

MLCC super small size catalog



C 0402 X5R 102 K C P S

PRODUCT CODE

C = MLCC

SIZE in mm (EIA CODE, in inch)

0402(01005)	0603(0201)	1005 (0402)	1608 (0603)	2012 (0805)
3216 (1206)	3225(1210)	4520 (1808)	4532 (1812)	

T. C.

NP0: 0 ± 30ppm/°C	-55°C to +125°C
X7R: ±15%	-55°C to +125°C
X6S: ±22%	-55°C to +105°C
X5R: ±15%	-55°C to +85°C
Y5V: +22%/-82%	-30°C to +85°C

CAPACITANCE CODE

Expressed in pico-farads and identified by a three-digit number.
 First two digits represent significant figures.
 Last digit specifies the number of zeros.
 (Use 9 for 1.0 through 9.9pF ; Use 8 for 0.2 through 0.99pF)
 (Example: 2.2pF=229 or 0.47pF=478)

TOLERANCE CODE

A: ± 0.05pF	B: ± 0.1pF	C: ± 0.25pF	D: ± 0.5pF	F: ±1%	G: ±2%
J: ±5%	K: ±10%	M: ±20%	Z: +80/-20%		

VOLTAGE CODE

B: 4V	C: 6.3V	D: 10V	E: 16V	F: 25V	N: 35V	G: 50V	H: 100V
J: 200V	K: 250V	L: 500V	M: 630V	P: 1KV	Q: 2KV	R: 3KV	S: 4KV

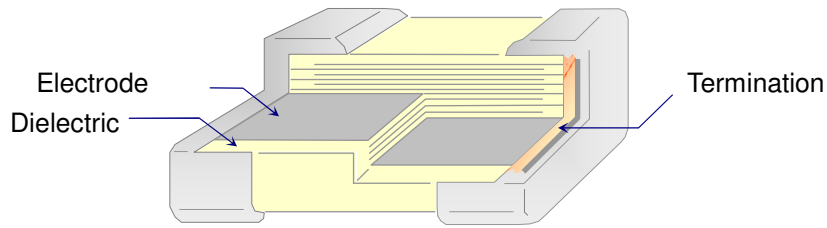
PACKAGING CODE

T: Paper tape reel Ø180mm (7")	P: Embossed tape reel Ø180mm (7")
N: Paper tape reel Ø250mm (10")	D: Embossed tape reel Ø250mm (10")
A: Paper tape reel Ø330mm (13")	E: Embossed tape reel Ø330mm (13")
B: Bulk, loosed in bag	C: Bulk cassette
W: Special Packing	

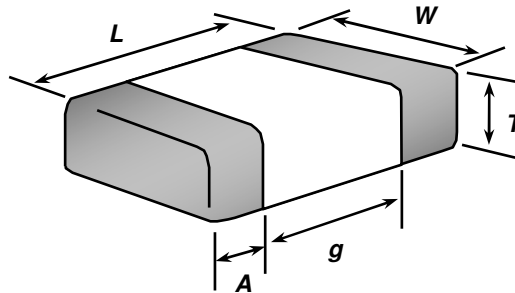
Product Type

S: Standard Ceramic Capacitor
 Q: High Q/Low ESR
 F: Microwave

MLCC Structure



Dimensions



Typical Size Tolerance

SIZE CODE (EIA)	L (Length)	W (Width)	T (Max Thickness)	g (Min)	A (Termination Min/Max)	UNIT
0402 (01005)	0.4+/-0.02 (0.016+/-0.0008)	0.2+/-0.02 (0.008+/-0.0008)	0.22 (0.0088)	0.13 (0.0052)	0.07/0.14 (0.0028/0.0056)	mm (inch)

