

ISO 9001

International Organization for Standardization

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for Certification
Registration NO: A1901(1996.5.7)

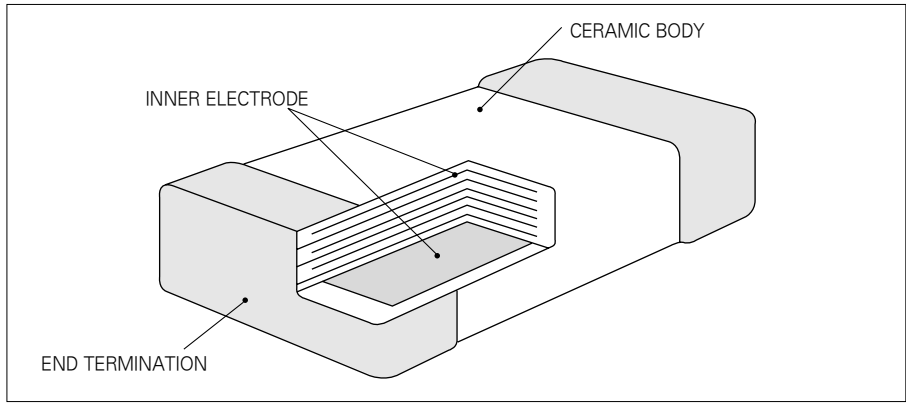
WE WILL PROVIDE A CUSTOMER WITH
HIGH RELIABLE PRODUCTS AND SERVICES



MULTILAYER CERAMIC CAPACITORS

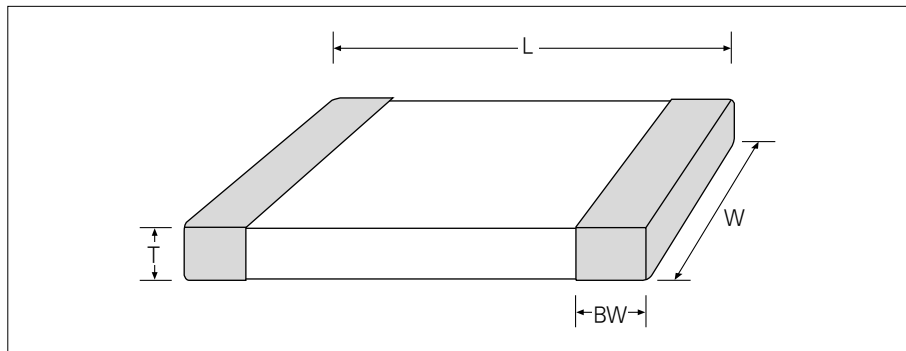


FEATURE



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/°C)	※Temperature Characteristics	Operation Temperature Range
C	COG(CH)	0±60	C△	-55 ~ +125°C
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/°C

J: ±120 PPM/°C

H: ±60 PPM/°C

G: ±30 PPM/°C

• CLASS II (High Dielectric Constant)

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

NOMINAL CAPACITANCE

• The nominal capacitance value is expressed in pico-Farad(pF) and identified by a 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) $100 = 10 \times 10^0 = 10\text{pF}$
 $102 = 10 \times 10^2 = 1000\text{pF}$
 $020 = 2 \times 10^0 = 2\text{pF}$
 $1R5 = 1.5\text{pF}$

CAPACITANCE TOLERANCE

Temperature Characteristics	Symbol	Tolerance	Applicable Capacitance & Range
COG(NPO) or T.C Series	B	±0.1pF	0.5~3pF
	C	±0.25pF	0.5~10pF
	D	±0.5pF	
	F	±1%	6~10pF
	*G	±2%	E-24 Series for over 10pF
	J	±5%	
	K	±10%	
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.

