1500	152	X	X	X	C	C	E	E	E	E	E	E	E											
	1800	182	X	X	C	C	C	E	E	E	E	E	E	E											
	2200	222	X	X	X	C	C	E	E	E	E	E	E	E											
	2700	272	C	C		C	C	E	E		E	E	F	E											
	3300	332	C	C		C	C	E			E	E	E	F	E	E	E	F	F						
	3900	392	C	C		C	C	E			E	E	E	F											
	4700	472	C	C		C	C	E			E	E	E	F											
	5600	562	C	C		C	C	E			E	E	E	F											
	6800	682	C	C		C	C	E			E	E	E												
	8200	822	C	C		C	C	E			E	E	E												
Cap (μF)	0.010	103	C	C		C	C	E	E		E	E	E	E											
	0.015	153	C	C		E	E	E			E	E	E	E											
	0.018	183	C	C		E	E				E	E	E	E											
	0.022	223	C	C		E	E				E	E	F												
	0.027	273				E	E				E	E		F	F										
	0.033	333				E	E				E	E			F	F									
	0.039	393				E	E				E	E		F	F										
	0.047	473				E	E				E	E		F	F										
	0.056	563				F	F				F	F		F	F										
	0.068	683				F	F				F	F		F	F										
	0.082	823				F	F				F	F													
	0.100	104				F	F																		
	0.150	154																							
	0.220	224																							
	0.270	274																							
	0.330	334																							
	0.390	394																							
	0.470	474																							
	0.560	564																							
	0.680	684																							
	0.820	824																							
	1.000	105																							
Voltage (V)	600	630	1000	600	630	1000	1500	2000	600	630	1000	1500	2000	2500	3000	4000	600	630	1000	1500	2000	2500	3000	4000	
Case Size	0805			1206			1210			1808			1812												

Letter	A	C	E	F	G	X	7
<b>Max.</b>	0.81	1.45	1.80	2.20	2.80	0.94	3.30
<b>Thickness</b>	(0.032)	(0.057)	(0.071)	(0.087)	(0.110)	(0.037)	(0.130)

NOTE: Contact factory for non-specified capacitance values



The Important Information/Disclaimer is incorporated in the catalog where these specifications came from or available online at [www.kyocera-avx.com/disclaimer/](http://www.kyocera-avx.com/disclaimer/) by reference and should be reviewed in full before placing any order.

# High Voltage MLC Chips

## For 600V to 5000V Applications



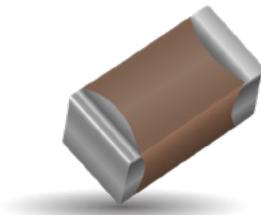
### X7R CAPACITANCE RANGE

PREFERRED SIZES ARE SHADED

Case Size	1825								2220								2225								3640																		
Soldering	Reflow Only								Reflow Only								Reflow Only								Reflow Only																		
(L) Length mm (in)			4.60 ± 0.50 (0.181 ± 0.020)							5.70 ± 0.50 (0.224 ± 0.020)							5.70 ± 0.50 (0.224 ± 0.020)								9.14 ± 0.25 (0.360 ± 0.010)																		
W) Width mm (in)			6.30 ± 0.40 (0.248 ± 0.016)							5.00 ± 0.40 (0.197 ± 0.016)							6.30 ± 0.40 (0.248 ± 0.016)								10.2 ± 0.25 (0.400 ± 0.010)																		
(t) Terminal mm max			0.75 ± 0.35 (0.030 ± 0.014)							0.85 ± 0.35 (0.033 ± 0.014)							0.85 ± 0.35 (0.033 ± 0.014)								0.76 (0.030) 1.52 (0.060)																		
Voltage (V)	600	630	1000	1500	2000	2500	3000	4000	600	630	1000	1500	2000	2500	3000	4000	5000	600	630	1000	1500	2000	2500	3000	4000	5000	600	630	1000	1500	2000	2500	3000	4000	5000								
Cap (pF)	100	101																																									
120	121																																										
150	151																																										
180	181																																										
220	221																																										
270	271																																										
330	331																																										
390	391																																										
470	471																																										
560	561																																										
680	681																																										
750	751																																										
820	821																																										
1000	102	F	F	F	F	F	F	F	F	F	F	F	F	F	F	G		F	F	F	F	F	F	F			G	G	G	G	G	G	G	G	G	G							
1200	122	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	G	F	F	F	F	F	F	F			G	G	G	G	G	G	G	G	G	G							
1500	152	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	G	F	F	F	F	F	F	F			G	G	G	G	G	G	G	G	G	G							
1800	182	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	G	F	F	F	F	F	F	F			G	G	G	G	G	G	G	G	G	G							
2200	222	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	G	F	F	F	F	F	F	F			G	G	G	G	G	G	G	G	G	G							
2700	272	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	G	F	F	F	F	F	F	F			G	G	G	G	G	G	G	G	G	G							
3300	332	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	G	F	F	F	F	F	F	F			G	G	G	G	G	G	G	G	G	G							
3900	392	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	G	F	F	F	F	F	F	F			G	G	G	G	G	G	G	G	G	G							
4700	472	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	G	F	F	F	F	F	F	F			G	G	G	G	G	G	G	G	G	G							
5600	562	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	G	F	F	F	F	F	F	F			G	G	G	G	G	G	G	G	G	G							
6800	682	F	F	F	G	G	G	G	G	F	F	F	G	G	G	G	G	F	F	F	G	G	G	G			G	G	G	G	G	G	G	G	G	G							
8200	822	F	F	F	G	G	G	G	G	F	F	F	G	G	G	G	G	F	F	F	G	G	G	G			G	G	G	G	G	G	G	G	G	G							
Cap (μF)	0.010	103	F	F	G	G	G	G	G	F	F	F	G	G	G	G	G	F	F	F	G	G	G	G			G	G	G	G	G	G	G	G	G	G							
0.015	153	F	F	F	G	G	G	G	G	F	F	F	G	G	G	G	G	F	F	F	G	G	G	G			G	G	G	G	G	G	G	G	G	G							
0.018	183	F	F	F	G	G	G	G	G	F	F	F	G	G	G	G	G	F	F	F	G	G	G	G			G	G	G	G	G	G	G	G	G	G							
0.022	223	F	F	F	G	G	G	G	G	F	F	F	G	G	G	G	G	F	F	F	G	G	G	G			G	G	G	G	G	G	G	G	G	G							
0.027	273	F	F	F	G	G	G	G	G	F	F	F	G	G	G	G	G	F	F	F	G	G	G	G			G	G	G	G	G	G	G	G	G	G							
0.033	333	F	F	F	G	G	G	G	G	F	F	F	G	G	G	G	G	F	F	F	G	G	G	G			G	G	G	G	G	G	G	G	G	G							
0.039	393	F	F	F	G	G	G	G	G	F	F	F	G	G	G	G	G	F	F	F	G	G	G	G			G	G	G	G	G	G	G	G	G	G							
0.047	473	F	F	F	P					F	F	F	G					F	F	F	G																						
0.056	553	F	F	F	G					F	F	F	G					F	F	F	G																						
0.068	683	F	F	G						F	F	G						F	F	F	G																						
0.082	823	F	F	G						F	F	G						F	F	G																							
0.100	104	F	F	G						F	F	G						F	F	G																							
0.150	154	F	F							F	F	G						F	F	G																							
0.220	224	F	F							F	F	G						F	F																								
0.270	274	F	F							F	F							F	F																								
0.330	334	F	F							F	F							F	F																								
0.390	394	F	F							F	F							F	F																								
0.470	474	F	F							F	F							F	F																								
0.560	564	G	G							G	G							G	G																								
0.680	684									G	G							G	G																								
0.820	824										G	G							G	G																							
1.000	105																																										
Voltage (V)	600	630	1000	1500	2000	2500	3000	4000	600	630	1000	1500	2000	2500	3000	4000	5000	600	630	1000	1500	2000	2500	3000	4000	5000	600																

# High Voltage MLC Chips

## Tin/Lead Termination "B" - 600V to 5000V Applications



### NEW 630V RANGE

KYOCERA AVX will support those customers for commercial and military Multilayer Ceramic Capacitors with a termination consisting of 5% minimum lead. This termination is indicated by the use of a "B" in the 12th position of the KYOCERA AVX Catalog Part Number. This fulfills KYOCERA AVX's commitment to providing a full range of products to our customers. KYOCERA AVX has provided in the following pages, a full range of values that we are offering in this "B" termination.

Larger physical sizes than normally encountered chips are used to make high voltage MLC chip product. Special precautions must be taken in applying these chips in surface mount assemblies. The temperature gradient during heating or cooling cycles should not exceed 4°C per second.

The preheat temperature must be within 50°C of the peak temperature reached by the ceramic bodies through the soldering process. Chip sizes 1210 and larger should be reflow soldered only. Capacitors may require protective surface coating to prevent external arcing.

For 1825, 2225 and 3640 sizes, KYOCERA AVX offers leaded version in either thru-hole or SMT configurations (for details see section on high voltage leaded MLC chips).

### HOW TO ORDER

LD08	A	A	271	K	A	B	2	A
Style	Voltage	Temperature Coefficient	Capacitance Code	Capacitance Tolerance	Test Level	Termination*	Packaging	Special Code
LD05 - 0805	600V/630V = C	COG = A	(2 significant digits + no. of zeros)	COG: J = ±5% K = ±10% M = ±20%	A = Standard 4 = Automotive*	B = 5% Min Pb X = FLEXITERM® 5% min. Pb*	2 = 7" Reel** 4 = 13" Reel** 6 = Tray (3640 Style)	A = Standard
LD06 - 1206	1000V = A							
LD10 - 1210	1500V = S	X7R = C	Examples: 10 pF = 100 100 pF = 101 1,000 pF = 102 22,000 pF = 223 220,000 pF = 224 1 μF = 105	X7R: K = ±10% M = ±20% Z = +80%, -20%				
LD08 - 1808	2000V = G							
LD12 - 1812	2500V = W							
LD13 - 1825	3000V = H							
LD20 - 2220	4000V = J							
LD14 - 2225	5000V = K							
LD40 - 3640								
***								

Notes: Capacitors with X7R dielectrics are not intended for applications across AC supply mains or AC line filtering with polarity reversal. Contact plant for recommendations. Contact factory for availability of Termination and Tolerance options for Specific Part Numbers.

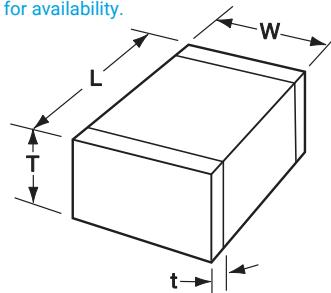
\* FLEXITERM is not available in the LD40 Style

\*\* The LD40 Style is not available on Reels.

\*\*\* KYOCERA AVX offers nonstandard chip sizes. Contact factory for details..

\* Not all values are supported in Automotive grade. Please contact factory for availability.

NOT RoHS Compliant



### DIMENSIONS

SIZE	LD05 (0805)	LD06 (1206)	LD10* (1210)	LD08* (1808)	LD12* (1812)	LD13* (1825)	LD20* (2220)	LD14* (2225)	LD40* (3640)
(L) Length	2.10 ± 0.20 (0.083 ± 0.008)	3.30 ± 0.30 (0.130 ± 0.012)	3.30 ± 0.40 (0.130 ± 0.016)	4.60 ± 0.50 (0.181 ± 0.020)	4.60 ± 0.50 (0.181 ± 0.020)	4.60 ± 0.50 (0.181 ± 0.020)	5.70 ± 0.50 (0.224 ± 0.020)	5.70 ± 0.50 (0.224 ± 0.020)	9.14 ± 0.25 (0.360 ± 0.010)
(W) Width	1.25 ± 0.20 (0.049 ± 0.008)	1.60 ± 0.20 (0.063 ± 0.008)	2.50 ± 0.30 (0.098 ± 0.012)	2.00 ± 0.20 (0.079 ± 0.008)	3.20 ± 0.30 (0.126 ± 0.012)	6.30 ± 0.40 (0.248 ± 0.016)	5.00 ± 0.40 (0.197 ± 0.016)	6.30 ± 0.40 (0.248 ± 0.016)	10.2 ± 0.25 (0.400 ± 0.010)
(t) min. terminal max.	0.50 ± 0.20 (0.020 ± 0.008)	0.60 ± 0.20 (0.024 ± 0.008)	0.75 ± 0.35 (0.030 ± 0.014)	0.85 ± 0.35 (0.033 ± 0.014)	0.85 ± 0.35 (0.033 ± 0.014)	0.76 (0.030) (1.52 (0.060)			

\*Reflow Soldering Only

### MILLIMETERS (INCHES)

Performance of ceramic capacitors can be simulated by using the online SpiMLCC software program - <http://spicat.avx.com/mlcc>  
Custom values, ratings and configurations are also available.

# High Voltage MLC Chips

## Tin/Lead Termination "B" - 600V to 5000V Applications

### NPO (COG) Dielectric Performance Characteristics

Capacitance Range	10 pF to 0.047 $\mu$ F (25°C, 1.0 $\pm$ 0.2 Vrms at 1kHz, for $\leq$ 1000 pF use 1 MHz)
Capacitance Tolerances	$\pm$ 5%, $\pm$ 10%, $\pm$ 20%
Dissipation Factor	0.1% max. (+25°C, 1.0 $\pm$ 0.2 Vrms, 1kHz, for $\leq$ 1000 pF use 1 MHz)
Operating Temperature Range	-55°C to +125°C
Temperature Characteristic	0 $\pm$ 30 ppm/ $^{\circ}$ C (0 VDC)
Voltage Ratings	600, 630, 1000, 1500, 2000, 2500, 3000, 4000 & 5000 VDC (+125°C)
Insulation Resistance (+25°C, at 500 VDC)	100K M $\Omega$ min. or 1000 M $\Omega$ - $\mu$ F min., whichever is less
Insulation Resistance (+125°C, at 500 VDC)	10K M $\Omega$ min. or 100 M $\Omega$ - $\mu$ F min., whichever is less
Dielectric Strength	Minimum 120% rated voltage for 5 seconds at 50 mA max. current

### HIGH VOLTAGE COG CAPACITANCE VALUES

VOLTAGE	LD05 (0805)	LD06 (1206)	LD10 (1210)	LD08 (1808)	LD12 (1812)	LD13 (1825)	LD20 (2220)	LD14 (2225)	LD40 (3640)
600/630	min. max.	10 pF 330 pF	10 pF 1200 pF	100 pF 2700 pF	100 pF 3300 pF	100 pF 5600 pF	1000 pF 0.012 $\mu$ F	1000 pF 0.018 $\mu$ F	1000 pF 0.047 $\mu$ F
	max.	10 pF 180 pF	10 pF 560 pF	100 pF 1500 pF	100 pF 2200 pF	100 pF 3300 pF	1000 pF 8200 pF	1000 pF 0.010 $\mu$ F	1000 pF 0.022 $\mu$ F
1000	min. max.	— —	10 pF 270 pF	10 pF 680 pF	10 pF 820 pF	10 pF 1800 pF	100 pF 4700 pF	100 pF 4700 pF	100 pF 5600 pF
	max.	— —	10 pF 120 pF	10 pF 270 pF	10 pF 330 pF	10 pF 1000 pF	100 pF 1800 pF	100 pF 2200 pF	100 pF 2700 pF
1500	min. max.	— —	10 pF 270 pF	10 pF 680 pF	10 pF 820 pF	10 pF 1800 pF	100 pF 4700 pF	100 pF 4700 pF	100 pF 5600 pF
	max.	— —	— —	— —	— —	— —	100 pF 1200 pF	100 pF 1500 pF	100 pF 1800 pF
2000	min. max.	— —	10 pF 120 pF	10 pF 270 pF	10 pF 330 pF	10 pF 1000 pF	100 pF 1800 pF	100 pF 2200 pF	100 pF 2700 pF
	max.	— —	— —	— —	— —	— —	100 pF 1500 pF	100 pF 1800 pF	100 pF 2700 pF
2500	min. max.	— —	— —	— —	10 pF 180 pF	10 pF 470 pF	10 pF 1200 pF	100 pF 1500 pF	100 pF 3900 pF
	max.	— —	— —	— —	— —	— —	10 pF 820 pF	10 pF 1000 pF	100 pF 1200 pF
3000	min. max.	— —	— —	— —	10 pF 120 pF	10 pF 330 pF	10 pF 820 pF	10 pF 1000 pF	100 pF 2700 pF
	max.	— —	— —	— —	— —	— —	10 pF 1000 pF	10 pF 1200 pF	100 pF 1200 pF
4000	min. max.	— —	— —	— —	10 pF 47 pF	10 pF 150 pF	10 pF 330 pF	10 pF 470 pF	100 pF 560 pF
	max.	— —	— —	— —	— —	— —	— —	— —	100 pF 1200 pF
5000	min. max.	— —	— —	— —	— —	— —	— —	10 pF 220 pF	10 pF 270 pF
	max.	— —	— —	— —	— —	— —	— —	— —	10 pF 820 pF

### X7R Dielectric Performance Characteristics

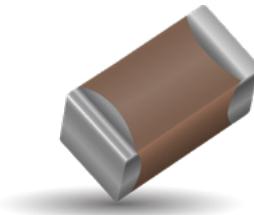
Capacitance Range	10 pF to 0.56 $\mu$ F (25°C, 1.0 $\pm$ 0.2 Vrms at 1kHz)
Capacitance Tolerances	$\pm$ 10%; $\pm$ 20%; +80%, -20%
Dissipation Factor	2.5% max. (+25°C, 1.0 $\pm$ 0.2 Vrms, 1kHz)
Operating Temperature Range	-55°C to +125°C
Temperature Characteristic	$\pm$ 15% (0 VDC)
Voltage Ratings	600, 630, 1000, 1500, 2000, 2500, 3000, 4000 & 5000 VDC (+125°C)
Insulation Resistance (+25°C, at 500 VDC)	100K M $\Omega$ min. or 1000 M $\Omega$ - $\mu$ F min., whichever is less
Insulation Resistance (+125°C, at 500 VDC)	10K M $\Omega$ min. or 100 M $\Omega$ - $\mu$ F min., whichever is less
Dielectric Strength	Minimum 120% rated voltage for 5 seconds at 50 mA max. current

### HIGH VOLTAGE X7R MAXIMUM CAPACITANCE VALUES

VOLTAGE	0805	1206	1210	1808	1812	1825	2220	2225	3640
600/630	min. max.	100 pF 6800 pF	1000 pF 0.022 $\mu$ F	1000 pF 0.056 $\mu$ F	1000 pF 0.068 $\mu$ F	0.010 $\mu$ F 0.120 $\mu$ F	0.010 $\mu$ F 0.390 $\mu$ F	0.010 $\mu$ F 0.270 $\mu$ F	0.010 $\mu$ F 0.330 $\mu$ F
	max.	— —	— —	— —	— —	— —	— —	— —	0.010 $\mu$ F 0.560 $\mu$ F
1000	min. max.	100 pF 1500 pF	100 pF 6800 pF	1000 pF 0.015 $\mu$ F	1000 pF 0.018 $\mu$ F	1000 pF 0.039 $\mu$ F	1000 pF 0.100 $\mu$ F	1000 pF 0.120 $\mu$ F	0.010 $\mu$ F 0.220 $\mu$ F
	max.	— —	— —	— —	— —	— —	— —	— —	— —
1500	min. max.	— —	100 pF 2700 pF	100 pF 5600 pF	100 pF 6800 pF	100 pF 0.015 $\mu$ F	1000 pF 0.056 $\mu$ F	1000 pF 0.056 $\mu$ F	1000 pF 0.068 $\mu$ F
	max.	— —	— —	— —	— —	— —	— —	— —	— —
2000	min. max.	— —	10 pF 1500 pF	100 pF 3300 pF	100 pF 3300 pF	100 pF 8200 pF	1000 pF 0.022 $\mu$ F	1000 pF 0.027 $\mu$ F	1000 pF 0.033 $\mu$ F
	max.	— —	— —	— —	— —	— —	— —	— —	— —
2500	min. max.	— —	— —	10 pF 2200 pF	10 pF 5600 pF	100 pF 0.015 $\mu$ F	100 pF 0.018 $\mu$ F	100 pF 0.022 $\mu$ F	1000 pF 0.022 $\mu$ F
	max.	— —	— —	— —	— —	— —	— —	— —	— —
3000	min. max.	— —	— —	— —	10 pF 1800 pF	10 pF 3900 pF	100 pF 0.010 $\mu$ F	100 pF 0.012 $\mu$ F	100 pF 0.015 $\mu$ F
	max.	— —	— —	— —	— —	— —	— —	— —	— —
4000	min. max.	— —	— —	— —	— —	— —	— —	— —	100 pF 6800 pF
	max.	— —	— —	— —	— —	— —	— —	— —	— —
5000	min. max.	— —	— —	— —	— —	— —	— —	— —	100 pF 3300 pF
	max.	— —	— —	— —	— —	— —	— —	— —	— —

# High Voltage MLC Chips

## FLEXITERM® - 600V to 5000V Applications



High value, low leakage and small size are difficult parameters to obtain in capacitors for high voltage systems. KYOCERA AVX special high voltage MLC chips capacitors meet these performance characteristics and are designed for applications such as snubbers in high frequency power converters, resonators in SMPS, and high voltage coupling/DC blocking. These high voltage chip designs exhibit low ESRs at high frequencies.

