

## *Data Sheet*

Customer: \_\_\_\_\_

Product: Multilayer Ceramic Chip Capacitors -ST series \_\_\_\_\_

Size : 0402/0603/0805/1206/1210/1808/1812/1825/2220/2225 \_\_\_\_\_

Issued Date: 11-Sep-2019 \_\_\_\_\_

Edition: Ver. 1 \_\_\_\_\_

### Record of change

Date	Ver.	Description	Page
17-Feb.-2016	1		
18-Oct.-2018	2	Add items	
11-SEP-2019	3	Add items	

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17-Feb.-2016	17-Feb.-2016	17-Feb.-2016	
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## Introduction

HITANO Multilayer Ceramic Chip Capacitors supplied in bulk or tape & reel package are ideally suitable for thick-film hybrid circuits and automatic surface mounting on any printed circuit boards.

ST series use a special material between nickel-barrier and ceramic body. It provides excellent performance to withstand bending stress occurred during process and provide more security for PCB process.

The nickel-barrier terminations are consisted of a nickel barrier layer over the silver metallization and then finished by electroplated solder layer to ensure the terminations have good solder ability. The nickel barrier layer in terminations prevents the dissolution of termination when extended immersion in molten solder at elevated solder temperature.

## Features

- \* High performance to withstanding 5mm of substrate bending test guarantee.
- \* A wide selection of sizes is available (0603 to 2225).
- \* High capacitance in given case size.
- \* Capacitor with lead-free termination (pure Tin).
- \* Reduction in PCB bend failure.
- \* High reliability and stability.
- \* RoHS & HALOGEN compliant.

## Applications

- \* For general digital circuit.
- \* For power supply bypass capacitors.
- \* For consumer electronics.
- \* For telecommunication.
- \* DC to DC converter

## Part Numbering

ST	0603	N	100	G	500	N	T
<u>Series</u>	<u>Size</u>	<u>Dielectric</u>	<u>Capacitance</u>	<u>Tolerance</u>	<u>Rated voltage</u>	<u>Termination</u>	<u>Packaging</u>
	Inch (mm)	N:COG(NPO)	Two significant digits followed by no. of zeros and R is in place of decimal point. eg.:	B=±0.1pF	Two significant digits followed by no. of zeros. And R is in place of decimal point.	N=Cu/Ni/Sn	B = Bulk in Tray
	<b>0402</b> (1005)	B: X7R	R47=0.47pF 0R5=0.5pF 1R0=1.0pF	C=±0.25pF	250= 25 VDC 500= 50 VDC 101= 100 VDC 201= 200 VDC 251= 250 VDC 501= 500 VDC 631= 630 VDC 102= 1000 VDC 202= 2000 VDC 302= 3000 VDC		05 = 500/Reel 1= 1K/Reel 2= 2K/Reel 3= 3K/Reel T= 4K/Reel U= 10K/ Reel V= 15K/ Reel
	<b>0603</b> (1608)			D=±0.5pF			
	<b>0805</b> (2012)			F=±1%			
	<b>1206</b> (3216)			G=±2%			
	<b>1210</b> (3225)			J=±5%			
	<b>1808</b> (4520)			K=±10%			
	<b>1812</b> (4532)			M=±20%			
	<b>1825</b> (4563)						
	<b>2220</b> (5750)						
	<b>2225</b> (5763)						
			100=10x10 <sup>0</sup> =10pF				
			102=10x10 <sup>2</sup> = 1000pF				
			104=10x10 <sup>4</sup> = 100000pF				

## ■Dimensions

Size inch(mm)	L (mm)	W (mm)	Thickness	MB (mm)
			T(mm)	
0402(1005)	1.00±0.10	0.5±0.10	Refer to range table	0.25+0.05/-0.10
0603 (1608)	1.60±0.20	0.80±0.15		0.40±0.15
0805 (2012)	2.10±0.20	1.25±0.20		0.50±0.20
1206 (3216)	3.30±0.30	1.60+0.30/-0.10		0.60±0.20
1210 (3225)	3.30±0.40	2.50±0.30		0.75±0.35
1808 (4520)	4.60±0.50	2.00±0.20		0.75±0.35
1812 (4532)	4.60±0.50	3.20±0.30		0.75±0.35
1825 (4563)	4.60±0.50	6.30±0.40		0.75±0.35
2220 (5750)	5.70±0.50	5.00±0.40		0.85±0.35
2225 (5763)	5.70±0.50	6.30±0.40		0.85±0.35

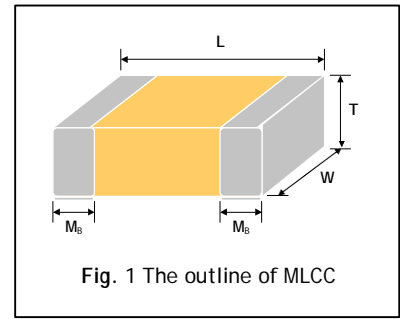


Fig. 1 The outline of MLCC

## ■General Electrical Data

Dielectric	NPO	X7R
Size	0402~2225	
Capacitance range	0.1PF~330NF	100PF~22UF
Capacitance tolerance	B,C,D,F,G,J,K	K,M
Rated voltage	10V~4KV	6.3V~4KV
Operating temperature	-55 to +125	-55 to +125
Capacitance characteristic	+/-30ppm	+/- 15%
Termination	Ni/Sn (lead-free termination)	

\* Measured at the condition of 30~70% related humidity.

