

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 2008. 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.

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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.

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一般積層セラミックコンデンサ (温度補償用・Class 1) STANDARD MULTILAYER CERAMIC CAPACITORS (CLASS1: TEMPERATURE COMPENSATING DIELECTRIC TYPE)

OPERATING TEMP. -55~+125°C



リフロー／REFLOW

特長 FEATURES

- ・実装密度の向上が図れます
- ・モノリシックの構造のため、信頼性が高い
- ・同一形状、静電容量範囲が広い

- ・ Improve Higher Mounting Densities.
- ・ Multilayer block structure provides higher reliability
- ・ A wide range of capacitance values available in standard case sizes.

用途 APPLICATIONS

- ・一般電子機器用
- ・通信機器用(携帯電話、PHS、コードレス電話 etc.)

- ・ General electronic equipment
- ・ Communication equipment (cellular phone, PHS, other wireless applications, etc.)

形名表記法 ORDERING CODE

1

定格電圧 [VDC]

E	16
T	25
U	50

2

シリーズ名

M	積層コンデンサ
---	---------

3

端子電極

K	メッキ品
---	------

4

形状寸法 (EIA) L×W [mm]

042 (01005)	0.4×0.2
063 (0201)	0.6×0.3
105 (0402)	1.0×0.5

5

温度特性 [ppm/°C]

C□	0 : CG、CH、CJ、CK		
R□	-220 : RH、		
S□	-330 : SH、SJ、SK	G	±30
T□	-470 : TJ、TK	H	±60
U□	-750 : UJ、UK	J	±120
S L	+350～-1000	K	±250

□=許容差

6

公称静電容量 [pF]

例	
0R5	0.5
010	1
100	10

※R=小数点

7

容量許容差

C	± 0.25 pF
D	± 0.5 pF
F	± 1 pF
J	± 5 %
K	± 10 %

8

製品厚み [mm]

C	0.2
P	0.3
V	0.5
W	0.5

9

個別仕様

—	標準
---	----

10

包装

F	φ178mm テーピング (2mmピッチ)
---	--------------------------

11

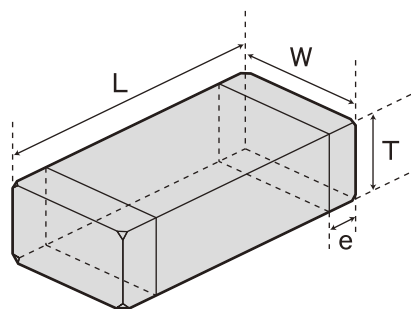
当社管理記号

△	標準品
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△=スペース

U	M	K	1	0	5	C	H	1	0	1	J	V	—	F	△
1	2	3	4	5	6	7	8	9	10	11					

1	Rated voltage [VDC]	
E	16	
T	25	
U	50	
2	Series name	
M	Multilayer ceramic capacitor	
3	End termination	
K	Plated	
4	Dimensions (case size) (EIA) L×W [mm]	
042 (01005)	0.4×0.2	
063 (0201)	0.6×0.3	
105 (0402)	1.0×0.5	
5	Temperature characteristics [ppm/°C]	
C□	0 : CG, CH, CJ, CK	
R□	-220 : RH,	
S□	-330 : SH, SJ, SK	G ±30
T□	-470 : TJ, TK	H ±60
U□	-750 : UJ, UK	J ±120
S L	+350~-1000	K ±250
□=Tolerance		
6	Nominal capacitance [pF]	
example		
0R5	0.5	
010	1	
100	10	
*R=decimal point		
7	Capacitance tolerance	
C	± 0.25 pF	
D	± 0.5 pF	
F	± 1 pF	
J	± 5 %	
K	± 10 %	
8	Thickness [mm]	
C	0.2	
P	0.3	
V	0.5	
W	0.5	
9	Special code	
—	Standard Products	
10	Packaging	
F	φ178mm Taping (2mm pitch)	
11	Internal code	
△	Standard Products	
△=Blank space		



Type (EIA)	L	W	T	e
□MK042 (01005)	0.4±0.02 (0.016±0.001)	0.2±0.02 (0.008±0.001)	0.2±0.02 (0.008±0.001)	C 0.1±0.03 (0.004±0.001)
□MK063 (0201)	0.6±0.03 (0.024±0.001)	0.3±0.03 (0.012±0.001)	0.3±0.03 (0.012±0.001)	P 0.15±0.05 (0.006±0.002)
□MK105 (0402)	1.0±0.05 (0.039±0.002)	0.5±0.05 (0.020±0.002)	0.5±0.05 (0.020±0.002)	W, V 0.25±0.10 (0.010±0.004)

Unit : mm (inch)

概略バリエーション AVAILABLE CAPACITANCE RANGE

Cap [pF]	Type	042	063			105				
	Temp.char.	C□	C□	U□	C□	U□	SL	R□	S□	T□
	VDC [pF:3digits]	16V	25V	50V						
0.5	0R5	C	P	P	W	W	W	W	W	W
1	010									
1.5	1R5									
2	020									
3	030									
4	040									
5	050									
6	060									
7	070									
8	080									
9	090									
10	100									
12	120									
15	150									
18	180									
22	220									
27	270									
33	330									
39	390				V					
47	470									
56	560									
68	680									
82	820					V				
100	101									
120	121									
150	151									
180	181									
220	221						V			
270	271									
330	331									
390	391									
470	471									
560	561									
680	681									
820	821									
1000	102									

注:グラフの記号は製品の厚み記号です。

Note: Letters in the table indicate thickness.

温度特性 Temperature Characteristics

温度特性 Temperature char. (EIA)	温度係数範囲 (ppm/°C) ※1 Temperature coefficient range	使用温度範囲 Operating Temp. range
C K (C0K)	0±250	-55~+125°C
C J (C0J)	0±120	
C H (C0H)	0±60	
C G (C0G)	0±30	
R H (R2H)	-220±60	
S K (S2K)	-330±250	
S J (S2J)	-330±120	
S H (S2H)	-330±60	
T K (T2K)	-470±250	
T J (T2J)	-470±120	
U K (U2K)	-750±250	
U J (U2J)	-750±120	
S L	-1000~+350	

※1: 20°Cにおける静電容量を基準。
Based on the capacitance at 20°C

静電容量許容差 Capacitance Tolerance Symbol

記号 Symbol	許容差 Tolerance	区分 Item
C	±0.25pF	~5pF
D	±0.5 pF	~10pF
F	±1pF	6~10 pF
J	±5 %	11pF~
K	±10 %	11pF~

Q

Q※2 Symbol	区分 Item
≥400+20・C※1	~27pF
≥1000	30pF~

※1: C=公称静電容量 Nominal capacitance [pF]

※2: 測定周波数 Measurement Frequency= 1±0.1MHz (C≤1000pF)
1±0.1kHz (C>1000pF)

測定電圧 Measurement voltage = 0.5~5Vrms (C≤1000pF)
1±0.2Vrms (C>1000pF)

セレクションガイド
Selection Guide

アイテム一覧
Part Numbers

特性図
Electrical Characteristics

梱包
Packaging

信頼性
Reliability Data

使用上の注意
Precautions



etc



042TYPE

Class 1

定格電圧 Rated Voltage (DC)	形 名 Ordering code	EHS (Environmental Hazardous Substances)	温度特性 Temperature characteristics (EIA)																	公称静電 容 量 Capacitance [pF]	静電容量 許 容 差 Capacitance tolerance	厚み Thicknees [mm] (inch)		
			CK (C0K)	CJ (C0J)	CH (C0H)	CG (C0G)	PK (P2K)	PJ (P2J)	PH (P2H)	RK (R2K)	RJ (R2J)	RH (R2H)	SK (S2K)	SJ (S2J)	SH (S2H)	TK (T2K)	TJ (T2J)	TH (T2H)	UK (U2K)				UJ (U2J)	SL
16V	EMK042 CK0R5□C	RoHS	●																		0.5	±0.25pF ±0.5pF	0.2±0.02 (0.008±0.001)	
	EMK042 CK010□C	RoHS	●																		1			
	EMK042 CK1R5□C	RoHS	●																		1.5			
	EMK042 CK020□C	RoHS	●																		2			
	EMK042 CJ030□C	RoHS		●																	3			
	EMK042 CH040□C	RoHS			●																	4		±0.5pF ±1pF
	EMK042 CH050□C	RoHS			●																	5		
	EMK042 CH060□C	RoHS			●																	6		
	EMK042 CH070□C	RoHS			●																	7		
	EMK042 CH080□C	RoHS			●																	8		
	EMK042 CH090□C	RoHS			●																	9		±5% ±10%
	EMK042 CH100□C	RoHS			●																	10		
	EMK042 CH120□C	RoHS			●																	12		
	EMK042 CH150□C	RoHS			●																	15		
	EMK042 CH180□C	RoHS			●																	18		
	EMK042 CH220□C	RoHS			●																	22		
	EMK042 CH270□C	RoHS			●																	27		
	EMK042 CH330□C	RoHS			●																	33		
	EMK042 CH390□C	RoHS			●																	39		
	EMK042 CH470□C	RoHS			●																	47		
	EMK042 CH560□C	RoHS			●																	56		
	EMK042 CH680□C	RoHS			●																	68		
	EMK042 CH820□C	RoHS			●																	82		
	EMK042 CH101□C	RoHS			●																	100		

注:形名の□には静電容量許容差記号が入ります。
□ Please specify the capacitance tolerance code.