To make high voltage chips, larger physical sizes than are normally encountered are necessary. These larger sizes require that special precautions be taken in applying these chips in surface mount assemblies. In response to this, and to follow from the success of the FLEXITERM® range of low voltage parts, KYOCERA AVX is delighted to offer a FLEXITERM® high voltage range of capacitors, FLEXITERM®.

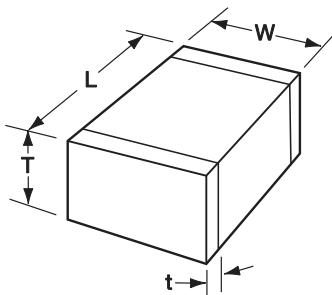
The FLEXITERM® layer is designed to enhance the mechanical flexure and temperature cycling performance of a standard ceramic capacitor, giving customers a solution where board flexure or temperature cycle damage are concerns.

### HOW TO ORDER

1808	A	C	272	K	A	Z	2	A
Style	Voltage	Temperature Coefficient	Capacitance Code (2 significant digits + no. of zeros)	Capacitance Tolerance	Test Level	Termination*	Packaging	Special Code
0805	600V/630V = C	COG = A	Examples:	COG: J = ±5%		Z=FLEXITERM®	2 = 7" Reel	A = Standard
1206	1000V = A	X7R = C	10 pF = 100	K = ±10%		100% Tin	4 = 13" Reel	
1210	1500V = S		100 pF = 101	M = ±20%		(RoHS Compliant)		
1808	2000V = G		1,000 pF = 102	X7R: K = ±10%				
1812	2500V = W		22,000 pF = 223	M = ±20%				
1825	3000V = H		220,000 pF = 224	Z = +80%, -20%				
2220	4000V = J		1 μF = 105					
2225	5000V = K							
***								

Notes: Capacitors with X7R dielectrics are not intended for applications across AC supply mains or AC line filtering with polarity reversal. Contact plant for recommendations. Contact factory for availability of Termination and Tolerance options for Specific Part Numbers.

\*\*\* KYOCERA AVX offers nonstandard chip sizes. Contact factory for details.



### DIMENSIONS millimeters (inches)

SIZE	0805	1206	1210*	1808*	1812*	1825*	2220*	2225*
(L) Length	$2.10 \pm 0.20$ ( $0.083 \pm 0.008$ )	$3.30 \pm 0.30$ ( $0.130 \pm 0.012$ )	$3.30 \pm 0.40$ ( $0.130 \pm 0.016$ )	$4.60 \pm 0.50$ ( $0.181 \pm 0.020$ )	$4.60 \pm 0.50$ ( $0.181 \pm 0.020$ )	$4.60 \pm 0.50$ ( $0.181 \pm 0.020$ )	$5.70 \pm 0.50$ ( $0.224 \pm 0.020$ )	$5.70 \pm 0.50$ ( $0.224 \pm 0.020$ )
(W) Width	$1.25 \pm 0.20$ ( $0.049 \pm 0.008$ )	$1.60^{+0.30}_{-0.10}$ ( $0.063^{+0.012}_{-0.004}$ )	$2.50 \pm 0.30$ ( $0.098 \pm 0.012$ )	$2.00 \pm 0.20$ ( $0.079 \pm 0.008$ )	$3.20 \pm 0.30$ ( $0.126 \pm 0.012$ )	$6.30 \pm 0.40$ ( $0.248 \pm 0.016$ )	$5.00 \pm 0.40$ ( $0.197 \pm 0.016$ )	$6.30 \pm 0.40$ ( $0.248 \pm 0.016$ )
(t) terminal	min. $0.50 \pm 0.20$ ( $0.020 \pm 0.008$ )	0.60 ± 0.20 ( $0.024 \pm 0.008$ )	$0.75 \pm 0.35$ ( $0.030 \pm 0.014$ )	$0.75 \pm 0.35$ ( $0.030 \pm 0.014$ )	$0.75 \pm 0.35$ ( $0.030 \pm 0.014$ )	$0.75 \pm 0.35$ ( $0.030 \pm 0.014$ )	$0.85 \pm 0.35$ ( $0.033 \pm 0.014$ )	$0.85 \pm 0.35$ ( $0.033 \pm 0.014$ )

\*Reflow Soldering Only



Performance of SMPS capacitors can be simulated by downloading SpiCalci software program - <http://www.avx.com/SpiApps/default.asp#spicalci>  
Custom values, ratings and configurations are also available.

# High Voltage MLC Chips

## **FLEXITERM® - 600V to 5000V Applications**



## **NP0 (C0G) Dielectric**

## Performance Characteristics

<b>Capacitance Range</b>	10 pF to 0.100 $\mu$ F (+25°C, 1.0 $\pm$ 0.2 Vrms, 1kHz)
<b>Capacitance Tolerances</b>	$\pm$ 5%, $\pm$ 10%, $\pm$ 20%
<b>Dissipation Factor</b>	0.1% max. (+25°C, 1.0 $\pm$ 0.2 Vrms, 1kHz)
<b>Operating Temperature Range</b>	-55°C to +125°C
<b>Temperature Characteristic</b>	0 $\pm$ 30 ppm/°C (0 VDC)
<b>Voltage Ratings</b>	600, 630, 1000, 1500, 2000, 2500, 3000, 4000 & 5000 VDC (+125°C)
<b>Insulation Resistance</b> (+25°C, at 500 VDC)	100K M $\Omega$ min. or 1000 M $\Omega$ - $\mu$ F min., whichever is less
<b>Insulation Resistance</b> (+125°C, at 500 VDC)	10K M $\Omega$ min. or 100 M $\Omega$ - $\mu$ F min., whichever is less
<b>Dielectric Strength</b>	Minimum 120% rated voltage for 5 seconds at 50 mA max. current

## NP0 (C0G) CAPACITANCE RANGE

## PREFERRED SIZES ARE SHADED

Case Size	0805			1206				1210				1808						1812													
Soldering	Reflow/Wave			Reflow/Wave				Reflow Only				Reflow Only						Reflow Only													
(L) Length mm (in.)	2.10 ± 0.20 (0.083 ± 0.008)				3.30 ± 0.30 (0.130 ± 0.012)				3.30 ± 0.40 (0.130 ± 0.016)				4.60 ± 0.50 (0.181 ± 0.020)						4.60 ± 0.50 (0.181 ± 0.020)												
W) Width mm (in.)	1.25 ± 0.20 (0.049 ± 0.008)				1.60 ± 0.30/-0.10 (0.063 ± 0.012/-0.004)				2.50 ± 0.30 (0.098 ± 0.012)				2.00 ± 0.20 (0.079 ± 0.008)						3.20 ± 0.30 (0.126 ± 0.012)												
(t) Terminal mm max max	0.50 ± 0.20 (0.020 ± 0.008)				0.60 ± 0.20 (0.024 ± 0.008)				0.75 ± 0.35 (0.030 ± 0.014)				0.75 ± 0.35 (0.030 ± 0.014)						0.75 ± 0.35 (0.030 ± 0.014)												
Voltage (V)	600	630	1000	600	630	1000	1500	2000	600	630	1000	1500	2000	600	630	1000	1500	2000	2500	3000	4000	600	630	1000	1500	2000	2500	3000	4000		
Cap (pF)	1.5	1R5	A	A	X	X	X	X	X	X	X	X	X	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	E		
	1.8	1R8	A	A	X	X	X	X	X	X	X	X	X	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	E		
	2.2	2R2	A	A	X	X	X	X	X	X	X	X	X	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	E		
	2.7	2R7	A	A	X	X	X	X	X	X	X	X	X	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	E		
	3.3	3R3	A	A	X	X	X	X	X	X	X	X	X	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	E		
	3.9	3R9	A	A	X	X	X	X	X	X	X	X	X	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	E		
	4.7	4R7	A	A	X	X	X	X	X	X	X	X	X	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	E		
	5.6	5R6	A	A	X	X	X	X	X	X	X	X	X	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	E		
	6.8	6R8	A	A	X	X	X	X	X	X	X	X	X	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	E		
	8.2	8R2	A	A	X	X	X	X	X	X	X	X	X	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	E		
	10	100	A	A	A	X	X	X	X	X	X	X	X	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	E		
	12	120	A	A	A	X	X	X	X	X	X	X	X	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	E		
	15	150	A	A	A	X	X	X	X	X	X	X	X	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	E		
	18	180	A	A	A	X	X	X	X	X	X	X	X	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	E		
	22	220	A	A	A	X	X	X	X	X	X	X	X	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	E		
	27	270	A	A	A	X	X	X	X	X	X	X	X	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	E		
	33	330	A	A	A	X	X	X	D	D	D	D	D	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	E		
	39	390	A	A	A	X	X	X	D	D	D	D	D	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	E		
	47	470	A	A	A	X	X	M	D	D	D	D	D	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	E		
	56	560	A	A	A	X	X	M	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	F			
	68	680	A	A	A	X	X	M	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	F			
	82	820	X	X	X	X	X	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	F			
	100	101	X	X	X	X	X	C	C	C	C	C	C	C	C	C	C	C	C	C	F	F	F	F	F	F	F	F			
	120	121	C	C	C	C	C	E	E	E	E	E	E	C	C	C	C	C	C	C	F	F	F	F	F	C	C	G			
	150	151	C	C	C	C	C	E	E	E	E	E	E	C	C	C	C	C	C	C	F	F	F	F	F	C	C	C	G		
	180	181	C	C	C	C	C	E	E	E	E	E	E	C	C	C	C	C	C	C	F	F	F	F	F	C	C	C	F		
	220	221	C	C		X	X	E	E	E	E	E	E	C	C	E	E	E	E	C	F	F	F	F	F	C	C	C	F		
	270	271	C	C		C	C	E	E	E	E	E	E	C	C	E	E	E	E	C	F	F	F	F	F	C	C	C	F		
	330	331	C	C		C	C	E	E	E	E	E	E	C	C	E	E	E	E	C	F	F	F	F	F	C	C	F	F		
	390	391	C	C		C	C	E	E	E	E	E	E	C	C	E	E	E	E	C	F	F	F	F	F	C	C	F	F		
	470	471	C	C		C	C	E	E	E	E	E	E	C	C	E	E	E	E	C	F	F	F	F	F	C	C	F	F		
	560	561	C	C		C	C	E	E	E	E	E	E	C	C	E	E	E	E	C	F	F	F	F	F	C	C	F	F		
	680	681	C	C		C	C	E	E	E	E	E	E	C	C	E	E	E	E	C	F	F	F	F	F	C	C	F	G		
	750	751	C	C		E	E	E	E	E	E	E	E	C	C	E	E	E	E	C	F	F	F	F	F	C	C	F	G		
	820	821	C	C		E	E	E	E	E	E	E	E	C	C	E	E	E	E	C	F	E	E	E	E	C	C	F	G		
	1000	102				E	E	E						C	C	E	F	F	C	C	F	E	E	E	E	C	C	F	G		
	1200	122				E	E							C	C	E	F	F	E	E	E	E	E	E	E	C	C	F	E		
	1500	152				E	E							C	C	F	G	G	E	E	F	E	E	E	E	C	C	F	F		
	1800	182				E	E							C	C	G	G	G	E	E	F	E	F	F	F	C	C	F	F		
	2200	222				E	E							C	C	G	G	G	E	E	E	E	E	E	E	C	C	E	G		
	2700	272				E	E							C	C	G	G	G	E	E	E	E	E	E	E	C	C	E	G		
	3300	332				E	E							C	C	G	G	G	E	E	E	E	E	E	E	C	C	F			
	3900	392												C	C	G	G	G	E	E	E	E	E	E	E	C	C	F			
	4700	472												C	C				E	E						C	C	G			
	5600	562												E	E				E	E						C	C				
	6800	682												E	E				F	F						C	C				
	8200	822												F	F											E	E				
Cap (μF)	0.010	103												F	F											E	E				
	0.012	123												F	F											F	F				
	0.015	153												G	G											G	G				
	0.018	183																									G	G			
	0.022	223																													
	0.033	333																													
	0.047	473																													
	0.056	563																													
	0.068	683																													
	0.100	104																													
Voltage (V)	600	630	1000	600	630	1000	1500	2000	600	630	1000	1500	2000	600	630	1000	1500	2000	2500	3000	4000	600	630	1000	1500	2000	2500	3000	4000		
Case Size	0805			1206				1210				1808						1812													

# High Voltage MLC Chips

## FLEXITERM® - 600V to 5000V Applications

### NPO (COG) CAPACITANCE RANGE

PREFERRED SIZES ARE SHADED

Case Size	1825								2220								2225									
Soldering	Reflow Only								Reflow Only								Reflow Only									
(L) Length mm (in.)																										
	4.60 ± 0.50								5.70 ± 0.50								5.70 ± 0.50									
	(0.181 ± 0.020)								(0.224 ± 0.020)								(0.224 ± 0.020)									
(W) Width mm (in.)									6.30 ± 0.40								6.30 ± 0.40									
	(0.248 ± 0.016)								(0.197 ± 0.016)								(0.248 ± 0.016)									
(t) Terminal mm max									0.75 ± 0.35								0.85 ± 0.35									
	(0.030 ± 0.014)								(0.033 ± 0.014)								(0.033 ± 0.014)									
Voltage (V)	600	630	1000	1500	2000	2500	3000	4000	600	630	1000	1500	2000	2500	3000	4000	5000	600	630	1000	1500	2000	2500	3000	4000	5000
Cap (pF)	1.5 1R5																									
	1.8 1R8																									
	2.2 2R2																									
	2.7 2R7																									
	3.3 3R3																									
	3.9 3R9																									
	4.7 4R7																									
	5.6 5R6																									
	6.8 6R8																									
	8.2 8R2																									
10 100	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	F	F	
12 120	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	F	F	
15 150	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	F	F		
18 180	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	F	F	
22 220	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	F	F	
27 270	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	F	F	
33 330	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	F	F	
39 390	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	F	F	
47 470	E	E	E	E	E	E	F	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	F	G	
56 560	E	E	E	E	E	E	F	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	F	G	
68 680	E	E	E	E	E	E	F	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	F	G	
82 820	E	E	E	E	E	E	F	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	F	G	
100 101	E	E	E	E	E	E	F	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	G	G	
120 121	E	E	E	E	E	E	F	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	G	G	
150 151	E	E	E	E	E	E	F	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	G	G	
180 181	E	E	E	E	E	E	F	E	E	E	E	E	E	E	E	F	F	E	E	E	E	E	E	G	G	
220 221	E	E	E	E	E	E	F	E	E	E	E	E	E	E	E	F	F	E	E	E	E	E	E	G	G	
270 271	E	E	E	E	E	E	F	E	E	E	E	E	E	E	E			E	E	E	E	E	E	E	G	
330 331	E	E	E	E	E	E	F	E	E	E	E	E	E	E	E			E	E	E	E	E	E	E	G	
390 391	E	E	E	E	E	E	E		E	E	E	E	E	E	E			E	E	E	E	E	E	E	G	
470 471	E	E	E	E	E	E	E		E	E	E	E	E	E	E			E	E	E	E	E	E	E	G	
560 561	E	E	E	E	E	E	E		E	E	E	E	E	E	E			E	E	E	E	E	E	E	G	
680 681	E	E	E	E	E	E	F		E	E	E	E	E	F	F			E	E	E	E	E	E	E		
750 751	E	E	E	E	E	F	F		E	E	E	E	E	F	F			E	E	E	E	E	E	E		
820 821	E	E	E	E	F	F	F		E	E	E	E	F	F	F			E	E	E	E	F	F	F		
1000 102	E	E	E	E	F	F	F		E	E	E	E	F	F	F			E	E	E	E	E	E	E		
1200 122	E	E	E	E	G	G	G		E	E	E	E	G	G	G			E	E	E	E	F	F	F		
1500 152	E	E	E	F	F	G	G		E	E	E	F	F	G	G			E	E	E	E	F	F	F		
1800 182	E	E	F	F	G	G	G		E	E	E	F	F	G	G			E	E	E	E	G	G	G		
2200 222	E	E	G	G					E	E	E	G	G					E	E	E	E	E				
2700 272	E	E	G	G					E	E	E	G	G					E	E	E	F	F				
3300 332	E	E	G	G					E	E	E	G	G					E	E	F	F	F				
3900 392	E	E	G	G					E	E	E	G	G					E	E	G	G	G				
4700 472	E	E	G	G					E	E	E	G	G					F	F	F	G	G				
5600 562	F	F	F	G	G				F	F	F							F	F	F	G	G				
6800 682	F	F	F						F	F	F							F	F	F	G	G				
8200 822	G	G	G						G	G	G							G	G	G						
Cap (μF)	0.010 103																									
	0.012 123																									
	0.015 153																									
	0.018 183																									
	0.022 223																									
	0.033 333																									
	0.047 473																									
	0.056 563																									
	0.068 683																									
	0.100 104																									
Voltage (V)	600	630	1000	1500	2000	2500	3000	4000	600	630	1000	1500	2000	2500	3000	4000	5000	600	630	1000	1500	2000	2500	3000	4000	5000
Case Size	1825								2220								2225									

NOTE: Contact factory for non-specified capacitance

Letter	A	C	E	F	G	X
Max.	0.81	1.45	1.80	2.20	2.80	0.94
Thickness	(0.032)	(0.057)	(0.071)	(0.087)	(0.110)	(0.037)

