

# 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 2011. 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.

# SUPER LOW DISTORTION MULTILAYER CERAMIC CAPACITORS(CFCAP™)



REFLOW

## FEATURES

- Newly developed dielectric material and the use of nickel for internal electrodes provide superior temperature characteristics with high capacitance, small case size and low cost.
- Low distortion and low shock noise make these capacitors appropriate for use in analog or digital mobile devices.
- Superior heat-resistance, high breakdown voltage, and mechanical strength make these capacitors appropriate for replacing film capacitors.

## APPLICATIONS

- Signal line for AV products
- Analog signal coupling applications
- PLL circuit of mobile phones
- Good temperature characteristics for time constant circuits, oscillation circuits and filters

## PART NUMBER

T M K 3 1 6 △ S D 1 0 4 K L - T △

**1** Rated voltage [VDC]

U	50
G	35
T	25
E	16
L	10
J	6.3

**2** Series name

M	Multilayer ceramic capacitor
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**3** End termination

K	Plated
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**4** Dimension

Type	(inch)	L×W (mm)
105	(0402)	1.0×0.5
107	(0603)	1.6×0.8
212	(0805)	2.0×1.25
316	(1206)	3.2×1.6

**5** Dimension tolerance

△	Standard
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△=Blank space

**6** Series symbol

SD	Standard
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**7** Nominal capacitance [μF]

example	
223	0.022
104	0.1

**8** Capacitance tolerance

K	±10%
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**9** Thickness [mm]

P	0.3
V	0.5
A	0.8
D	0.85
F	1.15
G	1.25
L	1.6

**10** Special code

-	Standard
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**11** Packaging

T	φ178mm Taping (4mm pitch) 107, 212, 316 Type
F	φ178mm Taping (2mm pitch) 105 Type

**12** Internal code

△	Standard
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△=Blank space

## STANDARD EXTERNAL DIMENSIONS/STANDARD QUANTITY

Type	Dimension [mm]				Standard quantity [pcs]	
	L	W	T	e	Paper tape	Embossed tape
□MK105 (0402 inch)	1.0±0.05	0.5±0.05	0.3±0.03 0.5±0.05	P V	0.25±0.10	10000 -
□MK107 (0603 inch)	1.6±0.10	0.8±0.10	0.8±0.10	A	0.35±0.25	4000 -
□MK212 (0805 inch)	2.0±0.10	1.25±0.10	0.85±0.10 1.25±0.10	D G	0.5±0.25	4000 3000
□MK316 (1206 inch)	3.2±0.15	1.6±0.15	1.15±0.10 1.6±0.20	F L	0.5+0.35/-0.25	3000 2000

## AVAILABLE CAPACITANCE RANGE

Cap [pF]	Type	105 SD					107 SD				212 SD				316 SD	
		50V	25V	16V	10V	6.3V	50V	25V	16V	10V	50V	35V	16V	10V	35V	25V
390	391	V														
470	471	V														
560	561	V														
680	681		V													
820	821		V													
1000	102		V				A									
1200	122		V				A									
1500	152			V	P		A									
1800	182			V			A									
2200	222			V			A									
2700	272			V		P	A									
3300	332				V		A									
3900	392				V							D				
4700	472				V			A				D				
5600	562								A			D				
6800	682								A			D				
8200	822								A			D				
10000	103								A			D				
12000	123									A			D			
15000	153									A			D			
18000	183									A			G			
22000	223									A			G			
27000	273											G				
33000	333													D		F
39000	393															F
47000	473														D	F
56000	563															F
68000	683														G	F
82000	823														G	L
100000	104														G	L

※Letters in the table indicate thickness.

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## REPRESENTATIVE PART NUMBERS

### 105TYPE

•0.5mm thickness(V)

Rated voltage	Part number 1	Part number 2	Temp. char.	Capacitance (pF)	Capacitance tolerance	tan δ (%)	Thickness (mm)	Soldering R:Reflow W:Wave	HALT	Internal code (P/N 1)	Note
									% Rated voltage		
50V	UMK105 SD391KV	Standard type		390	±10	0.1	0.5±0.05	R	200%		
	UMK105 SD471KV			470	±10	0.1	0.5±0.05	R	200%		
	UMK105 SD561KV			560	±10	0.1	0.5±0.05	R	200%		
25V	TMK105 SD681KV			680	±10	0.1	0.5±0.05	R	200%		
	TMK105 SD821KV			820	±10	0.1	0.5±0.05	R	200%		
	TMK105 SD102KV			1000	±10	0.1	0.5±0.05	R	200%		
16V	TMK105 SD122KV			1200	±10	0.1	0.5±0.05	R	200%		
	EMK105 SD152KV			1500	±10	0.1	0.5±0.05	R	200%		
	EMK105 SD182KV			1800	±10	0.1	0.5±0.05	R	200%		
	EMK105 SD222KV			2200	±10	0.1	0.5±0.05	R	200%		
	EMK105 SD272KV			2700	±10	0.1	0.5±0.05	R	200%		
10V	LMK105 SD332KV			3300	±10	0.1	0.5±0.05	R	200%		
	LMK105 SD392KV	3900	±10	0.1	0.5±0.05	R	200%				
	LMK105 SD472KV	4700	±10	0.1	0.5±0.05	R	200%				