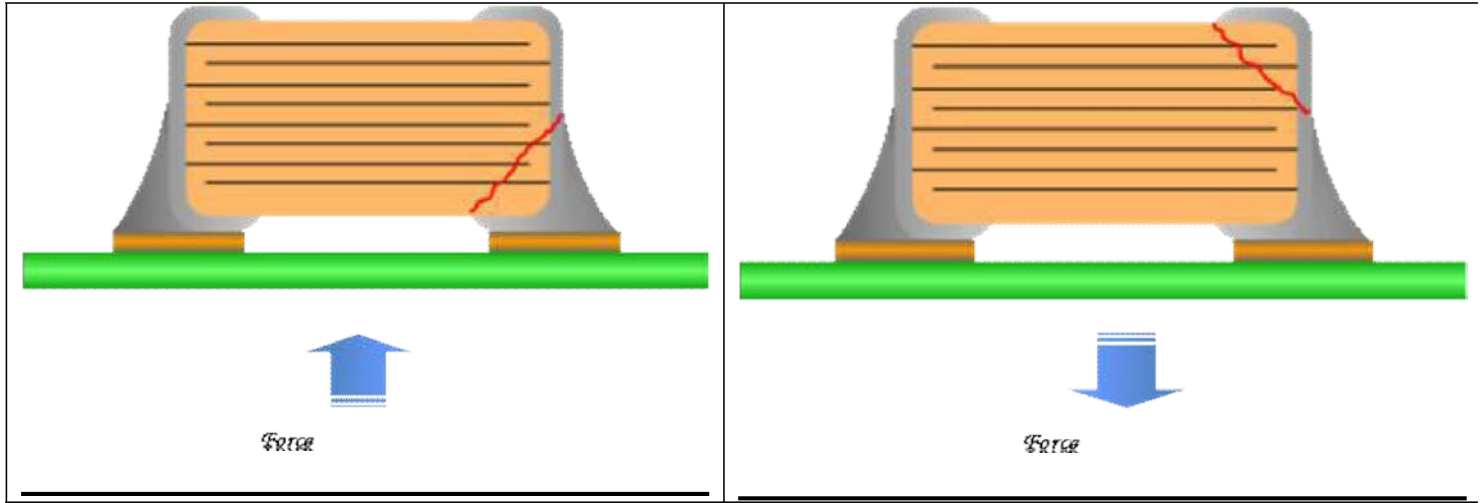
NPO: Apply 1.0±0.2Vrms, 1.0MHz±10% for Cap≤1000pF and 1.0±0.2Vrms, 1.0kHz±10% for Cap>1000pF, 25°C at ambient temperature

X7R, X5R: Apply 1.0±0.2Vrms, 1.0kHz±10%, at 25°C ambient temperature. Y5V: Apply 1.0±0.2Vrms, 1.0kHz±10%, at 20°C ambient temperature.

\*\* Preconditioning for Class II MLCC: Perform a heat treatment at 150±10°C for 1 hour, then leave in a mbient condition for 24±2 hours before measurement.

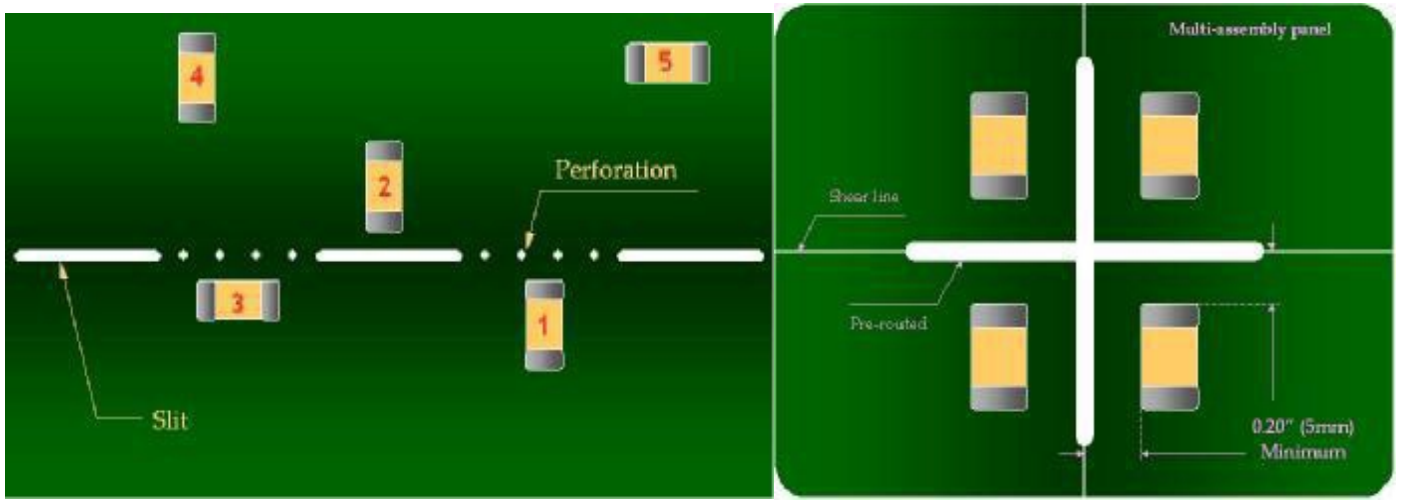
**Typical Bending Cracks of MLCC**

MLCC ceramic body is consisted of rigidity material. It will be suffered compressive and tensional stress when the carried board is bended. If the suffered stress is over ceramic body strength, the bending crack is occurred. Therefore, the bending crack will be only occurred after soldering process.



**The stress v.s. position on PCB during bending**

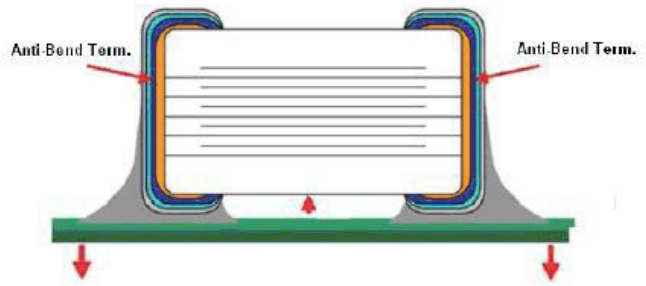
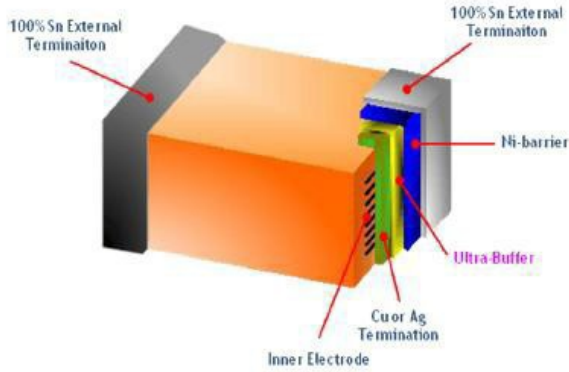
Chip mounting close to board separation point