# High Voltage MLC Chips

## **FLEXITERM® - 600V to 5000V Applications**



## X7R Dielectric

## Performance Characteristics

<b>Capacitance Range</b>	10 pF to 0.82 $\mu$ F (25°C, 1.0 ±0.2 Vrms at 1kHz)
<b>Capacitance Tolerances</b>	±10%; ±20%; +80%, -20%
<b>Dissipation Factor</b>	2.5% max. (+25°C, 1.0 ±0.2 Vrms, 1kHz)
<b>Operating Temperature Range</b>	-55°C to +125°C
<b>Temperature Characteristic</b>	±15% (0 VDC)
<b>Voltage Ratings</b>	600, 630, 1000, 1500, 2000, 2500, 3000, 4000 & 5000 VDC (+125°C)
<b>Insulation Resistance</b> (+25°C, at 500 VDC)	100K MΩ min. or 1000 MΩ - $\mu$ F min., whichever is less
<b>Insulation Resistance</b> (+125°C, at 500 VDC)	10K MΩ min. or 100 MΩ - $\mu$ F min., whichever is less
<b>Dielectric Strength</b>	Minimum 120% rated voltage for 5 seconds at 50 mA max. current

## X7R CAPACITANCE RANGE

## PREFERRED SIZES ARE SHADED

Case Size	0805			1206			1210			1808			1812		
Soldering	Reflow/Wave			Reflow/Wave			Reflow Only			Reflow Only			Reflow Only		
(L) Length mm (in)	2.10 ± 0.20 (0.083 ± 0.008)	3.30 ± 0.30 (0.130 ± 0.012)	3.30 ± 0.40 (0.130 ± 0.016)	4.60 ± 0.50 (0.181 ± 0.020)											
W) Width mm (in)	1.25 ± 0.20 (0.049 ± 0.008)	1.60 ± 0.30/-0.10 (0.063 ± 0.012/-0.004)	2.50 ± 0.30 (0.098 ± 0.012)	2.00 ± 0.20 (0.079 ± 0.008)	2.00 ± 0.20 (0.079 ± 0.008)	2.00 ± 0.20 (0.079 ± 0.008)	2.30 ± 0.30 (0.097 ± 0.012)								
(t) Terminal mm max	0.50 ± 0.20 (0.020 ± 0.008)	0.60 ± 0.20 (0.024 ± 0.008)	0.75 ± 0.35 (0.030 ± 0.014)												
Voltage (V)	600 630 1000	600 630 1000 1500 2000	600 630 1000 1500 2000	600 630 1000 1500 2000	600 630 1000 1500 2000	600 630 1000 1500 2000	600 630 1000 1500 2000	600 630 1000 1500 2000	600 630 1000 1500 2000	600 630 1000 1500 2000	600 630 1000 1500 2000	600 630 1000 1500 2000	600 630 1000 1500 2000	600 630 1000 1500 2000	600 630 1000 1500 2000
Cap (pF)	100 101	X X C C C E E E E E E E E													
	120 121	X X C C C E E E E E E E E													
	150 151	X X C C C E E E E E E E E													
	180 181	X X C C C E E E E E E E E													
	220 221	X X C C C E E E E E E E E													
	270 271	X X C C C E E E E E E E E													
	330 331	X X C C C E E E E E E E E													
	390 391	X X C C C E E E E E E E E													
	470 471	X X C C C E E E E E E E E													
	560 561	X X C C C E E E E E E E E													
	680 681	X X C C C E E E E E E E E													
	750 751	X X C C C E E E E E E E E													
	820 821	X X C C C E E E E E E E E													
	1000 102	X X C C C E E E E E E E E													
	1200 122	X X C C C E E E E E E E E													
	1500 152	X X C C C E E E E E E E E													
	1800 182	X X C C C E E E E E E E E													
	2200 222	X X C C C E E E E E F F F													
	2700 272	X X C C C E E E E F F F F													
	3300 332	X X C C C E E E E F F F F													
	3900 392	X X C C C E E E E G F F F													
	4700 472	X X C C C E E E E G F F F													
	5600 562	X X C C C E E E E G F F F													
	6800 682	X X C C C E E E E G F F F													
	8200 822	X X C C C E E E E G F F F													
Cap (μF)	0.010 103	C C C C C E E E E E E E													
	0.015 153	C C C C C E E E E E E E													
	0.018 183	C C C C E E E E E E E E													
	0.022 223	C C C C E E E E E F F F													
	0.027 273		E E E E E F F F F F F												
	0.033 333		E E E E E F F F F F F												
	0.039 393		E E E E E F F F F F F												
	0.047 473		E E E E E F F F F F F												
	0.056 563		E E E E E F F F F F F												
	0.068 683		E E E E E F F F F F F												
	0.082 823		E E E E E F F F F F F												
	0.100 104		F F F F F F F F F F F												
	0.150 154														
	0.220 224														
	0.270 274														
	0.330 334														
	0.390 394														
	0.470 474														
	0.560 564														
	0.680 684														
	0.820 824														
	1.000 105														
Voltage (V)	600 630 1000	600 630 1000 1500 2000	600 630 1000 1500 2000	600 630 1000 1500 2000	600 630 1000 1500 2000	600 630 1000 1500 2000	600 630 1000 1500 2000	600 630 1000 1500 2000	600 630 1000 1500 2000	600 630 1000 1500 2000	600 630 1000 1500 2000	600 630 1000 1500 2000	600 630 1000 1500 2000	600 630 1000 1500 2000	600 630 1000 1500 2000
Case Size	0805			1206			1210			1808			1812		

# High Voltage MLC Chips

## FLEXITERM® - 600V to 5000V Applications



## X7R CAPACITANCE RANGE

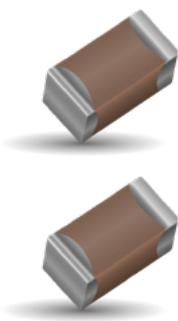
## PREFERRED SIZES ARE SHADEd

NOTE: Contact factory for non-specified capacitance values

Letter	A	C	E	F	G	P	X
<b>Max.</b>	0.81	1.45	1.80	2.20	2.80	3.10	0.94
<b>Thickness</b>	(0.032)	(0.057)	(0.071)	(0.087)	(0.110)	(0.120)	(0.037)

# High Voltage MLC Chip Capacitors

## For 600V to 3000V Automotive Applications - AEC-Q200



Modern automotive electronics could require components capable to work with high voltage (e.g. xenon lamp circuits or power converters in hybrid cards). KYOCERA AVX offers high voltage ceramic capacitors qualified according to AEC-Q200 standard.

High value, low leakage and small size are difficult parameters to obtain in capacitors for high voltage systems. KYOCERA AVX special high voltage MLC chip capacitors meet these performance characteristics and are designed for applications such as snubbers in high frequency power converters, resonators in SMPS, and high voltage coupling/dc blocking. These high voltage chip designs exhibit low ESRs at high frequencies.

Due to high voltage nature, larger physical dimensions are necessary. These larger sizes require special precautions to be taken in applying of MLC chips. The temperature gradient during heating or cooling cycles should not exceed 4°C per second. The preheat temperature must be within 50°C of the peak temperature reached by the ceramic bodies through the soldering process. Chip sizes 1210 and larger should be reflow soldered only. Capacitors may require protective surface coating to prevent external arcing.

To improve mechanical and thermal resistance, KYOCERA AVX recommend to use flexible terminations system - FLEXITERM®.

### HOW TO ORDER

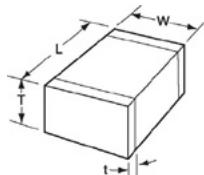
1210	C	C	223	K	4	T	2	A
Size 1206	Voltage C = 630V	Dielectric X7R = C	Capacitance Code 2 Sig. Digits + Number of Zeros e.g. 103 = 10nF (223 = 22nF)	Capacitance Tolerance K = ±10% M = ±20%	Failure Rate 4 = Automotive	Terminations T = Plated Ni and Sn Z = FLEXITERM®	Packaging 2 = 7" Reel 4 = 13" Reel	Special Code A = Std. Product
1210	A = 1000V							
1808	S = 1500V							
1812	G = 2000V							
2220	W = 2500V							
	H = 3000V							

\*KYOCERA AVX offers nonstandard case size. Contact factory for details.

Notes: Capacitors with X7R dielectrics are not intended for applications across AC supply mains or AC line filtering with polarity reversal. Please contact KYOCERA AVX for recommendations

### CHIP DIMENSIONS DESCRIPTION

(SEE CAPACITANCE RANGE CHART ON PAGE 128)



L = Length  
W = Width  
T = Thickness  
t = Terminal

### X7R DIELECTRIC PERFORMANCE CHARACTERISTICS

Parameter/Test	Specification Limits	Measuring Conditions
Operating Temperature Range	-55°C to +125°C	Temperature Cycle Chamber
Capacitance Dissipation Factor Capacitance Tolerance	within specified tolerance 2.5% max. ±5% (J), ±10% (K), ±20% (M)	Freq.: 1kHz ±10% Voltage: 1.0Vrms s ±0.2Vrms T = +25°C, V = 0Vdc
Temperature Characteristics	X7R = ±15%	Vdc = 0V, T = (-55°C to +125°C)
Insulation Resistance	100GΩ min. or 1000MΩ • μF min. (whichever is less) 10GΩ min. or 100MΩ • μF min. (whichever is less)	T = +25°C, V = 500Vdc T = +125°C, V = 500Vdc (t ≥ 120 sec, I ≤ 50mA)
Dielectric Strength	No breakdown or visual defect	120% of rated voltage t ≤ 5 sec, I ≤ 50mA

# High Voltage MLC Chips FLEXITERM®

## For 600V to 3000V Automotive Applications - AEC-Q200



### X7R CAPACITANCE RANGE

PREFERRED SIZES ARE SHADED

Case Size	1206					1210					1808					1812					2220							
Soldering	Reflow/Wave					Reflow/Wave					Reflow Only					Reflow Only					Reflow Only							
(L) Length mm (in.)		3.2 ± 0.2 (0.126 ± 0.008)				3.2 ± 0.2 (0.126 ± 0.008)					4.57 ± 0.25 (0.18 ± 0.01)					4.5 ± 0.3 (0.177 ± 0.012)					5.7 ± 0.5 (0.224 ± 0.02)							
(W) Width mm (in.)		1.6 ± 0.2 (0.063 ± 0.008)				2.5 ± 0.2 (0.098 ± 0.008)					2.03 ± 0.25 (0.08 ± 0.01)					3.2 ± 0.2 (0.126 ± 0.008)					5 ± 0.4 (0.197 ± 0.016)							
(t) Terminal max mm		0.5 ± 0.25 (0.02 ± 0.01)				0.5 ± 0.25 (0.02 ± 0.01)					0.61 ± 0.36 (0.024 ± 0.014)					0.61 ± 0.36 (0.024 ± 0.014)					0.64 ± 0.39 (0.025 ± 0.015)							
Voltage (V)	630	1000	1500	2000	2500	630	1000	1500	2000	630	1000	1500	2000	2500	3000	630	1000	1500	2000	2500	3000	630	1000	1500	2000	3000		
Cap (pF)	101	100	C	E	E	E	E	E	E																			
	121	120	C	E	E	E	E	E	E																			
	151	150	C	E	E	E	E	E	E																			
	181	180	C	E	E	E	E	E	E																			
	221	220	C	E	E	E	E	E	E								E	E	E	E	E	E						
	271	270	C	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E						
	331	330	C	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	F	E	E							
	391	390	C	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	F	E	E							
	471	470	C	E	E	E	E	E	E	E	E	E	E	E	E	E	F	F	E	E	E	E	E	E	E	E		
	561	560	C	E	E	E	E	E	E	E	E	E	E	E	E	E	F	F	E	E	E	E	E	E	E	E		
	681	680	C	E	E	E	E	E	E	E	E	E	E	E	E	F	F	F	E	E	E	E	F	F				
	821	820	C	E	E	E	E	E	E	E	E	E	E	E	E	F	F	F	E	E	E	E	F	F				
	102	1000	C	E	E	E	E	E	E	E	E	E	E	E	E	F	F	F	E	E	E	F	F	F	F	F	G	
	122	1220	C	E	E	E	E	E	E	E	E	E	E	E	E				F	F	F	F	G		F	F	F	G
	152	1500	C	E	E	E	E	E	E	E	E	E	E	E	E				F	F	F	F	G		F	F	F	G
	182	1800	C	E	E	E	E	E	E	E	E	E	E	E	E				F	F	F	F	G		F	F	F	G
	222	2200	C	E	E	E	E	E	E	E	E	E	E	E	E				F	F	F	F	G		F	F	F	G
	272	2700	C	E	E	E	E	E	E	E	E	E	E	E	E				F	F	F	F			F	F	F	
	332	3300	C	E	E	E	E	E	E	E	E	E	E	E	E				F	F	F	F			F	F	F	
	392	3900	C	E	E	E	E	E	E	E	E	E	E	E	E				F	F	F	F			F	F	F	
	472	4700	C	E	E	E	E	E	E	E	E	E	E	E	E				F	F	G	G			F	F	F	
	562	5600	C	E	E	E	E	E	E	E	E	E	E	E	E				F	F	G	G			F	F	F	
	682	6800	E	E	E	E	E	E	E	E	E	E	E	E	E				F	F	G	G			F	F	F	
	822	8200	E	E	E	E	E	E	E	E	E	E	E	E	E				F	F	G	G			F	F	G	
	103	0.01	E	E	E	E	E	E	E	E	E	E	E	E	E				F	F	G	G			G	G	G	
	123	0.012		E	E	E	E	E	E	E	E	E	E	E	E				F	F	G	G			G	G	G	
	153	0.015		E	E	E	E	E	E	E	E	E	E	E	E				F	F	G	G			G	G	G	
	183	0.018		E	E	E	E	E	E	E	E	E	E	E	E				F	F					G	G	G	
	223	0.022		E															F	F					G	G	G	
	273	0.027																	F						G	G		
	333	0.033																	F						G	G		
	393	0.039																	F						G	G		
	473	0.047																	F						G	G		
	563	0.056																	F						G	G		
	683	0.068																	F						G	G		
	823	0.082																	F						G	G		
	104	0.1																	F						G	G		
	124	0.12																	F						G			
	154	0.15																	F						G			
	224	0.22																	F									
	334	0.33																	F									
	474	0.47																	F									
	684	0.68																	F									
	105	1																	F									
	155	1.5																	F									
	225	2.2																	F									
	335	3.3																	F									
	475	4.7																	F									
	106	10																	F									
	226	22																	F									
	WVDC		630	1000	1500	2000	2500	630	1000	1500	2000	630	1000	1500	2000	2500	3000	630	1000	1500	2000	2500	3000	630	1000	1500	2000	3000
	Size		1206					1210					1808					1812					2220					

NOTE: Contact factory for non-specified capacitance values

Letter	A	C	E	F	G	Q
Max Thickness	0.81 (0.032)	1.45 (0.057)	1.80 (0.071)	2.20 (0.087)	2.80 (0.110)	1.78 (0.070)

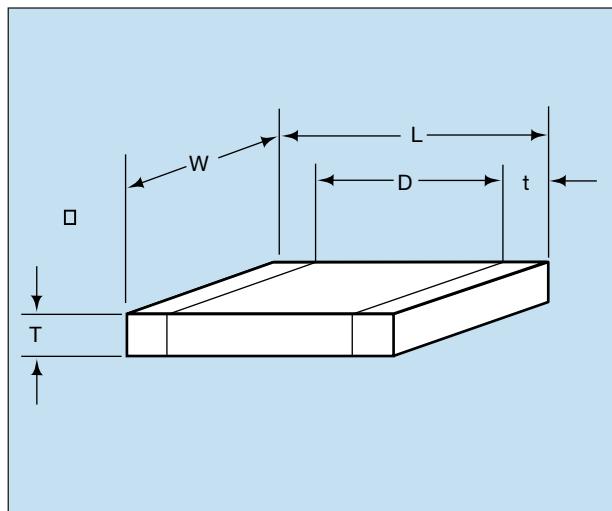


The Important Information/Disclaimer is incorporated in the catalog where these specifications came from or available online at [www.kyocera-avx.com/disclaimer/](http://www.kyocera-avx.com/disclaimer/) by reference and should be reviewed in full before placing any order.

# MIL-PRF-55681/Chips

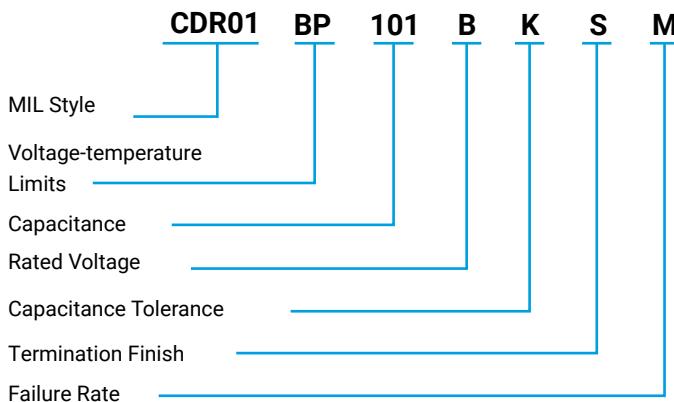
## Part Number Example

CDR01 thru CDR06



### MILITARY DESIGNATION PER MIL-PRF-55681

#### Part Number Example



NOTE: Contact factory for availability of Termination and Tolerance Options for Specific Part Numbers.

