Multilayer Ceramic Capacitor

SAMSUNG ELECTRO-MECHANICS

Multilayer Ceramic Capacitor

■ INTRODUCTION

MLCC is an electronic part that temporarily stores an electrical charge and is classified according to the rate of decay of capacity at a certain temperature. MLCC consists of a conducting material and electrodes. To manufacture a chip-type SMT and achieve miniaturization, high density and high efficiency, ceramic condensers are used.

For use in applications at high frequencies such as cellular phones, PDAs and camcorders, ceramic capacitors must feature low equivalent series resistance(ESR) and high quality factor(high Q). MLCC used at high frequencies generally have a small temperature coefficient of capacitance(TCC), typical within the ±30ppm/℃ required for COG classification and have internal electrode of Pd and Cu. Thus, the technologies will lead to extremely reliably, stable capacitors that feature low ESR and high Q characteristics as well as high conducting electrode.

SAMSUNG (Electro-Mechanics) mid/high voltage MLCC products with C0G(NP0) and X7R temperature characteristics are designed for commercial and industrial applications up to DC 3 KV, including power supply and voltage multiplier circuits applications. The specially-designed internal and external structures are capable of enhancing high voltage performance of chips. Various sizes and voltage ratings are available for corresponding capacitance ranges. Please contact and consult the local offices/headquarter of SAMSUNG Electro-Mechanics.

■ FEATURE AND APPLICATION

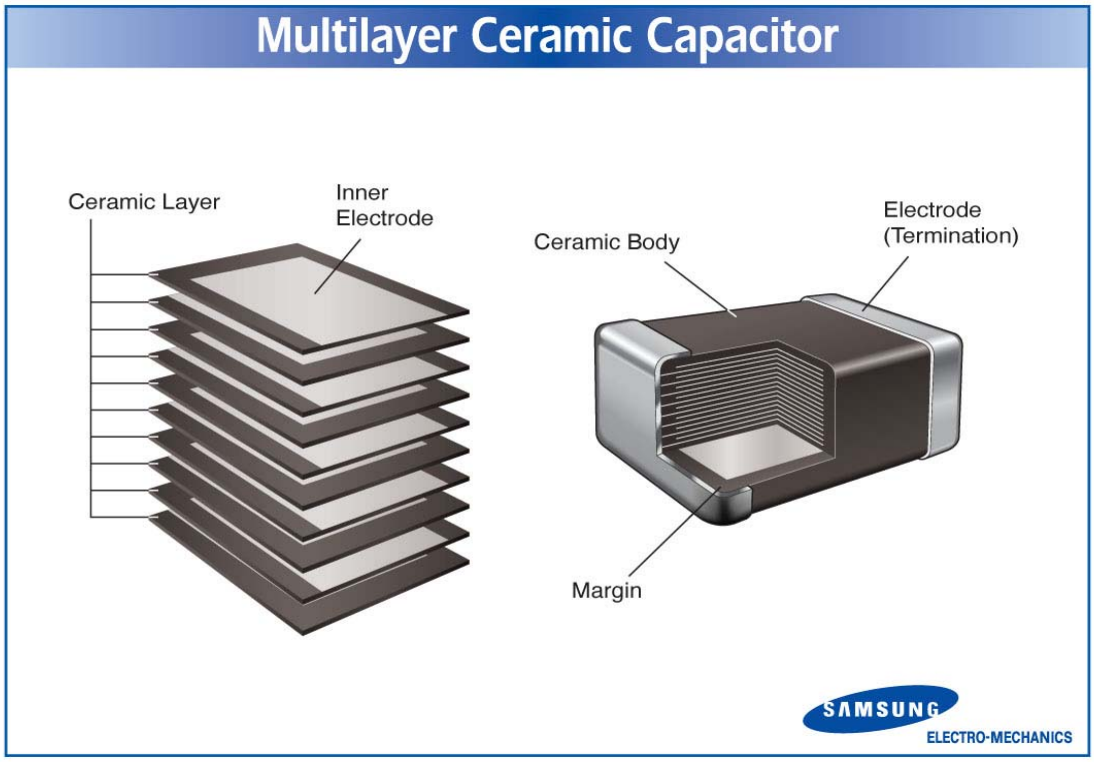
● Feature

- Miniature Size
- Wide Capacitance, Temperature Compensation and Voltage Range
- Highly Reliable Performance
- Industry Standard Size
- Tape & Reel for Surface Mount Assembly
- Low ESR at high frequencies
- High Q at high frequencies
- Stable temperature dependence of capacitance(C0G)
- Ultra-small size
- Highly reliable performance
- High RF power handling capabilities
- Highly reliable performance in high-voltage
- Industry standard size
- Tape & reel for surface mount assembly

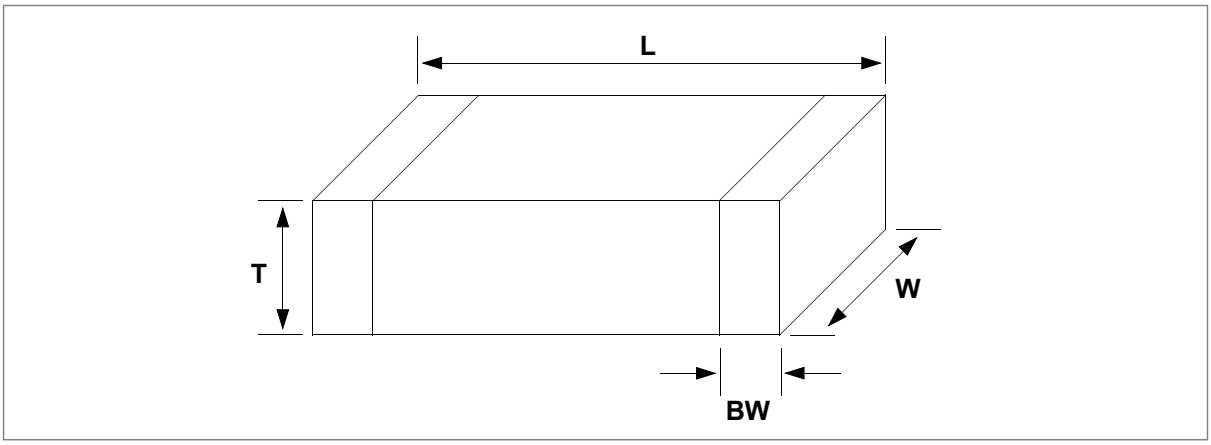
● Application

- General electronic equipment
- High frequency module and high power circuit
- Input signal filtering circuit of modem and LAN interface
- General high voltage circuits
- Inverter circuits with a liquid backlight

■ STRUCTURE


Multilayer Ceramic Capacitor
Ceramic Layer
Inner Electrode
Ceramic Body
Electrode (Termination)
Margin
SAMSUNG ELECTRO-MECHANICS

■ APPEARANCE AND DIMENSION



CODE	EIA CODE	DIMENSION (mm)			
		L	W	T (MAX)	BW
03	0201	0.6 ± 0.03	0.3 ± 0.03	0.3 ± 0.03	0.15±0.05
05	0402	1.0 ± 0.05	0.5 ± 0.05	0.5 ± 0.05	0.2+0.15/-0.1
10	0603	1.6 ± 0.1	0.8 ± 0.1	0.8 ± 0.1	0.3 ± 0.2
21	0805	2.0 ± 0.1	1.25 ± 0.1	1.25± 0.1	0.5+0.2/-0.3
31	1206	3.2 ± 0.2	1.6 ± 0.2	1.6 ± 0.2	0.5+0.2/-0.3
32	1210	3.2 ± 0.3	2.5 ± 0.2	2.5 ± 0.2	0.6 ± 0.3
43	1812	4.5 ± 0.4	3.2 ± 0.3	3.2 ± 0.3	0.8 ± 0.3
55	2220	5.7 ± 0.4	5.0 ± 0.4	3.2 ± 0.3	1.0 ± 0.3

■ PART NUMBERING

CL	10	C	101	J	B	N	C
❶	❷	❸	❹	❺	❻	❼	❽

❶ SAMSUNG Multilayer Ceramic Chip Capacitor
❷ Type(Size)
❸ Capacitance Temperature Characteristics
❹ Nominal Capacitance
❺ Capacitance Tolerance
❻ Rated Voltage
❼ Thickness Option
❽ Packaging Type

❸ CAPACITANCE TEMPERATURE CHARACTERISTICS

▶ **CLASS Ⅰ(Temperature Compensation)**

Symbol	EIA Code	Temperature Coefficient(PPM/℃)	※ Temperature Characteristics	Operation Temperature Range
C	C0G	0 ± 30	CΔ	-55 ~ +125℃
P	PH	-150 ± 60	PΔ	
R	RH	-220 ± 60	RΔ	
S	SH	-330 ± 60	SΔ	
T	TH	-470 ± 60	TΔ	
U	UJ	-750 ± 120	UΔ	
L	SL	+350 ~ -1000	SL	

※ Temperature Characteristics

Temperature Characteristics	below 2.0pF	2.2 ~ 3.9pF	above 4.0pF	above 10pF
CΔ	C0G	C0G	C0G	C0G
PΔ	-	PJ	PH	PH
RΔ	-	RJ	RH	RH
SΔ	-	SJ	SH	SH
TΔ	-	TJ	TH	TH
UΔ	-	UJ	UJ	UJ

☞ J : ±120 PPM/℃
H : ±60 PPM/℃
G : ±30 PPM/℃

▶ **CLASS Ⅱ(High Dielectric Constant)**

Symbol	EIA Code	Capacitance Change (ΔC : %)	Operation Temperature Range
A	X5R	± 15	-55 ~ +85℃
B	X7R	± 15	-55 ~ +125℃
F	Y5V	+22 ~ -82	-30 ~ +85℃

❹ NOMINAL CAPACITANCE

The nominal capacitance value is expressed in pico-Farad(pF) and identified by three-digit number, first two digits represent significant figures and last digit specifies the number of zeros to follow. For values below 1pF, the letter "R" is used as the decimal point and the last digit becomes significant.

example)

100 : 10 × 10^0 = 10pF
102 : 10 × 10^2 = 1000pF
020 : 2 × 10^0 = 2pF
1R5 : 1.5pF

❺ CAPACITANCE TOLERANCE

Temperature Characteristies	Symbol	Tolerance	Applicable Capacitance & Range
C0G(NPO) or T.C Series	A	± 0.05pF	0.5 ~ 3pF
	B	± 0.1pF	
	C	± 0.25pF	0.5 ~ 10pF
	D	± 0.5pF	
	F	± 1pF	6 ~ 10pF
	F	± 1%	E-24 Series for over 10pF
	G	± 2%	
	J	± 5%	
	K	± 10%	
A(X5R) B(X7R)	J	± 5%	E-12 Series
	K	± 10%	
	M	± 20%	
F(Y5V)	Z	-20% ~ +80%	E-6 Series

※ Please Consult us for special tolerances.