Product Range and Available Tolerance

T. C.	Series (Code)	Capacitance Range	Standard Tolerance	Available Tolerance on Request
NP0	Microwave (F)	Cap < 5pF	C = ± 0.25pF D = ± 0.5pF	B = ± 0.1pF
		5pF ≤ Cap ≤ 6.2 pF	D = ± 0.5pF	B = ± 0.1pF C = ± 0.25pF
NP0	Standard (S)	Cap < 5pF	C = ± 0.25pF D = ± 0.5pF	B = ± 0.1pF
		5pF ≤ Cap < 10pF	D = ± 0.5pF	B = ± 0.1pF C = ± 0.25pF
		10pF ≤ Cap ≤ 100pF	J = ± 5% K = ± 10%	F = ± 1% G = ± 2%
X7R	Standard (S)	100pF ≤ Cap ≤ 3.3 nF	K = ± 10% M = ± 20%	J = ± 5%
X5R	Standard (S)	3.3 nF < Cap ≤ 10 nF	K = ± 10% M = ± 20%	J = ± 5%

* Non-standard capacitance or tolerance is available on request.

■ Feature

1. Small chip size (L: 0.4 x W: 0.2 x T: 0.2 mm)
2. No polarity
3. Suited to only reflow soldering
4. RoHS compliant

■ Application

1. Microwave module
2. Potable equipment

CLASS	Class I	
TYPE	Microwave(F series)	Standard (S series)
T.C.	NP0 (COG)	NP0(COG)
SIZE (EIA)	0402 (01005)	0402 (01005)
RV	16V	16V
0.50 p	Z	Z
1.0 p	Z	Z
1.2 p	Z	Z
1.5 p	Z	Z
1.8 p	Z	Z
2.2 p	Z	Z
2.7 p	Z	Z
3.3 p	Z	Z
3.9 p	Z	Z
4.7 p	Z	Z
5.6 p	Z	Z
6.2 p	Z	Z
6.8 p		Z
8.2 p		Z
10 p		Z
12 p		Z
15 p		Z
18 p		Z
22 p		Z
27 p		Z
33 p		Z
39 p		Z
47 p		Z
56 p		Z
68 p		Z
100 p		Z

CLASS	Class II		
TYPE	Standard(S series)		
T.C.	X5R		X7R
SIZE (EIA)	0402 (01005)		0402 (01005)
RV	6.3V	10V	10V
100 p			Z
120 p			
150 p			Z
180 p			
220 p			Z
270 p			
330 p			Z
390 p			
470 p			Z
560 p			
680 p			Z
820 p			
1.0 n			Z
1.2 n			
1.5 n			Z
1.8 n			
2.2 n			Z
2.7 n			
3.3 n			Z
3.9 n	Z	Z	
4.7 n	Z	Z	
5.6 n			
6.8 n	Z	Z	
8.2 n			
10 n	Z	Z	
22 n			

● Non-standard capacitance or thickness is available on request

● * Special length/width tolerance

Thickness Tolerance

Thickness (mm)		Thickness (mm)		Thickness (mm)		Thickness (mm)		Thickness (mm)		Thickness (mm)	
Code	Class	Code	Class	Code	Class	Code	Class	Code	Class	Code	Class
A	0.30+/-0.03	C	0.60+/-0.15	E	0.85+/-0.15	G	1.25+0.3/-0.20	L	1.60+0.3/-0.20	P	2.50+/-0.20
B	0.50+/-0.05	D	0.80+/-0.10	F	1.15+/-0.20	I	0.95+/-0.15	N	2.00+/-0.20	Q	0.45+/-0.05
B	0.50+/-0.15	D	0.8+0.15/-0.1	G	1.25+/-0.20	L	1.60+/-0.20	N	2.00+/-0.30	Z	0.20+/-0.02

