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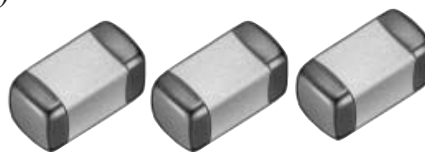
In addition, even electronic components or functional modules that are used for the general electronic equipment, if the equipment or the electric circuit require high safety or reliability function or performances, a sufficient reliability evaluation check for safety shall be performed before commercial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

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Should you have any question or inquiry on this matter, please contact our sales staff.

# 高周波積層セラミックコンデンサ

## MULTILAYER CERAMIC CAPACITORS

### FOR HIGH FREQUENCY APPLICATIONS(1GHz+)



リフロー/REFLOW

OPERATING TEMP. -55~+125°C

#### 特長 FEATURES

- 積層磁器コンデンサとしては高いQ値が高周波で得られる
- 1005形状であるため、実装密度の向上、軽量化が図れる
- Q values in the high frequency range (1 GHz+) are excellent compared to other types of multilayer capacitors.
- The 1005(0402) case size is designed for high density mounting and weight reduction in various applications.

#### 用途 APPLICATIONS

- 高周波におけるコンデンサのQ値および小型化が求められる用途向き  
VCO、TCXO etc
- 高周波回路の特性調整用途
- Suitable for those high frequency applications in which a capacitor with both a high Q-value and small size is required such as portable communications and other wireless applications.  
VCO, TCXO, etc.
- Adjustment of characteristics in high frequency circuit

#### 形名表記法 ORDERING CODE

<b>1</b> 定格電圧 [VDC]	<b>4</b> 形状寸法 (EIA) L×W [mm]	<b>6</b> 公称静電容量 [pF]	<b>8</b> 製品厚み [mm]	<b>10</b> 包装
E 16 U 50	105(0402) 1.0×0.5	例 020 2 4R3 4.3	W 0.5	F φ178mm テーピング (2mmピッチ)
<b>2</b> シリーズ名	<b>5</b> 温度特性 [ppm/°C]	<b>7</b> 容量許容差	<b>9</b> 個別仕様	
V 高周波用積層コンデンサ	CH 0±60 RH -220±60	B ±0.1pF J ±5%	- 標準	
<b>3</b> 端子電極				
K メッキ品				

※R=小数点

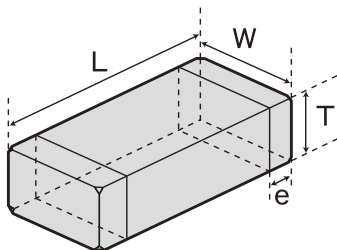
U V K 1 0 5 R H 4 R 3 J W - F

1 2 3 4 5 6 7 8 9 10

<b>1</b> Rated voltage [VDC]	<b>4</b> Dimensions (case size) (L×W) [mm]	<b>6</b> Nominal capacitance [pF]	<b>8</b> Thickness [mm]	<b>10</b> Packaging
E 16 U 50	105(0402) 1.0×0.5	example 020 2 4R3 4.3	W 0.5	F φ178mm Taping (2mm pitch)
<b>2</b> Series name	<b>5</b> Temperature characteristics [ppm/°C]	<b>7</b> Capacitance tolerance	<b>9</b> Special code	
V MULTILAYER CERAMIC CAPACITORS FOR HIGH FREQUENCY	CH 0±60 RH -220±60	B ±0.1pF J ±5%	- Standard Products	
<b>3</b> End termination				
K Plated				

※R=Decimal point

外形寸法 EXTERNAL DIMENSIONS



Type(EIA)	L	W	T	e
<input type="checkbox"/> VK105 (0402)	1.0±0.05 (0.039±0.002)	0.5±0.05 (0.020±0.002)	0.5±0.05 (0.020±0.002)	0.25±0.1 (0.010±0.004)

Unit : mm (inch)

アイテム一覧 PART NUMBERS

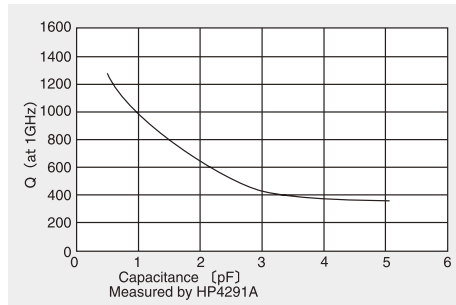
定格電圧 Rated Voltage (DC)	形名 Ordering code	EHS (Environmental Hazardous Substances)	温度特性 Temperature characteristics		公称 静電容量 Capacitance [pF]	静電容量 許容差 Capacitance tolerance	Q規格値 (at 1GHz) Q (min)	厚み Thickness [mm]	Q typ.値 (参考値) Typical Q
			CH	RH					
E: 16V U: 50V	<input type="checkbox"/> VK105 CH0R3BW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

注: には定格電圧記号がはいります。 Please specify the Rated Voltage code.

