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SAMSUNG ELECTRO-MECHANICS

0105

MULTILAYER CERAMIC CAPACITORS

SAMSUNG

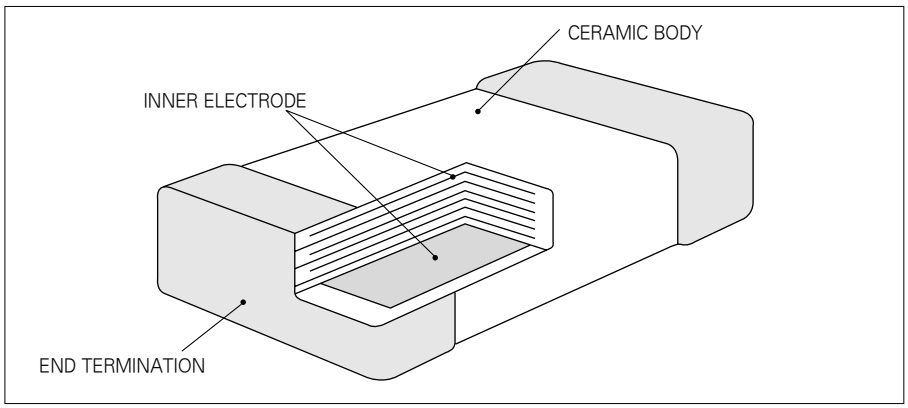
ISO 9001

International Organization for Standardization

Registered by UL to ISO 9001 under UL's accreditation by Raad voor de Certificatie(RvC), the Dutch Council for Certification
Registration NO:A1901(1996. 5. 7)

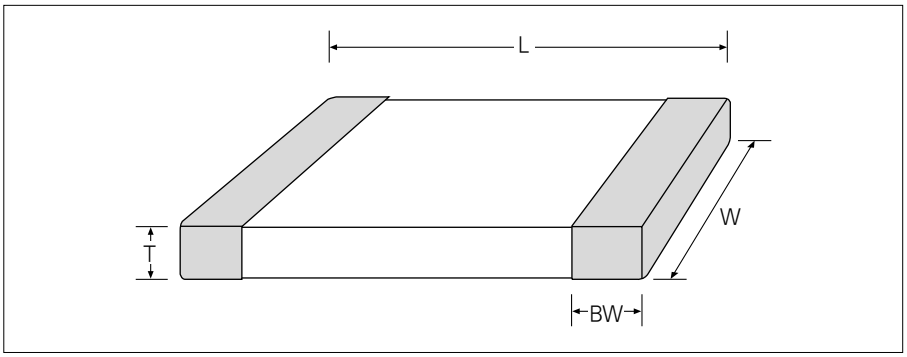
WE WILL PROVIDE A CUSTOMER WITH HIGH RELIABLE PRODUCTS AND SERVICES

FEATURE



CONFIGURATION AND DIMENSIONS

- Miniature Size
- Wide Capacitance, Temperature Compensation and Voltage Range
- Highly Reliable Performance
- Industry Standard Size
- Tape & Reel for Surface Mount Assembly



Code	EIA Code	DIMENSION(mm)			
		L	W	T(MAX)	BW
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	2.5±0.2	0.8±0.3
55	2220	5.7±0.4	5.0±0.3	2.5±0.3	1.0±0.3

PART NUMBER CODE

CL	10	C	101	J	B	N	C
1	2	3	4	5	6	7	8

(1) SAMSUNG Multilayer Ceramic Chip Capacitor
(2) Type(Size)
(3) Capacitance Temperature Characteristics
(4) Nominal Capacitance
(5) Capacitance Tolerance
(6) Rated Voltage
(7) Option
(8) Packaging Type

CAPACITANCE TEMPERATURE CHARACTERISTICS

• CLASS Ⅰ(Temperature Compensation)

Symbol	EIA Code	Temperature Coefficient (PPM/℃)	※Temperature Characteristics	Operation Temperature Range
C	C0G(CH)	0±60	C△	-55 ~ +125℃
P	P2H	-150±60	P△	
R	R2H	-220±60	R△	
S	S2H	-330±60	S△	
T	T2H	-470±60	T△	
U	U2J	-750±120	U△	
L	S2L	+350 ~ -1000	SL	

※ Temperature Characteristics

Temperature Characteristics	below 2.0pF	2.2 ~3.9pF	above 4.0pF	above 10pF
C△	CK	CJ	CH	CG/CH
P△	PK	PJ	PH	PH
R△	RK	RJ	RH	RH
S△	SK	SJ	SH	SH
T△	TK	TJ	TH	TH
U△	UK	UJ	UJ	UJ

K:±250 PPM/℃
J:±120 PPM/℃
H:±60 PPM/℃
G:±30 PPM/℃

• CLASS Ⅱ(High Dielectric Constant)

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

NOMINAL CAPACITANCE

• The value of nominal capacitance is expressed in pico-Farad(pF) with a three-digit number. The first two digits denote significant figures and the last digit denotes the multiple of 10 in pF. For values below 1pF, the letter "R" is used as the decimal point and the last digit becomes significant.

example)
$100 = 10 \times 10^{0} = 10\,pF$
$222 = 22 \times 10^{2} = 2200\,pF$
$020 = 2 \times 10^{0} = 2\,pF$
$1R5 = 1.5\,pF$

CAPACITANCE TOLERANCE

Temperature Characteristics	Symbol	Tolerance	Applicable Capacitance & Range
C0G(NPO) or T.C Series	B	±0.1pF	0.5~3pF
	C	±0.25pF	0.5~10pF
	D	±0.5pF	
	F	±1.0pF	6~10pF
	F	±1%	E-24 Series for over 10pF
	*G	±2%	
	J	±5%	
	K	±10%	E-12 Series
B(X7R)	J	±5%	
	K	±10%	
	M	±20%	
F(Y5V)	Z	-20%~+80%	E-6 Series

※ Please Consult us for special tolerances.
* Option

RATED VOLTAGE

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

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	Reserved for future use
E	Reserved for future use

* Please consult us for other termination type.