❻ RATED VOLTAGE

Symbol	Rated Voltage(Vdc)	Symbol	Rated Voltage(Vdc)
R	4V	C	100V
Q	6.3V	D	200V
P	10V	G	500V
O	16V	I	1000V
A	25V	J	2000V
B	50V	K	3000V

❼ THICKNESS OPTION

Symbol	Description of the Code
N	Standard thickness (please refer to standard thickness table on next page)
A	Thinner than standard thickness
B	Thicker than standard thickness
C	Standard Thickness High Q (Low ` D.F `)
D	Sn-100% (High-Q)
E	Sn-100% (General)

※ Please Consult us for other termination type.

❽ PACKAGING TYPE

Symbol	Packaging	Symbol	Packaging
B	Bulk	F	Embossed Tape, 13" Reel
P	Cassette	L	Paper 13" Reel
C	Paper Tape, 7" Reel	O	Paper 10" Reel
D	Paper Tape, 13" Reel	S	Embossed Tape, 10" Reel
E	Embossed Tape, 7" Reel		

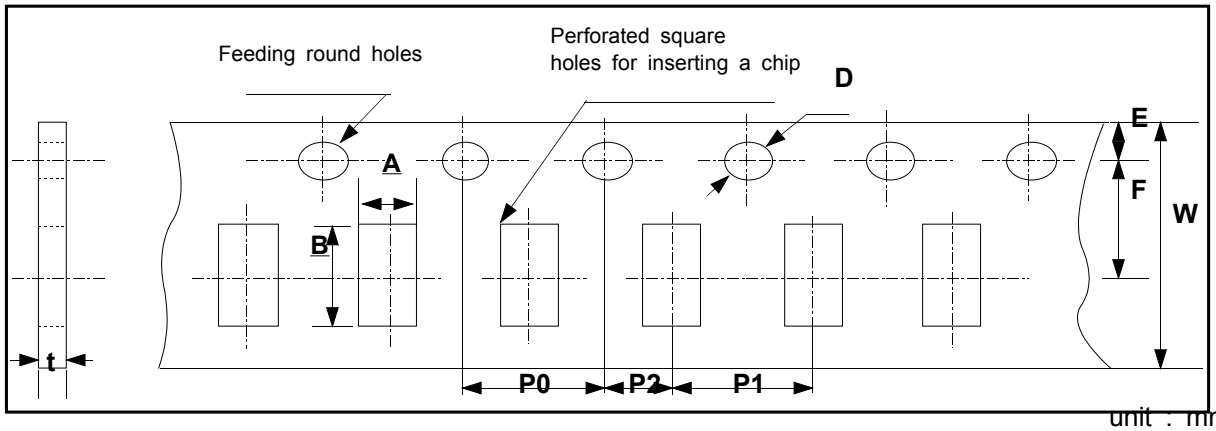
▶ STANDARD CAPACITANCE STEP

Series	Capacitance Step											
E- 3	1.0				2.2				4.7			
E- 6	1.0		1.5		2.2		3.3		4.7		6.8	
E-12	1.0	1.2	1.5	1.8	2.2	2.7	3.3	3.9	4.7	5.6	6.8	8.2
E-24	1.0	1.2	1.5	1.8	2.2	2.7	3.3	3.9	4.7	5.6	6.8	8.2
	1.1	1.3	1.6	2.0	2.4	3.0	3.6	4.3	5.1	6.2	7.5	9.1

※ Standard Capacitance is " Each step $\times 10^{n}$ "

■ PACKAGING

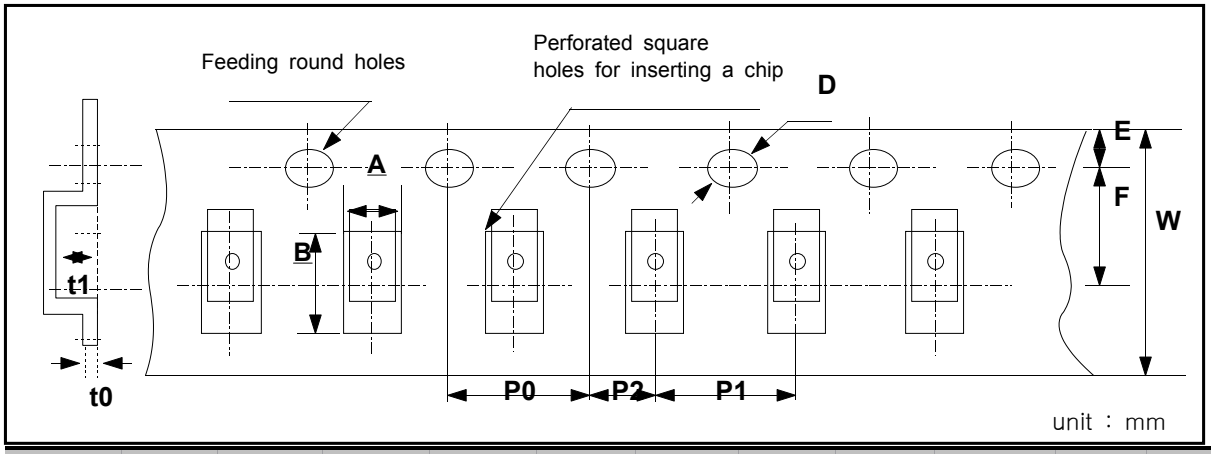
● CARDBOARD PAPER TAPE



unit : mm

Symbol / Type		W	F	E	P1	P2	P0	D	t	A	B
Dimension	03	8.0 ±0.3	3.5 ±0.05	1.75 ±0.1	2.0 ±0.05	2.0 ±0.05	4.0 ±0.1	Φ1.5 +0.1/-0	0.37 ±0.03	0.38 ±0.03	0.68 ±0.03
	05								0.6 ±0.05	0.65 +0.05/-0.1	1.15 +0.05/-0.1
	10				4.0 ±0.1				1.1 MAX	1.1 ±0.2	1.9 ±0.2
	21									1.6 ±0.2	2.4 ±0.2
	31									2.0 ±0.2	3.6 ±0.2

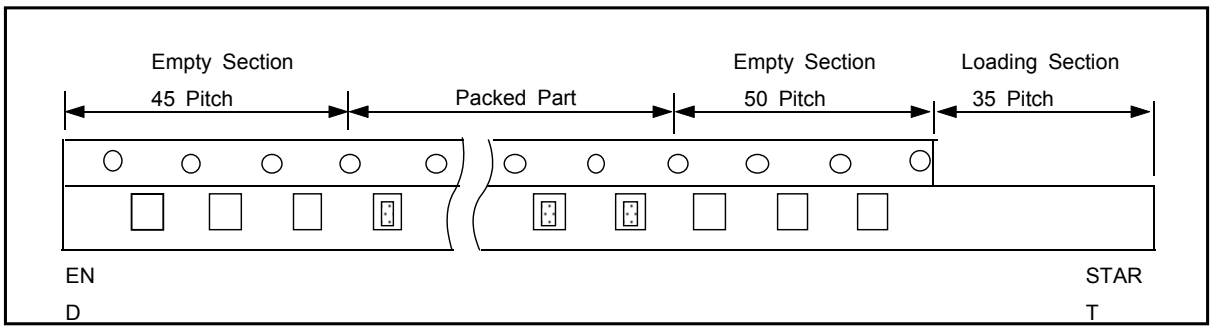
● EMBOSSED PLASTIC TAPE



unit : mm

Symbol / Type		W	F	E	P1	P2	P0	D	t0	t1	A	B
Dimension	21	8.0 ±0.3	3.5 ±0.05	1.75 ±0.1	4.0 ±0.1	2.0 ±0.05	4.0 ±0.1	Φ1.5 +0.1/-0	0.6 max	2.5 max	1.45 ±0.2	2.3 ±0.2
	31										2.0 ±0.2	3.6 ±0.2
	32										2.9 ±0.2	3.6 ±0.2
	43										3.6 ±0.2	4.9 ±0.2
	55										5.4 ±0.2	6.0 ±0.2

