

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.

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AXIAL LEADED CERAMIC CAPACITORS



WAVE

FEATURES

- This widely used ceramic capacitor provides a wide capacitance range of 1pF through 10μF in one standard size and shape.
- Automatic insertion related costs are lower than with radial type capacitors.
- Mounting pitch can be between 5mm to 26mm which could be used as a jumper.

APPLICATIONS

- The class 1 temperature compensating (NPO) products can be used in circuits to stabilize frequency and temperature characteristics. The B, and F dielectrics are optimum for bypass capacitors.

ORDERING CODE

U P 0 2 5 △ B 1 0 4 K - A - B ○ ○

1 Rated voltage (VDC)	2 Type	3 Outside Dimensions (L×φD) (mm)	4 Temperature Characteristics	5 Nominal Capacitance (pF)	6 Capacitance Tolerances	7 Lead Configuration (mm)	8 Packaging	9 Internal code
L 10 E 16 T 25 G 35 U 50	P Axial leaded capacitors	025 2.3×2.0 (multilayer type) 050 3.2×2.2 (multilayer type) 075 4.2×3.2 (multilayer type)	CH 0±60 (ppm/°C) SL +350~-1000 (ppm/°C) △B ±10% B5 ±15% △F $\begin{matrix} +30 \\ -85 \end{matrix}$ %	example 010 1 1R2 1.2 103 10000	D- ±0.5pF J- ±5% K- ±10% M- ±20% Z- $\begin{matrix} +80 \\ -20 \end{matrix}$ %	A- 26mm lead space, ammo pack B- 52mm lead space, ammo pack KF 5.0mm pitch formed lead bulk KE 7.5mm pitch formed lead bulk NA Axial lead, bulk	B Ammo C Bulk	△,△Z Multilayer type Standard products △J Multilayer type (Low voltage products)
			△=Blank space	*R=decimal point				△=Blank space

EXTERNAL DIMENSIONS/Minimum Quantity

TYPE	Dimensions			Taped product	Bulk Product		Minimum Quantity [PCS]		
	L	φD	φd		Straight	Formed	A	Bulk	Taping
Multilayer Type 025	2.3max. (0.09max.)	2.0max. (0.079max.)	0.45±0.05 (0.018±0.002)		NA		A	—	2000 (075) 3000 (050) 5000 (025)
Multilayer Type 050	3.2max. (0.126max.)	2.2max. (0.087max.)	0.55±0.05 (0.022±0.002)		—		NA	1000	—
Multilayer Type 075	4.2max. (0.165max.)	3.2max. (0.126max.)	0.55±0.05 (0.022±0.002)		—		KE (075)	3000	—
							KF (050)	3000	—
							KF (025)	4000	—

Unit : mm (inch)

RATED VOLTAGE CAPACITANCE RANGE RATED Voltage

Class 1 (Temperature compensating)				Class 2 (High dielectric constant)												Multilayer type	
Rated voltage		50V (UP)		50V (UP)				35V (GP)		25V (TP)		16V (EP)		10V (LP)			
Temp.char.		CH	SL	B, B5		F		B, B5	F	B	F	B	F	B	F		
Type cap.		025	050	025	050	075	025	050	050	075	075	075	025	025	050	025	050
[pF]																	
1	010																
1.2	1R2																
1.5	1R5																
1.8	1R8																
2.2	2R2																
2.7	2R7																
3.3	3R3																
3.9	3R9																
4.7	4R7																
5.6	5R6																
6.8	6R8																
8.2	8R2																
10	100																
11	110																
12	120																
13	130																
15	150																
16	160																
18	180																
20	200																
22	220																
24	240																
27	270																
30	300																
33	330																
36	360																
39	390																
43	430																
47	470																
51	510																
56	560																
62	620																
68	680																
100	101																
150	151																
220	221																
330	331																
470	471																
680	681																
1000	102																

Temperature char.	Capacitance change	Capacitance Tolerance	Q or tan δ	Class
CH	0±60ppm/°C	D (±0.5pF) K (±10%) J (±5%)	eng · Refer to the Part number	1
SL	+350~-1000ppm/°C	K (±10%), M (±20%)		2
△B, B5	±10%, ±15%	Z ($\begin{matrix} +80 \\ -20 \end{matrix}$ %)		
△F	$\begin{matrix} +30 \\ -85 \end{matrix}$ %			

*Capacitance characteristics measured at 20°C, However, the B5 characteristic is 25°C.

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PART NUMBERS

Multilayer 025 Type Class 1

Rated Voltage (DC)	Ordering code	EHS (Environmental Hazardous Substances)	Temperature characteristics	Capacitance (pF)	Capacitance tolerance	Q or tan δ	Insulation resistance
50V	UP025△010D -○ Z	RoHS	CH SL	1.0	±0.5pF	Q ≥ 400+20C	10000MΩmin.
	UP025△1R2D -○ Z	RoHS		1.2			
	UP025△1R5D -○ Z	RoHS		1.5			
	UP025△1R8D -○ Z	RoHS		1.8			
	UP025△2R2D -○ Z	RoHS		2.2			
	UP025△2R7D -○ Z	RoHS		2.7			
	UP025△3R3D -○ Z	RoHS		3.3			
	UP025△3R9D -○ Z	RoHS		3.9			
	UP025△4R7D -○ Z	RoHS		4.7			
	UP025△5R6K -○ Z	RoHS		5.6			
	UP025△6R8K -○ Z	RoHS		6.8			
	UP025△8R2K -○ Z	RoHS		8.2			
	UP025△100J -○ Z	RoHS		10			
	UP025△120J -○ Z	RoHS		12			
	UP025△150J -○ Z	RoHS		15			
	UP025△180J -○ Z	RoHS		18			
	UP025△220J -○ Z	RoHS		22			
	UP025△270J -○ Z	RoHS		27			
	UP025△330J -○ Z	RoHS		33			
	UP025△390J -○ Z	RoHS		39			
	UP025△470J -○ Z	RoHS	47				
	UP025△560J -○ Z	RoHS	56				
	UP025△680J -○ Z	RoHS	68				
	UP025△820J -○ Z	RoHS	82				
	UP025CH101J -○ Z	RoHS	100				
	UP025CH151J -○ Z	RoHS	150				
	UP025CH221J -○ Z	RoHS	220				
	UP025CH331J -○ Z	RoHS	330				
	UP025CH471J -○ Z	RoHS	470				
	UP025CH681J -○ Z	RoHS	680				
UP025CH102J -○ Z	RoHS	1000					

△Please specify the temperature characteristics code and ○ lead configuration code.

Multilayer 025 Type Class 2

Rated Voltage (DC)	Ordering code	EHS (Environmental Hazardous Substances)	Temperature characteristics	Capacitance (pF)	Capacitance tolerance	Q or tan δ	Insulation resistance
50V	UP025 B101K -○ Z	RoHS	B	100	±10%	tan δ ≤ 3.5%	5000MΩmin.
	UP025 B121K -○ Z	RoHS		120			
	UP025 B151K -○ Z	RoHS		150			
	UP025 B181K -○ Z	RoHS		180			
	UP025 B221K -○ Z	RoHS		220			
	UP025 B271K -○ Z	RoHS		270			
	UP025 B331K -○ Z	RoHS		330			
	UP025 B391K -○ Z	RoHS		390			
	UP025 B471K -○ Z	RoHS		470			
	UP025 B561K -○ Z	RoHS		560			
	UP025 B681K -○ Z	RoHS		680			
	UP025 B821K -○ Z	RoHS		820			
	UP025 B102K -○ Z	RoHS		1000			
	UP025 B122K -○ Z	RoHS		1200			
	UP025 B152K -○ Z	RoHS		1500			
	UP025 B222K -○ Z	RoHS		2200			
	UP025 B332K -○ Z	RoHS		3300			
	UP025 B472K -○ Z	RoHS		4700			
	UP025 B682K -○ Z	RoHS		6800			
	UP025 B103K -○ Z	RoHS		10000			
	UP025 B153K -○ Z	RoHS		15000			
	UP025 B223K -○ Z	RoHS		22000			
	UP025 B333K -○ Z	RoHS		33000			
	UP025 B473K -○ Z	RoHS		47000			
UP025 B683K -○ Z	RoHS	68000					
UP025 B104K -○ Z	RoHS	100000					
16V	EP025 B224K -○ Z	RoHS	B5	220000	±10%	tan δ ≤ 5.0%	1000MΩmin. 500MΩmin. 200MΩmin.
	EP025 B474K -○ Z	RoHS		470000			
	EP025 B105K -○ Z	RoHS		1000000			
50V	UP025 B5105K -○ Z	RoHS	F	1000000	+80% -20%	tan δ ≤ 7.5%	1000MΩmin.
	UP025 F103Z -○ Z	RoHS		10000			
	UP025 F223Z -○ Z	RoHS		22000			
	UP025 F473Z -○ Z	RoHS		47000			
16V	EP025 F104Z -○ Z	RoHS	F	100000	+80% -20%	tan δ ≤ 10.0%	500MΩmin. 250MΩmin.
	EP025 F224Z -○ Z	RoHS		220000			
	EP025 F474Z -○ Z	RoHS		470000			
	EP025 F105Z -○ Z	RoHS		1000000		tan δ ≤ 17.5%	

