Notice for TAIYO YUDEN products

Please read this notice before using the TAIYO YUDEN products.

⚠ REMINDERS

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

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

- Please contact Taiyo Yuden Co., Ltd. for further details of product specifications as the individual specification is available.

- Please conduct validation and verification of products in actual condition of mounting and operating environment before commercial shipment of the equipment.

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

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

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

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

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

❶ Rated voltage (VDC)

L	10
E	16
T	25
G	35
U	50

❷ Type

P	Axial leaded capacitors

❸ Outside Dimensions (L×φd) (mm)

075	4.2×3.2(multilayer type)
050	3.2×2.2(multilayer type)
025	2.3×2.0(multilayer type)

❹ Temperature haracteristics

CH	0±60(ppm/℃)
SL	+350～−1000(ppm/℃)
△B	±10%
△F	$^{+30}_{-85}$%

△=Blank space

❺ Nominal Capacitance (pF)

example	
010	1
1R2	1.2
103	10000

※R=decimal point

❻ Capacitance Tolerances

D—	±0.5pF
J—	±5%
K—	±10%
M—	±20%
Z—	$^{+80}_{-20}$%

❼ Lead Configuration (mm)

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

❽ Packaging

B	Ammo
C	Bulk

❾ Internal code

△,△Z	Multilayer type Standard products
△J	Multilayer type (Low voltage products)

△=Blank space

EXTERNAL DIMENSIONS/Minimum Quantity

TYPE	Dimensions L	Dimensions φD	Dimensions φd	Taped product Straight	Bulk Product Straight	Bulk Product Formed
Multilayer Type 075	4.2max. (0.165max.)	3.2max. (0.126max.)	0.55±0.05 (0.022±0.002)	B 52mm (2.05)	NA	K E Pitch:7.5mm (0.295)
Multilayer Type 050	3.2max. (0.126max.)	2.2max. (0.87max.)	0.45±0.05 (0.018±0.002)	A 26mm (1.02)		K F Pitch: 5mm (0.197)
Multilayer Type 025	2.3max. (0.09max.)	2.0max. (0.079max.)				

Unit : mm(inch)

Minimum Quantity [PCS]	Bulk	Taping
A	—	2000 (075) 3000 (050) 5000 (025)
B	—	
NA	1000	—
KE (075)	3000	—
KF (050)	3000	—
KF (025)	4000	—

AVAILABLE CAPACITANCE RANGE

Class 1 (Temperature compensating)

WV		50V(UP)		
Temp.char.		CH		SL
Type cap.		025	050	025
[pF]	[pF : 3digits]			
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			

Class 2 (High dielectric constant)

Multilayer type

WV		50V(UP)					35V(GP)			25V(TP)		16V (EP)				10V(LP)
Temp.char.		B			F		B		F	B	F	B		F		F
Type cap.		025	050	075	025	050	050	075	075	075	025	025	050	025	050	050
[pF]	[pF : 3digits]															
100	101															
120	121															
150	151															
180	181															
220	221															
270	271															
330	331															
390	391															
470	471															
560	561															
680	681															
820	821															
1000	102															
1200	122															
1500	152															
1800	182															
2200	222															
2700	272															
3300	332															
3900	392															
4700	472															
5600	562															
6800	682															
8200	822															
10000	103															
12000	123															
15000	153															
18000	183															
22000	223															
27000	273															
33000	333															
39000	393															
47000	473															
56000	563															
68000	683															
82000	823															
100000	104															
220000	224															
470000	474															
1000000	105															
2200000	225															
4700000	475															
10000000	106															

Temperature char.	Capacitance change	Capacitance Tolerance	Q or tanδ	Class
CH	0±60ppm/℃	D(±0.5pF) K(±10%) J(±5%)	eng・Refer to the Part munber	1
SL	+350～−1000ppm/℃			
△B	±10%	K(±10%), M(±20%)		2
△F	$^{+30}_{-85}$%	Z($^{+80}_{-20}$%)		

※Capacitance characteristics measured at 20℃

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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	±10%		
	UP025△6R8K −○ Z		RoHS		6.8			
	UP025△8R2K −○ Z		RoHS		8.2			
	UP025△100J −○ Z		RoHS		10	±5%		
	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		Q≧1000	
	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	CH	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		tan δ ≦5.0%	1000MΩmin.
	UP025 B683K −○ Z		RoHS		68000			
	UP025 B104K −○ Z		RoHS		100000			
16V	EP025 B224K −○ Z		RoHS		220000			500MΩmin.
	EP025 B474K −○ Z		RoHS		470000			200MΩmin.
	EP025 B105K −○ Z		RoHS		100000		tan δ ≦7.5%	100MΩmin.
50V	UP025 F103Z −○ Z		RoHS	F	10000	+80 −20 %	tan δ ≦7.5%	1000MΩmin.
	UP025 F223Z −○ Z		RoHS		22000			
	UP025 F473Z −○ Z		RoHS		47000			
	UP025 F104Z −○ Z		RoHS		100000			
16V	EP025 F224Z −○ Z		RoHS		220000		tan δ ≦10.0%	500MΩmin.
	EP025 F474Z −○ Z		RoHS		470000			
	EP025 F105Z −○ Z		RoHS		100000		tan δ ≦17.5%	250MΩmin.