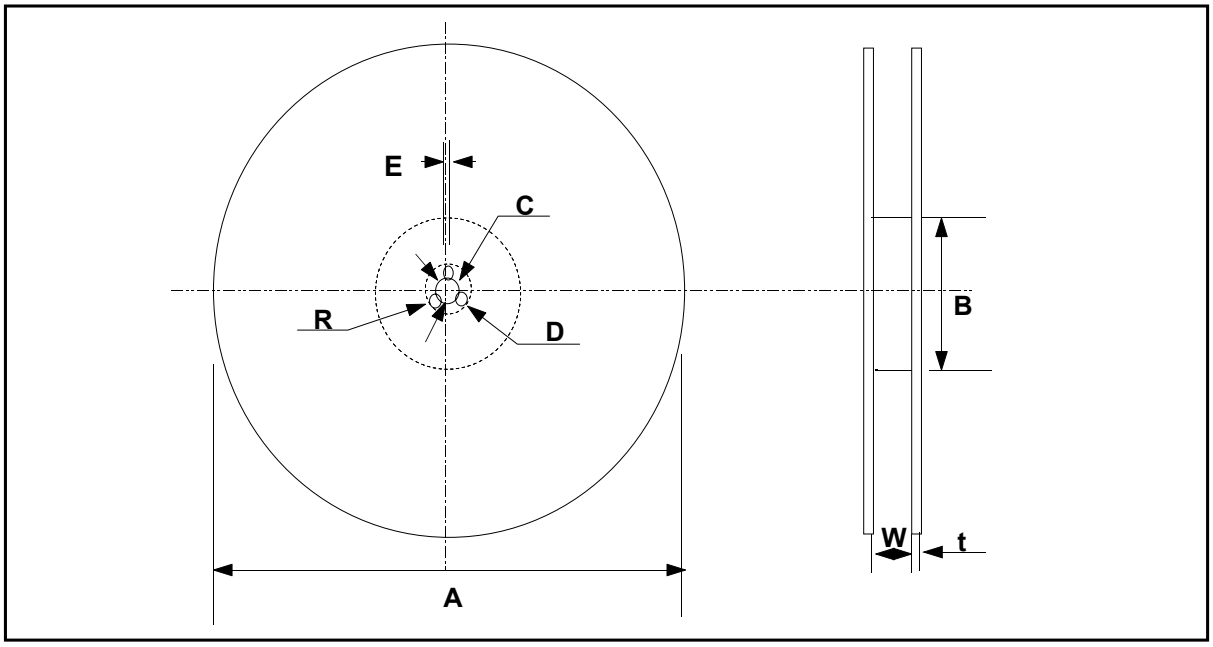
● TAPING SIZE



unit : pcs

Symbol	Cardboard Paper Tape	Embossed Plastic Tape
7" Reel	4000	2000
13" Reel	15000	-

● REEL DEMENSION

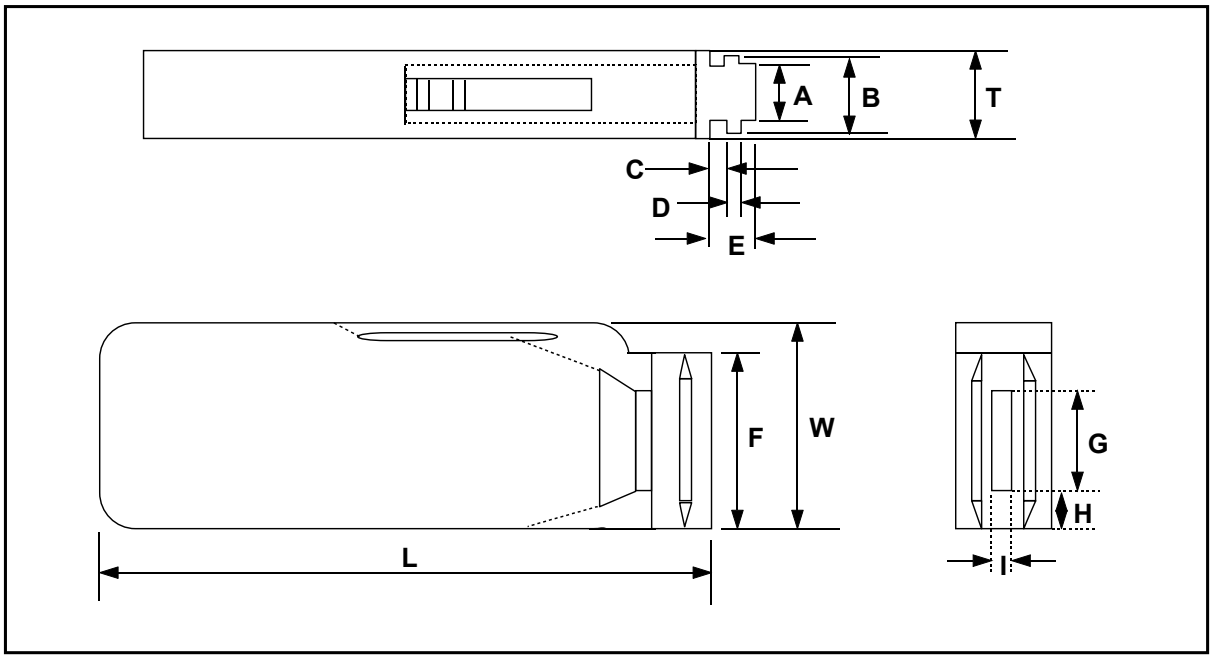


unit : mm

Symbol	A	B	C	D	E	W	t	R
7" Reel	ϕ178±2.0	min.ϕ50	ϕ13±0.5	21±0.8	2.0±0.5	10±1.5	0.8±0.2	1.0
13" Reel	ϕ330±2.0	min.ϕ70						

● BULK CASE PACKAGING

- Bulk case packaging can reduce the stock space and transportation costs.
- The bulk feeding system can increase the productivity.
- It can eliminate the components loss.



Symbol	A	B	T	C	D	E
Dimension	6.8±0.1	8.8±0.1	12±0.1	1.5+0.1/-0	2+0/-0.1	4.7±0.1

Symbol	F	W	G	H	L	I
Dimension	31.5+0.2/-0	36+0/-0.2	19±0.35	7±0.35	110±0.7	5±0.35

● QUANTITY

Size	05(0402)	10(0603)	21(0805)	
			0.65t	0.85t
Quantity	50,000	10,000~15,000*	10,000	5,000 or 10,000 LESS THAN *

* Option

■ CHARACTERISTIC MAP

● CAPACITANCE RANGE

▶ CLASS Ⅰ

※ ▬ The Developed Capacitance Range

※ ▬ The Developing Capacitance Range

Temperature Characteristics	Size	Voltage	Capacitance Range (pF)
			0.5 10 100 1000 10000 100000 1000000 10000000 100000000
SL,UJ	05 (0402)	50V	240
	10 (0603)	50V	1000
		100V	680
	21 (0805)	50V	2700
		100V	1000
	31 (1206)	50V	8200
		100V	3900
C(COG) & TC Series	03 (0201)	25V	20
	05 (0402)	25V	220
		50V	180
	10 (0603)	25V	1000
		50V	1000
		100V	220
	21 (0805)	25V	3300 8200
		50V	3300
		100V	1000
		200V	220
	31 (1206)	25V	1500 10000
		50V	4700
		100V	2200
		200V	220
		500V	470
		1000V	10 100
		2000V	10 47
	32 (1210)	50V	560 47000
		100V	2200 4700
		200V	220
		500V	470
		1000V	100 470
	43 (1812)	25V	100000
		50V	1000 68000
		100V	4700 10000
		200V	220
		500V	470
		1000V	470 1200
		2000V	47 100
		3000V	10 100
	55 (2220)	50V	43000 130000

▶ CLASS Ⅱ X(5R)

※ The Developed Capacitance Range
※ The Developing Capacitance Range

Temperature Characteristics	Size	Voltage	Capacitance Range (pF) 10 100 1000 10000 100000 1000000 10000000 100000000
A(X5R)	03 (0201)	6.3V	10000
		10V	10000
	05 (0402)	6.3V	220000
	10 (0603)	6.3V	2200000
		10V	1000000
	21 (0805)	6.3V	4700000 10000000
		10V	2200000
		16V	1000000
	31 (1206)	6.3V	10000000 220000000
		10V	4700000 10000000
		16V	4700000
	32 (1210)	6.3V	22000000
		10V	22000000
	43 (1812)	6.3V	47000000 100000000
	55 (2220)	6.3V	100000000
		10V	47000000

▶ CLASS Ⅱ X(7R)

※ The Developed Capacitance Range
※ The Developing Capacitance Range

Temperature Characteristics	Size	Voltage	Capacitance Range (pF)
B(X7R)	03 (0201)	6.3V	100 – 10000
		10V	100 – 10000
		16V	100 – 1000
	05 (0402)	6.3V	100 – 100000
		10V	100 – 100000
		16V	100 – 82000
		25V	100 – 22000
		50V	100 – 10000
	10 (0603)	6.3V	1000000
		10V	100 – 470000 / 1000000
		16V	100 – 220000
		25V	100 – 100000
		50V	100 – 100000
		100V	100 – 4700
	21 (0805)	6.3V	2200000
		10V	100 – 2200000
		16V	100 – 1000000
		25V	100 – 470000
		50V	100 – 220000
		100V	220 – 47000
		200V	220 – 10000
		250V	1000 – 10000
	31 (1206)	6.3V	6800000 – 10000000
		10V	1000 – 4700000
		16V	1000 – 3300000
		25V	1000 – 2200000
		50V	1000 – 470000 / 1000000
		100V	1000 – 150000
		200V	470 – 100000
		250V	2200 – 47000
		500V	470 – 33000
		1000V	100 – 3300
		2000V	100 – 1000

▶ **CLASS Ⅱ X(7R)**

※ The Developed Capacitance Range
※ The Developing Capacitance Range

Temperature Characteristics	Size	Voltage	Capacitance Range (pF)
B(X7R)	32 (1210)	6.3V	22000000
		10V	1000 – 10000000
		16V	1000 – 10000000
		25V	1000 – 4700000
		50V	1000 – 2200000
		100V	2200 – 220000
		250V	68000 – 100000
		500V	1000 – 22000
		1000V	3300 – 6800
		2000V	1000
	43 (1812)	10V	22000000
		16V	6800000 – 10000000
		25V	3300000 – 4700000
		50V	10000 – 3300000
		100V	100000 – 470000
		200V	47000 – 100000
		250V	100000
		500V	10000 – 47000
		1000V	1500 – 22000
		2000V	1000 – 3300
	55 (2220)	25V	10000000
		50V	3300000 – 4700000