•0.3mm thickness(P)

Rated voltage	Part number 1	Part number 2	Temp. char.	Capacitance (pF)	Capacitance tolerance	tan δ (%)	Thickness (mm)	Soldering R:Reflow W:Wave	HALT	Internal code (P/N 1)	Note
									% Rated voltage		
10V	LMK105 SD152KP	Standard type		1500	±10	0.1	0.3±0.03	R	200%		
6.3V	JMK105 SD272KP			2700	±10	0.1	0.3±0.03	R	200%		

Note : Capacitance tolerance J (±5%) is also available. Please contact Taiyo Yuden sales channels.

### 107TYPE

Rated voltage	Part number 1	Part number 2	Temp. char.	Capacitance (pF)	Capacitance tolerance	tan δ (%)	Thickness (mm)	Soldering R:Reflow W:Wave	HALT	Internal code (P/N 1)	Note
									% Rated voltage		
50V	UMK107 SD102KA	Standard type		1000	±10	0.1	0.8±0.1	R	200%		
	UMK107 SD122KA			1200	±10	0.1	0.8±0.1	R	200%		
	UMK107 SD152KA			1500	±10	0.1	0.8±0.1	R	200%		
	UMK107 SD182KA			1800	±10	0.1	0.8±0.1	R	200%		
	UMK107 SD222KA			2200	±10	0.1	0.8±0.1	R	200%		
	UMK107 SD272KA			2700	±10	0.1	0.8±0.1	R	200%		
25V	UMK107 SD332KA			3300	±10	0.1	0.8±0.1	R	200%		
	TMK107 SD392KA			3900	±10	0.1	0.8±0.1	R	200%		
	TMK107 SD472KA			4700	±10	0.1	0.8±0.1	R	200%		
16V	EMK107 SD562KA			5600	±10	0.1	0.8±0.1	R	200%		
	EMK107 SD682KA			6800	±10	0.1	0.8±0.1	R	200%		
	EMK107 SD822KA			8200	±10	0.1	0.8±0.1	R	200%		
	EMK107 SD103KA			10000	±10	0.1	0.8±0.1	R	200%		
10V	LMK107 SD123KA			12000	±10	0.1	0.8±0.1	R	200%		
	LMK107 SD153KA			15000	±10	0.1	0.8±0.1	R	200%		
	LMK107 SD183KA			18000	±10	0.1	0.8±0.1	R	200%		
	LMK107 SD223KA			22000	±10	0.1	0.8±0.1	R	200%		

Note : Capacitance tolerance J (±5%) is also available. Please contact Taiyo Yuden sales channels.

### 212TYPE

•1.25mm thickness(G)

Rated voltage	Part number 1	Part number 2	Temp. char.	Capacitance (pF)	Capacitance tolerance	tan δ (%)	Thickness (mm)	Soldering R:Reflow W:Wave	HALT	Internal code (P/N 1)	Note
									% Rated voltage		
35V	GMK212 SD183KG	Standard type		18000	±10	0.1	1.25±0.1	R	200%		
	GMK212 SD223KG			22000	±10	0.1	1.25±0.1	R	200%		
	GMK212 SD273KG			27000	±10	0.1	1.25±0.1	R	200%		
10V	LMK212 SD683KG			68000	±10	0.1	1.25±0.1	R	200%		
	LMK212 SD823KG			82000	±10	0.1	1.25±0.1	R	200%		
	LMK212 SD104KG			100000	±10	0.1	1.25±0.1	R	200%		

•0.85mm thickness(D)