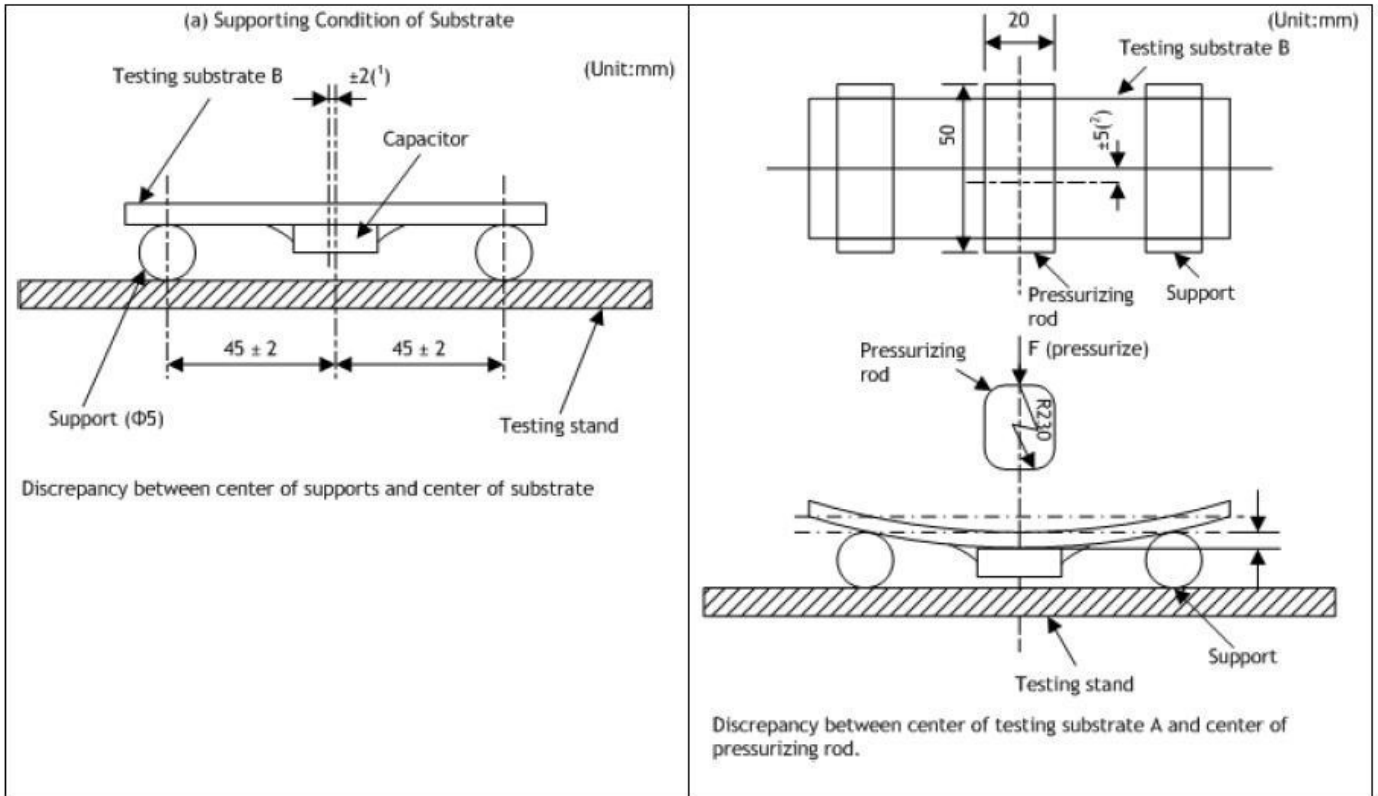
**Magnitude of stress 1 > 2 ~ 3 > 4 > 5**

## 9. Structure

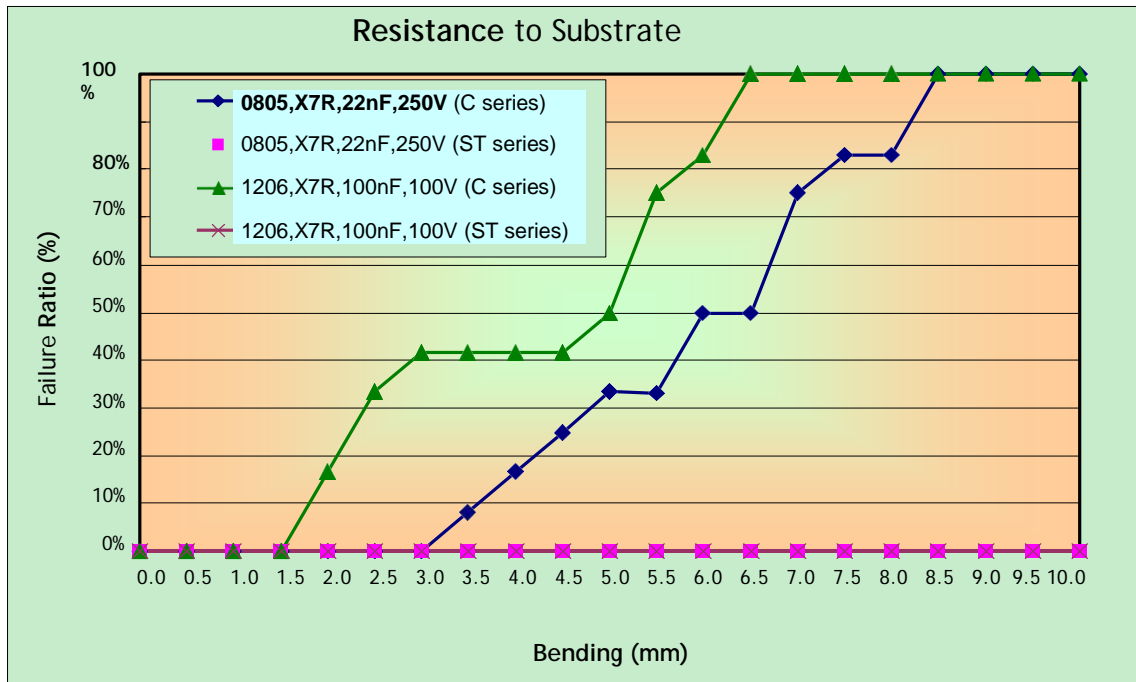
HITANO ST series is added a special termination material (Ultra-Buffer or Anti-Bend) between ceramic body and Ni-barrier that can absorb mechanical stress to prevent bending crack occurred.



