

Notice for TAIYO YUDEN products

Please read this notice before using the TAIYO YUDEN products.

REMINDERS

- Product information in this catalog is as of October 2009. All of the contents specified herein are subject to change without notice due to technical improvements, etc. Therefore, please check for the latest information carefully before practical application or usage of the Products.

Please note that Taiyo Yuden Co., Ltd. shall not be responsible for any defects in products or equipment incorporating such products, which are caused under the conditions other than those specified in this catalog or individual specification.

- Please contact Taiyo Yuden Co., Ltd. for further details of product specifications as the individual specification is available.
- Please conduct validation and verification of products in actual condition of mounting and operating environment before commercial shipment of the equipment.

- All electronic components or functional modules listed in this catalog are developed, designed and intended for use in general electronics equipment.(for AV, office automation, household, office supply, information service, telecommunications, (such as mobile phone or PC) etc.). Before incorporating the components or devices into any equipment in the field such as transportation,(automotive control, train control, ship control), transportation signal, disaster prevention, medical, public information network (telephone exchange, base station) etc. which may have direct influence to harm or injure a human body, please contact Taiyo Yuden Co., Ltd. for more detail in advance. Do not incorporate the products into any equipment in fields such as aerospace, aviation, nuclear control, submarine system, military, etc. where higher safety and reliability are especially required.

In addition, even electronic components or functional modules that are used for the general electronic equipment, if the equipment or the electric circuit require high safety or reliability function or performances, a sufficient reliability evaluation check for safety shall be performed before commercial shipment and moreover, due consideration to install a protective circuit is strongly recommended at customer's design stage.

- The contents of this catalog are applicable to the products which are purchased from our sales offices or distributors (so called "TAIYO YUDEN' s official sales channel"). It is only applicable to the products purchased from any of TAIYO YUDEN' s official sales channel.

- Please note that Taiyo Yuden Co., Ltd. shall have no responsibility for any controversies or disputes that may occur in connection with a third party's intellectual property rights and other related rights arising from your usage of products in this catalog. Taiyo Yuden Co., Ltd. grants no license for such rights.

- Caution for export

Certain items in this catalog may require specific procedures for export according to "Foreign Exchange and Foreign Trade Control Law" of Japan, "U.S. Export Administration Regulations", and other applicable regulations. Should you have any question or inquiry on this matter, please contact our sales staff. Should you have any question or inquiry on this matter, please contact our sales staff.

MULTILAYER CERAMIC CAPACITORS FOR HIGH FREQUENCY APPLICATIONS(1GHz+)



REFLOW

FEATURES

- Q value in the high frequency range (1 GHz+) is superior compared to other types of multilayer capacitors.
- The 1005(0402) case size is designed for high density mounting and weight reduction in various applications.

APPLICATIONS

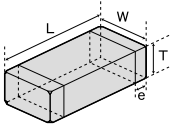
- Suitable for those high frequency applications in which a capacitor with both a high Q-value and small size is required such as portable communications and other wireless applications. VCO, TCXO etc.
- Adjustment of characteristics in high frequency circuit

ORDERING CODE

U V K 1 0 5 R H 4 R 3 J W - F

1 Rated voltage [VDC]	3 End termination	5 Temperature characteristics [ppm/°C]	6 Nominal capacitance [pF]	7 Capacitance tolerance	9 Special code
E 16 U 50	K Plated	CH 0±60 RH -220±60	example 020 2 4R3 4.3 ※R=Decimal point	B ±0.1pF J ±5%	- Standard Product
2 Series name	4 Dimensions (EIA) (L×W) [mm]	8 Thickness [mm]	10 Packaging		
V Multilayer ceramic capacitor for high frequency	105(0402) 1.0×0.5	W 0.5	F φ178mm Taping (2mm pitch)		

EXTERNAL DIMENSIONS/STANDARD QUANTITY



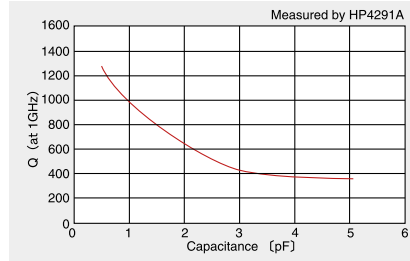
Type(EIA)	L	W	T	e	Standard quantity [pcs]	
					Paper tape	Embossed tape
□VK105 (0402)	1.0±0.05 (0.039±0.002)	0.5±0.05 (0.020±0.002)	0.5±0.05 (0.020±0.002)	0.25±0.1 (0.010±0.004)	10000	-

Unit : mm (inch)

SPECIFICATIONS

Temperature Characteristics	Operating Temperature range	Temperature Coefficient range [ppm/°C]	Capacitance Tolerance
CH	-55~+125°C	0±60	±0.1pF (~2.0pF)
RH		-220±60	±5% (2.2pF~)

Capacitance vs Q value (Typical for CH characteristic)



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PART NUMBERS

Rated Voltage (DC)	Ordering code	EHS (Environmental Hazardous Substances)	Temperature characteristics		Capacitance (pF)	Capacitance tolerance	Q (at 1GHz) (min.)	Thickness [mm]	Typical Q
			CH	RH					
E: 16V U: 50V	<input type="checkbox"/> VK105 CH0R3BW	RoHS	●		0.3	±0.1pF	300	0.5±0.05	1200
	<input type="checkbox"/> VK105 CH0R4BW	RoHS	●		0.4		300		1200
	<input type="checkbox"/> VK105 CH0R5BW	RoHS	●		0.5		300		1200
	<input type="checkbox"/> VK105 CH0R6BW	RoHS	●		0.6		300		1100
	<input type="checkbox"/> VK105 CH0R7BW	RoHS	●		0.7		300		1100
	<input type="checkbox"/> VK105 CH0R8BW	RoHS	●		0.8		300		1000
	<input type="checkbox"/> VK105 CH0R9BW	RoHS	●		0.9		300		950
	<input type="checkbox"/> VK105 CH010BW	RoHS	●		1.0		300		950
	<input type="checkbox"/> VK105 CH1R1BW	RoHS	●		1.1		280		930
	<input type="checkbox"/> VK105 CH1R2BW	RoHS	●		1.2		270		850
	<input type="checkbox"/> VK105 CH1R3BW	RoHS	●		1.3		260		740
	<input type="checkbox"/> VK105 CH1R5BW	RoHS	●		1.5		240		710
	<input type="checkbox"/> VK105 CH1R6BW	RoHS	●		1.6		230		670
	<input type="checkbox"/> VK105 CH1R8BW	RoHS	●		1.8		210		650
	<input type="checkbox"/> VK105 CH020BW	RoHS	●		2.0		190		610
	<input type="checkbox"/> VK105 CH2R2JW	RoHS	●		2.2		180		530
	<input type="checkbox"/> VK105 CH2R4JW	RoHS	●		2.4		170		510
	<input type="checkbox"/> VK105 CH2R7JW	RoHS	●		2.7		150		460
	<input type="checkbox"/> VK105 CH030JW	RoHS	●		3.0		130		390
	<input type="checkbox"/> VK105 CH3R3JW	RoHS	●		3.3		120		370
	<input type="checkbox"/> VK105 CH3R6JW	RoHS	●		3.6	110	360		
	<input type="checkbox"/> VK105 CH3R9JW	RoHS	●		3.9	99	360		
	<input type="checkbox"/> VK105 CH4R3JW	RoHS	●		4.3	84	360		
	<input type="checkbox"/> VK105 CH4R7JW	RoHS	●		4.7	84	340		
	<input type="checkbox"/> VK105 CH5R1JW	RoHS	●		5.1	84	320		
	<input type="checkbox"/> VK105 RH0R5BW	RoHS		●	0.5	300	1100		
	<input type="checkbox"/> VK105 RH0R6BW	RoHS		●	0.6	300	1000		
	<input type="checkbox"/> VK105 RH0R7BW	RoHS		●	0.7	300	1000		
	<input type="checkbox"/> VK105 RH0R8BW	RoHS		●	0.8	300	970		
	<input type="checkbox"/> VK105 RH0R9BW	RoHS		●	0.9	300	950		
	<input type="checkbox"/> VK105 RH010BW	RoHS		●	1.0	300	900		
	<input type="checkbox"/> VK105 RH1R1BW	RoHS		●	1.1	280	900		
	<input type="checkbox"/> VK105 RH1R2BW	RoHS		●	1.2	270	740		
	<input type="checkbox"/> VK105 RH1R3BW	RoHS		●	1.3	260	700		
	<input type="checkbox"/> VK105 RH1R5BW	RoHS		●	1.5	240	680		
	<input type="checkbox"/> VK105 RH1R6BW	RoHS		●	1.6	230	640		
	<input type="checkbox"/> VK105 RH1R8BW	RoHS		●	1.8	210	620		
	<input type="checkbox"/> VK105 RH020BW	RoHS		●	2.0	190	570		
	<input type="checkbox"/> VK105 RH2R2JW	RoHS		●	2.2	180	480		
	<input type="checkbox"/> VK105 RH2R4JW	RoHS		●	2.4	170	470		
<input type="checkbox"/> VK105 RH2R7JW	RoHS		●	2.7	150	420			
<input type="checkbox"/> VK105 RH030JW	RoHS		●	3.0	130	360			
<input type="checkbox"/> VK105 RH3R3JW	RoHS		●	3.3	120	350			
<input type="checkbox"/> VK105 RH3R6JW	RoHS		●	3.6	110	340			
<input type="checkbox"/> VK105 RH3R9JW	RoHS		●	3.9	99	340			
<input type="checkbox"/> VK105 RH4R3JW	RoHS		●	4.3	84	340			
<input type="checkbox"/> VK105 RH4R7JW	RoHS		●	4.7	84	320			
<input type="checkbox"/> VK105 RH5R1JW	RoHS		●	5.1	84	310			