Rated voltage	Part number 1	Part number 2	Temp. char.	Capacitance (pF)	Capacitance tolerance	tan δ (%)	Thickness (mm)	Soldering R:Reflow W:Wave	HALT	Internal code (P/N 1)	Note
									% Rated voltage		
50V	UMK212 SD392KD	Standard type		3900	±10	0.1	0.85±0.1	R	200%		
	UMK212 SD472KD			4700	±10	0.1	0.85±0.1	R	200%		
	UMK212 SD562KD			5600	±10	0.1	0.85±0.1	R	200%		
	UMK212 SD682KD			6800	±10	0.1	0.85±0.1	R	200%		
	UMK212 SD822KD			8200	±10	0.1	0.85±0.1	R	200%		
	UMK212 SD103KD			10000	±10	0.1	0.85±0.1	R	200%		
35V	GMK212 SD123KD			12000	±10	0.1	0.85±0.1	R	200%		
	GMK212 SD153KD			15000	±10	0.1	0.85±0.1	R	200%		
16V	EMK212 SD333KD			33000	±10	0.1	0.85±0.1	R	200%		
10V	LMK212 SD473KD			47000	±10	0.1	0.85±0.1	R	200%		

Note : Capacitance tolerance J (±5%) is also available. Please contact Taiyo Yuden sales channels.

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## REPRESENTATIVE PART NUMBERS

### ● 316TYPE

• 1.6mm thickness (L)

Rated voltage	Part number 1	Part number 2	Temp. char.	Capacitance [pF]	Capacitance tolerance	tan δ [%]	Thickness (mm)	Soldering R:Reflow W:Wave	HALT	Internal code (P/N 1)	Note
									% Rated voltage		
25V	TMK316 SD823KL		Standard type	82000	±10	0.1	1.6±0.2	R	200%		
	TMK316 SD104KL			100000	±10	0.1	1.6±0.2	R	200%		

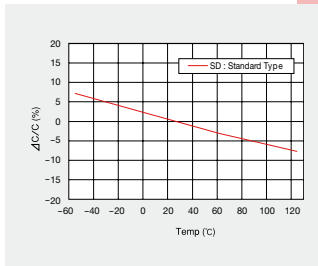
• 1.15mm thickness (F)

Rated voltage	Part number 1	Part number 2	Temp. char.	Capacitance [pF]	Capacitance tolerance	tan δ [%]	Thickness (mm)	Soldering R:Reflow W:Wave	HALT	Internal code (P/N 1)	Note
									% Rated voltage		
35V	GMK316 SD333KF		Standard type	33000	±10	0.1	1.15±0.1	R	200%		
	GMK316 SD393KF			39000	±10	0.1	1.15±0.1	R	200%		
25V	TMK316 SD473KF			47000	±10	0.1	1.15±0.1	R	200%		
	TMK316 SD563KF			56000	±10	0.1	1.15±0.1	R	200%		
	TMK316 SD683KF			68000	±10	0.1	1.15±0.1	R	200%		

Note : Capacitance tolerance J (±5%) is also available. Please contact Taiyo Yuden sales channels.

## ELECTRICAL CHARACTERISTICS

### ■ Capacitance-temperature characteristics



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# PACKAGING

## ① Minimum Quantity

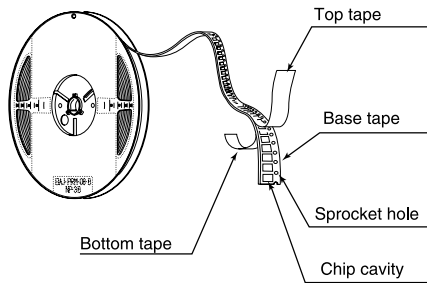
### ● Taped package

Type	Thickness		Standard quantity [pcs]	
	mm	code	Paper tape	Embossed tape
□MK042	0.2	C, D	—	40000
□MK063	0.3	P, T	15000	—
□2K096	0.3	P	10000	
□WK105	0.45	K		
□WK105	0.3	P		
□MK105	0.2	C	20000	
□MK105	0.3	P	15000	
□VK105	0.5	V, W	10000	
□VK105	0.5	W		
□MK107	0.45	K	4000	
□WK107	0.5	V	—	
□2K110	0.8	A	4000	—
□2K110	0.5	V		
□2K110	0.6	B		
□2K110	0.8	A		
□MK212	0.45	K	—	3000
□WK212	0.85	D		
□WK212	1.25	G		
□4K212	0.85	D	4000	—
□2K212	0.85	D		
□MK316	1.15	F	—	3000
□MK316	1.25	G		
□MK316	1.6	L		
□MK325	0.85	D	—	2000
□MK325	1.15	F		
□MK325	1.9	N		
□MK325	2.0max	Y		
□MK325	2.5	M		
□MK432	2.5	M	—	500(T), 1000(P)
□MK432	2.5	M	—	500