▶ CLASS Ⅱ F(Y5V)

※ The Developed Capacitance Range
※ The Developing Capacitance Range

Temperature Characteristics	Size	Voltage	Capacitance Range (pF)
F(Y5V)	03 (0201)	6.3V	100000
	05 (0402)	10 V	2200 – 220000
		16 V	2200 – 220000
		25 V	2200 – 33000
		50 V	2200 – 10000
	10 (0603)	6.3V	2200000
		10 V	2200 – 1000000
		16 V	2200 – 1000000
		25 V	2200 – 330000
		50 V	2200 – 100000
	21 (0805)	6.3V	10000000
		10 V	4700000
		16 V	10000 – 2200000
		25 V	10000 – 1000000
		50 V	10000 – 470000
	31 (1206)	10 V	100000 – 10000000 / 22000000
		16 V	10000 – 4700000
		25 V	10000 – 3300000
		50 V	10000 – 1000000
	32 (1210)	10 V	22000000
		16 V	100000 – 15000000
		25 V	100000 – 4700000
		50 V	100000 – 1000000
	43 (1812)	25 V	10000000
		50 V	10000000
	55 (2220)	10 V	100000000
		25 V	22000000
		50 V	10000000

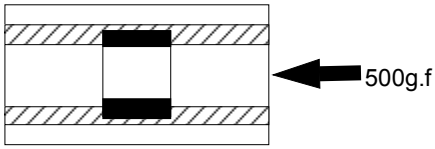
■ RELIABILITY TEST DATA

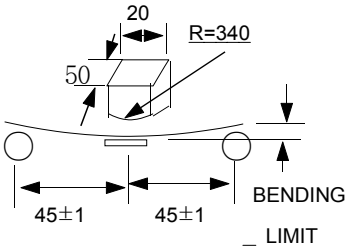
NO	ITEM		PERFORMANCE	TEST CONDITION		
1	APPEARANCE		NO ABNORMAL EXTERIOR APPEARANCE	THROUGH MICROSCOPE(×10)		
2	INSULATION RESISTANCE		10,000MΩ OR 500MΩ·μF PRODUCT WHICHEVER IS SMALLER (RATED VOLTAGE IS BELOW 16V : 10,000MΩ OR 100MΩ·μF)	RATED VOLTAGE SHALL BE APPLIED. MEASUREMENT TIME IS 60 ~ 120 RATED VOLTAGE TIME 60 SEC.		
3	WITHSTANDING VOLTAGE		NO DIELECTRIC BREAKDOWN OR MECHANICAL BREAKDOWN	CLASS Ⅰ: 300% OF THE RATED VOLTAGE FOR 1~5 SEC, CLASS Ⅱ:250% OF THE RATED VOLTAGE FOR 1~5 SEC IS APPLIED WITH LESS THAN 50mA CURRENT		
4	CAPACITANCE	CLASS Ⅰ	WITHIN THE SPECIFIED TOLERANCE	CAPACITANCE	FREQUENCY	VOLTAGE
				1,000pF AND BELOW	1MHz±10%	0.5 ~ 5 Vrms
				MORE THAN 1,000pF	1kHz±10%	0.5 ~ 5 Vrms
		CLASS Ⅱ	WITHIN THE SPECIFIED TOLERANCE	CAPACITANCE	FREQUENCY	VOLTAGE
				10μF AND BELOW	1kHz±10%	1.0±0.2Vrms
				MORE THAN 10μF	120Hz±20%	0.5±0.1Vrms
5	Q	CLASS Ⅰ	OVER 30pF : Q ≥1,000 LESS THAN 30pF: Q ≥400 +20C (C : CAPACITANCE)	CAPACITANCE	FREQUENCY	VOLTAGE
				1,000pF AND BELOW	1MHz±10%	0.5 ~ 5 Vrms
				MORE THAN 1,000pF	1kHz±10%	0.5 ~ 5 Vrms
6	Tanδ	CLASS Ⅱ		CAPACITANCE	FREQUENCY	VOLTAGE
				10μF AND BELOW	1kHz±10%	1.0±0.2Vrms
				MORE THAN 10μF	120Hz±20%	0.5±0.1Vrms

CHAR	25V AND OVER	16V
A/B	0.025 MAX	0.035 MAX

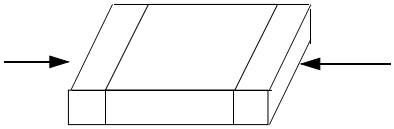
A/B	6.3V	10V
1005	0.05max, 0.10max (C ≥0.22μF)	0.05 max
1608	0.05max, 0.10max (C ≥2.2μF)	0.05 max
2012	0.05max, 0.10max (C ≥4.7μF)	0.05 max
3216	0.05max, 0.10max (C ≥10.0μF)	0.05 max
3225	0.05max, 0.10max (C ≥22.0μF)	0.05 max
4532	0.05max, 0.10max (C ≥47.0μF)	0.05 max
5750	0.05max, 0.10max (C ≥100.0μF)	0.05 max

F	6.3V	10V	16V	25V	50V
1005	-	0.125max	0.09max (C≤220nF) 0.125max (C>220nF)	0.05max	0.05max
1608	0.16max	0.125max	0.09max	0.05max(C≤100nF) 0.07max(C>100nF)	0.05max
2012	0.16max	0.125max	0.09max	0.07max	0.05max
3216	0.16max	0.125max	0.09max	0.07max	0.05max
3225	0.16max	0.125max	0.09max	0.07max(C≤6.8μF) 0.09max(C>6.8μF)	0.05max
4532	0.16max	0.16max	-	-	-
5750		0.125max	-	-	-

<table>
<tr><th>NO</th><th colspan="2">ITEM</th><th>PERFORMANCE</th><th>TEST CONDITION</th></tr>
<tr><td>7</td><td>CAPACITANCE TEMPERATURE COEFFICIENT</td><td>CLASS
Ⅰ</td><td>
<table>
<tr><th>CHARACTERISTIC</th><th>TEMP. COEFFICIENT (PPM/℃)</th></tr>
<tr><td>C0G</td><td>0 ± 30</td></tr>
<tr><td>P</td><td>-150 ± 60</td></tr>
<tr><td>R</td><td>-220 ± 60</td></tr>
<tr><td>S</td><td>-330 ± 60</td></tr>
<tr><td>T</td><td>-470 ± 60</td></tr>
<tr><td>U</td><td>-750 ± 120</td></tr>
<tr><td>L</td><td>+350 ~ -1000</td></tr>
</table>
</td><td>THESE SYMMETRICAL TOLERANCE APPLY TO 2 POINT MEASUREMENT OF TEMPERATURE COEFFICIENT: ONE AT 25℃ AND AT 85℃
<table>
<tr><th>STEP</th><th>TEMPERATURE</th></tr>
<tr><td>1</td><td>25 ± 2</td></tr>
<tr><td>2</td><td>MIN RATED TEMP ± 2</td></tr>
<tr><td>3</td><td>25 ± 2</td></tr>
<tr><td>4</td><td>MAX RATED TEMP ± 2</td></tr>
<tr><td>5</td><td>25 ± 2</td></tr>
</table>
Temp. Coeff.= $\frac{C2 - C1}{C1 \cdot \triangle T} \times 100\ \%$
C1 : CAPACITANCE AT STANDARD TEMPERATURE(25℃)
C2 : CAPACITANCE AT STANDARD TEMPERATURE(85℃)
△T : 85℃-25℃=60℃</td></tr>
<tr><td>8</td><td>TEMPERATURE CHARACTERISTICS</td><td>CLASS
Ⅱ</td><td>CAPACITANCE CHANGE
<table>
<tr><th>CHAR.</th><th>Cap.Change(%) Without Applying Rated Voltage</th><th>Cap.Change(%) With 50% of Rated Voltage</th></tr>
<tr><td>A,B</td><td>±15%</td><td>+10%~-40%</td></tr>
<tr><td>F</td><td>+22% ~ -82%</td><td>-</td></tr>
</table>
</td><td>The change of capacitance should be got from the capacitance at 25℃.
After capacitance measured from Min. Temp. to Max. Temp.,
it should be calculated from the formula below.
$\frac{C2 - C1}{C1} \times 100\ \%$
C1 : CAPACITANCE AT STANDARD TEMPERATURE(25℃)
C2 : CAPACITANCE AT EACH TEMPERATURE
AS MENTIONED ABOVE, IT SHOULD BE MEASURED IN SITUATION OF APPLYING RATED VOLTAGE AND WITHOUT RATED VOLTAGE.
(IN APPLYING VOLTAGE, IT SHOULD BE 50% OF RATED VOLTAGE)</td></tr>
<tr><td>9</td><td colspan="2">ADHESIVE STRENGTH OF TERMINATION</td><td>NO INDICATION OF PEELING SHALL OCCUR ON THE TERMINAL ELECTRODE.</td><td>A 500g.f PRESSURE SHALL BE APPLIED FOR 10±1 SECOND.
 

SEE (FIG.1)</td></tr>
<tr><td rowspan="5">10</td><td rowspan="5">BENDING STRENGTH</td><td>APPEARANCE</td><td colspan="3">NO MECHANICAL DAMAGE SHALL OCCUR.</td><td rowspan="5">BENDING SHALL BE APPLIED TO THE LIMIT(1mm) WITH 0.3mm/SEC.
KEEP THE TEST BOARD AT THE LIMIT POINT IN 5 SEC., THEN MEASURE CAPACITANCE.
 