* 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	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 × 10ⁿ"

CAPACITANCE Vs CHIP THICKNESS STANDARD

Size		1005 Type (0402)	1608 Type (0603)	2012 Type (0805)			3216 Type (1206)			
DIMENSION (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	
CAPACITANCE RANGE (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	-	-	-	-	-	-	-	-

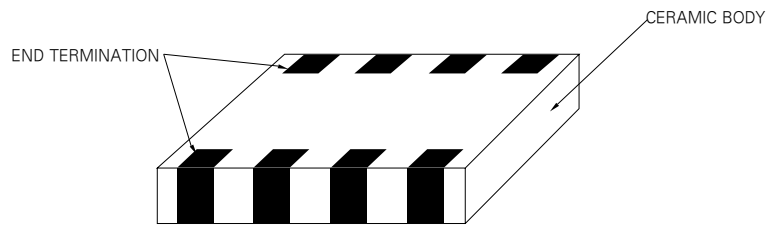
CAPACITANCE RANGE

Temperature Characteristics	Size	Voltage	Capacitance Range (pF)											
			0.5	10	100	1000	10000	100000	1000000	10000000	100000000			
CLASS I	SL,UJ	05 (0402) 50 V				240								
		10 (0603) 50 V					1000							
		10 (0603) 100 V					680							
		21 (0805) 50 V						2700						
		21 (0805) 100 V							1000					
		31 (1206) 50 V								8200				
	31 (1206) 100 V									3900				
	C(C0G) & TC Series	05 (0402)	25 V				150							
			50 V					150						
			100 V											
		10 (0603)	25 V						1000					
			50 V							1000				
			100 V								300			
		21 (0805)	50 V								2200			
			100 V									1200		
			200 V										560	
		31 (1206)	25 V							1500		10000		
			50 V								4700			
			100 V									5100		
			200 V										2400	
			500 V											820
		32 (1210)	50 V							560			47000	
			100 V								2200		18000	
			200 V									470		8200
			500 V									330		2700
			1000 V											820
			2000 V											560
3000 V													390	
43 (1812)		50 V							1000			68000		
		100 V								1000		36000		
		200 V									1000		16000	
	500 V										1000	5100		
	1000 V											2400		
	2000 V											1600		
	3000 V											1100		
55 (2220)	200 V										6800			
	500 V											4700		
	1000 V											3300		
	2000 V											2200		
	3000 V											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											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**



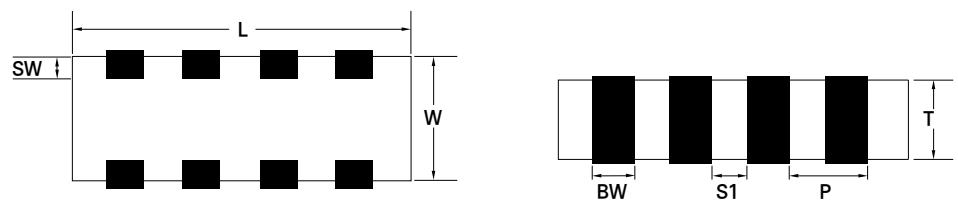
- ★ Reduction in required real estate (more than 50%)
- ★ Reduced cost, Space and Time for placement on PCB
- ★ Reduction in number of solder joints
- ★ Easier PCB design
- ★ Reduced waste from tape and reel packaging process
- ★ It protect EMI bypassing digital signal line nose

▪ **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

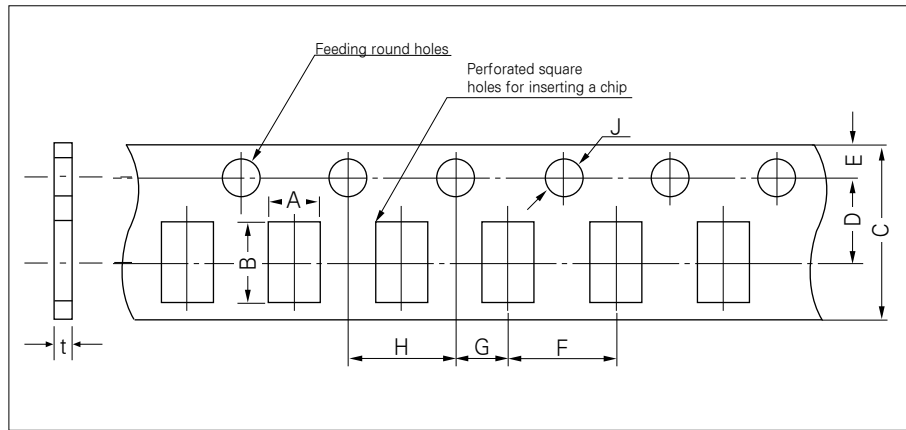
THICKNESS 0.85±0.1mm

TEMPERATURE CHARACTERISTICS	CH	X7R			Y5V		
	50V	16V	25V	50V	16V	25V	50V
RATED VOLTAGE(DC)							
CAPACITANCE(μF)							
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