**MIL Style:** CDR01, CDR02, CDR03, CDR04, CDR05, CDR06

#### Voltage Temperature Limits:

BP =  $0 \pm 30 \text{ ppm}/^\circ\text{C}$  without voltage;  $0 \pm 30 \text{ ppm}/^\circ\text{C}$  with rated voltage from  $-55^\circ\text{C}$  to  $+125^\circ\text{C}$

BX =  $\pm 15\%$  without voltage;  $+15 - 25\%$  with rated voltage from  $-55^\circ\text{C}$  to  $+125^\circ\text{C}$

**Capacitance:** Two digit figures followed by multiplier (number of zeros to be added) e.g., 101 = 100 pF

**Rated Voltage:** A = 50V, B = 100V

**Capacitance Tolerance:** J  $\pm 5\%$ , K  $\pm 10\%$ , M  $\pm 20\%$

#### Termination Finish:

M = Palladium silver

N = Silver-nickel-gold

S = Solder coated final with a minimum of 4 percent lead

T = Silver

U = Base metallization-barrier metal-solder coated (tin/lead alloy, with a minimum of 4 percent lead)

W = Base metallization-barrier metal-tinned (tin or tin/lead alloy)

Y = Base metallization-barrier metal-tin (100 percent)

Z = Base metallization-barrier metal-tinned (tin/lead alloy, with a minimum of 4 percent lead)

\*See MIL-PRF-55681 Specification for more details

**Failure Rate Level:** M = 1.0%, P = .1%, R = .01%, S = .001%

**Packaging:** Bulk is standard packaging. Tape and reel per RS481 is available upon request.

**\*Not RoHS Compliant**

### CROSS REFERENCE: MIL-PRF-55681/CDR01 THRU CDR06\*

Per MIL-PRF-55681	Style	Length (L)	Width (W)	Thickness (T)		D		Termination Band (t)	
				Min.	Max.	Min.	Max.	Min.	Max.
CDR01	0805	.080 $\pm .015$	.050 $\pm .015$	.022	.055	.030	—	.010	—
CDR02	1805	.180 $\pm .015$	.050 $\pm .015$	.022	.055	—	—	.010	.030
CDR03	1808	.180 $\pm .015$	.080 $\pm .018$	.022	.080	—	—	.010	.030
CDR04	1812	.180 $\pm .015$	.125 $\pm .015$	.022	.080	—	—	.010	.030
CDR05	1825	.180 $^{+.020}_{-.015}$	.250 $^{+.020}_{-.015}$	.020	.080	—	—	.010	.030
CDR06	2225	.225 $\pm .020$	.250 $\pm .020$	.020	.080	—	—	.010	.030

\*For CDR11, 12, 13, and 14 see KYOCERA AVX Microwave Chip Capacitor Catalog

## CDR01 thru CDR06 to MIL-PRF-55681

Military Type Designation	Capacitance in pF	Capacitance tolerance	Rated temperature and voltage-temperature limits	WVDC
<b>Style 0805/CDR01</b>				
CDR01BP100B--	10	J,K	BP	100
CDR01BP120B--	12	J	BP	100
CDR01BP150B--	15	J,K	BP	100
CDR01BP180B--	18	J	BP	100
CDR01BP220B--	22	J,K	BP	100
CDR01BP270B--	27	J	BP	100
CDR01BP330B--	33	J,K	BP	100
CDR01BP390B--	39	J	BP	100
CDR01BP470B--	47	J,K	BP	100
CDR01BP560B--	56	J	BP	100
CDR01BP680B--	68	J,K	BP	100
CDR01BP820B--	82	J	BP	100
CDR01BP101B--	100	J,K	BP	100
CDR01B-121B--	120	J,K	BP,BX	100
CDR01B-151B--	150	J,K	BP,BX	100
CDR01B-181B--	180	J,K	BP,BX	100
CDR01BX221B--	220	K,M	BX	100
CDR01BX271B--	270	K	BX	100
CDR01BX331B--	330	K,M	BX	100
CDR01BX391B--	390	K	BX	100
CDR01BX471B--	470	K,M	BX	100
CDR01BX561B--	560	K	BX	100
CDR01BX681B--	680	K,M	BX	100
CDR01BX821B--	820	K	BX	100
CDR01BX102B--	1000	K,M	BX	100
CDR01BX122B--	1200	K	BX	100
CDR01BX152B--	1500	K,M	BX	100
CDR01BX182B--	1800	K	BX	100
CDR01BX222B--	2200	K,M	BX	100
CDR01BX272B--	2700	K	BX	100
CDR01BX332B--	3300	K,M	BX	100
CDR01BX392A--	3900	K	BX	50
CDR01BX472A--	4700	K,M	BX	50
<b>Style 1805/CDR02</b>				
CDR02BP221B--	220	J,K	BP	100
CDR02BP271B--	270	J	BP	100
CDR02BX392B--	3900	K	BX	100
CDR02BX472B--	4700	K,M	BX	100
CDR02BX562B--	5600	K	BX	100
CDR02BX682B--	6800	K,M	BX	100
CDR02BX822B--	8200	K	BX	100
CDR02BX103B--	10,000	K,M	BX	100
CDR02BX123A--	12,000	K	BX	50
CDR02BX153A--	15,000	K,M	BX	50
CDR02BX183A--	18,000	K	BX	50
CDR02BX223A--	22,000	K,M	BX	50

- └ Add appropriate failure rate
- └ Add appropriate termination finish
- └ Capacitance Tolerance

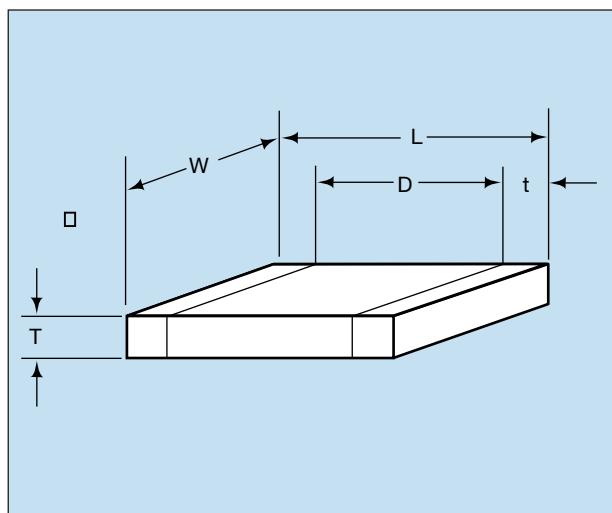
Military Type Designation/	Capacitance in pF	Capacitance tolerance	Rated temperature and voltage-temperature limits	WVDC
<b>Style 1808/CDR03</b>				
CDR03BP331B--	330	J,K	BP	100
CDR03BP391B--	390	J	BP	100
CDR03BP471B--	470	J,K	BP	100
CDR03BP561B--	560	J	BP	100
CDR03BP681B--	680	J,K	BP	100
CDR03BP821B--	820	J	BP	100
CDR03BP102B--	1000	J,K	BP	100
CDR03BX123B--	12,000	K	BX	100
CDR03BX153B--	15,000	K,M	BX	100
CDR03BX183B--	18,000	K	BX	100
CDR03BX223B--	22,000	K,M	BX	100
CDR03BX273B--	27,000	K	BX	100
CDR03BX333B--	33,000	K,M	BX	100
CDR03BX393A--	39,000	K	BX	50
CDR03BX473A--	47,000	K,M	BX	50
CDR03BX563A--	56,000	K	BX	50
CDR03BX683A--	68,000	K,M	BX	50
<b>Style 1812/CDR04</b>				
CDR04BP122B--	1200	J	BP	100
CDR04BP152B--	1500	J,K	BP	100
CDR04BP182B--	1800	J	BP	100
CDR04BP222B--	2200	J,K	BP	100
CDR04BP272B--	2700	J	BP	100
CDR04BP322B--	3300	J,K	BP	100
CDR04BX393B--	39,000	K	BX	100
CDR04BX473B--	47,000	K,M	BX	100
CDR04BX563B--	56,000	K	BX	100
CDR04BX823A--	82,000	K	BX	50
CDR04BX104A--	100,000	K,M	BX	50
CDR04BX124A--	120,000	K	BX	50
CDR04BX154A--	150,000	K,M	BX	50
CDR04BX184A--	180,000	K	BX	50
<b>Style 1825/CDR05</b>				
CDR05BP392B--	3900	J,K	BP	100
CDR05BP472B--	4700	J,K	BP	100
CDR05BP562B--	5600	J,K	BP	100
CDR05BX683B--	68,000	K,M	BX	100
CDR05BX823B--	82,000	K	BX	100
CDR05BX104B--	100,000	K,M	BX	100
CDR05BX124B--	120,000	K	BX	100
CDR05BX154B--	150,000	K,M	BX	100
CDR05BX224A--	220,000	K,M	BX	50
CDR05BX274A--	270,000	K	BX	50
CDR05BX334A--	330,000	K,M	BX	50
<b>Style 2225/CDR06</b>				
CDR06BP682B--	6800	J,K	BP	100
CDR06BP822B--	8200	J,K	BP	100
CDR06BP103B--	10,000	J,K	BP	100
CDR06BX394A--	390,000	K	BX	50
CDR06BX474A--	470,000	K,M	BX	50

- └ Add appropriate failure rate
- └ Add appropriate termination finish
- └ Capacitance Tolerance

# MIL-PRF-55681/Chips

## Part Number Example

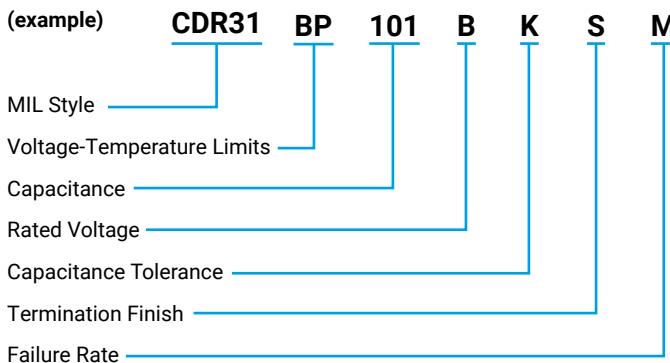
CDR31 thru CDR35



### MILITARY DESIGNATION PER MIL-PRF-55681

#### Part Number Example

(example)



**MIL Style:** CDR31, CDR32, CDR33, CDR34, CDR35

**Voltage-Temperature Limits:**

BP =  $0 \pm 30 \text{ ppm}/^\circ\text{C}$  without voltage;  $0 \pm 30 \text{ ppm}/^\circ\text{C}$  with rated voltage from  $-55^\circ\text{C}$  to  $+125^\circ\text{C}$

BX =  $\pm 15\%$  without voltage;  $+15 - 25\%$  with rated voltage from  $-55^\circ\text{C}$  to  $+125^\circ\text{C}$

**Capacitance:** Two digit figures followed by multiplier (number of zeros to be added) e.g., 101 = 100 pF

**Rated Voltage:** A = 50V, B = 100V

**Capacitance Tolerance:** B  $\pm .10 \text{ pF}$ , C  $\pm .25 \text{ pF}$ , D  $\pm .5 \text{ pF}$ , F  $\pm 1\%$ , J  $\pm 5\%$ , K  $\pm 10\%$ , M  $\pm 20\%$

**Termination Finish:**

M = Palladium silver

N = Silver-nickel-gold

S = Solder coated final with a minimum of 4 percent lead

T = Silver

U = Base metallization-barrier metal-solder coated (tin/lead alloy, with a minimum of 4 percent lead)

W = Base metallization-barrier metal-tinned (tin or tin/lead alloy)

Y = Base metallization-barrier metal-tin (100 percent)

Z = Base metallization-barrier metal-tinned (tin/lead alloy, with a minimum of 4 percent lead)

\*See MIL-PRF-55681 Specification for more details

**Failure Rate Level:** M = 1.0%, P = .1%, R = .01%, S = .001%

**Packaging:** Bulk is standard packaging. Tape and reel per RS481 is available upon request.

**\*Not RoHS Compliant**

### CROSS REFERENCE: MIL-PRF-55681/CDR31 THRU CDR35

Per MIL-PRF-55681	Style	Length (L) (mm)	Width (W) (mm)	Termination Band (t)			
				Max. (mm)	Max. (mm)	Min. (mm)	Max. (mm)
CDR31	0805	2.00	1.25	1.3	.50	.70	.30
CDR32	1206	3.20	1.60	1.3	—	.70	.30
CDR33	1210	3.20	2.50	1.5	—	.70	.30
CDR34	1812	4.50	3.20	1.5	—	.70	.30
CDR35	1825	4.50	6.40	1.5	—	.70	.30

## CDR31 to MIL-PRF-55681/7

Military Type Designation 1 /	Capacitance in pF	Capacitance tolerance	Rated temperature and voltage-temperature limits	WVDC
<b>Style 0805/CDR31 (BP)</b>				
CDR31BP1R0B--	1.0	B,C	BP	100
CDR31BP1R1B--	1.1	B,C	BP	100
CDR31BP1R2B--	1.2	B,C	BP	100
CDR31BP1R3B--	1.3	B,C	BP	100
CDR31BP1R5B--	1.5	B,C	BP	100
CDR31BP1R6B--	1.6	B,C	BP	100
CDR31BP1R8B--	1.8	B,C	BP	100
CDR31BP2R0B--	2.0	B,C	BP	100
CDR31BP2R2B--	2.2	B,C	BP	100
CDR31BP2R4B--	2.4	B,C	BP	100
CDR31BP2R7B--	2.7	B,C,D	BP	100
CDR31BP3R0B--	3.0	B,C,D	BP	100
CDR31BP3R3B--	3.3	B,C,D	BP	100
CDR31BP3R6B--	3.6	B,C,D	BP	100
CDR31BP3R9B--	3.9	B,C,D	BP	100
CDR31BP4R3B--	4.3	B,C,D	BP	100
CDR31BP4R7B--	4.7	B,C,D	BP	100
CDR31BP5R1B--	5.1	B,C,D	BP	100
CDR31BP5R6B--	5.6	B,C,D	BP	100
CDR31BP6R2B--	6.2	B,C,D	BP	100
CDR31BP6R8B--	6.8	B,C,D	BP	100
CDR31BP7R5B--	7.5	B,C,D	BP	100
CDR31BP8R2B--	8.2	B,C,D	BP	100
CDR31BP9R1B--	9.1	B,C,D	BP	100
CDR31BP100B--	10	F,J,K	BP	100
CDR31BP110B--	11	F,J,K	BP	100
CDR31BP120B--	12	F,J,K	BP	100
CDR31BP130B--	13	F,J,K	BP	100
CDR31BP150B--	15	F,J,K	BP	100
CDR31BP160B--	16	F,J,K	BP	100
CDR31BP180B--	18	F,J,K	BP	100
CDR31BP200B--	20	F,J,K	BP	100
CDR31BP220B--	22	F,J,K	BP	100
CDR31BP240B--	24	F,J,K	BP	100
CDR31BP270B--	27	F,J,K	BP	100
CDR31BP300B--	30	F,J,K	BP	100
CDR31BP330B--	33	F,J,K	BP	100
CDR31BP360B--	36	F,J,K	BP	100
CDR31BP390B--	39	F,J,K	BP	100
CDR31BP430B--	43	F,J,K	BP	100
CDR31BP470B--	47	F,J,K	BP	100
CDR31BP510B--	51	F,J,K	BP	100
CDR31BP560B--	56	F,J,K	BP	100
CDR31BP620B--	62	F,J,K	BP	100
CDR31BP680B--	68	F,J,K	BP	100
CDR31BP750B--	75	F,J,K	BP	100
CDR31BP820B--	82	F,J,K	BP	100
CDR31BP910B--	91	F,J,K	BP	100

- Add appropriate failure rate
- Add appropriate termination finish
- Capacitance Tolerance

Military Type Designation 1 /	Capacitance in pF	Capacitance tolerance	Rated temperature and voltage-temperature limits	WVDC
<b>Style 0805/CDR31 (BP) cont'd</b>				
CDR31BP101B--	100	F,J,K	BP	100
CDR31BP111B--	110	F,J,K	BP	100
CDR31BP121B--	120	F,J,K	BP	100
CDR31BP131B--	130	F,J,K	BP	100
CDR31BP151B--	150	F,J,K	BP	100
CDR31BP161B--	160	F,J,K	BP	100
CDR31BP181B--	180	F,J,K	BP	100
CDR31BP201B--	200	F,J,K	BP	100
CDR31BP221B--	220	F,J,K	BP	100
CDR31BP241B--	240	F,J,K	BP	100
CDR31BP271B--	270	F,J,K	BP	100
CDR31BP301B--	300	F,J,K	BP	100
CDR31BP331B--	330	F,J,K	BP	100
CDR31BP361B--	360	F,J,K	BP	100
CDR31BP391B--	390	F,J,K	BP	100
CDR31BP431B--	430	F,J,K	BP	100
CDR31BP471B--	470	F,J,K	BP	100
CDR31BP511A--	510	F,J,K	BP	50
CDR31BP561A--	560	F,J,K	BP	50
CDR31BP621A--	620	F,J,K	BP	50
CDR31BP681A--	680	F,J,K	BP	50

Military Type Designation 1 /	Capacitance in pF	Capacitance tolerance	Rated temperature and voltage-temperature limits	WVDC
CDR31BX471B--	470	K,M	BX	100
CDR31BX561B--	560	K,M	BX	100
CDR31BX681B--	680	K,M	BX	100
CDR31BX821B--	820	K,M	BX	100
CDR31BX102B--	1,000	K,M	BX	100
CDR31BX122B--	1,200	K,M	BX	100
CDR31BX152B--	1,500	K,M	BX	100
CDR31BX182B--	1,800	K,M	BX	100
CDR31BX222B--	2,200	K,M	BX	100
CDR31BX272B--	2,700	K,M	BX	100
CDR31BX332B--	3,300	K,M	BX	100
CDR31BX392B--	3,900	K,M	BX	100
CDR31BX472B--	4,700	K,M	BX	100
CDR31BX562A--	5,600	K,M	BX	50
CDR31BX682A--	6,800	K,M	BX	50
CDR31BX822A--	8,200	K,M	BX	50
CDR31BX103A--	10,000	K,M	BX	50
CDR31BX123A--	12,000	K,M	BX	50
CDR31BX153A--	15,000	K,M	BX	50
CDR31BX183A--	18,000	K,M	BX	50

- Add appropriate failure rate
- Add appropriate termination finish
- Capacitance Tolerance

1/ The complete part number will include additional symbols to indicate capacitance tolerance, termination and failure rate level.