## 10. Illustration of Bending Test



**Comparison of Bending Test Result**



PCB TEST RESULT			
Size	Mean Bend C series(mm)	Mean Bend ST series.(mm)	Improvement with Ultra-buffer
0402	≥ 2	≥ 5	300%
0603	≥ 2	≥ 5	300%
0805	≥ 2	≥ 5	300%
1206	≥ 2	≥ 5	300%
1210	≥ 2	≥ 5	300%
1808	≥ 3	≥ 5	300%
1812	≥ 3	≥ 5	140%
1825	≥ 3	≥ 5	117%
2220	≥ 5	≥ 7	114%
2225	≥ 5	≥ 7	114%



**■NPO(C0G) Dielectric 0805 Size**

DIELECTRIC		NPO									
SIZE		0805									
RATED VOLTAGE (VDC)		10	16	25	50	100	200	250	500	630	1000
Capacitance	0.5pF (0R5)	A	A	A	A	A	A	A	A	A	X
	0.6pF (0R6)	A	A	A	A	A	A	A	A	A	X
	0.7pF (0R7)	A	A	A	A	A	A	A	A	A	X
	0.8pF (0R8)	A	A	A	A	A	A	A	A	A	X
	0.9pF (0R9)	A	A	A	A	A	A	A	A	A	X
	1.0pF (1R0)	A	A	A	A	A	A	A	A	A	X
	1.2pF (1R2)	A	A	A	A	A	A	A	A	A	X
	1.5pF (1R5)	A	A	A	A	A	A	A	A	A	X
	1.8pF (1R8)	A	A	A	A	A	A	A	A	A	X
	2.2pF (2R2)	A	A	A	A	A	A	A	A	A	X
	2.7pF (2R7)	A	A	A	A	A	A	A	A	A	X
	3.3pF (3R3)	A	A	A	A	A	A	A	A	A	X
	3.9pF (3R9)	A	A	A	A	A	A	A	A	A	X
	4.7pF (4R7)	A	A	A	A	A	A	A	A	A	X
	5.6pF (5R6)	A	A	A	A	A	A	A	A	A	X
	6.8pF (6R8)	A	A	A	A	A	A	A	A	A	X
	8.2pF (8R2)	A	A	A	A	A	A	A	A	A	X
	10pF (100)	A	A	A	A	A	A	A	A	A	X
	12pF (120)	A	A	A	A	A	A	A	A	A	X
	15pF (150)	A	A	A	A	A	A	A	A	A	X
	18pF (180)	A	A	A	A	A	A	A	A	A	X
	22pF (220)	A	A	A	A	A	A	A	A	A	X
	27pF (270)	A	A	A	A	A	A	A	A	A	X
	33pF (330)	A	A	A	A	A	A	A	A	A	X
	39pF (390)	A	A	A	A	A	A	A	A	A	X
	47pF (470)	A	A	A	A	A	A	A	A	A	X
	56pF (560)	A	A	A	A	A	A	A	A	A	X
	68pF (680)	A	A	A	A	A	A	A	A	A	X
	82pF (820)	A	A	A	A	A	A	A	H	H	X
	100pF (101)	A	A	A	A	A	A	A	H	H	X
	120pF (121)	A	A	A	A	A	A	A	H	X	X
	150pF (151)	A	A	A	A	A	A	H	X	X	X
	180pF (181)	A	A	A	A	A	A	H	X	X	X
	220pF (221)	A	A	A	A	A	A	X	X	X	X
	270pF (271)	A	A	A	A	A	A	X	X	X	X
	330pF (331)	A	A	A	A	A	A	X	X	X	X
	390pF (391)	H	H	H	H	H	H	X	X	X	X
	470pF (471)	H	H	H	H	H	H	X	X	X	
	560pF (561)	H	H	H	H	H	H	X	X	X	
	680pF (681)	H	H	H	H	H	H	X	X	X	
820pF (821)	H	H	H	H	H	H	X	X	X		
1,000pF (102)	H	H	H	H	H	H	X	X	X		
1,200pF (122)	H	H	H	H	H	H	X	X			
1,500pF (152)	H	H	H	H	H	H	X	X			
1,800pF (182)	H	H	H	H	H	H	X	X			
2,200pF (222)	H	H	H	H	H	H	X	X			
2,700pF (272)	X	X	X	X	X	X					
3,300pF (332)	X	X	X	X	X	X					
3,900pF (392)	X	X	X	X	X	X					
4,700pF (472)	X	X	X	X	X	X					
5,600pF (562)	X	X	X	X	X	X					
6,800pF (682)	X	X	X	X	X	X					
8,200pF (822)	X	X	X	X	X						
0.010μF (103)	X	X	X	X							