仕様 SPECIFICATIONS

温度特性 Temperature Characteristics	使用温度範囲 Operating Temperature range	温度係数範囲 Temperature Coefficient range [ppm/°C]	静電容量許容差 Capacitance Tolerance (区分)
CH	-55~+125°C	0±60	±0.1pF (~2.0pF)
RH		-220±60	±5% (2.2pF~)

■容量値とQの関係例 (CH特性例) Capacitance vs Q value (Typical for CH T.C.)



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

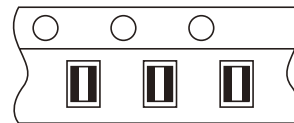
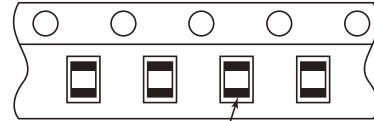
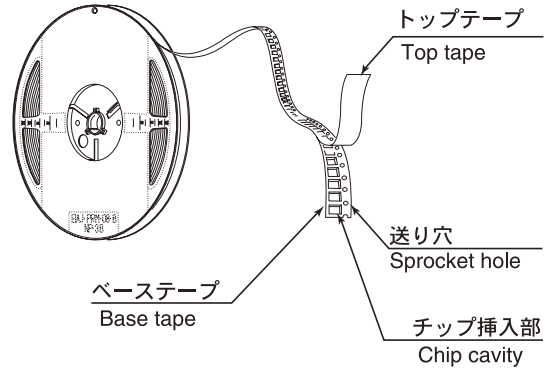
# 梱包 PACKAGING

①最小受注単位数 Minimum Quantity

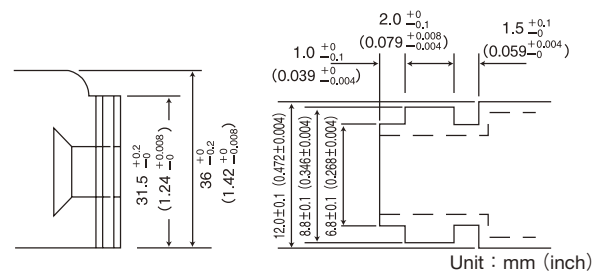
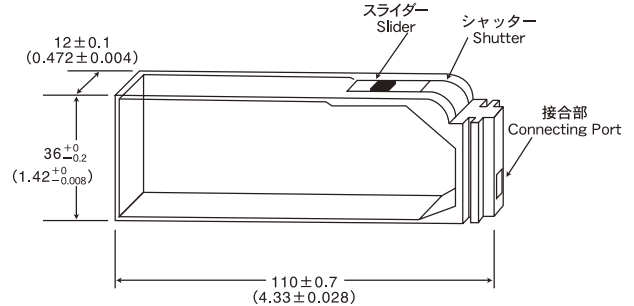
■テーピング梱包 Taped packaging

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	—
		W		
□MK107(0603)	0.45 (0.018)	K	4000	—
		V		
□WK107(0306)	0.5 (0.020)	V	—	4000
		A		
□2K110(0504)	0.8 (0.031)	A	4000	—
		B		
□MK212(0805)	0.45 (0.018)	K	4000	—
		D		
□WK212(0508)	0.85 (0.033)	D	4000	—
		G		
□4K212(0805)	0.85 (0.033)	D	4000	—
		D		
□2K212(0805)	0.85 (0.033)	D	4000	—
		D		
□MK316(1206)	1.15 (0.045)	F	—	3000
		G		
		L		
□MK325(1210)	0.85 (0.033)	D	—	2000
		F		
		H		
		N		
		Y		
□MK432(1812)	2.5 (0.098)	M	—	500(T), 1000(P)
		M		

エンボステープ  
Embossed Tape



③バルクカセット Bulk Cassette

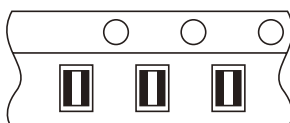
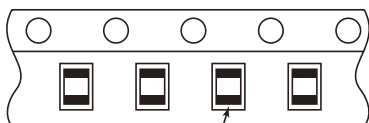
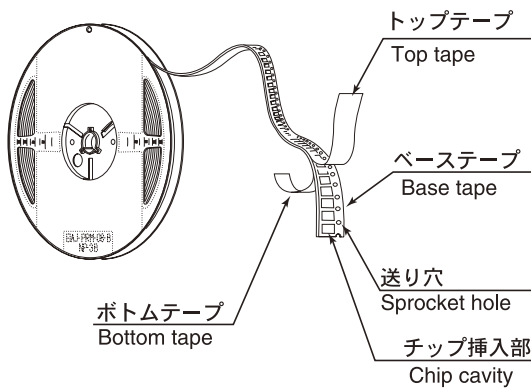


105, 107, 212形状で個別対応致しますのでお問い合わせ下さい。  
Please contact any of our offices for accepting your requirement according to dimensions 0402, 0603, 0805.(inch)