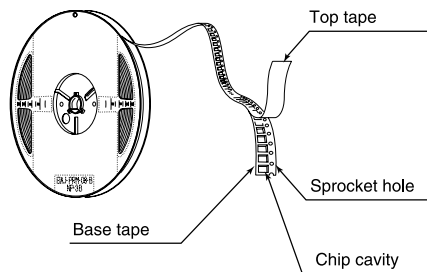
## ② Taping material

※ No bottom tape for pressed carrier tape

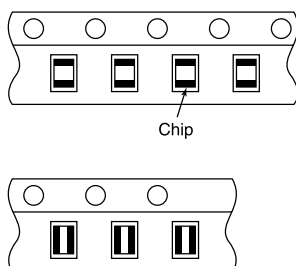
### ● Paper tape



### ● Embossed tape



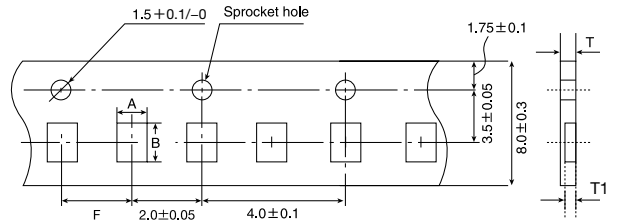
### ● Chip filled



## ③ Representative taping dimensions

### ● Paper Tape (8mm wide)

#### ● Pressed carrier tape (2mm pitch)

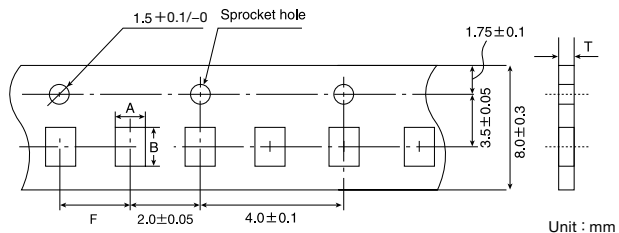


Unit : mm

Type	Chip Cavity		Insertion Pitch F	Tape Thickness	
	A	B		T	T1
□MK063	0.37	0.67	2.0±0.05	0.45max.	0.42max.
□2K096	0.65	1.02			
□WK105	0.65	1.15		0.4max.	0.3max.
MK105(+C)				0.45max.	0.42max.

\* Thickness, C : 0.2mm, P : 0.3mm

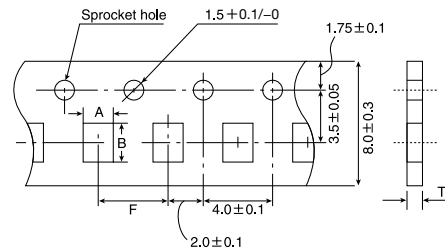
#### ● Punched carrier tape (2mm pitch)



Unit : mm

Type	Chip Cavity		Insertion Pitch F	Tape Thickness
	A	B		T
□2K096	0.72	1.02	2.0±0.05	0.6max.
□MK105	0.65	1.15		0.8max.
□VK105				

#### ● Punched carrier tape (4mm pitch)



Unit : mm

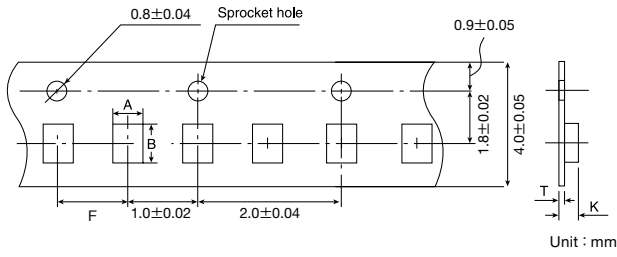
Type	Chip Cavity		Insertion Pitch F	Tape Thickness
	A	B		T
□MK107	1.0	1.8	4.0±0.1	1.1max.
□WK107				
□2K110	1.15	1.55		1.0max.
□MK212	1.65	2.4		1.1max.
□WK212				
□4K212	2.0	3.6		
□2K212				
□MK316				

Note : Taping size might be different depending on the size of the product.