## CDR32 to MIL-PRF-55681/8

Military Type Designation 1 /	Capacitance in pF	Capacitance Tolerance	Rated temperature and Voltage-Temperature Limits	WVDC
<b>Style 1206/CDR32 (BP)</b>				
CDR32BP1R0B--	1.0	B,C	BP	100
CDR32BP1R1B--	1.1	B,C	BP	100
CDR32BP1R2B--	1.2	B,C	BP	100
CDR32BP1R3B--	1.3	B,C	BP	100
CDR32BP1R5B--	1.5	B,C	BP	100
CDR32BP1R6B--	1.6	B,C	BP	100
CDR32BP1R8B--	1.8	B,C	BP	100
CDR32BP2R0B--	2.0	B,C	BP	100
CDR32BP2R2B--	2.2	B,C	BP	100
CDR32BP2R4B--	2.4	B,C	BP	100
CDR32BP2R7B--	2.7	B,C,D	BP	100
CDR32BP3R0B--	3.0	B,C,D	BP	100
CDR32BP3R3B--	3.3	B,C,D	BP	100
CDR32BP3R6B--	3.6	B,C,D	BP	100
CDR32BP3R9B--	3.9	B,C,D	BP	100
CDR32BP4R3B--	4.3	B,C,D	BP	100
CDR32BP4R7B--	4.7	B,C,D	BP	100
CDR32BP5R1B--	5.1	B,C,D	BP	100
CDR32BP5R6B--	5.6	B,C,D	BP	100
CDR32BP6R2B--	6.2	B,C,D	BP	100
CDR32BP6R8B--	6.8	B,C,D	BP	100
CDR32BP7R5B--	7.5	B,C,D	BP	100
CDR32BP8R2B--	8.2	B,C,D	BP	100
CDR32BP9R1B--	9.1	B,C,D	BP	100
CDR32BP100B--	10	F,J,K	BP	100
CDR32BP110B--	11	F,J,K	BP	100
CDR32BP120B--	12	F,J,K	BP	100
CDR32BP130B--	13	F,J,K	BP	100
CDR32BP150B--	15	F,J,K	BP	100
CDR32BP160B--	16	F,J,K	BP	100
CDR32BP180B--	18	F,J,K	BP	100
CDR32BP200B--	20	F,J,K	BP	100
CDR32BP220B--	22	F,J,K	BP	100
CDR32BP240B--	24	F,J,K	BP	100
CDR32BP270B--	27	F,J,K	BP	100
CDR32BP300B--	30	F,J,K	BP	100
CDR32BP330B--	33	F,J,K	BP	100
CDR32BP360B--	36	F,J,K	BP	100
CDR32BP390B--	39	F,J,K	BP	100
CDR32BP430B--	43	F,J,K	BP	100
CDR32BP470B--	47	F,J,K	BP	100
CDR32BP510B--	51	F,J,K	BP	100
CDR32BP560B--	56	F,J,K	BP	100
CDR32BP620B--	62	F,J,K	BP	100
CDR32BP680B--	68	F,J,K	BP	100
CDR32BP750B--	75	F,J,K	BP	100
CDR32BP820B--	82	F,J,K	BP	100
CDR32BP910B--	91	F,J,K	BP	100

- └ Add appropriate failure rate
- └ Add appropriate termination finish
- └ Capacitance Tolerance

Military Type Designation 1 /	Capacitance in pF	Capacitance Tolerance	Rated Temperature and Voltage-Temperature Limits	WVDC
<b>Style 1206/CDR32 (BP) cont'd</b>				
CDR32BP101B--	100	F,J,K	BP	100
CDR32BP111B--	110	F,J,K	BP	100
CDR32BP121B--	120	F,J,K	BP	100
CDR32BP131B--	130	F,J,K	BP	100
CDR32BP151B--	150	F,J,K	BP	100
CDR32BP161B--	160	F,J,K	BP	100
CDR32BP181B--	180	F,J,K	BP	100
CDR32BP201B--	200	F,J,K	BP	100
CDR32BP221B--	220	F,J,K	BP	100
CDR32BP241B--	240	F,J,K	BP	100
CDR32BP271B--	270	F,J,K	BP	100
CDR32BP301B--	300	F,J,K	BP	100
CDR32BP331B--	330	F,J,K	BP	100
CDR32BP361B--	360	F,J,K	BP	100
CDR32BP391B--	390	F,J,K	BP	100
CDR32BP431B--	430	F,J,K	BP	100
CDR32BP471B--	470	F,J,K	BP	100
CDR32BP511B--	510	F,J,K	BP	100
CDR32BP561B--	560	F,J,K	BP	100
CDR32BP621B--	620	F,J,K	BP	100
CDR32BP681B--	680	F,J,K	BP	100
CDR32BP751B--	750	F,J,K	BP	100
CDR32BP821B--	820	F,J,K	BP	100
CDR32BP911B--	910	F,J,K	BP	100
CDR32BP102B--	1,000	F,J,K	BP	100
CDR32BP112A--	1,100	F,J,K	BP	50
CDR32BP122A--	1,200	F,J,K	BP	50
CDR32BP132A--	1,300	F,J,K	BP	50
CDR32BP152A--	1,500	F,J,K	BP	50
CDR32BP162A--	1,600	F,J,K	BP	50
CDR32BP182A--	1,800	F,J,K	BP	50
CDR32BP202A--	2,000	F,J,K	BP	50
CDR32BP222A--	2,200	F,J,K	BP	50
<b>Style 1206/CDR32 (BX)</b>				
CDR32BX472B--	4,700	K,M	BX	100
CDR32BX562B--	5,600	K,M	BX	100
CDR32BX682B--	6,800	K,M	BX	100
CDR32BX822B--	8,200	K,M	BX	100
CDR32BX103B--	10,000	K,M	BX	100
CDR32BX123B--	12,000	K,M	BX	100
CDR32BX153B--	15,000	K,M	BX	100
CDR32BX183A--	18,000	K,M	BX	50
CDR32BX223A--	22,000	K,M	BX	50
CDR32BX273A--	27,000	K,M	BX	50
CDR32BX333A--	33,000	K,M	BX	50
CDR32BX393A--	39,000	K,M	BX	50

- └ Add appropriate failure rate
- └ Add appropriate termination finish
- └ Capacitance Tolerance

1/ The complete part number will include additional symbols to indicate capacitance tolerance, termination and failure rate level.

### CDR33/34/35 to MIL-PRF-55681/9/10/11

Military Type Designation 1 /	Capacitance in pF	Capacitance tolerance	Rated temperature and voltage-temperature limits	WVDC
-------------------------------	-------------------	-----------------------	--	------

#### Style 1210/CDR33 (BP)

CDR33BP102B--	1,000	F,J,K	BP	100
CDR33BP112B--	1,100	F,J,K	BP	100
CDR33BP122B--	1,200	F,J,K	BP	100
CDR33BP132B--	1,300	F,J,K	BP	100
CDR33BP152B--	1,500	F,J,K	BP	100
CDR33BP162B--	1,600	F,J,K	BP	100
CDR33BP182B--	1,800	F,J,K	BP	100
CDR33BP202B--	2,000	F,J,K	BP	100
CDR33BP222B--	2,200	F,J,K	BP	100
CDR33BP242A--	2,400	F,J,K	BP	50
CDR33BP272A--	2,700	F,J,K	BP	50
CDR33BP302A--	3,000	F,J,K	BP	50
CDR33BP332A--	3,300	F,J,K	BP	50

#### Style 1210/CDR33 (BX)

CDR33BX153B--	15,000	K,M	BX	100
CDR33BX183B--	18,000	K,M	BX	100
CDR33BX223B--	22,000	K,M	BX	100
CDR33BX273B--	27,000	K,M	BX	100
CDR33BX393A--	39,000	K,M	BX	50
CDR33BX473A--	47,000	K,M	BX	50
CDR33BX563A--	56,000	K,M	BX	50
CDR33BX683A--	68,000	K,M	BX	50
CDR33BX823A--	82,000	K,M	BX	50
CDR33BX104A--	100,000	K,M	BX	50

#### Style 1812/CDR34 (BP)

CDR34BP222B--	2,200	F,J,K	BP	100
CDR34BP242B--	2,400	F,J,K	BP	100
CDR34BP272B--	2,700	F,J,K	BP	100
CDR34BP302B--	3,000	F,J,K	BP	100
CDR34BP332B--	3,300	F,J,K	BP	100
CDR34BP362B--	3,600	F,J,K	BP	100
CDR34BP392B--	3,900	F,J,K	BP	100
CDR34BP432B--	4,300	F,J,K	BP	100
CDR34BP472B--	4,700	F,J,K	BP	100
CDR34BP512A--	5,100	F,J,K	BP	50
CDR34BP562A--	5,600	F,J,K	BP	50
CDR34BP622A--	6,200	F,J,K	BP	50
CDR34BP682A--	6,800	F,J,K	BP	50
CDR34BP752A--	7,500	F,J,K	BP	100
CDR34BP822B--	8,200	F,J,K	BP	100
CDR34BP823A--	8,600	F,J,K	BP	50
CDR34BP912A--	9,100	F,J,K	BP	50
CDR34BP103A--	10,000	F,J,K	BP	50

Military Type Designation 1 /	Capacitance in pF	Capacitance tolerance	Rated temperature and voltage-temperature limits	WVDC
-------------------------------	-------------------	-----------------------	--	------

#### Style 1812/CDR34 (BX)

CDR34BX273B--	27,000	K,M	BX	100
CDR34BX333B--	33,000	K,M	BX	100
CDR34BX393B--	39,000	K,M	BX	100
CDR34BX473B--	47,000	K,M	BX	100
CDR34BX563B--	56,000	K,M	BX	100
CDR34BX104A--	100,000	K,M	BX	50
CDR34BX124A--	120,000	K,M	BX	50
CDR34BX154A--	150,000	K,M	BX	50
CDR34BX184A--	180,000	K,M	BX	50

#### Style 1825/CDR35 (BP)

CDR35BP472B--	4,700	F,J,K	BP	100
CDR35BP512B--	5,100	F,J,K	BP	100
CDR35BP562B--	5,600	F,J,K	BP	100
CDR35BP622B--	6,200	F,J,K	BP	100
CDR35BP682B--	6,800	F,J,K	BP	100
CDR35BP752B--	7,500	F,J,K	BP	100
CDR35BP822B--	8,200	F,J,K	BP	100
CDR35BP912B--	9,100	F,J,K	BP	100
CDR35BP103B--	10,000	F,J,K	BP	100
CDR35BP113A--	11,000	F,J,K	BP	50
CDR35BP123A--	12,000	F,J,K	BP	50
CDR35BP133A--	13,000	F,J,K	BP	50
CDR35BP153A--	15,000	F,J,K	BP	50
CDR35BP163A--	16,000	F,J,K	BP	50
CDR35BP183A--	18,000	F,J,K	BP	50
CDR35BP203A--	20,000	F,J,K	BP	50
CDR35BP223A--	22,000	F,J,K	BP	50

#### Style 1825/CDR35 (BX)

CDR35BX563B--	56,000	K,M	BX	100
CDR35BX683B--	68,000	K,M	BX	100
CDR35BX823B--	82,000	K,M	BX	100
CDR35BX104B--	100,000	K,M	BX	100
CDR35BX124B--	120,000	K,M	BX	100
CDR35BX154B--	150,000	K,M	BX	100
CDR35BX184A--	180,000	K,M	BX	50
CDR35BX224A--	220,000	K,M	BX	50
CDR35BX274A--	270,000	K,M	BX	50
CDR35BX334A--	330,000	K,M	BX	50
CDR35BX394A--	390,000	K,M	BX	50
CDR35BX474A--	470,000	K,M	BX	50

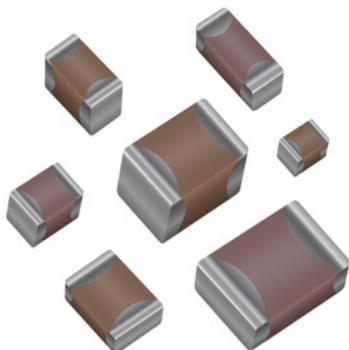
- Add appropriate failure rate
- Add appropriate termination finish
- Capacitance Tolerance

- Add appropriate failure rate
- Add appropriate termination finish
- Capacitance Tolerance

1/ The complete part number will include additional symbols to indicate capacitance tolerance, termination and failure rate level.

# MLCC Medical Applications – MM Series

## General Specifications



The MM series is a multi-layer ceramic capacitor designed for use in medical applications other than implantable/life support. These components have the design & change control expected for medical devices and also offer enhanced LAT including reliability testing and 100% inspection.

### APPLICATIONS

#### Implantable, Non-Life Supporting Medical Devices

- e.g. implanted temporary cardiac monitor, insulin pumps

#### External, Life Supporting Medical Devices

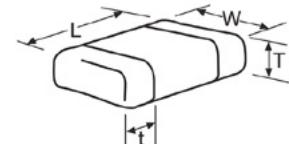
- e.g. heart pump external controller

#### External Devices

- e.g. patient monitoring, diagnostic equipment

### HOW TO ORDER

MM02	Z	A	100	J	G	T	3	A
Size	Rated Voltage	Dielectric Code	Capacitance Code (In pF) (2 significant digits + number of zeros)	Capacitance Tolerance	Failure Rate	Termination Finish	Packaging	Special Code
MM02 = 0402	Z = 10V	A = NPO (COG)	B = $\pm 0.1\text{pF}$	C = Standard Range	T = Plated Ni & Sn (NPO only)	2 = 7" Reel	A = Standard	
MM03 = 0603	Y = 16V	C = X7R	C = $\pm 0.25\text{pF}$	Contact KYOCERA AVX for others	Z = Flexiterm (X7R only)	4 = 13" Reel	Contact KYOCERA AVX for others	
MM05 = 0805	3 = 25V		D = $\pm 0.5\text{pF}$					
MM06 = 1206	5 = 50V		F = $\pm 1\%$ ( $\geq 10\text{pF}$ )					
MM10 = 1210	1 = 100V		G = $\pm 2\%$ ( $\geq 10\text{pF}$ )					
MM08 = 1808	2 = 200V		J = $\pm 5\%$					
MM12 = 1812	V = 250V		K = $\pm 10\%$					
MM20 = 2220	7 = 500V		M = $\pm 20\%$					
<b>for values <math>&lt; 10\text{pF}</math>:</b> letter R denotes decimal point. Example: 68pF = 680 8.2pF = 8R2								



### COMMERCIAL VS MM SERIES PROCESS COMPARISON

	Commercial	MM Series
<b>Administrative</b>	Standard part numbers; no restriction on who purchases these parts	Specific series part number, used to control supply of product
<b>Lot Qualification Destructive Physical Analysis (DPA)</b>	As per EIA RS469	Increased sample plan – stricter criteria
<b>Visual/Cosmetic Quality</b>	Standard process and inspection	100% inspection
<b>Application Robustness</b>	Standard sampling for accelerated wave solder on X7R and NPO followed by lot by lot reliability testing	Increased sampling for accelerated wave solder on X7R and NPO followed by lot by lot reliability testing
<b>Design/Change Control</b>	Required to inform customer of changes in: form fit function	KYOCERA AVX will qualify and notify customers before making any change to the following materials or processes: Dielectric formulation, type, or supplier Metal formulation, type, or supplier Termination material formulation, type, or supplier Manufacturing equipment type Quality testing regime including sample size and accept/ reject criteria

# MM Series – MLCC for Medical Applications

## 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 ± 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		
	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 ± 5°C for 5.0 ± 0.5 seconds	
Resistance to Solder Heat	Appearance	No defects, <25% leaching of either end terminal		
	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: -55°C ± 2° 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: +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	Charge device with twice rated voltage in test chamber set at 125°C ± 2°C 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	≥ 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 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 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)		



The Important Information/Disclaimer is incorporated in the catalog where these specifications came from or available online at [www.kyocera-avx.com/disclaimer/](http://www.kyocera-avx.com/disclaimer/) by reference and should be reviewed in full before placing any order.

# MM Series – MLCC for Medical Applications

## NP0/C0G Capacitance Range

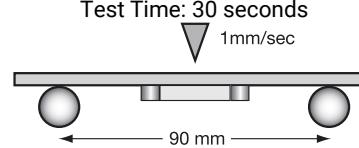


### PREFERRED SIZES ARE SHADED

SIZE	0603				0805				1206				
	WVDC	16	25	50	100	16	25	50	100	16	25	50	100
Cap (pF)	0.5	0R5											
	1.0	1R0											
	1.2	1R2											
	1.5	1R5											
	1.8	1R8											
	2.2	2R2											
	2.7	2R7											
	3.3	3R3											
	3.9	3R9											
	4.7	4R7											
	5.6	5R6											
	6.8	6R8											
	8.2	8R2											
	10	100											
	12	120											
	15	150											
	18	180											
	22	220											
	27	270											
	33	330											
	39	390											
	47	470											
	56	560											
	68	680											
	82	820											
	100	101											
	120	121											
	150	151											
	180	181											
	220	221											
	270	271											
	330	331											
	390	391											
	470	471											
	560	561											
	680	681											
	820	821											
	1000	102											
	1200	122											
	1500	152											
WVDC	16	25	50	100	16	25	50	100	16	25	50	100	
SIZE	0603				0805				1206				

# MM Series – MLCC for Medical Applications

## X7R 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				
Dissipation Factor	$\leq 10\%$ for $\geq 50V$ DC rating $\leq 12.5\%$ for $25V$ DC rating $\leq 12.5\%$ for $25V$ and $16V$ DC rating $\leq 12.5\%$ for $\leq 10V$ DC rating		Freq.: 1.0 kHz $\pm 10\%$ Voltage: 1.0Vrms $\pm .2V$		
Insulation Resistance	100,000MΩ or 1000MΩ - $\mu$ 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 250% 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			
	Capacitance Variation	$\leq \pm 12\%$			
	Dissipation Factor	Meets Initial Values (As Above)			
	Insulation Resistance	$\geq$ Initial Value $\times 0.3$			
Solderability	$\geq 95\%$ of each terminal should be covered with fresh solder		Dip device in eutectic solder at $230 \pm 5^\circ C$ 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 $260^\circ C$ 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: $-55^\circ C \pm 2^\circ$ $30 \pm 3$ minutes	
	Capacitance Variation	$\leq \pm 7.5\%$		Step 2: Room Temp $\leq 3$ minutes	
	Dissipation Factor	Meets Initial Values (As Above)		Step 3: $+125^\circ C \pm 2^\circ$ $30 \pm 3$ 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	
Load Life	Appearance	No visual defects		Charge device with 1.5 rated voltage ( $\leq 10V$ ) in test chamber set at $125^\circ C \pm 2^\circ C$ 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)			
Load Humidity	Appearance	No visual defects		Store in a test chamber set at $85^\circ C \pm 2^\circ C / 85\% \pm 5\%$ 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)			

# MM Series – MLCC for Medical Applications



## X7R Capacitance Range

PREFERRED SIZES ARE SHADED

SIZE	0402		0603		0805		1206		1210		1808		1812		2220													
	WVDC	16	25	50	10	16	25	50	100	200	250	10	16	25	50	100	200	250	500	100	200	50	100	200	250	25	50	100
Cap (pF)	220	221																										
	270	271																										
	330	331																										
	390	391																										
	470	471																										
	560	561																										
	680	681																										
	820	821																										
	1000	102																										
	1200	122																										
	1500	152																										
	1800	182																										
	2200	222																										
	2700	272																										
	3300	332																										
	3900	392																										
	4700	472																										
	5600	562																										
	6800	682																										
	8200	822																										
cap	0.010	103																										
uF	0.012	123																										
	0.015	153																										
	0.018	183																										
	0.022	223																										
	0.027	273																										
	0.033	333																										
	0.039	393																										
	0.047	473																										
	0.056	563																										
	0.068	683																										
	0.082	823																										
	0.10	104																										
	0.12	124																										
	0.15	154																										
	0.22	224																										
	0.33	334																										
	0.47	474																										
	0.56	564																										
	0.68	684																										
	0.82	824																										
	1.0	105																										
	1.2	125																										
	1.5	155																										
WVDC	16	25	50	10	16	25	50	100	200	10	16	25	50	100	200	250	500	10	16	25	50	100	200	250	500	25	50	100
SIZE	0402	0603	0805	1206	1210	1808	1812	2220																				

# Packaging of Chip Components

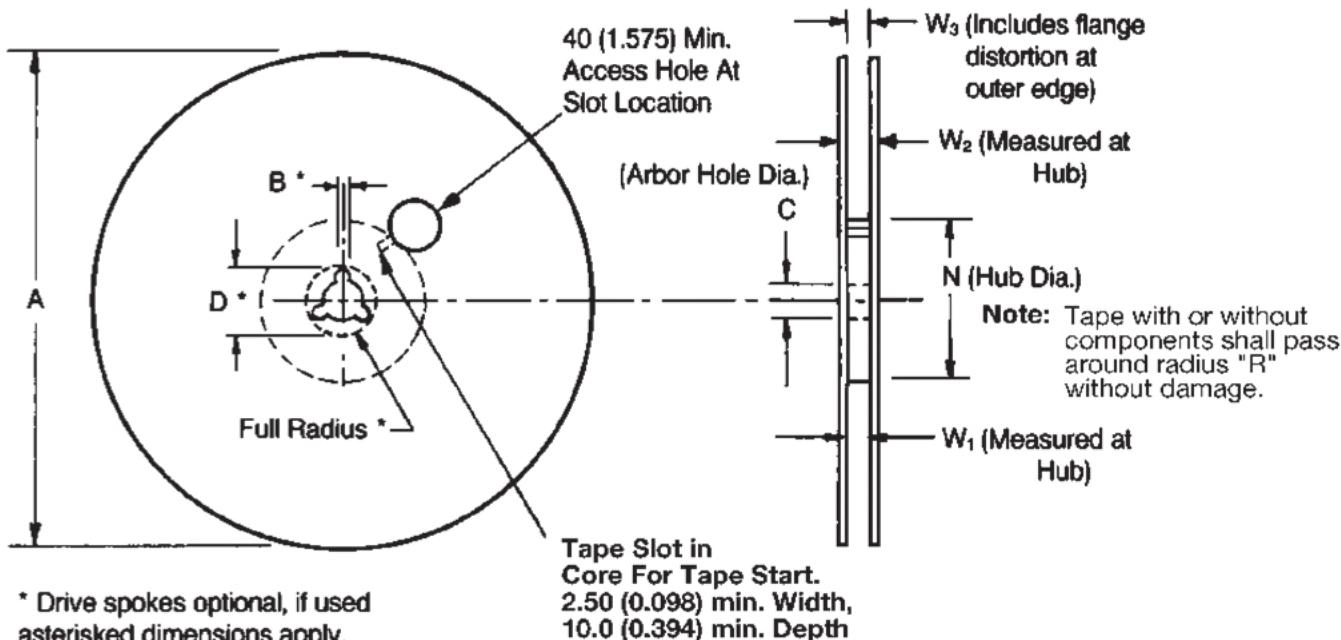
## Automatic Insertion Packaging

### TAPE & REEL QUANTITIES

All tape and reel specifications are in compliance with RS481.