Specification Super Small Size

Item	Specification		Test Method																	
	Class I (NP0)	Class II (X5R/X7R)																		
1 Operating Temperature Range	NP0: -55 to 125 °C	X7R: -55 to 125 °C X5R: -55 to 85 °C																		
2 Rated Voltage	4VDC, 6.3VDC, 10VDC, 16VDC		The rated voltage is defined as the maximum voltage, which may be applied continuously to the capacitor.																	
3 Appearance	No defects or abnormalities.		Visual inspection																	
4 Dimensions	Within the specified dimension.		Using microscope																	
5 Dielectric Strength	No defects or abnormalities.		No failure shall be observed when 250%* of the rated voltage is applied between the terminations for 1 to 5 seconds. The charge and discharge current is less than 50mA.																	
6 Insulation Resistance (I.R.)	To apply rated voltage I.R. $\geq 10G$ or $R_1C_R \geq 500\Omega\cdot F$ (whichever is smaller) $R_1C_R \geq 50\Omega\cdot F$ for some of the parts, please refer to table 1		The insulation resistance shall be measured with a DC voltage not exceeding the rated voltage at 25°C and 75%RH max, and within 1 minute of charging.																	
7 Capacitance	Within the specified tolerance * X7R, X5R at 1000 hours		The capacitance / D.F. shall be measured at 25°C at the frequency and voltage shown in the tables.																	
8 Q/Dissipation Factor (D.F.)	NP0: If $C \leq 30pF$, $DF \leq 1/(400+20C)$, C in pF If $C > 30pF$, $DF \leq 0.1\%$.	X5R, X7R: See X5R, X7R DF table	<table border="1"> <thead> <tr> <th>Item</th> <th>Frequency</th> <th>Voltage</th> </tr> </thead> <tbody> <tr> <td rowspan="2">Class I</td> <td>$C \leq 1,000pF$</td> <td>1.0±0.2MHz</td> <td>1.0±0.2Vrms</td> </tr> <tr> <td>$C > 1,000pF$</td> <td>1.0±0.2kHz</td> <td>1.0±0.2Vrms</td> </tr> <tr> <td rowspan="2">Class II</td> <td>$C \leq 10 uF$</td> <td>1.0±0.2kHz</td> <td>1.0±0.2Vrms</td> </tr> <tr> <td>$C > 10 uF$</td> <td>120Hz±24Hz</td> <td>0.5±0.1Vrms</td> </tr> </tbody> </table>	Item	Frequency	Voltage	Class I	$C \leq 1,000pF$	1.0±0.2MHz	1.0±0.2Vrms	$C > 1,000pF$	1.0±0.2kHz	1.0±0.2Vrms	Class II	$C \leq 10 uF$	1.0±0.2kHz	1.0±0.2Vrms	$C > 10 uF$	120Hz±24Hz	0.5±0.1Vrms
Item	Frequency	Voltage																		
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	$C > 10 uF$	120Hz±24Hz	0.5±0.1Vrms																	
9 Capacitance Temperature Characteristics	Capacitance change NP0 within $0 \pm 30ppm/^\circ C$ under operating temperature range.	Capacitance change X7R/X5R within $\pm 15\%$	<p>1.Class I (NP0)</p> <p>The capacitance value at 25°C and 85°C shall be measured and calculated from the formula given below. $T.C. = (C_{85} - C_{25}) / C_{25} \cdot \Delta T \cdot 10^6$ (PPM/°C)</p> <p>2.Class II (X5R/X7R)</p> <p>The ranges of capacitance change compared with the 25°C value over the temperature ranges shall be within the specified ranges.</p>																	
10 Termination Strength	No removal of the terminations or marking defect.		Apply a parallel force of 1N to a PCB mounted sample for 10±1sec																	
11 Deflection (Bending Strength)	No cracking or marking defects shall occur at 1mm deflection. Capacitance change: NP0: within $\pm 5\%$ or $\pm 0.5pF$. (whichever is larger) X7R, X5R: within $\pm 12.5\%$		<p>Solder the capacitor to the test jig (glass epoxy boards) shown in Fig.a using a SAC305(Sn96.5Ag3.0Cu0.5) solder (then let sit for 48±4 hours for X7R X5R).</p> <p>Then apply a force in the direction shown in Fig.b. The soldering shall be done with the reflow method and shall be conducted with care so that the soldering is uniform and free of defects such as heat shock.</p>																	
	<p>(Unit in mm)</p> <p>Fig. a.</p>	<table border="1"> <thead> <tr> <th>Size</th> <th>a</th> <th>b</th> <th>C</th> </tr> </thead> <tbody> <tr> <td>0402</td> <td>0.2</td> <td>0.56</td> <td>0.23</td> </tr> </tbody> </table>	Size	a	b	C	0402	0.2	0.56	0.23	<p>Fig. b.</p>									