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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%	5000MΩmin.
	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			
	EP025 B223M −○ J		RoHS		22000			
25V	TP025 F103Z −○ J		RoHS	F	10000	+80 −20%	tan δ ≦7.5%	1000MΩmin.
	TP025 F223Z −○ J		RoHS		22000			
	TP025 F473Z −○ J		RoHS		47000			

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

●Multilayer type Class 1

Rated Voltage (DC)	Ordering code		EHS (Environmental Hazardous Substances)	Temperature characteristics	Capacitance [pF]	Capacitance tolerance	Q or tan δ	Insulation resistance
	UP050CH220J−○ Z		RoHS	CH	22	±5%	Q≧400+20C	10000MΩmin.
★	UP050CH240J−○ Z		RoHS		24			
	UP050CH270J−○ Z		RoHS		27			
★	UP050CH300J−○ Z		RoHS		30		Q≧1000	
	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			
50V	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 type Class 2

Rated Voltage (DC)	Ordering code		EHS (Environmental Hazardous Substances)	Temperature characteristics	Capacitance (pF)	Capacitance tolerance	Q or tan δ	Insulation resistance
★	UP050B122K—○ Z		RoHS	B	1200	±10%	tan δ ≦3.5%	5000MΩmin.
	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			
50V ★	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		tan δ ≦5.0%	1000MΩmin.
★	UP050B563K—○ Z		RoHS		56000			
	UP050B683K—○ Z		RoHS		68000			
★	UP050B823K—○ Z		RoHS		82000			
	UP050B104K—○ Z		RoHS		100000			
	UP050B224K—○ Z		RoHS		220000			500MΩmin.
	UP050B474K—○ Z		RoHS		470000			200MΩmin.
35V	GP050B105K—○ Z		RoHS		1000000			100MΩmin.
16V	EP050B225K—○ Z		RoHS		2200000		tan δ ≦7.5%	50MΩmin.
	EP050B475K—○ Z		RoHS		4700000		tan δ ≦12.5%	20MΩmin.
	EP050B106K—○ Z		RoHS		10000000			
50V	UP050F103Z—○ Z		RoHS	F	10000	+80 −20 %	tan δ ≦7.5%	1000MΩmin.
	UP050F223Z—○ Z		RoHS		22000			
	UP050F473Z—○ Z		RoHS		47000			
	UP050F104Z—○ Z		RoHS		100000			
	UP050F224Z—○ Z		RoHS		220000		tan δ ≦10.0%	500MΩmin.
	UP050F474Z—○ Z		RoHS		470000			
	UP050F105Z—○ Z		RoHS		1000000		tan δ ≦15%	250MΩmin.
16V	EP050F225Z—○ Z		RoHS		2200000			125MΩmin.
10V	LP050F475Z—○ Z		RoHS		4700000		tan δ ≦17.5%	50MΩmin.
	LP050F106Z—○ Z		RoHS		10000000			25MΩmin.
50V	UP075B105K—○		RoHS	B	1000000	±10%	tan δ ≦5.0%	100MΩmin.
35V	GP075B225K—○		RoHS		2200000		tan δ ≦7.5%	50MΩmin.
	GP075B475K—○		RoHS		4700000			20MΩmin.
25V	TP075B106K—○		RoHS		10000000		tan δ ≦12.5%	
35V	GP075F106Z—○		RoHS	F	10000000	+80 −20 %	tan δ ≦17.5%	25MΩmin.

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★ : Option

CAPACITORS

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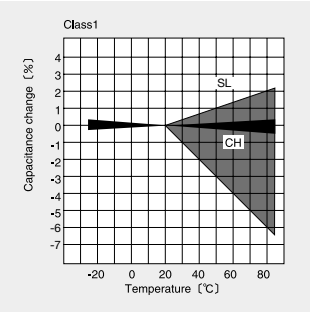
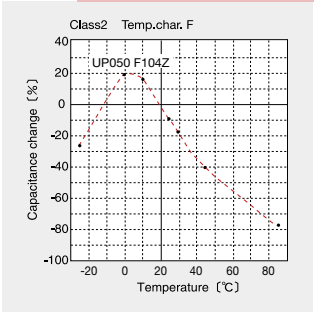
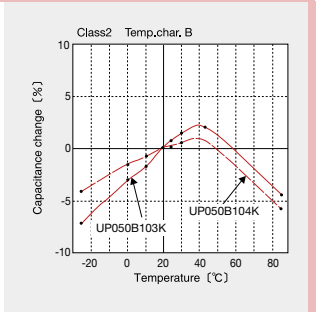
Capacitance -vs- Temperature Characteristics







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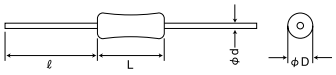
PACKAGING

①Minimum Quantity

Type	Lead configuration code	Minimum Quantity (PCS)	
		Bulk	Taping
Multilayer type (075, 050, 025)	A− (1.024 inch wide)	—	2000 (075) 3000 (050) 5000 (025)
	B− (2.047 inches wide)		
	NA	1000	—
	KE (075)	3000	
	KF (050)	3000	
	KF (025)	4000	

②Dimensions of Bulk Products

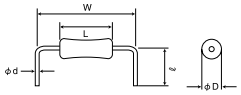
● NA configuration



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

Unit : mm (inch)

● KF/KE configuration

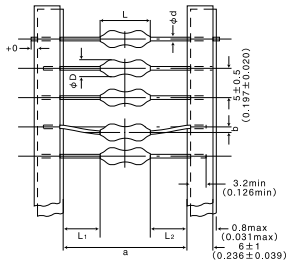


Type	リード形状記号	Dimensions (mm)				
		φD	L	W	φd	ℓ
Multilayer type 025	KF	2.0max (0.079max)	2.3max (0.09max)	5.0±0.5 (0.197±0.020)	0.45±0.05 (0.018±0.002)	6.5±0.5 (0.256±0.020)
Multilayer type 050	KF	2.2max (0.087max)	3.2max (0.126max)	5.0±0.5 (0.197±0.020)	0.45±0.05 (0.018±0.002)	6.5±0.5 (0.256±0.020)
Multilayer 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)

