

## Ceramic Chip Capacitors Type X5R

ISO 9001:2000  
TS-16949

### 1. General

- 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  $\mu\text{F}$ )

### 2. Dimensions

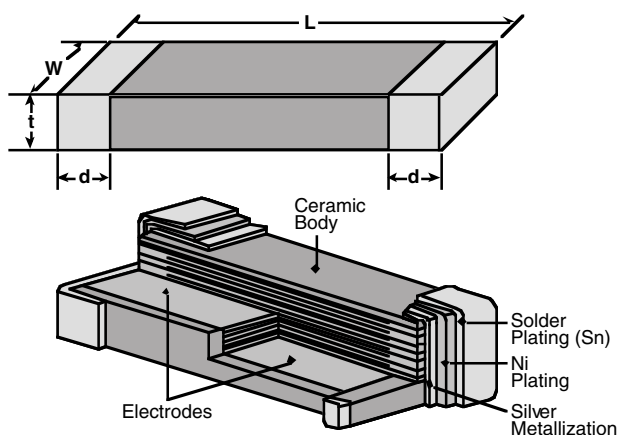


Table 1

Dimensions in inches (mm)

Case Size	Dimensions inches (mm)			
	L	W	t (Max.)	d
0402	.039 $\pm$ .004 (1.0 $\pm$ 0.1)	.02 $\pm$ .004 (0.5 $\pm$ 0.1)	.021 (0.55)	.01 $\pm$ .006 (0.25 $\pm$ 0.15)
0603	.063 $\pm$ .006 (1.6 $\pm$ 0.15)	.032 $\pm$ .006 (0.81 $\pm$ 0.15)	.035 (0.9)	.014 $\pm$ .006 (0.35 $\pm$ 0.15)
0805	.079 $\pm$ .008 (2.01 $\pm$ 0.2)	.049 $\pm$ .008 (1.25 $\pm$ 0.2)	.051 (1.3)	.02 $\pm$ .01 (0.50 $\pm$ 0.25)
1206	.126 $\pm$ .008 (3.2 $\pm$ 0.2)	.063 $\pm$ .008 (1.6 $\pm$ 0.2)	.059 (1.5)	.02 $\pm$ .01 (0.5 $\pm$ 0.25)
1210	.126 $\pm$ .008 (3.2 $\pm$ 0.2)	.098 $\pm$ .008 (2.5 $\pm$ 0.2)	.067 (1.7)	.02 $\pm$ .01 (0.5 $\pm$ 0.25)

### 3. Type Designation

The type designation shall be the following form:

<b>X5R</b>	<b>0805</b>	<b>A</b>	<b>T</b>	<b>TD</b>	<b>225</b>	<b>K</b>
Dielectric	Size	Voltage	Termination	Packaging	Capacitance Code	Capacitance Tolerance
	0402 0603 0805 1206 1210	K = 6.3V A = 10V C = 16V	T: Sn	TP: 7" 2mm pitch (0402 only) TD: 7" Paper tape TE: 7" Embossed plastic TDB: 13" Paper tape TEB: 13" Embossed plastic	2 significant digits + no. of zeros.	K: $\pm 10\%$

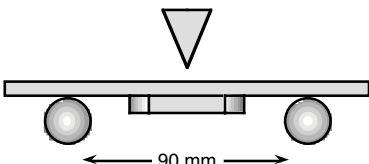
## 4. X5R Dielectric Capacitance Range

Available sizes are shaded.

Size	0402			0603				0805				1206				1210	
Capacitance values pF μF	6.3 (K)	10 (A)	16 (C)	6.3 (K)	10 (A)	16 (C)	25 (E)	6.3 (K)	10 (A)	16 (C)	25 (E)	6.3 (K)	10 (A)	16 (C)	25 (E)	6.3 (K)	10 (A)
100																	
150																	
220																	
330																	
470																	
680																	
1000																	
1200																	
1500																	
1800																	
2200																	
2700																	
3300																	
3900																	
4700																	
5600																	
6800																	
8200																	
0.010																	
0.012																	
0.015																	
0.018																	
0.022																	
0.027																	
0.033																	
0.039																	
0.047																	
0.056																	
0.068																	
0.082																	
0.10																	
0.12																	
0.15																	
0.18																	
0.22																	
0.27																	
0.33																	
0.47																	
0.56																	
0.68																	
0.82																	
1.0																	
1.2																	
1.5																	
1.8																	
2.2																	
3.3																	
4.7																	
6.8																	
10																	
22																	
47																	
100																	