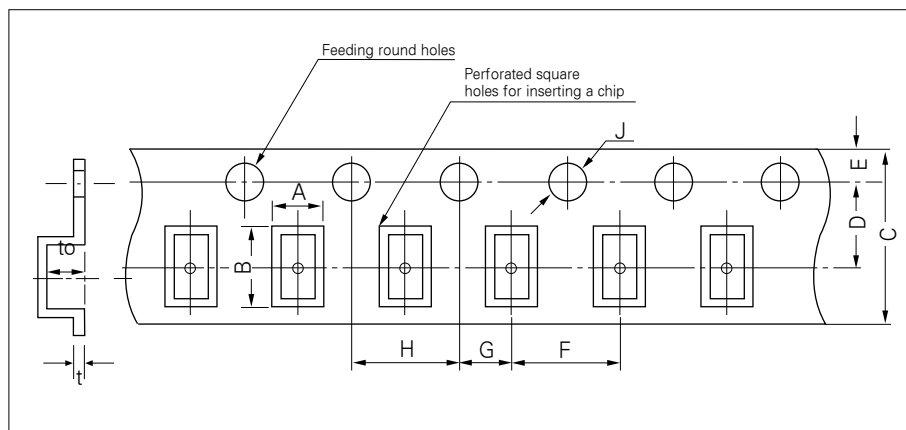
• Cardboard Paper Tape



Unit: mm

Symbol Type	A	B	C	D	E	F	G	H	J	t	
Dimension	05	0.65 ±0.1	1.10 ±0.1				2.0 ±0.05	1.0 ±0.05			
	10	1.10 ±0.2	1.90 ±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	∅ 1.5 +0.1 -0	1.1 max
	21	1.16 ±0.2	2.4 ±0.2								
	31	2.0 ±0.2	3.6 ±0.2								

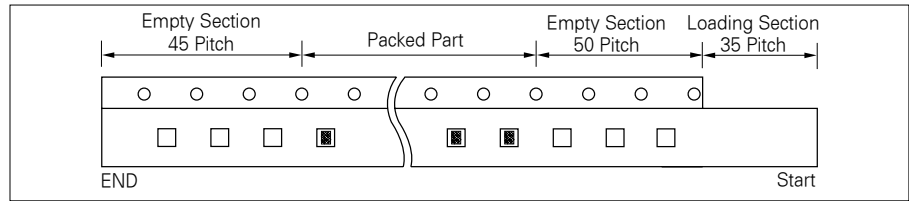
• Embossed Plastic Tape



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									
	31	2.0 ±0.2	3.6 ±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	∅ 1.5 +0.1 -0	2.5 max	0.6 BEL- OW
	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

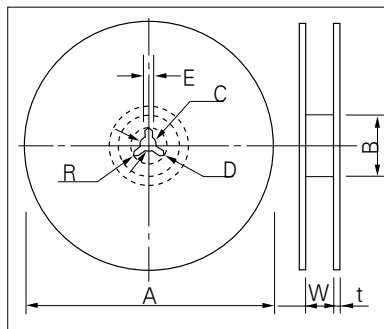


Unit: pcs

Symbol	Cardboard Paper Tape	Embossed Plastic Tape
7" Reel	4,000	2,000
13" Reel	15,000	-