③Taping Dimensions

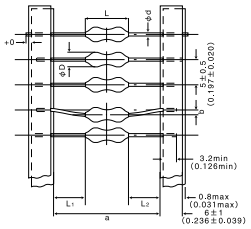
● A− (a : 1.024 inch wide) configuration



Type	Dimensions (mm)						Minimum insertion pitch
	φD	L	a	b	$\lvert L_1-L_2 \rvert$	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)	7.5 (0.295)

Unit : mm (inch)

● B− (a : 2.047 inches wide) configuration



Type	Dimensions (mm)						Minimum insertion pitch
	φD	L	a	b	$\lvert L_1-L_2 \rvert$	φd	
Multilayer type 025	2.0max (0.079max)	2.3max (0.09max)	52^{+2}_{-1} ($2.047^{+0.079}_{-0.039}$)	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)	7.5 (0.295)

※Radial taping is available for 075 type (Optional)

Unit : mm (inch)

RELIABILITYDATA

AXIAL LEADED CERAMIC CAPACITORS

1. Operating Temperature Range			
Specified Value	Temperature Compensating (Class1)	Multilayer type	−25 to +85℃
	High Permittivity (Class2)	Multilayer type (Characteristics : B)	
		Multilayer type (Characteristics : F)	

2. Storage Temperature Range			
Specified Value	Temperature Compensating (Class1)	Multilayer type	−25 to +85℃
	High Permittivity (Class2)	Multilayer type (Characteristics : B)	
		Multilayer type (Characteristics : F)	

3. Rated Voltage			
Specified Value	Temperature Compensating (Class1)	Multilayer type	50VDC
	High Permittivity (Class2)	Multilayer type (Characteristics : B)	16VDC、25VDC、35VDC、50VDC
		Multilayer type (Characteristics : F)	10VDC、16VDC、25VDC、35VDC、50VDC

4. Withstanding Voltage	
Between terminals	
Specified Value	No abnormality

【Test Methods and Remarks】
Applied voltage : Rated Voltage×3 (Class 1)
: Rated Voltage×2.5 (Class 2)
Duration : 1 to 5 sec.
Charge/discharge current : 50mA max. (Class 1,2)

Between terminals and body	
Specified Value	No abnormality

【Test Methods and Remarks】
Metal globule method Applied voltage : Rated Voltage×2.5, Duration : 1 to 5 sec., Charge/Discharge current : 50mA max.

5. Insulation Resistance			
Specified Value	Temperature Compensating (Class1)	Multilayer type	10000MΩmin.
	High Permittivity (Class2)	Multilayer type (Characteristics : B)	Rated Ivoltage : 16VDC 1200pF～22000pF (Item : △) : 5000MΩ min 220000pF : 500MΩ min 470000pF : 200MΩ min 1000000pF : 100MΩ min 4700000pF : 20MΩ min 2200000pF : 50MΩ min 10000000pF : 20MΩ min 10000000pF : 20MΩ min
			Rated Ivoltage : 25VDC 10000000pF : 20MΩmin
			Rated Ivoltage : 35VDC 1000000pF : 100MΩ min 2200000pF : 50MΩ min 4700000pF : 20MΩ min
			Rated Ivoltage : 50VDC 100pF～39000pF : 5000MΩ min 47000pF～100000pF : 1000MΩ min 220000pF : 500MΩ min 470000pF : 200MΩ min 1000000pF : 100MΩ min
		Multilayer type (Characteristics : F)	Rated Ivoltage : 10VDC 4700000pF : 50MΩ min 10000000pF : 25MΩ min
			Rated Ivoltage : 16VDC 220000pF : 500MΩ min 470000pF : 500MΩ min 1000000pF : 250MΩ min 2200000pF : 125MΩ min
			Rated voltage : 25VDC 10000pF～47000pF (Item△J) : 1000MΩ min
			Rated voltage : 35VDC 10000000pF : 25MΩ min
			Rated voltage : 50VDC 10000pF～100000pF : 1000MΩ min 220000pF～470000pF : 500MΩ min 1000000pF : 250MΩ min

【Test Methods and Remarks】
Applied voltage : Rated voltage, Duration : 60±5 sec.

6. Capacitance			
Specified Value	Temperature Compensating (Class1)	Multilayer type	±0.5pF ±5% ±10%
	High Permittivity (Class2)	Multilayer type (Characteristics : B)	±10%、±20% (Item△J)
		Multilayer type (Characteristics : F)	$^{+80}_{-20}$%

【Test Methods and Remarks】
Measuring frequency : 1MHz±10% (Class 1 : C≦1000pF)
: 1kHz±10% (Class 1 : C>1000pF)
: 1kHz±10% (Class 2 : C≦10μF)
: 120Hz±10% (Class 2 : C>10μF)
Measuring voltage : 1.0±0.5Vrms (Class 1 : C≦1000pF)
: 1.0±0.2Vrms (Class 1 : C>1000pF)
: 1.0±0.2Vrms (Class 2 : C≦10μF)
: 0.5±0.1Vrms (Class 2 : C>10μF)
Bias application : None

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7. Q or Tangent of Loss Angle(tanδ)