Please specify the Rated Voltage code.

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PACKAGING

① Minimum Quantity

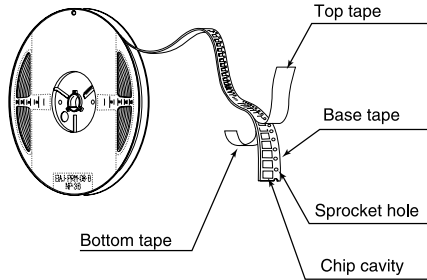
● Taped packaging

Type (EIA)	Thickness		Standard quantity [pcs]		
	mm (inch)	code	Paper tape	Embossed tape	
<input type="checkbox"/> MK042(01005)	0.2 (0.008)	C	20000	—	
<input type="checkbox"/> MK063(0201)	0.3 (0.012)	P,T	15000		
<input type="checkbox"/> 2K096(0302)	0.3 (0.012)	P	10000		
<input type="checkbox"/> WK105(0204)	0.45 (0.018)	K			
<input type="checkbox"/> MK105(0402)	0.5 (0.020)	V, W			
<input type="checkbox"/> VK105(0402)	0.5 (0.020)	W			
<input type="checkbox"/> MK107(0603)	0.45 (0.018)	K	4000		4000
<input type="checkbox"/> WK107(0306)	0.5 (0.020)	V	—		
<input type="checkbox"/> 2K110(0504)	0.8 (0.031)	A	4000		—
	0.5 (0.020)	V			
	0.6 (0.024)	B			
	0.8 (0.031)	A			
<input type="checkbox"/> MK212(0805)	0.45 (0.018)	K	—	3000	
<input type="checkbox"/> WK212(0508)	0.85 (0.033)	D			
<input type="checkbox"/> 4K212(0805)	0.85 (0.033)	D	4000	—	
<input type="checkbox"/> 2K212(0805)	0.85 (0.033)	D			
<input type="checkbox"/> MK316(1206)	1.15 (0.045)	F	—	3000	
	1.25 (0.049)	G			
	1.6 (0.063)	L			
<input type="checkbox"/> MK325(1210)	0.85 (0.033)	D	—	2000	
	1.15 (0.045)	F			
	1.9 (0.075)	N			
	2.0max (0.079)	Y			
<input type="checkbox"/> MK432(1812)	2.5 (0.098)	M	—	500(T), 1000(P)	
<input type="checkbox"/> MK432(1812)	2.5 (0.098)	M	—	500	

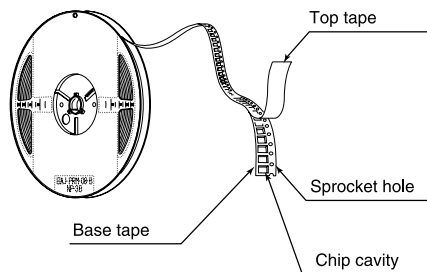
② Taping material

※ No bottom tape for pressed carrier tape

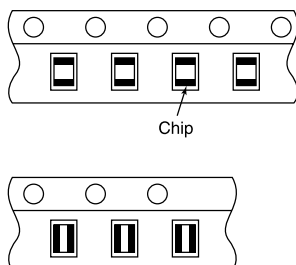
● Paper tape



● Embossed tape



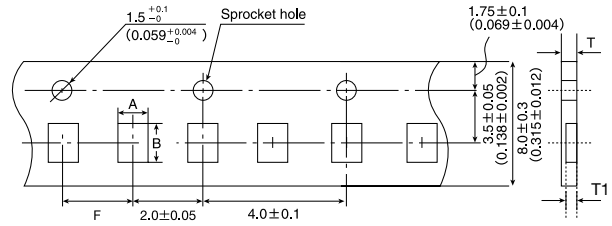
● Chip filled



③ Taping dimensions

● Paper Tape (0.315 inches wide)

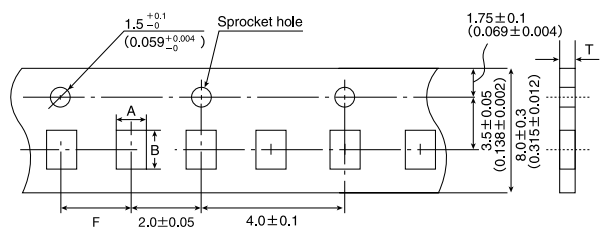
● Pressed carrier tape (2mm pitch)



Type (EIA)	Chip Cavity		Insertion Pitch F	Tape Thickness	
	A	B		T	T1
<input type="checkbox"/> MK042(01005)	0.25 (0.010)	0.45 (0.018)	2.0 ± 0.05 (0.079 ± 0.002)	0.36max. (0.014)	0.27max. (0.011)
<input type="checkbox"/> MK063(0201)	0.37 (0.016)	0.67 (0.027)		0.45max. (0.018)	0.42max. (0.017)
<input type="checkbox"/> WK105(0204)	0.65 (0.026)	1.15 (0.045)		0.45max. (0.018max.)	0.42max. (0.017max.)