SEE (FIG.2)</td></tr>
<tr><td rowspan="4">CAPACITANCE</td><td colspan="2">CHARACTER</td><td>CHANGE OF CAPACITANCE</td></tr>
<tr><td colspan="2">CLASS Ⅰ</td><td>WITHIN ±5% OR ± 0.5 pF WHICHEVER IS LARGER</td></tr>
<tr><td rowspan="2">CLASS Ⅱ</td><td>A,B</td><td>WITHIN ±12.5%</td></tr>
<tr><td>F</td><td>WITHIN ±30%</td></tr>
</table>

<table>
<tr><th>NO</th><th colspan="3">ITEM</th><th colspan="3">PERFORMANCE</th><th>TEST CONDITION</th></tr>
<tr><td>11</td><td colspan="2">SOLDERABILITY</td><td colspan="3">MORE THAN 75% OF THE TERMINAL SURFACE IS TO BE SOLDERED NEWLY, SO METAL PART DOES NOT COME OUT OR DISSOLVE
  </td><td>SOLDER TEMPERATURE : 230±5℃
SOLDER : H63A
FLUX : RMA TYPE
PRE-HEATING : AT 80~120℃
FOR 10~30SEC.</td></tr>
<tr><td rowspan="7">12</td><td rowspan="7">RESISTANCE TO SOLDERING HEAT</td><td>APPEARANCE</td><td colspan="3">NO MECHANICAL DAMAGE.
Pb SHOULD BE ATTACHED OVER 60% OF TERMINATION.</td><td rowspan="7">DIP : SOLDER TEMPERATURE OF 270±5℃
DIP TIME :10±1 SEC.
EACH TERMINATION SHALL BE FULLY IMMERSED AND PREHEATED AS FOLLOWING:
<table><tr><th>STEP</th><th>TEMP.(℃)</th><th>TIME (SEC.)</th></tr><tr><td>1</td><td>80~100</td><td>60</td></tr><tr><td>2</td><td>150~180</td><td>60</td></tr></table>
MEASURE AT ROOM TEMP. AFTER COOLING FOR
CLASS Ⅰ : 24 ± 2 HOURS
CLASS Ⅱ : 48 ± 4 HOURS</td></tr>
<tr><td rowspan="3">CAPACITANCE</td><td>CHARACTERISTIC</td><td colspan="2">CAP. CHANGE</td></tr>
<tr><td>CLASS Ⅰ</td><td colspan="2">WITHIN ±2.5% OR ±0.25pF WHICHEVER IS LARGER</td></tr>
<tr><td rowspan="2">CLASS Ⅱ</td><td>A,B</td><td>WITHIN ±7.5%</td></tr>
<tr><td>F</td><td>WITHIN ±20%</td></tr>
<tr><td>Q
CLASS Ⅰ</td><td colspan="3">30pF AND OVER : Q≥ 1000
LESS THAN 30pF : Q≥ 400+20×C</td></tr>
<tr><td>Tanδ
CLASS Ⅱ</td><td colspan="3">TO SATISFY THE SPECIFIED INITIAL VALUE</td></tr>
<tr><td>INSULATION RESISTANCE</td><td colspan="3">TO SATISFY THE SPECIFIED INITIAL VALUE</td></tr>
<tr><td>WITHSTANDING VOLTAGE</td><td colspan="3">TO SATISFY THE SPECIFIED INITIAL VALUE</td></tr>
<tr><td rowspan="7">13</td><td rowspan="7">VIBRATION TEST</td><td>APPEARANCE</td><td colspan="3">NO MECHANICAL DAMAGE SHALL OCCUR.</td><td rowspan="7">BENDING SHALL BE APPLIED TO THE LIMIT(1mm) WITH 0.3mm/SEC.
KEEP THE TEST BOARD AT THE LIMIT POINT IN 5 SEC., THEN MEASURE CAPACITANCE.
<table><tr><th>CHAR.</th><th>FREQUENCY RANGE</th></tr><tr><td>A,B,C,F</td><td>10Hz → 55Hz → 10Hz</td></tr></table>
<table><tr><th>CHAR.</th><th>TRAVERSED TIME</th></tr><tr><td>A,B,C,F</td><td>1 min</td></tr></table>
THE ENTIRE FREQUENCY RANGE, FROM 10 TO 55Hz AND RETURN TO 10Hz, SHALL BE TRAVERSED IN 1 MINUTE.

THIS CYCLE SHALL BE PERFORMED 2 HOURS IN EACH THERE MUTUALLY PERPENDICULAR DIRECTION, FOR TOTAL PERIOD OF 6 HOURS.</td></tr>
<tr><td rowspan="3">CAPACITANCE</td><td>CHARACTERISTIC</td><td colspan="2">CAP. CHANGE</td></tr>
<tr><td>CLASS Ⅰ</td><td colspan="2">WITHIN ±2.5% OR ±0.25pF WHICHEVER IS LARGER</td></tr>
<tr><td rowspan="2">CLASS Ⅱ</td><td>A,B</td><td>WITHIN ±5%</td></tr>
<tr><td>F</td><td>WITHIN ±20%</td></tr>
<tr><td>Q
CLASS Ⅰ</td><td colspan="3">30pF AND OVER : Q≥ 1000
LESS THAN 30pF : Q≥ 400+20×C</td></tr>
<tr><td>Tanδ
CLASS Ⅱ</td><td colspan="3">TO SATISFY THE SPECIFIED INITIAL VALUE</td></tr>
<tr><td>INSULATION RESISTANCE</td><td colspan="3">TO SATISFY THE SPECIFIED INITIAL VALUE</td></tr>
</table>

* THE INITIAL VALUE OF HIGH DIELECTRIC CONSTANT SERIES SHALL BE MEASURED AFTER THE HEAT TREATMENT OF 150 +0/-10℃, 1Hr AND SITTING OF 48±4hr AT ROOM TEMPERATURE & ROOM HUMIDITY. .
(IT IS PERFORMED WITH THE EXCEPTION OF PRODUCTS ON PCB)

<table>
<tr><th>NO</th><th colspan="2">ITEM</th><th colspan="3">PERFORMANCE</th><th>TEST CONDITION</th></tr>
<tr><td rowspan="6">14</td><td rowspan="6">HUMIDITY
(STEADY
STATE)</td><td>APPEARANCE</td><td colspan="3">NO MECHANICAL DAMAGE SHALL OCCUR</td><td rowspan="6">TEMPERATURE : 40±2 ℃
RELATIVE HUMIDITY:90~95 %RH
TEST TIME : 500 +12/-0 Hr.

MEASURE AT ROOM TEMPERATURE
AFTER COOLING FOR
CLASS Ⅰ : 24±2 Hr.
CLASS Ⅱ : 48±4 Hr.

0.125 MAX *Condition
CLASS Ⅱ (A,B)
1005 C ≥0.22㎌
1608 C ≥2.2㎌
2012 C ≥4.7㎌
3216 C ≥10.0㎌
3225 C ≥22.0㎌
4532 C ≥47.0㎌
5750 C ≥100.0㎌</td></tr>
<tr><td rowspan="3">CAPACITANCE</td><td>CHARACTERISTIC</td><td colspan="2">CAPACITANCE CHANGE</td></tr>
<tr><td>CLASS Ⅰ</td><td colspan="2">WITHIN ±5% OR
±0.5pF WHICHEVER
IS LARGER</td></tr>
<tr><td rowspan="2">CLASS Ⅱ</td><td>A,B</td><td>WITHIN ±12.5%</td></tr>
<tr><td>F</td><td>WITHIN ±30%</td></tr>
<tr><td>Q
CLASS Ⅰ</td><td colspan="3">30pF AND OVER : Q≥ 350
10 ~30pF : Q≥ 275 + 2.5×C
LESS THAN 10pF : Q≥ 200 + 10×C</td></tr>
<tr><td>Tanδ
CLASS Ⅱ</td><td colspan="3"><table><tr><td>CHAR.</td><td>25V AND OVER</td><td>16V</td><td>10V</td><td>6.3V</td></tr><tr><td>A,B</td><td>0.05</td><td>0.05 MAX</td><td>0.05 MAX</td><td>0.075 MAX
0.125* MAX</td></tr><tr><td>F</td><td>0.075 MAX</td><td>0.1MAX (C〈1.0㎌)
0.125MAX (C≥1.0㎌)</td><td>0.15 MAX</td><td>0.195 MAX</td></tr></table></td></tr>
<tr><td>INSULATION
RESISTANCE</td><td colspan="3">MINIMUM INSULATION RESISTANCE:
1,000 MΩ OR 50MΩ·㎌ PRODUCT WHICHEVER IS SMALLER</td></tr>
<tr><td rowspan="7">15</td><td rowspan="7">MOISTURE
RESISTANCE</td><td>APPEARANCE</td><td colspan="3">NO MECHANICAL DAMAGE SHALL OCCUR</td><td rowspan="7">APPLIED VOLTAGE :
RATED VOLTAGE
TEMPERATURE : 40±2 ℃
RELATIVE HUMIDITY:90~95%RH
TEST TIME : 500 +12/-0 Hr.
CURRENT APPLIED : 50mA MAX.

<INITIAL MEASUREMENT>
CLASS Ⅱ SHOULD BE MEASURED INITIAL VALUE AFTER BE HEAT-TREATED FOR 1 HR IN 150℃ +0/-10℃ AND BE LEFT FOR 48±4HR AT ROOM TEMPERATURE.