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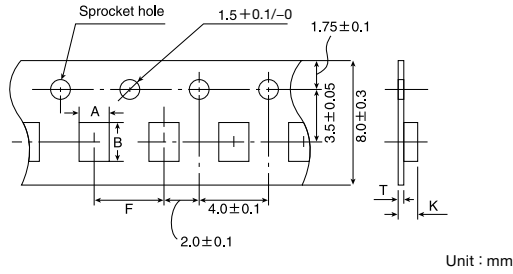
## PACKAGING

### ● Embossed tape (4mm wide)



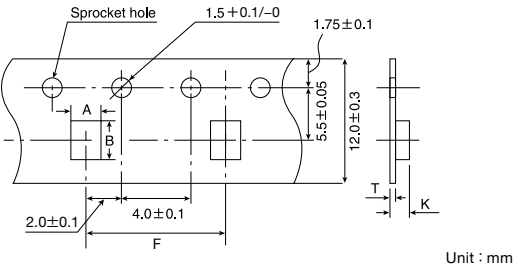
Type	Chip Cavity		Insertion Pitch F	Tape Thickness	
	A	B		K	T
□MK042	0.23	0.43	1.0±0.02	0.5max.	0.25max.

### ● Embossed tape (8mm wide)



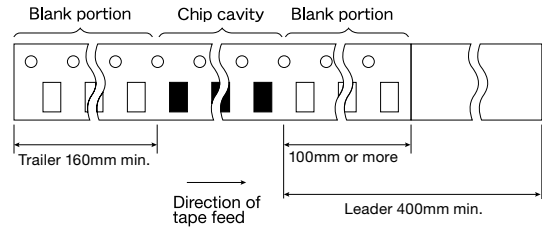
Type	Chip Cavity		Insertion Pitch F	Tape Thickness	
	A	B		K	T
□WK107	1.0	1.8	4.0±0.1	1.3max	0.25±0.1
□MK212	1.65	2.4		3.4max.	0.6max.
□MK316	2.0	3.6			
□MK325	2.8	3.6			

### ● Embossed tape (12mm wide)

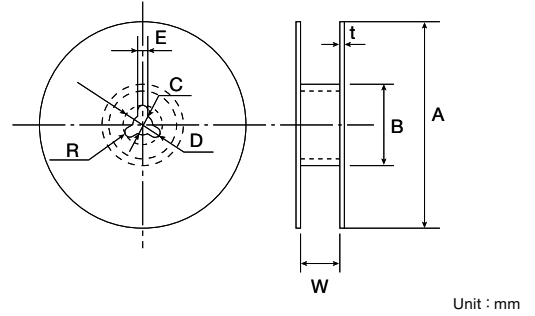


Type	Chip Cavity		Insertion Pitch F	Tape Thickness	
	A	B		K	T
□MK432	3.7	4.9	8.0±0.1	4.0max.	0.6max.

### ④ Trailer and Leader



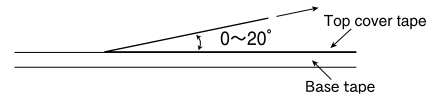
### ⑤ Reel size



A	B	C
φ178±2.0	φ50min.	φ13.0±0.2
D	E	R
φ21.0±0.8	2.0±0.5	1.0
	t	W
4mm wide tape	1.5max.	5±1.0
8mm wide tape	2.5max.	10±1.5
12mm wide tape	2.5max.	14±1.5

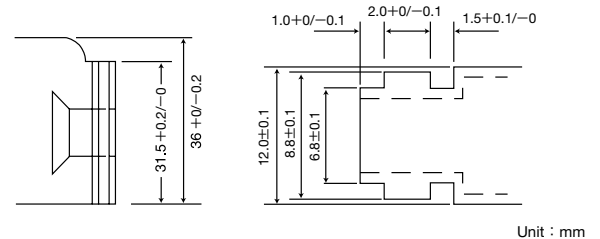
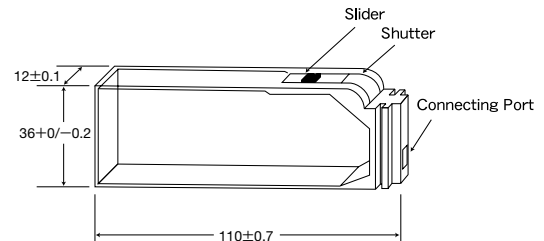
### ⑥ Top Tape Strength

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

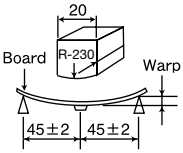
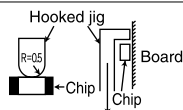
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Multilayer Ceramic Capacitors and Medium-High Voltage Multilayer Ceramic Capacitors are noted separately.