Unit: mm (inch)

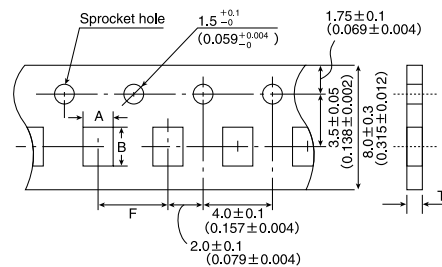
● Punched carrier tape (2mm pitch)



Type (EIA)	Chip Cavity		Insertion Pitch F	Tape Thickness
	A	B		T
<input type="checkbox"/> 2K096(0302)	0.72 (0.028)	1.02 (0.040)	2.0 ± 0.05 (0.079 ± 0.002)	0.45max.(0.018max.) 0.6max.(0.024max.)
<input type="checkbox"/> MK105(0402)	0.65 (0.026)	1.15 (0.045)		0.8max. (0.031max.)
<input type="checkbox"/> VK105(0402)	0.65 (0.026)	1.15 (0.045)	—	—

Unit: mm (inch)

● Punched carrier tape (4mm pitch)



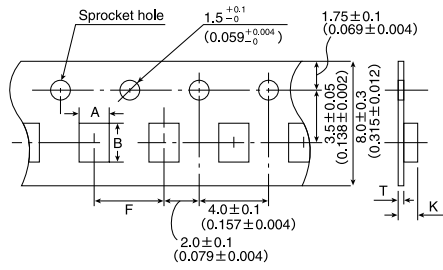
Type (EIA)	Chip Cavity		Insertion Pitch F	Tape Thickness
	A	B		T
<input type="checkbox"/> MK107(0603)	1.0 (0.039)	1.8 (0.071)	4.0 ± 0.1 (0.157 ± 0.004)	1.1max. (0.043max.)
<input type="checkbox"/> WK107(0306)	1.15 (0.045)	1.55 (0.061)		1.0max. (0.039max.)
<input type="checkbox"/> 2K110(0504)	1.15 (0.045)	1.55 (0.061)	4.0 ± 0.1 (0.157 ± 0.004)	1.1max. (0.043max.)
<input type="checkbox"/> MK212(0805)	1.65 (0.065)	2.4 (0.094)		
<input type="checkbox"/> WK212(0508)	1.65 (0.065)	2.4 (0.094)		
<input type="checkbox"/> 4K212(0805)	1.65 (0.065)	2.4 (0.094)		
<input type="checkbox"/> 2K212(0805)	1.65 (0.065)	2.4 (0.094)	—	—
<input type="checkbox"/> MK316(1206)	2.0 (0.079)	3.6 (0.142)	—	—

Unit: mm (inch)

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PACKAGING

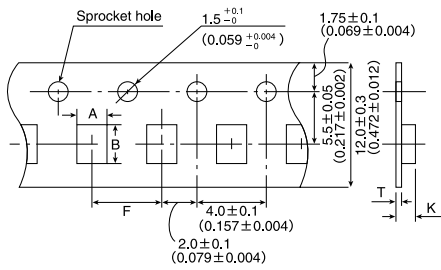
● Embossed tape (0.315 inches wide)



Type(EIA)	Chip Cavity		Insertion Pitch F	Tape Thickness	
	A	B		K	T
□WK107 (0306)	1.0 (0.039)	1.8 (0.071)	4.0 ± 0.1 (0.157 ± 0.004)	1.3max. (0.051max.)	0.25 ± 0.1 (0.01 ± 0.004)
□MK212 (0805)	1.65 (0.065)	2.4 (0.094)		3.4max. (0.134max.)	0.6max. (0.024max.)
□MK316 (1206)	2.0 (0.079)	3.6 (0.142)			
□MK325 (1210)	2.8 (0.110)	3.6 (0.142)			

Unit : mm (inch)

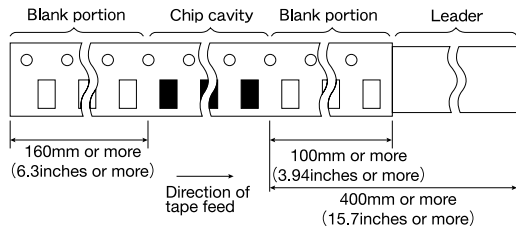
● Embossed tape (0.472 inches wide)



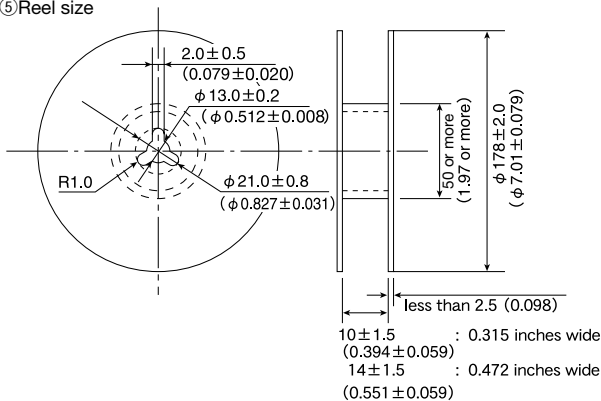
Type(EIA)	Chip Cavity		Insertion Pitch F	Tape Thickness	
	A	B		K	T
□MK432 (1812)	3.7 (0.146)	4.9 (0.193)	8.0 ± 0.1 (0.315 ± 0.004)	4.0max. (0.157max.)	0.6max. (0.024max.)

Unit : mm (inch)

④ Leader and Blank portion



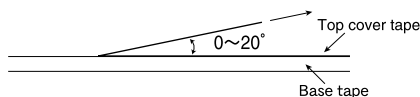
⑤ Reel size



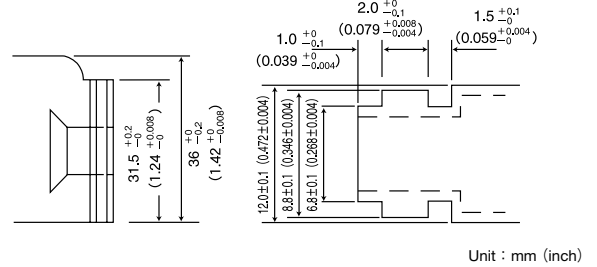
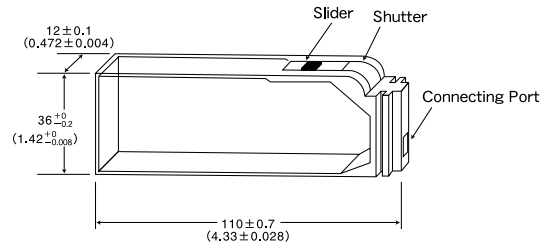
⑥ Top Tape Strength

Unit : mm (inch)

The top tape requires a peel-off force of 0.1 to 0.7N in the direction of the arrow as illustrated below.



⑦ Bulk Cassette



Unit : mm (inch)

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Super Low Distortion Multilayer Ceramic Capacitors and Medium-High Voltage Multilayer Ceramic Capacitors are noted separately.