PACKAGING TYPE

Symbol	Packaging	Symbol	Packaging
B	Bulk	D	Cardboard tape, 13″ Reel
P	Cassette	L	Cardboard tape, 13″ Reel
C	Cardboard tape, 7″ Reel	E	Embossed tape, 7″ Reel
O	Cardboard tape, 10″ Reel	F	Embossed tape, 13″ 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$\times 10^{n}$"

CAPACITANCE Vs CHIP THICKNESS STANDARD

Description			1005 Type (0402)	1608 Type (0603)	2012 Type (0805)			3216 Type (1206)		
DIMEN-SION (mm)		L	1.0 ± 0.05	1.6 ± 0.1	2.0 ± 0.1			3.2 ± 0.2		
		W	0.5 ± 0.05	0.8 ± 0.1	1.25 ± 0.1			1.6 ± 0.2		
		T	0.5 ± 0.05	0.8 ± 0.1	0.65 - +0.05/-0.1	0.85 - +0.05/-0.1	1.25 ± 0.1	0.85 ± 0.15	1.25 ± 0.2	1.6 ± 0.2
MAX CAPACITANCE (pF)	SL	50V	240	1000	1000	1500	2700	2700	5600	8200
		100V	-	680	560	910	1000	1500	3300	3900
	C,TC (Except SL)	25V	150	1000	-	-	-	3600	6800	10000
		50V	150	1000	560	1000	2200	2200	4700	-
		100V	-	300	430	680	1200	2200	3600	5100
		200V	-	-	-	300	560	820	1600	2400
		500V	-	-	-	-	-	-	560	820
		1000V	-	-	-	-	-	-	-	-
		2000V	-	-	-	-	-	-	-	-
		3000V	-	-	-	-	-	-	-	-
	B (X7R)	6.3V	-	1000000	-	-	4700000	-	-	10000000
		10V	100000	470000	270000	470000	1000000	1000000	3300000	4700000
		16V	68000	220000	200000	330000	1000000	910000	1500000	3300000
		25V	10000	47000	68000	130000	330000	390000	620000	1000000
		50V	4700	27000	39000	56000	100000	150000	240000	470000
		100V	-	4700	12000	20000	33000	62000	100000	150000
		200V	-	-	-	12000	20000	30000	56000	75000
		500V	-	-	-	-	-	-	24000	36000
		1000V	-	-	-	-	-	-	-	-
		2000V	-	-	-	-	-	-	-	-
		3000V	-	-	-	-	-	-	-	-
	F (Y5V)	10V	220000	1000000	-	-	4700000	-	-	1000000
		16V	220000	470000	680000	1000000	2200000	2200000	4700000	-
		25V	33000	330000	220000	470000	1000000	1000000	2200000	3300000
		50V	10000	100000	68000	150000	470000	470000	680000	-

3225 Type (1210)				4532 Type (1812)				5750 Type (2220)
3.2 ± 0.3				4.5 ± 0.4				5.7 ± 0.4
2.5 ± 0.2				3.2 ± 0.3				5.0 ± 0.3
1.25 ± 0.2	1.6 ± 0.2	2.0 ± 0.2	2.5 ± 0.2	1.25 ± 0.2	1.6 ± 0.2	2.0 ± 0.2	2.5 ± 0.2	2.5 ± 0.3
-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-
10000	22000	47000	-	13000	22000	47000	68000	-
7500	10000	13000	18000	15000	20000	24000	36000	-
3600	5100	6200	8200	6800	10000	12000	16000	6800
1200	1800	2000	2700	2400	3600	3900	5100	4700
-	-	-	820	-	-	-	2400	3300
-	-	-	560	-	-	-	1600	2200
-	-	-	390	-	-	-	1100	1500
-	-	-	22000000	-	-	-	-	-
2200000	3300000	10000000	-	-	-	-	22000000	-
2400000	-	-	10000000	-	-	-	-	-
1000000	-	-	-	-	-	-	-	-
470000	-	-	-	1500000	2200000	2700000	3300000	-
180000	270000	330000	430000	360000	510000	560000	820000	-
120000	160000	200000	270000	220000	300000	330000	430000	430000
33000	51000	62000	82000	62000	100000	120000	160000	240000
-	-	-	20000	-	-	-	10000	130000
-	-	-	12000	-	-	-	6200	75000
-	-	-	6800	-	-	-	3600	43000
-	-	-	22000000	-	-	-	-	-
6800000	10000000	-	-	-	-	-	-	-
3300000	-	-	-	-	-	-	-	-
1000000	-	-	-	-	-	-	-	-