Capacitance tolerance available: ±10%

## 5. Characteristics

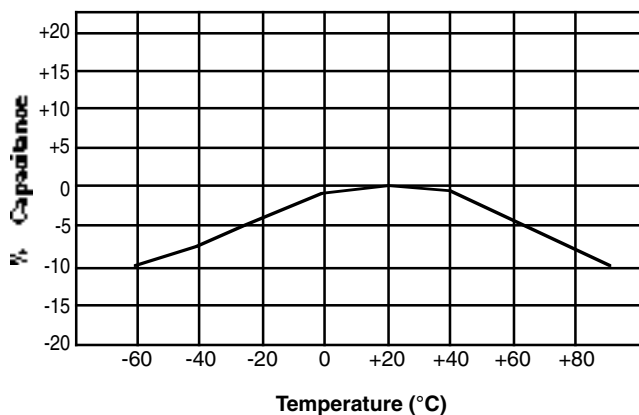
Item	Requirement		Test Methods
Operating Temperature Range	-55°C to +85°C		Temperature cycle chamber
Capacitance	Within specified tolerance		Frequency: 1.0 kHz ± 10% Voltage: 1.0 Vrms ± .2 V For Cap > 10 µF, 0.5 Vrms @ 120 Hz
Dissipation Factor	2.5% for 50V DC rating 5.0% for 10V DC rating		
Insulation Resistance	100,000 M or 500 M - 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)
Resistance to Flexure Stresses	Appearance	No defects	Deflection: 1 mm      Test Time: 30 seconds 
	Capacitance Variation	± 10%	
	Dissipation Factor	Meets initial values	
	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	Dip device in eutectic solder at 260°C for 60 seconds. Store at room temperature for 24 ± 2 hours before measuring electrical properties
	Capacitance Variation	± 7.5%	
	Dissipation Factor	Meets initial values	
	Insulation Resistance	Meets initial values	
	Dielectric Strength	Meets initial values	
Thermal Shock	Appearance	No visual defects	Step 1: -55°C ± 2°      30 ± 3 minutes
	Capacitance Variation	± 7.5%	Step 2: Room temp      3 minutes
	Dissipation Factor	Meets initial values	Step 3: +85°C ± 2°      30 ± 3 minutes
	Insulation Resistance	Meets initial values	Step 4: Room temp      3 minutes
	Dielectric Strength	Meets initial values	Repeat for 5 cycles and measure after 24 ± 2 hours at room temperature

## 5. Characteristics (continued)

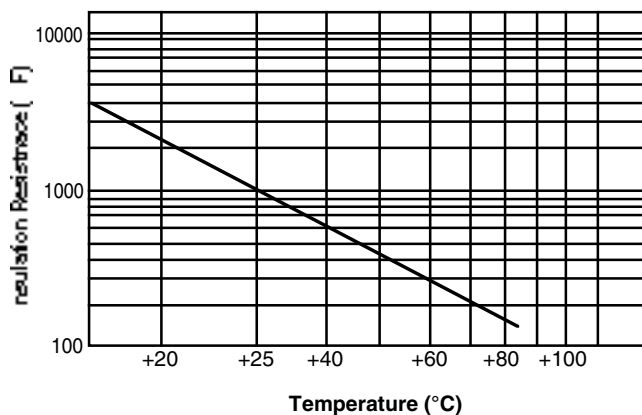
Item	Requirement		Test Methods
Load Life	Appearance	No visual defects	Charge device with twice rated voltage in test chamber set at $85^{\circ}\text{C} \pm 2^{\circ}\text{C}$ for 1000 hours (+48, -0)  Remove from test chamber and stabilize at room temp. and humidity for $24 \pm 2$ hours before measuring
	Capacitance Variation	$\pm 12.5\%$	
	Dissipation Factor	Initial value x 2.0	
	Insulation Resistance	Initial value x 0.3	
	Dielectric Strength	Meets initial values	
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 temp. and humidity for $24 \pm 2$ hours before measuring
	Capacitance Variation	$\pm 12.5\%$	
	Dissipation Factor	Initial value x 2.0	
	Insulation Resistance	Initial value x 0.3	
	Dielectric Strength	Meets initial values	