Multilayer Ceramic Capacitors

1. Operating Temperature Range				
Specified Value	Temperature Compensating (Class 1)	Standard	-55 to +125°C	
		High Frequency Type		
Specified Value	High Permittivity (Class 2)		Specification	Temperature Range
		BJ	B	-25 to +85°C
			X5R	-55 to +85°C
		B7	X7R	-55 to +125°C
		C6	X6S	-55 to +105°C
		C7	X7S	-55 to +125°C
		F	F	-25 to +85°C
			Y5V	-30 to +85°C

2. Storage Temperature Range				
Specified Value	Temperature Compensating (Class 1)	Standard	-55 to +125°C	
		High Frequency Type		
Specified Value	High Permittivity (Class 2)		Specification	Temperature Range
		BJ	B	-25 to +85°C
			X5R	-55 to +85°C
		B7	X7R	-55 to +125°C
		C6	X6S	-55 to +105°C
		C7	X7S	-55 to +125°C
		F	F	-25 to +85°C
			Y5V	-30 to +85°C

3. Rated Voltage			
Specified Value	Temperature Compensating (Class 1)	Standard	50VDC, 25VDC, 16VDC
		High Frequency Type	50VDC, 16VDC
	High Permittivity (Class 2)		50VDC, 35VDC, 25VDC, 16VDC, 10VDC, 6.3VDC, 4VDC

4. Withstanding Voltage (Between terminals)			
Specified Value	Temperature Compensating (Class 1)	Standard	No breakdown or damage
		High Frequency Type	
	High Permittivity (Class 2)		

[Test Methods and Remarks]

	Class 1	Class 2
Applied voltage	Rated voltage×3	Rated voltage×2.5
Duration	1 to 5 sec.	
Charge/discharge current	50mA max.	

5. Insulation Resistance			
Specified Value	Temperature Compensating (Class 1)	Standard	10000 MΩ min.
		High Frequency Type	
	High Permittivity (Class 2) Note 1		C≤0.047μF : 10000 MΩ min. C>0.047μF : 500MΩ·μF

[Test Methods and Remarks]

Applied voltage: Rated voltage
Duration: 60±5 sec.
Charge/discharge current: 50mA max.

6. Capacitance (Tolerance)											
Specified Value	Temperature Compensating (Class 1)	Standard	<table border="1"> <tr> <td>C△</td> <td>0.5pF≤C≤5pF : ±0.25pF</td> <td rowspan="3">RH</td> <td rowspan="3">0.5pF≤C≤2pF : ±0.1pF</td> </tr> <tr> <td>U△</td> <td>0.5pF<C≤10pF : ±0.5pF</td> </tr> <tr> <td></td> <td>C>10pF : ±5%</td> </tr> </table>	C△	0.5pF≤C≤5pF : ±0.25pF	RH	0.5pF≤C≤2pF : ±0.1pF	U△	0.5pF<C≤10pF : ±0.5pF		C>10pF : ±5%
		C△	0.5pF≤C≤5pF : ±0.25pF	RH	0.5pF≤C≤2pF : ±0.1pF						
	U△	0.5pF<C≤10pF : ±0.5pF									
	C>10pF : ±5%										
	High Frequency Type	<table border="1"> <tr> <td>CH</td> <td>0.5pF≤C≤2pF : ±0.1pF</td> </tr> <tr> <td>RH</td> <td>C>2pF : ±5%</td> </tr> </table>	CH	0.5pF≤C≤2pF : ±0.1pF	RH	C>2pF : ±5%					
CH	0.5pF≤C≤2pF : ±0.1pF										
RH	C>2pF : ±5%										
	High Permittivity (Class 2)		BJ, B7, C6,C7 : ±10% or ±20%, F : -20%/+80%								

[Test Methods and Remarks]

	Class 1		Class 2	
	Standard	High Frequency Type	C≤10μF	C>10μF
Preconditioning	None		Thermal treatment (at 150°C for 1hr) Note 2	
Measuring frequency	1MHz±10%		1kHz±10%	120±10Hz
Measuring voltage Note 1	0.5 to 5Vrms		1±0.2Vrms	0.5±0.1Vrms
Bias application	None			

7. Q or Dissipation Factor			
Specified Value	Temperature Compensating (Class 1)	Standard	C<30 pF : Q≥400+20C, C≥30 pF : Q≥1000 (C : Nominal capacitance)
		High Frequency Type	Refer to detailed specification
	High Permittivity (Class 2) Note 1		BJ, B7, C6,C7 : 2.5% max., F : 7% max.

[Test Methods and Remarks]

	Class 1		Class 2	
	Standard	High Frequency Type	C≤10μF	C>10μF
Preconditioning	None		Thermal treatment (at 150°C for 1hr) Note 2	
Measuring frequency	1MHz±10%	1GHz	1kHz±10%	120±10Hz
Measuring voltage Note 1	0.5 to 5Vrms		1±0.2Vrms	0.5±0.1Vrms
Bias application	None			

High Frequency Type
Measuring equipment: HP4291A
Measuring jig: HP16192A

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RELIABILITY DATA

8. Temperature Characteristic of Capacitance (Without voltage application)

Specified Value	Temperature Compensating (Class 1)	Standard	Temperature Characteristic [ppm/°C]	Tolerance H±60 J±120 K±250			
		High Frequency Type	C□ : 0 CH, CJ, CK R□ : -220 RH S□ : -330 SH, SJ, SK T□ : -470 TJ, TK U□ : -750 UJ, UK SL : +350 to -1000				
High Permittivity (Class 2)			Specification	Capacitance change	Reference temperature	Temperature Range	
			BJ	B	±10%	20°C	-25 to +85°C
				X5R	±15%	25°C	-55 to +85°C
			B7	X7R	±15%	25°C	-55 to +125°C
			C6	X6S	±22%	25°C	-55 to +105°C
			C7	X7S	±22%	25°C	-55 to +125°C
			F	F	+30/-80%	20°C	-25 to +85°C
	Y5V	+22/-82%	25°C	-30 to +85°C			

[Test Methods and Remarks]

Class 1

Capacitance at 20°C and 85°C shall be measured in thermal equilibrium, and the temperature characteristic shall be calculated from the following equation.

$$\frac{(C_{85} - C_{20})}{C_{20} \times \Delta T} \times 10^6 \text{ (ppm/°C)} \quad \Delta T = 65$$

Class 2

Capacitance at each step shall be measured in thermal equilibrium, and the temperature characteristic shall be calculated from the following equation.

Step	B, F	5R, X7R, X6S, X7S, Y5V	$\frac{(C - C_2)}{C_2} \times 100 (\%)$
1	Minimum operating temperature		C : Capacitance in Step 1 or Step 3 C ₂ : Capacitance in Step 2
2	20°C	25°C	
3	Maximum operating temperature		

9. Deflection

Specified Value	Temperature Compensating (Class 1)	Standard	Appearance : No abnormality Capacitance change : Within ±5% or ±0.5 pF, whichever is larger.
		High Frequency Type	Appearance : No abnormality Capacitance change : Within ±0.5 pF
	High Permittivity (Class 2)		Appearance : No abnormality Capacitance change : Within ±12.5% (BJ, B7, C6, C7), Within ±30% (F)

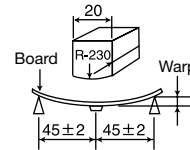
[Test Methods and Remarks]

Multilayer Ceramic Capacitors

	Board	Thickness	Warp	Duration
042, 063 Type	glass epoxy-resin substrate	0.8mm	1mm	10 sec.
105 Type or more		1.6mm		

Array Type

	Board	Thickness	Warp	Duration
096, 110, 212 Type	glass epoxy-resin substrate	1.6mm	1mm	10 sec.



Capacitance measurement shall be conducted with the board bent (Unit: mm)

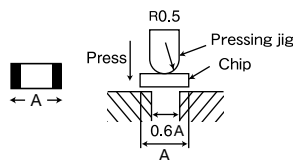
10. Body Strength

Specified Value	Temperature Compensating (Class 1)	Standard	—
		High Frequency Type	No mechanical damage.
	High Permittivity (Class 2)		—

[Test Methods and Remarks]

High Frequency Type

Applied force: 5N
Duration: 10 sec.