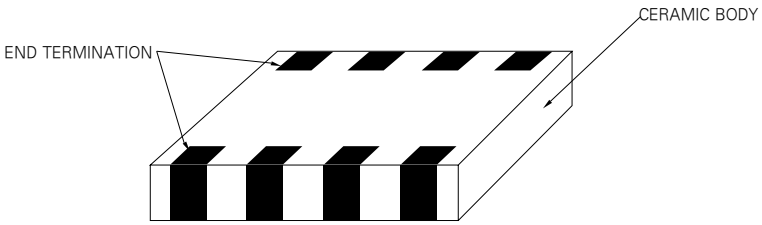
CAPACITANCE RANGE

Temperature Characteristics		Size	Voltage	Capacitance Range(pF)
CLASS I	SL,UJ	05 (0402)	50 V	10 ~ 240
		10 (0603)	50 V	10 ~ 1000
			100 V	10 ~ 680
		21 (0805)	50 V	10 ~ 2700
			100 V	10 ~ 1000
		31 (1206)	50 V	10 ~ 8200
			100 V	10 ~ 3900
	C(C0G) & TC Series	05 (0402)	25 V	10 ~ 150
			50 V	10 ~ 150
		10 (0603)	25 V	10 ~ 1000
			50 V	10 ~ 1000
			100 V	10 ~ 300
		21 (0805)	50 V	10 ~ 2200
			100 V	10 ~ 1200
			200 V	10 ~ 560
		31 (1206)	25 V	1500 ~ 10000
			50 V	10 ~ 4700
			100 V	10 ~ 5100
			200 V	10 ~ 2400
			500 V	10 ~ 820
		32 (1210)	50 V	560 ~ 47000
			100 V	2200 ~ 18000
			200 V	470 ~ 8200
			500 V	330 ~ 2700
			1000 V	10 ~ 820
			2000 V	10 ~ 560
			3000 V	10 ~ 390
		43 (1812)	50 V	1000 ~ 68000
			100 V	1000 ~ 36000
			200 V	1000 ~ 16000
			500 V	1000 ~ 5100
			1000 V	10 ~ 2400
			2000 V	10 ~ 1600
			3000 V	10 ~ 1100
		55 (2220)	200 V	10 ~ 6800
			500 V	10 ~ 4700
			1000 V	10 ~ 3300
			2000 V	10 ~ 2200
			3000 V	10 ~ 1500
	B(X7R)	05 (0402)	10 V	100 ~ 100000
			16 V	100 ~ 68000
			25 V	100 ~ 10000
			50 V	100 ~ 4700
		10 (0603)	6.3 V	100000 ~ 1000000
			10 V	100 ~ 470000
			16 V	100 ~ 220000
			25 V	100 ~ 47000
			50 V	100 ~ 27000
			100 V	100 ~ 4700
		21 (0805)	6.3 V	2200000 ~ 4700000
			10 V	100 ~ 1000000
			16 V	100 ~ 1000000
			25 V	100 ~ 330000
			50 V	100 ~ 100000
			100 V	100 ~ 33000
			200 V	100 ~ 20000

Temperature Characteristics		Size	Voltage	Capacitance Range(pF) 0.5 10 100 1000 10000 100000 1000000 10000000 100000000
CLASS Ⅱ	B(X7R)	31 (1206)	6.3 V	6800000 10000000
			10 V	1000 4700000
			16 V	1000 3300000
			25 V	1000 1000000
			50 V	1000 470000
			100 V	1000 150000
			200 V	1000 75000
			500 V	1000 36000
		32 (1210)	6.3 V	10000000 22000000
			10 V	1000 10000000
			16 V	1000 10000000
			25 V	1000 1000000
			50 V	1000 470000
			100 V	1000 430000
			200 V	1000 270000
			500 V	1000 82000
			1000 V	820 20000
			2000 V	560 12000
			3000 V	390 6800
		43 (1812)	10 V	10000000 22000000
			16 V	
			25 V	
			50 V	10000 3300000
			100 V	10000 820000
			200 V	10000 430000
			500 V	10000 160000
			1000V	2400 10000
			2000V	1600 6200
			3000V	1100 3600
		55 (2220)	200 V	6800 430000
			500 V	4700 240000
			1000V	3300 130000
			2000V	2200 75000
			3000V	1500 43000
	F(Y5V)	05 (0402)	10 V	2200 220000
			16 V	2200 220000
			25 V	2200 33000
			50 V	2200 10000
		10 (0603)	10 V	2200 1000000
			16 V	2200 470000
			25 V	2200 330000
			50 V	2200 100000
		21 (0805)	10 V	1000000 4700000
			16 V	10000 2200000
			25 V	10000 1000000
			50 V	10000 470000
		31 (1206)	10 V	100000 10000000
			16 V	10000 4700000
			25 V	10000 3300000
			50 V	10000 680000
		32 (1210)	10 V	10000000 22000000
			16 V	100000 10000000
			25 V	100000 3300000
			50 V	100000 1000000

CAPACITOR ARRAY

▪ FEATURE



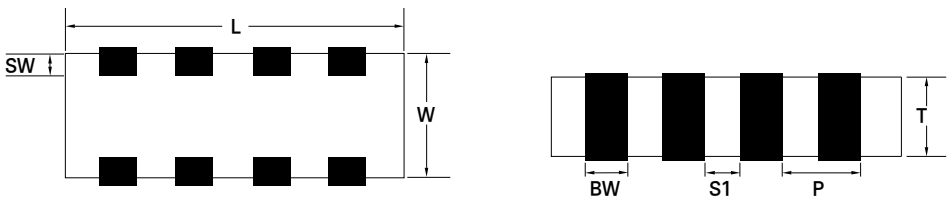
★ Reduction in required real estate(more than 50%)
★ Reduced cost, Space and Time for placement on PCB
★ Reduction in number of solder joints
★ Easier PCB design
★ Reduced waste from tape and reel packaging process
★ Protect EMI bypassing digital signal line noise

▪ PRODUCT IDENTIFICATION

CL	A	4	C	101	K	B	N	E
①	②	③	④	⑤	⑥	⑦	⑧	⑨

① Samsung Multilayer Ceramic Chip Capacitor
② Capacitor Array
③ Array Type
④ Capacitance Temperature Characteristics
⑤ Nominal Capacitance
⑥ Capacitance Tolerance(NPO:"K" only, X7R:"M" only)
⑦ Rated Voltage
⑧ Thickness Option
⑨ Packaging Type("E" only)

▪ STRUCTURE AND DIMENSION



Unit: mm

Type	Size (inch)	Element	L	W	T	BW	SW	S1	P
4	0612	4	3.2±0.15	1.6±0.15	1.35 max	0.4±0.2	0.3±0.15	0.4±0.2	0.8±0.2