	4mm	8mm	12mm	
Paper or Embossed Carrier		0612, 0508, 0805, 1206, 1210		
Embossed Only	0101		1808	1812, 1825 2220, 2225
Paper Only		0101, 0201, 0306, 0402, 0603		
Qty. per Reel/7" Reel	4,000	1,000, 2,000, 3,000 or 4,000, 10,000, 15,000, 20,000 Contact factory for exact quantity	3,000	500, 1,000 Contact factory for exact quantity
Qty. per Reel/13" Reel		5,000, 10,000, 50,000 Contact factory for exact quantity	10,000	4,000

### REEL DIMENSIONS



\* Drive spokes optional, if used asterisked dimensions apply.

Tape Size <sup>(1)</sup>	A Max.	B* Min.	C	D* Min.	N Min.	W <sub>1</sub>	W <sub>2</sub> Max.	W <sub>3</sub>
4mm	1.80 (7.087)	1.5 (0.059)	13.0 <sup>±0.5</sup> (0.522 <sup>±0.020</sup> )	20.2 (0.795)	60.0 (2.362)	4.35 <sup>±0.3</sup> (0.171 <sup>±0.011</sup> )	7.95 (0.312)	
8mm						8.40 <sup>±1.5</sup> (0.331 <sup>±0.059</sup> )	14.4 (0.567)	7.90 Min. (0.311) 10.9 Max. (0.429)
12mm	330 (12.992)	1.5 (0.059)	13.0 <sup>±0.50</sup> (0.512 <sup>±0.020</sup> )	20.2 (0.795)	50.0 (1.969)	12.4 <sup>±2.0</sup> (0.488 <sup>±0.079</sup> )	18.4 (0.724)	11.9 Min. (0.469) 15.4 Max. (0.607)

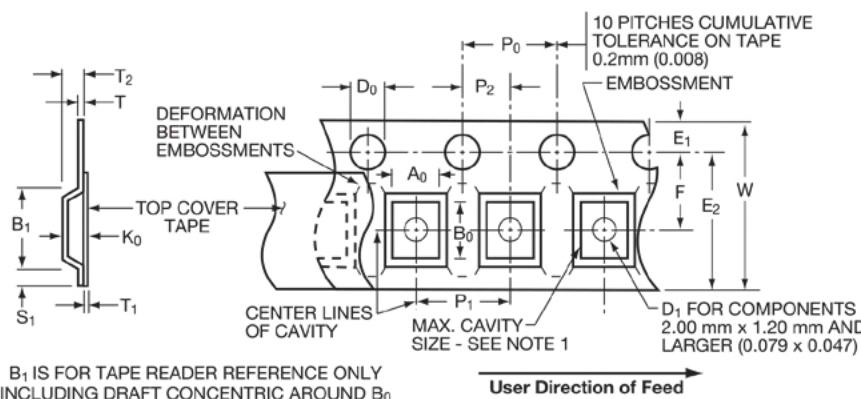
Metric dimensions will govern.

English measurements rounded and for reference only.

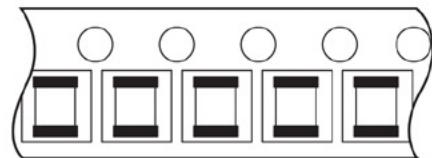
(1) For tape sizes 16mm and 24mm (used with chip size 3640) consult EIA RS-481 latest revision.

# Embossed Carrier Configuration

## 4, 8 & 12mm Tape Only



### Chip Orientation



## 4, 8 & 12mm Embossed Tape Metric Dimensions Will Govern

### CONSTANT DIMENSIONS

Tape Size	D <sub>0</sub>	E <sub>1</sub>	P <sub>0</sub>	P <sub>2</sub>	S <sub>1</sub> Min.	T Max.	T <sub>1</sub> Max.
4mm	0.80±0.04 (0.031±0.001)	0.90±0.05 (0.035±0.001)	2.0±0.04 (0.078±0.001)	1.00±0.02 (0.039±0.0007)	1.075 (0.042)	0.26 (0.010)	0.06 (0.002)
8mm & 12mm	1.50 <sup>+0.10</sup> (0.059 <sup>+0.004</sup> )	1.75 ± 0.10 (0.069 ± 0.004)	4.0 ± 0.10 (0.157 ± 0.004)	2.0 ± 0.05 (0.079 ± 0.002)	0.60 (0.024)	0.60 (0.024)	0.10 (0.004)

### VARIABLE DIMENSIONS

Tape Size	B <sub>1</sub> Max.	D <sub>1</sub> Min.	E <sub>2</sub> Min.	F	P <sub>1</sub> See Note 5	R Min. See Note 2	T <sub>2</sub>	W Max.	A <sub>0</sub> B <sub>0</sub> K <sub>0</sub>
8mm	4.35 (0.171)	1.00 (0.039)	6.25 (0.246)	3.50 ± 0.05 (0.138 ± 0.002)	4.00 ± 0.10 (0.157 ± 0.004)	25.0 (0.984)	2.50 Max. (0.098)	8.30 (0.327)	See Note 1
12mm	8.20 (0.323)	1.50 (0.059)	10.25 (0.404)	5.50 ± 0.05 (0.217 ± 0.002)	4.00 ± 0.10 (0.157 ± 0.004)	30.0 (1.181)	6.50 Max. (0.256)	12.3 (0.484)	See Note 1
8mm 1/2 Pitch	4.35 (0.171)	1.00 (0.039)	6.25 (0.246)	3.50 ± 0.05 (0.138 ± 0.002)	2.00 ± 0.10 (0.079 ± 0.004)	25.0 (0.984)	2.50 Max. (0.098)	8.30 (0.327)	See Note 1
12mm Double Pitch	8.20 (0.323)	1.50 (0.059)	10.25 (0.404)	5.50 ± 0.05 (0.217 ± 0.002)	8.00 ± 0.10 (0.315 ± 0.004)	30.0 (1.181)	6.50 Max. (0.256)	12.3 (0.484)	See Note 1

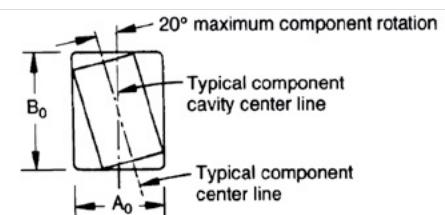
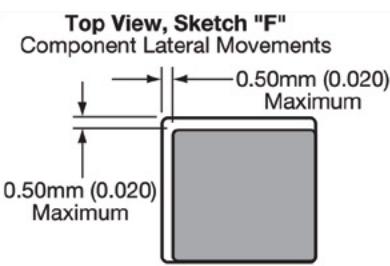
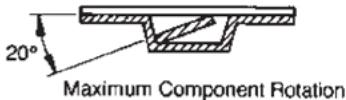
#### NOTES:

1. The cavity defined by A<sub>0</sub>, B<sub>0</sub>, and K<sub>0</sub> shall be configured to provide the following:  
Surround the component with sufficient clearance such that:  
b) the component does not protrude beyond the sealing plane of the cover tape.  
c) the component can be removed from the cavity in a vertical direction without mechanical restriction, after the cover tape has been removed.  
d) rotation of the component is limited to 20° maximum (see Sketches D & E).  
e) lateral movement of the component is restricted to 0.5mm maximum (see Sketch F).
2. Tape with or without components shall pass around radius "R" without damage.

3. Bar code labeling (if required) shall be on the side of the reel opposite the round sprocket holes. Refer to EIA-556.

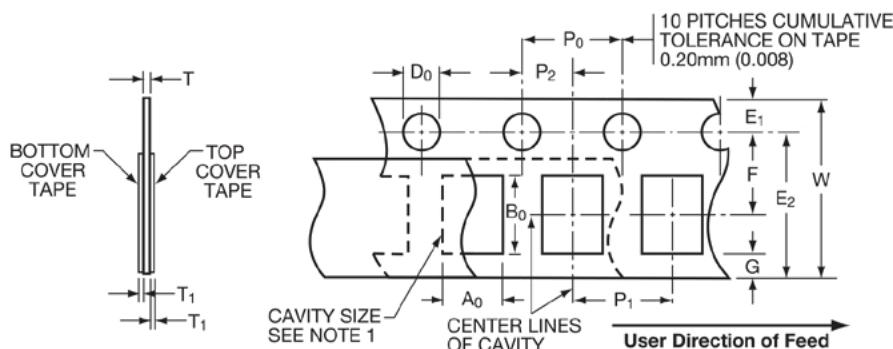
4. B<sub>1</sub> dimension is a reference dimension for tape feeder clearance only.

5. If P<sub>1</sub> = 2.0mm, the tape may not properly index in all tape feeders.



# Paper Carrier Configuration

## 8 & 12mm Tape Only



## 4, 8 & 12mm Embossed Tape Metric Dimensions Will Govern

### CONSTANT DIMENSIONS

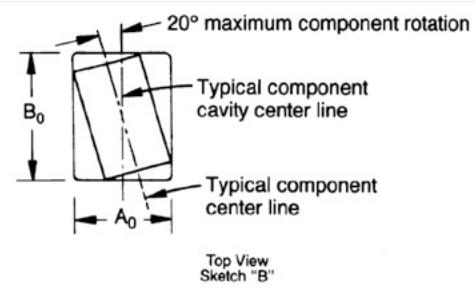
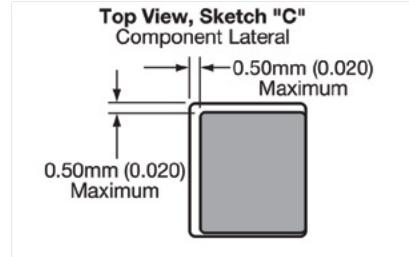
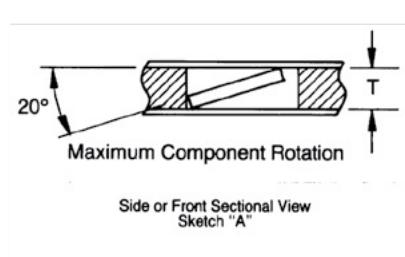
Tape Size	D <sub>0</sub>	E	P <sub>0</sub>	P <sub>2</sub>	T <sub>1</sub>	G. Min.	R Min.
8mm and 12mm	1.50 <sup>+0.10</sup> (0.059 <sup>+0.004</sup> )	1.75 ± 0.10 (0.069 ± 0.004)	4.00 ± 0.10 (0.157 ± 0.004)	2.00 ± 0.05 (0.079 ± 0.002)	0.10 (0.004) Max.	0.75 (0.030) Min.	25.0 (0.984) See Note 2 Min.

### VARIABLE DIMENSIONS

Tape Size	P <sub>1</sub> See Note 4	E <sub>2</sub> Min.	F	W	A <sub>0</sub> B <sub>0</sub>	T
8mm	4.00 ± 0.10 (0.157 ± 0.004)	6.25 (0.246)	3.50 ± 0.05 (0.138 ± 0.002)	8.00 <sup>+0.30</sup> (0.315 <sup>+0.012</sup> )	See Note 1	1.10mm (0.043) Max. for Paper Base Tape and 1.60mm (0.063) Max. for Non-Paper Base Compositions
12mm	4.00 ± 0.10 (0.157 ± 0.004)	10.25 (0.404)	5.50 ± 0.05 (0.217 ± 0.002)	12.0 ± 0.30 (0.472 ± 0.012)		
8mm 1/2 Pitch	2.00 ± 0.05 (0.079 ± 0.002)	6.25 (0.246)	3.50 ± 0.05 (0.138 ± 0.002)	8.00 <sup>+0.30</sup> (0.315 <sup>+0.012</sup> )		
12mm Double Pitch	8.00 ± 0.10 (0.315 ± 0.004)	10.25 (0.404)	5.50 ± 0.05 (0.217 ± 0.002)	12.0 ± 0.30 (0.472 ± 0.012)		

#### NOTES:

- The cavity defined by A<sub>0</sub>, B<sub>0</sub>, and T shall be configured to provide sufficient clearance surrounding the component so that:
  - the component does not protrude beyond either surface of the carrier tape;
  - the component can be removed from the cavity in a vertical direction without mechanical restriction after the top cover tape has been removed;
  - rotation of the component is limited to 20° maximum (see Sketches A & B);
  - lateral movement of the component is restricted to 0.5mm maximum (see Sketch C).
- Tape with or without components shall pass around radius "R" without damage.
- Bar code labeling (if required) shall be on the side of the reel opposite the sprocket holes. Refer to EIA-556.
- If P<sub>1</sub> = 2.0mm, the tape may not properly index in all tape feeders.



## Bar Code Labeling Standard

KYOCERA AVX bar code labeling is available and follows latest version of EIA-556

# Basic Capacitor Formulas

## I. Capacitance (farads)

English:  $C = \frac{.224 \text{ K A}}{T_D}$

Metric:  $C = \frac{.0884 \text{ K A}}{T_D}$

## II. Energy stored in capacitors (Joules, watt - sec)

$E = \frac{1}{2} CV^2$

## III. Linear charge of a capacitor (Amperes)

$$I = C \frac{dV}{dt}$$

## IV. Total Impedance of a capacitor (ohms)

$$Z = \sqrt{R_S^2 + (X_C - X_L)^2}$$

## V. Capacitive Reactance (ohms)

$$X_C = \frac{1}{2 \pi f C}$$

## VI. Inductive Reactance (ohms)

$$X_L = 2 \pi f L$$

## VII. Phase Angles:

Ideal Capacitors: Current leads voltage 90°

Ideal Inductors: Current lags voltage 90°

Ideal Resistors: Current in phase with voltage

## VIII. Dissipation Factor (%)

$$D.F. = \tan \delta \text{ (loss angle)} = \frac{E.S.R.}{X_C} = (2 \pi f C) \text{ (E.S.R.)}$$

## IX. Power Factor (%)

P.F. = Sine (loss angle) =  $\cos \varphi$  (phase angle)

P.F. = (when less than 10%) = DF

## X. Quality Factor (dimensionless)

$$Q = \text{Cotan } \delta \text{ (loss angle)} = \frac{1}{D.F.}$$

## XI. Equivalent Series Resistance (ohms)

$$E.S.R. = (D.F.) (X_C) = (D.F.) / (2 \pi f C)$$

## XII. Power Loss (watts)

$$\text{Power Loss} = (2 \pi f C V^2) (D.F.)$$

## XIII. KVA (Kilowatts)

$$KVA = 2 \pi f C V^2 \times 10^{-3}$$

## XIV. Temperature Characteristic (ppm/°C)

$$T.C. = \frac{C_t - C_{25}}{C_{25} (T_t - 25)} \times 10^6$$

## XV. Cap Drift (%)

$$C.D. = \frac{C_1 - C_2}{C_1} \times 100$$

## XVI. Reliability of Ceramic Capacitors

$$L_0 = \left( \frac{V_t}{V_o} \right)^X \left( \frac{T_t}{T_o} \right)^Y$$

## XVII. Capacitors in Series (current the same)

$$\text{Any Number: } \frac{1}{C_T} = \frac{1}{C_1} + \frac{1}{C_2} + \dots + \frac{1}{C_N}$$

$$\text{Two: } C_T = \frac{C_1 C_2}{C_1 + C_2}$$

## XVIII. Capacitors in Parallel (voltage the same)

$$C_T = C_1 + C_2 + \dots + C_N$$

## XIX. Aging Rate

$$A.R. = \% \Delta C / \text{decade of time}$$

## XX. Decibels

$$db = 20 \log \frac{V_1}{V_2}$$

## METRIC PREFIXES

Pico	$\times 10^{-12}$
Nano	$\times 10^{-9}$
Micro	$\times 10^{-6}$
Milli	$\times 10^{-3}$
Deci	$\times 10^{-1}$
Deca	$\times 10^{+1}$
Kilo	$\times 10^{+3}$
Mega	$\times 10^{+6}$
Giga	$\times 10^{+9}$
Tera	$\times 10^{+12}$

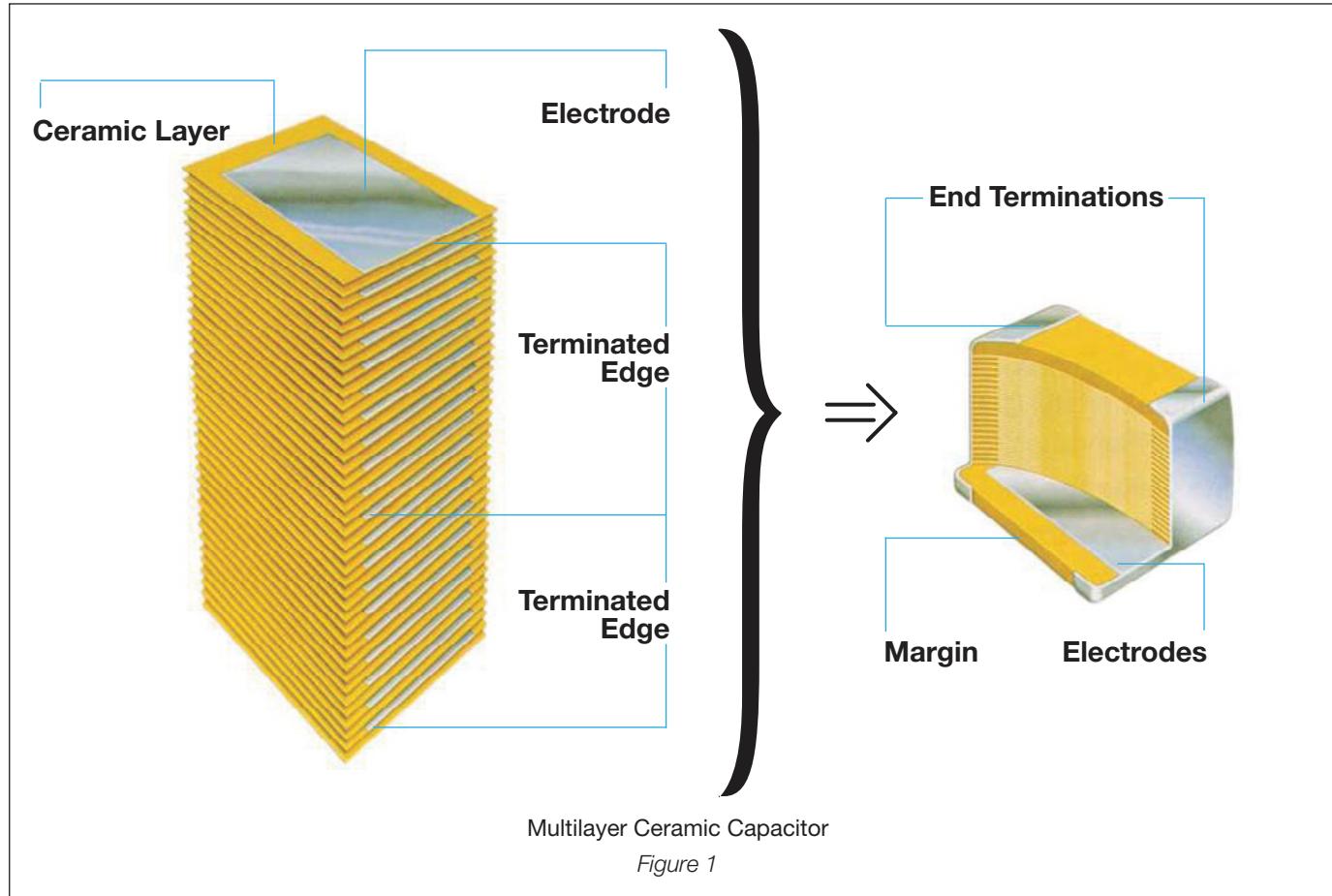
## SYMBOLS

$K$ = Dielectric Constant	$f$ = frequency	$L_t$ = Test life
$A$ = Area	$L$ = Inductance	$V_t$ = Test voltage
$T_D$ = Dielectric thickness	$\delta$ = Loss angle	$V_o$ = Operating voltage
$V$ = Voltage	$\varphi$ = Phase angle	$T_t$ = Test temperature
$t$ = time	$X \& Y$ = exponent effect of voltage and temp.	$T_o$ = Operating temperature
$R_S$ = Series Resistance	$L_o$ = Operating life	

## General Description

**Basic Construction** – A multilayer ceramic (MLC) capacitor is a monolithic block of ceramic containing two sets of offset, interleaved planar electrodes that extend to two opposite surfaces of the ceramic dielectric. This simple structure requires a considerable amount of sophistication, both in material and manufacture, to produce it in the quality and quantities needed in

today's electronic equipment.