• Reel Dimensions

Unit: mm

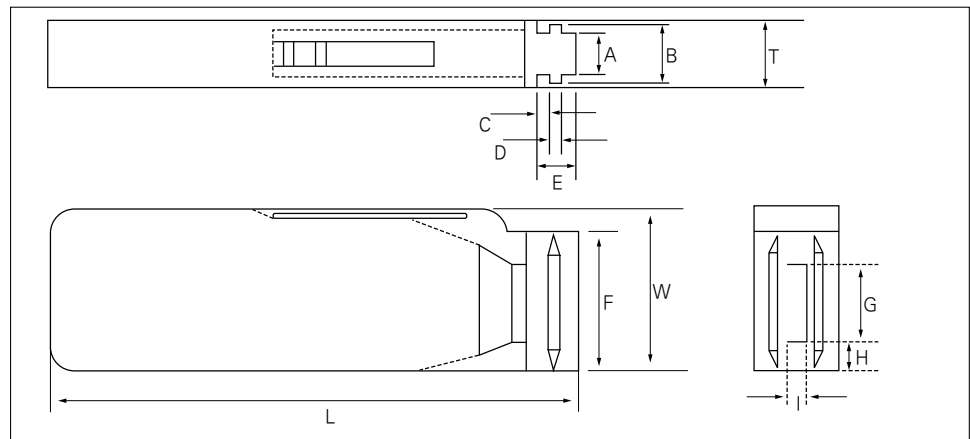


Symbol	A	B	C	D
7" Reel	$\phi 178 \pm 2.0$	min. $\phi 50$	$\phi 13 \pm 0.5$	21 ± 0.8
13" Reel	$\phi 330 \pm 2.0$	min. $\phi 70$		

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	$1.5 \begin{smallmatrix} +0.1 \\ -0 \end{smallmatrix}$	$2 \begin{smallmatrix} +0 \\ -0.1 \end{smallmatrix}$	4.7 ± 0.1
Symbol	F	W	G	H	L	I
Dimension	$31.5 \begin{smallmatrix} +0.2 \\ -0 \end{smallmatrix}$	$36 \begin{smallmatrix} +0 \\ -0.2 \end{smallmatrix}$	19 ± 0.35	7 ± 0.35	110 ± 0.7	5 ± 0.35

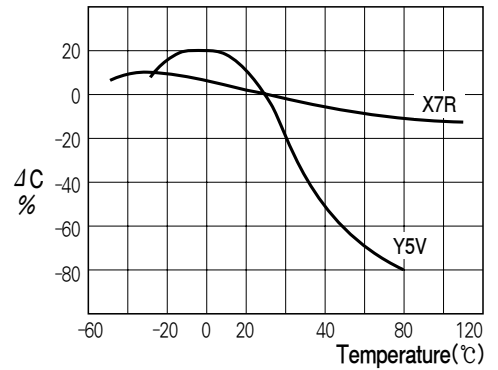
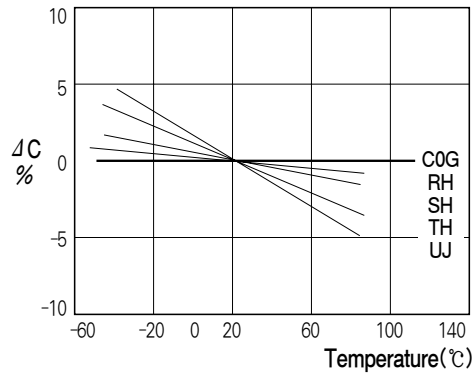
• Quantity

Unit: pcs

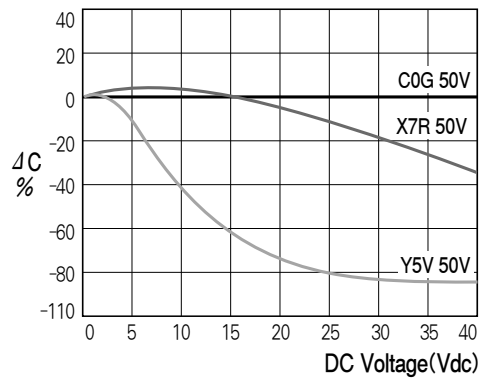
Size	05(0402)	10(0603)	21(0805)	
			T ≤ 0.85mm	T ≥ 1.0mm
Quantity	80,000	15,000	10,000	5,000