CAPACITANCE RANGE OF C-ARRAY

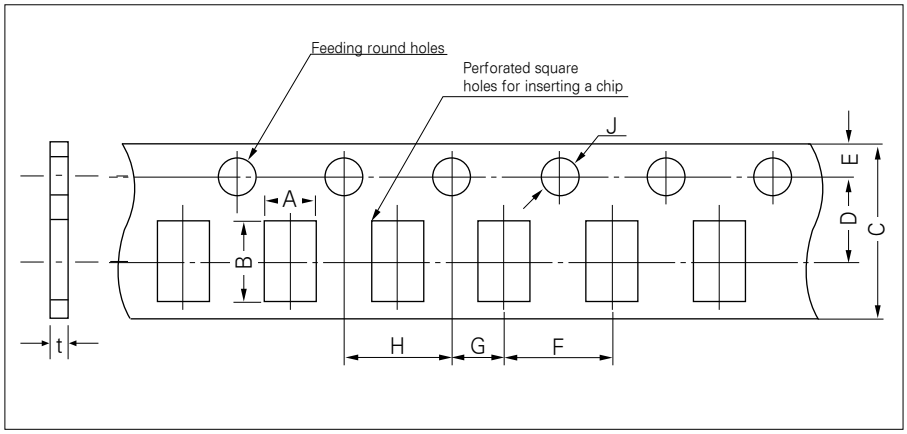
THICKNESS 0.85±0.1㎜

TEMPERATURE CHARACTERISTICS	CH	X7R			Y5V		
RATED VOLTAGE(DC) / CAPACITANCE(pF)	50V	16V	25V	50V	16V	25V	50V
10							
15							
22							
33							
47							
68							
100							
150							
220							
330							
470							
680							
1000							
1500							
3300							
4700							
10000							
22000							
47000							
100000							
150000							

* Please contact us for special capacitance and high voltage(100V)

PACKAGING SPECIFICATIONS

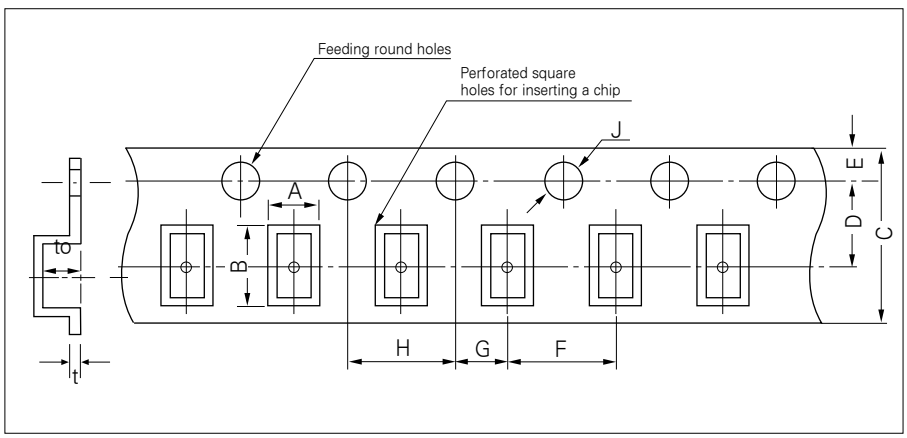
• Cardboard Paper Tape



Unit: mm

Symbol / Type		A	B	C	D	E	F	G	H	J	t
Dimension	05	0.65 ±0.1	1.10 ±0.1	8.0 ±0.3	3.5 ±0.05	1.75 ±0.1	2.0 ±0.05	1.0 ±0.05	4.0 ±0.1	ø 1.5 +0.1 −0	1.1 max
	10	1.10 ±0.2	1.90 ±0.2				4.0 ±0.1	2.0 ±0.05			
	21	1.16 ±0.2	2.4 ±0.2								
	31	2.0 ±0.2	3.6 ±0.2								

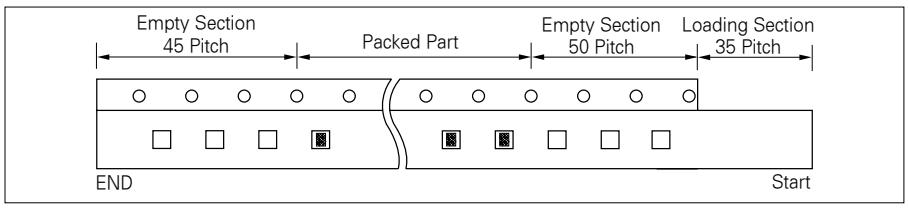
• Embossed Plastic Tape



Unit: mm

Symbol / Type		A	B	C	D	E	F	G	H	J	to	t
Dimension	21	1.45 ±0.2	2.3 ±0.2	8.0 ±0.3	3.5 ±0.05	1.75 ±0.1	4.0 ±0.1	2.0 ±0.05	4.0 ±0.1	ø 1.5 +0.1 −0	2.5 max	0.6 BELOW
	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	12.0 ±0.3	5.6 ±0.05		8.0 ±0.1				3.8 max	

• **Taping Size**

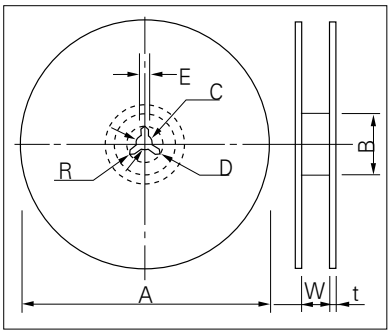


Unit: pcs

Type	Symbol	Cardboard Paper Tape	Symbol	Embossed Plastic Tape
7″ Reel	C	4,000	E	2,000
10″ Reel	O	10,000	-	-
13″ Reel	D	10,000	F	10,000
	L	15,000		