②テーピング材質 Taping material

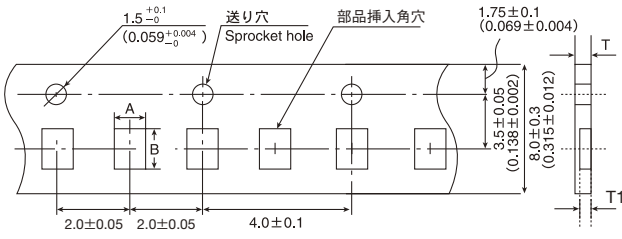
紙テープ  
Card board carrier tape

※プレスポケットタイプは、  
ボトムテープ無し。



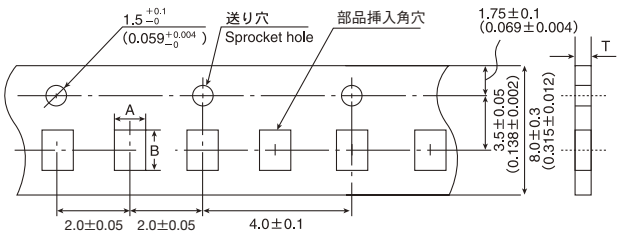
# 梱包 PACKAGING

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



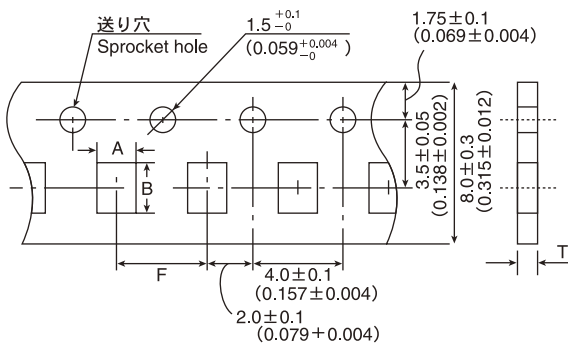
Type (EIA)	チップ挿入部 Chip Cavity		挿入ピッチ Insertion Pitch F	テープ厚み Tape Thickness	
	A	B		T	T1
□MK042 (01005)	0.25 (0.010)	0.45 (0.018)	2.0±0.05 (0.079±0.002)	0.36max. (0.014)	0.27max. (0.011)
□MK063 (0201)	0.37 (0.016)	0.67 (0.027)	2.0±0.05 (0.079±0.002)	0.45max. (0.018)	0.42max. (0.017)
□WK105 (0204)	0.65 (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 F	テープ厚み Tape Thickness	
	A	B		T	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)	0.65 (0.026)	1.15 (0.045)	2.0±0.05 (0.079±0.002)	0.8max. (0.031max.)	

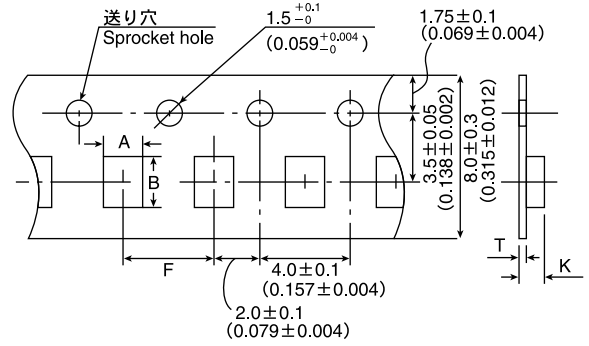
Unit : mm (inch)



Type (EIA)	チップ挿入部 Chip Cavity		挿入ピッチ Insertion Pitch F	テープ厚み Tape Thickness	
	A	B		T	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)	1.0 (0.039)	1.8 (0.071)	4.0±0.1 (0.157±0.004)	1.1max. (0.043max.)	
□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)				1.1max. (0.043max.)	
□4K212 (0805)				1.1max. (0.043max.)	
□2K212 (0805)				1.1max. (0.043max.)	
□MK316 (1206)	2.0 (0.079)	3.6 (0.142)	4.0±0.1 (0.157±0.004)	1.1max. (0.043max.)	

Unit : mm (inch)

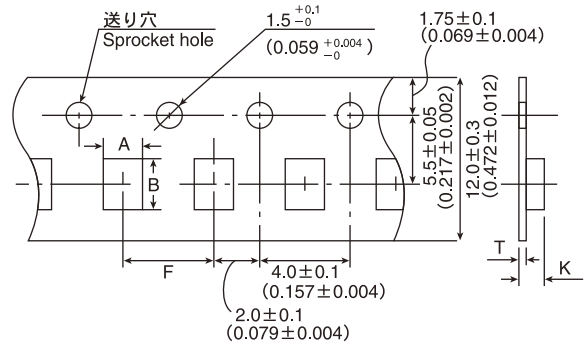
エンボステープ Embossed tape (8mm幅) (0.315inches wide)



Type (EIA)	チップ挿入部 Chip cavity		挿入ピッチ Insertion Pitch F	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)		3.4max. (0.134max.)	0.6max. (0.024max.)
□MK316 (1206)	2.0 (0.079)	3.6 (0.142)	4.0±0.1 (0.157±0.004)	3.4max. (0.134max.)	0.6max. (0.024max.)
□MK325 (1210)	2.8 (0.110)	3.6 (0.142)		3.4max. (0.134max.)	0.6max. (0.024max.)