Specified Value	Temperature Compensating(Class1)	Multilayer type	30pF or under : Q≧400+20C 33pF or over : Q≧1000 C : Nominal Capacitance[pF]
	High Permittivity(Class2)	Multilayer type (Characteristics : B)	Rated Ivoltage : 16VDC 1200pF～22000pF(Item△J) : 3.5% max 100000pF : 5.0% max 220000pF～470000pF : 5.0% max 1000000pF～2200000pF : 7.5% max 4700000pF～10000000pF : 12.5% max Rated Ivoltage : 25VDC 10000000pF : 12.5% max Rated Ivoltage : 35VDC 1000000pF : 5.0% max 2200000pF～4700000pF : 7.5% max Rated Ivoltage : 50VDC 100pF～39000pF : 3.5% max 47000pF～1000000pF : 5.0% max
		Multilayer type (Characteristics : F)	Rated Ivoltage : 10VDC 4700000pF～10000000pF : 17.5% max Rated Ivoltage : 16VDC 220000pF : 10.0% max 470000pF : 10.0% max 1000000pF : 17.5% max 2200000pF : 15.0% max Rated Ivoltage : 25VDC 10000pF～47000pF(Item△J) : 7.5% max Rated Ivoltage : 35VDC 10000000pF : 17.5% max Rated Ivoltage : 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	Temperature Compensating(Class1)	Multilayer type	CH : 0±60 SL : −350～+1000 [ppm/℃]
	High Permittivity(Class2)	Multilayer type (Characteristics : B)	±10%
		Multilayer type (Characteristics : F)	$^{+30}_{-85}$%

【Test Methods and Remarks】

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

$$\frac{(C_{85}-C_{20})}{C_{20}\times\triangle T}\times 10^{6}\ (\text{ppm/℃})$$

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

Temperature at step 1 : 20℃ Temperature at step 4 : 85℃
Temperature at step 2 : −25℃ Temperature at step 5 : 20℃
Temperature at step 3 : 20℃ (Reference temperature)

9. Terminal Strength

Tensile

Specified Value	Temperature Compensating(Class1)	Multilayer type	No abnomalities, such as cuts or looseness of terminals.
	High Permittivity(Class2)	Multilayer type (Characteristics : B)	
		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]	Duratio[s]
0.45	19.6	5

Torsional

Specified Value	Temperature Compensating(Class1)	Multilayer type	No abnomalities, such as cuts or looseness of terminals.
	High Permittivity(Class2)	Multilayer type (Characteristics : B)	
		Multilayer type (Characteristics : F)	

【Test Methods and Remarks】

Suspend a mass at the end the terminal, incline the body through angle of 90˚ and return it to 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			
Specified Value	Temperature Compensating (Class1)	Multilayer type	Appearance : No significant abnomality Withstanding Voltage : No abnomality 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]
	High Permittivity (Class2)	Multilayer type (Characteristics : B)	Appearance : No significant abnomality Withstanding Voltage : No abnomality Rated Voltage : 16VDC Capacitance : Within ±10% 1200pF～22000pF (Item△J) : Within ±20% 220000pF~10000000pF : Within ±10% tanδ : 1200pF～22000pF (Item△J) : 3.5% max 220000pF～470000pF : 5.0% max 1000000pF～2200000pF : 7.5% max 4700000pF～10000000pF : 12.5% max Insulation Resistance : 1200pF～22000pF (Item△J) : 5000MΩ min 220000pF : 500MΩ min 470000pF : 200MΩ min 1000000pF : 100MΩ min 2200000pF : 50MΩ min 4700000pF～10000000pF : 20MΩ min Rated Voltage : 25VDC Capacitance : Within ±10% tanδ : 10000000pF : 12.5% max Insulation Resistance : 10000000pF : 20MΩ min Rated Voltage : 35VDC Capacitance : Within ±10% tanδ : 1000000pF : 5.0% max 2200000pF～4700000pF : 7.5% max Insulation Resistance : 1000000pF : 100MΩ min 2200000pF : 50MΩ min 4700000pF : 20MΩ min Rated Voltage : 50VDC Capacitance : Within ±10% tanδ : 100pF～39000pF : 3.5% max 47000pF～1000000pF : 5.0% max Insulation Resistance : 100pF～39000pF : 5000MΩ min 47000pF～100000pF : 1000MΩ min 220000pF : 500MΩ min 470000pF : 200MΩ min 1000000pF : 100MΩ min
		Multilayer type (Characteristics : F)	Appearance : No significant abnomality Withstanding Voltage : No abnomality Rated Voltage : 10VDC Capacitance : Within $^{+80}_{-20}$ % tanδ : 4700000pF～10000000pF : 17.5% max Insulation Resistance : 4700000pF : 50MΩ min 10000000pF : 25MΩ min Rated Voltage : 16VDC Capacitance : Within $^{+80}_{-20}$ % 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

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10. Resistance to Vibration			
Specified Value	High Permittivity (Class2)	Multilayer type (Characteristics : F)	Rated Voltage : 25VDC Capacitance : Within $^{+80}_{-20}$ % tanδ : 10000pF～47000pF (Item△J) : 7.5% max Insulation Resistance : 10000pF～47000pF (Item△J) : 1000MΩ min
			Rated Voltage : 35VDC Capacitance : Within $^{+80}_{-20}$ % tanδ : 10000000pF : 17.5% max Insulation Resistance : 10000000pF : 25MΩ min
			Rated Voltage : 50VDC Capacitance : Within $^{+80}_{-20}$ % tanδ : 10000pF～100000pF : 7.5% max 220000pF～470000pF : 10.0% max 1000000pF : 15.0% max Insulation Resistance : 10000pF～100000pF : 1000MΩ min 220000pF～470000pF : 500MΩ min 1000000pF : 250MΩ 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	Temperature Compensating (Class1)	Multilayer type	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 : 10000MΩ min. C : Nominal Capacitance[pF]
	High Permittivity (Class2)	Multilayer type (Characteristics : B)	Appearance : No significant abnormality Withstanding Voltage : No abnormality Rated Voltage : 16VDC Capacitance : 1200pF～22000pF (Item△J) : Within ±20% 220000pF～10000000pF : Within ±10% tanδ : 1200pF～22000pF (Item△J) : 3.5% max 220000pF～470000pF : 5.0% max 1000000pF～2200000pF : 7.5% max 4700000pF～10000000pF : 12.5% max Insulation resistance : 1200pF～22000pF (Item△J) : 5000MΩ min 220000pF : 500MΩ min 470000pF : 200MΩ min 1000000pF : 100MΩ min 2200000pF : 50MΩ min 4700000pF～10000000pF : 20MΩ min
			Rated Voltage : 25VDC Capacitance : Within ±10% tanδ : 10000000pF : 12.5% max Insulation resistance : 10000000pF : 20MΩ min
			Rated Voltage : 35VDC Capacitance : Within ±10% tanδ : 1000000pF : 5.0% max 2200000pF～4700000pF : 7.5% max Insulation resistance : 1000000pF : 100MΩ min 2200000pF : 50MΩ min 4700000pF : 20MΩ min
			Rated Voltage : 50VDC Capacitance : Within±10% tanδ : 100pF～39000pF : 3.5% max 47000pF～1000000pF : 5.0% max Insulation resistance : 100pF～39000pF : 5000MΩ min 47000pF～100000pF : 1000MΩ min 220000pF : 500MΩ min 470000pF : 200MΩ min 1000000pF : 100MΩ min