063TYPE

Class 1

定格電圧 Rated Voltage (DC)	形 名 Ordering code	EHS (Environmental Hazardous Substances)	温度特性 Temperature characteristics (EIA)																	公称静電 容 量 Capacitance [pF]	静電容量 許 容 差 Capacitance tolerance	厚み Thicknees [mm] (inch)
			CK (C0K)	CJ (C0J)	CH (C0H)	CG (C0G)	PK (P2K)	PJ (P2J)	PH (P2H)	RK (R2K)	RJ (R2J)	RH (R2H)	SK (S2K)	SJ (S2J)	SH (S2H)	TK (T2K)	TJ (T2J)	TH (T2H)	UK (U2K)	UJ (U2J)	SL	
25V	TMK063 △0R5□P	RoHS	●															●		0.5	±0.25pF ±0.5pF	0.3±0.03 (0.012±0.001)
	TMK063 △010□P	RoHS	●															●		1		
	TMK063 △1R5□P	RoHS	●															●		1.5		
	TMK063 △020□P	RoHS	●															●		2		
	TMK063 △030□P	RoHS		●														●		3		
	TMK063 △040□P	RoHS			●														●			
	TMK063 △050□P	RoHS			●														●		5	
	TMK063 △060□P	RoHS			●														●		6	
	TMK063 △070□P	RoHS			●														●		7	
	TMK063 △080□P	RoHS			●														●		8	
	TMK063 △090□P	RoHS			●														●		9	
	TMK063 △100□P	RoHS			●														●		10	
	TMK063 △120□P	RoHS			●														●		12	
	TMK063 △150□P	RoHS			●														●		15	
	TMK063 CH180□P	RoHS			●																18	
	TMK063 CH220□P	RoHS			●																22	
	TMK063 CH270□P	RoHS			●																27	
	TMK063 CH330□P	RoHS			●																33	
	TMK063 CH390□P	RoHS			●																39	
	TMK063 CH470□P	RoHS			●																47	
	TMK063 CH560□P	RoHS			●																56	
	TMK063 CH680□P	RoHS			●																68	
	TMK063 CH820□P	RoHS			●																82	
	TMK063 CH101□P	RoHS			●																100	

注:形名の△には温度特性、□には静電容量許容差記号が入ります。
△ Please specify the temperature characteristics code and □ the capacitance tolerance code.

105TYPE

Class 1

定格電圧 Rated Voltage (DC)	形 名 Ordering code	EHS (Environmental Hazardous Substances)	温度特性 Temperature characteristics (EIA)																	公称静電 容 量 Capacitance [pF]	静電容量 許 容 差 Capacitance tolerance	厚み Thickness [mm] [inch]
			CK (C0K)	CJ (C0J)	CH (C0H)	CG (C0G)	PK (P2K)	PJ (P2J)	PH (P2H)	RK (R2K)	RJ (R2J)	RH (R2H)	SK (S2K)	SJ (S2J)	SH (S2H)	TK (T2K)	TJ (T2J)	TH (T2H)	UK (U2K)	UJ (U2J)	SL	
50V	UMK105 △ 0R5□W	RoHS	●															●		0.5	±0.25pF ±0.5pF	0.5±0.05 (0.020±0.002)
	UMK105 △ 010□W	RoHS	●															●		1		
	UMK105 △ 1R5□W	RoHS	●															●		1.5		
	UMK105 △ 020□W	RoHS	●															●		2		
	UMK105 △ 030□W	RoHS		●														●		3		
	UMK105 △ 040□W	RoHS			●														●			
	UMK105 △ 050□W	RoHS			●														●		5	
	UMK105 △ 060□W	RoHS			●														●		6	
	UMK105 △ 070□W	RoHS			●														●		7	
	UMK105 △ 080□○	RoHS			●														●		8	
	UMK105 △ 090□○	RoHS			●														●		9	
	UMK105 △ 100□○	RoHS			●														●		10	
	UMK105 △ 120□○	RoHS			●														●		12	
	UMK105 △ 150□○	RoHS			●														●		15	
	UMK105 △ 180□○	RoHS			●														●		18	
	UMK105 △ 220□V	RoHS			●														●		22	
	UMK105 △ 270□V	RoHS			●														●		27	
	UMK105 △ 330□V	RoHS			●														●		33	
	UMK105 △ 390□V	RoHS			●														●		39	
	UMK105 △ 470□V	RoHS			●														●		47	
	UMK105 △ 560□V	RoHS			●														●		56	
	UMK105 △ 680□V	RoHS			●														●		68	
	UMK105 △ 820□V	RoHS			●														●		82	
	UMK105 △ 101□V	RoHS			●														●		100	
	UMK105 △ 121□V	RoHS			●														●		120	
	UMK105 △ 151□V	RoHS			●														●		150	
	UMK105 △ 181□V	RoHS			●														●		180	
	UMK105 △ 221□V	RoHS			●														●		220	
	UMK105 △ 271□V	RoHS			●														●		270	
	UMK105 △ 331□V	RoHS			●														●		330	
	UMK105 SL121□V	RoHS																	●		120	
	UMK105 SL151□V	RoHS																	●		150	
	UMK105 SL181□V	RoHS																	●		180	
	UMK105 SL221□V	RoHS																	●		220	
	UMK105 SL271□V	RoHS																	●		270	
	UMK105 SL331□V	RoHS																	●		330	

注:形名の△には温度特性、□には静電容量許容差記号、○にはCHの時には「V」、UJの時は「W」が入ります。
△ Please specify the temperature characteristics code. □ Please specify the capacitance tolerance code.
○ comes to "V" when △ is "CH" and "W" when △ is "UJ".

105TYPE

Class 1

定格電圧 Rated Voltage (DC)	形 名 Ordering code		EHS (Environmental Hazardous Substances)	温度特性 Temperature characteristics (EIA)																	公称静電 容 量 Capacitance [pF]	静電容量 許 容 差 Capacitance tolerance	厚み Thickness [mm] (inch)
				CK (C0K)	CJ (C0J)	CH (C0H)	CG (C0G)	PK (P2K)	PJ (P2J)	PH (P2H)	RK (R2K)	RJ (R2J)	RH (R2H)	SK (S2K)	SJ (S2J)	SH (S2H)	TK (T2K)	TJ (T2J)	TH (T2H)	UK (U2K)			
50V	UMK105 △ 0R5BW		RoHS									●			●						0.5	±0.1pF	0.5±0.05 (0.020±0.002)
	UMK105 △ 010BW		RoHS									●			●						1		
	UMK105 △ 1R2BW		RoHS									●			●						1.2		
	UMK105 △ 1R5BW		RoHS									●			●						1.5		
	UMK105 △ 1R8BW		RoHS									●			●						1.8		
	UMK105 △ 2R2JW		RoHS									●			●						2.2	±5%	
	UMK105 △ 2R7JW		RoHS									●			●						2.7		
	UMK105 △ 3R3JW		RoHS										●		●						3.3		
	UMK105 △ 3R9JW		RoHS										●		●						3.9		
	UMK105 △ 4R7JW		RoHS										●		●		●				4.7		
	UMK105 △ 5R6JW		RoHS								●			●		●					5.6		
	UMK105 △ 6R8JW		RoHS								●			●		●					6.8		
	UMK105 △ 8R2JW		RoHS								●			●		●					8.2		
	UMK105 △ 100JW		RoHS								●			●		●					10		
	UMK105 △ 120JW		RoHS								●			●		●					12		
	UMK105 △ 150JW		RoHS								●			●		●					15		
	UMK105 △ 180JW		RoHS								●			●		●					18		
	UMK105 △ 200JW		RoHS								●			●		●					20		

注:形名の△には温度特性が入ります。
△ Please specify the temperature characteristics code.