Unit : mm (inch)

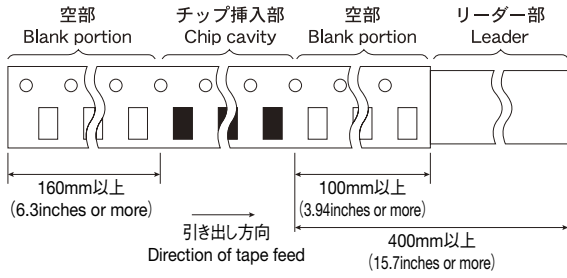
エンボステープ Embossed tape (12mm幅) (0.472inches wide)



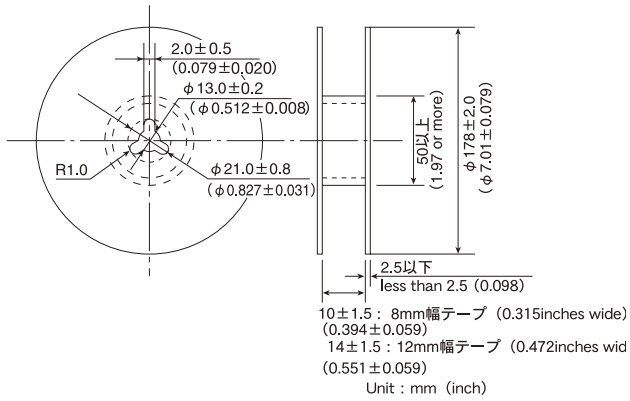
Type (EIA)	チップ挿入部 Chip cavity		挿入ピッチ Insertion Pitch F	テープ厚み Tape Thickness	
	A	B		K	T
□MK432 (1812)	3.7 (0.146)	4.9 (0.193)	8.0±0.1 (0.315±0.004)	4.0max. (0.157max.)	0.6max. (0.024max.)

Unit : mm (inch)

④リーダー部/空部 Leader and Blank portion

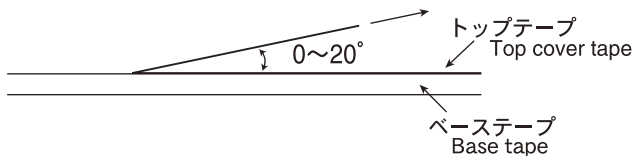


⑤リール寸法 Reel size



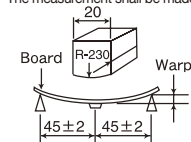
⑥トップテープ強度 Top Tape Strength

トップテープのはがし力は下図矢印方向にて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.

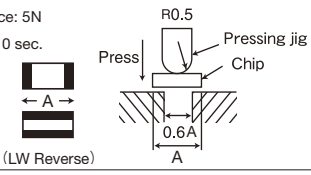
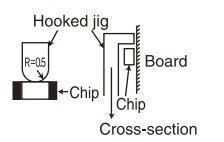