ELECTRICAL CHARACTERISTICS

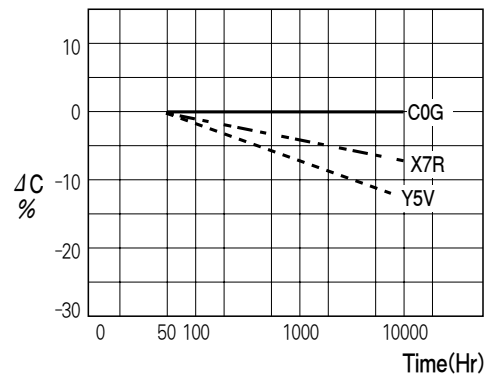
CAPACITANCE - TEMPERATURE CHARACTERISTICS



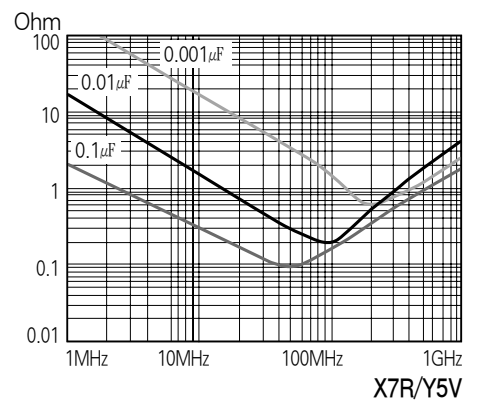
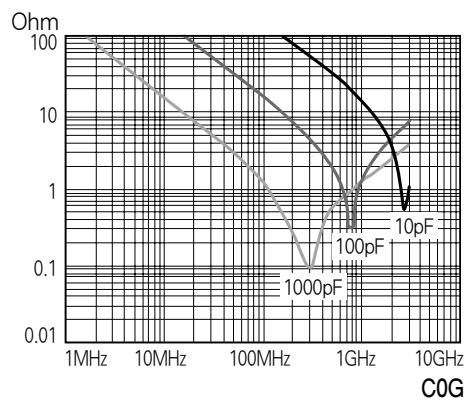
CAPACITANCE - DC VOLTAGE CHARACTERISTICS



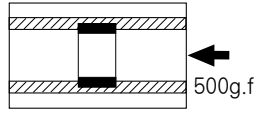
CAPACITANCE CHANGE - AGING



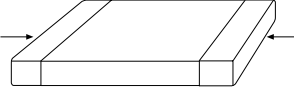
IMPEDANCE - FREQUENCY CHARACTERISTICS



RELIABILITY AND TEST CONDITIONS

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	1MHz±10%	0.5 ~ 5 Vrms												
		>1,000pF	1KHz±10%	Capacitance		Frequency	Voltage										
		≤22μF	1KHz±10%	1.0±0.2 Vrms	>22μF	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	1MHz±10%	0.5 ~ 5 Vrms												
6	Tanδ	CLASS II	Capacitance	Frequency		Voltage											
			≤22μF	1KHz±10%	1.0± 0.2Vrms												
			>22μF	120Hz ±20%	0.5± 0.1Vrms												
			<table border="1"> <thead> <tr> <th>Char</th> <th>25V And over</th> <th>16V</th> <th>10V</th> <th>6.3V</th> </tr> </thead> <tbody> <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<1.0μF) 0.09 MAX (C≥1.0μF)</td> <td>0.125 MAX</td> <td>-</td> </tr> </tbody> </table>			Char	25V And over	16V	10V	6.3V	B	0.025 MAX	0.035 MAX	0.05 MAX	0.05 MAX	F	0.05 MAX
Char	25V And over	16V	10V	6.3V													
B	0.025 MAX	0.035 MAX	0.05 MAX	0.05 MAX													
F	0.05 MAX	0.07 MAX (C<1.0μF) 0.09 MAX (C≥1.0μF)	0.125 MAX	-													
7	Adhesive strength of termination	No indication of peeling shall occur on the terminal electrode.	A 500g.f pressure shall be applied for 10±1 second. 														