## ■NPO(C0G) Dielectric 1808 Size

DIELECTRIC		NPO					
SIZE		1808					
RATED VOLTAGE (VDC)		500	630	1000	1500	2000	3000
Capacitance	2.0pF (2R0)						
	2.2pF (2R2)	X	X	X	X	X	X
	2.7pF (2R7)	X	X	X	X	X	X
	3.3pF (3R3)	X	X	X	X	X	X
	3.9pF (3R9)	X	X	X	X	X	X
	4.7pF (4R7)	X	X	X	X	X	X
	5.6pF (5R6)	X	X	X	X	X	X
	6.8pF (6R8)	X	X	X	X	X	X
	8.2pF (8R2)	X	X	X	X	X	X
	10pF (100)	X	X	X	X	X	X
	12pF (120)	X	X	X	X	X	X
	15pF (150)	X	X	X	X	X	X
	18pF (180)	X	X	X	X	X	X
	22pF (220)	X	X	X	X	X	X
	27pF (270)	X	X	X	X	X	X
	33pF (330)	X	X	X	X	X	X
	39pF (390)	X	X	X	X	X	X
	47pF (470)	X	X	X	X	X	X
	56pF (560)	X	X	X	X	X	X
	68pF (680)	X	X	X	X	X	X
	82pF (820)	X	X	X	X	X	X
	100pF (101)	X	X	X	X	X	Z
	120pF (121)	X	X	X	X	X	Z
	150pF (151)	X	X	X	Z	Z	Z
	180pF (181)	X	X	X	Z	Z	Z
	220pF (221)	X	X	X	Z	Z	Z
	270pF (271)	Z	Z	Z	Z	Z	Z
	330pF (331)	Z	Z	Z	Z	Z	Z
	390pF (391)	Z	Z	Z	Z	Z	Z
	470pF (471)	Z	Z	Z	Z	Z	Z
	560pF (561)	Z	Z	Z	Z	Z	Z
	680pF (681)	Z	Z	Z	Z	Z	Z
	820pF (821)	Z	Z	Z	X	X	
1,000pF (102)	Z	Z	Z	L	L		
1,200pF (122)	Z	Z	L				
1,500pF (152)	Z	Z	L				
1,800pF (182)	Z	Z	Z				
2,200pF (222)	Z	Z	Z				
2,700pF (272)	Z	Z					
3,300pF (332)	Z	Z					
3,900pF (392)							



















## 軒 Thickness Code & Standard Packaging Q'ty per Reel

Thickness Code	Chip Size	Chip Thickness	Max Tape Thickness	Q'ty of carboard tape in		Q'ty of Embosses tape in	
S	0402	0.50±0.05 mm	0.60 mm	10,000	50,000	--	--
P	0603	0.80±0.10 mm	0.95 mm	4,000	15,000	--	--
A	0805	0.60±0.10 mm	0.75 mm	4,000	15,000	--	--
H		0.85±0.10 mm	0.95 mm	4,000	15,000	--	--
X		1.25±0.10 mm	1.80 mm	--	--	3,000	10,000
H	1206	0.85±0.10 mm	0.90 mm	4,000	15,000	--	--
C		0.95±0.10 mm	1.80 mm			3,000	10,000
X		1.25±0.10 mm	1.80 mm	--	--	3,000	10,000
L		1.65±0.20 mm	1.80 mm	--	--	2,000	--
C	1210	0.95±0.10 mm	1.80 mm			3,000	10,000
X		1.25±0.10 mm	1.80 mm	--	--	2,000	--
L		1.65±0.20 mm	1.80 mm	--	--	2,000	--
Z		2.00±0.20 mm	2.20 mm	--	--	2,000	--
G		2.50±0.20 mm	2.75 mm	--	--	1,000	--
X	1808	1.25±0.10 mm	1.80 mm	--	--	2,000	--
F		1.40±0.20 mm	1.80 mm	--	--	2,000	--
L		1.65±0.20 mm	1.80 mm	--	--	2,000	--
Z		2.00±0.20 mm	2.20 mm	--	--	1,000	--
X	1812	1.25±0.20 mm	1.80 mm	--	--	1,000	--
L		1.65±0.20 mm	1.80 mm			1,000	
Z		2.00±0.20 mm	2.20 mm	--	--	1,000	--
G		2.50±0.20 mm	2.75 mm	--	--	500	--
U		2.80±0.30 mm	3.00 mm	--	--	500	--
Z	1825	2.00±0.20 mm	2.20 mm	--	--	1,000	--
G		2.50±0.20 mm	2.75 mm	--	--	500	--
U		2.80±0.30 mm	3.00 mm	--	--	500	--
Z	2220	2.00±0.20 mm	2.20 mm	--	--	500	--
G		2.50±0.20 mm	2.75 mm	--	--	500	--
U		2.80±0.30 mm	3.00 mm	--	--	500	--
L	2211	1.65±0.20 mm	1.80 mm			1,000	
Z		2.00±0.20 mm	2.20 mm	--	--	1,000	--
G		2.50±0.20 mm	2.75 mm	--	--	500	--
Z	2225	2.00±0.20 mm	2.20 mm	--	--	1,000	--
G		2.50±0.20 mm	2.75 mm	--	--	500	--
U		2.80±0.30 mm	3.00 mm	--	--	500	--

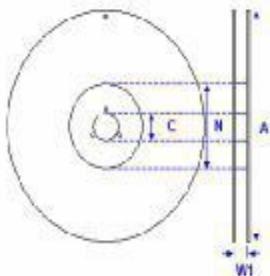


Fig. 4 The dimension of reel

Size	0603, 0805, 1206, 1210			1812, 1825, 2220, 2225
Reel size	7"	10"	13"	7"
C	13.0+0.5/-0.2	13.0+0.5/-0.2	13.0+0.5/-0.2	13.0+0.5/-0.2
W <sub>1</sub>	8.4+1.5/-0	8.4+1.5/-0	8.4+1.5/-0	12.4+2.0/-0
A	178.0±0.10	250.0±1.0	330.0±1.0	178.0±0.10
N	60.0+1.0/-0	100.0±1.0	100±1.0	80.0±1.0



## Application Note

### Storage

To prevent the damage of solder ability of terminations, the following storage conditions are recommended: Indoors under 5 ~ 40°C and 20% ~ 70% RH. No harmful gases containing sulfuric acid, ammonia, hydrogen sulfide or chlorine. Packaging should not be opened until the capacitors are required for use. If opened, the pack should be re-sealed as soon as is practicable. Taped product should be stored out of direct sunlight, which might promote deterioration in tape or adhesion performance. The capacitors should be used within 6 months and checked the solder ability before use.

### Handling

Chip capacitors are dense, hard, brittle, and abrasive materials. They are liable to suffer mechanical damage, in the form of cracks or chips. Chip Capacitors should be handled with care to avoid contamination or damage. To use vacuum or plastic tweezers to pick up or plastic tweezers is recommended for manual placement. Tape and reeled packages are suitable for automatic pick and placement machine.

### Preheat

In order to minimize the risk of thermal shock during soldering, a carefully controlled preheat is required. The rate of preheat should not exceed 4°C per second and the final preheat temperature should be within 100°C of the soldering temperature for small chips such as 0603, 0805 and 1206, within 50°C of the soldering temperature chip size for bigger such as 1210 ~ 2520.