Multilayer Ceramic Capacitor Chips

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°C		BJ : -55 to +125°C F : -25 to +85°C	-25 to +85°C	High Capacitance Type BJ (X7R) : -55~+125°C, BJ (X5R) : -55~+85°C E (Y5U) : -30~+85°C, F (Y5V) : -30~+85°C
2. Storage Temperature Range	-55 to +125°C		BJ : -55 to +125°C F : -25 to +85°C	-25 to +85°C	High Capacitance Type BJ (X7R) : -55~+125°C, BJ (X5R) : -55~+85°C E (Y5U) : -30~+85°C, F (Y5V) : -30~+85°C
3. Rated Voltage	50VDC, 25VDC, 16VDC	16VDC 50VDC	50VDC, 25VDC	50VDC, 35VDC, 25VDC 16VDC, 10VDC, 6.3VDC 4VDC, 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 10 pF : ± 0.5 pF 5 to 10 pF : ± 1 pF 11 pF or over : ± 5% ± 10% 105TYPE <sup>△</sup> , S <sup>△</sup> , T <sup>△</sup> , U <sup>△</sup> 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 : Class 1 : 1MHz ± 10% (C ≤ 1000pF) 1 k Hz ± 10% (C > 1000pF) Class 2 : 1 k Hz ± 10% (C ≤ 10 μF) 120Hz ± 10Hz (C > 10 μF) Measuring voltage : Note 4 Class 1 : 0.5~5Vrms (C ≤ 1000pF) 1 ± 0.2Vrms (C > 1000pF) Class 2 : 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 : Class 1 : 1MHz ± 10% (C ≤ 1000pF) 1 k Hz ± 10% (C > 1000pF) Class 2 : 1 k Hz ± 10% (C ≤ 10 μF) 120Hz ± 10Hz (C > 10 μF) Measuring voltage : Note 4 Class 1 : 0.5~5Vrms (C ≤ 1000pF) 1 ± 0.2Vrms (C > 1000pF) Class 2 : 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/°C)	CH : 0 ± 60 RH : -220 ± 60 (ppm/°C)	BJ : ± 10% (-25~85°C) F : +30% (-25~85°C) -80 BJ (X7R) : ± 15% F (Y5V) : +22% -82	BJ : ± 10% (-25~+85°C) F : +30% / -80% (-25~+85°C) BJ (X7R, X5R) : ± 15% F (Y5V) : +22% / -82%	According to JIS C 5102 clause 7.12. Temperature compensating: Measurement of capacitance at 20°C and 85°C shall be made to calculate temperature characteristic by the following equation. $\frac{C_{85} - C_{20}}{C_{20} \times \Delta T} \times 10^6 \text{ (ppm/°C)}$ High permittivity: Change of maximum capacitance deviation in step 1 to 5 Temperature at step 1: +20°C Temperature at step 2: minimum operating temperature Temperature at step 3: +20°C (Reference temperature) Temperature at step 4: maximum operating temperature Temperature at step 5: +20°C Reference temperature for X7R, X5R, Y5U and Y5V shall be +25°C
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. 
11.Adhesion of Electrode	No separation or indication of separation of electrode.			Applied force: 5N Duration: 30±5 sec. 	
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 MΩμF 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 MΩμF 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: $C \geq 30\text{ pF}$ : $Q \geq 200$ $C < 30\text{ pF}$ : $Q \geq 100 + 10C/3$ C : Nominal capacitance Insulation resistance: 500 M $\Omega$ 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 $\Omega$ min.	Appearance: No abnormality Capacitance change: BJ: Within $\pm 12.5\%$ F: Within $\pm 30\%$ Note 4 tan $\delta$ : BJ: 5.0% max. F: 7.5% max. Note 4 Insulation resistance: 25 M $\Omega$ $\mu\text{F}$ or 500 M $\Omega$ , whichever is the smaller. Note 5	Appearance: No abnormality Capacitance change: BJ : Within $\pm 12.5\%$ F : Within $\pm 30\%$ Note 4 tan $\delta$ : BJ : 5.0% max. F : 11% max. Note 4 Insulation resistance: 25 M $\Omega$ $\mu\text{F}$ or 500 M $\Omega$ , 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 $\pm 2$ 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: $C \geq 30\text{ pF}$ : $Q \geq 350$ $10 \leq C < 30\text{ pF}$ : $Q \geq 275 + 2.5C$ $C < 10\text{ pF}$ : $Q \geq 200 + 10C$ C : Nominal capacitance Insulation resistance: 1000 M $\Omega$ min.	Appearance: No abnormality Capacitance change: Within $\pm 3\%$ or $\pm 0.3\text{pF}$ , whichever is larger. Insulation resistance: 1000 M $\Omega$ min.	Appearance: No abnormality Capacitance change: BJ: Within $\pm 12.5\%$ F: Within $\pm 30\%$ Note 4 tan $\delta$ : BJ: 4.0% max. F: 7.5% max. Note 4 Insulation resistance: 50 M $\Omega$ $\mu\text{F}$ or 1000 M $\Omega$ , whichever is smaller. Note 5	Appearance: No abnormality Capacitance change: BJ : Within $\pm 12.5\%$ Within $\pm 20\% \text{ **}$ Within $\pm 25\% \text{ **}$ F : Within $\pm 30\%$ Note 4 tan $\delta$ : BJ : 5.0% max. F : 11% max. Note 4 Insulation resistance: 50 M $\Omega$ $\mu\text{F}$ or 1000 M $\Omega$ , 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 $\pm 2$ 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  $24 \pm 2$  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  $24 \pm 2$  hrs of recovery under the standard condition shall be performed before the measurement.

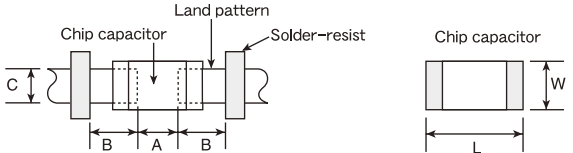
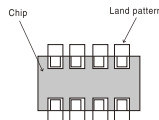
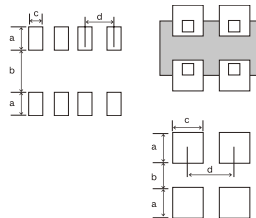
Note 4, 5 :The figure indicates typical inspection. Please refer to individual specifications.

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

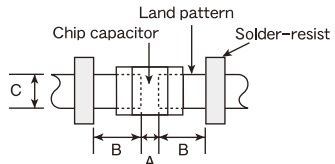
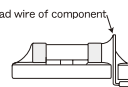
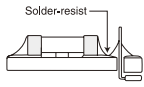
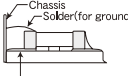
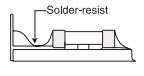
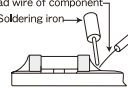
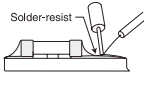


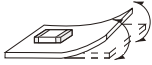
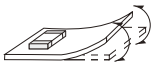
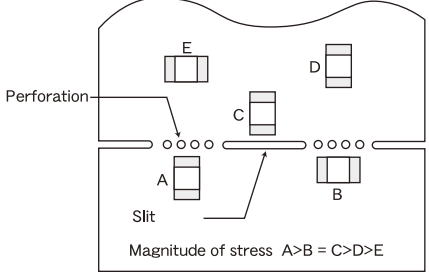
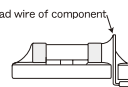
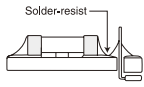
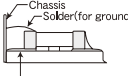
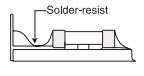
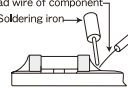
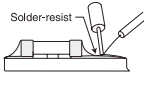