11. Adhesive Strength of Terminal Electrodes

Specified Value	Temperature Compensating (Class 1)	Standard	No terminal separation or its indication.
		High Frequency Type	
	High Permittivity (Class 2)		

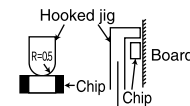
[Test Methods and Remarks]

Multilayer Ceramic Capacitors

	Applied force	Duration
042, 063 Type	2N	30±5 sec.
105 Type or more	5N	

Array Type

	Applied force	Duration
096 Type	2N	30±5 sec.
110, 212 Type	5N	



12. Solderability

Specified Value	Temperature Compensating (Class 1)	Standard	At least 95% of terminal electrode is covered by new solder.
		High Frequency Type	
	High Permittivity (Class 2)		

[Test Methods and Remarks]

	Solder type	Solder temperature	Duration
Eutectic solder	H60A or H63A	230±5°C	4±1 sec.
Lead-free solder	Sn-3.0Ag-0.5Cu	245±3°C	

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RELIABILITY DATA

13. Resistance to Soldering

Specified Value	Temperature Compensating (Class 1)	Standard	Appearance: No abnormality Capacitance change: Within $\pm 2.5\%$ or $\pm 0.25\text{pF}$, whichever is larger. Q: Initial value Insulation resistance: Initial value Withstanding voltage (between terminals): No abnormality
		High Frequency Type	Appearance: No abnormality Capacitance change: Within $\pm 2.5\%$ Q: Initial value Insulation resistance: Initial value Withstanding voltage (between terminals): No abnormality
	High Permittivity (Class 2) Note 1	Appearance: No abnormality Capacitance change: Within $\pm 7.5\%$ (BJ, B7, C6, C7) Within $\pm 20\%$ (F) Dissipation factor: Initial value Insulation resistance: Initial value Withstanding voltage (between terminals): No abnormality	

[Test Methods and Remarks]

Class 1			Class 2			
	042, 063 Type	105 Type Array (096, 110 Type)		042, 063 Type	105, 107, 212 Type Array (096, 110, 212 Type)	316, 325 Type
Preconditioning	None		Preconditioning	Thermal treatment (at 150°C for 1 hr) Note 2		
Preheating	150°C, 1 to 2 min.	80 to 100°C, 2 to 5 min. 150 to 200°C, 2 to 5 min.	Preheating	150°C, 1 to 2 min.	80 to 100°C, 2 to 5 min. 150 to 200°C, 2 to 5 min.	80 to 100°C, 5 to 10 min. 150 to 200°C, 5 to 10 min.
Solder temperature	270 \pm 5°C		Solder temperature	270 \pm 5°C		
Duration	3 \pm 0.5 sec.		Duration	3 \pm 0.5 sec.		
Recovery	6 to 24 hrs (Standard condition) Note 5		Recovery	24 \pm 2 hrs (Standard condition) Note 5		

14. Temperature Cycle (Thermal Shock)

Specified Value	Temperature Compensating (Class 1)	Standard	Appearance: No abnormality Capacitance change: Within $\pm 2.5\%$ or $\pm 0.25\text{pF}$, whichever is larger. Q: Initial value Insulation resistance: Initial value Withstanding voltage (between terminals): No abnormality
		High Frequency Type	Appearance: No abnormality Capacitance change: Within $\pm 0.25\text{pF}$ Q: Initial value Insulation resistance: Initial value Withstanding voltage (between terminals): No abnormality
	High Permittivity (Class 2) Note 1	Appearance: No abnormality Capacitance change: Within $\pm 7.5\%$ (BJ, B7, C6, C7) Within $\pm 20\%$ (F) Dissipation factor: Initial value Insulation resistance: Initial value Withstanding voltage (between terminals): No abnormality	

[Test Methods and Remarks]

	Class 1		Class 2	
	None		Thermal treatment (at 150°C for 1 hr) Note 2	
1 cycle	Step	Temperature (°C)	Time (min.)	
	1	Minimum operating temperature +0/-3	30 \pm 3	
	2	Room temperature	2 to 3	
	3	Maximum operating temperature +0/-3	30 \pm 3	
	4	Room temperature	2 to 3	
Number of cycles	5 times			
Recovery	6 to 24 hrs (Standard condition) Note 5		24 \pm 2 hrs (Standard condition) Note 5	

15. Humidity (Steady State)

Specified Value	Temperature Compensating (Class 1)	Standard	Appearance: No abnormality Capacitance change: Within $\pm 5\%$ or $\pm 0.5\text{pF}$, whichever is larger. Q: C < 10pF : Q \geq 200+10C 10 \leq C < 30pF : Q \geq 275+2.5C C \geq 30pF : Q \geq 350 (C : Nominal capacitance) Insulation resistance: 1000 M Ω min.
		High Frequency Type	Appearance: No abnormality Capacitance change: Within $\pm 0.5\text{pF}$ Insulation resistance: 1000 M Ω min.
	High Permittivity (Class 2) Note 1	Appearance: No abnormality Capacitance change: Within $\pm 12.5\%$ (BJ, B7, C6, C7) Within $\pm 30\%$ (F) Dissipation factor : 5.0% max. (BJ, B7, C6, C7) 11.0% max. (F) Insulation resistance: 50 M $\Omega\mu\text{F}$ or 1000 M Ω whichever is smaller.	

[Test Methods and Remarks]

Class 1			Class 2	
	Standard	High Frequency Type	All items	
Preconditioning	None		Preconditioning	Thermal treatment (at 150°C for 1 hr) Note 2
Temperature	40 \pm 2°C	60 \pm 2°C	Temperature	40 \pm 2°C
Humidity	90 to 95%RH		Humidity	90 to 95%RH
Duration	500+24/-0 hrs		Duration	500+24/-0 hrs
Recovery	6 to 24 hrs (Standard condition) Note 5		Recovery	24 \pm 2 hrs (Standard condition) Note 5

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RELIABILITY DATA

16. Humidity Loading

Specified Value	Temperature Compensating (Class 1)	Standard	Appearance: No abnormality Capacitance change: Within $\pm 7.5\%$ or $\pm 0.75\text{pF}$, whichever is larger. Q : $C < 30\text{pF} : Q \geq 100 + 10C/3$ $C \geq 30\text{pF} : Q \geq 200$ (C : Nominal capacitance) Insulation resistance: 500 M Ω min.
		High Frequency Type	Appearance: No abnormality Capacitance change: $C \leq 2\text{pF} : \text{Within } \pm 0.4 \text{ pF}$ $C > 2\text{pF} : \text{Within } \pm 0.75 \text{ pF}$ (C : Nominal capacitance) Insulation resistance: 500 M Ω min.
	High Permittivity (Class 2) Note 1	Appearance: No abnormality Capacitance change: Within $\pm 12.5\%$ (BJ, B7, C6, C7) Within $\pm 30\%$ (F) Dissipation factor : 5.0% max. (BJ, B7, C6, C7) 11.0% max. (F) Insulation resistance: 25 M $\Omega\mu\text{F}$ or 500 M Ω , whichever is smaller.	