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11. Free Fall

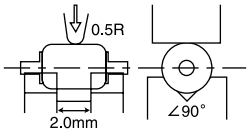
Specified Value	High Permittivity (Class2)	Multilayer type (Characteristics : F)	Appearance : No significant abnormality Withstanding Voltage : No abnomality Rated Voltage : 10VDC Capacitance : Within $^{+80}_{-20}$ % tanδ : 4700000pF～10000000pF : 17.5% max Insulation resistance : 4700000pF : 50MΩ min 10000000pF : 25MΩ min
			Rated Voltage : 16VDC Capacitance : Within $^{+80}_{-20}$ % 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
			Rated Voltage : 25VDC Capacitance : Within $^{+80}_{-20}$ % tanδ : 10000pF～47000pF (Item△J) : 7.5% max Insulation resistance : 10000pF～47000pF (Item△J) : 1000MΩ min
			Rated Voltage : 35VDC Capacitance : Within $^{+80}_{-20}$ % tanδ : 10000000pF : 17.5% max Insulation resistance : 10000000pF : 25MΩ min
			Rated Voltage : 50VDC Capacitance : Within $^{+80}_{-20}$ % tanδ : 10000pF～100000pF : 7.5% max 220000pF～470000pF : 10.0% max 1000000pF : 15.0% max Insulation resistance : 10000pF～100000pF : 1000MΩ min 220000pF～470000pF : 500MΩ min 1000000pF : 250MΩ 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	Temperature Compensating (Class1)	Multilayer type	No abnomality such as damage.
	High Permittivity (Class2)	Multilayer type (Characteristics : B)	
		Multilayer type (Characteristics : F)	

【Test Methods and Remarks】
Applied force : 19.6N
Duration : 5 sec.
Speed : Shall attain to specified force in 2 sec.



1.5mm (025type)

13. Solderability

Specified Value	Temperature Compensating (Class1)	Multilayer type	At least 75% of lead surface is covered with new solder.
	High Permittivity (Class2)	Multilayer type (Characteristics : B)	
		Multilayer type (Characteristics : F)	

【Test Methods and Remarks】
Solder temperature : 230±5℃
Duration : 2±0.5 sec. (This test may be applicable after 6 months storage.)

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14. Soldering			
Specified Value	Temperature Compensating (Class1)	Multilayer type	Appearance : No significant abnormality Withstanding Voltage : No abnormality Capacitance change : 8.2pF or under : Within ±0.25pF 10pF or over : Within ±2.5% Q : 30pF or under Q≧400+20C : 33pF or over Q≧1000 Insulation resistance : 10000MΩ min. C : Nominal Capacitance[pF]
	High Permittivity (Class2)	Multilayer type (Characteristics : B)	Appearance : No significant abnormality Withstanding Voltage : No abnormality
			Rated Voltage : 16VDC Capacitance change : 1200pF～22000pF (Item△J) : Within ±7.5% 220000pF～10000000pF : Within ±10.0% tanδ : 1200pF～22000pF (Item△J) : 3.5% max 220000pF～470000pF : 5.0% max 1000000pF～2200000pF : 7.5% max 4700000pF～10000000pF : 12.5% max Insulation resistance : 1200pF～22000pF (Item△J) : 5000MΩ min 220000pF : 500MΩ min 470000pF : 200MΩ min 1000000pF : 100MΩ min 2200000pF : 50MΩ min 4700000pF～10000000pF : 20MΩ min
			Rated Voltage : 25VDC Capacitance change : 10000000pF : Within ±10.0% tanδ : 10000000pF : 12.5% max Insulation resistance : 10000000pF : 20MΩ min
			Rated Voltage : 35VDC Capacitance change : 1000000pF～4700000pF : Within ±10.0% tanδ : 1000000pF : 5.0% max 2200000pF～4700000pF : 7.5% max Insulation resistance : 1000000pF : 100MΩ min 2200000pF : 50MΩ min 4700000pF : 20MΩ min
			Rated Voltage : 50VDC Capacitance change : 100pF～39000pF : Within ±7.5% 47000pF～1000000pF : Within ±10.0% tanδ : 100pF～39000pF : 3.5% max 47000pF～1000000pF : 5.0% max Insulation resistance : 100pF～39000pF : 5000MΩ min 47000pF～100000pF : 1000MΩ min 220000pF : 500MΩ min 470000pF : 200MΩ min 1000000pF : 100MΩ min
		Multilayer type (Characteristics : F)	Appearance : No significant abnormality Withstanding Voltage : No abnormality Rated Voltage : 10VDC Capacitance change : Within ±20% tanδ : 4700000pF～10000000pF : 17.5% max Insulation resistance : 4700000pF : 50MΩ min 10000000pF : 25MΩ min
			Rated Voltage : 16VDC Capacitance change : Within ±20% tanδ : 220000pF～470000pF : 10.0% max 1000000pF : 17.5% max 2200000pF : 15.0% max Insulation resistance : 220000pF～470000pF : 500MΩ min 1000000pF : 250MΩ min 2200000pF : 125MΩ min
			Rated Voltage : 25VDC Capacitance change : Within ±20% tanδ : 10000pF～47000pF (Item△J) : 7.5% max Insulation resistance : 10000pF～47000pF (Item△J) : 1000MΩ min