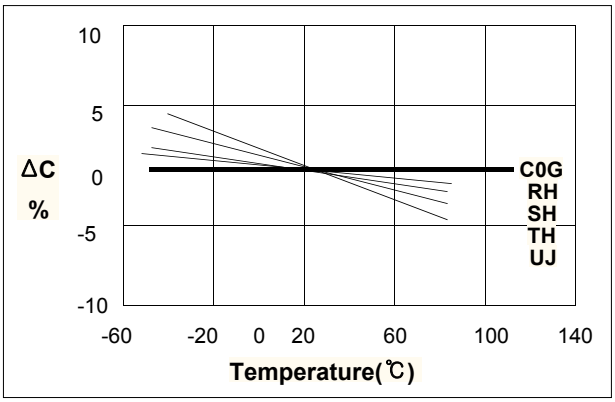
<LATTER MEASUREMENT>
CLASS Ⅰ SHOULD BE MEASURED AFTER LEFT FOR 24±2 HRS IN ROOM TEMPERATURE AND HUMIDITY.
CLASS Ⅱ SHOULD BE MEASURED LATTER VALUE AFTER BE HEAT-TREATED FOR 1 HR IN 150℃ +0/-10℃ AND BE LEFT FOR 48±4HR AT ROOM TEMPERATURE.</td></tr>
<tr><td rowspan="4">CAPACITANCE</td><td>CHARACTERISTIC</td><td colspan="2">CAPACITANCE CHANGE</td></tr>
<tr><td>CLASS Ⅰ</td><td colspan="2">WITHIN ±7.5% OR
±0.75pF WHICHEVER
IS LARGER</td></tr>
<tr><td rowspan="3">CLASS Ⅱ</td><td>A,B</td><td>WITHIN ±12.5%</td></tr>
<tr><td rowspan="2">F</td><td>WITHIN ±30%</td></tr>
<tr><td>WITHIN +30~−40%
1005 C>0.47μF
1608 C>1.0μF
2012 C>4.7μF
3216 C>10.0μF
3225 C>22.0μF
4532 C>47.0μF</td></tr>
<tr><td>Q
CLASS Ⅰ</td><td colspan="3">30pF AND OVER : Q≥ 200
30pF AND BELOW : Q≥ 100 + 10/3×C</td></tr>
<tr><td>Tanδ
CLASS Ⅱ</td><td colspan="3"><table><tr><td>CHAR.</td><td>25V AND OVER</td><td>16V</td><td>10V</td><td>6.3V</td></tr><tr><td>A,B</td><td>0.05 MAX</td><td>0.05 MAX</td><td>0.05 MAX</td><td>0.075 MAX
0.125* MAX</td></tr><tr><td>F</td><td>0.075 MAX</td><td>0.1MAX (C〈1.0㎌)
0.125MAX (C≥1.0㎌)</td><td>0.15 MAX</td><td>0.195 MAX</td></tr></table></td></tr>
<tr><td>INSULATION
RESISTANCE</td><td colspan="3">MINIMUM INSULATION RESISTANCE:
500 MΩ OR 25MΩ·㎌ PRODUCT,
WHICHEVER IS SMALLER.</td></tr>
</table>

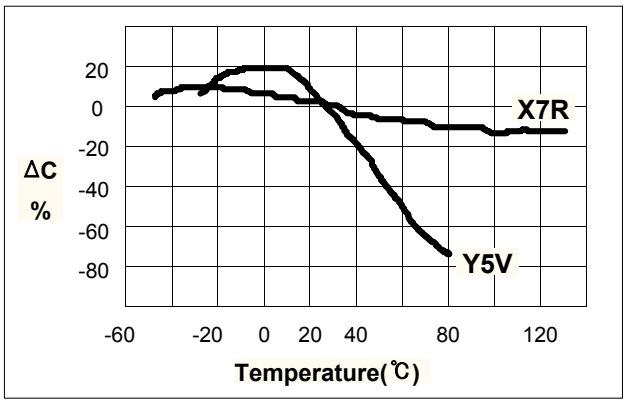
<table>
<tr><th>NO</th><th colspan="2">ITEM</th><th colspan="3">PERFORMANCE</th><th>TEST CONDITION</th></tr>
<tr><td rowspan="5">16</td><td rowspan="5">HIGH TEMPERATURE RESISTANCE</td><td>APPEARANCE</td><td colspan="3">NO MECHANICAL DAMAGE SHALL OCCUR</td><td rowspan="5">APPLIED VOLTAGE :
200% OF RATED VOLTAGE
TEST TIME : 1000 +48/-0 Hr.
CURRENT APPLIED : 50㎃ MAX.
<table><tr><th>CHAR.</th><th>TEMP.</th></tr><tr><td>CLASS Ⅰ</td><td>125 ±3 ℃</td></tr><tr><td rowspan="2">CLASS Ⅱ</td><td>A,F</td><td>85 ±3 ℃</td></tr><tr><td>B</td><td>125 ±3 ℃</td></tr></table>
<INITIAL MEASUREMENT>
CLASS Ⅱ SHOULD BE MEASURED INITIAL VALUE AFTER BE HEAT-TREATED FOR 1 HR IN 150℃+0/-10℃ AND BE LEFT FOR 48±4HR AT ROOM TEMPERATURE.
<LATTER MEASUREMENT>
CLASS Ⅰ SHOULD BE MEASURED AFTER LEFT FOR 24±2 HRS IN ROOM TEMPERATURE AND HUMIDITY.
CLASS Ⅱ SHOULD BE MEASURED LATTER VALUE AFTER BE HEAT-TREATED FOR 1 HR IN 150℃+0/-10℃ AND BE LEFT FOR 48±4HR AT ROOM TEMPERATURE.
<table><tr><td></td><td>*150% Boat Authorization Conditions</td></tr><tr><td>CLASS Ⅱ (A,B,F)</td><td>1005 C>0.47μF
1608 C ≥2.2㎌
2012 C ≥4.7㎌
3216 C ≥10.0㎌
3225 C ≥22.0㎌
4532 C ≥47.0㎌
5750 C ≥100.0㎌</td></tr></table>
(TWICE OF RATED VOLTAGE WILL BE APPLIED TO ALL SERIES BUT ABOVE)
** HOWEVER, A/B旨1005 C ≥0.22㎌</td></tr>
<tr><td>CAPACITANCE</td><td colspan="3"><table><tr><td>CHARACTERISTIC</td><td colspan="2">CAP. CHANGE</td></tr><tr><td colspan="2">CLASS Ⅰ</td><td>WITHIN ±3% OR ±0.3pF, WHICHEVER IS LARGER</td></tr><tr><td rowspan="2">CLASS Ⅱ</td><td>A,B</td><td>WITHIN ±12.5%</td></tr><tr><td>F</td><td>WITHIN ±30%
WITHIN+30~40%
1005 C>0.47μF
1608 C>1.0μF
2012 C>4.7μF
3216 C>10.0μF
3225 C>22.0μF
4532 C>47.0μF</td></tr></table></td></tr>
<tr><td>Q
CLASS Ⅰ</td><td colspan="3">30pF AND OVER : Q ≥ 350
10 ~ 30 pF : Q ≥ 275 + 2.5×C
LESS THAN 10pF :Q ≥200 + 10×C</td></tr>
<tr><td>Tanδ
CLASS Ⅱ</td><td colspan="3"><table><tr><td>CHAR.</td><td>25V AND OVER</td><td>16V</td><td>10V</td><td>6.3V</td></tr><tr><td>A,B</td><td>0.05 MAX</td><td>0.05 MAX</td><td>0.05 MAX</td><td>0.075 MAX
0.125* MAX</td></tr><tr><td>F</td><td>0.075 MAX</td><td>0.1MAX (C<1.0㎌)
0.125MAX (C≥1.0㎌)</td><td>0.15 MAX</td><td>0.195 MAX</td></tr></table><table><tr><td></td><td>0.125 MAX *Condition</td></tr><tr><td>CLASS Ⅱ (A,B)</td><td>1005** C ≥0.22㎌
1608 C ≥2.2㎌
2012 C ≥4.7㎌
3216 C ≥10.0㎌
3225 C ≥22.0㎌
4532 C ≥47.0㎌
5750 C ≥100.0㎌</td></tr></table></td></tr>
<tr><td>INSULATION RESISTANCE</td><td colspan="3">MINIMUM INSULATION RESISTANCE:
1,000 ㏁ OR 50㏁·㎌ PRODUCT
WHICHEVER IS SMALLER</td></tr>
<tr><td rowspan="5">17</td><td rowspan="5">TEMPERATURE CYCLE</td><td>APPEARANCE</td><td colspan="3">NO MECHANICAL DAMAGE SHALL OCCUR</td><td rowspan="5">CAPACITORS SHALL BE SUBJECTED TO FIVE CYCLES OF THE TEMPERATURE CYCLE AS FOLLOWING
<table><tr><th>STEP</th><th>TEMP.(℃)</th><th>TIME(MIN)</th></tr><tr><td>1</td><td>MIN.RATED TEMP.+0/-3</td><td>30</td></tr><tr><td>2</td><td>25</td><td>2~3</td></tr><tr><td>3</td><td>MAX.RATED TEMP.+3/-0</td><td>30</td></tr><tr><td>4</td><td>25</td><td>2~3</td></tr></table>MEASURE AT ROOM TEMPERATURE AFTER COOLING FOR
CLASS Ⅰ : 24±2 Hr.
CLASS Ⅱ : 48±4 Hr.</td></tr>
<tr><td>CAPACITANCE</td><td colspan="3"><table><tr><td>CHARACTERISTIC</td><td colspan="2">CAP. CHANGE</td></tr><tr><td colspan="2">CLASS Ⅰ</td><td>WITHIN ±2.5% OR ±0.25pF WHICHEVER IS LARGER</td></tr><tr><td rowspan="2">CLASS Ⅱ</td><td>A,B</td><td>WITHIN ±7.5%</td></tr><tr><td>F</td><td>WITHIN ±20%</td></tr></table></td></tr>
<tr><td>Q
CLASS Ⅰ</td><td colspan="3">30 pF AND OVER : Q ≥ 1000
LESS THAN 30pF:Q ≥400 +20×C</td></tr>
<tr><td>Tanδ
CLASS Ⅱ</td><td colspan="3">TO SATISFY THE SPECIFIED INITIAL VALUE</td></tr>
<tr><td>INSULATION RESISTANCE</td><td colspan="3">TO SATISFY THE SPECIFIED INITIAL VALUE</td></tr>
</table>