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PART NUMBERS

Rated Voltage (DC)	Ordering code	EHS (Environmental Hazardous Substances)	Temperature characteristics	Capacitance [pF]	Capacitance tolerance	Q or tan δ	Insulation resistance
16V	EP025 B122M -○ J	RoHS	B	1200	±20%	tan δ ≦ 3.5%	5000MΩ min.
	EP025 B152M -○ J	RoHS		1500			
	EP025 B182M -○ J	RoHS		1800			
	EP025 B222M -○ J	RoHS		2200			
	EP025 B272M -○ J	RoHS		2700			
	EP025 B332M -○ J	RoHS		3300			
	EP025 B392M -○ J	RoHS		3900			
	EP025 B472M -○ J	RoHS		4700			
	EP025 B562M -○ J	RoHS		5600			
	EP025 B682M -○ J	RoHS		6800			
	EP025 B822M -○ J	RoHS		8200			
	EP025 B103M -○ J	RoHS		10000			
	EP025 B123M -○ J	RoHS		12000			
	EP025 B153M -○ J	RoHS		15000			
EP025 B183M -○ J	RoHS	18000					
25V	TP025 F103Z -○ J	RoHS	F	10000	+80% -20%	tan δ ≦ 7.5%	1000MΩ min.
	TP025 F223Z -○ J	RoHS		22000			
	TP025 F473Z -○ J	RoHS		47000			

△Please specify the temperature characteristics code and ○ lead configuration code.

Multilayer 050 type Class 1

Rated Voltage (DC)	Ordering code	EHS (Environmental Hazardous Substances)	Temperature characteristics	Capacitance [pF]	Capacitance tolerance	Q or tan δ	Insulation resistance
50V	UP050CH220J-○ Z	RoHS	CH	22	±5%	Q ≧ 400+20C	10000MΩ min.
	★ UP050CH240J-○ Z	RoHS		24			
	UP050CH270J-○ Z	RoHS		27			
	★ UP050CH300J-○ Z	RoHS		30			
	UP050CH330J-○ Z	RoHS		33			
	★ UP050CH360J-○ Z	RoHS		36			
	UP050CH390J-○ Z	RoHS		39			
	★ UP050CH430J-○ Z	RoHS		43			
	UP050CH470J-○ Z	RoHS		47			
	★ UP050CH510J-○ Z	RoHS		51			
	UP050CH560J-○ Z	RoHS		56			
	★ UP050CH620J-○ Z	RoHS		62			
	UP050CH680J-○ Z	RoHS		68			
	★ UP050CH750J-○ Z	RoHS		75			
	★ UP050CH820J-○ Z	RoHS		82			
	★ UP050CH910J-○ Z	RoHS		91			
	UP050CH101J-○ Z	RoHS		100			
	★ UP050CH111J-○ Z	RoHS		110			
	★ UP050CH121J-○ Z	RoHS		120			
	★ UP050CH131J-○ Z	RoHS		130			
	UP050CH151J-○ Z	RoHS		150			
	★ UP050CH161J-○ Z	RoHS		160			
	★ UP050CH181J-○ Z	RoHS		180			
	★ UP050CH201J-○ Z	RoHS		200			
	UP050CH221J-○ Z	RoHS		220			
	★ UP050CH241J-○ Z	RoHS		240			
	★ UP050CH271J-○ Z	RoHS		270			
	★ UP050CH301J-○ Z	RoHS		300			
	UP050CH331J-○ Z	RoHS		330			
	★ UP050CH361J-○ Z	RoHS		360			
	★ UP050CH391J-○ Z	RoHS		390			
	★ UP050CH431J-○ Z	RoHS		430			
	UP050CH471J-○ Z	RoHS		470			
	★ UP050CH511J-○ Z	RoHS		510			
	★ UP050CH561J-○ Z	RoHS		560			
	★ UP050CH621J-○ Z	RoHS		620			
	UP050CH681J-○ Z	RoHS		680			
	★ UP050CH751J-○ Z	RoHS		750			
	★ UP050CH821J-○ Z	RoHS		820			
	★ UP050CH911J-○ Z	RoHS		910			
	UP050CH102J-○ Z	RoHS		1000			

△Please specify the temperature characteristics code and ○ lead configuration code.

★ : Option

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PART NUMBERS

● Multilayer 050 type Class 2

Rated Voltage (DC)	Ordering code		EHS (Environmental Hazardous Substances)	Temperature characteristics	Capacitance (pF)	Capacitance tolerance	Q or tan δ	Insulation resistance
50V	★ UP050B122K-○ Z		RoHS	B	1200	±10%	tan δ ≤ 3.5%	5000MΩ min.
	UP050B152K-○ Z		RoHS		1500			
	★ UP050B182K-○ Z		RoHS		1800			
	UP050B222K-○ Z		RoHS		2200			
	★ UP050B272K-○ Z		RoHS		2700			
	UP050B332K-○ Z		RoHS		3300			
	★ UP050B392K-○ Z		RoHS		3900			
	UP050B472K-○ Z		RoHS		4700			
	★ UP050B562K-○ Z		RoHS		5600			
	UP050B682K-○ Z		RoHS		6800			
	★ UP050B822K-○ Z		RoHS		8200			
	UP050B103K-○ Z		RoHS		10000			
	★ UP050B123K-○ Z		RoHS		12000			
	UP050B153K-○ Z		RoHS		15000			
	★ UP050B183K-○ Z		RoHS		18000			
	UP050B223K-○ Z		RoHS		22000			
	★ UP050B273K-○ Z		RoHS		27000			
	UP050B333K-○ Z		RoHS		33000			
	★ UP050B393K-○ Z		RoHS		39000			
	UP050B473K-○ Z		RoHS		47000			
★ UP050B563K-○ Z		RoHS	56000					
UP050B683K-○ Z		RoHS	68000					
★ UP050B823K-○ Z		RoHS	82000					
UP050B104K-○ Z		RoHS	100000					
UP050B224K-○ Z		RoHS	220000					
UP050B474K-○ Z		RoHS	470000					
35V	GP050B105K-○ Z		RoHS	1000000			tan δ ≤ 7.5%	1000MΩ min. 500MΩ min. 200MΩ min. 100MΩ min.
16V	EP050B225K-○ Z		RoHS	2200000			tan δ ≤ 7.5%	50MΩ min.
	EP050B475K-○ Z		RoHS	4700000			tan δ ≤ 12.5%	20MΩ min.
50V	UP050F103Z-○ Z		RoHS	F	10000	+80% -20%	tan δ ≤ 7.5%	1000MΩ min.
	UP050F223Z-○ Z		RoHS		22000			
	UP050F473Z-○ Z		RoHS		47000			
	UP050F104Z-○ Z		RoHS		100000			
	UP050F224Z-○ Z		RoHS		220000			
	UP050F474Z-○ Z		RoHS		470000			
16V	EP050F225Z-○ Z		RoHS	2200000			tan δ ≤ 15%	250MΩ min. 125MΩ min.
	LP050F475Z-○ Z		RoHS	4700000			tan δ ≤ 17.5%	50MΩ min.
10V	LP050F106Z-○ Z		RoHS	10000000				25MΩ min.

△Please specify the temperature characteristics code and ○ lead configuration code.

★ : Option

● Multilayer 075 type Class 2

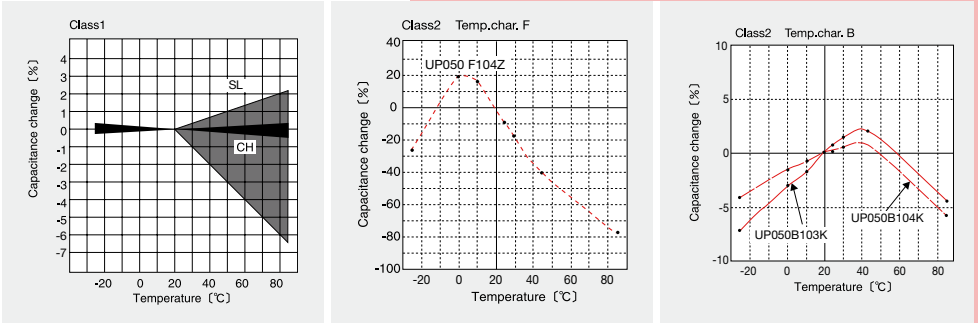
Rated Voltage (DC)	Ordering code		EHS (Environmental Hazardous Substances)	Temperature characteristics	Capacitance (pF)	Capacitance tolerance	Q or tan δ	Insulation resistance
50V	UP075 B105K-○		RoHS	B	1000000	±10%	tan δ ≤ 5.0%	100MΩ min.
35V	GP075 B225K-○		RoHS		2200000		tan δ ≤ 7.5%	50MΩ min.
	GP075 B475K-○		RoHS		4700000		tan δ ≤ 12.5%	20MΩ min.
25V	TP075 B106K-○		RoHS	10000000	tan δ ≤ 12.5%	40MΩ min.		
50V	UP075B5225K-○		RoHS	B5		2200000	tan δ ≤ 12.5%	10MΩ min.
	UP075B5475K-○		RoHS		4700000			
35V	GP075B5106K-○		RoHS	F	10000000	+80% -20%	tan δ ≤ 17.5%	25MΩ min.
	GP075 F106Z-○		RoHS					

△Please specify the temperature characteristics code and ○ lead configuration code.