## 6. Typical Impedance Characteristics

### X5R - Temperature Coefficient



### Insulation Resistance vs Temp.



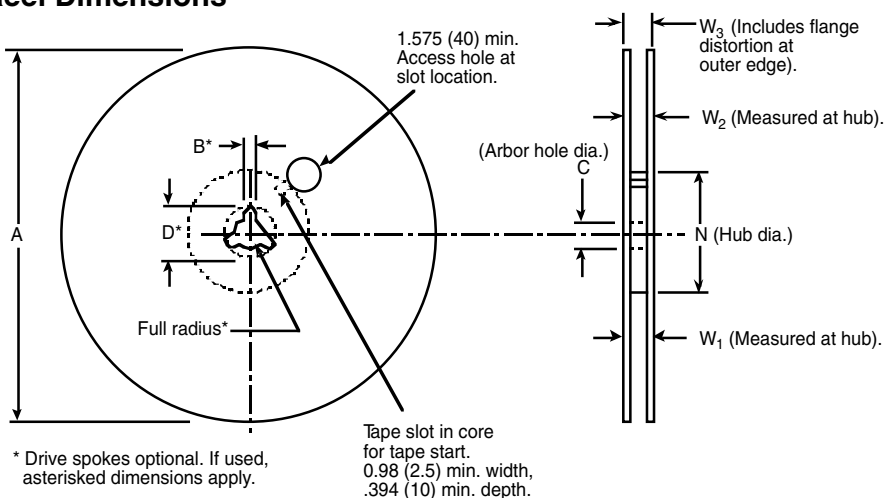
## 7. Tape and Reel Quantities

All tape and reel specifications are in compliance with RS481.

Size	Dielectric	Voltage	Cap. Range	TP	TD	TE	TDB	TEB
0402	All	All	All	10000	—	—	—	—
0603	All	All	All	—	4000	—	15000	—
0805	X5R	All	All	—	—	3000	—	—
1206	X5R	All	All	—	—	2000	—	—
1210	X5R	10	106 ~ 226	—	—	2000	—	—

\* TP is a 7" reel with a 2mm pitch,  
TD & TE are 7" reels,  
TDB & TEB are 13" reels

## 8. Reel Dimensions



Dimensions in inches (mm)

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>
8mm	12.992 (330)	0.059 (1.5)	0.512 ± 0.008 (13.0 ± 0.20)	.795 (20.2)	1.969 (50)	.331 ± .060 - 0.0 (8.4 ± 1.0) - 0.0	.567 14.4	.311 (7.9 Min.) .429 (10.9 Max.)
12mm						.488 ± .076 - 0.0 (12.4 ± 2.0) - 0.0	.724 (18.4)	.469 (11.9 Min.) .607 (15.4 Max.)

Metric dimensions will govern.

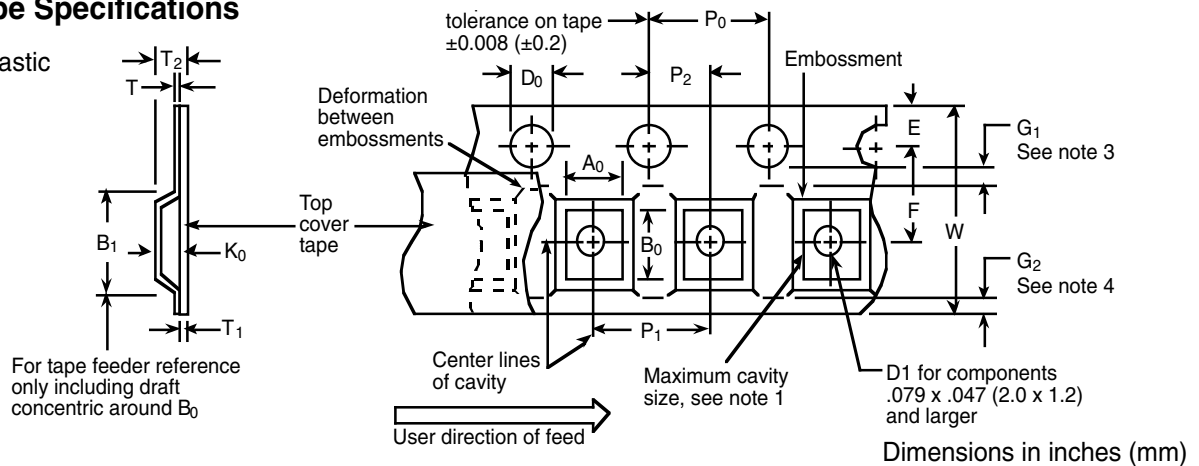
English measurements rounded and for reference only.