Size	a	b	C																	
0402	0.2	0.56	0.23																	
12 Solderability of Termination	90% of the terminations are to be soldered evenly and continuously.		Immerse the test capacitor into a methanol solution containing rosin for 3 to 5 seconds, preheat it 150 to 180°C for 2 to 3 minutes and immerse it into SAC305(Sn96.5Ag3.0Cu0.5) solder of $245 \pm 5^\circ C$ for 3±1seconds.																	
13 Temperature cycle (Thermal shock)	Appearance	No marking defects																		
	Cap. Change	NP0 within $\pm 2.5\%$ or 0.25pF (whichever is larger)	X7R/X5R within $\pm 7.5\%$																	
	Q/D.F.	If $C \leq 30pF$, $DF \leq 1/(400+20C)$ If $C > 30pF$, $DF \leq 0.1\%$	To satisfy the specified initial spec.																	
	I.R.	I.R. $\geq 10,000M\Omega$ or $R_1C_R \geq 500\Omega\cdot F$. (whichever is smaller)	I.R. $\geq 10,000M\Omega$ or $R_1C_R \geq 500\Omega\cdot F$. (whichever is smaller)																	
<p>Solder the capacitor to supporting jig (glass epoxy board) and perform the five cycles according to the four heat treatments listed in the following table. Let sit for 24±2hrs at room temperature, then measure.</p> <table border="1"> <tbody> <tr> <td>Step 1: Minimum operating temperature</td> <td>30±3min</td> </tr> <tr> <td>Step 2: Room temperature</td> <td>2~3 min</td> </tr> <tr> <td>Step 3: Maximum operating temperature</td> <td>30±3min</td> </tr> <tr> <td>Step 4: Room temperature</td> <td>2~3min</td> </tr> </tbody> </table> <p>*Class II: Initial measurement: perform a heat treatment at 150+/-10°C for one hour and then let sit for 48±4 hours at room temp. Perform the initial measurement.</p>				Step 1: Minimum operating temperature	30±3min	Step 2: Room temperature	2~3 min	Step 3: Maximum operating temperature	30±3min	Step 4: Room temperature	2~3min									
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	Item	Specification		Test Method	
		Class I (NP0)	Class II (X5R/X7R)		
14	Humidity load	Appearance	No marking defects		Apply the rated voltage at 40±2°C and 90 to 95% humidity for 500±12 hours. Remove and let sit for 24±2 hours (temperature compensating type) or 48±4 hours (high dielectric constant type) at room temperature, then measure. The charge / discharge current is less than 50mA. *Class II: Initial measurement: perform a heat treatment at 150+/-10°C for one hour and then let sit for 48±4hours at room temperature. Perform the initial measurement.
		Cap. Change	NP0 within ±7.5% or 0.75pF (whichever is larger)	X7R/X5R within ±12.5%	
		Q/D.F.	If C > 30pF, DF ≤ 0.5% If C ≤ 30pF, D ≤ 1/(100+10xC/3) C in pF	X7R/X5R 200% max of initial spec.	
		I.R.	I.R. ≥ 500MΩ or R _i C _r ≥ 25Ω-F. (whichever is smaller)	I.R. ≥ 500MΩ or R _i C _r ≥ 25Ω-F. (whichever is smaller) * some of the parts are RiCr ≥ 12.5Ω-F, please refer to table 1	
15	High temperature load life test	Appearance	No marking defects		Apply 200%(150% for ≥ 500V; 120% for ≥ 1000V) of the rated voltage for 1000±12 hours at the maximum operating temperature ± 3°C. Let sit for 24± 2 hours (temperature compensating type) or 48±4 hours (high dielectric constant type) at room temperature, then measure. The charge/discharge current is less than 50mA. *High dielectric constant type: Initial measurement: perform a heat treatment at 150+/-10°C for one hour and then let sit for 48±4hours at room temperature. Perform the initial measurement. * 150% for high dielectric constant type ≥ 500V. * 120% for voltage ≥ 1000V. * some of the parts are applicable in rated voltage *1.5. please refer to table 1
		Cap. Change	NP0 within ±7.5% or 0.75pF (whichever is larger)	X7R/X5R within ±12.5%	
		Q/D.F.	If C > 30pF, DF ≤ 0.3% If 10pF < C ≤ 30pF, DF ≤ 1/(275+5xC/2) If C ≤ 10pF, DF ≤ 1/(200+10C), C in pF	X7R/X5R 200% max of initial value	
		I.R.	More than 1GΩ or R _i C _r ≥ 50Ω-F (whichever is less.)	More than 1GΩ or R _i C _r ≥ 50Ω-F (whichever is less.) * some of the parts are RiCr ≥ 25Ω-F, please refer to table 1	