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Capacitance -vs- Temperature Characteristics



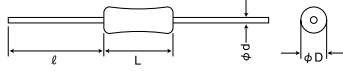
* This catalog contains the typical specification only due to the limitation of space. When you consider the purchase of our products, please check our specification. For details of each product (characteristics graph, reliability information, precautions for use, and so on), see our Web site (<http://www.ty-top.com/>)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

① Minimum Quantity

Type	Lead configuration code	Minimum Quantity (PCS)	
		Bulk	Taping
Multilayer type (075, 050, 025)	A- (1.024 inch wide)	—	2000 (075)
	B- (2.047 inches wide)		3000 (050)
	NA		5000 (025)
	KE (075)		—
	KF (050)		—
	KF (025)	4000	—

② Dimensions of Bulk Products

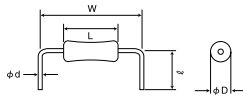
● NA configuration



Type	Dimensions (mm)			
	φD	L	φd	ℓ
Multilayer type 025	2.0max (0.079max)	2.3max (0.09max)	0.45±0.05 (0.018±0.002)	20.0min. (0.787min.)
Multilayer type 050	2.2max (0.087max)	3.2max (0.126max)	0.45±0.05 (0.018±0.002)	20.0min. (0.787min.)
Multilayer type 075	3.2max (0.126max)	4.2max (0.165max)	0.55±0.05 (0.022±0.002)	20.0min. (0.787min.)

Unit : mm (inch)

● KF/KE configuration

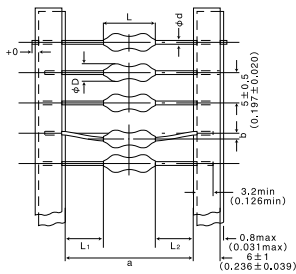


Type	Lead configuration code	Dimensions (mm)				
		φD	L	W	φd	ℓ
Multilayer type 025	KF	2.0max (0.079max)	2.3max (0.09max)	5.0±0.5 (0.197±0.020)	0.45±0.05 (0.018±0.002)	6.5±0.5 (0.256±0.020)
Multilayer type 050	KF	2.2max (0.087max)	3.2max (0.126max)	5.0±0.5 (0.197±0.020)	0.45±0.05 (0.018±0.002)	6.5±0.5 (0.256±0.020)
Multilayer type 075	KE	3.2max (0.126max)	4.2max (0.165max)	7.5±0.5 (0.295±0.020)	0.55±0.05 (0.022±0.002)	6.5±0.5 (0.256±0.020)

Unit : mm (inch)

③ Taping Dimensions

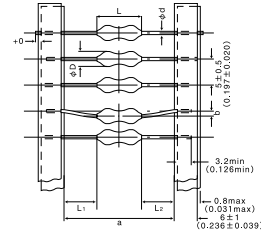
● A- (a : 1.024 inch wide) configuration



Type	Dimensions (mm)						Minimum insertion pitch
	φD	L	a	b	L ₁ -L ₂	φd	
Multilayer type 025	2.0max (0.079max)	2.3max (0.09max)	26 ^{+0.5} ₀ (1.024 ^{+0.020} ₀)	0.8max. (0.031max.)	0.5max (0.020max.)	0.45±0.05 (0.018±0.002)	5.0 (0.197)
Multilayer type 050	2.2max (0.087max)	3.2max (0.126max)				0.45±0.05 (0.018±0.002)	
Multilayer type 075	3.2max (0.126max)	4.2max (0.165max)				0.55±0.05 (0.022±0.002)	

Unit : mm (inch)

● B- (a : 2.047 inches wide) configuration



Type	Dimensions (mm)						Minimum insertion pitch
	φD	L	a	b	L ₁ -L ₂	φd	
Multilayer type 025	2.0max (0.079max)	2.3max (0.09max)	52 ⁺² ₋₁ (2.047 ^{+0.076} _{-0.038})	1.2max. (0.047max.)	1.0max (0.039max.)	0.45±0.05 (0.018±0.002)	5.0 (0.197)
Multilayer type 050	2.2max (0.087max)	3.2max (0.126max)				0.45±0.05 (0.018±0.002)	
Multilayer type 075	3.2max (0.126max)	4.2max (0.165max)				0.55±0.05 (0.022±0.002)	

※Radial taping is available for 075 type (Optional)

Unit : mm (inch)

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7. Q or Tangent of Loss Angle (tanδ)

Specified Value	Class 1 (Temperature Compensating)	Multilayer type	30pF or under : $Q \geq 400 + 20C$ 33pF or over : $Q \geq 1000$ C : Nominal Capacitance [pF]
	Class 2 (High Dielectric)	Multilayer type (Characteristics : B, B5)	Rate voltage : 16VDC 1200pF~22000pF (Item ΔJ) : 3.5% max 100000pF : 5.0% max 220000pF~470000pF : 5.0% max 1000000pF~2200000pF : 7.5% max 4700000pF~10000000pF : 12.5% max Rate voltage : 25VDC 10000000pF : 12.5% max Rate voltage : 35VDC 1000000pF : 5.0% max 2200000pF~4700000pF : 7.5% max 10000000pF : 12.5% max Rate voltage : 50VDC 100pF~39000pF : 3.5% max 47000pF~1000000pF : 5.0% max (10000000pF/B5 : 12.5% max) 2200000pF~4700000pF : 12.5% max
		Multilayer type (Characteristics : F)	Rate voltage : 10VDC 4700000pF~10000000pF : 17.5% max Rate voltage : 16VDC 220000pF : 10.0% max 470000pF : 10.0% max 1000000pF : 17.5% max 2200000pF : 15.0% max Rate voltage : 25VDC 10000pF~47000pF (Item ΔJ) : 7.5% max Rate voltage : 35VDC 10000000pF : 17.5% max Rate voltage : 50VDC 10000pF~100000pF : 7.5% max 220000pF~470000pF : 10.0% max 1000000pF : 15.0% max

[Test Methods and Remarks]

Measuring frequency : 1MHz±10% (Class 1 : C≤1000pF)	Measuring voltage : 1.0±0.5Vrms (Class 1 : C≤1000pF)	Bias application : None
: 1kHz±10% (Class 1 : C>1000pF)	: 1.0±0.2Vrms (Class 1 : C>1000pF)	
: 1kHz±10% (Class 2 : C≤10μF)	: 1.0±0.2Vrms (Class 2 : C≤10μF)	
: 120Hz±10% (Class 2 : C>10μF)	: 0.5±0.1Vrms (Class 2 : C>10μF)	

8. Capacitance : Change due to Temperature or Rate of Capacitance Change

When voltage is not applied

Specified Value	Class 1 (Temperature Compensating)	Multilayer type	CH : 0±60 SL : -350~+1000 [ppm/°C]
	Class 2 (High Dielectric)	Multilayer type (Characteristics : B, B5)	±10% (B5 : ±15%)
		Multilayer type (Characteristics : F)	+30% -85%

[Test Methods and Remarks]

Measurement of capacitance at 20°C and 85°C, -25°C shall be made to calculate temperature characteristic by the following equation. (Class 1)

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

Change of maximum capacitance deviation in step 1 to 5 (Class 2)

Temperature at step 1 : 20°C Temperature at step 4 : 85°C
Temperature at step 2 : -25°C Temperature at step 5 : 20°C
Temperature at step 3 : 20°C (Reference temperature) *In the B5 characteristics is, the Temperatures of step 1,3, and 5 are 25°C.

9. Terminal Strength

Tensile

Specified Value	Class 1 (Temperature Compensating)	Multilayer type	No abnormalities, such as cuts or looseness of terminals.
	Class 2 (High Dielectric)	Multilayer type (Characteristics : B, B5)	
		Multilayer type (Characteristics : F)	

[Test Methods and Remarks]

Apply the stated tensile force progressively in the direction to draw terminal.

Nominal wire diameter [mm]	Tensile force [N]	Duration [s]
0.45	19.6	5

Torsional

Specified Value	Class 1 (Temperature Compensating)	Multilayer type	No abnormalities, such as cuts or looseness of terminals.
	Class 2 (High Dielectric)	Multilayer type (Characteristics : B, B5)	
		Multilayer type (Characteristics : F)	

[Test Methods and Remarks]

Suspend a weight of specified mass at the end of the terminals and incline the body through the angle of 90 degrees and return it to the initial position. This operation is done over a period of 5 sec. Then second bend in the opposite direction shall be made.