• **Reel Dimensions**

Unit: mm

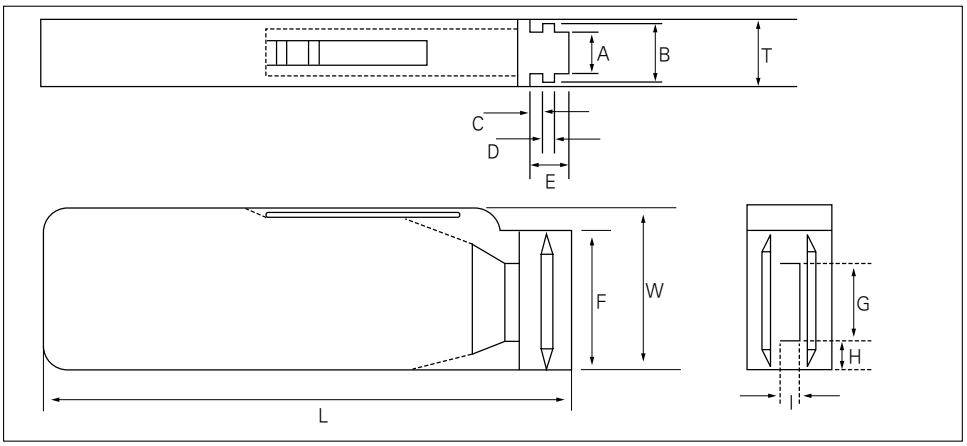


Symbol	A	B	C	D
7″ Reel	ø178 ±2.0	min. ø50	ø13 ±0.5	21 ±0.8
13″ Reel	ø330 ±2.0	min. ø70		

Symbol	E	W	t	R
7″ Reel	2.0 ±0.5	10 ±1.5	0.8 ±0.2	1.0
13″ Reel				

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.



Unit: mm

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

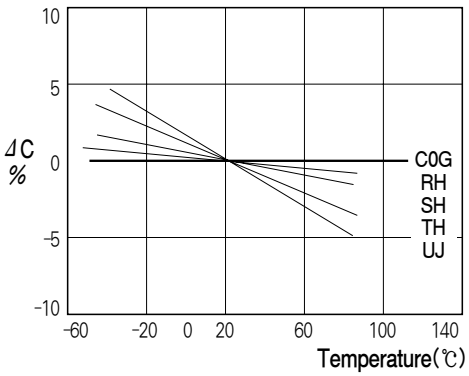
• **Quantity**

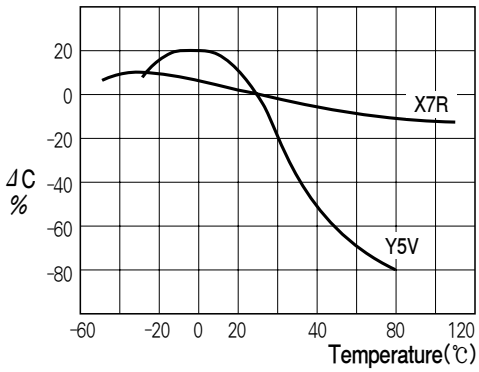
Unit: pcs

Size	05(0402)	10(0603)	21(0805)	
			T≤0.85㎜	T≥1.0㎜
Quantity	80,000	15,000	10,000	5,000

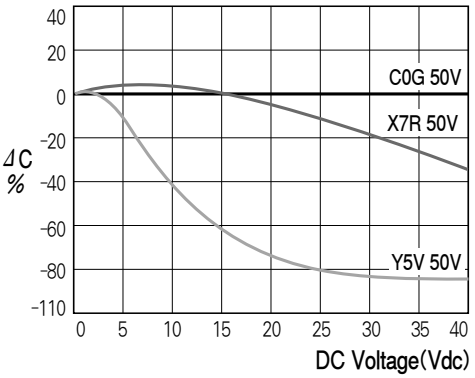
ELECTRICAL CHARACTERISTICS

CAPACITANCE - TEMPERATURE CHARACTERISTICS

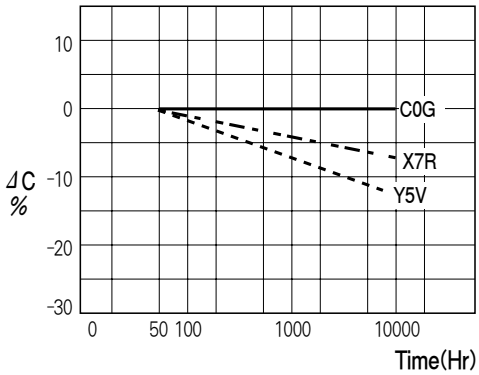




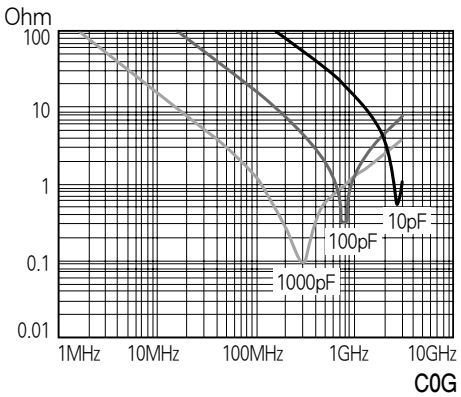
CAPACITANCE - DC VOLTAGE CHARACTERISTICS



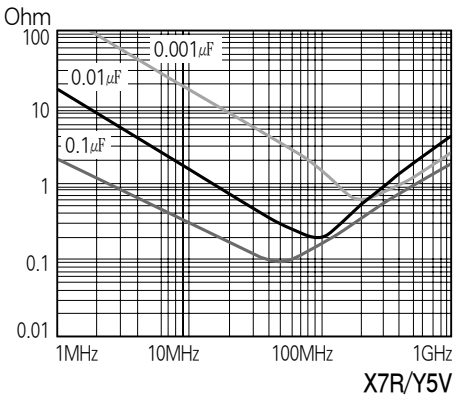
CAPACITANCE CHANGE - AGING



IMPEDANCE - FREQUENCY CHARACTERISTICS



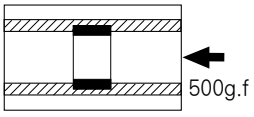
C0G



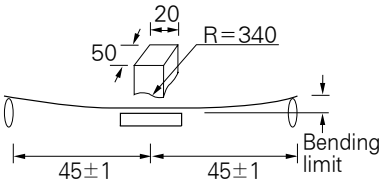
X7R/Y5V

※ Please consult us for high frequency MLCC.