### Soldering

Use mildly activated rosin RA and RMA fluxes do not use activated flux. The amount of solder in each solder joint should be controlled to prevent the damage of chip capacitors caused by the stress between solder, chips, and substrate. Hand soldering with temperature-controlled iron not exceeding 30 watts and diameter of tip less than 1.2 mm is recommended, tip of iron should not contact the ceramic body directly, and the temperature of iron should be set to not more than 260°C. For bigger chips such as 1210, 1808, 1812, 2211, 2220 etc. wave soldering and hand soldering are not recommended. Refer IPC/JEDEC J-STD-020D Method recommended soldering profiles :

Reflow not sooner than 15 minutes and not longer than 4 hrs after removal from the temperature/humidity chamber, subject the sample to 3 cycle of the appropriate reflow conditions as defined as below Table description.

Profile Feature	Pb-Free Assembly
Preheat/Soak	150°C
Temperature Min.(T <sub>smin</sub> )	200°C
Temperature Max.(T <sub>smax</sub> )	60 to 120 seconds
Time(t <sub>s</sub> ) from (T <sub>smin</sub> to T <sub>smax</sub> )	3°C/second max.
Ramp-up rate(T <sub>L</sub> to T <sub>p</sub> )	217°C
Liquidous temperature(T <sub>L</sub> )	60 to 150 seconds
Time(t <sub>L</sub> ) maintained above T <sub>L</sub>	For user T <sub>p</sub> must not exceed the Classification temp 260°C For suppliers T <sub>p</sub> must equal or exceed the Classification temp 260°C
Peak package body temperature(T <sub>p</sub> )	30* second
Time(T <sub>p</sub> )* within 5°C of the specified classification temperature(T <sub>c</sub> )	6°C/second max.
Ramp-down rate (T <sub>p</sub> to T <sub>L</sub> )	8 minutes max.
Time 25°C to peak temperature 260°C	

Lead-free : Soldering temperature = 235 to 260°C, depending on product.

Maximum temperature = Minimum temperature (235°C) + ΔT + Tolerance for oven process and measurement (5 ~ 7°C)

Time at peak temperature = 10sec, Dwell above 217°C = 90sec, Ramping rate = 3°C/sec(heating) and 6°C/sec(heating).

## Cooling

After soldering, cool the chips and the substrate gradually to room temperature. Natural cooling in air is recommended to minimize stress in the solder joint. A cooling rate not exceeding 4°C per second should be used when forced cooling is necessary.

## Cleaning

All flux residues must be removed by using suitable electronic-grade vapor-cleaning solvents to eliminate contamination that could cause electrolytic surface corrosion. Good results can be obtained by using ultrasonic cleaning of the solvent. The choice of the proper system is depends upon many factors such as component mix, flux, and solder paste and assembly method. The ability of the cleaning system to remove flux residues and contamination from under the chips is very important.