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

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AXIAL LEADED CERAMIC CAPACITORS

14. Soldering

Specified Value	High Permittivity(Class2)	Multilayer type(Characteristics : F)	Rated Voltage : 35VDC Capacitance change : Within ±20% tanδ : 10000000pF : 17.5% max Insulation resistance : 10000000pF : 25MΩ min
			Rated Voltage : 50VDC Capacitance change : 10000pF～1000000pF : Within ±20.0% tanδ : 10000pF～100000pF : 7.5% max 220000pF～470000pF : 10.0% max 1000000pF : 15.0% max Insulation resistance : 10000pF～100000pF : 1000MΩ min 220000pF～470000pF : 500MΩ min 1000000pF : 250MΩ min

【Test Methods and Remarks】
Solder temperature : 270±5℃
Duration : 5±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 $^{+0}_{-10}$℃ followed by 48±4 hrs of recovery under the standard condition.
Recovery : Recovery for the following period under the standard condition after the test.
24±2 hrs(Class 1)
48±4 hrs(Class 2)

15. Resistance to Solvent

Specified Value	Temperature Compensating(Class1)	Multilayer type	No significant abnormality in appearance and legible marking.
	High Permittivity(Class2)	Multilayer type(Characteristics : B)	
		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℃
Duration : 30±5 sec.
Solvent Type : A in Table 23, Isopropyl alcohol

16. Thermal Shock

Specified Value	Temperature Compensating(Class1)	Multilayer type	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 or over C : Nominal Capacitance[pF]
	High Permittivity(Class2)	Multilayer type(Characteristics : B)	Appearance : No significant abnormality Withstanding Voltage : No abnormality
			Rated Voltage : 16VDC Capacitance change : 1200pF～22000pF(ItemΔJ) : Within ±12.5% 220000pF～10000000pF : Within ±15.0% tanδ : 1200pF～22000pF(ItemΔJ) : 5.0% max 220000pF～470000pF : 7.5% max 1000000pF～2200000pF : 10.0% max 4700000pF～10000000pF : 22.5% max Insulation resistance : 1200pF～22000pF(ItemΔJ) : 1000MΩ min 220000pF : 125MΩ min 470000pF : 50MΩ min 1000000pF : 25MΩ min 2200000pF : 12.5MΩ min 4700000pF～10000000pF : 5MΩ min
			Rated Voltage : 25VDC Capacitance change : 10000000pF : Within ±15.0% tanδ : 10000000pF : 15.0% max Insulation resistance : 10000000pF : 5MΩ min
			Rated Voltage : 35VDC Capacitance change : 1000000pF : Within ±15.0% 2200000pF～4700000pF : Within ±15.0% tanδ : 1000000pF : 7.5% max 2200000pF～4700000pF : 10.0% max Insulation resistance : 1000000pF : 25MΩ min 2200000pF : 25MΩ min 4700000pF : 5MΩ min

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

16. Thermal Shock			
Specified Value	High Permittivity (Class2)	Multilayer type (Characteristics : B)	Rated Voltage : 50VDC Capacitance change : 100pF～39000pF : Within ±12.5% 47000pF～1000000pF : Within ±15.0% tanδ : 100pF～39000pF : 5.0% max 47000pF～1000000pF : 7.5% max Insulation resistance : 100pF～39000pF : 1000MΩ min 47000pF～100000pF : 500MΩ min 220000pF : 250MΩ min 470000pF : 100MΩ min 1000000pF : 50MΩ min
		Multilayer type (Characteristics : F)	Appearance : No significant abnomality Withstanding Voltage : No abnomality
			Rated Voltage : 10VDC Capacitance change : Within ±30.0% tanδ : 4700000pF～10000000pF : 20.0% max Insulation resistance : 4700000pF : 10MΩ min 10000000pF : 5MΩ min
			Rated 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
			Rated Voltage : 25VDC Capacitance change : Within ±30% tanδ : 10000pF～47000pF (Item△J) : 12.5% max Insulation resistance : 10000pF～47000pF (Item△J) : 500MΩ min
			Rated Voltage : 35VDC Capacitance change : Within ±30.0% tanδ : 10000000pF : 20.0% max Insulation resistance : 10000000pF : 5MΩ min
			Rated 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 [℃]	Duration [min.]
1	Room temperature	Within 3
2	-25^{0}_{-3}	30±3
3	Room temperature	Within 3
4	$+85^{+3}_{0}$	30±3
5	Room temperature	Within 3