[Test Methods and Remarks]

Class 1

	Standard	High Frequency Type
Preconditioning	None	
Temperature	40 \pm 2 $^{\circ}\text{C}$	60 \pm 2 $^{\circ}\text{C}$
Humidity	90 to 95%RH	
Duration	500+24/-0 hrs	
Applied voltage	Rated voltage	
Charge/discharge current	50mA max.	
Recovery	6 to 24 hrs (Standard condition) Note 5	

Class 2

	All items
Preconditioning	Voltage treatment (Rated voltage are applied for 1 hour at 40 $^{\circ}\text{C}$) Note 3
Temperature	40 \pm 2 $^{\circ}\text{C}$
Humidity	90 to 95%RH
Duration	500+24/-0 hrs
Applied voltage	Rated voltage
Charge/discharge current	50mA max.
Recovery	24 \pm 2 hrs (Standard condition) Note 5

17. High Temperature Loading

Specified Value	Temperature Compensating (Class 1)	Standard	Appearance: No abnormality Capacitance change: Within $\pm 3\%$ or $\pm 0.3\text{pF}$, whichever is larger. Q : $C < 10\text{pF} : Q \geq 200 + 10C$ $10 \leq C < 30\text{pF} : Q \geq 275 + 2.5C$ $C \geq 30\text{pF} : Q \geq 350$ (C : Nominal capacitance) Insulation resistance: 1000 M Ω min.
		High Frequency Type	Appearance: No abnormality Capacitance change: Within $\pm 3\%$ or $\pm 0.3\text{pF}$, whichever is larger. Insulation resistance: 1000 M Ω min.
	High Permittivity (Class 2) Note 1	Appearance: No abnormality Capacitance change: Within $\pm 12.5\%$ (BJ, B7, C6, C7) Within $\pm 30\%$ (F) Dissipation factor : 5.0% max. (BJ, B7, C6, C7) 11.0% max. (F) Insulation resistance: 50 M $\Omega\mu\text{F}$ or 1000 M Ω , whichever is smaller.	

[Test Methods and Remarks]

Class 1

	Standard	High Frequency Type
Preconditioning	None	
Temperature	125 \pm 3 $^{\circ}\text{C}$	
Duration	1000+48/-0 hrs	
Applied voltage	Rated voltage \times 2	
Charge/discharge current	50mA max.	
Recovery	6 to 24hr (Standard condition) Note 5	

Class 2

	BJ, F	C6	B7, C7
Preconditioning	Voltage treatment (Twice the rated voltage shall be applied for 1 hour at 85 $^{\circ}\text{C}$, 105 $^{\circ}\text{C}$ or 125 $^{\circ}\text{C}$) Note 3, 4		
Temperature	85 \pm 2 $^{\circ}\text{C}$	105 \pm 3 $^{\circ}\text{C}$	125 \pm 3 $^{\circ}\text{C}$
Duration	1000+48/-0 hrs		
Applied voltage	Rated voltage \times 2 Note 4		
Charge/discharge current	50mA max.		
Recovery	24 \pm 2 hrs (Standard condition) Note 5		

Note 1 The figures indicate typical specifications. Please refer to individual specifications in detail.

Note 2 Thermal treatment : Initial value shall be measured after test sample is heat-treated at 150+0/-10 $^{\circ}\text{C}$ for an hour and kept at room temperature for 24 \pm 2hours.

Note 3 Voltage treatment : Initial value shall be measured after test sample is voltage-treated for an hour at both the temperature and voltage specified in the test conditions, and kept at room temperature for 24 \pm 2hours.

Note 4 Standard condition: Temperature: 5 to 35 $^{\circ}\text{C}$, Relative humidity: 45 to 85 % RH, Air pressure: 86 to 106kPa
When there are questions concerning measurement results, in order to provide correlation data, the test shall be conducted under the following condition.

Temperature: 20 \pm 2 $^{\circ}\text{C}$, Relative humidity: 60 to 70 % RH, Air pressure: 86 to 106kPa
Unless otherwise specified, all the tests are conducted under the "standard condition".

PRECAUTIONS

Precautions on the use of Multilayer Ceramic Capacitors

1. Circuit Design

- ◆ Verification of operating environment, electrical rating and performance
 1. A malfunction of equipment in fields such as medical, aerospace, nuclear control, etc. may cause serious harm to human life or have severe social ramifications. Therefore, any capacitors to be used in such equipment may require higher safety and reliability, and shall be clearly differentiated from them used in general purpose applications.
- ◆ Operating Voltage (Verification of Rated voltage)
 1. The operating voltage for capacitors must always be their rated voltage or less.
 If an AC voltage is loaded on a DC voltage, the sum of the two peak voltages shall be the rated voltage or less.
 For a circuit where an AC or a pulse voltage may be used, the sum of their peak voltages shall also be the rated voltage or less.
2. Even if an applied voltage is the rated voltage or less reliability of capacitors may be deteriorated in case that either a high frequency AC voltage or a pulse voltage having rapid rise time is used in a circuit.

2. PCB Design

- ◆ Pattern configurations (Design of Land-patterns)
 1. When capacitors are mounted on PCBs, the amount of solder used (size of fillet) can directly affect the capacitor performance. Therefore, the following items must be carefully considered in the design of land patterns:
 (1) Excessive solder applied can cause mechanical stresses which lead to chip breaking or cracking. Therefore, please consider appropriate land-patterns for proper amount of solder.
 (2) When more than one component are jointly soldered onto the same land, each component's soldering point shall be separated by solder-resist.
- ◆ Pattern configurations (Capacitor layout on PCBs)
 After capacitors are mounted on boards, they can be subjected to mechanical stresses in subsequent manufacturing processes (PCB cutting, board inspection, mounting of additional parts, assembly into the chassis, wave soldering of the boards, etc.). For this reason, land pattern configurations and positions of capacitors shall be carefully considered to minimize stresses.

- ◆ Pattern configurations (Design of Land-patterns)
 The following diagrams and tables show some examples of recommended land patterns to prevent excessive solder amounts.

- (1) Recommended land dimensions for typical chip capacitors
 ● Multilayer Ceramic Capacitors : Recommended land dimensions (unit: mm)
 Wave-soldering

Type	107	212	316	325	
Size	L	1.6	2.0	3.2	3.2
	W	0.8	1.25	1.6	2.5
A	0.8 to 1.0	1.0 to 1.4	1.8 to 2.5	1.8 to 2.5	
B	0.5 to 0.8	0.8 to 1.5	0.8 to 1.7	0.8 to 1.7	
C	0.6 to 0.8	0.9 to 1.2	1.2 to 1.6	1.8 to 2.5	

Reflow-soldering

Type	042	063	105	107	212	316	325	432
Size	L	0.4	0.6	1.0	1.6	2.0	3.2	4.5
	W	0.2	0.3	0.5	0.8	1.25	1.6	3.2
A	0.15 to 0.25	0.20 to 0.30	0.45 to 0.55	0.8 to 1.0	0.8 to 1.2	1.8 to 2.5	1.8 to 2.5	2.5 to 3.5
B	0.15 to 0.20	0.20 to 0.30	0.40 to 0.50	0.6 to 0.8	0.8 to 1.2	1.0 to 1.5	1.0 to 1.5	1.5 to 1.8
C	0.15 to 0.30	0.25 to 0.40	0.45 to 0.55	0.6 to 0.8	0.9 to 1.6	1.2 to 2.0	1.8 to 3.2	2.3 to 3.5

- LWDC: Recommended land dimensions for reflow-soldering (unit: mm)