RELIABILITY AND TEST CONDITIONS

No	Item	Performance	Test Condition									
8	Bending Strength	Appearance	No mechanical damage shall occur.									
		Capacitance	Character	Change of capacitance								
			CLASS I	Within $\pm 5\%$ or ± 0.5 pF whichever is larger								
				CLASS II	Within $\pm 12.5\%$							
F	Within $\pm 30\%$											
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 : $230 \pm 5^\circ\text{C}$ Solder : H63A Flux : ROSIN Pre-heating : AT $80 \sim 120^\circ\text{C}$ FOR 10~30SEC.									
10	Resistance to Soldering Heat	Appearance	No mechanical damage shall occur.									
		Capacitance	Characteristic	Cap Change								
			CLASS I	Within $\pm 2.5\%$ or ± 0.25 pF whichever is larger								
				CLASS II	Within $\pm 7.5\%$							
		F	Within $\pm 20\%$									
		Q CLASS I	30 pF And over : $Q \geq 1000$ Less than 30 pF : $Q \geq 400 + 20 \times C$									
		Tan δ CLASS II	To satisfy the specified initial value									
		Insulation resistance	To satisfy the specified initial value									
Withstanding voltage	To satisfy the specified initial value											
			DIP: Solder temperature of $270 \pm 5^\circ\text{C}$ DIP TIME: 10 ± 1 SEC. Each termination shall be fully immersed and preheated as following:									
			<table border="1"> <thead> <tr> <th>Step</th> <th>TEMP. ($^\circ\text{C}$)</th> <th>TIME (SEC.)</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>80~100</td> <td>60</td> </tr> <tr> <td>2</td> <td>150~180</td> <td>60</td> </tr> </tbody> </table>	Step	TEMP. ($^\circ\text{C}$)	TIME (SEC.)	1	80~100	60	2	150~180	60
Step	TEMP. ($^\circ\text{C}$)	TIME (SEC.)										
1	80~100	60										
2	150~180	60										
11	Vibration Test	Appearance	No mechanical damage shall occur.									
		Capacitance	Characteristic	Cap Change								
			CLASS I	Within $\pm 2.5\%$ or ± 0.25 pF whichever is larger								
				CLASS II	Within $\pm 5\%$							
		F	Within $\pm 20\%$									
		Q CLASS I	30 pF And over : $Q \geq 1000$ Less than 30 pF : $Q \geq 400 + 20 \times C$									
		Tan δ CLASS II	To satisfy the specified initial value									
Insulation resistance	To satisfy the specified initial value											
			The capacitor shall be subjected to a harmonic motion having a total amplitude of 1.5mm. 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.									

*The initial value of high dielectric constant series shall be measured After the heat treatment of $150 \pm 0/-10^\circ\text{C}$, 1Hr and sitting of 48 ± 4 hr at room temperature & room humidity.

RELIABILITY AND TEST CONDITIONS

No	Item	Performance	Test Condition		
12	Humidity (Steady state)	Appearance	No mechanical damage shall occur.		
		Capacitance	Characteristic	Capacitance Change	
			CLASS I	Within ±5% or ±0.5 pF whichever is larger	
				CLASS II	Within ±12.5%
		Q CLASS I	B	Within ±12.5%	
			F	Within ±30%	
Tanδ CLASS II	30pF And over : Q ≥ 350 10 ~ 30pF : Q ≥ 275 + 2.5×C Less than 10pF : Q ≥ 200 + 10×C	Measure at room temperature. After Cooling for CLASS I : 24±2 Hr. CLASS II : 48±4 Hr.			
	Char	25V And over	16V	10V	6.3V
	B	0.05	0.05 MAX	0.05 MAX	0.075 MAX
F	0.075 MAX	0.1MAX (C<1.0pF) 0.125MAX (C≥1.0pF)	0.15 MAX	-	
Insulation resistance	Minimum insulation Resistance: 1,000 MΩ or 50MΩ · μF product whichever is smaller				
13	Moisture Resistance	Appearance	No mechanical damage shall occur.		
		Capacitance	Characteristic	Capacitance Change	
			CLASS I	Within ±7.5% or ±0.75 pF whichever is larger	
				CLASS II	Within ±12.5%
		Q CLASS I	B	Within ±12.5%	
			F	Within ±30%	
Tanδ CLASS II	30pF And over : Q ≥ 200 30pF And below : Q ≥ 100 + 10/3×C	Applied voltage : rated voltage Temperature : 40±2 °C Relative humidity : 90~95%RH Test time : 500 + 12/-0 Hr. Current applied : 50mA MAX.			
	Char	25V And over	16V	10V	6.3V
	B	0.05 MAX	0.05 MAX	0.05 MAX	0.075 MAX
F	0.075 MAX	0.1MAX (C<1.0pF) 0.125MAX (C≥1.0pF)	0.15 MAX	-	
Insulation resistance	Minimum insulation Resistance: 500 MΩ or 25MΩ · μF product whichever is smaller		Measuring at room temperature After cooling for CLASS I : 24±2 Hr. CLASS II : 48±4 Hr.		