Number of cycles : 5
Preconditioning : 1 hr of preconditioning at 150 $^{+0}_{-10}$℃ 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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17. Damp Heat (steady state)			
Specified Value	Temperature Compensating (Class1)	Multilayer type	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]
	High Permittivity (Class2)	Multilayer type (Characteristics : B)	Appearance : No significant abnormality Withstanding Voltage : No abnormality
			Rated 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
			Rated Voltage : 25VDC Capacitance change : 10000000pF : Within ±15.0% tanδ : 10000000pF : 15.0% max Insulation resistance : 10000000pF : 5MΩ min
			Rated Voltage : 35VDC Capacitance change : 1000000pF : Within ±15.0% 2200000pF～4700000pF : Within ±15.0% tanδ : 1000000pF : 10.0% max 2200000pF～4700000pF : 10.0% max Insulation resistance : 1000000pF : 25MΩ min 2200000pF : 25MΩ min 4700000pF : 5MΩ min
			Rated Voltage : 50VDC Capacitance change : 100pF～39000pF : Within ±12.5% 47000pF～1000000pF : Within ±15.0% tanδ : 100pF～39000pF : 5.0% max 47000pF～1000000pF : 7.5% max Insulation resistance : 100pF～39000pF : 1000MΩ min 47000pF～100000pF : 500MΩ min 220000pF : 250MΩ min 470000pF : 100MΩ min 1000000pF : 50MΩ min
		Multilayer type (Characteristics : F)	Appearance : No significant abnormality Withstanding Voltage : No abnormality
			Rated Voltage:10VDC Capacitance change : Within ±30.0% tanδ: 4700000pF~10000000pF : 20.0% max Insulation resistance: 4700000pF : 10MΩ min 10000000pF : 5MΩ min
			Rated 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

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

AXIAL LEADED CERAMIC CAPACITORS

17. Damp Heat (steady state)			
Specified Value	High Permittivity (Class2)	Multilayer type (Characteristics : F)	Rated Voltage:25VDC Capacitance change : Within ±30% tanδ: 10000pF～47000pF (Item△J):12.5% max Insulation resistance: 10000pF～47000pF (Item△J) : 500MΩ min
			Rated Voltage : 35VDC Capacitance change : Within ±30.0% tanδ: 10000000pF : 20.0% max Insulation resistance: 10000000pF : 5MΩ min
			Rated 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℃
Humidity : 90 to 95 % RH
Duration : 500hrs $^{+24}_{-0}$ hrs
Preconditioning : 1 hr of preconditioning at 150 $^{+0}_{-10}$ ℃ 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 $^{+10}_{-0}$ ℃ 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	Temperature Compensating (Class1)	Multilayer type	Appearance : No significant abnomality Withstanding Voltage : No abnomality 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]
	High Permittivity (Class2)	Multilayer type (Characteristics : B)	Appearance : No significant abnomality Withstanding Voltage : No abnomality
			Rated 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
			Rated Voltage : 25VDC Capacitance change : 10000000pF : Within ±22.5% tanδ : 10000000pF : 22.5% max Insulation resistance : 10000000pF : 2.5MΩ min
			Rated Voltage : 35VDC Capacitance change : 1000000pF : Within ±15.0% 2200000pF : Within ±15.0% 4700000pF : Within ±22.5% tanδ : 1000000pF : 10.0% max 2200000pF～4700000pF : 10.0% max Insulation resistance : 1000000pF : 12.5MΩ min 2200000pF : 5.0MΩ min 4700000pF : 2.5MΩ min
			Rated Voltage : 50VDC Capacitance change : 100pF～39000pF : Within ±12.5% 47000pF～1000000p : Within ±15.0% tanδ : 100pF～39000pF : 5.0% max 47000pF～1000000pF : 7.5% max Insulation resistance : 100pF～39000pF : 500MΩ min 47000pF～100000pF : 250MΩ min 220000pF : 125MΩ min 470000pF : 25MΩ min 1000000pF : 12.5MΩ min

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18. Loading under Damp Heat			
Specified Value	High Permittivity(Class2)	Multilayer type(Characteristics : F)	Appearance : No significant abnomality Withstanding Voltage : No abnomality
			Rated Voltage : 10VDC Capacitance change : Within ±30.0% tanδ : 4700000pF～10000000pF : 20.0% max Insulation resistance : 4700000pF : 5MΩ min 10000000pF : 2.5MΩ min
			Rated Voltage : 16VDC Capacitance change : Within ±30.0% tanδ : 220000pF～470000pF : 15.0% max 1000000pF : 22.5% max 2200000pF : 17.5% max Insulation resistance : 220000pF : 50MΩ min 470000pF : 25MΩ min 1000000pF : 12.5MΩ min 2200000pF : 12.5MΩ min
			Rated Voltage : 25VDC Capacitance change : Within ±30.0% tanδ : 10000pF～47000pF(Item△J) : 12.5% max Insulation resistance : 10000pF～47000pF(Item△J) : 250MΩ min
			Rated Voltage : 35VDC Capacitance change : Within ±30.0% tanδ : 10000000pF : 20.0% max Insulation resistance : 10000000pF : 2.5MΩ min
			Rated 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 : 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 : Rated voltage
Preconditioning : 1 hr of preconditioning at 150 $^{+0}_{-10}$ ℃ 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 $^{+10}_{-0}$ ℃ followed by 48±4 hrs of recovery under the standard condition after the removal from chamber. (Class 2)

19. High Temperature Lading Test			
Specified Value	Temperature Compensating(Class1)	Multilayer type	Appearance : No significant abnomality Withstanding Voltage : No abnomality Capacitance change : 8.2pF or under : Within ±0.3pF 10pF or over : Within ±3.0% 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]
	High Permittivity(Class2)	Multilayer type(Characteristics : B)	Appearance : No significant abnomality Withstanding Voltage : No abnomality
			Rated 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) : 1000MΩ min 220000pF : 125MΩ min 470000pF : 50MΩ min 1000000pF : 25MΩ min 2200000pF : 12.5MΩ min 4700000pF～10000000pF : 5.0MΩ min