RELIABILITY AND TEST CONDITIONS

<table>
<tr><th>No</th><th colspan="2">Item</th><th>Performance</th><th colspan="3">Test Condition</th></tr>
<tr><td>1</td><td colspan="2">Appearance</td><td>No abnormal exterior appearance</td><td colspan="3">Through microscope(×10)</td></tr>
<tr><td>2</td><td colspan="2">Insulation resistance</td><td>10,000㏁ or 500㏁ · ㎌ product whichever is smaller
(Rated voltage is below 16V : 10,000㏁ or 100㏁ · ㎌)</td><td colspan="3">Rated voltage shall be applied.
Measurement time is 60 ~ 120 rated voltage time 60 sec.</td></tr>
<tr><td>3</td><td colspan="2">Withstanding voltage</td><td>No dielectric breakdown or mechanical breakdown</td><td colspan="3">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 50㎃ current</td></tr>
<tr><td rowspan="5">4</td><td rowspan="5">Capacitance</td><td rowspan="3">CLASS Ⅰ</td><td rowspan="3">Within the specified tolerance</td><td>Capacitance</td><td>Frequency</td><td>Voltage</td></tr>
<tr><td>≤1,000㎊</td><td>1MHz±10%</td><td rowspan="2">0.5 ~ 5 Vrms</td></tr>
<tr><td>〉1,000㎊</td><td>1KHz±10%</td></tr>
<tr><td rowspan="3">CLASS Ⅱ</td><td rowspan="3">Within the specified tolerance</td><td>Capacitance</td><td>Frequency</td><td>Voltage</td></tr>
<tr><td>≤22㎌</td><td>1KHz±10%</td><td>1.0±0.2 Vrms</td></tr>
<tr><td>〉22㎌</td><td>120Hz ±20%</td><td>0.5± 0.1Vrms</td></tr>
<tr><td rowspan="3">5</td><td rowspan="3">Q</td><td rowspan="3">CLASS Ⅰ</td><td rowspan="3">Over 30㎊ : Q ≥1,000
less than 30㎊ : Q ≥400 +20C
(C : Capacitance)</td><td>Capacitance</td><td>Frequency</td><td>Voltage</td></tr>
<tr><td>≤1,000㎊</td><td>1MHz±10%</td><td rowspan="2">0.5 ~ 5 Vrms</td></tr>
<tr><td>〉1,000㎊</td><td>1KHz±10%</td></tr>
<tr><td rowspan="4">6</td><td rowspan="4">Tanδ</td><td rowspan="4">CLASS Ⅱ</td><td rowspan="4">
<table>
<tr><th>Char</th><th>25V And over</th><th>16V</th><th>10V</th><th>6.3V</th></tr>
<tr><td>B</td><td>0.025 MAX</td><td>0.035 MAX</td><td>0.05 MAX</td><td>0.05 MAX</td></tr>
<tr><td>F</td><td>0.05 MAX</td><td>0.07 MAX (C〈1.0㎌) 0.09 MAX (C≥1.0㎌)</td><td>0.125 MAX</td><td>-</td></tr>
</table>
</td><td>Capacitance</td><td>Frequency</td><td>Voltage</td></tr>
<tr><td>≤22㎌</td><td>1KHz±10%</td><td>1.0± 0.2Vrms</td></tr>
<tr><td>〉22㎌</td><td>120Hz ±20%</td><td>0.5± 0.1Vrms</td></tr>
<tr><td>7</td><td colspan="2">Adhesive strength of termination</td><td>No indication of peeling shall occur on the terminal electrode.</td><td colspan="3">A 500g.f pressure shall be applied for 10±1 second.
 
</td></tr>
</table>

RELIABILITY AND TEST CONDITIONS

No	Item		Performance			Test Condition
8	Bending Strength	Appearance	No mechanical damage shall occur.			Bending shall be applied to the limit(1mm) with 0.3mm/sec. 
		Capacitance	Character		Change of capacitance	
			CLASS Ⅰ		Within±5% or ± 0.5 pF whichever is larger	
			CLASS Ⅱ	B(X7R)	Within ±12.5%	
				F	Within ±30%	
9	Solderability		More than 95% of the terminal surface is to be soldered newly, so metal part(A) does not come out or dissolve 			Solder temperature : 230±5℃ Solder : H63A Flux : ROSIN Pre-heating : AT 80~120℃ FOR 10~30SEC.
10	Resistance to Soldering Heat	Appearance	No mechanical damage shall occur.			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
		Capacitance	Characteristic		Cap Change	
			CLASS Ⅰ		Within±2.5% or ± 0.25 pF whichever is larger	
			CLASS Ⅱ	B	Within ±7.5%	
				F	Within ±20%	
		Q CLASS Ⅰ	30㎊ And over :Q≥1000 Less than 30㎊:Q≥400+20×C			
		Tanδ CLASS Ⅱ	To satisfy the specified initial value			
		Insulation resistance	To satisfy the specified initial value			
		Withstanding voltage	To satisfy the specified initial value			
11	Vibration Test	Appearance	No mechanical damage shall occur.			The capacitor shall be subjected to a harmonic motion having a total amplitude of 1.5mm. The entire frequency range, from 10 to 55㎐ and return to10㎐, 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.
		Capacitance	Characteristic		Cap Change	
			CLASS Ⅰ		Within±2.5% or ±0.25㎊ whichever is larger	
			CLASS Ⅱ	B	Within ±5%	
				F	Within ±20%	
		Q CLASS Ⅰ	30㎊ And over :Q≥1000 Less than 30㎊:Q≥400+20×C			
		Tanδ CLASS Ⅱ	To satisfy the specified initial value			
		Insulation resistance	To satisfy the specified initial value			

*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.