梱包 PACKAGING

①最小受注単位数 Minimum Quantity

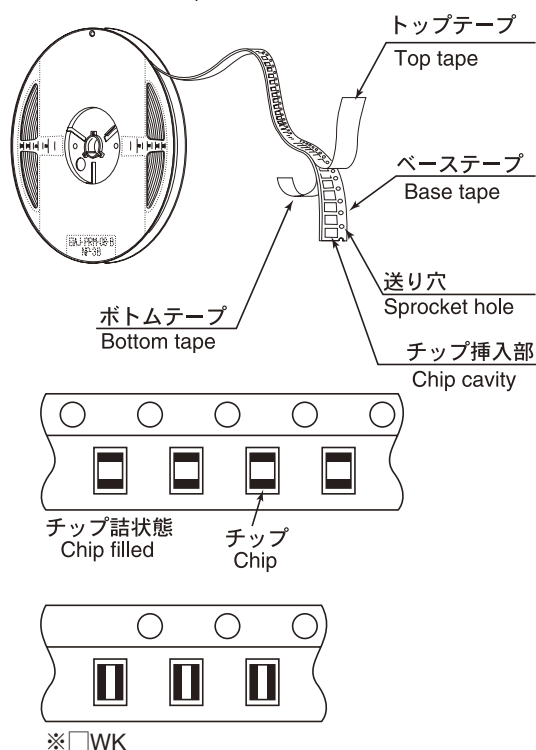
■テーピング梱包 Taped packaging

形式 (EIA) Type	製品厚み Thickness		標準数量 Standard quantity [pcs]	
	mm (inch)	code	紙テープ paper	エンボステープ Embossed tape
□MK042 (01005)	0.2 (0.008)	C	15000	—
□MK063 (0201)	0.3 (0.012)	P	15000	—
□2K096 (0302)	0.3 (0.012)	P	10000	—
	0.45 (0.018)	K		
□WK105 (0204)	0.3 (0.012)	P	10000	—
□MK105 (0402)	0.5 (0.020)	V, W	10000	—
□VK105 (0402)		W		
□MK107 (0603) □WK107 (0306)	0.45 (0.018)	K	4000	—
	0.5 (0.020)	V	—	4000
	0.8 (0.031)	A	4000	—
□2K110 (0504)	0.5 (0.020)	V	4000	—
	0.8 (0.031)	A	4000	—
	0.6 (0.024)	B	4000	—
□MK212 (0805) □WK212 (0508)	0.45 (0.018)	K	4000	—
	0.85 (0.033)	D	4000	—
	1.25 (0.049)	G	—	3000
□4K212 (0805) □2K212 (0805)	0.85 (0.033)	D	4000	—
	0.85 (0.033)	D	4000	—
	0.85 (0.033)	D	4000	—
□MK316 (1206)	1.15 (0.045)	F	—	3000
	1.25 (0.049)	G	—	3000
	1.6 (0.063)	L	—	2000
□MK325 (1210)	0.85 (0.033)	D	—	2000
	1.15 (0.045)	F		
	1.5 (0.059)	H		
	1.9 (0.075)	N		
	2.0max (0.079)	Y	—	2000
□MK432 (1812)	2.5 (0.098)	M	—	500 (T), 1000 (P)
	2.5 (0.098)	M	—	500

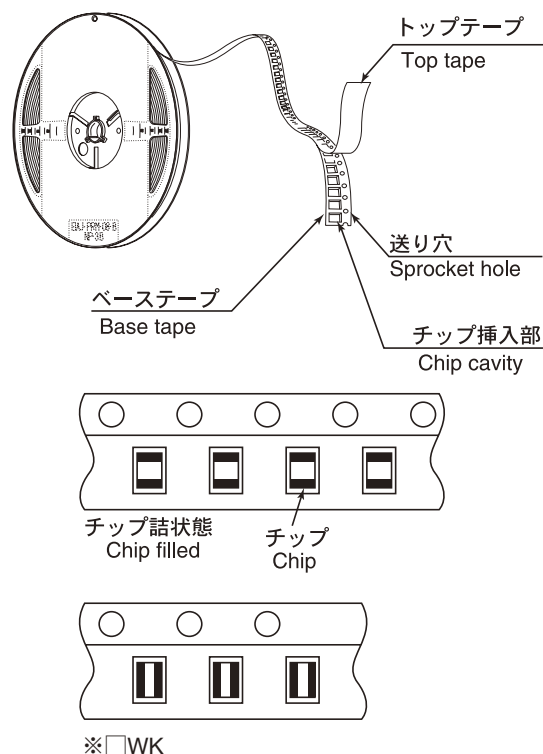
②テーピング材質 Taping material

紙テープ
Card board carrier tape

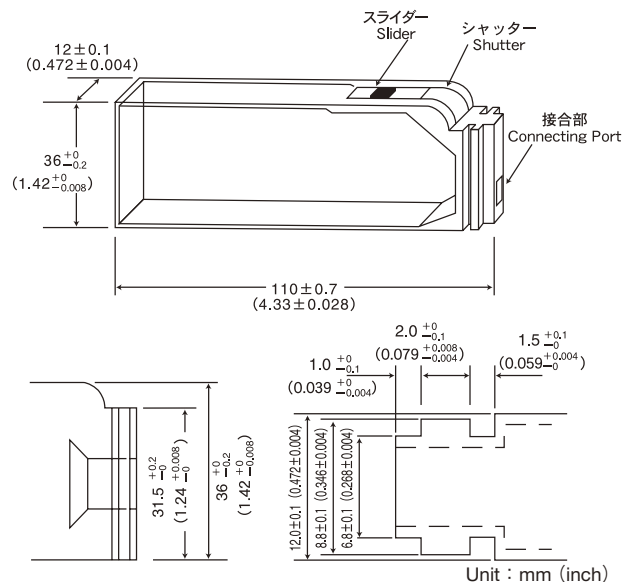
※プレスポケットタイプは、
ボトムテープ無し。



エンボステープ Embossed Tape



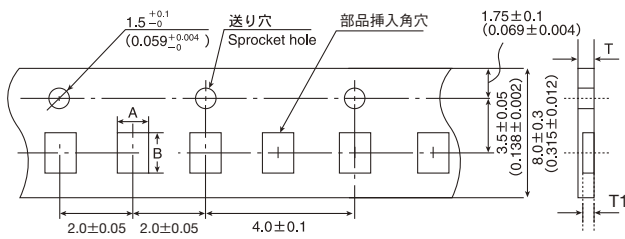
③バルクカセット Bulk Cassette



105, 107, 212形状で個別対応致しますのでお問い合わせ下さい。
Please contact any of our offices for accepting your requirement according to dimensions 0402, 0603, 0805 (inch)

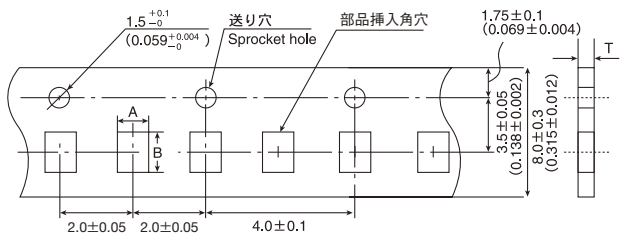
梱包 PACKAGING

③テーピング寸法 Taping dimensions 紙テープ Paper Tape (8mm幅) (0.315inches wide)



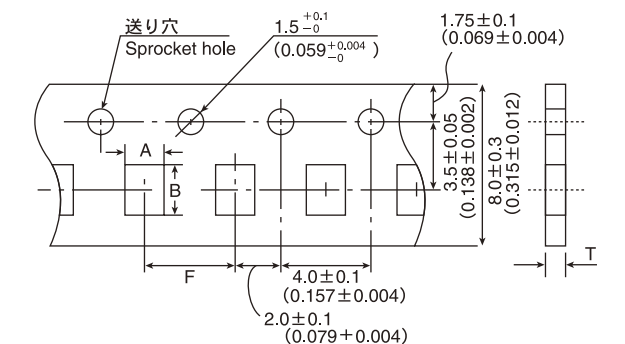
Type (EIA)	チップ挿入部 Chip Cavity		挿入ピッチ Insertion Pitch	テープ厚み Tape Thickness	
	A	B		T	T1
□MK042 (01005)	0.25 (0.010)	0.45 (0.018)	2.0 ± 0.05 (0.079 ± 0.002)	0.36max. (0.014)	0.27max. (0.011)
□MK063 (0201)	0.37 (0.016)	0.67 (0.027)	2.0 ± 0.05 (0.079 ± 0.002)	0.45max. (0.018)	0.42max. (0.017)
□WK105 (0204)	0.65 (0.026)	1.15 (0.045)	2.0 ± 0.05 (0.079 ± 0.002)	0.45max. (0.018max)	0.42max. (0.017max)