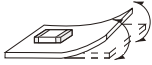
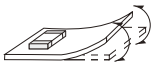
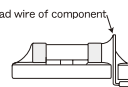
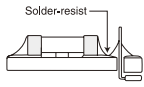
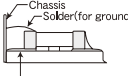
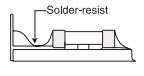
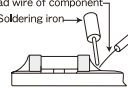
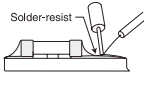


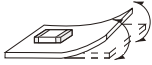
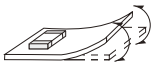
Note on standard condition: "standard condition" referred to herein is defined as follows: 5 to  $35^\circ\text{C}$  of temperature, 45 to 85% relative humidity, and 86 to 106kPa of air pressure.

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."

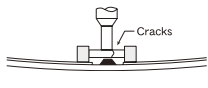
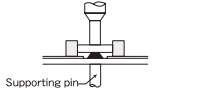
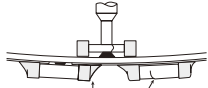
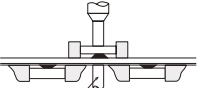
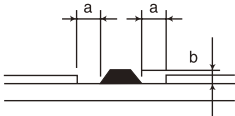
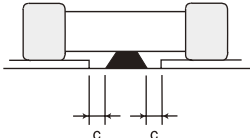
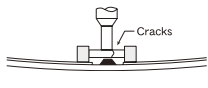
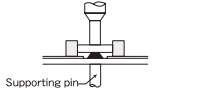
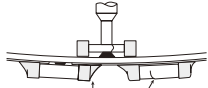
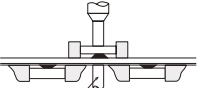
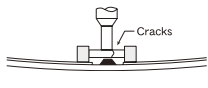
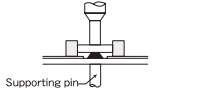
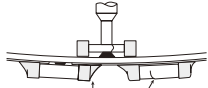
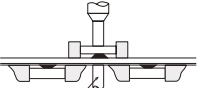
Precautions on the use of Multilayer Ceramic Capacitors