RELIABILITY AND TEST CONDITIONS

<table>
<tr><th>No</th><th colspan="2">Item</th><th colspan="3">Performance</th><th>Test Condition</th></tr>
<tr><td rowspan="6">12</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.</td></tr>
<tr><td rowspan="3">Capacitance</td><td colspan="2">Characteristic</td><td>Capacitance Change</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>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">30㎊ And over : Q≥ 350
10 ~30㎊ : Q≥ 275 + 2.5×C
Less than 10㎊: Q≥ 200 +10×C</td></tr>
<tr><td>Tanδ
CLASS Ⅱ</td><td colspan="3"><table><tr><th>Char</th><th>25V And over</th><th>16V</th><th>10V</th><th>6.3V</th></tr><tr><td>B</td><td>0.05</td><td>0.05 MAX</td><td>0.05 MAX</td><td>0.075 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>-</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="6">13</td><td rowspan="6">Moisture Resistance</td><td>Appearance</td><td colspan="3">No mechanical damage shall occur.</td><td rowspan="6">Applied voltage : rated voltage

Temperature : 40±2 ℃

Relative humidity : 90~95%RH

Test time : 500 +12/-0 Hr.

Current applied : 50㎃ MAX.

Measuring at room temperature

After cooling for
CLASS Ⅰ : 24±2 Hr.
CLASS Ⅱ : 48±4 Hr.</td></tr>
<tr><td rowspan="3">Capacitance</td><td colspan="2">Characteristic</td><td>Capacitance Change</td></tr>
<tr><td colspan="2">CLASS Ⅰ</td><td>Within±7.5% or ±0.75㎊ whichever is larger</td></tr>
<tr><td rowspan="2">CLASS Ⅱ</td><td>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">30㎊ And over:Q≥200
30㎊ And below:Q≥100+10/3×C</td></tr>
<tr><td>Tanδ
CLASS Ⅱ</td><td colspan="3"><table><tr><th>Char</th><th>25V And over</th><th>16V</th><th>10V</th><th>6.3V</th></tr><tr><td>B</td><td>0.05 MAX</td><td>0.05 MAX</td><td>0.05 MAX</td><td>0.075 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>-</td></tr></table></td></tr>
<tr><td>Insulation resistance</td><td colspan="3">Minimum insulation Resistance:
500 ㏁ or 25㏁ · ㎌ product whichever is smaller</td></tr>
</table>

RELIABILITY AND TEST CONDITIONS

<table>
<tr><th>No</th><th colspan="2">Item</th><th colspan="3">Performance</th><th>Test Condition</th></tr>
<tr><td rowspan="5">14</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><td colspan="2">Char</td><td>Temp</td></tr><tr><td colspan="2">CLASS Ⅰ</td><td>125 ±3 ℃</td></tr><tr><td rowspan="2">CLASS Ⅱ</td><td>B</td><td>125 ±3 ℃</td></tr><tr><td>F</td><td>85 ±3 ℃</td></tr></table>
(Initial value measurement)
For CLASS Ⅱ capacitors, 200 % of rated voltage shall be applied for 1 hour at the maximum operating temperature, then keep it at room temperature. for 48 ± 4 Hrs.</td></tr>
<tr><td>Capacitance</td><td colspan="3"><table><tr><td>Characteristic</td><td colspan="2">Cap Change</td></tr><tr><td>CLASS Ⅰ</td><td colspan="2">Within±3% or ± 0.3 pF whichever is larger</td></tr><tr><td rowspan="2">CLASS Ⅱ</td><td>B</td><td>Within ±12.5%</td></tr><tr><td>F</td><td>Within ±30%</td></tr></table></td></tr>
<tr><td>Q
CLASS Ⅰ</td><td colspan="3">30㎊ And over : Q≥ 350
10 ~30㎊ : Q≥ 275 + 2.5×C
Less tahn 10㎊: 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>B</td><td>0.05 MAX</td><td>0.05 MAX</td><td>0.05 MAX</td><td>0.075 MAX</td></tr><tr><td>F</td><td>0.75 MAX</td><td>0.1MAX (C〈1.0㎊) 0.125MAX (C≥1.0㎊)</td><td>0.15 MAX</td><td>-</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">15</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 cycle 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>
Measuring 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>CLASS Ⅰ</td><td colspan="2">Within±2.5% or ±0.25㎊ whichever is larger</td></tr><tr><td rowspan="2">CLASS Ⅱ</td><td>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㎊ And over : Q≥1000
Less tahn 30㎊ : Q≥400+20×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>B</td><td>0.025 MAX</td><td>0.035 MAX</td><td>0.05 MAX</td><td>0.05 MAX</td></tr><tr><td>F</td><td>0.05 MAX</td><td>0.07MAX (C〈1.0㎊) 0.09MAX (C≥1.0㎊)</td><td>0.125 MAX</td><td>-</td></tr></table></td></tr>
<tr><td>Insulation resistance</td><td colspan="3">To satisfy the specified initial value</td></tr>
</table>

APPLICATION MANUAL FOR SURFACE MOUNTING

1.Storage of products.