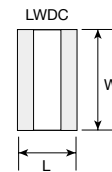
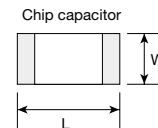
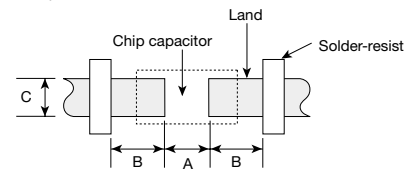
Type	105	107	212	
Size	L	0.52	0.8	1.25
	W	1.0	1.6	2.0
A	0.18 to 0.22	0.25 to 0.3	0.5 to 0.7	
B	0.2 to 0.25	0.3 to 0.4	0.4 to 0.5	
C	0.9 to 1.1	1.5 to 1.7	1.9 to 2.1	

(unit: mm)

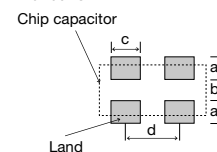
- Array type: Recommended land dimensions for reflow-soldering (unit: mm)

Type	096 (2 circuits)	110 (2 circuits)	212 (2 circuits)	212 (4 circuits)	
Size	L	0.9	1.37	2.0	2.0
	W	0.6	1.0	1.25	1.25
a	0.25 to 0.35	0.35 to 0.45	0.5 to 0.6	0.5 to 0.6	
b	0.15 to 0.25	0.55 to 0.65	0.5 to 0.6	0.5 to 0.6	
c	0.15 to 0.25	0.3 to 0.4	0.5 to 0.6	0.2 to 0.3	
d	0.45	0.64	1.0	0.5	

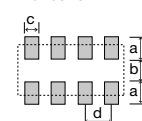
Land patterns for PCBs



2 circuits



4 circuits



Technical considerations

(2) Examples of good and bad solder application

Items	Not recommended	Recommended
Mixed mounting of SMD and leaded components	Lead wire of component	Solder-resist
Component placement close to the chassis	Chassis Solder (for grounding)	Solder-resist
Hand-soldering of leaded components near mounted components	Lead wire of component Soldering iron	Solder-resist
Horizontal component placement		Solder-resist

To next page

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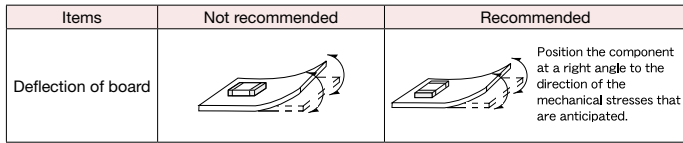
PRECAUTIONS

Precautions on the use of Multilayer Ceramic Capacitors

2. PCB Design

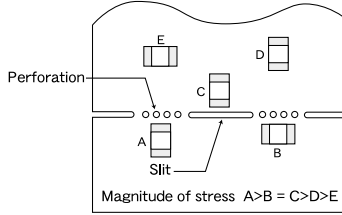
◆Pattern configurations (Capacitor layout on PCBs)

1-1. The following are examples of good and bad capacitor layouts ; capacitors shall be located to minimize any possible mechanical stresses from board warp or deflection.



Technical considerations

1-2. The amount of mechanical stresses given will vary depending on capacitor layout. Please refer to diagram below.



1-3. When PCB is split, the amount of mechanical stress on the capacitors can vary according to the method used. The following methods are listed in order from least stressful to most stressful: push-back, slit, V-grooving, and perforation. Thus, please consider the PCB split methods as well as chip location.

3. Mounting

◆Adjustment of mounting machine

- When capacitors are mounted on PCB, excessive impact load shall not be imposed on them.
- Maintenance and inspection of mounting machines shall be conducted periodically.

Precautions

◆Selection of Adhesives

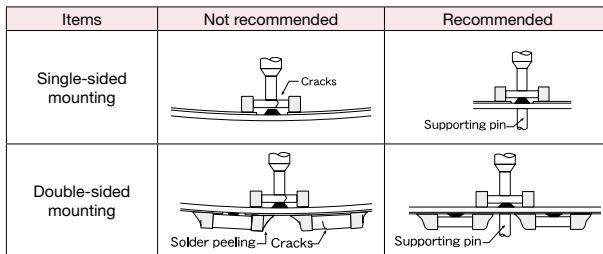
1. When chips are attached on PCBs with adhesives prior to soldering, it may cause capacitor characteristics degradation unless the following factors are appropriately checked : size of land patterns, type of adhesive, amount applied, hardening temperature and hardening period. Therefore, please contact us for further information.

◆Adjustment of mounting machine

1. When the bottom dead center of a pick-up nozzle is too low, excessive force is imposed on capacitors and causes damages. To avoid this, the following points shall be considerable.

- The bottom dead center of the pick-up nozzle shall be adjusted to the surface level of PCB without the board deflection.
- The pressure of nozzle shall be adjusted between 1 and 3 N static loads.

(3) To reduce the amount of deflection of the board caused by impact of the pick-up nozzle, supporting pins or back-up pins shall be used on the other side of the PCB. The following diagrams show some typical examples of good and bad pick-up nozzle placement:



Technical considerations

2. As the alignment pin is worn out, adjustment of the nozzle height can cause chipping or cracking of capacitors because of mechanical impact on the capacitors. To avoid this, the monitoring of the width between the alignment pins in the stopped position, maintenance, check and replacement of the pin shall be conducted periodically.

◆Selection of Adhesives

Some adhesives may cause IR deterioration. The different shrinkage percentage of between the adhesive and the capacitors may result in stresses on the capacitors and lead to cracking. Moreover, too little or too much adhesive applied to the board may adversely affect components. Therefore, the following precautions shall be noted in the application of adhesives.

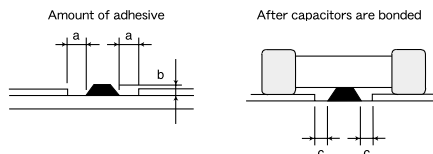
(1) Required adhesive characteristics

- The adhesive shall be strong enough to hold parts on the board during the mounting & solder process.
- The adhesive shall have sufficient strength at high temperatures.
- The adhesive shall have good coating and thickness consistency.
- The adhesive shall be used during its prescribed shelf life.
- The adhesive shall harden rapidly.
- The adhesive shall have corrosion resistance.
- The adhesive shall have excellent insulation characteristics.
- The adhesive shall have no emission of toxic gasses and no effect on the human body.

(2) The recommended amount of adhesives is as follows;

[Recommended condition]

Figure	212/316 case sizes as examples
a	0.3mm min
b	100 to 120 μ m
c	Adhesives shall not contact land



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Precautions on the use of Multilayer Ceramic Capacitors

4. Soldering

Precautions

◆ Selection of Flux

Since flux may have a significant effect on the performance of capacitors, it is necessary to verify the following conditions prior to use:
 (1) Flux used shall be less than or equal to 0.1 wt% (in Cl equivalent) of halogenated content. Flux having a strong acidity content shall not be applied.
 (2) When shall capacitors are soldered on boards, the amount of flux applied shall be controlled at the optimum level.
 (3) When water-soluble flux is used, special care shall be taken to properly clean the boards.

◆ Soldering

Temperature, time, amount of solder, etc. shall be set in accordance with their recommended conditions.

Sn-Zn solder paste can adversely affect MLCC reliability.
 Please contact us prior to usage of Sn-Zn solder.

◆ Selection of Flux

1-1. When too much halogenated substance (Chlorine, etc.) content is used to activate flux, or highly acidic flux is used, it may lead to corrosion of terminal electrodes or degradation of insulation resistance on the surfaces of the capacitors.