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1.Circuit Design	<p>Verification of operating environment, electrical rating and performance</p> <p>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.</p> <p>Operating Voltage (Verification of Rated voltage)</p> <p>1. The operating voltage for capacitors must always be lower than their rated values.</p> <p>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.</p> <p>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.</p>																																																																																																																																			
2.PCB Design	<p>Pattern configurations (Design of Land-patterns)</p> <p>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:</p> <p>(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.</p> <p>(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.</p>	<p>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)</p> <p>Examples of improper pattern designs are also shown.</p> <p>(1) Recommended land dimensions for a typical chip capacitor land patterns for PCBs</p>  <p>Recommended land dimensions for wave-soldering (unit: mm)</p> <table border="1" data-bbox="853 1255 1228 1430"> <thead> <tr> <th>Type</th> <th>107</th> <th>212</th> <th>316</th> <th>325</th> </tr> </thead> <tbody> <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> </tbody> </table> <p>Recommended land dimensions for reflow-soldering (unit: mm)</p> <table border="1" data-bbox="845 1496 1452 1681"> <thead> <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> </thead> <tbody> <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> </tbody> </table> <p>Excess solder can affect the ability of chips to withstand mechanical stresses. Therefore, please take proper precautions when designing land-patterns.</p> <table border="1" data-bbox="853 1758 997 1921"> <thead> <tr> <th>Type</th> <th>212 (4 circuits)</th> </tr> </thead> <tbody> <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> </tbody> </table>  <table border="1" data-bbox="853 1932 1181 2107"> <thead> <tr> <th>Type</th> <th>212 (2 circuits)</th> <th>110 (2 circuits)</th> <th>096 (2 circuits)</th> </tr> </thead> <tbody> <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> </tbody> </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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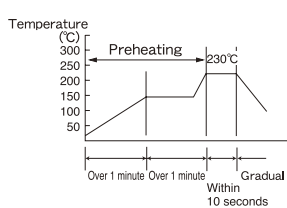
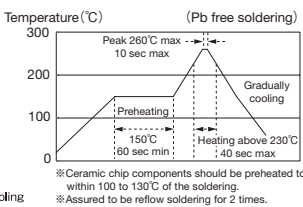
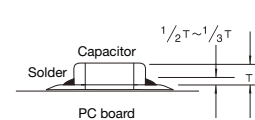
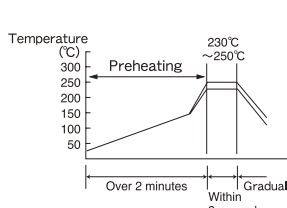
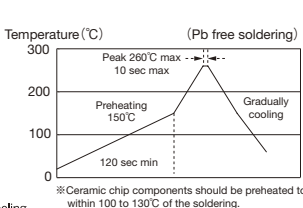
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<p>2.PCB Design</p>	<p>Pattern configurations (Capacitor layout on panelized [breakaway] PC boards)</p> <p>1. After capacitors have been mounted on the boards, chips can be subjected to mechanical stresses in subsequent manufacturing processes (PCB 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.</p>	<p>LWDC Recommended land dimensions for reflow-soldering</p>  <table border="1" data-bbox="853 469 1157 655"> <thead> <tr> <th>Type</th> <th>105</th> <th>107</th> <th>212</th> </tr> </thead> <tbody> <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> </tbody> </table> <p>(unit: mm)</p> <p>(2) Examples of good and bad solder application</p> <table border="1" data-bbox="845 753 1444 1190"> <thead> <tr> <th>Items</th> <th>Not recommended</th> <th>Recommended</th> </tr> </thead> <tbody> <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> </tbody> </table> <p>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.</p> <table border="1" data-bbox="845 1299 1444 1452"> <thead> <tr> <th></th> <th>Not recommended</th> <th>Recommended</th> </tr> </thead> <tbody> <tr> <td>Deflection of the board</td> <td></td> <td></td> </tr> </tbody> </table> <p>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.</p>  <p>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.</p>	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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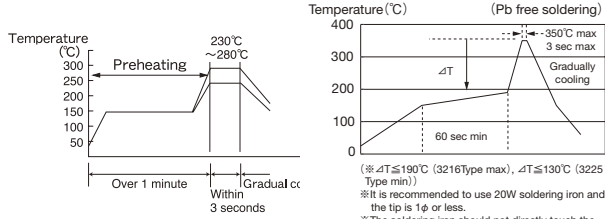
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<p>3.Considerations for auto-automatic placement</p>	<p>Adjustment of mounting machine</p> <ol style="list-style-type: none"> <li>Excessive impact load should not be imposed on the capacitors when mounting onto the PC boards.</li> <li>The maintenance and inspection of the mounters should be conducted periodically.</li> </ol> <p>Selection of Adhesives</p> <ol style="list-style-type: none"> <li>Mounting capacitors with adhesives in preliminary assembly, before the soldering stage, may lead to degraded capacitor characteristics unless the following factors are appropriately checked; the size of land patterns, type of adhesive, amount applied, hardening temperature and hardening period. Therefore, it is imperative to consult the manufacturer of the adhesives on proper usage and amounts of adhesive to use.</li> </ol>	<ol style="list-style-type: none"> <li>If the lower limit of the pick-up nozzle is low, too much force may be imposed on the capacitors, causing damage. To avoid this, the following points should be considered before lowering the pick-up nozzle:                     <ol style="list-style-type: none"> <li>The lower limit of the pick-up nozzle should be adjusted to the surface level of the PC board after correcting for deflection of the board.</li> <li>The pick-up pressure should be adjusted between 1 and 3 N static loads.</li> <li>To reduce the amount of deflection of the board caused by impact of the pick-up nozzle, supporting pins or back-up pins should be used under the PC board. The following diagrams show some typical examples of good pick-up nozzle placement:</li> </ol> </li> </ol> <table border="1" data-bbox="850 526 1449 794"> <thead> <tr> <th></th> <th>Not recommended</th> <th>Recommended</th> </tr> </thead> <tbody> <tr> <td>Single-sided mounting</td> <td></td> <td></td> </tr> <tr> <td>Double-sided mounting</td> <td></td> <td></td> </tr> </tbody> </table> <ol style="list-style-type: none"> <li>As the alignment pin wears out, adjustment of the nozzle height can cause chipping or cracking of the capacitors because of mechanical impact on the capacitors. To avoid this, the monitoring of the width between the alignment pin in the stopped position, and maintenance, inspection and replacement of the pin should be conducted periodically.</li> <li>Some adhesives may cause reduced insulation resistance. The difference between the shrinkage percentage of the adhesive and that of the capacitors may result in stresses on the capacitors and lead to cracking. Moreover, too little or too much adhesive applied to the board may adversely affect component placement, so the following precautions should be noted in the application of adhesives.                     <ol style="list-style-type: none"> <li>Required adhesive characteristics                             <ol style="list-style-type: none"> <li>The adhesive should be strong enough to hold parts on the board during the mounting &amp; solder process.</li> <li>The adhesive should have sufficient strength at high temperatures.</li> <li>The adhesive should have good coating and thickness consistency.</li> <li>The adhesive should be used during its prescribed shelf life.</li> <li>The adhesive should harden rapidly</li> <li>The adhesive must not be contaminated.</li> <li>The adhesive should have excellent insulation characteristics.</li> <li>The adhesive should not be toxic and have no emission of toxic gasses.</li> </ol> </li> <li>The recommended amount of adhesives is as follows;</li> </ol> </li> </ol> <table border="1" data-bbox="850 1469 1404 1589"> <thead> <tr> <th>Figure</th> <th>212/316 case sizes as examples</th> </tr> </thead> <tbody> <tr> <td>a</td> <td>0.3mm min</td> </tr> <tr> <td>b</td> <td>100 ~ 120 μm</td> </tr> <tr> <td>c</td> <td>Adhesives should not contact the pad</td> </tr> </tbody> </table> <div style="display: flex; justify-content: space-around; margin-top: 20px;"> <div data-bbox="874 1662 1109 1808"> <p>Amount of adhesive</p>  </div> <div data-bbox="1173 1662 1423 1852"> <p>After capacitors are bonded</p>  </div> </div>		Not recommended	Recommended	Single-sided mounting			Double-sided mounting			Figure	212/316 case sizes as examples	a	0.3mm min	b	100 ~ 120 μm	c	Adhesives should not contact the pad
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Precautions on the use of Multilayer Ceramic Capacitors