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19. High Temperature Lading Test			
Specified Value	High Permittivity (Class2)	Multilayer type (Characteristics : B)	Rated Voltage : 25VDC Capacitance change : 10000000pF : Within ±22.5% tanδ : 10000000pF : 22.5% max Insulation resistance : 10000000pF : 5MΩ min
			Rated Voltage : 35VDC Capacitance change : 1000000pF : Within ±15.0% 2200000pF : Within ±15.0% 4700000pF : Within ±22.5% tanδ : 1000000pF : 10.0% max 2200000pF～4700000pF : 10.0% max Insulation resistance : 1000000pF : 25MΩ min 2200000pF : 25MΩ min 4700000pF : 5MΩ min
			Rated Voltage : 50VDC Capacitance change : 100pF～39000pF : Within ±12.5% 47000pF~1000000pF : Within ±15.0% tanδ : 100pF～39000pF : 5.0% max 47000pF～1000000pF : 7.5% max Insulation resistance : 100pF～39000pF : 1000MΩ min 47000pF～100000pF : 500MΩ min 220000pF : 250MΩ min 470000pF : 100MΩ min 1000000pF : 50MΩ min
		Multilayer type (Characteristics : F)	Appearance : No significant abnomality Withstanding Voltage : No abnomality
			Rated Voltage : 10VDC Capacitance change : Within ±30.0% tanδ : 4700000pF～10000000pF : 20.0% max Insulation resistance : 4700000pF : 10MΩ min 10000000pF : 5MΩ min
			Rated Voltage : 16VDC Capacitance change : ±30% 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
			Rated Voltage : 25VDC Capacitance change : Within ±30% tanδ : 10000pF～47000pF (Item△J) : 10.0% max Insulation resistance : 10000pF～47000pF (Item△J) : 500MΩ min
			Rated Voltage : 35VDC Capacitance change : Within ±30.0% tanδ : 10000000pF : 20.0% max Insulation resistance : 10000000pF : 5MΩ min
			Rated Voltage : 50VDC Capacitance change : 10000pF～1000000pF : Within 30.0% tanδ : 10000pF～100000pF : 10.0% max 220000pF～470000pF : 12.5% max 1000000pF : 17.5% max Insulation resistance : 10000pF～100000pF : 500MΩ min 220000pF～470000pF : 250MΩ min 1000000pF : 50MΩ min

【Test Methods and Remarks】
Temperature : 85± $^{3}_{0}$ ℃
Duration : 1000± $^{48}_{0}$ hrs
Applied voltage : Rated voltage×2
: Rated voltage×1.5
Class 2 : B 1000000pF (025Type)
B 220000pF～10000000pF (050Type, 075Type)
Preconditioning : 1 hr of preconditioning at 150 $^{+10}_{-0}$℃ followed by 48±4 hrs of recovery under the standard condition.
Recovery : 24±2hrs of recovery under the standard condition after the removal from test chamber. (Class1)
: 1 hr of preconditioning at 150 $^{+10}_{-0}$℃ 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℃ 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±2℃ 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

◆Verification of operating environment, electrical rating and performance
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)
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.

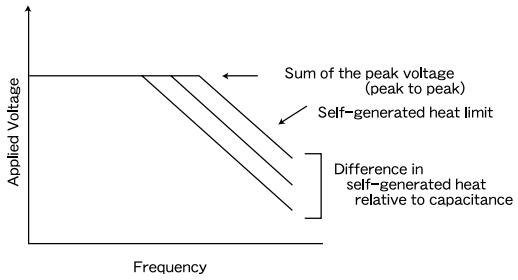
◆Self-generated heat (Verification of Temperature)
1. If the capacitors specified only for DC use are used in AC or pulse circuits, the AC or a pulse current can generate heat inside the capacitor so the self-generated temperature rise should be limited to within 20℃. The surface temperature measured 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℃.

◆Operating Environment precautions
1. Capacitors should not be used in the following environments:
(1) Environmental conditions to avoid
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

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

◆Design of the capacitor mount
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.

3. Considerations for automatic insertion

Precautions

◆Adjustment Automatic Insertion machines (leaded components)
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 chucking or clinching.

Technical considerations

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

◆Selection of Flux
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 Chroline) 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
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:
1. Put the soldering iron on the land-pattern.
Soldering iron's temperature - below 350℃
Duration - 3 seconds or less
Numbers of times - 1 times
The soldering iron should not directly touch the capacitor.

Technical considerations

◆Selection of Flux
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
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:
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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For details of each product (characteristics graph, reliability information, precautions for use, and so on), see our Web site (http://www.ty-top.com/) or CD catalogs.

PRECAUTIONS

5. Cleaning	
Precautions	◆Board cleaning 1. When cleaning the mounted PC boards, make sure that cleaning conditions are consistent with prescribed usage conditions.
Technical consider-ations	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. 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.

6. Post-cleaning-process	
Precautions	◆Application of resin molding, etc. to the PCB and components. 1. Please contact your local Taiyo Yuden sales office before performing resin coating or molding on mounted capacitors. Please verify on the actual application that the coating process will not adversely affect the component quality.
Technical consider-ations	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. 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, causing a deterioration of the capacitor's performance. 1-3. Some mold resins may have poor moisture proofing properties. Please verify the contents of the resins before they are applied. 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.

7. Handling	
Precautions	◆Mechanical considerations 1. Be careful not to subject the capacitors to excessive mechanical shocks. Withstanding voltage failure may result. 2. If ceramic capacitors are dropped onto the floor or a hard surface they should not be used.
Technical consider-ations	1. Because the capacitor is made of ceramic, mechanical shocks applied to the board may damage or crack the capacitors. 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.

8. Storage conditions	
Precautions	◆Storage 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 ℃ 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. 2. Capacitors should not be kept in an environment filled with decomposition gases such as sulfurous hydrogen, sulfurous acid, chlorine, ammonia, etc. 3. Capacitors should not be kept in a location where they may be exposed to moisture, condensation or direct sunlight.
Technical consider-ations	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.

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