Unit : mm (inch)



Type (EIA)	チップ挿入部 Chip Cavity		挿入ピッチ Insertion Pitch	テープ厚み Tape Thickness	
	A	B		T	
□2K096 (0302)	0.72 (0.028)	1.02 (0.040)	2.0 ± 0.05 (0.079 ± 0.002)	0.45max.(0.018max) 0.6max.(0.024max)	
□MK105 (0402)	0.65 (0.026)	1.15 (0.045)	2.0 ± 0.05 (0.079 ± 0.002)	0.8max. (0.031max.)	
□VK105 (0402)					

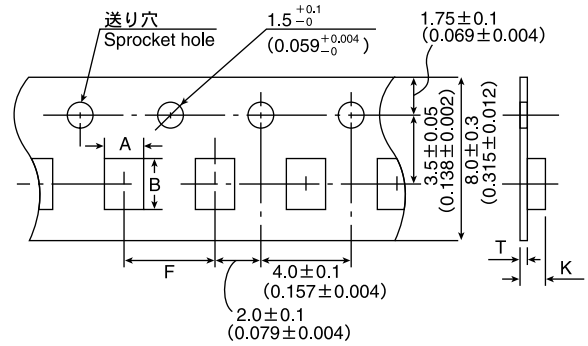
Unit : mm (inch)



Type (EIA)	チップ挿入部 Chip Cavity		挿入ピッチ Insertion Pitch	テープ厚み Tape Thickness	
	A	B		T	
□MK107 (0603)	1.0 (0.039)	1.8 (0.071)	4.0 ± 0.1 (0.157 ± 0.004)	1.1max. (0.043max.)	
□WK107 (0306)					
□2K110 (0504)	1.15 (0.045)	1.55 (0.061)	4.0 ± 0.1 (0.157 ± 0.004)	1.0max. (0.039max.)	
□MK212 (0805)	1.65 (0.065)	2.4 (0.094)	4.0 ± 0.1 (0.157 ± 0.004)	1.1max. (0.043max.)	
□WK212 (0508)					
□4K212 (0805)					
□2K212 (0805)					
□MK316 (1206)	2.0 (0.079)	3.6 (0.142)			

Unit : mm (inch)

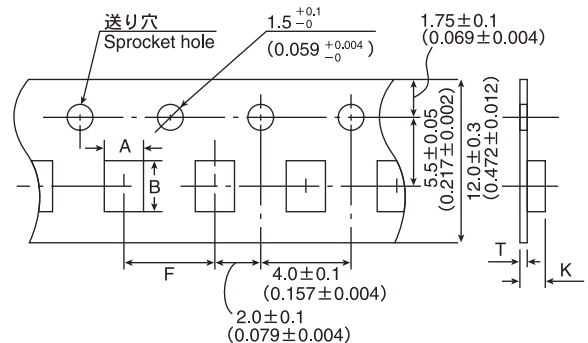
エンボステープ Embossed tape (8mm幅) (0.315inches wide)



Type (EIA)	チップ挿入部 Chip cavity		挿入ピッチ Insertion Pitch	テープ厚み Tape Thickness	
	A	B		K	T
□WK107 (0306)	1.0 (0.039)	1.8 (0.071)	4.0 ± 0.1 (0.157 ± 0.004)	1.3max. (0.051max.)	0.25 ± 0.1 (0.01 ± 0.004)
□MK212 (0805)	1.65 (0.065)	2.4 (0.094)			
□MK316 (1206)	2.0 (0.079)	3.6 (0.142)		3.4max. (0.134max.)	0.6max. (0.024max.)
□MK325 (1210)	2.8 (0.110)	3.6 (0.142)			

Unit : mm (inch)

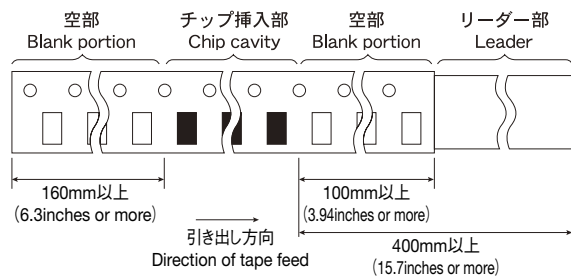
エンボステープ Embossed tape (12mm幅) (0.472inches wide)



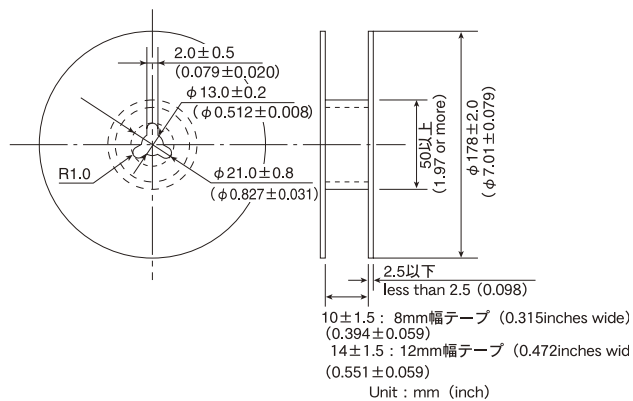
Type (EIA)	チップ挿入部 Chip cavity		挿入ピッチ Insertion Pitch	テープ厚み Tape Thickness	
	A	B		K	T
□MK432 (1812)	3.7 (0.146)	4.9 (0.193)	8.0 ± 0.1 (0.315 ± 0.004)	4.0max. (0.157max.)	0.6max. (0.024max.)

Unit : mm (inch)

④ リーダー部／空部 Leader and Blank portion

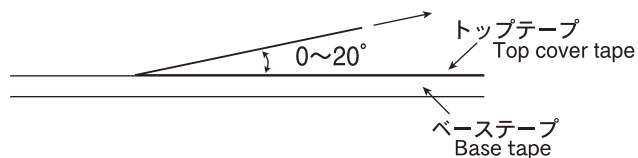


⑤ リール寸法 Reel size

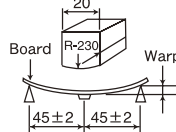


⑥ トップテープ強度 Top Tape Strength

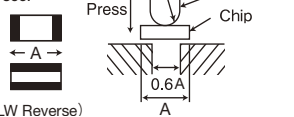
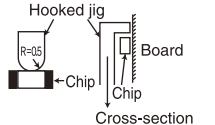
トップテープのはがし力とは図矢印方向にて0.1～0.7Nとなります。
The top tape requires a peel-off force of 0.1～0.7N in the direction of the arrow as illustrated below.