1-2. Flux is used to increase solderability in wave soldering. However if too much flux is applied, a large amount of flux gas may be emitted and may adversely affect the solderability. To minimize the amount of flux applied, it is recommended to use a flux-bubbling system.

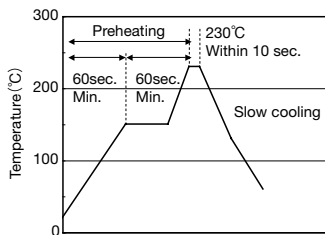
1-3. Since the residue of water-soluble flux is easily dissolved in moisture in the air, the residues on the surfaces of capacitors in high humidity conditions may cause a degradation of insulation resistance and reliability of the capacitors. Therefore, the cleaning methods and the capability of the machines used shall also be considered carefully when water-soluble flux is used.

◆ Soldering

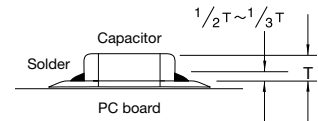
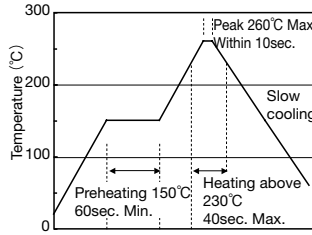
- Ceramic chip capacitors are susceptible to thermal shock when exposed to rapid or concentrated heating or rapid cooling.
- Therefore, the soldering must be conducted with great care so as to prevent malfunction of the components due to excessive thermal shock.
- Preheating : Capacitors shall be preheated sufficiently, and the temperature difference between the capacitors and solder shall be within 100 to 130°C.
- Cooling : The temperature difference between the capacitors and cleaning process shall not be greater than 100°C.

[Reflow soldering]

[Recommended conditions for eutectic soldering]



[Recommended condition for Pb-free soldering]



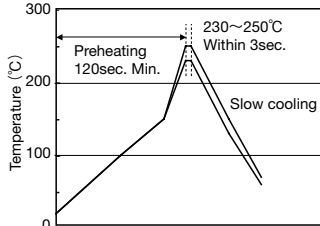
Caution

- ① The ideal condition is to have solder mass (fillet) controlled to 1/2 to 1/3 of the thickness of a capacitor.
- ② Because excessive dwell times can adversely affect solderability, soldering duration shall be kept as close to recommended times as possible.

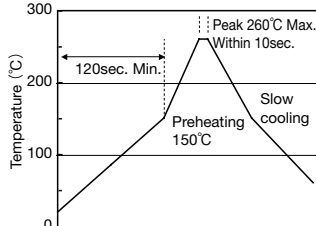
Technical considerations

[Wave soldering]

[Recommended conditions for eutectic soldering]



[Recommended condition for Pb-free soldering]

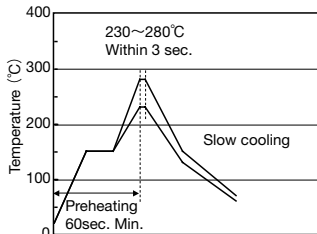


Caution

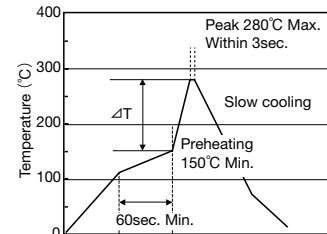
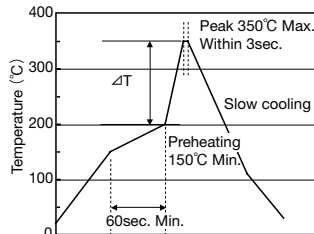
- ① Wave soldering must not be applied to capacitors designated as for reflow soldering only.

[Hand soldering]

[Recommended conditions for eutectic soldering]



[Recommended condition for Pb-free soldering]



Caution

- ① Use a 50W soldering iron with a maximum tip diameter of 1.0 mm.
- ② The soldering iron shall not directly touch capacitors.

* This catalog contains the typical specification only due to the limitation of space. When you consider purchase of our products, please check our specification. For details of each product (characteristics graph, reliability information, precautions for use, and so on), see our Web site (<http://www.ty-top.com/>) or CD catalogs.

■ PRECAUTIONS

Precautions on the use of Multilayer Ceramic Capacitors

5. Cleaning	
Precautions	<p>◆Cleaning conditions</p> <ol style="list-style-type: none"> When PCBs are cleaned after capacitors mounting, Please select the appropriate cleaning solution in accordance with the intended use of the cleaning. (e.g. to remove soldering flux or other materials from the production process.) Cleaning condition shall be determined after it is verified by using actual cleaning machine that the cleaning process does not affect capacitor's characteristics.
Technical considerations	<ol style="list-style-type: none"> The use of inappropriate cleaning solutions can cause foreign substances such as flux residue to adhere to capacitors or deteriorate their outer coating, resulting in a degradation of the capacitor's electrical properties (especially insulation resistance). Inappropriate cleaning conditions (insufficient or excessive cleaning) may adversely affect the performance of the capacitors. In the case of ultrasonic cleaning, too much power output can cause excessive vibration of PCBs which may lead to the cracking of capacitors or the soldered portion, or decrease the terminal electrodes' strength. Therefore, the following conditions shall be carefully checked; Ultrasonic output : 20 W/l or less Ultrasonic frequency : 40 kHz or less Ultrasonic washing period : 5 min. or less
6. Resin coating and mold	
Precautions	<ol style="list-style-type: none"> With some type of resins, decomposition gas or chemical reaction vapor may remain inside the resin during the hardening period or while left under normal storage conditions resulting in the deterioration of the capacitor's performance. When a resin's hardening temperature is higher than capacitor's operating temperature, the stresses generated by the excessive heat may lead to damage or destruction of capacitors. The use of such resins, molding materials etc. is not recommended.
7. Handling	
Precautions	<p>◆Splitting of PCB</p> <ol style="list-style-type: none"> When PCBs are split after components mounting, care shall be taken so as not to give any stresses of deflection or twisting to the board. Board separation shall not be done manually, but by using the appropriate devices. <p>◆Mechanical considerations</p> <p>Be careful not to subject capacitors to excessive mechanical shocks.</p> <ol style="list-style-type: none"> If ceramic capacitors are dropped onto a floor or a hard surface, they shall not be used. Please be careful that the mounted components do not come in contact with or bump against other boards or components.
8. Storage conditions	
Precautions	<p>◆Storage</p> <ol style="list-style-type: none"> To maintain the solderability of terminal electrodes and to keep packaging materials in good condition, care must be taken to control temperature and humidity in the storage area. Humidity should especially be kept as low as possible. <ul style="list-style-type: none"> Recommended conditions <ul style="list-style-type: none"> Ambient temperature : Below 30°C Humidity : Below 70% RH <p>The ambient temperature must be kept below 40°C. Even under ideal storage conditions, solderability of capacitor is deteriorated as time passes, so capacitors shall be used within 6 months from the time of delivery.</p> <ul style="list-style-type: none"> Ceramic chip capacitors shall be kept where no chlorine or sulfur exists in the air. The capacitance values of high dielectric constant capacitors will gradually decrease with the passage of time. So care shall be taken to design circuits. Even if capacitance value decreases as time passes, it will get back to the initial value by a heat treatment at 150°C for 1hour.
Technical considerations	<p>If capacitors are stored in a high temperature and humidity environment, it might rapidly cause poor solderability due to terminal oxidation and quality loss of taping/packaging materials. For this reason, capacitors shall be used within 6 months from the time of delivery. If exceeding the above period, please check solderability before using the capacitors.</p>

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