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4. Soldering	<p><b>Selection of Flux</b></p> <p>1. Since flux may have a significant effect on the performance of capacitors, it is necessary to verify the following conditions prior to use;</p> <p>(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.</p> <p>(2) When soldering capacitors on the board, the amount of flux applied should be controlled at the optimum level.</p> <p>(3) When using water-soluble flux, special care should be taken to properly clean the boards.</p> <p><b>Soldering</b></p> <p>Temperature, time, amount of solder, etc. are specified in accordance with the following recommended conditions.</p> <p>Sn-Zn solder paste can affect MLCC reliability performance. Please contact us prior to usage.</p>	<p>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.</p> <p>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.</p> <p>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.</p> <p>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.</p> <p><b>Recommended conditions for soldering</b></p> <p>[Reflow soldering]</p> <p>Temperature profile</p>   <p>Caution</p> <p>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:</p>  <p>2. Because excessive dwell times can detrimentally affect solderability, soldering duration should be kept as close to recommended times as possible.</p> <p>[Wave soldering]</p> <p>Temperature profile</p>   <p>Caution</p> <p>1. Make sure the capacitors are preheated sufficiently.</p> <p>2. The temperature difference between the capacitor and melted solder should not be greater than 100 to 130°C</p> <p>3. Cooling after soldering should be as gradual as possible.</p> <p>4. Wave soldering must not be applied to the capacitors designated as for reflow soldering only.</p>

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4. Soldering		<p>[Hand soldering]</p> <p>Temperature profile</p>  <p>Caution</p> <ol style="list-style-type: none"> <li>1. Use a 20W soldering iron with a maximum tip diameter of 1.0 mm.</li> <li>2. The soldering iron should not directly touch the capacitor.</li> </ol>
5. Cleaning	<p>Cleaning conditions</p> <ol style="list-style-type: none"> <li>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.)</li> <li>2. Cleaning conditions should be determined after verifying, through a test run, that the cleaning process does not affect the capacitor's characteristics.</li> </ol>	<ol style="list-style-type: none"> <li>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).</li> <li>2. Inappropriate cleaning conditions (insufficient or excessive cleaning) may detrimentally affect the performance of the capacitors.</li> </ol> <p>(1) Excessive cleaning</p> <p>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;</p> <p>Ultrasonic output           Below 20 W/ℓ          Ultrasonic frequency       Below 40 kHz          Ultrasonic washing period 5 min. or less</p>
6. Post cleaning processes	<ol style="list-style-type: none"> <li>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.</li> <li>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.</li> </ol>	
7. Handling	<p>Breakaway PC boards (splitting along perforations)</p> <ol style="list-style-type: none"> <li>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.</li> <li>2. Board separation should not be done manually, but by using the appropriate devices.</li> </ol> <p>Mechanical considerations</p> <ol style="list-style-type: none"> <li>1. Be careful not to subject the capacitors to excessive mechanical shocks.                     <ol style="list-style-type: none"> <li>(1) If ceramic capacitors are dropped onto the floor or a hard surface, they should not be used.</li> <li>(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.</li> </ol> </li> </ol>	



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8.Storage conditions	<p>Storage</p> <p>1. To maintain the solderability of terminal electrodes and to keep the packaging material in good condition, care must be taken to control temperature and humidity in the storage area. Humidity should especially be kept as low as possible.</p> <ul style="list-style-type: none"> <li>• Recommended conditions                             <table border="0" style="margin-left: 20px;"> <tr> <td style="padding-right: 20px;">Ambient temperature</td> <td>Below 30°C</td> </tr> <tr> <td>Humidity</td> <td>Below 70% RH</td> </tr> </table> </li> </ul> <p>The ambient temperature must be kept below 40°C. Even under ideal storage conditions capacitor electrode solderability decreases as time passes, so should be used within 6 months from the time of delivery.</p> <ul style="list-style-type: none"> <li>• Ceramic chip capacitors should be kept where no chlorine or sulfur exists in the air.</li> </ul> <p>2. The capacitance value of high dielectric constant capacitors (type 2 &amp;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°C for 1hour will return the capacitance to its initial level.</p>	Ambient temperature	Below 30°C	Humidity	Below 70% RH	<p>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/package 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.</p>
Ambient temperature	Below 30°C					
Humidity	Below 70% RH					