## Reliability Test Condition and Requirement

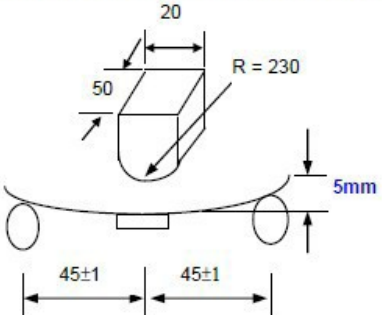
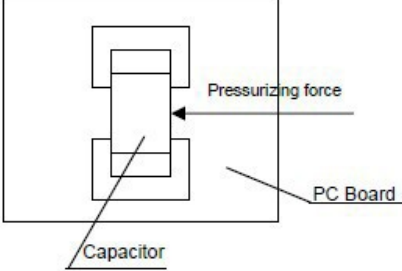
No.	Item	Test Condition	Requirements																										
1.	Visual and Dimensions	---	<ul style="list-style-type: none"> <li>* No remarkable defect.</li> <li>* Dimensions to conform to individual specification sheet.</li> </ul>																										
2.	Capacitance	Class I: (NPO)	* Shall not exceed the limits given in the detailed spec.																										
3.	Q/ D.F. (Dissipation Factor)	Cap $\leq$ 1000pF, 1.0 $\pm$ 0.2Vrms, 1MHz $\pm$ 10% Cap $>$ 1000pF, 1.0 $\pm$ 0.2Vrms, 1KHz $\pm$ 10%  Class II: (X7R): Cap $\leq$ 10 $\mu$ F, 1.0 $\pm$ 0.2Vrms, 1KHz $\pm$ 10%	<table border="1"> <thead> <tr> <th>Dielectric</th> <th>Rated vol.(V)</th> <th>Q/D.F.</th> <th>Remark</th> </tr> </thead> <tbody> <tr> <td rowspan="2">Class I(NPO)</td> <td rowspan="2">All</td> <td>Q<math>\geq</math>1000</td> <td>Cap<math>\geq</math>30pF</td> </tr> <tr> <td>Q<math>\geq</math>400+20C</td> <td>Cap<math>&lt;</math>30pF</td> </tr> <tr> <td rowspan="3">Class II(X7R)</td> <td rowspan="2">25V</td> <td>D.F. <math>&lt;</math> 3.5%</td> <td></td> </tr> <tr> <td>D.F. <math>&lt;</math> 2.5%</td> <td></td> </tr> <tr> <td><math>\geq</math>50</td> <td>D.F. <math>&lt;</math> 3.0%</td> <td>0603<math>\geq</math>0.047<math>\mu</math>F; 0805<math>\geq</math>0.18<math>\mu</math>F, 1206<math>\geq</math>0.47<math>\mu</math>F</td> </tr> </tbody> </table>	Dielectric	Rated vol.(V)	Q/D.F.	Remark	Class I(NPO)	All	Q $\geq$ 1000	Cap $\geq$ 30pF	Q $\geq$ 400+20C	Cap $<$ 30pF	Class II(X7R)	25V	D.F. $<$ 3.5%		D.F. $<$ 2.5%		$\geq$ 50	D.F. $<$ 3.0%	0603 $\geq$ 0.047 $\mu$ F; 0805 $\geq$ 0.18 $\mu$ F, 1206 $\geq$ 0.47 $\mu$ F							
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6.	Solderability	<ul style="list-style-type: none"> <li>* Solder temperature: 235<math>\pm</math>5<math>^{\circ}</math>C for (0603~1210)</li> <li>* Solder temperature: 245<math>\pm</math>5<math>^{\circ}</math>C for (1808~2225)</li> <li>* Dipping time: 2<math>\pm</math>0.5 sec.</li> </ul>	75% min. coverage of all metalized area.																										
7.	Dielectric Strength	<table border="1"> <thead> <tr> <th>Rated vol.(V)</th> <th>Condition</th> </tr> </thead> <tbody> <tr> <td><math>\leq</math> 250</td> <td>2.0 times of <math>U_R</math></td> </tr> <tr> <td>250<math>&lt;</math>V<math>\leq</math>500</td> <td>1.5 times of <math>U_R</math></td> </tr> <tr> <td>630<math>\leq</math>V<math>\leq</math>3000V</td> <td>1.2 times of <math>U_R</math></td> </tr> <tr> <td>3000<math>&lt;</math>V<math>\leq</math>5000V</td> <td>1.1 times of <math>U_R</math></td> </tr> <tr> <td><math>&gt;</math>5000V</td> <td>1.0 times of <math>U_R</math></td> </tr> </tbody> </table> <ul style="list-style-type: none"> <li>* Duration: 1 to 5 sec.</li> <li>* Charge and discharge current less than 50mA.</li> </ul>	Rated vol.(V)	Condition	$\leq$ 250	2.0 times of $U_R$	250 $<$ V $\leq$ 500	1.5 times of $U_R$	630 $\leq$ V $\leq$ 3000V	1.2 times of $U_R$	3000 $<$ V $\leq$ 5000V	1.1 times of $U_R$	$>$ 5000V	1.0 times of $U_R$	* No evidence of damage or flash over during test.														
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8.	Resistance to Soldering Heat	<ul style="list-style-type: none"> <li>* Solder temperature: 260<math>\pm</math>5<math>^{\circ}</math>C</li> <li>* Dipping time: 10<math>\pm</math>1 sec</li> <li>* Preheating: 120 to 150<math>^{\circ}</math>C for 1 minute before immerse the capacitor in a eutectic solder.</li> <li>* Before initial measurement (Class II only): Perform 150<math>\pm</math>0/-10<math>^{\circ}</math>C for 1 hr and then set for 48<math>\pm</math>4 hrs at room temp.</li> <li>* Measurement to be made after keeping at room temp. for 24<math>\pm</math>2 hrs (Class I) or 48<math>\pm</math>4 hrs (Class II).</li> </ul>	<ul style="list-style-type: none"> <li>* No remarkable damage.</li> <li>* 25% max. leaching on each edge.</li> </ul> <table border="1"> <thead> <tr> <th>Dielectric</th> <th>Cap Change</th> <th>Q/D.F &amp; IR</th> </tr> </thead> <tbody> <tr> <td>Class I(NPO)</td> <td>Within <math>\pm</math>2.5% or <math>\pm</math>0.25pF whichever is larger.</td> <td rowspan="2">To meet Initial requirement</td> </tr> <tr> <td>Class II(X7R)</td> <td>within <math>\pm</math>7.5%</td> </tr> </tbody> </table>	Dielectric	Cap Change	Q/D.F & IR	Class I(NPO)	Within $\pm$ 2.5% or $\pm$ 0.25pF whichever is larger.	To meet Initial requirement	Class II(X7R)	within $\pm$ 7.5%																		
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9.	Temperature Cycle	<ul style="list-style-type: none"> <li>* Conduct the five cycles according to the temperatures and time.</li> </ul> <table border="1"> <thead> <tr> <th>Step</th> <th>Temp. (<math>^{\circ}</math>C)</th> <th>Time (min.)</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>Min. operating temp. +0/-3</td> <td>30<math>\pm</math>3</td> </tr> <tr> <td>2</td> <td>Room temp.</td> <td>2~3</td> </tr> <tr> <td>3</td> <td>Max. operating temp. +3/-0</td> <td>30<math>\pm</math>3</td> </tr> <tr> <td>4</td> <td>Room temp.</td> <td>2~3</td> </tr> </tbody> </table> <ul style="list-style-type: none"> <li>* Before initial measurement (Class II only): Perform 150<math>\pm</math>0/-10<math>^{\circ}</math>C for 1 hr and then set for 48<math>\pm</math>4 hrs at room temp.</li> <li>* Measurement to be made after keeping at room temp. for 24<math>\pm</math>2 hrs (Class I) or 48<math>\pm</math>4 hrs (Class II).</li> </ul>	Step	Temp. ( $^{\circ}$ C)	Time (min.)	1	Min. operating temp. +0/-3	30 $\pm$ 3	2	Room temp.	2~3	3	Max. operating temp. +3/-0	30 $\pm$ 3	4	Room temp.	2~3	<ul style="list-style-type: none"> <li>* No remarkable damage.</li> </ul> <table border="1"> <thead> <tr> <th>Dielectric</th> <th>I.R.</th> <th>Cap Change</th> <th>Q/D.F</th> </tr> </thead> <tbody> <tr> <td>Class I(NPO)</td> <td rowspan="2">To meet Initial requirement</td> <td>Within <math>\pm</math>2.5% or <math>\pm</math>0.25pF whichever is larger.</td> <td><math>\leq</math> 1.0(Q) <math>\times</math> Initial requirement</td> </tr> <tr> <td>Class II(X7R)</td> <td>within <math>\pm</math>7.5%</td> <td><math>\leq</math> 1.5(D.F.) <math>\times</math> Initial requirement</td> </tr> </tbody> </table>	Dielectric	I.R.	Cap Change	Q/D.F	Class I(NPO)	To meet Initial requirement	Within $\pm$ 2.5% or $\pm$ 0.25pF whichever is larger.	$\leq$ 1.0(Q) $\times$ Initial requirement	Class II(X7R)	within $\pm$ 7.5%	$\leq$ 1.5(D.F.) $\times$ Initial requirement
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## Reliability Test Condition and Requirement (Continued)