Number of bends : 2 times

Nominal wire diameter [mm]	Bending force [N]	Mass weight [kg]
0.45	2.45	0.25

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10. Resistance to Vibration

			Appearance : No significant abnormality Withstanding Voltage : No abnormality Capacitance : 4.7pF or under : Within ±0.5pF 5.6pF~8.2pF : Within ±10% 10pF or over : Within ±5% Q : 30pF or under : Q≥400+20C 33pF or over : Q≥1000 Insulation resistance : 10000MΩmin. C : Nominal Capacitance : [pF]
Specified Value	Class 1 (Temperature Compensating)	Multilayer type	Appearance : No significant abnormality Withstanding Voltage : No abnormality Rate Voltage : 16VDC Capacitance : Within ±10% 1200pF~2200pF (Item△J) : Within ±20% 220000pF~1000000pF : Within ±10% tanδ : 1200pF~2200pF (Item△J) : 3.5% max 220000pF~470000pF : 5.0% max 1000000pF~2200000pF : 7.5% max 4700000pF~10000000pF : 12.5% max Insulation Resistance : 1200pF~2200pF (Item△J) : 5000MΩ min 220000pF : 500MΩ min 470000pF : 200MΩ min 1000000pF : 100MΩ min 2200000pF : 50MΩ min 4700000pF~10000000pF : 20MΩ min Rate Voltage : 25VDC Capacitance : Within ±10% tanδ : 1000000pF : 12.5% max Insulation Resistance : 1000000pF : 20MΩ min Rate Voltage : 35VDC Capacitance : Within ±10% tanδ : 1000000pF : 5.0% max 2200000pF~4700000pF : 7.5% max 10000000pF : 12.5% max Insulation Resistance : 1000000pF : 100MΩ min 2200000pF : 50MΩ min 4700000pF : 20MΩ min 10000000pF : 10MΩ min Rate Voltage : 50VDC Capacitance : Within ±10% tanδ : 100pF~3900pF : 3.5% max 4700pF~100000pF : 5.0% max (1000000pF/B5 : 12.5%max) 2200000pF~4700000pF : 12.5%max Insulation Resistance : 100pF~3900pF : 5000MΩ min 4700pF~100000pF : 1000MΩ min 220000pF : 500MΩ min 470000pF : 200MΩ min 1000000pF : 100MΩ min 2200000pF : 40MΩ min 4700000pF : 10MΩ min
	Class 2 (High Dielectric)	Multilayer type (Characteristics : B, B5)	Appearance : No significant abnormality Withstanding Voltage : No abnormality Rate Voltage : 10VDC Capacitance : Within $\begin{matrix} +80 \\ -20 \end{matrix}$ % tanδ : 4700000pF~10000000pF : 17.5% max Insulation Resistance : 4700000pF : 50MΩ min 10000000pF : 25MΩ min Rate Voltage : 16VDC Capacitance : Within $\begin{matrix} +80 \\ -20 \end{matrix}$ % tanδ : 220000pF : 10.0% max 470000pF : 10.0% max 1000000pF : 17.5% max 2200000pF : 15.0% max Insulation Resistance : 220000pF : 500MΩ min 470000pF : 500MΩ min 1000000pF : 250MΩ min 2200000pF : 125MΩ min
		Multilayer type (Characteristics : F)	Appearance : No significant abnormality Withstanding Voltage : No abnormality Rate Voltage : 10VDC Capacitance : Within $\begin{matrix} +80 \\ -20 \end{matrix}$ % tanδ : 4700000pF~10000000pF : 17.5% max Insulation Resistance : 4700000pF : 50MΩ min 10000000pF : 25MΩ min Rate Voltage : 16VDC Capacitance : Within $\begin{matrix} +80 \\ -20 \end{matrix}$ % tanδ : 220000pF : 10.0% max 470000pF : 10.0% max 1000000pF : 17.5% max 2200000pF : 15.0% max Insulation Resistance : 220000pF : 500MΩ min 470000pF : 500MΩ min 1000000pF : 250MΩ min 2200000pF : 125MΩ min

Withstanding voltage is also referred to as "voltage proof" under IEC specifications.

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10. Resistance to Vibration			
Specified Value	Class 2 (High Dielectric)	Multilayer type (Characteristics : F)	Rate Voltage : 25VDC Capacitance : Within $\pm 80_{-20}$ % tan δ : 10000pF~47000pF (Item Δ J) : 7.5% max Insulation Resistance : 10000pF~47000pF (Item Δ J) : 1000M Ω min
			Rate Voltage : 35VDC Capacitance : Within $\pm 80_{-20}$ % tan δ : 10000000pF : 17.5% max Insulation Resistance : 10000000pF : 25M Ω min
			Rate Voltage : 50VDC Capacitance : Within $\pm 80_{-20}$ % tan δ : 10000pF~100000pF : 7.5% max 220000pF~470000pF : 10.0% max 1000000pF : 15.0% max Insulation Resistance : 10000pF~100000pF : 1000M Ω min 220000pF~470000pF : 500M Ω min 1000000pF : 250M Ω min

[Test Methods and Remarks]

According to JIS C 5102 clause 8.2
Vibration type : A
Directions : 2 hrs each in X, Y and Z directions
Total : 6 hrs
Frequency range : 10 to 55 to 10Hz (1min)
Amplitude : 1.5 mm
Mounting method : Soldering onto the PC board

11. Free Fall			
Specified Value	Class 1 (Temperature Compensating)	Multilayer type	Appearance : No significant abnormality Withstanding Voltage : No abnormality Capacitance : 4.7pF or under : Within ± 0.5 pF 5.6pF~8.2pF : Within ± 10 % 10pF or over : Within ± 5 % Q : 30pF or under $Q \geq 400+20C$: 33pF or over $Q \geq 1000$ Insulation resistance : 10000M Ω min. C : Nominal Capacitance[pF]
	Class 2 (High Dielectric)	Multilayer type (Characteristics : B, B5)	Appearance : No significant abnormality Withstanding Voltage : No abnormality Rate Voltage : 16VDC Capacitance : 1200pF~22000pF (Item Δ J) : Within ± 20 % 220000pF~1000000pF : Within ± 10 % tan δ : 1200pF~22000pF (Item Δ J) : 3.5% max 220000pF~470000pF : 5.0% max 1000000pF~2200000pF : 7.5% max 4700000pF~10000000pF : 12.5% max Insulation resistance : 1200pF~22000pF (Item Δ J) : 5000M Ω min 220000pF : 500M Ω min 470000pF : 200M Ω min 1000000pF : 100M Ω min 2200000pF : 50M Ω min 4700000pF~10000000pF : 20M Ω min Rate Voltage : 25VDC Capacitance : Within ± 10 % tan δ : 10000000pF : 12.5% max Insulation resistance : 10000000pF : 20M Ω min Rate Voltage : 35VDC Capacitance : Within ± 10 % tan δ : 1000000pF : 5.0% max 2200000pF~4700000pF : 7.5% max 10000000pF : 12.5% max Insulation resistance : 1000000pF : 100M Ω min 2200000pF : 50M Ω min 4700000pF : 20M Ω min 10000000pF : 10M Ω min

Withstanding voltage is also referred to as "voltage proof" under IEC specifications.

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11. Free Fall

Specified Value	Class 2 (High Dielectric)	Multilayer type (Characteristics : B, B5)	Rate Voltage : 50VDC Capacitance : Within $\pm 10\%$ tan δ : 100pF~39000pF : 3.5% max 47000pF~1000000pF : 5.0% max (1000000pF/B5 : 12.5% max) 2200000pF~4700000pF : 12.5% max Insulation resistance : 100pF~39000pF : 5000M Ω min 47000pF~100000pF : 1000M Ω min 220000pF : 500M Ω min 470000pF : 200M Ω min 1000000pF : 100M Ω min 2200000pF : 40M Ω min 4700000pF : 10M Ω min
			Appearance : No significant abnormality Withstanding Voltage : No abnormality Rate Voltage : 10VDC Capacitance : Within $\pm 80_{-20}\%$ tan δ : 4700000pF~10000000pF : 17.5% max Insulation resistance : 4700000pF : 50M Ω min 10000000pF : 25M Ω min
			Rate Voltage : 16VDC Capacitance : Within $\pm 80_{-20}\%$ tan δ : 220000pF : 10.0% max 470000pF : 10.0% max 1000000pF : 17.5% max 2200000pF : 15.0% max Insulation resistance : 220000pF : 500M Ω min 470000pF : 500M Ω min 1000000pF : 250M Ω min 2200000pF : 125M Ω min
		Multilayer type (Characteristics : F)	Rate Voltage : 25VDC Capacitance : Within $\pm 80_{-20}\%$ tan δ : 10000pF~47000pF (Item Δ J) : 7.5% max Insulation resistance : 10000pF~47000pF (Item Δ J) : 1000M Ω min
			Rate Voltage : 35VDC Capacitance : Within $\pm 80_{-20}\%$ tan δ : 10000000pF : 17.5% max Insulation resistance : 10000000pF : 25M Ω min
			Rate Voltage : 50VDC Capacitance : Within $\pm 80_{-20}\%$ tan δ : 10000pF~100000pF : 7.5% max 220000pF~470000pF : 10.0% max 1000000pF : 15.0% max Insulation resistance : 10000pF~100000pF : 1000M Ω min 220000pF~470000pF : 500M Ω min 1000000pF : 250M Ω min

【Test Methods and Remarks】

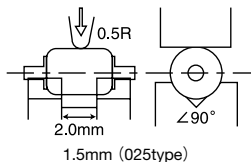
Drop Test : Free fall
Impact material : Floor
Height : 1 m
Total number of drops : 5 times

12. Body Strength

Specified Value	Class 1 (Temperature Compensating)	Multilayer type	No abnormality such as damage.
	Class 2 (High Dielectric)	Multilayer type (Characteristics : B, B5)	
		Multilayer type (Characteristics : F)	

【Test Methods and Remarks】

Applied force : 19.6N
Duration : 5 sec.
Speed : Shall attain to specified force in 2 sec.