**Formulations** – Multilayer ceramic capacitors are available in both Class 1 and Class 2 formulations. Temperature compensating formulation are Class 1 and temperature stable and general application formulations are classified as Class 2.

**Class 1** – Class 1 capacitors or temperature compensating capacitors are usually made from mixtures of titanates where barium titanate is normally not a major part of the mix. They have predictable temperature coefficients and in general, do not have an aging characteristic. Thus they are the most stable capacitor available. The most popular Class 1 multilayer ceramic capacitors are COG (NPO) temperature compensating capacitors (negative-positive 0 ppm/°C).

**Class 2** – EIA Class 2 capacitors typically are based on the chemistry of barium titanate and provide a wide range of capacitance values and temperature stability. The most commonly used Class 2 dielectrics are X7R and Y5V. The X7R provides intermediate capacitance values which vary only  $\pm 15\%$  over the temperature range of -55°C to 125°C. It finds applications where stability over a wide temperature range is required.

The Y5V provides the highest capacitance values and is used in applications where limited temperature changes are expected. The capacitance value for Y5V can vary from 22% to -82% over the -30°C to 85°C temperature range.

All Class 2 capacitors vary in capacitance value under the influence of temperature, operating voltage (both AC and DC), and frequency. For additional information on performance changes with operating conditions, consult KYOCERA AVX's software, SpiCap.

## General Description

Table 1: EIA and MIL Temperature Stable and General Application Codes

EIA CODE	
Percent Capacity Change Over Temperature Range	
RS198	Temperature Range
X7	-55°C to +125°C
X6	-55°C to +105°C
X5	-55°C to +85°C
Y5	-30°C to +85°C
Z5	+10°C to +85°C
Code	Percent Capacity Change
D	±3.3%
E	±4.7%
F	±7.5%
P	±10%
R	±15%
S	±22%
T	+22%, -33%
U	+22%, -56%
V	+22%, -82%

EXAMPLE – A capacitor is desired with the capacitance value at 25°C to increase no more than 7.5% or decrease no more than 7.5% from -30°C to +85°C. EIA Code will be Y5F.

MIL CODE		
Symbol	Temperature Range	
A	-55°C to +85°C	
B	-55°C to +125°C	
C	-55°C to +150°C	
Symbol	Cap. Change Zero Volts	Cap. Change Rated Volts
R	+15%, -15%	+15%, -40%
S	+22%, -22%	+22%, -56%
W	+22%, -56%	+22%, -66%
X	+15%, -15%	+15%, -25%
Y	+30%, -70%	+30%, -80%
Z	+20%, -20%	+20%, -30%

Temperature characteristic is specified by combining range and change symbols, for example BR or AW. Specification slash sheets indicate the characteristic applicable to a given style of capacitor.

In specifying capacitance change with temperature for Class 2 materials, EIA expresses the capacitance change over an operating temperature range by a 3 symbol code. The first symbol represents the cold temperature end of the temperature range, the second represents the upper limit of the operating temperature range and the third symbol represents the capacitance change allowed over the operating temperature range. Table 1 provides a detailed explanation of the EIA system.

**Effects of Voltage** – Variations in voltage have little effect on Class 1 dielectric but does affect the capacitance and dissipation factor of Class 2 dielectrics. The application of DC voltage reduces both the capacitance and dissipation factor while the application of an AC voltage within a reasonable range tends to increase both capacitance and dissipation factor readings. If a high enough AC voltage is applied, eventually it will reduce capacitance just as a DC voltage will. Figure 2 shows the effects of AC voltage.

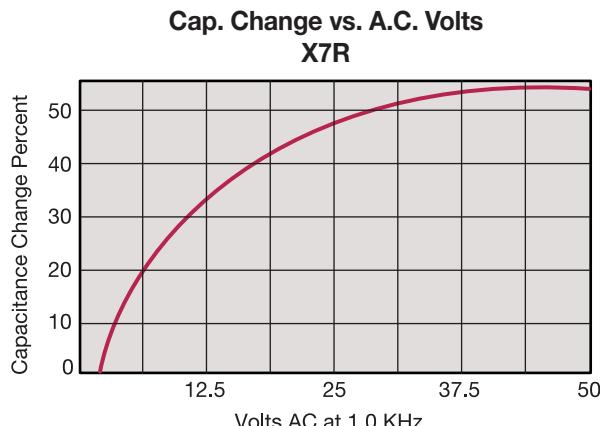


Figure 2

Capacitor specifications specify the AC voltage at which to measure (normally 0.5 or 1 VAC) and application of the wrong voltage can cause spurious readings. Figure 3 gives the voltage coefficient of dissipation factor for various AC voltages at 1 kilohertz. Applications of different frequencies will affect the percentage changes versus voltages.

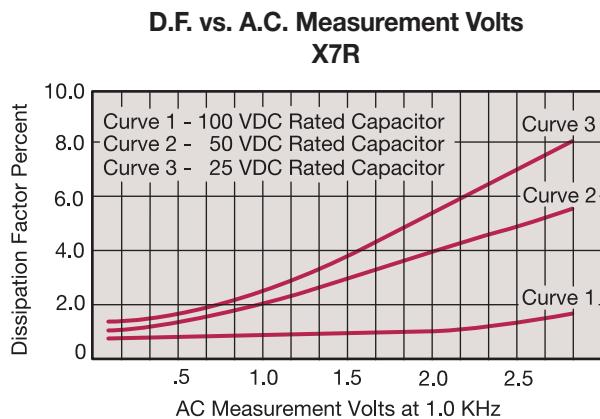


Figure 3

Typical effect of the application of DC voltage is shown in Figure 4. The voltage coefficient is more pronounced for higher K dielectrics. These figures are shown for room temperature conditions. The combination characteristic known as voltage temperature limits which shows the effects of rated voltage over the operating temperature range is shown in Figure 5 for the military BX characteristic.

## General Description

**Example Change vs. D.C. Volts**  
X7R

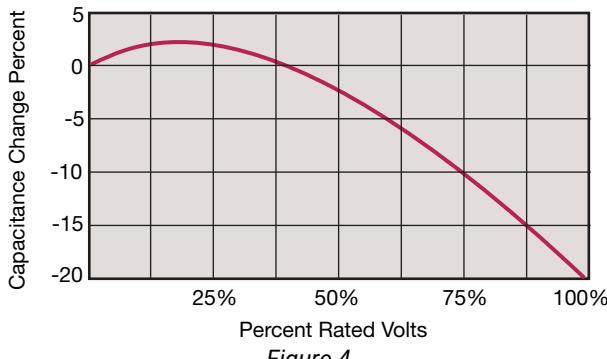


Figure 4

**Example Cap. Change vs. Temperature**  
X7R

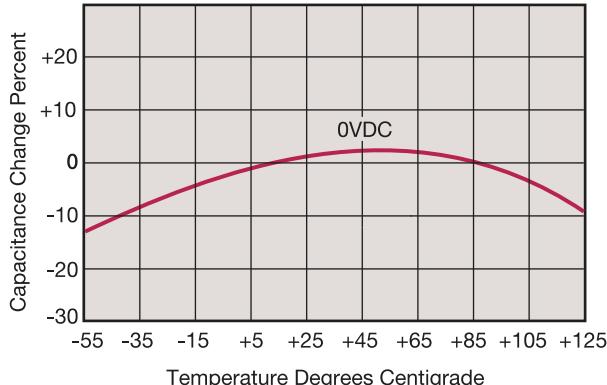
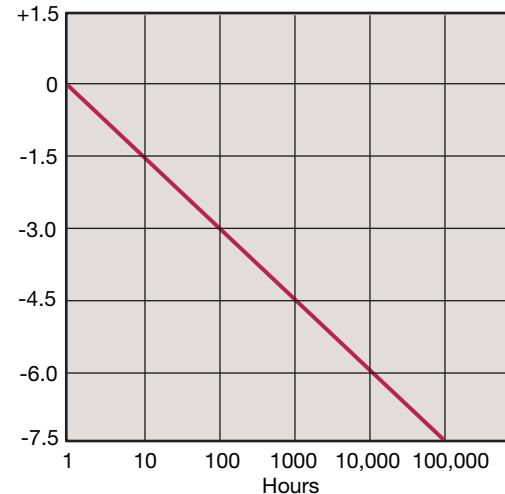


Figure 5

**Effects of Time** – Class 2 ceramic capacitors change capacitance and dissipation factor with time as well as temperature, voltage and frequency. This change with time is known as aging. Aging is caused by a gradual re-alignment of the crystalline structure of the ceramic and produces an exponential loss in capacitance and decrease in dissipation factor versus time. A typical curve of aging rate for semistable ceramics is shown in Figure 6.

If a Class 2 ceramic capacitor that has been sitting on the shelf for a period of time, is heated above its curie point, (125°C for 4 hours or 150°C for 1/2 hour will suffice) the part will de-age and return to its initial capacitance and dissipation factor readings. Because the capacitance changes rapidly, immediately after de-aging, the basic capacitance measurements are normally referred to a time period sometime after the de-aging process. Various manufacturers use different time bases but the most popular one is one day or twenty-four hours after "last heat." Change in the aging curve can be caused by the application of voltage and other stresses. The possible changes in capacitance due to de-aging by heating the unit explain why capacitance changes are allowed after test, such as temperature cycling, moisture resistance, etc., in MIL specs. The application of high voltages such as dielectric withstanding voltages also tends to de-age capacitors and is why re-reading of capacitance after 12 or 24 hours is allowed in military specifications after dielectric strength tests have been performed.

**Example Curve of Aging Rate**  
X7R



Characteristic	Max. Aging Rate %/Decade
C0G (NP0)	None
X7R, X5R	2
Y5V	7

Figure 6

**Effects of Frequency** – Frequency affects capacitance and impedance characteristics of capacitors. This effect is much more pronounced in high dielectric constant ceramic formulation than in low K formulations. KYOCERA AVX's SpiCap software generates impedance, ESR, series inductance, series resonant frequency and capacitance all as functions of frequency, temperature and DC bias for standard chip sizes and styles. It is available free from KYOCERA AVX and can be downloaded for free from KYOCERA AVX website: [www.kyocera-avx.com](http://www.kyocera-avx.com).



## General Description

**Effects of Mechanical Stress** – High "K" dielectric ceramic capacitors exhibit some low level piezoelectric reactions under mechanical stress. As a general statement, the piezoelectric output is higher, the higher the dielectric constant of the ceramic. It is desirable to investigate this effect before using high "K" dielectrics as coupling capacitors in extremely low level applications.

**Reliability** – Historically ceramic capacitors have been one of the most reliable types of capacitors in use today. The approximate formula for the reliability of a ceramic capacitor is:

$$\frac{L_o}{L_t} = \left( \frac{V_t}{V_o} \right)^X \left( \frac{T_t}{T_o} \right)^Y$$

where

$L_o$  = operating life

$L_t$  = test life

$V_t$  = test voltage

$V_o$  = operating voltage

$T_t$  = test temperature and

$T_o$  = operating temperature  
in °C

$X, Y$  = see text

Historically for ceramic capacitors exponent X has been considered as 3. The exponent Y for temperature effects typically tends to run about 8.

A capacitor is a component which is capable of storing electrical energy. It consists of two conductive plates (electrodes) separated by insulating material which is called the dielectric. A typical formula for determining capacitance is:

$$C = \frac{.224 \text{ KA}}{t}$$

$C$  = capacitance (picofarads)

$K$  = dielectric constant (Vacuum = 1)

$A$  = area in square inches

$t$  = separation between the plates in inches  
(thickness of dielectric)

.224 = conversion constant  
(.0884 for metric system in cm)

**Capacitance** – The standard unit of capacitance is the farad. A capacitor has a capacitance of 1 farad when 1 coulomb charges it to 1 volt. One farad is a very large unit and most capacitors have values in the micro ( $10^{-6}$ ), nano ( $10^{-9}$ ) or pico ( $10^{-12}$ ) farad level.

**Dielectric Constant** – In the formula for capacitance given above the dielectric constant of a vacuum is arbitrarily chosen as the number 1. Dielectric constants of other materials are then compared to the dielectric constant of a vacuum.

**Dielectric Thickness** – Capacitance is indirectly proportional to the separation between electrodes. Lower voltage requirements mean thinner dielectrics and greater capacitance per volume.

**Area** – Capacitance is directly proportional to the area of the electrodes. Since the other variables in the equation are usually set by the performance desired, area is the easiest parameter to modify to obtain a specific capacitance within a material group.

**Energy Stored** – The energy which can be stored in a capacitor is given by the formula:

$$E = \frac{1}{2}CV^2$$

$E$  = energy in joules (watts-sec)

$V$  = applied voltage

$C$  = capacitance in farads

**Potential Change** – A capacitor is a reactive component which reacts against a change in potential across it. This is shown by the equation for the linear charge of a capacitor:

$$I_{\text{ideal}} = C \frac{dV}{dt}$$

where

$I$  = Current

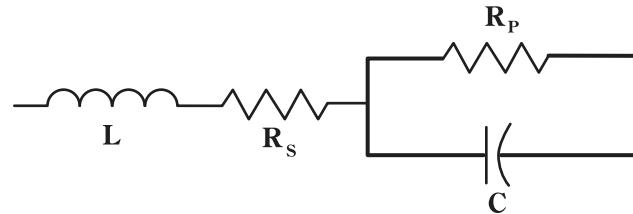
$C$  = Capacitance

$dV/dt$  = Slope of voltage transition across capacitor

Thus an infinite current would be required to instantly change the potential across a capacitor. The amount of current a capacitor can "sink" is determined by the above equation.

**Equivalent Circuit** – A capacitor, as a practical device, exhibits not only capacitance but also resistance and inductance. A simplified schematic for the equivalent circuit is:

$C$  = Capacitance  $L$  = Inductance  
 $R_s$  = Series Resistance  $R_p$  = Parallel Resistance



**Reactance** – Since the insulation resistance ( $R_p$ ) is normally very high, the total impedance of a capacitor is:

$$Z = \sqrt{R_s^2 + (X_C - X_L)^2}$$

where

$Z$  = Total Impedance

$R_s$  = Series Resistance

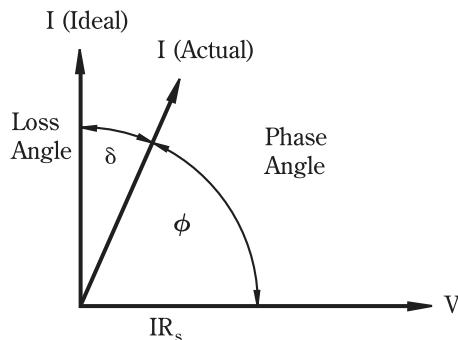
$X_C$  = Capacitive Reactance  $= \frac{1}{2\pi fC}$

$X_L$  = Inductive Reactance  $= 2\pi fL$

The variation of a capacitor's impedance with frequency determines its effectiveness in many applications.

**Phase Angle** – Power Factor and Dissipation Factor are often confused since they are both measures of the loss in a capacitor under AC application and are often almost identical in value. In a "perfect" capacitor the current in the capacitor will lead the voltage by 90°.

## General Description



In practice the current leads the voltage by some other phase angle due to the series resistance  $R_s$ . The complement of this angle is called the loss angle and:

$$\text{Power Factor (P.F.)} = \cos \phi \text{ or Sine } \delta$$

$$\text{Dissipation Factor (D.F.)} = \tan \delta$$

for small values of the tan and sine are essentially equal which has led to the common interchangeability of the two terms in the industry.

**Equivalent Series Resistance** – The term E.S.R. or Equivalent Series Resistance combines all losses both series and parallel in a capacitor at a given frequency so that the equivalent circuit is reduced to a simple R-C series connection.

**Dissipation Factor** – The DF/PF of a capacitor tells what percent of the apparent power input will turn to heat in the capacitor.

The  $\frac{di}{dt}$  seen in current microprocessors can be as high as 0.3 A/ns, and up to 10A/ns. At 0.3 A/ns, 100pH of parasitic inductance can cause a voltage spike of 30mV. While this does not sound very drastic, with the  $V_{cc}$  for microprocessors decreasing at the current rate, this can be a fairly large percentage.

Another important, often overlooked, reason for knowing the parasitic inductance is the calculation of the resonant frequency. This can be important for high frequency, bypass capacitors, as the resonant point will give the most signal attenuation. The resonant frequency is calculated from the simple equation:

$$f_{res} = \frac{1}{2\pi\sqrt{LC}}$$

**Insulation Resistance** – Insulation Resistance is the resistance measured across the terminals of a capacitor and consists principally of the parallel resistance  $R_p$  shown in the equivalent circuit. As capacitance values and hence the area of dielectric increases, the I.R. decreases and hence the product ( $C \times IR$  or  $RC$ ) is often specified in ohm farads or more commonly megohm-microfarads. Leakage current is determined by dividing the rated voltage by  $IR$  (Ohm's Law).

**Dielectric Strength** – Dielectric Strength is an expression of the ability of a material to withstand an electrical stress. Although dielectric strength is ordinarily expressed in volts, it is actually dependent on the thickness of the dielectric and thus is also more generically a function of volts/mil.

**Dielectric Absorption** – A capacitor does not discharge instantaneously upon application of a short circuit, but drains gradually after the capacitance proper has been discharged. It is common practice to measure the dielectric absorption by determining the "reappearing voltage" which appears across a capacitor at some point in time after it has been fully discharged under short circuit conditions.