RELIABILITY AND TEST CONDITIONS

No	Item	Performance	Test Condition																
14	High Temperature Resistance	Appearance	No mechanical damage shall occur.																
		Capacitance	Characteristic	Cap Change															
			CLASS I	Within ±3% or ±0.3 pF whichever is larger															
			CLASS II	B: Within ±12.5% F: Within ±30%															
		Q CLASS I	30 pF And over : Q ≥ 350 10 ~ 30 pF : Q ≥ 275 + 2.5 × C Less tahn 10 pF : Q ≥ 200 + 10 × C	<table border="1"> <tr> <th>Char</th> <th>Temp</th> </tr> <tr> <td>CLASS I</td> <td>125 ± 3 °C</td> </tr> <tr> <td rowspan="2">CLASS II</td> <td>B</td> <td>125 ± 3 °C</td> </tr> <tr> <td>F</td> <td>85 ± 3 °C</td> </tr> </table>	Char	Temp	CLASS I	125 ± 3 °C	CLASS II	B	125 ± 3 °C	F	85 ± 3 °C						
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CLASS I	125 ± 3 °C																		
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Char	25V And over	16V	10V	6.3V															
B	0.05 MAX	0.05 MAX	0.05 MAX	0.075 MAX															
F	0.75 MAX	0.1 MAX (C<1.0 pF) 0.125 MAX (C ≥ 1.0 pF)	0.15 MAX	-															
Insulation resistance	Minimum insulation Resistance: 1,000 MΩ or 50 MΩ · μF product whichever is smaller																		
15	Temperature Cycle	Appearance	No mechanical damage shall occur.																
		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 pF And over : Q ≥ 1000 Less tahn 30 pF : Q ≥ 400 + 20 × C	<table border="1"> <tr> <th>Step</th> <th>TEMP. (°C)</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>	Step	TEMP. (°C)	TIME (MIN)	1	MIN. RATED TEMP. +0/-3	30	2	25	2~3	3	MAX. RATED TEMP. +3/-0	30	4	25	2~3
		Step	TEMP. (°C)	TIME (MIN)															
1	MIN. RATED TEMP. +0/-3	30																	
2	25	2~3																	
3	MAX. RATED TEMP. +3/-0	30																	
4	25	2~3																	
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Char	25V And over	16V	10V	6.3V															
B	0.025 MAX	0.035 MAX	0.035 MAX	0.05 MAX															
F	0.05 MAX	0.07 MAX (C<1.0 pF) 0.09 MAX (C ≥ 1.0 pF)	0.125 MAX	-															
Insulation resistance	To satisfy the specified initial value																		

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°C with a relative humidity of less than 70%. Allowable storage period is within six months from the outgoing date of delivery.

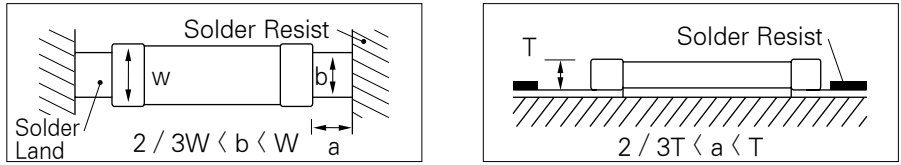
1-2. Corrosive Gases
Since sulfur and chlorine may degrade the solderability of the end termination, it is important to store the capacitors in an environment free of these gases