No.	Item	Test Condition	Requirements																																									
10.	Humidity (Damp Heat) Steady State	* Test temp.: 40±2°C * Humidity: 90~95% RH * Test time: 500+24/-0hrs. * Measurement to be made after keeping at room temp. for 24±2 hrs (Class I) or 48±4 hrs (Class II).	* No remarkable damage.																																									
			Dielectric I.R	Cap Change	Q/D.F																																							
			Class I(NPO)	$\geq 1G\Omega$ or $RxC \geq 50\Omega-F$ whichever is smaller.	within ± 5.0% or ± 0.5pF whichever is larger	Cap $\geq 30pF$ 10pF $\leq$ Cap $<$ 30pF Cap $<$ 10pF	Q $\geq 350$ ; Q $\geq 275+2.5C$ Q $\geq 200+10C$																																					
Class II(X7R)		within ±12.5%	D.F. $\leq 200\% \times$ Initial requirement																																									
11	Humidity (Damp Heat) Load	* Test temp.: 40±2°C * Humidity: 90~95% RH * Test time: 500+24/-0hrs. * To apply voltage :rated voltage * Measurement to be made after keeping at room temp. for 24±2 hrs (Class I) or 48±4 hrs (Class II).	* No remarkable damage.																																									
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			Class I(NPO)	$\geq 1G\Omega$ or $RxC \geq 50\Omega-F$ whichever is smaller.	within ± 7.5% or ± 0.75pF whichever is larger	Cap $\geq 30pF$ 10pF $\leq$ Cap $<$ 30pF Cap $<$ 10pF	Q $\geq 350$ ; Q $\geq 275+2.5C$ Q $\geq 200+10C$																																					
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12.	High Temperature Load (Endurance)	* Test temp.: NP0, X7R : 125±3°C  <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr style="background-color: #D3D3D3;"> <th>Rated vol.(V)</th> <th>Apply Voltage</th> </tr> </thead> <tbody> <tr> <td><math>\leq 250</math></td> <td>2.0 times of <math>U_R</math></td> </tr> <tr> <td><math>250 &lt; V \leq 500</math></td> <td>1.5 times of <math>U_R</math></td> </tr> <tr> <td><math>630 \leq V \leq 1000</math></td> <td>1.2 times of <math>U_R</math></td> </tr> <tr> <td><math>1000 &lt; V \leq 5000V</math></td> <td>1.1 times of <math>U_R</math></td> </tr> <tr> <td><math>&gt; 5000</math></td> <td>1.0 times of <math>U_R</math></td> </tr> </tbody> </table> Exception item(X7R only): <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr style="background-color: #D3D3D3;"> <th>Rated vol.(V)</th> <th>Size</th> <th>Cap. Range</th> <th>Apply Voltage</th> </tr> </thead> <tbody> <tr> <td rowspan="5">100</td> <td>0805</td> <td><math>\geq 124</math></td> <td rowspan="10">1.5 times of <math>U_R</math></td> </tr> <tr> <td>1206</td> <td></td> </tr> <tr> <td>1210</td> <td></td> </tr> <tr> <td>1825</td> <td><math>\geq 105</math></td> </tr> <tr> <td>2220</td> <td></td> </tr> <tr> <td>2225</td> <td></td> </tr> <tr> <td rowspan="5">200 &amp; 250</td> <td>1210</td> <td><math>&gt; 224</math></td> </tr> <tr> <td>1812</td> <td><math>&gt; 474</math></td> </tr> <tr> <td>1825</td> <td></td> </tr> <tr> <td>2220</td> <td><math>\geq 105</math></td> </tr> <tr> <td>2225</td> <td></td> </tr> </tbody> </table> * Test time: 1000+24/-0 hrs. * Measurement to be made after keeping at room temp. for 24±2 hrs (Class I) or 48±4 hrs (Class II).	Rated vol.(V)	Apply Voltage	$\leq 250$	2.0 times of $U_R$	$250 < V \leq 500$	1.5 times of $U_R$	$630 \leq V \leq 1000$	1.2 times of $U_R$	$1000 < V \leq 5000V$	1.1 times of $U_R$	$> 5000$	1.0 times of $U_R$	Rated vol.(V)	Size	Cap. Range	Apply Voltage	100	0805	$\geq 124$	1.5 times of $U_R$	1206		1210		1825	$\geq 105$	2220		2225		200 & 250	1210	$> 224$	1812	$> 474$	1825		2220	$\geq 105$	2225		* No remarkable damage.
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**Reliability Test Condition and Requirement (continued)**

No.	Item	Test Condition	Requirements						
13.	Resistance to Flexure of Substrate	<p>* The middle part of substrate shall be pressurized by means of the pressurizing rod at a rate of about 1mm per second until the deflection becomes 5mm.</p> 	<p>* No remarkable damage.</p> <table border="1" data-bbox="746 304 1270 456"> <thead> <tr> <th>Dielectric</th> <th>Cap Change</th> </tr> </thead> <tbody> <tr> <td>Class I(NPO)</td> <td>within ±3.0% or ±0.3pF whichever is larger</td> </tr> <tr> <td>Class II(X7R)</td> <td>within ±12.5%</td> </tr> </tbody> </table> <p>(This capacitance change means the change of capacitance under specified flexure of substrate from the capacitance measured before the test.)</p>	Dielectric	Cap Change	Class I(NPO)	within ±3.0% or ±0.3pF whichever is larger	Class II(X7R)	within ±12.5%
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14.	Adhesive Strength of Termination	<p>* Capacitors mounted on a substrate. A force of 5N(≤0603) or 10N(&gt; 0603) applied perpendicular to the place of substrate and parallel the line joining the center of terminations for 10±1 second.</p> 	<p>* No remarkable damage or removal of the terminations.</p>						
15.	Vibration Resistance	<p>* Vibration frequency: 10~55 Hz/min. * Total amplitude: 1.5mm * Test time: 6 hrs. (Two hrs each in three mutually perpendicular directions.)</p>	<p>* No remarkable damage. * Cap change and Q/D.F.: To meet initial spec.</p>						