■ CHARACTERISTIC GRAPH

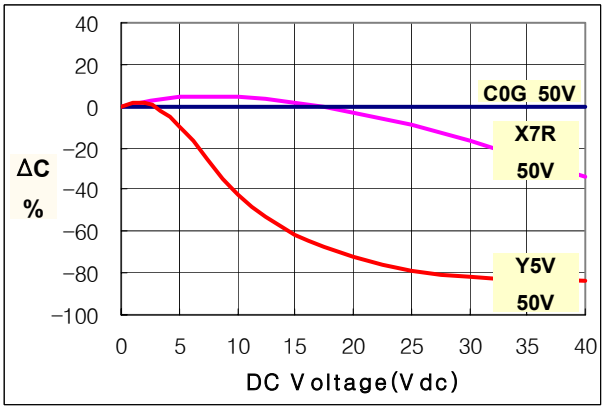
● ELECTRICAL CHARACTERISTICS

▶ CAPACITANCE - TEMPERATURE CHARACTERISTICS

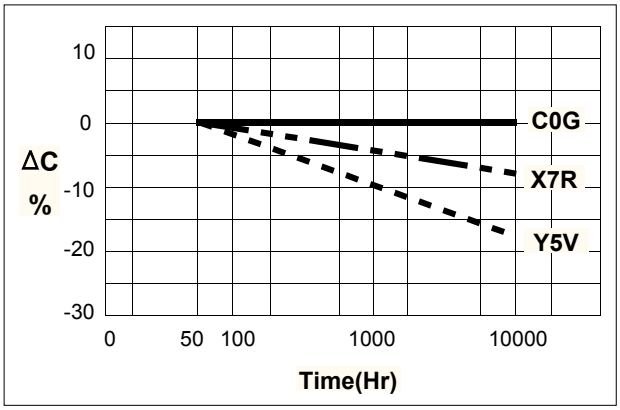




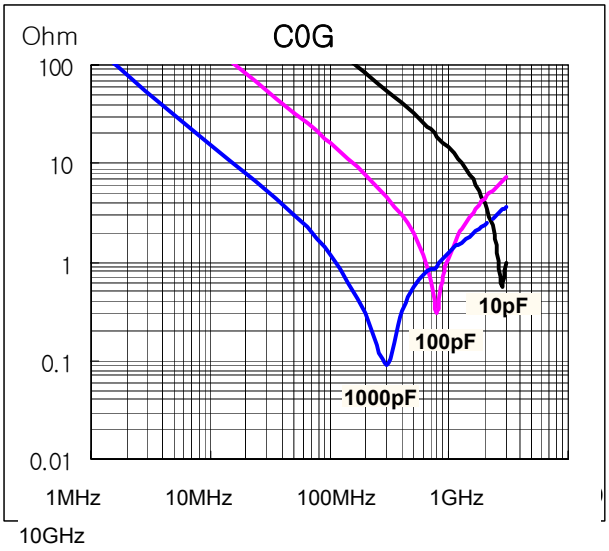
▶ CAPACITANCE - DC VOLTAGE CHARACTERISTICS

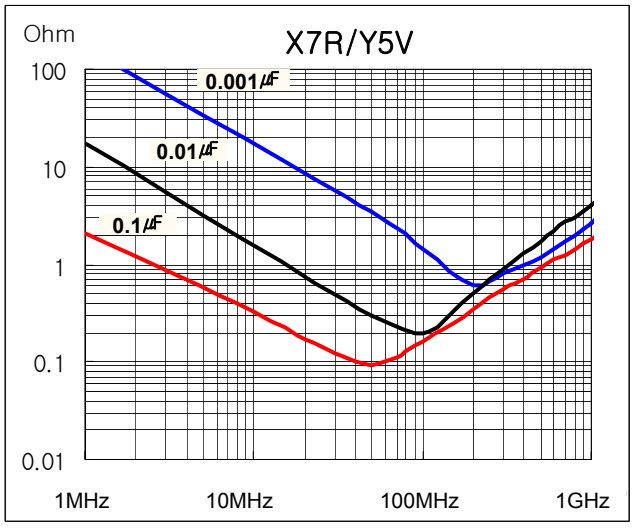


▶ CAPACITANCE CHANGE - AGING



▶ IMPEDANCE - FREQUENCY CHARACTERISTICS





■ APPLICATION MANUAL

● Storage of products.

▶ **Storage Environment**

Tape packing materials are designed to withstand long-term storage, but they will degrade more rapidly in the presence of high temperature or high humidity, therefor, the products must be stored in an ambient temperature of less than 40℃ with a relative humidity of less than 70%. Allowable storage period is within 6 months from the outgoing date of delivery.

▶ **Corrosive Gases**

Since sulfur and chlorine may degrade the solderability of the end termination, it is important to store the capacitors in an environment free of these gases.

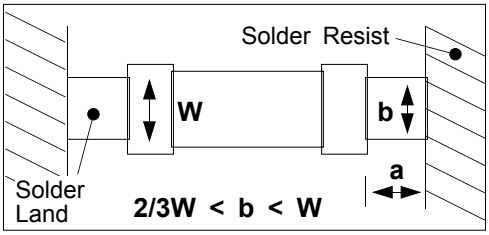
▶ **Temperature Fluctuations**

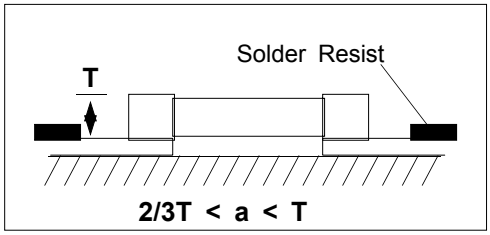
Since dew condensation may occur by the differences in temperature when the products are taken out of storage, it is important to maintain a temperature-controlled environment.

● Design of Solder Land Pattern

When designing priented circuit boards, the shape and size of the solder lands must allow for the proper amount of solder on the capacitor. The amount of solder at the end terminations has a direct effect on the probability that the chip will crack. The greater amount of solder, the amount of stress on the chip, and the more likely that it will break. Use the following illustrations as guidelines for proper solder land design.

Recommendation of Solder Land Shape and Size





● Adhesives

MICCs generally require the use of an adhesive to position the chips to the circuit board prior to soldering.

▶ **Requirements for Adhesives**

They must have enough adhesion so that the chips will not fall off or move during the handling of the circuit board.

They must maintain their adhesive strength when exposed to soldering temperature.

They should not spread or run when applied to the circuit board.

They should have a long pot life.

They should harden quickly.

They should not corrode the circuit board or chip material.

They should be a good insulator.
They should be non-toxic, and not produce harmful gases, nor be harmful when touched.

▶ Application Method

It is important to use the proper amount of adhesive. Too little will cause poor adhesion to the circuit board, and too much may strain the conductor pattern, thereby causing defective soldering.

▶ Adhesive hardening Characteristics

To prevent oxidation of the terminations, the adhesive must harden at 160℃ or less, within 2 minutes or less.

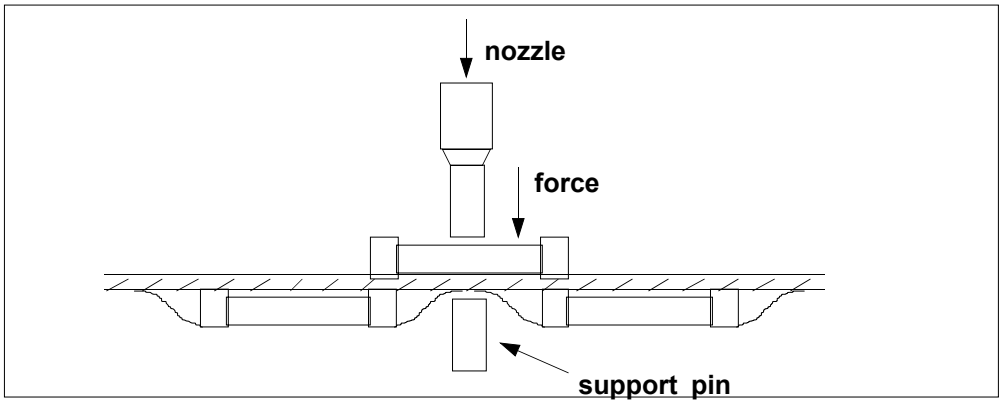
● Mounting

▶ Mounting Head Pressure

Excessive pressure will cause chip capacitors to crack. The pressure between nozzle and chip capacitor will be 300g maximum during mounting.

▶ Bending Stress

Bending of printed circuit board by mounting head when double-sided circuit boards are used, chip capacitors first are mounted and soldered onto one side of the board. When the capacitors are mounted onto the other side, it is important to support the board as shown in the illustration. If the circuit board is not supported, it may bend, causing the already-installed capacitors to crack



● Flux

Although highly-activated flux gives better solderability, substances which increase activity may also degrade the insulation of the chip capacitors. To avoid such degradation, it is recommended that a mildly activated rosin flux(less than 0.2% chlorine) be used.

● Soldering

Since a multilayer ceramic chip capacitor comes into direct contact with melted solder during soldering, it is exposed to potentially mechanical stress caused by the sudden temperature change. The capacitor may also be subject to silver migration, and to contamination by the flux. Because of these factors, soldering technique is critical.