13. Solderability

Specified Value	Class 1 (Temperature Compensating)	Multilayer type	At least 75% of lead surface is covered with new solder.
	Class 2 (High Dielectric)	Multilayer type (Characteristics : B, B5)	
		Multilayer type (Characteristics : F)	

【Test Methods and Remarks】

Solder temperature : 230 \pm 5 $^{\circ}$ C
Duration : 2 \pm 0.5 sec. (This test may be applicable after 6 months storage.)

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14. Soldering

Specified Value	Class 1 (Temperature Compensating)	Multilayer type	<p>Appearance : No significant abnormality Withstanding Voltage : No abnormality</p> <p>Capacitance change : 8.2pF or under : Within ± 0.25pF 10pF or over : Within ± 2.5% Q : 30pF or under $Q \geq 400+20C$: 33pF or over $Q \geq 1000$ Insulation resistance : 10000MΩ min. C : Nominal Capacitance[pF]</p>
	Class 2 (High Dielectric)	Multilayer type (Characteristics : B, B5)	<p>Appearance : No significant abnormality Withstanding Voltage : No abnormality</p> <p>Rate Voltage : 16VDC Capacitance change : 1200pF~22000pF (ItemΔJ) : Within ± 7.5% 220000pF~1000000pF : Within ± 10.0% tanδ : 1200pF~22000pF (ItemΔJ) : 3.5% max 220000pF~470000pF : 5.0% max 1000000pF~2200000pF : 7.5% max 4700000pF~10000000pF : 12.5% max Insulation resistance : 1200pF~22000pF (ItemΔJ) : 5000MΩ min 220000pF : 500MΩ min 470000pF : 200MΩ min 1000000pF : 100MΩ min 2200000pF : 50MΩ min 4700000pF~10000000pF : 20MΩ min</p> <p>Rate Voltage : 25VDC Capacitance change : 10000000pF : Within ± 10.0% tanδ : 10000000pF : 12.5% max Insulation resistance : 10000000pF : 20MΩ min</p> <p>Rate Voltage : 35VDC Capacitance change : 1000000pF~10000000pF : Within ± 10.0% tanδ : 1000000pF : 5.0% max 2200000pF~4700000pF : 7.5% max 10000000pF : 12.5% max Insulation resistance : 1000000pF : 100MΩ min 2200000pF : 50MΩ min 4700000pF : 20MΩ min 10000000pF : 10MΩ min</p>
		Multilayer type (Characteristics : F)	<p>Appearance : No significant abnormality Withstanding Voltage : No abnormality Rate Voltage : 10VDC Capacitance change : Within ± 20%</p> <p>tanδ : 4700000pF~10000000pF : 17.5% max</p> <p>Insulation resistance : 4700000pF : 50MΩ min 10000000pF : 25MΩ min</p> <p>Rate Voltage : 16VDC Capacitance change : Within ± 20%</p> <p>tanδ : 220000pF~470000pF : 10.0% max 1000000pF : 17.5% max 2200000pF : 15.0% max</p> <p>Insulation resistance : 220000pF~470000pF : 500MΩ min 1000000pF : 250MΩ min 2200000pF : 125MΩ min</p> <p>Rate Voltage : 25VDC Capacitance change : Within ± 20% tanδ : 10000pF~47000pF (ItemΔJ) : 7.5% max Insulation resistance : 10000pF~47000pF (ItemΔJ) : 1000MΩ min</p>
		Class 1 (Temperature Compensating)	Multilayer type

Withstanding voltage is also referred to as "voltage proof" under IEC specifications.
Thermal Shock is also referred to as "rapid change of temperature" under IEC specifications.

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14. Soldering			
Specified Value	Class 2 (High Dielectric)	Multilayer type (Characteristics : F)	Rate Voltage : 35VDC Capacitance change : Within $\pm 20\%$ tan δ : 1000000pF : 17.5% max Insulation resistance : 1000000pF : 25M Ω min
			Rate Voltage : 50VDC Capacitance change : 1000pF~100000pF : Within $\pm 20.0\%$ tan δ : 1000pF~10000pF : 7.5% max 22000pF~47000pF : 10.0% max 100000pF : 15.0% max Insulation resistance : 1000pF~10000pF : 1000M Ω min 22000pF~47000pF : 500M Ω min 100000pF : 250M Ω min

[Test Methods and Remarks]
 Solder temperature : 270 \pm 5 $^{\circ}$ C
 Duration : 5 \pm 0.5 sec.
 Immersed conditions : Inserted into the PC board (with t=1.6mm, hole=1.0mm diameter)
 Preconditioning : 1 hr of preconditioning at 150 \pm 10 $^{\circ}$ C followed by 48 \pm 4 hrs of recovery under the standard condition.
 Recovery : Recovery for the following period under the standard condition after the test.
 24 \pm 2 hrs (Class 1)
 48 \pm 4 hrs (Class 2)

15. Resistance to Solvent			
Specified Value	Class 1 (Temperature Compensating)	Multilayer type	No significant abnormality in appearance and legible marking.
	Class 2 (High Dielectric)	Multilayer type (Characteristics : B, B5)	
		Multilayer type (Characteristics : F)	

[Test Methods and Remarks]
 According to JIS C 5102 clause 8.7.4.
 Type of test : Method 1
 Solvent temperature : 20 to 25 $^{\circ}$ C
 Duration : 30 \pm 5 sec.
 Solvent Type : A in Table 23, Isopropyl alcohol

16. Thermal Shock			
Specified Value	Class 1 (Temperature Compensating)	Multilayer type	Appearance : No significant abnormality Withstanding Voltage : No abnormality Capacitance change : 8.2pF or under : Within $\pm 0.5\text{pF}$ 10pF or over : Within $\pm 5.0\%$ Q : 8.2pF or under Q $\geq 200+10\text{C}$: 10pF~30pF Q $\geq 275+2.5\text{C}$: 33pF or over Q ≥ 350 Insulation resistance : 1000M Ω or over C : Nominal Capacitance[pF]
	Class 2 (High Dielectric)	Multilayer type (Characteristics : B, B5)	Appearance : No significant abnormality Withstanding Voltage : No abnormality Rate Voltage : 16VDC Capacitance change : 1200pF~2200pF (Item Δ J) : Within $\pm 12.5\%$ 22000pF~1000000pF : Within $\pm 15.0\%$ tan δ : 1200pF~2200pF (Item Δ J) : 5.0% max 22000pF~47000pF : 7.5% max 100000pF~220000pF : 10.0% max 470000pF~1000000pF : 22.5% max Insulation resistance : 1200pF~2200pF (Item Δ J) : 1000M Ω min 22000pF : 125M Ω min 47000pF : 50M Ω min 100000pF : 25M Ω min 220000pF : 12.5M Ω min 470000pF~1000000pF : 5M Ω min Rate Voltage : 25VDC Capacitance change : 1000000pF : Within $\pm 15.0\%$ tan δ : 1000000pF : 15.0% max Insulation resistance : 1000000pF : 5M Ω min Rate Voltage : 35VDC Capacitance change : 100000pF : Within $\pm 15.0\%$ 220000pF~470000pF : Within $\pm 15.0\%$ 1000000pF : $\pm 22.5\%$ max tan δ : 100000pF : 7.5% max 220000pF~470000pF : 10.0% max 1000000pF : $\pm 22.5\%$ max Insulation resistance : 100000pF : 50M Ω min 220000pF : 25M Ω min 470000pF~1000000pF : 5M Ω min

Withstanding voltage is also referred to as "voltage proof" under IEC specifications. To next page
 Thermal Shock is also referred to as "rapid change of temperature" under IEC specifications.

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16. Thermal Shock

Specified Value	Class 2 (High Dielectric)	Multilayer type (Characteristics : B, B5)	Rate Voltage : 50VDC Capacitance change : 100pF~39000pF : Within ±12.5% 47000pF~470000pF : Within ±15.0% (1000000pF/B5 : Within ±22.5%) tanδ : 100pF~39000pF : 5.0% max 47000pF~100000pF : 7.5% max (1000000pF/B5 : Within ±17.5%) 2200000pF~47000000pF : 22.5% max Insulation resistance : 100pF~39000pF : 1000MΩ min 47000pF~100000pF : 500MΩ min 220000pF : 250MΩ min 470000pF : 100MΩ min 1000000pF : 50MΩ min 2200000pF : 20MΩ min 4700000pF : 5MΩ min
			Appearance : No significant abnormality Withstanding Voltage : No abnormality Rate Voltage : 10VDC Capacitance change : Within ±30.0% tanδ : 4700000pF~10000000pF : 20.0% max Insulation resistance : 4700000pF : 10MΩ min 10000000pF : 5MΩ min
			Rate Voltage : 16VDC Capacitance change : Within ±30.0% tanδ : 220000pF~470000pF : 15.0% max 1000000pF : 22.5% max 2200000pF : 17.5% max Insulation resistance : 220000pF : 100MΩ min 470000pF : 50MΩ min 1000000pF : 25MΩ min 2200000pF : 25MΩ min
		Multilayer type (Characteristics : F)	Rate Voltage : 25VDC Capacitance change : Within ±30% tanδ : 10000pF~47000pF (Item△J) : 12.5% max Insulation resistance : 10000pF~47000pF (Item△J) : 500MΩ min
			Rate Voltage : 35VDC Capacitance change : Within ±30.0% tanδ : 10000000pF : 20.0% max Insulation resistance : 10000000pF : 5MΩ min
			Rate Voltage : 50VDC Capacitance change : 10000pF~1000000pF : Within ±30.0% tanδ : 10000pF~100000pF : 12.5% max 220000pF~470000pF : 15.0% max 1000000pF : 17.5% max Insulation resistance : 10000pF~100000pF : 500MΩ min 220000pF~470000pF : 250MΩ min 1000000pF : 50MΩ min

[Test Methods and Remarks]

Conditions for 1 cycle

Step	Temperature [°C]	Duration [min.]
1	Room temperature	Within 3
2	-25± ₃ ⁰	30±3
3	Room temperature	Within 3
4	+85± ₀ ³	30±3
5	Room temperature	Within 3

Number of cycles : 5

Preconditioning : 1 hr of preconditioning at 150⁺⁰₋₁₀ °C followed by 48±4 hrs of recovery under the standard condition.