Multilayer Ceramic Capacitor Chips

Item		Specified Value			Test Methods and Remarks	
		Temperature Compensating (Class 1)		High Permittivity (Class 2)		
		Standard	High Frequency Type	Standard Note1		High Value
1.Operating Temperature Range		-55 to +125℃		BJ : -55 to +125℃ F : -25 to +85℃	-25 to +85℃	High Capacitance Type BJ (X7R) : -55~+125℃, BJ (X5R) : -55~+85℃ E (Y5U) : -30~+85℃, F (Y5V) : -30~+85℃
2.Storage Temperature Range		-55 to +125℃		BJ : -55 to +125℃ F : -25 to +85℃	-25 to +85℃	High Capacitance Type BJ (X7R) : -55~+125℃, BJ (X5R) : -55~+85℃ E (Y5U) : -30~+85℃, F (Y5V) : -30~+85℃
3.Rated Voltage		50VDC,25VDC, 16VDC	16VDC 50VDC	50VDC,25VDC	50VDC,35VDC,25VDC 16VDC,10VDC,6.3VDC 4DVC, 2.5VDC	
4.Withstanding Voltage Between terminals		No breakdown or damage	No abnormality	No breakdown or damage		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)
5.Insulation Resistance		10000 MΩ min.		500 MΩ μF. or 10000 MΩ., whichever is the smaller. Note 5		Applied voltage: Rated voltage Duration: 60±5 sec. Charge/discharge current: 50mA max.
6.Capacitance (Tolerance)		0.5 to 5 pF: ±0.25 pF 1 to 10pF: ±0.5 pF 5 to 10 pF: ±1 pF 11 pF or over: ± 5% ±10% 105TYPER△,S△,T△,U△ only 0.5~2pF: ±0.1pF 2.2~20pF: ±5%	0.5 to 2 pF : ±0.1 pF 2.2 to 5.1 pF : ±5%	BJ: ±10%, ±20% F : +80% -20%	BJ : ±10%、 ±20% F : -20%／+80%	Measuring frequency : Class1 : 1MHz±10% (C≤1000pF) 1 k Hz±10% (C>1000pF) Class2 : 1 k Hz±10% (C≤10 μF) 120Hz±10Hz (C>10 μF) Measuring voltage : Note 4 Class1 : 0.5~5Vrms (C≤1000pF) 1±0.2Vrms (C>1000pF) Class2 : 1±0.2Vrms (C≤10 μF) 0.5±0.1Vrms (C>10 μF) Bias application: None
7.Q or Tangent of Loss Angle (tan δ)		Under 30 pF : Q≥400 + 20C 30 pF or over : Q≥1000 C= Nominal capacitance	Refer to detailed specification	BJ: 2.5% max. (50V, 25V) F: 5.0% max. (50V, 25V) Note 4	BJ : 2.5% max. F : 7% max. Note 4	Multilayer: Measuring frequency : Class1 : 1MHz±10% (C≤1000pF) 1 k Hz±10% (C>1000pF) Class2 : 1 k Hz±10% (C≤10 μF) 120Hz±10Hz (C>10 μF) Measuring voltage : Note 4 Class1 : 0.5~5Vrms (C≤1000pF) 1±0.2Vrms (C>1000pF) Class2 : 1±0.2Vrms (C≤10 μF) 0.5±0.1Vrms (C>10 μF) Bias application: None High—Frequency—Multilayer: Measuring frequency: 1GHz Measuring equipment: HP4291A Measuring jig: HP16192A
8.Temperature Characteristic of Capacitance	(Without voltage application)	CK : 0±250 CJ : 0±120 CH : 0±60 CG : 0±30 RH : -220±60 SK : -330±250 SJ : -330±120 SH : -330±60 TK : -470±250 TJ : -470±120 UK : -750±250 UJ : -750±120 SL : +350 to -1000 (ppm/℃)	CH : 0±60 RH : -220±60 (ppm/℃)	BJ : ±10% (-25~85℃) F : +30% (-25~85℃) -80 BJ (X7R) : ±15% F (Y5V) : +22% -82	BJ : ±10% (-25~+85℃) F : +30%／-80% (-25~+85℃) BJ (X7R、X5R) : ±15% F (Y5V) : +22%／-82%	According to JIS C 5102 clause 7.12. Temperature compensating: Measurement of capacitance at 20℃ and 85℃ shall be made to calculate temperature characteristic by the following equation. $\frac{(C_{85}-C_{20})}{C_{20} \times \Delta T} \times 10^6 \text{ (ppm/℃)}$ High permittivity: Change of maximum capacitance deviation in step 1 to 5 Temperature at step 1: +20℃ Temperature at step 2: minimum operating temperature Temperature at step 3: +20℃ (Reference temperature) Temperature at step 4: maximum operating temperature Temperature at step 5: +20℃ Reference temperature for X7R, X5R, Y5U and Y5V shall be +25℃
9.Resistance to Flexure of Substrate		Appearance: No abnormality Capacitance change: Within ±5% or ±0.5 pF, whichever is larger.	Appearance: No abnormality Capacitance change: Within±0.5 pF	Appearance: No abnormality Capacitance change: BJ : Within ±12.5% F : Within ±30%		Warp: 1mm Testing board: glass epoxy—resin substrate Thickness: 1.6mm (063 TYPE : 0.8mm) The measurement shall be made with board in the bent position.  (Unit: mm)

Multilayer Ceramic Capacitor Chips

Item	Specified Value				Test Methods and Remarks
	Temperature Compensating (Class 1)		High Permittivity (Class 2)		
	Standard	High Frequency Type	Standard Note1	High Value	
10.Body Strength	—	No mechanical damage.	—	—	High Frequency Multilayer: Applied force: 5N Duration: 10 sec.  (LW Reverse)
11.Adhesion of Electrode	No separation or indication of separation of electrode.				Applied force: 5N (01005, 0201, 0302 TYPE 2N) Duration: 30±5 sec.  Cross-section
12.Solderability	At least 95% of terminal electrode is covered by new solder.				Solder temperature: 230±5°C Duration: 4±1 sec.
13.Resistance to soldering	Appearance: No abnormality Capacitance change: Within ±2.5% or ±0.25pF, whichever is larger. Q: Initial value Insulation resistance: Initial value Withstanding voltage (between terminals): No abnormality	Appearance: No abnormality Capacitance change: Within ±2.5% Q: Initial value Insulation resistance: Initial value Withstanding voltage (between terminals): No abnormality	Appearance: No abnormality Capacitance change: Within ±7.5% (BJ) Within ±20% (F) tan δ: Initial value Note 4 Insulation resistance: Initial value Withstanding voltage (between terminals): No abnormality		Preconditioning: Thermal treatment (at 150°C for 1 hr) (Applicable to Class 2.) Solder temperature: 270±5°C Duration: 3±0.5 sec. Preheating conditions: 80 to 100°C, 2 to 5 min. or 5 to 10 min. 150 to 200°C, 2 to 5 min. or 5 to 10 min. Recovery: Recovery for the following period under the standard condition after the test. 6~24 hrs (Class 1) 24±2 hrs (Class 2)
14.Thermal shock	Appearance: No abnormality Capacitance change: Within ±2.5% or ±0.25pF, whichever is larger. Q: Initial value Insulation resistance: Initial value Withstanding voltage (between terminals): No abnormality	Appearance: No abnormality Capacitance change: Within ±0.25pF Q: Initial value Insulation resistance: Initial value Withstanding voltage (between terminals): No abnormality	Appearance: No abnormality Capacitance change: Within ±7.5% (BJ) Within ±20% (F) tan δ: Initial value Note 4 Insulation resistance: Initial value Withstanding voltage (between terminals): No abnormality		Preconditioning: Thermal treatment (at 150°C for 1 hr) (Applicable to Class 2.) Conditions for 1 cycle: Step 1: Minimum operating temperature $+0_{-3}^{\circ}\text{C}$ 30±3 min. Step 2: Room temperature 2 to 3 min. Step 3: Maximum operating temperature $+0_{+3}^{\circ}\text{C}$ 30±3 min. Step 4: Room temperature 2 to 3 min. Number of cycles: 5 times Recovery after the test: 6~24 hrs (Class 1) 24±2 hrs (Class 2)
15.Damp Heat (steady state)	Appearance: No abnormality Capacitance change: Within ±5% or ±0.5pF, whichever is larger. Q: $C\geq 30\text{ pF} : Q\geq 350$ $10\leq C<30\text{ pF} : Q\geq 275+2.5C$ $C<10\text{ pF} : Q\geq 200+10C$ C: Nominal capacitance Insulation resistance: 1000 MΩ min.	Appearance: No abnormality Capacitance change: Within ±0.5pF, Insulation resistance: 1000 MΩ min.	Appearance: No abnormality Capacitance change: BJ: Within ±12.5% F: Within ±30% tan δ: BJ: 5.0% max. F: 7.5% max. Note 4 Insulation resistance: 50 MΩ μF or 1000 MΩ whichever is smaller. Note 5	Appearance: No abnormality Capacitance change: BJ: Within ±12.5% Note 4 tan δ: BJ: 5.0% max. Note 4. F: 11.0% max. Insulation resistance: 50 MΩ μF or 1000 MΩ whichever is smaller. Note 5	Multilayer : Preconditioning: Thermal treatment (at 150°C for 1 hr) (Applicable to Class 2.) Temperature: 40±2°C Humidity: 90 to 95% RH Duration: 500 $+24_{-0}$ hrs Recovery: Recovery for the following period under the standard condition after the removal from test chamber. 6~24 hrs (Class 1) 24±2 hrs (Class 2) High—Frequency Multilayer: Temperature: 60±2°C Humidity: 90 to 95% RH Duration: 500 $+24_{-0}$ hrs Recovery: Recovery for the following period under the standard condition after the removal from test chamber. 6~24 hrs (Class 1)