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



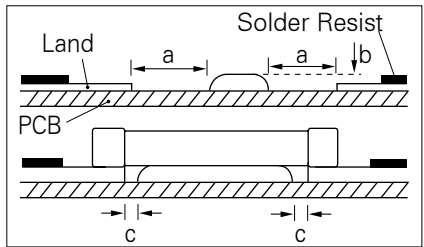
3. Adhesives

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	70~100μm	70~100μm
c	>0	>0

3-3. Adhesive hardening Characteristics

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

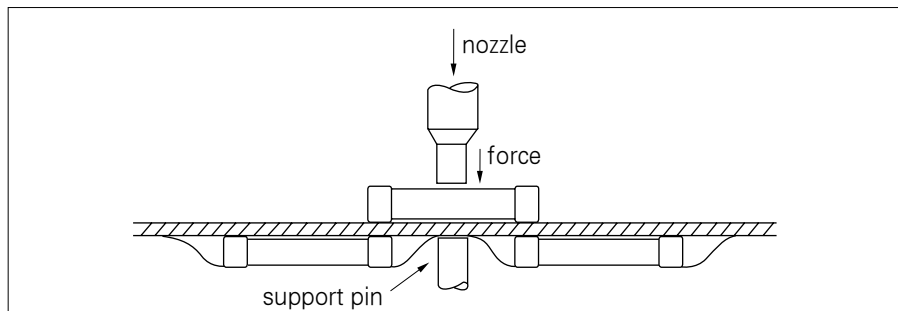
4. Mounting

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 capacitors. To avoid such degradation, it is recommended that a mildly activated rosin flux (less than 0.2% chlorine) be used.

6. Soldering

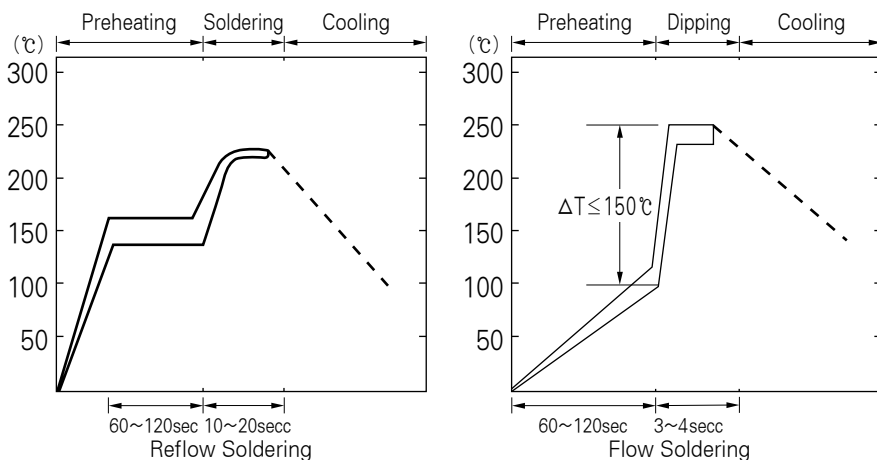
Since a multilayer ceramic chip capacitor comes into direct contact with melted solder during soldering, it is exposed to potentially mechanical stress caused by the sudden temperature change. The capacitor may also be subject to silver migration, and to contamination by the flux. Because of these factors,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

6-1. Soldering Methods

Method	Classification	
Reflow soldering	· 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

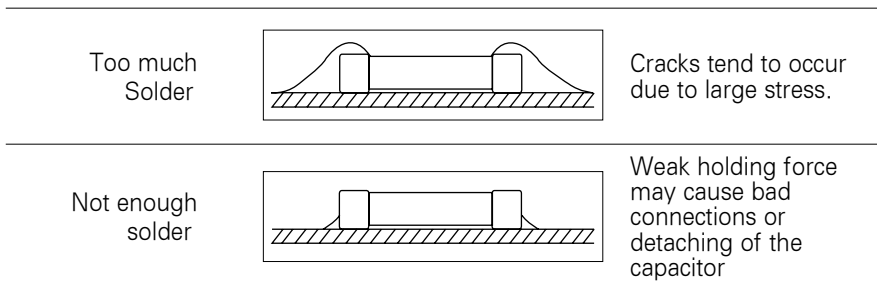
To avoid the crack problem by sudden temperature change, follow the temperature profile in the adjacent graph.



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



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°C

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.



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