**Corona** – Corona is the ionization of air or other vapors which causes them to conduct current. It is especially prevalent in high voltage units but can occur with low voltages as well where high voltage gradients occur. The energy discharged degrades the performance of the capacitor and can in time cause catastrophic failures.

$$\text{Dissipation Factor} = \frac{\text{E.S.R.}}{X_C} = (2\pi fC) (\text{E.S.R.})$$

The watts loss are:

$$\text{Watts loss} = (2\pi fCV^2) (\text{D.F.})$$

Very low values of dissipation factor are expressed as their reciprocal for convenience. These are called the "Q" or Quality factor of capacitors.

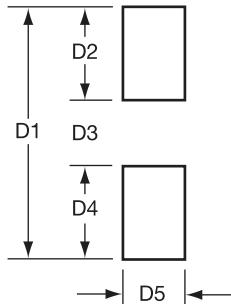
**Parasitic Inductance** – The parasitic inductance of capacitors is becoming more and more important in the decoupling of today's high speed digital systems. The relationship between the inductance and the ripple voltage induced on the DC voltage line can be seen from the simple inductance equation:

$$V = L \frac{di}{dt}$$

# Surface Mounting Guide

## MLC Chip Capacitors

### REFLOW SOLDERING



Case Size	D1	D2	D3	D4	D5
0201	0.85 (0.033)	0.30 (0.012)	0.25 (0.010)	0.30 (0.012)	0.35 (0.014)
0402	1.70 (0.067)	0.60 (0.024)	0.50 (0.020)	0.60 (0.024)	0.50 (0.020)
0603	2.30 (0.091)	0.80 (0.031)	0.70 (0.028)	0.80 (0.031)	0.75 (0.030)
0805	3.00 (0.118)	1.00 (0.039)	1.00 (0.039)	1.00 (0.039)	1.25 (0.049)
1206	4.00 (0.157)	1.00 (0.039)	2.00 (0.079)	1.00 (0.039)	1.60 (0.063)
1210	4.00 (0.157)	1.00 (0.039)	2.00 (0.079)	1.00 (0.039)	2.50 (0.098)
1808	5.60 (0.220)	1.00 (0.039)	3.60 (0.142)	1.00 (0.039)	2.00 (0.079)
1812	5.60 (0.220)	1.00 (0.039)	3.60 (0.142)	1.00 (0.039)	3.00 (0.118)
1825	5.60 (0.220)	1.00 (0.039)	3.60 (0.142)	1.00 (0.039)	6.35 (0.250)
2220	6.60 (0.260)	1.00 (0.039)	4.60 (0.181)	1.00 (0.039)	5.00 (0.197)
2225	6.60 (0.260)	1.00 (0.039)	4.60 (0.181)	1.00 (0.039)	6.35 (0.250)

Dimensions in millimeters (inches)

### Component Pad Design

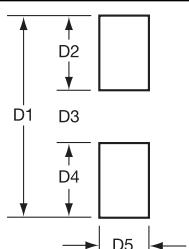
Component pads should be designed to achieve good solder fillets and minimize component movement during reflow soldering. Pad designs are given below for the most common sizes of multilayer ceramic capacitors for both wave and reflow soldering. The basis of these designs is:

- Pad width equal to component width. It is permissible to

decrease this to as low as 85% of component width but it is not advisable to go below this.

- Pad overlap 0.5mm beneath component.
- Pad extension 0.5mm beyond components for reflow and 1.0mm for wave soldering.

### WAVE SOLDERING



Case Size	D1	D2	D3	D4	D5
0603	3.10 (0.12)	1.20 (0.05)	0.70 (0.03)	1.20 (0.05)	0.75 (0.03)
0805	4.00 (0.15)	1.50 (0.06)	1.00 (0.04)	1.50 (0.06)	1.25 (0.05)
1206	5.00 (0.19)	1.50 (0.06)	2.00 (0.09)	1.50 (0.06)	1.60 (0.06)

Dimensions in millimeters (inches)

### Component Spacing

For wave soldering components must be spaced sufficiently far apart to avoid bridging or shadowing (inability of solder to penetrate properly into small spaces). This is less important for reflow soldering but sufficient space must be allowed to enable rework should it be required.

### Preheat & Soldering

The rate of preheat should not exceed 4°C/second to prevent thermal shock. A better maximum figure is about 2°C/second.

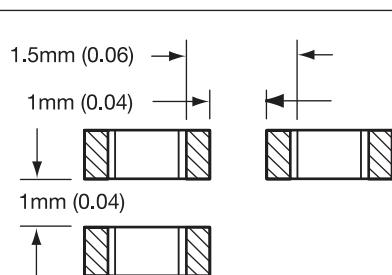
For capacitors size 1206 and below, with a maximum thickness of 1.25mm, it is generally permissible to allow a temperature differential from preheat to soldering of 150°C. In all other cases this differential should not exceed 100°C.

For further specific application or process advice, please consult KYOCERA AVX.

### Cleaning

Care should be taken to ensure that the capacitors are thoroughly cleaned of flux residues especially the space beneath the capacitor. Such residues may otherwise become conductive and effectively offer a low resistance bypass to the capacitor.

Ultrasonic cleaning is permissible, the recommended conditions being 8 Watts/litre at 20-45 kHz, with a process cycle of 2 minutes vapor rinse, 2 minutes immersion in the ultrasonic solvent bath and finally 2 minutes vapor rinse.



# Surface Mounting Guide

## Recommended Soldering Profiles

### REFLOW SOLDER PROFILES

KYOCERA AVX RoHS compliant products utilize termination finishes (e.g. Sn or SnAg) that are compatible with all Pb-Free soldering systems and are fully reverse compatible with SnPb soldering systems. A recommended SnPb profile is shown for comparison; for Pb-Free soldering, IPC/JEDECJ-STD-020C may be referenced. The upper line in the chart shows the maximum envelope to which products are qualified (typically 3x reflow cycles at 260°C max). The center line gives the recommended profile for optimum wettability and soldering in Pb-Free Systems.

#### Preheat:

The pre-heat stabilizes the part and reduces the temperature differential prior to reflow. The initial ramp to 125°C may be rapid, but from that point (2-3)°C/sec is recommended to allow ceramic parts to heat uniformly and plastic encapsulated parts to stabilize through the glass transition temperature of the body (~ 180°C).

#### Reflow:

In the reflow phase, the maximum recommended time > 230°C is 40secs. Time at peak reflow is 10secs max.; optimum reflow is achieved at 250°C, (see wetting balance chart opposite) but products are qualified to 260°C max. Please reference individual product datasheets for maximum limits

#### Cool Down:

Cool down should not be forced and 6°C/sec is recommended. A slow cool down will result in a finer grain structure of the reflow solder in the solder fillet.

### WAVE SOLDER PROFILES

For wave solder, there is no change in the recommended wave profile; all standard Pb-Free (SnCu/SnCuAg) systems operate at the same 260°C max recommended for SnPb systems.

#### Preheat:

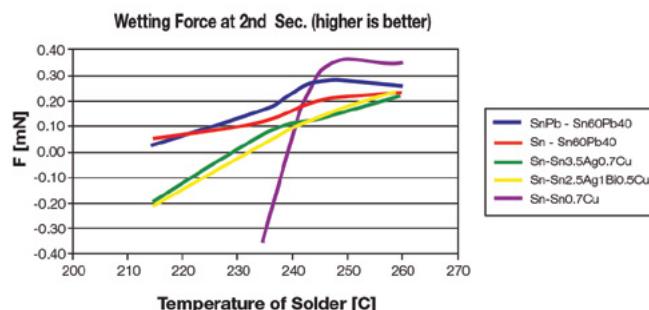
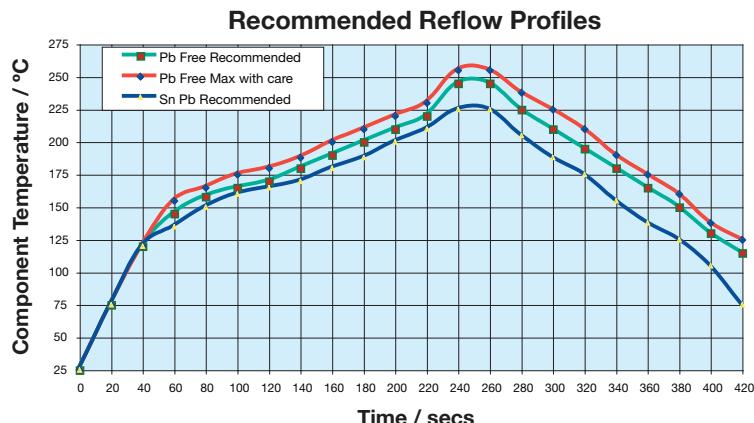
This is more important for wave solder; a higher temperature preheat will reduce the thermal shock to SMD parts that are immersed (please consult individual product data sheets for SMD parts that are suited to wave solder). SMD parts should ideally be heated from the bottom-side prior to wave. PTH (Pin through hole) parts on the topside should not be separately heated.

#### Wave:

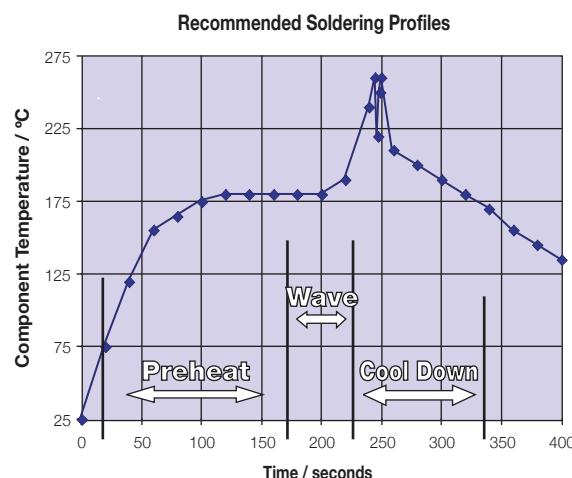
250°C – 260°C recommended for optimum solderability.

#### Cool Down:

As with reflow solder, cool down should not be forced and 6°C/sec is recommended. Any air knives at the end of the 2nd wave should be heated.



**IMPORTANT NOTE:** Typical Pb-Free reflow solders have a more dull and grainy appearance compared to traditional SnPb. Elevating the reflow temperature will not change this, but extending the cool down can help improve the visual appearance of the joint.



# Surface Mounting Guide

## MLC Chip Capacitors

### APPLICATION NOTES

#### Storage

The components should be stored in their "as received packaging" where possible. If the components are removed from their original packaging then they should be stored in an airtight container (e.g. a heat sealed plastic bag) with desiccant (e.g. silica gel). Storage area temperature should be kept between +5 degrees C and +30 degrees C with humidity < 70% RH. Storage atmosphere must be free of gas containing sulfur and chlorine. Avoid exposing the product to saline moisture or to temperature changes that might result in the formation of condensation. To assure good solderability performance we recommend that the product be used within 6 months from our shipping date, but can be used for up to 12 months. Chip capacitors may crack if exposed to hydrogen (H<sub>2</sub>) gas while sealed or if coated with silicon, which generates hydrogen gas.

#### Solderability

Terminations to be well soldered after immersion in a 60/40 tin/lead solder bath at 245°C +/- 5°C for 5 +0/-0.5 seconds.

#### Leaching

Terminations will resist leaching for at least the immersion times and conditions shown below.

Termination Type	Solder Tin/Lead/Silver	Solder Temp °C	Immersion Time Seconds
Nickel Barrier	60/40/0	260 ± 5	30 ± 1

#### Lead-Free Wave Soldering

The recommended peak temperature for lead-free wave soldering is 250°C-260°C for 3-5 seconds. The other parameters of the profile remains the same as above.

The following should be noted by customers changing from lead based systems to the new lead free pastes.

- The visual standards used for evaluation of solder joints will need to be modified as lead free joints are not as bright as with tin-lead pastes and the fillet may not be as large.
- Lead-free solder pastes do not allow the same self alignment as lead containing systems. Standard mounting pads are acceptable, but machine set up may need to be modified.

#### General

Surface mounting chip multilayer ceramic capacitors are designed for soldering to printed circuit boards or other substrates. The construction of the components is such that they will withstand the time/temperature profiles used in both wave and reflow soldering methods.

#### Handling

Chip multilayer ceramic capacitors should be handled with care to avoid damage or contamination from perspiration and skin oils. The use of tweezers or vacuum pick ups is strongly recommended for individual components. Bulk handling should ensure that abrasion and mechanical shock are minimized. Taped and reeled components provides the ideal medium for direct presentation to the placement machine. Any mechanical shock should be minimized during handling chip multilayer ceramic capacitors.

#### Preheat

It is important to avoid the possibility of thermal shock during soldering and carefully controlled preheat is therefore required. The rate of preheat should not exceed 4°C/second and a target figure 2°C/second is recommended. Although an 80°C to 120°C temperature differential is preferred, recent developments allow a temperature differential between the component surface and the soldering temperature of 150°C (Maximum) for capacitors of 1210 size and below with a maximum thickness of 1.25mm. The user is cautioned that the risk of thermal shock increases as chip size or temperature differential increases.

#### Soldering

Mildly activated rosin fluxes are preferred. The minimum amount of solder to give a good joint should be used. Excessive solder can lead to damage from the stresses caused by the difference in coefficients of expansion between solder, chip and substrate. KYOCERA AVX terminations are suitable for all wave and reflow soldering systems. If hand soldering cannot be avoided, the preferred technique is the utilization of hot air soldering tools.

#### Cooling

Natural cooling in air is preferred, as this minimizes stresses within the soldered joint. When forced air cooling is used, cooling rate should not exceed 4°C/second. Quenching is not recommended but if used, maximum temperature differentials should be observed according to the preheat conditions above.

#### Cleaning

Flux residues may be hygroscopic or acidic and must be removed. KYOCERA AVX MLC capacitors are acceptable for use with all of the solvents described in the specifications MIL-STD-202 and EIA-RS-198. Alcohol based solvents are acceptable and properly controlled water cleaning systems are also acceptable. Many other solvents have been proven successful, and most solvents that are acceptable to other components on circuit assemblies are equally acceptable for use with ceramic capacitors.

#### Prevention of Metallic Migration

Note that when components with Sn plating on the end terminations are to be used in applications that are likely to experience conditions of high humidity under bias voltage, we strongly recommend that the circuit boards be conformally coated to protect the Sn from moisture that might lead to migration and eventual current leakage.

When using Capacitor Arrays we recommend that there is no differential in applied voltage between adjacent elements.

# Surface Mounting Guide

## MLC Chip Capacitors

### POST SOLDER HANDLING

Once SMP components are soldered to the board, any bending or flexure of the PCB applies stresses to the soldered joints of the components. For leaded devices, the stresses are absorbed by the compliancy of the metal leads and generally don't result in problems unless the stress is large enough to fracture the soldered connection.

Ceramic capacitors are more susceptible to such stress because they don't have compliant leads and are brittle in nature. The most frequent failure mode is low DC resistance or short circuit. The second failure mode is significant loss of capacitance due to severing of contact between sets of the internal electrodes.

Cracks caused by mechanical flexure are very easily identified and generally take one of the following two general forms:

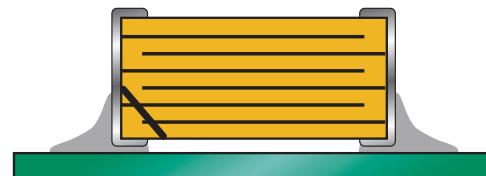
Mechanical cracks are often hidden underneath the termination and are difficult to see externally. However, if one end termination falls off during the removal process from PCB, this is one indication that the cause of failure was excessive mechanical stress due to board warping.

### COMMON CAUSES OF MECHANICAL CRACKING

The most common source for mechanical stress is board depanelization equipment, such as manual breakapart, v-cutters and shear presses. Improperly aligned or dull cutters may cause torqueing of the PCB resulting in flex stresses being transmitted to components near the board edge. Another common source of flexural stress is contact during parametric testing when test points are probed. If the PCB is allowed to flex during the test cycle, nearby ceramic capacitors may be broken.

A third common source is board to board connections at vertical connectors where cables or other PCBs are connected to the PCB. If the board is not supported during the plug/unplug cycle, it may flex and cause damage to nearby components.

Special care should also be taken when handling large (>6" on a side) PCBs since they more easily flex or warp than smaller boards.



Type A:  
Angled crack between bottom of device to top of solder joint.

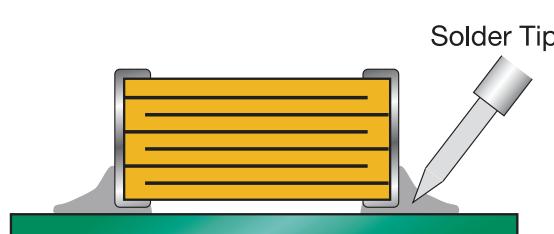


Type B:  
Fracture from top of device to bottom of device.

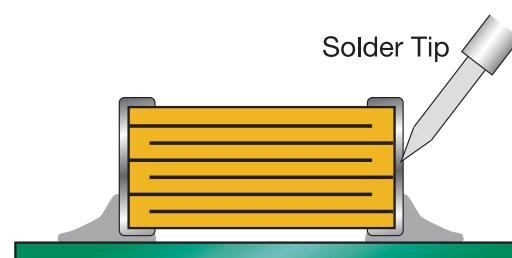
### REWORKING OF MLCS

Thermal shock is common in MLCS that are manually attached or reworked with a soldering iron. KYOCERA AVX strongly recommends that any reworking of MLCS be done with hot air reflow rather than soldering irons. It is practically impossible to cause any thermal shock in ceramic capacitors when using hot air reflow.

However direct contact by the soldering iron tip often causes thermal cracks that may fail at a later date. If rework by soldering iron is absolutely necessary, it is recommended that the wattage of the iron be less than 30 watts and the tip temperature be <300°C. Rework should be performed by applying the solder iron tip to the pad and not directly contacting any part of the ceramic capacitor.



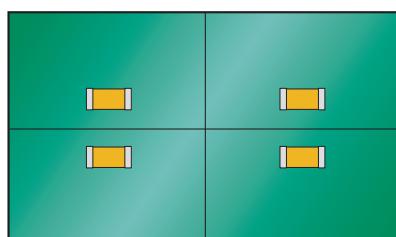
Preferred Method - No Direct Part Contact



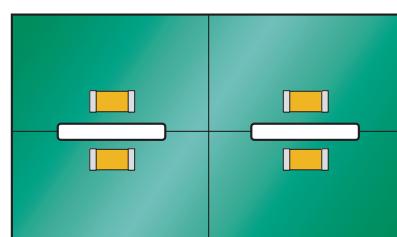
Poor Method - Direct Contact with Part

### PCB BOARD DESIGN

To avoid many of the handling problems, KYOCERA AVX recommends that MLCS be located at least .2" away from nearest edge of board. However when this is not possible, KYOCERA AVX recommends that the panel be routed along the cut line, adjacent to where the MLC is located.



No Stress Relief for MLCS



Routed Cut Line Relieves Stress on MLC



**FOLLOW US:**

VISIT US AT [WWW.KYOCERA-AVX.COM](http://WWW.KYOCERA-AVX.COM)

**North America**  
Tel: +1 864-967-2150

**Europe**  
Tel: +44 1276-697000

**Asia**  
Tel: +65 6286-7555

**Central America**  
Tel: +55 11-46881960

**Japan**  
Tel: +81 740-321250