Super Low Distortion Multilayer Ceramic Capacitors (CFCAP)

<b>1. Operating Temperature Range</b>												
Specified Value	-55 to +125°C											
<b>2. Storage Temperature Range</b>												
Specified Value	-55 to +125°C											
<b>3. Rated Voltage</b>												
Specified Value	6.3VDC, 10VDC, 16VDC, 25VDC, 35VDC, 50VDC											
<b>4. Dielectric Withstanding Voltage (Between terminals)</b>												
Specified Value	No breakdown or damage											
<b>[Test Methods and Remarks]</b> Applied voltage: Rated voltage×3 Duration: 1 to 5 sec. Charge/discharge current: 50mA max.												
<b>5. Insulation Resistance</b>												
Specified Value	10000 MΩ or 500MΩ μF, whichever is smaller											
<b>[Test Methods and Remarks]</b> Applied voltage: Rated voltage Duration: 60±5 sec. Charge/discharge current: 50mA max.												
<b>6. Capacitance (Tolerance)</b>												
Specified Value	±10%											
<b>[Test Methods and Remarks]</b> Measuring frequency : 1kHz±10% Measuring voltage : 1±0.2Vrms Bias application: None												
<b>7. Dissipation Factor</b>												
Specified Value	0.1%max											
<b>[Test Methods and Remarks]</b> Measuring frequency : 1kHz±10% Measuring voltage : 1±0.2Vrms Bias application: None												
<b>8. Bending Strength</b>												
Specified Value	Appearance: No abnormality Capacitance change: ±5%											
<b>[Test Methods and Remarks]</b> Warp: 1mm Speed: 0.5mm/second Duration: 10 seconds Test board: glass epoxy resin substrate Thickness: 1.6mm Capacitance measurement shall be conducted with the board bent.												
 <p style="text-align: center;">(Unit: mm)</p>												
<b>9. Adhesive Force of Terminal Electrodes</b>												
Specified Value	Terminal electrodes shall be no exfoliation or a sign of exfoliation.											
<b>[Test Methods and Remarks]</b> Applied force: 5N Duration: 30 ±5 seconds												
												
<b>10. Solderability</b>												
Specified Value	At least 95% of terminal electrode is covered by new solder.											
<b>[Test Methods and Remarks]</b>												
	<table border="1"> <thead> <tr> <th></th> <th>Solder type</th> <th>Solder temperature</th> <th>Duration</th> </tr> </thead> <tbody> <tr> <td>Eutectic solder</td> <td>H60A or H63A</td> <td>230±5°C</td> <td rowspan="2">4±1 sec.</td> </tr> <tr> <td>Lead-free solder</td> <td>Sn-3.0Ag-0.5Cu</td> <td>245±3°C</td> </tr> </tbody> </table>		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
	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										
<b>11. Resistance to Soldering Heat</b>												
Specified Value	Appearance: No abnormality Capacitance change: ±2.5% max. Dissipation factor : Initial value Insulation resistance: Initial value Withstanding voltage (between terminals): No abnormality											
<b>[Test Methods and Remarks]</b> Solder temp.: 270 ±5°C Duration: 3 ±0.5 sec. Preheating conditions : 80 to 100°C, 2 to 5 min. or 5 to 10 min. 150 to 200°C, 2 to 5 min. or 5 to 10 min. Measurement shall be conducted : 24±2hrs under the standard condition Note1												

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**RELIABILITY DATA****12. Temperature Cycle (Thermal Shock)**

Specified Value	Appearance: No abnormality Capacitance change: $\pm 2.5\%$ max Dissipation factor : Initial value Insulation resistance: Initial value Withstanding voltage (between terminals) : No abnormality
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**[Test Methods and Remarks]**

Conditions for 1 cycle / Step 1: Minimum operating temperature  $\pm 0_{-3}^{\circ}\text{C}$  30 $\pm$ 3 min.  
Step 2: Normal temperature 2 to 3 min.  
Step 3: Maximum operating temperature  $\pm 0_{-3}^{\circ}\text{C}$  30 $\pm$ 3 min.  
Step 4: Normal temperature 2 to 3 min.