■ Table 1

TC	Product Range
X5R/X7R	0402 (EIA 01005): C ≥ 680 pF

■ X5R/X7R DF (tan δ) Table

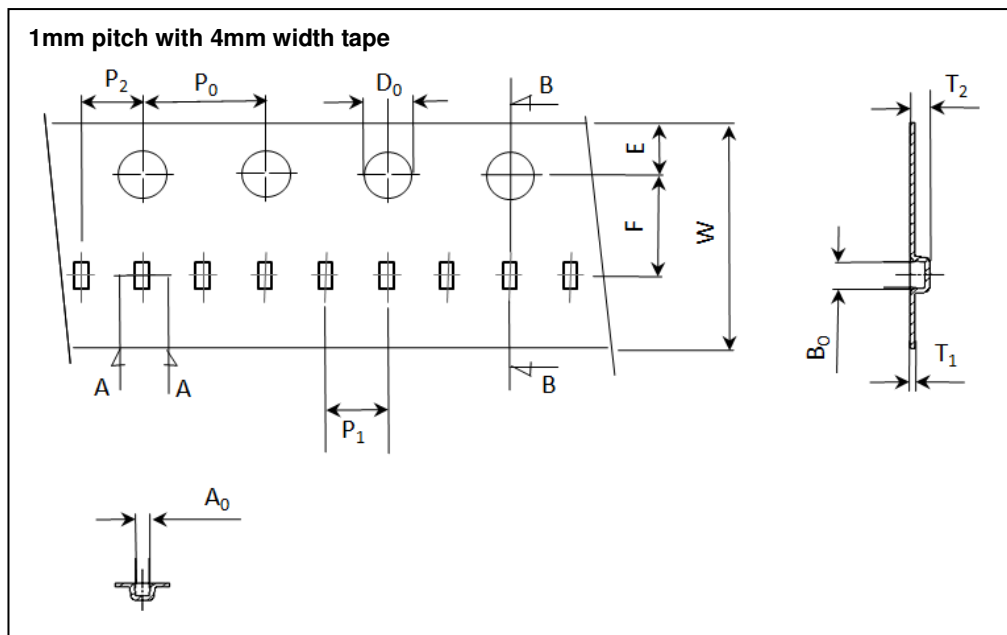
Rated Voltage	Capacitance	D.F Max.	
		X5R	X7R
6.3V	cap ≤ 10nF	5.0%	5.0%
10V	cap ≤ 10nF	5.0%	5.0%

■ Packing

- **Tape and reel packaging**

Tape and reel packaging is currently the most promising system for high-speed production.