Multilayer Ceramic Capacitor Chips

Item	Specified Value				Test Methods and Remarks
	Temperature Compensating (Class 1)		High Permittivity (Class 2)		
	Standard	High Frequency Type	Standard Note1	High Value	
16.Loading under Damp Heat	Appearance: No abnormality Capacitance change: Within $\pm 7.5\%$ or $\pm 0.75\text{pF}$, whichever is larger. Q: $C\geq 30\text{ pF}$: $Q\geq 200$ $C<30\text{ pF}$: $Q\geq 100 + 10\text{C}/3$ C : Nominal capacitance Insulation resistance: 500 M Ω min.	Appearance: No abnormality Capacitance change: $C\leq 2\text{ pF}$: Within $\pm 0.4\text{ pF}$ $C>2\text{ pF}$: Within $\pm 0.75\text{ pF}$ C : Nominal capacitance Insulation resistance: 500 M Ω min.	Appearance: No abnormality Capacitance change: BJ: Within $\pm 12.5\%$ F: Within $\pm 30\%$ Note 4 tan δ : BJ: 5.0% max. F: 7.5% max. Note 4 Insulation resistance: 25 M $\Omega\text{ }\mu\text{F}$ or 500 M Ω , whichever is the smaller. Note 5	Appearance: No abnormality Capacitance change: BJ : Within $\pm 12.5\%$ F : Within $\pm 30\%$ Note 4 tan δ : BJ : 5.0% max. F : 11% max. Note 4 Insulation resistance: 25 M $\Omega\text{ }\mu\text{F}$ or 500 M Ω , whichever is the smaller. Note 5	According to JIS C 5102 Clause 9. 9. Multilayer: Preconditioning: Voltage treatment (Class 2) Temperature: $40\pm 2^{\circ}\text{C}$ Humidity: 90 to 95% RH Duration: 500 $^{+24}_{-0}$ hrs Applied voltage: Rated voltage Charge and discharge current: 50mA max. (Class 1,2) Recovery: Recovery for the following period under the standard condition after the removal from test chamber. 6~24 hrs (Class 1) 24 ± 2 hrs (Class 2) High—Frequency Multilayer: Temperature: $60\pm 2^{\circ}\text{C}$ Humidity: 90 to 95% RH Duration: 500 $^{+24}_{-0}$ hrs Applied voltage: Rated voltage Charge and discharge current: 50mA max. Recovery: 6~24 hrs of recovery under the standard condition after the removal from test chamber.
17.Loading at High Temperature	Appearance: No abnormality Capacitance change: Within $\pm 3\%$ or $\pm 0.3\text{pF}$, whichever is larger. Q: $C\geq 30\text{ pF}$: $Q\geq 350$ $10\leq C<30\text{ pF}$: $Q\geq 275 + 2.5\text{C}$ $C<10\text{ pF}$: $Q\geq 200 + 10\text{C}$ C : Nominal capacitance Insulation resistance: 1000 M Ω min.	Appearance: No abnormality Capacitance change: Within $\pm 3\%$ or $\pm 0.3\text{pF}$, whichever is larger. Insulation resistance: 1000 M Ω min.	Appearance: No abnormality Capacitance change: BJ: Within $\pm 12.5\%$ F: Within $\pm 30\%$ Note 4 tan δ : BJ: 4.0% max. F: 7.5% max. Note 4 Insulation resistance: 50 M $\Omega\text{ }\mu\text{F}$ or 1000 M Ω , whichever is smaller. Note 5	Appearance: No abnormality Capacitance change: BJ : Within $\pm 12.5\%$ Within $\pm 20\% \times \times$ Within $\pm 25\% \times \times$ F : Within $\pm 30\%$ Note 4 tan δ : BJ : 5.0% max. F : 11% max. Note 4 Insulation resistance: 50 M $\Omega\text{ }\mu\text{F}$ or 1000 M Ω , whichever is smaller. Note 5	According to JIS C 5102 clause 9.10. Multilayer: Preconditioning: Voltage treatment (Class 2) Temperature: $125\pm 3^{\circ}\text{C}$ (Class 1, Class 2: B, BJ (X7R)) $85\pm 2^{\circ}\text{C}$ (Class 2: BJ,F) Duration: 1000 $^{+48}_{-0}$ hrs Applied voltage: Rated voltage $\times 2$ Note 6 Recovery: Recovery for the following period under the standard condition after the removal from test chamber. 6~24 hrs (Class 1) 24 ± 2 hrs (Class 2) High—Frequency Multilayer: Temperature: $125\pm 3^{\circ}\text{C}$ (Class 1) Duration: 1000 $^{+48}_{-0}$ hrs Applied voltage: Rated voltage $\times 2$ Recovery: 6~24 hrs of recovery under the standard condition after the removal from test chamber.

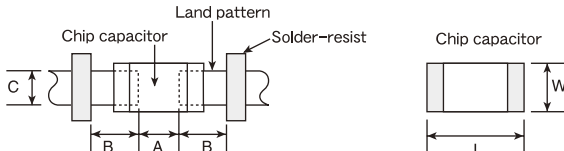
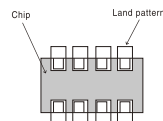
Note 1 :For 105 type, specified in "High value".

Note 2 :Thermal treatment (Multilayer): 1 hr of thermal treatment at $150 \pm 0 / -10^\circ\text{C}$ followed by 24 ± 2 hrs of recovery under the standard condition shall be performed before the measurement.Note 3 :Voltage treatment (Multilayer): 1 hr of voltage treatment under the specified temperature and voltage for testing followed by 24 ± 2 hrs of recovery under the standard condition shall be performed before the measurement.

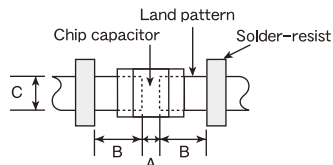
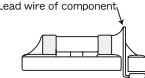
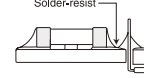
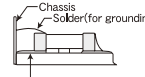
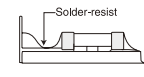
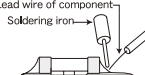
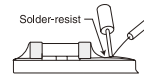
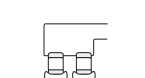
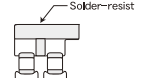
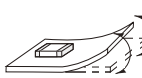
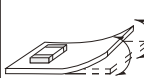
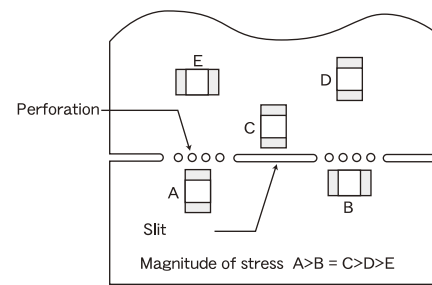
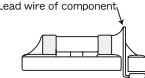
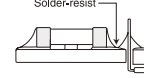
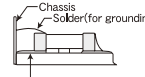
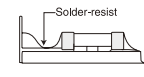
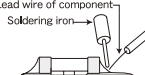
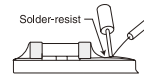
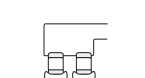
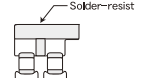
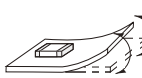
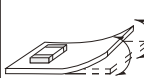
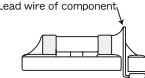
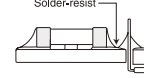
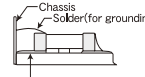
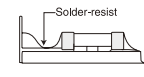
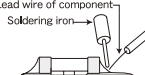
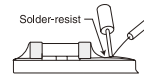
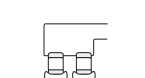
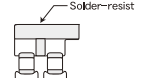
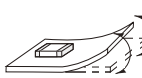
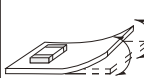
Note 4, 5 :The figure indicates typical inspection. Please refer to individual specifications.

Note 6 :Some of the parts are applicable in rated voltage $\times 1.5$. Please refer to individual specifications.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."