Number of cycles: 5 times

Measurement shall be conducted : 24 $\pm$ 2hrs under the standard condition Note1

**13. Humidity (Steady state)**

Specified Value	Appearance: No abnormality Capacitance change: $\pm 5\%$ max Dissipation factor : 0.5% max Insulation resistance 50M $\Omega$ $\mu$ F or 1000M $\Omega$ , whichever is smaller
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**[Test Methods and Remarks]**

Temperature: 40 $\pm$ 2 $^{\circ}\text{C}$   
Humidity: 90 to 95% RH  
Duration: 500 $^{+24}_{-0}$  hrs

Measurement shall be conducted : 24 $\pm$ 2hrs under the standard condition Note1

**14. Humidity Loading**

Specified Value	Appearance: No abnormality Capacitance change: $\pm 7.5\%$ max Dissipation factor : 0.5% max Insulation resistance: 25M $\Omega$ $\mu$ F or 500M $\Omega$ , whichever is smaller
-----------------	---

**[Test Methods and Remarks]**

According to JIS C 5102 clause 9.9.  
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

Measurement shall be conducted : 24 $\pm$ 2hrs under the standard condition Note1

**15. High Temperature Loading**

Specified Value	Appearance: No abnormality Capacitance change: $\pm 3\%$ max Dissipation factor : 0.35% max Insulation resistance: 50M $\Omega$ $\mu$ F or 1000M $\Omega$ , whichever is smaller
-----------------	---

**[Test Methods and Remarks]**

According to JIS C 5102 clause 9.10.  
Temperature: 125 $\pm$ 3 $^{\circ}\text{C}$   
Duration: 1000 $^{+48}_{-0}$  hrs

Applied voltage: Rated voltage x 2  
Charge/discharge current: 50mA max

Measurement shall be conducted : 24 $\pm$ 2hrs under the standard condition Note1

Note1 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".

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# 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
	W	0.8	1.25	1.6
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	2.5
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

Note : Recommended land size might be different according to the allowance of the size of the product.

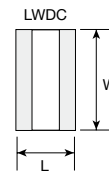
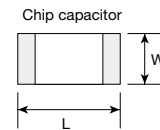
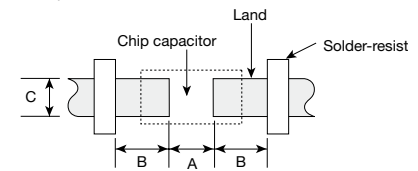
- LWDC: Recommended land dimensions for reflow-soldering (unit: mm)

Type	105	107	212
Size	L	0.52	0.8
	W	1.0	1.6
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

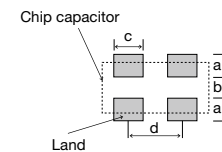
- Array type: Recommended land dimensions for reflow-soldering (unit: mm)

Type	096 (2 circuits)	110 (2 circuits)	212 (2 circuits)	212 (4 circuits)
Size	L	0.9	1.37	2.0
	W	0.6	1.0	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

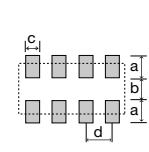
Land patterns for PCBs



2 circuits



4 circuits



(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) Land	Solder-resist
Hand-soldering of leaded components near mounted components	Lead wire of component Soldering iron	Solder-resist
Horizontal component placement	Solder	Solder-resist

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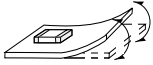
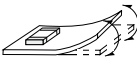
## PRECAUTIONS

### Precautions on the use of Multilayer Ceramic Capacitors

#### 2. PCB Design

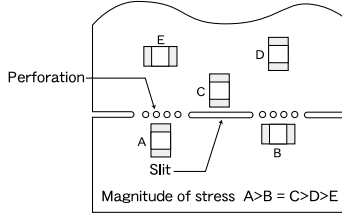
##### ◆Pattern configurations (Capacitor layout on PCBs)

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

Items	Not recommended	Recommended
Deflection of board		 Position the component at a right angle to the direction of the mechanical stresses that are anticipated.

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

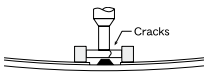
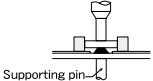
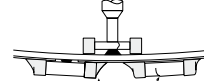
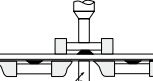
##### ◆Selection of Adhesives

- 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

- 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.
- 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:

Items	Not recommended	Recommended
Single-sided mounting	 Cracks	 Supporting pin
Double-sided mounting	 Solder peeling Cracks	 Supporting pin

Technical considerations

- 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.

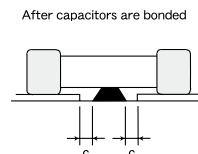
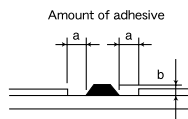
##### (1) Required adhesive characteristics

- 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.

- 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 $\mu$ m
c	Adhesives shall not contact land



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**PRECAUTIONS**

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.