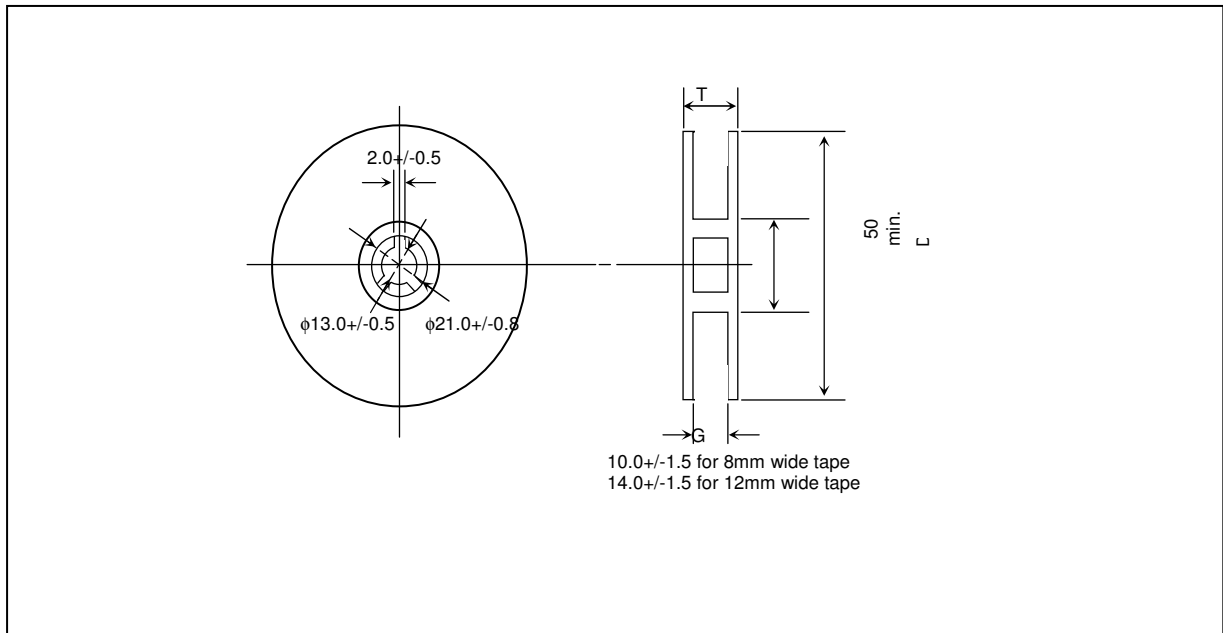
- **Embossed tape specifications**



DIMENSION (mm)	PRODUCT SIZE CODE
	1 mm tape
	0402(01005)
P ₁	1±0.02
P ₀	2±0.04
P ₂	1±0.02
A ₀	0.23±0.02
B ₀	0.45±0.02
W	4±0.05
E1	0.9±0.05
F	1.8±0.02
D ₀	0.8±0.04
T ₁	0.15~0.40
T ₂	0.5 max

* Nominal value

- Reel specifications



TAPE WIDTH (mm)	G (mm)	T max. (mm)	D (mm)
4	5.0 ± 1.5	9.5	180

- Thickness and Packing Amount

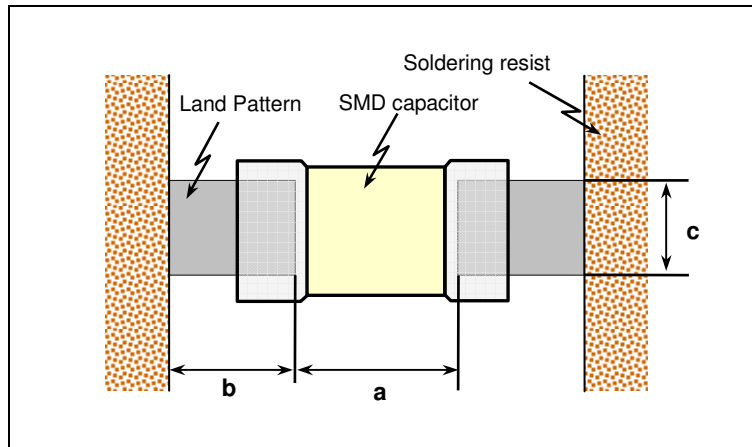
Thickness			Amount per reel					
			180 mm (7")		250 mm (10")		330 mm (13")	
Code	Spec	Size(EIA)	Paper	Embossed	Paper	Embossed	Paper	Embossed
Z	0.20+/-0.02	0402 (01005)		40K ^{#1}				

#1: 4mm width 1mm pitch Embossed Taping

Recommended Land Pattern Dimensions

When mounting the capacitor to substrate, it's important to consider that the amount of solder (size of fillet) used has a direct effect upon the capacitor once it's mounted.

1. The greater the amount of solder, the greater the stress to the elements, as this may cause the substrate to break or crack.
2. In the situation where two or more devices are mounted onto a common land, separate the device into exclusive pads by using soldering resist.
3. Land width equal to or less than component. It is permissible to reduce land width to 80% of component width.



Size mm (EIA)	L x W (mm)	a (mm)	b (mm)	c (mm)
0402 (01005)	0.4*0.2	0.16 to 0.20	0.12 to 0.18	0.20 to 0.23