Recovery : Recovery for the following period under the standard condition after the removal from test chamber.

24±2 hrs (Class 1)

48±4 hrs (Class 2)

Withstanding voltage is also referred to as "voltage proof" under IEC specifications.

Thermal Shock is also referred to as "rapid change of temperature" under IEC specifications.

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AXIAL LEADED CERAMIC CAPACITORS

17. Damp Heat (steady state)

Specified Value	Class 1 (Temperature Compensating)	Multilayer type	<p>Appearance : No significant abnormality Withstanding Voltage : No abnormality Capacitance change : 8.2pF or under : Within ±0.5pF 10pF or over : Within ±5.0% Q : 8.2pF or under Q_≥200+10C : 10pF~30pF Q_≥275+2.5C : 33pF or over Q_≥350 Insulation resistance : 1000MΩ min C : Nominal Capacitance [pF]</p>
		Multilayer type (Characteristics : B, B5)	<p>Appearance : No significant abnormality Withstanding Voltage : No abnormality Rate Voltage : 16VDC Capacitance change : 1200pF~22000pF (Item△J) : Within ±12.5% 220000pF~10000000pF : Within ±15.0% tanδ : 1200pF~22000pF (Item△J) : 5.0% max 220000pF~470000pF : 7.5% max 1000000pF~2200000pF : 10.0% max 4700000pF~10000000pF : 22.5% max Insulation resistance : 1200pF~22000pF (Item△J) : 1000MΩ min 220000pF : 125MΩ min 470000pF : 50MΩ min 1000000pF : 25MΩ min 2200000pF : 12.5MΩ min 4700000pF~10000000pF : 5MΩ min Rate Voltage : 25VDC Capacitance change : 10000000pF : Within ±15.0% tanδ : 10000000pF : 15.0% max Insulation resistance : 10000000pF : 5MΩ min Rate Voltage : 35VDC Capacitance change : 1000000pF : Within ±15.0% 2200000pF~4700000pF : Within ±15.0% 10000000pF : Within 22.5% tanδ : 1000000pF : 10.0% max 2200000pF~4700000pF : 10.0% max 10000000pF : 22.5% max Insulation resistance : 1000000pF : 50MΩ min 2200000pF : 25MΩ min 4700000pF~10000000pF : 5MΩ min Rate Voltage : 50VDC Capacitance change : 100pF~39000pF : Within ±12.5% 47000pF~4700000pF : Within ±15.0% (1000000pF/B5 : Within 22.5%) tanδ : 100pF~39000pF : 5.0% max 47000pF~1000000pF : 7.5% max (1000000/B5 : 17.5% max) 2200000pF~4700000pF : 22.5% max Insulation resistance : 100pF~39000pF : 1000MΩ min 47000pF~1000000pF : 500MΩ min 220000pF : 250MΩ min 470000pF : 100MΩ min 1000000pF : 50MΩ min 2200000pF : 20MΩ min 4700000pF : 5MΩ min</p>
	Multilayer type (Characteristics : B, B5)	<p>Appearance : No significant abnormality Withstanding Voltage : No abnormality Rate Voltage:10VDC Capacitance change : Within ±30.0% tanδ: 4700000pF~10000000pF : 20.0% max Insulation resistance: 4700000pF : 10MΩ min 10000000pF : 5MΩ min Rate Voltage:16VDC Capacitance change : Within ±30.0% tanδ: 220000pF~470000pF : 15.0% max 1000000pF : 22.5% max 2200000pF : 17.5% max Insulation resistance: 220000pF : 100MΩ min 470000pF : 50MΩ min 1000000pF : 25MΩ min 2200000pF : 25MΩ min</p>	
	Class 2 (High Dielectric)	Multilayer type (Characteristics : F)	<p>Appearance : No significant abnormality Withstanding Voltage : No abnormality Rate Voltage:10VDC Capacitance change : Within ±30.0% tanδ: 4700000pF~10000000pF : 20.0% max Insulation resistance: 4700000pF : 10MΩ min 10000000pF : 5MΩ min Rate Voltage:16VDC Capacitance change : Within ±30.0% tanδ: 220000pF~470000pF : 15.0% max 1000000pF : 22.5% max 2200000pF : 17.5% max Insulation resistance: 220000pF : 100MΩ min 470000pF : 50MΩ min 1000000pF : 25MΩ min 2200000pF : 25MΩ min</p>

Withstanding voltage is also referred to as "voltage proof" under IEC specifications.

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AXIAL LEADED CERAMIC CAPACITORS

17. Damp Heat (steady state)			
Specified Value	Class 2 (High Dielectric)	Multilayer type (Characteristics : F)	Rate Voltage: 25VDC Capacitance change : Within ±30% tanδ: 10000pF~47000pF (Item△J): 12.5% max Insulation resistance: 10000pF~47000pF (Item△J) : 500MΩ min
			Rate Voltage : 35VDC Capacitance change : Within ±30.0% tanδ: 10000000pF : 20.0% max Insulation resistance: 10000000pF : 5MΩ min
			Rate Voltage: 50VDC Capacitance change: 10000pF~1000000pF : Within ±30.0% tanδ: 10000pF~100000pF : 12.5% max 220000pF~470000pF : 15.0% max 1000000pF : 17.5% max Insulation resistance: 10000pF~100000pF : 500MΩ min 220000pF~470000pF : 250MΩ min 1000000pF : 50MΩ min

[Test Methods and Remarks]

Temperature : 40±2°C
 Humidity : 90 to 95 % RH
 Duration : 500hrs⁺²⁴₋₀ hrs
 Preconditioning : 1 hr of preconditioning at 150⁺⁰₋₁₀ °C followed by 48±4 hrs of recovery under the standard condition.
 Recovery : 24±2 hrs of recovery under the standard condition after the removal from test chamber. (Class 1)
 : 1 hr of preconditioning at 150⁺¹⁰₋₀ °C followed by 48±4 hrs of recovery under the standard condition after the removal from chamber. (Class 2)

18. Loading under Damp Heat			
Specified Value	Class 1 (Temperature Compensating)	Multilayer type	Appearance : No significant abnormality Withstanding Voltage : No abnormality Capacitance change : 8.2pF or under : Within ±0.75pF 10pF or over : Within ±7.5% Q : 30pF or under Q≥100+10/3°C : 33pF or over Q≥200 Insulation resistance : 500MΩ min C : Nominal Capacitance [pF]
			Appearance : No significant abnormality Withstanding Voltage : No abnormality Rate Voltage : 16VDC Capacitance change : 1200pF~22000pF (Item△J) : Within ±12.5% 220000pF~470000pF : Within ±15.0% 1000000pF~10000000pF : Within ±22.5% tanδ : 1200pF~22000pF (Item△J) : 5.0% max 220000pF~470000pF : 7.5% max 1000000pF~2200000pF : 10.0% max 4700000pF~10000000pF : 22.5% max Insulation resistance : 1200pF~22000pF (Item△J) : 500MΩ min 220000pF : 50MΩ min 470000pF : 25MΩ min 1000000pF : 12.5MΩ min 2200000pF : 5.0MΩ min 4700000pF~10000000pF : 2.5MΩ min
	Class 2 (High Dielectric)	Multilayer type (Characteristics : B, B5)	Rate Voltage : 25VDC Capacitance change : 10000000pF : Within ±22.5% tanδ : 10000000pF : 22.5% max Insulation resistance : 10000000pF : 2.5MΩ min Rate Voltage : 35VDC Capacitance change : 1000000pF : Within ±15.0% 2200000pF : Within ±15.0% 4700000pF~10000000pF : Within ±22.5% tanδ : 1000000pF : 10.0% max 2200000pF~4700000pF : 10.0% max 1000000pF : 22.5% max Insulation resistance : 1000000pF : 12.5MΩ min 2200000pF : 5.0MΩ min 4700000pF~10000000pF : 2.5MΩ min

Withstanding voltage is also referred to as "voltage proof" under IEC specifications.