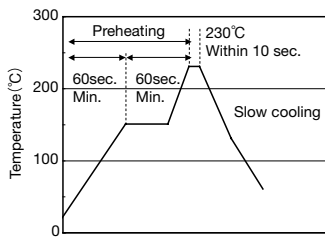
1-3. Since the residue of water-soluble flux is easily dissolved in moisture in the air, the residues on the surfaces of capacitors in high humidity conditions may cause a degradation of insulation resistance and reliability of the capacitors. Therefore, the cleaning methods and the capability of the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

◆ Soldering

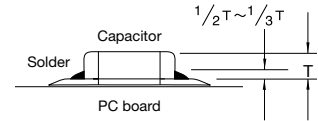
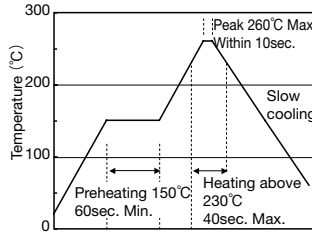
- Ceramic chip capacitors are susceptible to thermal shock when exposed to rapid or concentrated heating or rapid cooling.
- Therefore, the soldering must be conducted with great care so as to prevent malfunction of the components due to excessive thermal shock.
- Preheating : Capacitors shall be preheated 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]



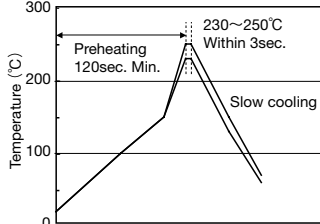
Caution

- 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.

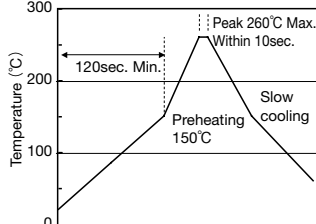
Technical considerations

[Wave soldering]

[Recommended conditions for eutectic soldering]



[Recommended condition for Pb-free soldering]

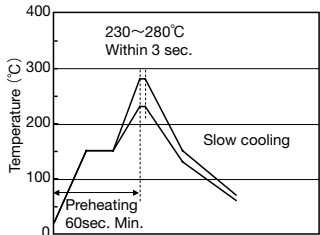


Caution

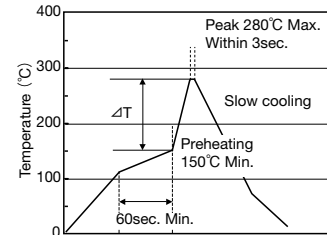
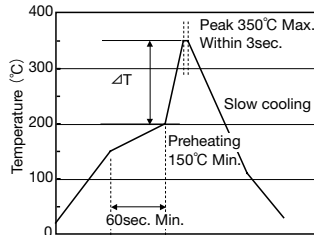
- ① Wave soldering must not be applied to capacitors designated as for reflow soldering only.

[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.

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## PRECAUTIONS

### Precautions on the use of Multilayer Ceramic Capacitors

5. Cleaning	
Precautions	<ul style="list-style-type: none"><li>◆Cleaning conditions</li><li>1. 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.)</li><li>2. Cleaning condition shall be determined after it is verified by using actual cleaning machine that the cleaning process does not affect capacitor's characteristics.</li></ul>
Technical considerations	<ul style="list-style-type: none"><li>1. 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).</li><li>2. 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</li></ul>
6. Resin coating and mold	
Precautions	<ul style="list-style-type: none"><li>1. 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.</li><li>2. 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.</li></ul>
7. Handling	
Precautions	<ul style="list-style-type: none"><li>◆Splitting of PCB</li><li>1. 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.</li><li>2. Board separation shall not be done manually, but by using the appropriate devices.</li><li>◆Mechanical considerations</li><li>Be careful not to subject capacitors to excessive mechanical shocks. (1) If ceramic capacitors are dropped onto a floor or a hard surface, they shall not be used. (2) Please be careful that the mounted components do not come in contact with or bump against other boards or components.</li></ul>
8. Storage conditions	
Precautions	<ul style="list-style-type: none"><li>◆Storage</li><li>1. 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"><li>•Recommended conditions</li><li>Ambient temperature : Below 30°C</li><li>Humidity : Below 70% RH</li></ul>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.<ul style="list-style-type: none"><li>•Ceramic chip capacitors shall be kept where no chlorine or sulfur exists in the air.</li></ul></li><li>2. 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.</li></ul>
Technical considerations	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.

※RCR-2335B (Safety Application Guide for fixed ceramic capacitors for use in electronic equipment) is published by JEITA.  
Please check the guide regarding precautions for deflection test, soldering by spot heat, and so on.