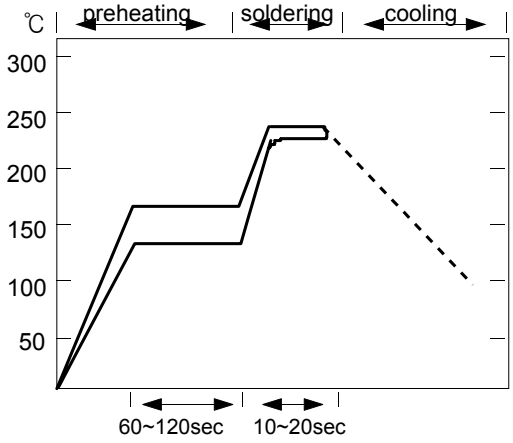
▶ Soldering Methods

Method	Classification	
Reflow soldering	- Overall heating	- Infrared rays - Hot plate - VPS(vapor phase)
	- Local heating	- Air heater - Laser - Light beam
Flow soldering	- Single wave - Double wave	-

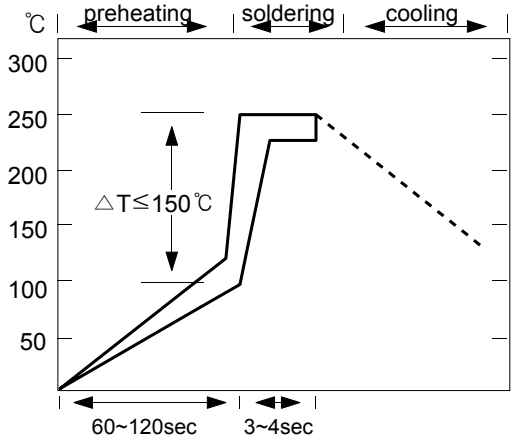
* We recommend the reflow soldering method.

▶ Soldering Profile

To avoid crack problem by sudden temperature change, follow the temperature profile in the adjacent graph.



Reflow Soldering

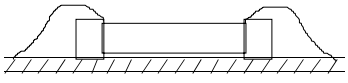
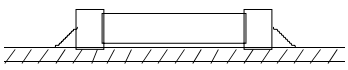


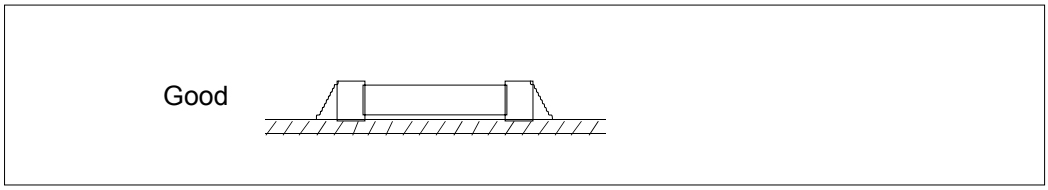
Flow Soldering

▶ Manual Soldering

Manual soldering can pose a great risk of creating thermal cracks in chip capacitors. The hot soldering iron tip comes into direct contact with the end terminations, and operator's carelessness may cause the tip of the soldering iron to come into direct contact with the ceramic body of the capacitor. Therefor the soldering iron must be handled carefully, and close attention must be paid to the selection of the soldering iron tip and to temperature control of the tip.

▶ Amount of Solder

Too much Solder		Cracks tend to occur due to large stress
Not enough Solder		Weak holding force may cause bad connections or detaching of the capacitor



▶ **Cooling**

Natural cooling using air is recommended. If the chips are dipped into solvent for cleaning, the temperature difference(△T) must be less than 100℃

6-6. Cleaning

If rosin flux is used, cleaning usually is unnecessary. When strongly activated flux is used, chlorine in the flux may dissolve into some types of cleaning fluids, thereby affecting the chip capacitors. This means that the cleaning fluid must be carefully selected, and should always be new.

▶ **Notes for Separating Multiple, Shared PC Boards.**

A multi-PC board is separated into many individual circuit boards after soldering has been completed. If the board is bent or distorted at the time of separation, cracks may occur in the chip capacitors. Carefully choose a separation method that minimizes the bending of the circuit board.

■ CROSS REFERENCE

P/N / COMPANY		SAMSUNG	AVX	JOHANSON	KEMET	KYOCERA	MURATA	NOVACAP	PANASONIC	ROHM	TAIYO - YUDEN	TDK	VITRAMON
① COMPANY MODEL(MLCC)		CL	-	-	C	CM	GRM	-	ECJ	MCH	MK	C	VJ
② SIZE (EIA/JIS)	0201(0603)	03	-	-	-	03	33	-	Z	-	063	0603	-
	0402(1005)	05	0402	R07	0402	05	36	0402	0	15	105	1005	0402
	0603(1608)	10	0603	R14	0603	105	39	0603	1	18	107	1608	0603
	0805(2012)	21	0805	R15	0805	21	40	0805	2	21	212	2012	0805
	1206(3216)	31	1206	R18	1206	316	42-6	1206	3	31	316	3216	1206
	1210(3225)	32	1210	S41	1210	32	42-2	1210	4	32	325	3225	1210
	1808(4520)	42	1808	R29	1808	42	-	1808	-	-	-	4520	1808
	1812(4532)	43	1812	S43	1812	43	43-2	1812	-	43	432	4532	1812
	2220(5750)	55	-	-	2220	55	44-1	2221	-	-	550	5650	-
③ TEMPERATURE CHARACTERISTIC	COG(NPO)	C	A	N	G	CG	COG/CH	N	C	A	C	COG/CH	A
	P2H(N150)	P	S	-	-	P	P2H	-	P	-	P	PH	-
	R2H(N220)	R	1	-	-	R	R2H	-	R	-	R	RH	-
	S2H(N330)	S	3	-	-	S	S2H	-	S	-	S	SH	-
	T2H(N470)	T	O	-	-	T	T2H	-	T	-	T	TH	-
	U2J(N750)	U	Z	-	-	U	U2J	-	U	UJ	U	UJ	-
	S2L	L	Y	-	-	SL	SL	-	G	SL	SL	SL	-
	X7R	B	C	W	R(X)	X7R	X7R	B	B	C	BJ	X7R(B)	Y(X)
	Z5U	E	E	Z	U	-	Z5U	Z	-	E	-	Z5U	U
	Y5V	F	G	Y	V	Y5V	Y5V	Y	F	F	F	Y5V	-
④ NOMINAL CAPACITANCE		EX) 103=10,000pF 221=220pF 225=2,200,000pF=2.2μF 1R5=1.5pF 010=1pF											
⑤ CAPACITANCE TOLERANCE		B:±0.1pF C:±0.25pF D:±0.5pF F:±1% G:±2% J:±5% K:±10% M:±20% Z:-20~+80%											
⑥ RATED VOLTAGE	6.3V	Q	6	-	9	06	6.3	-	0J	-	J	0J	-
	10 V	P	Z	100	8	10	10	-	1A	4	L	1A	-
	16 V	O	Y	160	4	16	16	160	1C	3	E	1C	J
	25 V	A	3	250	3	25	25	250	1E	2	T	1E	X
	50 V	B	5	500	5	50	50	500	1H	5	U	1H	A
	100 V	C	1	101	1	100	100	101	2A	1	-	2A	B
	200V	D	2	201	2	200	200	201	2D	-	-	-	C
	250V	E	V	-	-	250	250	251	-	-	-	2E	-
	500V	G	7	501	-	500	500	501	-	-	-	-	E
	630V	H	-	-	-	630	630	-	-	-	-	2J	-
	1000V	I	A	102	-	1000	1K	102	-	-	-	3A	G
	2000V	J	G	202	-	2000	2K	202	-	-	-	3D	-
	3000V	K	H	302	-	3000	3K	302	-	-	-	3F	H
	4000V	-	J		-	4000	-	402	-	-	-	-	-
⑦ TERMINATION	NICKEL BARRIER	N	T	V	C	A	(GRM)	N	-	(MCH)	-	-	X
	Ag/Pd	P	1	-	-	B	(GR)	P	-	(MC)	-	-	F
⑧ PACKAGE	BULK(VINYL)	B	9	(NONE)	-	B	PB	*	X	-	B	B	B
	PAPER TAPING	C	2, 4	T, R	-	T, L	PT	T	E,V,W	K, L	T	T	C, P
	PLASTIC TAPING	E	1, 3	E, U	-	H, N	PT	-	F, Y	P, Q	T	-	T, R
	BULK CASE	P	7	-	-	C	PC	-	C	C	-	-	G

Multilayer Ceramic Capacitor

▷ SAMSUNG : CL 31 B 102 K B N C
① ② ③ ④ ⑤ ⑥ ⑦ ⑧

▷ AVX : 1206 5 C 103 K A T 2 A
② ⑥ ③ ④ ⑤ ⑦ ⑧

▷ JOHANSON : 500 R18 W 103 K B 4 T
⑥ ② ③ ④ ⑤ ⑦ ⑧

▷ KEMET : C 1206 C 103 K 5 R A C
① ② ④ ⑤ ⑥ ③ ⑦

▷ KYOCERA : CM 316 X7R 103 K 50 A T
① ② ③ ④ ⑤ ⑥ ⑦ ⑧

▷ MURATA : GRM 42-6 R 103 K 50 PT
① ② ③ ④ ⑤ ⑥ ⑧

▷ NOVACAP : 1206 N 272 J 101 N X T M
② ③ ④ ⑤ ⑥ ⑦ ⑧

▷ PANASONIC : ECJ V 1H 103 K B H
① ⑧ ⑥ ④ ⑤ ③ ②

▷ ROHM : MCH 31 5 C 103 K K
①⑦ ② ⑥ ③ ④ ⑤ ⑧

▷ TAIYO-YUDEN : U MK 316 B 103 K - T
⑥ ① ② ③ ④ ⑤ ⑧

▷ TDK : C 3216 X7R 1H 103 K T
① ② ③ ⑥ ④ ⑤ ⑧

▷ VITRAMON : VJ 1206 Y 103 K X A A T
① ② ③ ④ ⑤ ⑦ ⑥ ⑧