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

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## 9. Carrier Tape Specifications

Embossed plastic  
8 & 12mm



Tape Size <i>Constant</i>	D <sub>0</sub>	E	P <sub>0</sub>	P <sub>2</sub>	T Max.	T <sub>1</sub>	G <sub>1</sub>	G <sub>2</sub>
8mm and 12mm	.059 $\pm$ .004 (1.5 $\pm$ 0.10)	.069 $\pm$ .004 (1.75 $\pm$ 0.10)	.157 $\pm$ .004 (4.0 $\pm$ 0.10)	.079 $\pm$ .002 (2.0 $\pm$ 0.05)	.024 (0.600)	.004 (0.10) Max.	.030 (0.75) Min. See note 3	.030 (0.75) Min. See note 4
Tape Size <i>Variable</i>	B <sub>1</sub> Max. See note 6	D <sub>1</sub> Min. See note 5	F	P <sub>1</sub>	R Min. See note 2	T <sub>2</sub>	W	A <sub>0</sub> B <sub>0</sub> K <sub>0</sub>
8mm	.179 (4.55)	.039 (1.0)	.138 $\pm$ .002 (3.5 $\pm$ 0.05)	.157 $\pm$ .004 (4.0 $\pm$ 0.10)	.984 (25)	.098 (2.5 Max.)	.315 $\pm$ .012 (8.0 $\pm$ 0.3) - 0.1	See note 1
12mm	.323 (8.2)	.059 (1.5)	.217 $\pm$ .002 (5.5 $\pm$ 0.05)	.157 $\pm$ .004 (4.0 $\pm$ 0.10)	1.181 (30)	.256 (6.5 Max.)	.472 $\pm$ .012 (12.0 $\pm$ .30)	See note 1
12mm 1/2 Pitch	.179 (4.55)	.039 (1.0)	.138 $\pm$ .002 (3.5 $\pm$ 0.05)	.079 $\pm$ .004 (2.0 $\pm$ 0.10)	.984 (25)	.098 (2.5 Max.)	.315 $\pm$ .012 (8.0 $\pm$ 0.3) - 0.1	See note 1
12mm Double Pitch	.323 (8.2)	.059 (1.5)	.217 $\pm$ .002 (5.5 $\pm$ 0.05)	.315 $\pm$ .004 (8.0 $\pm$ 0.10)	1.181 (30)	.256 (6.5 Max.)	.472 $\pm$ .012 (12.0 $\pm$ .30)	See note 1

Notes:

- A<sub>0</sub>, B<sub>0</sub> and K<sub>0</sub> are determined by the max. dimensions to the ends of the terminals extending from the components body and/or the body of the component. The clearance between the end of the terminals of the body of the components to the sides and depth of the cavity (A<sub>0</sub>, B<sub>0</sub> and K<sub>0</sub>) must be within .002" (0.05)mm min. and .020" (0.50)mm max. The clearance allowed must also prevent rotation of the component within the cavity of not more than 20 degrees (see examples A & B).
- Tape with components shall pass around radius "R" without damage. The minimum trailer length (Note 2 Fig. 3) may require additional length to provide R min. for .472" (12)mm embossed tape for reels with hub diameters approaching N min. (Table 4).
- G<sub>1</sub> dimension is the flat area from the edge of the sprocket hole to either the outward deformation of the carrier tape between the embossed cavities or to the edge of the cavity whichever is less.
- G<sub>2</sub> dimension is the flat area from the edge of the carrier tape opposite the sprocket holes to either the outward deformation of the carrier tape between the embossed cavity or to the edge of the cavity whichever is less.

## 9. Carrier Tape Specifications (continued)

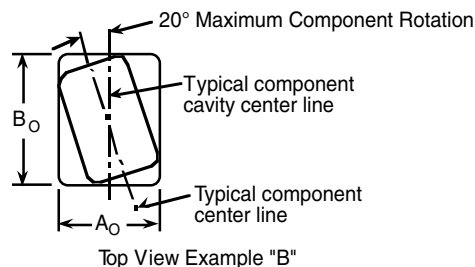
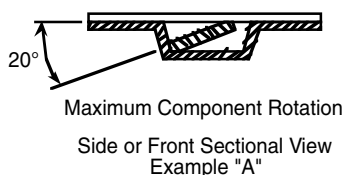
Embossed plastic

8 & 12mm

Notes:

5. The embossed hole location shall be measured from the sprocket hole controlling the location of the embossment. Dimensions of embossment location and hole location shall be applied independent of each other.

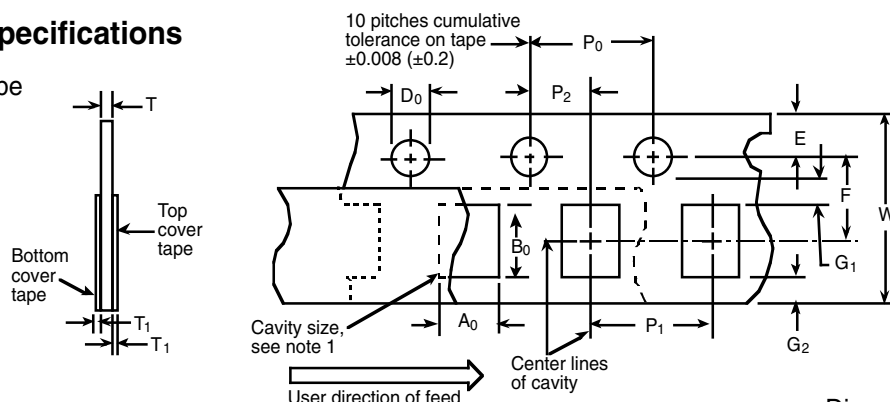
6. B<sub>1</sub> dimension is a reference dimension for tape feeder clearance only.