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AXIAL LEADED CERAMIC CAPACITORS

18. Loading under Damp Heat

Specified Value	Class 2(High Dielectric)	Multilayer type (Characteristics : B, B5)	Rate Voltage : 50VDC Capacitance change : 100pF~39000pF : Within ±12.5% 47000pF~100000pF : Within ±15.0% (1000000pF/B5 : Within 22.5%) 2200000pF~4700000pF : Within 22.5% tanδ : 100pF~39000pF : 5.0% max 47000pF~100000pF : 7.5% max 1000000pF/B5 : 17.5% max 2200000pF~4700000pF : 22.5% max Insulation resistance : 100pF~39000pF : 500MΩ min 47000pF~100000pF : 250MΩ min 2200000pF : 125MΩ min 4700000pF : 25MΩ min 10000000pF : 12.5MΩ min 22000000pF : 10MΩ min 47000000pF : 2.5MΩ min
		Multilayer type (Characteristics : F)	Appearance : No significant abnormality Withstanding Voltage : No abnormality Rate Voltage : 10VDC Capacitance change : Within ±30.0% tanδ : 47000000pF~100000000pF : 20.0% max Insulation resistance : 47000000pF : 5MΩ min 100000000pF : 2.5MΩ min Rate Voltage : 16VDC Capacitance change : Within ±30.0% tanδ : 2200000pF~4700000pF : 15.0% max 10000000pF : 22.5% max 22000000pF : 17.5% max Insulation resistance : 2200000pF : 50MΩ min 4700000pF : 25MΩ min 10000000pF : 12.5MΩ min 22000000pF : 12.5MΩ min Rate Voltage : 25VDC Capacitance change : Within ±30.0% tanδ : 10000pF~47000pF (Item△J) : 12.5% max Insulation resistance : 10000pF~47000pF (Item△J) : 250MΩ min Rate Voltage : 35VDC Capacitance change : Within ±30.0% tanδ : 100000000pF : 20.0% max Insulation resistance : 100000000pF : 2.5MΩ min Rate Voltage : 50VDC Capacitance change : 10000pF~100000pF : Within ±30.0% tanδ : 10000pF~100000pF : 12.5% max 220000pF~470000pF : 15.0% max 1000000pF : 17.5% max Insulation resistance : 10000pF~100000pF : 250MΩ min 220000pF~470000pF : 125MΩ min 1000000pF : 25MΩ min

【Test Methods and Remarks】

Temperature : 40±2℃

Humidity : 90 to 95 % RH

Duration : 500 ⁺²⁴/₋₀ hrs

Applied voltage : Rate voltage

Preconditioning : 1 hr of preconditioning at 150 ⁺⁰/₋₁₀ °C followed by 48±4 hrs of recovery under the standard condition.

Recovery : 24±2 hrs of recovery under the standard condition after the removal from test cham-ber. (Class 1)

: 1 hr of preconditioning at 150 ⁺¹⁰/₋₀ °C followed by 48±4 hrs of recovery under the standard condition after the removal from chamber. (Class 2)

Withstanding voltage is also referred to as "voltage proof" under IEC specifications.

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AXIAL LEADED CERAMIC CAPACITORS

19. High Temperature Lading Test

Specified Value	Class 1 (Temperature Compensating)	Multilayer type	Appearance : No significant abnormality Withstanding Voltage : No abnormality Capacitance change : 8.2pF or under : Within $\pm 0.3\text{pF}$ 10pF or over : Within $\pm 3.0\%$ Q : 8.2pF or under : $Q \geq 200+10C$: 10pF~30pF : $Q \geq 275+2.5C$: 33pF or over : $Q \geq 350$ Insulation resistance : 1000M Ω min C : Nominal Capacitance[pF]
Specified Value	Class 2 (High Dielectric)	Multilayer type (Characteristics : B, B5)	Appearance : No significant abnormality Withstanding Voltage : No abnormality Rate Voltage : 16VDC Capacitance change : 1200pF~2200pF (Item Δ J) : Within $\pm 12.5\%$ 22000pF~47000pF : Within $\pm 15.0\%$ 100000pF~1000000pF : Within $\pm 22.5\%$ tan δ : 1200pF~2200pF (Item Δ J) : 5.0% max 22000pF~47000pF : 7.5% max 100000pF~220000pF : 10.0% max 470000pF~1000000pF : 22.5% max Insulation resistance : 1200pF~2200pF (Item Δ J) : 1000M Ω min 22000pF : 125M Ω min 47000pF : 50M Ω min 100000pF : 25M Ω min 220000pF : 12.5M Ω min 470000pF~1000000pF : 5.0M Ω min
			Rate Voltage : 25VDC Capacitance change : 1000000pF : Within $\pm 22.5\%$ tan δ : 1000000pF : 22.5% max Insulation resistance : 1000000pF : 5M Ω min Rate Voltage : 35VDC Capacitance change : 1000000pF : Within $\pm 15.0\%$ 220000pF : Within $\pm 15.0\%$ 470000pF~1000000pF : Within 22.5% tan δ : 1000000pF : 10.0% max 220000pF~470000pF : 10.0% max 1000000pF : 22.5% max Insulation resistance : 1000000pF : 25M Ω min 220000pF : 25M Ω min 470000pF~1000000pF : 5M Ω min Rate Voltage : 50VDC Capacitance change : 100pF~39000pF : Within $\pm 12.5\%$ 47000pF~100000pF : Within $\pm 15.0\%$ (1000000pF/B5 : Within 22.5%) 220000pF~470000pF : Within $\pm 22.5\%$ tan δ : 100pF~39000pF : 5.0% max 47000pF~100000pF : 7.5% max (1000000/B5 : 17.5% max) 220000pF~470000pF : 22.5% max Insulation resistance : 100pF~39000pF : 1000M Ω min 47000pF~100000pF : 500M Ω min 220000pF : 250M Ω min 470000pF : 100M Ω min 1000000pF : 50M Ω min 220000pF : 20M Ω min 470000pF : 5M Ω min

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AXIAL LEADED CERAMIC CAPACITORS

19. High Temperature Lading Test

Specified Value	Class 2(High Dielectric)	Multilayer type (Characteristics : F)	Appearance : No significant abnormality Withstanding Voltage : No abnormality
			Rate Voltage : 10VDC Capacitance change : Within ±30.0% tanδ : 4700000pF~10000000pF : 20.0% max Insulation resistance : 4700000pF : 10MΩ min 10000000pF : 5MΩ min
			Rate Voltage : 16VDC Capacitance change : ±30% tanδ : 2200000pF~4700000pF : 15.0% max 10000000pF : 22.5% max 22000000pF : 17.5% max Insulation resistance : 2200000pF : 100MΩ min 4700000pF : 50MΩ min 10000000pF : 25MΩ min 22000000pF : 25MΩ min
			Rate Voltage : 25VDC Capacitance change : Within ±30% tanδ : 10000pF~47000pF (ItemΔJ) : 10.0% max Insulation resistance : 10000pF~47000pF (ItemΔJ) : 500MΩ min
			Rate Voltage : 35VDC Capacitance change : Within ±30.0% tanδ : 10000000pF : 20.0% max Insulation resistance : 10000000pF : 5MΩ min
			Rate Voltage : 50VDC Capacitance change : Within 30.0% tanδ : 10000pF~100000pF : 10.0% max 2200000pF~4700000pF : 12.5% max 10000000pF : 17.5% max Insulation resistance : 10000pF~100000pF : 500MΩ min 2200000pF~4700000pF : 250MΩ min 10000000pF : 50MΩ min

【Test Methods and Remarks】

Temperature : $85 \pm \begin{smallmatrix} 3 \\ 0 \end{smallmatrix} ^\circ\text{C}$

Duration : $1000 \pm \begin{smallmatrix} 48 \\ 0 \end{smallmatrix} \text{ hrs}$

Applied voltage : Rate voltage×2

: Rate voltage×1.5

Class 2 : B,B5 1000000pF (025Type)

B,B5 2200000pF~10000000pF (050Type, 075Type)

Preconditioning : 1 hr of preconditioning at $150 \pm \begin{smallmatrix} 10 \\ 0 \end{smallmatrix} ^\circ\text{C}$ followed by 48 ± 4 hrs of recovery under the standard condition.

Recovery : 24 ± 2 hrs of recovery under the standard condition after the removal from test chamber. (Class1)

: 1 hr of preconditioning at $150 \pm \begin{smallmatrix} 10 \\ 0 \end{smallmatrix} ^\circ\text{C}$ followed by 48 ± 4 hrs of recovery under the standard condition after the removal from chamber. (Class 2)

Note on standard condition : "standard condition" referred to herein is defined as follows :

5 to 35°C of temperature, 45 to 85% relative humidity, and 86 to 106kPa of air pressure.

When there are questions concerning measurement results :

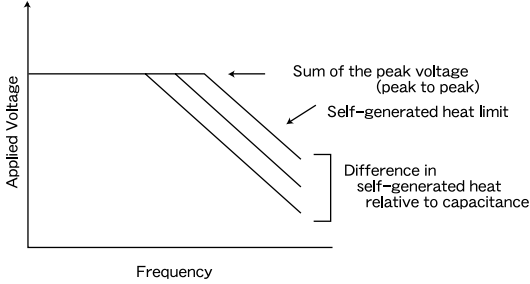
In order to provide correlation data, the test shall be conducted under condition of $20 \pm 2^\circ\text{C}$ of temperature, 60 to 70% relative humidity, and 86 to 106kPa of air pressure. Unless otherwise specified, all the tests are conducted under the "standard condition."