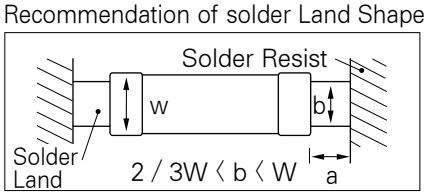
1-1. Storage Environment
Tape packing materials are designed to withstand long-term storage, but they will degrade more rapidly in the presence of high temperature or high humidity, Therefore, the products must be stored in an ambient temperature of less than 40℃ with a relative humidity of less than 70%. Allowable storage period is within six months from the outgoing date of delivery.

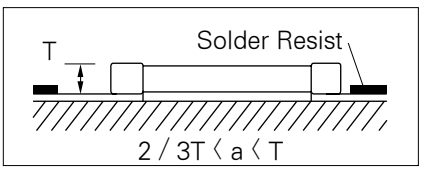
1-2. Corrosive Gases
Since sulfur and chlorine may degrade the solderability of the end termination, it is important to store the capacitors in an environment free of these gases

1-3. 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.

2. Design of Solder Land Pattern
When designing printed 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 larger 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

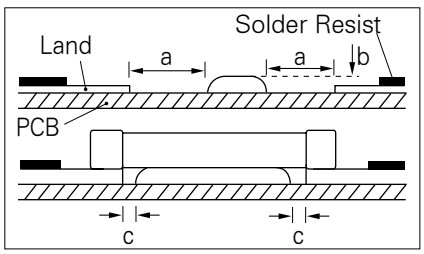




3. Adhesives
MLCCs generally require the use of an adhesive to position the chips to the circuit board prior to soldering.

3-1. 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 temperatures.
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.

3-2. 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. The following illustrations show the proper quantity of adhesive.



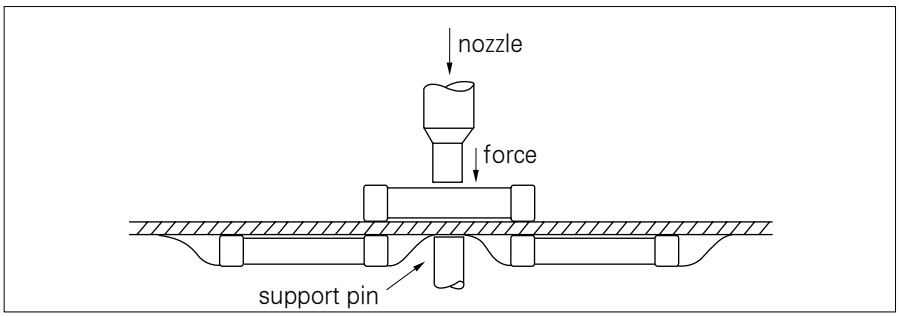
Unit: mm

Type	21	31
a	0.2min	0.2min
b	70~100㎛	70~100㎛
c	〉0	〉0

3-3. Adhesive hardening Characteristics
To prevent oxidation of the terminations, the adhesive must harden at 160℃ or less, within 2 minutes or less.

4. Mounting
4-1. Mounting Head Pressure
Excessive pressure will cause chip capacitors to crack. The pressure between nozzle and chip capacitor will be 300g maximum during mounting.

4-2. Bending Stress
Bending of printed circuit board by mouning 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.



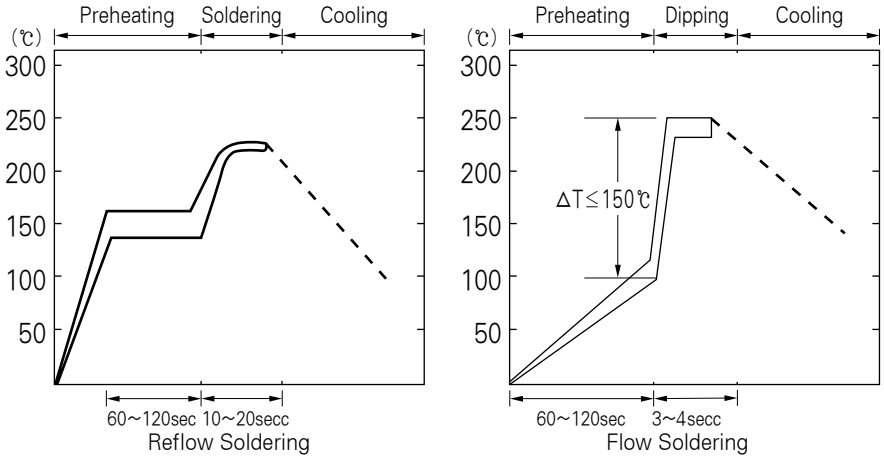
5. Flux
Although highly-activated flux gives better solderability, substances which increase activity may also degrade the insulation of the chip capactiors, To avoid such degradation, it is recommended that a mildly activated rosin flux (less than 0.2% chlorine) be used.

6. 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.

6-1. Soldering Methods

Method	Classification	
Reflow slodering	· Overall heating	· Infrared rays · Hot plate · VPS (Vapor phase)
	· Local heating	· Air heater · Laser · Light beam
Flow Soldering	· Single wave · Double wave	

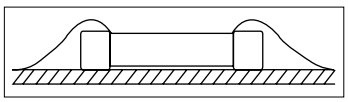
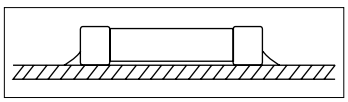
6-2 Soldering Profile
To avoid the crack problem by sudden temperature change, follow the temperature profile in the adjacent graph.



6-3. 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. Therefore 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.

6-4. 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

6-5. Cooling

Natural cooling using air is recommended. If the chips are dipped into solvent for cleaning, the temperature difference (ΔT) 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.

7. 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.

MEMO

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