## 10. Carrier Tape Specifications

Punched paper tape

8 & 12mm



Dimensions in inches (mm)

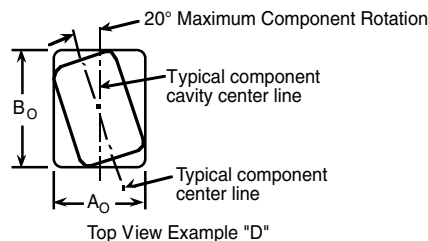
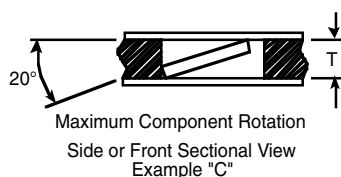
Tape Size <i>Constant</i>	D <sub>0</sub>	E	P <sub>0</sub>	P <sub>2</sub>	T <sub>1</sub>	G <sub>1</sub>	G <sub>2</sub>	R MIN
8mm and 12mm	.059 ± .004 - .000 (1.5 ± 0.1) - 0.0	.069 ± .004 (1.75 ± 0.10)	.157 ± .004 (4.0 ± 0.10)	.079 ± .002 (2.0 ± 0.05)	.004 (0.10) Max.	.030 (0.75) Min.	.030 (0.75) Min.	.984 (25) See note 2
Tape Size <i>Variable</i>	P <sub>1</sub>		F		W		A <sub>0</sub> B <sub>0</sub>	T
8mm	.157 ± .004 (4.0 ± 0.10)		.138 ± .002 (3.5 ± 0.05)		.315 ± .012 - .004 (8.0 ± 0.3) - 0.1		See note 1	See note 3
12mm	.157 ± .004 (4.0 ± .010)		.217 ± .002 (5.5 ± 0.05)		.472 ± .012 (12.0 ± 0.3)			
8mm 1/2 Pitch	.079 ± .004 (2.0 ± 0.10)		.138 ± .002 (3.5 ± 0.05)		.315 ± .012 - .004 (8.0 ± 0.3) - 0.1			
12mm Double Pitch	.315 ± .004 (8.0 ± .010)		.217 ± .002 (5.5 ± 0.05)		.472 ± .012 (12.0 ± 0.3)			

## 10. Carrier Tape Specifications (continued)

Punched paper tape  
8 & 12mm

Notes:

1.  $A_0$ ,  $B_0$  and  $T$  are determined by the max. dimensions to the ends of the terminals extending from the component body and/or the body dimensions of the component. The clearance between the ends of the terminals or body of the components to the sides and depth of the cavity ( $A_0$ ,  $B_0$  and  $T$ ) must be within .002" (0.05) mm min. and .020" (0.50) mm max. The clearance allowed must also prevent rotation of the component within the cavity of not more than 20 degrees (see examples C & D).
2. Tape with components shall pass around radius "R" without damage.
3. .043" (1.1) mm base tape and .063" (1.6) mm max. for non-paper base compositions.

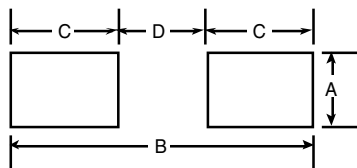


## 11. Recommended Land Pattern Dimensions

Component pads should be designed to achieve good solder fillets and minimize component movement during reflow soldering.

Pad dimensions are given below for multilayer ceramic capacitors for both reflow and wave soldering. The basis for 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



Case Size	Dimensions inches (mm)			
	A	B	C	D
0402	0.02 (0.50)	0.07 (1.70)	0.02 (0.60)	0.02 (0.50)
0603	0.03 (0.75)	0.09 (2.30)	0.03 (0.80)	0.03 (0.70)
0805	0.05 (1.25)	0.12 (3.00)	0.04 (1.00)	0.04 (1.00)
1206	0.06 (1.60)	0.16 (4.00)	0.04 (1.00)	0.09 (2.00)
1210	0.10 (2.50)	0.16 (4.00)	0.04 (1.00)	0.09 (2.00)