Precautions on the use of Multilayer Ceramic Capacitors

Stages	Precautions	Technical considerations																																																																																																																																		
1.Circuit Design	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. Operating Voltage (Verification of 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. 2. Even if the applied voltage is lower than the rated value, the reliability of capacitors might be reduced if either a high frequency AC voltage or a pulse voltage having rapid rise time is present in the circuit.																																																																																																																																			
2.PCB Design	Pattern configurations (Design of Land-patterns) 1. When capacitors are mounted on a PCB, the amount of solder used (size of fillet) can directly affect capacitor performance. Therefore, the following items must be carefully considered in the design of solder land patterns: (1) The amount of solder applied can affect the ability of chips to withstand mechanical stresses which may lead to breaking or cracking. Therefore, when designing land-patterns it is necessary to consider the appropriate size and configuration of the solder pads which in turn determines the amount of solder necessary to form the fillets. (2) When more than one part is jointly soldered onto the same land or pad, the pad must be designed so that each component's soldering point is separated by solder-resist.	1.The following diagrams and tables show some examples of recommended patterns to prevent excessive solder amounts. (larger fillets which extend above the component end terminations) Examples of improper pattern designs are also shown. (1) Recommended land dimensions for a typical chip capacitor land patterns for PCBs  Recommended land dimensions for wave-soldering (unit: mm) <table><tr><th>Type</th><th>107</th><th>212</th><th>316</th><th>325</th></tr><tr><td rowspan="2">Size</td><td>L</td><td>1.6</td><td>2.0</td><td>3.2</td><td>3.2</td></tr><tr><td>W</td><td>0.8</td><td>1.25</td><td>1.6</td><td>2.5</td></tr><tr><td>A</td><td>0.8~1.0</td><td>1.0~1.4</td><td>1.8~2.5</td><td>1.8~2.5</td></tr><tr><td>B</td><td>0.5~0.8</td><td>0.8~1.5</td><td>0.8~1.7</td><td>0.8~1.7</td></tr><tr><td>C</td><td>0.6~0.8</td><td>0.9~1.2</td><td>1.2~1.6</td><td>1.8~2.5</td></tr></table> Recommended land dimensions for reflow-soldering (unit: mm) <table><tr><th>Type</th><th>042</th><th>063</th><th>105</th><th>107</th><th>212</th><th>316</th><th>325</th><th>432</th></tr><tr><td rowspan="2">Size</td><td>L</td><td>0.4</td><td>0.6</td><td>1.0</td><td>1.6</td><td>2.0</td><td>3.2</td><td>3.2</td><td>4.5</td></tr><tr><td>W</td><td>0.2</td><td>0.3</td><td>0.5</td><td>0.8</td><td>1.25</td><td>1.6</td><td>2.5</td><td>3.2</td></tr><tr><td>A</td><td>0.15~0.25</td><td>0.20~0.30</td><td>0.45~0.55</td><td>0.8~1.0</td><td>0.8~1.2</td><td>1.8~2.5</td><td>1.8~2.5</td><td>2.5~3.5</td></tr><tr><td>B</td><td>0.10~0.20</td><td>0.20~0.30</td><td>0.40~0.50</td><td>0.6~0.8</td><td>0.8~1.2</td><td>1.0~1.5</td><td>1.0~1.5</td><td>1.5~1.8</td></tr><tr><td>C</td><td>0.15~0.30</td><td>0.25~0.40</td><td>0.45~0.55</td><td>0.6~0.8</td><td>0.9~1.6</td><td>1.2~2.0</td><td>1.8~3.2</td><td>2.3~3.5</td></tr></table> Excess solder can affect the ability of chips to withstand mechanical stresses. Therefore, please take proper precautions when designing land-patterns.  <table><tr><th>Type</th><th>212 (4 circuits)</th></tr><tr><td rowspan="2">Size</td><td>L</td><td>2.0</td></tr><tr><td>W</td><td>1.25</td></tr><tr><td>a</td><td>0.5~0.6</td></tr><tr><td>b</td><td>0.5~0.6</td></tr><tr><td>c</td><td>0.2~0.3</td></tr><tr><td>d</td><td>0.5</td></tr></table> <table><tr><th>Type</th><th>212 (2 circuits)</th><th>110 (2 circuits)</th><th>096 (2 circuits)</th></tr><tr><td rowspan="2">Size</td><td>L</td><td>2.0</td><td>1.37</td><td>0.9</td></tr><tr><td>W</td><td>1.25</td><td>1.0</td><td>0.6</td></tr><tr><td>a</td><td>0.5~0.6</td><td>0.35~0.45</td><td>0.25~0.35</td></tr><tr><td>b</td><td>0.5~0.6</td><td>0.55~0.65</td><td>0.15~0.25</td></tr><tr><td>c</td><td>0.5~0.6</td><td>0.3~0.4</td><td>0.15~0.25</td></tr><tr><td>d</td><td>1.0</td><td>0.64</td><td>0.45</td></tr></table>	Type	107	212	316	325	Size	L	1.6	2.0	3.2	3.2	W	0.8	1.25	1.6	2.5	A	0.8~1.0	1.0~1.4	1.8~2.5	1.8~2.5	B	0.5~0.8	0.8~1.5	0.8~1.7	0.8~1.7	C	0.6~0.8	0.9~1.2	1.2~1.6	1.8~2.5	Type	042	063	105	107	212	316	325	432	Size	L	0.4	0.6	1.0	1.6	2.0	3.2	3.2	4.5	W	0.2	0.3	0.5	0.8	1.25	1.6	2.5	3.2	A	0.15~0.25	0.20~0.30	0.45~0.55	0.8~1.0	0.8~1.2	1.8~2.5	1.8~2.5	2.5~3.5	B	0.10~0.20	0.20~0.30	0.40~0.50	0.6~0.8	0.8~1.2	1.0~1.5	1.0~1.5	1.5~1.8	C	0.15~0.30	0.25~0.40	0.45~0.55	0.6~0.8	0.9~1.6	1.2~2.0	1.8~3.2	2.3~3.5	Type	212 (4 circuits)	Size	L	2.0	W	1.25	a	0.5~0.6	b	0.5~0.6	c	0.2~0.3	d	0.5	Type	212 (2 circuits)	110 (2 circuits)	096 (2 circuits)	Size	L	2.0	1.37	0.9	W	1.25	1.0	0.6	a	0.5~0.6	0.35~0.45	0.25~0.35	b	0.5~0.6	0.55~0.65	0.15~0.25	c	0.5~0.6	0.3~0.4	0.15~0.25	d	1.0	0.64	0.45
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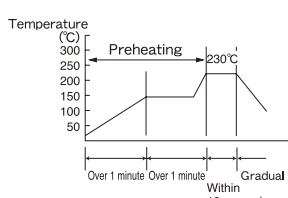
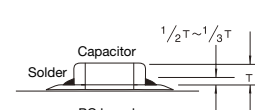
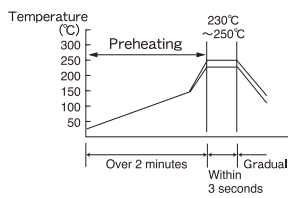
Precautions on the use of Multilayer Ceramic Capacitors

Stages	Precautions	Technical considerations																																														
2.PCB Design	Pattern configurations (Capacitor layout on panelized [breakaway] PC boards) 1. After capacitors have been mounted on the boards, chips can be subjected to mechanical stresses in subsequent manufacturing processes (PCB cutting, board inspection, mounting of additional parts, assembly into the chassis, wave soldering the reflow soldered boards etc.) For this reason, planning pattern configurations and the position of SMD capacitors should be carefully performed to minimize stress.	LWDC Recommended land dimensions for reflow-soldering  <table><tr><th>Type</th><th>105</th><th>107</th><th>212</th></tr><tr><td rowspan="2">Size</td><td>L</td><td>0.52</td><td>0.8</td><td>1.25</td></tr><tr><td>W</td><td>1.0</td><td>1.6</td><td>2.0</td></tr><tr><td>A</td><td>0.18~0.22</td><td>0.25~0.3</td><td>0.5~0.7</td></tr><tr><td>B</td><td>0.2~0.25</td><td>0.3~0.4</td><td>0.4~0.5</td></tr><tr><td>C</td><td>0.9~1.1</td><td>1.5~1.7</td><td>1.9~2.1</td></tr></table> (unit: mm) (2) Examples of good and bad solder application <table><tr><th>Items</th><th>Not recommended</th><th>Recommended</th></tr><tr><td>Mixed mounting of SMD and leaded components</td><td></td><td></td></tr><tr><td>Component placement close to the chassis</td><td></td><td></td></tr><tr><td>Hand-soldering of leaded components near mounted components</td><td></td><td></td></tr><tr><td>Horizontal component placement</td><td></td><td></td></tr></table> 1-1. The following are examples of good and bad capacitor layout; SMD capacitors should be located to minimize any possible mechanical stresses from board warp or deflection. <table><tr><th></th><th>Not recommended</th><th>Recommended</th></tr><tr><td>Deflection of the board</td><td></td><td></td></tr></table> 1-2. To layout the capacitors for the breakaway PC board, it should be noted that the amount of mechanical stresses given will vary depending on capacitor layout. The example below shows recommendations for better design.  1-3. When breaking PC boards along their perforations, the amount of mechanical stress on the capacitors can vary according to the method used. The following methods are listed in order from least stressful to most stressful: push-back, slit, V-grooving, and perforation. Thus, any ideal SMD capacitor layout must also consider the PCB splitting procedure.	Type	105	107	212	Size	L	0.52	0.8	1.25	W	1.0	1.6	2.0	A	0.18~0.22	0.25~0.3	0.5~0.7	B	0.2~0.25	0.3~0.4	0.4~0.5	C	0.9~1.1	1.5~1.7	1.9~2.1	Items	Not recommended	Recommended	Mixed mounting of SMD and leaded components			Component placement close to the chassis			Hand-soldering of leaded components near mounted components			Horizontal component placement				Not recommended	Recommended	Deflection of the board		
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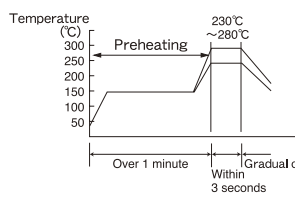
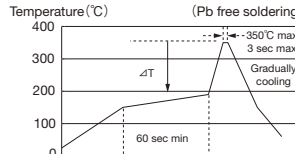
Precautions on the use of Multilayer Ceramic Capacitors