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PRECAUTIONS

1. Circuit Design

Precautions	<ul style="list-style-type: none"> ◆Verification of operating environment, electrical rating and performance <ol style="list-style-type: none"> 1. A malfunction in medical equipment, spacecraft, nuclear reactors, etc. may cause serious harm to human life or have severe social ramifications. As such, any capacitors to be used in such equipment may require higher safety and/or reliability considerations and should be clearly differentiated from components used in general purpose applications. ◆Verification of Rated voltage (DC rated voltage) <ol style="list-style-type: none"> 1. The operating voltage for capacitors must always be lower than their rated values. If an AC voltage is loaded on a DC voltage, the sum of the two peak voltages should be lower than the rated value of the capacitor chosen. For a circuit where both an AC and a pulse voltage may be present, the sum of their peak voltages should also be lower than the capacitor's rated voltage. ◆Self-generated heat (Verification of Temperature) <ol style="list-style-type: none"> 1. If the capacitors specified only for DC use are used in AC or pulse circuits, the AC or a pulse current can generate heat inside the capacitor so the self-generated temperature rise should be limited to within 20°C. The surface temperature measured should include this self-temperature rise. Therefore, it is required to limit capacitor surface temperature including self-generated heat should not exceed the maximum operating temperature of +85°C. ◆Operating Environment precautions <ol style="list-style-type: none"> 1. Capacitors should not be used in the following environments: <ol style="list-style-type: none"> (1) Environmental conditions to avoid <ol style="list-style-type: none"> a. exposure to water or salt water. b. exposure to moisture or condensation. c. exposure to corrosive gases (such as hydrogen sulfide, sulfurous acid, chlorine, and ammonia)
Technical considerations	<ol style="list-style-type: none"> 1-1. When an AC or a pulse voltage is applied to capacitors specified for DC use, even if the voltage is less than the rated voltage, the AC current or pulse current running through the capacitor will cause the capacitor to self-generate heat because of the loss characteristics. The amount of heat generated depends on the dielectric materials used, capacitance, applied voltage, frequency, voltage waveform, etc. The surface temperature changes due to emitted heat which differs by capacitor shape or mounting method. Please contact Taiyo Yuden with any questions regarding emitted heat levels in your particular application. It is recommended the temperature rise be measured in the actual circuit to be used. 1-2. For capacitors, the voltage and frequency relationship is generally determined by peak voltage at low frequencies, and by self-generated heat at high frequencies. (Refer to the following curve.) 

2. PCB Design

Precautions	<ul style="list-style-type: none"> ◆Design of the capacitor mount <ol style="list-style-type: none"> 1. When capacitors are mounted onto a PC board, hole dimensions on the board should match the lead pitch of the component, if not it will cause breakage of the terminals or cracking of terminal roots covered with resin as excess stress travels through the terminal legs. As a result, humidity resistance performance would be lost and may lead to a reduction in insulation resistance and cause a withstand voltage failure.
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3. Considerations for automatic insertion

Precautions	<ul style="list-style-type: none"> ◆Adjustment Automatic Insertion machines (lead components) <ol style="list-style-type: none"> 1. When inserting capacitors in a PC board by auto-insertion machines the impact load imposed on the capacitors should be minimized to prevent the leads from chocking or clinching.
Technical considerations	<ol style="list-style-type: none"> 1. When installing products, care should be taken not to apply distortion stress as it may deform the products. 2. Our company recommends the method to place the lead with fewer loads that join the product.

4. Soldering

Precautions	<ul style="list-style-type: none"> ◆Selection of Flux <ol style="list-style-type: none"> 1. When soldering capacitors are on the board, flux should be applied thinly and evenly. 2. Flux used should be with less than or equal to 0.1 wt% (equivalent to Chlorine) of halogenated content. Flux having a strong acidity content should not be applied. 3. When using water-soluble flux, special care should be taken to properly clean the boards. ◆Wave Soldering <ol style="list-style-type: none"> 1. Temperature, time, amount of solder, etc. are specified in accordance with the following recommended conditions. 2. Do not immerse the entire capacitor in the flux during the soldering operation. Only solder the lead wires on the bottom of the board. ◆Recommended conditions for using a soldering iron: <ol style="list-style-type: none"> 1. Put the soldering iron on the land-pattern. <ul style="list-style-type: none"> Soldering iron's temperature - below 350°C Duration - 3 seconds or less Numbers of times - 1 times The soldering iron should not directly touch the capacitor.
Technical considerations	<ul style="list-style-type: none"> ◆Selection of Flux <ol style="list-style-type: none"> 1. Flux is used to increase solderability in wave soldering, but if too much is applied, a large amount of flux gas may be emitted and may detrimentally affect solderability. To minimize the amount of flux applied, it is recommended to use a flux-bubbling system. 2. With too much halogenated substance (Chlorine, etc.) content is used to activate the flux, an excessive amount of residue after soldering may lead to corrosion of the terminal electrodes or degradation of insulation resistance on the surface of the capacitors. 3. Since the residue of water-soluble flux is easily dissolved by water content in the air, the residue on the surface of capacitors in high humidity conditions may cause a degradation of insulation resistance and therefore affect the reliability of the components. The cleaning methods and the capability of the machines used should also be considered carefully when selecting water-soluble flux. ◆Wave Soldering <ol style="list-style-type: none"> 1. If capacitors are used beyond the range of the recommended conditions, heat stresses may cause cracks inside the capacitors, and consequently degrade the reliability of the capacitors. 2. When the capacitors are dipped in solder, some soldered parts of the capacitor may melt due to solder heat and cause short-circuits or cracking of the ceramic material. Deterioration of the resin coating may lower insulation resistance and cause a reduction of withstand voltage. ◆Recommended conditions for using a soldering iron: <ol style="list-style-type: none"> 1. If products are used beyond the range of the recommended conditions, heat stress may deform the products, and consequently degrade the reliability of the products.

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PRECAUTIONS

5. Cleaning	
Precautions	<p>◆Board cleaning</p> <p>1. When cleaning the mounted PC boards, make sure that cleaning conditions are consistent with prescribed usage conditions.</p>
Technical considerations	<p>1. The resin material used for the outer coating of capacitors is occasionally a wax substance for moisture resistance which can easily be dissolved by some solutions. So before cleaning, special care should be taken to test the component's vulnerability to the solutions used.</p> <p>When using water-soluble flux please clean the PCB with purified water sufficiently and dry thoroughly at the end of the process. Insufficient washing or drying could lower the reliability of the capacitors.</p>
6. Post-cleaning-process	
Precautions	<p>◆Application of resin molding, etc. to the PCB and components.</p> <p>1. Please contact your local Taiyo Yuden sales office before performing resin coating or molding on mounted capacitors. Please contact your local Taiyo Yuden sales office in case of sealing the capacitor with resin or molding it on mounted capacitors. Please verify that the sealing or molding does not affect on the actual application in quality.</p>
Technical considerations	<p>1-1. The thermal expansion and coefficient of contraction of the molded resin are not necessarily matched with those of the capacitor. The capacitors may be exposed to stresses due to thermal expansion and contraction during and after hardening. This may lower the specified characteristics and insulation resistance or cause reduced withstanding voltage by cracking the ceramic or separating the coated resin from the ceramics.</p> <p>1-2. With some types of mold resins, the resin's decomposition gas or reaction gas may remain inside the resin during the hardening period or while left under normal conditions, cause a deterioration of the capacitor's performance.</p> <p>1-3. Some mold resins may have poor moisture proofing properties. Please verify the contents of the resins before they are applied.</p> <p>1-4. Please contact Taiyo Yuden before using if the hardening process temperature of the mold resins is higher than the operating temperature of the capacitors.</p>
7. Handling	
Precautions	<p>◆Mechanical considerations</p> <p>1. Be careful not to subject the capacitors to excessive mechanical shocks. Withstanding voltage failure may result.</p> <p>2. If ceramic capacitors are dropped onto the floor or a hard surface they should not be used.</p>
Technical considerations	<p>1. Because the capacitor is made of ceramic, mechanical shocks applied to the board may damage or crack the capacitors.</p> <p>2. Ceramic capacitors which are dropped onto the floor or a hard surface may develop defects and have a higher risk of failure over time.</p>
8. Storage conditions	
Precautions	<p>◆Storage</p> <p>1. To maintain the solderability of terminal electrodes and to keep the packaging material 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. Recommended conditions: Ambient temperature Below 40 °C Humidity Below 70% RH. Products should be used within 6 months after delivery. After the above period, the solderability should be checked before using the capacitors.</p> <p>2. Capacitors should not be kept in an environment filled with decomposition gases such as sulfurous hydrogen, sulfurous acid, chlorine, ammonia, etc.</p> <p>3. Capacitors should not be kept in a location where they may be exposed to moisture, condensation or direct sunlight.</p>
Technical considerations	<p>1. Under high temperature/high humidity conditions, the decrease in solderability due to the oxidation of terminal electrodes and deterioration of taping and packaging characteristics may be accelerated.</p>

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