Stages	Precautions	Technical considerations
3.Considerations for auto-matic placement	Adjustment of mounting machine 1. Excessive impact load should not be imposed on the capacitors when mounting onto the PC boards. 2. The maintenance and inspection of the mounters should be conducted periodically. 	

Precautions on the use of Multilayer Ceramic Capacitors

Stages	Precautions	Technical considerations
4. Soldering	Selection of Flux 1. Since flux may have a significant effect on the performance of capacitors, it is necessary to verify the following conditions prior to use; (1) Flux used 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. (2) When soldering capacitors on the board, the amount of flux applied should be controlled at the optimum level. (3) When using water-soluble flux, special care should be taken to properly clean the boards. Soldering Temperature, time, amount of solder, etc. are specified in accordance with the following recommended conditions. Sn-Zn solder paste can affect MLCC reliability performance. Please contact us prior to usage.	1-1. When too much halogenated substance (Chlorine, etc.) content is used to activate the flux, or highly acidic flux is used, 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. 1-2. Flux is used to increase solderability in flow 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. 1-3. 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. 1-1. Preheating when soldering Heating: Ceramic chip components should be preheated to within 100 to 130°C of the soldering. Cooling: The temperature difference between the components and cleaning process should not be greater than 100°C. Ceramic chip capacitors are susceptible to thermal shock when exposed to rapid or concentrated heating or rapid cooling. Therefore, the soldering process must be conducted with great care so as to prevent malfunction of the components due to excessive thermal shock. Recommended conditions for soldering [Reflow soldering] Temperature profile  Temperature (°C) (Pb free soldering) Peak 260°C max 10 sec max Preheating 150°C 60 sec min Heating above 230°C 40 sec max Gradually cooling ※ Ceramic chip components should be preheated to within 100 to 130°C of the soldering. ※ Assured to be reflow soldering for 2 times. Caution 1. The ideal condition is to have solder mass (fillet) controlled to 1/2 to 1/3 of the thickness of the capacitor, as shown below:  Capacitor Solder PC board $\frac{1}{2}T \sim \frac{1}{3}T$ 2. Because excessive dwell times can detrimentally affect solderability, soldering duration should be kept as close to recommended times as possible. [Wave soldering] Temperature profile  Temperature (°C) (Pb free soldering) Peak 260°C max 10 sec max Preheating 150°C 120 sec min Heating above 230°C 40 sec max Gradually cooling ※ Ceramic chip components should be preheated to within 100 to 130°C of the soldering. ※ Assured to be wave soldering for 1 time. ※ Except for reflow soldering type. Caution 1. Make sure the capacitors are preheated sufficiently. 2. The temperature difference between the capacitor and melted solder should not be greater than 100 to 130°C 3. Cooling after soldering should be as gradual as possible. 4. Wave soldering must not be applied to the capacitors designated as for reflow soldering only.

Precautions on the use of Multilayer Ceramic Capacitors

Stages	Precautions	Technical considerations						
4. Soldering		[Hand soldering] Temperature profile   (Pb free soldering) ※ $\Delta T \leq 190^{\circ}\text{C}$ (3216 Type max), $\Delta T \leq 130^{\circ}\text{C}$ (3225 Type min.) ※ It is recommended to use 20W soldering iron and the tip is 1φ or less. ※ The soldering iron should not directly touch the components. ※ Assured to be soldering iron for 1 time. Note: The above profiles are the maximum allowable soldering condition, therefore these profiles are not always recommended. Caution 1. Use a 20W soldering iron with a maximum tip diameter of 1.0 mm. 2. The soldering iron should not directly touch the capacitor.						
5. Cleaning	Cleaning conditions 1. When cleaning the PC board after the capacitors are all mounted, select the appropriate cleaning solution according to the type of flux used and purpose of the cleaning (e.g. to remove soldering flux or other materials from the production process.) 2. Cleaning conditions should be determined after verifying, through a test run, that the cleaning process does not affect the capacitor's characteristics.	1. The use of inappropriate solutions can cause foreign substances such as flux residue to adhere to the capacitor or deteriorate the capacitor's outer coating, resulting in a degradation of the capacitor's electrical properties (especially insulation resistance). 2. Inappropriate cleaning conditions (insufficient or excessive cleaning) may detrimentally affect the performance of the capacitors. (1) Excessive cleaning In the case of ultrasonic cleaning, too much power output can cause excessive vibration of the PC board which may lead to the cracking of the capacitor or the soldered portion, or decrease the terminal electrodes' strength. Thus the following conditions should be carefully checked; <table><tr><td>Ultrasonic output</td><td>Below 20 W/ ℓ</td></tr><tr><td>Ultrasonic frequency</td><td>Below 40 kHz</td></tr><tr><td>Ultrasonic washing period</td><td>5 min. or less</td></tr></table>	Ultrasonic output	Below 20 W/ ℓ	Ultrasonic frequency	Below 40 kHz	Ultrasonic washing period	5 min. or less
Ultrasonic output	Below 20 W/ ℓ							
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6. Post cleaning processes	1. With some type of resins a decomposition gas or chemical reaction vapor may remain inside the resin during the hardening period or while left under normal storage conditions resulting in the deterioration of the capacitor's performance. 2. When a resin's hardening temperature is higher than the capacitor's operating temperature, the stresses generated by the excess heat may lead to capacitor damage or destruction. The use of such resins, molding materials etc. is not recommended.							
7. Handling	Breakaway PC boards (splitting along perforations) 1. When splitting the PC board after mounting capacitors and other components, care is required so as not to give any stresses of deflection or twisting to the board. 2. Board separation should not be done manually, but by using the appropriate devices. Mechanical considerations 1. Be careful not to subject the capacitors to excessive mechanical shocks. (1) If ceramic capacitors are dropped onto the floor or a hard surface, they should not be used. (2) When handling the mounted boards, be careful that the mounted components do not come in contact with or bump against other boards or components.							

Precautions on the use of Multilayer Ceramic Capacitors

Stages	Precautions	Technical considerations				
8.Storage conditions	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 <table><tr><td>Ambient temperature</td><td>Below 30℃</td></tr><tr><td>Humidity</td><td>Below 70% RH</td></tr></table> The ambient temperature must be kept below 40℃. Even under ideal storage conditions capacitor electrode solderability decreases as time passes, so should be used within 6 months from the time of delivery. • Ceramic chip capacitors should be kept where no chlorine or sulfur exists in the air. 2. The capacitance value of high dielectric constant capacitors (type 2 &3) will gradually decrease with the passage of time, so this should be taken into consideration in the circuit design. If such a capacitance reduction occurs, a heat treatment of 150℃ for 1hour will return the capacitance to its initial level.	Ambient temperature	Below 30℃	Humidity	Below 70% RH	1. If the parts are stored in a high temperature and humidity environment, problems such as reduced solderability caused by oxidation of terminal electrodes and deterioration of taping/packageging materials may take place. For this reason, components should be used within 6 months from the time of delivery. If exceeding the above period, please check solderability before using the capacitors.
Ambient temperature	Below 30℃					
Humidity	Below 70% RH					