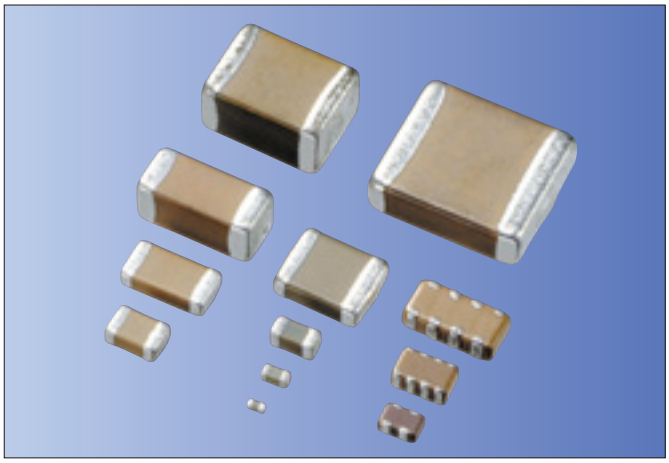
Multilayer Ceramic Chip Capacitors

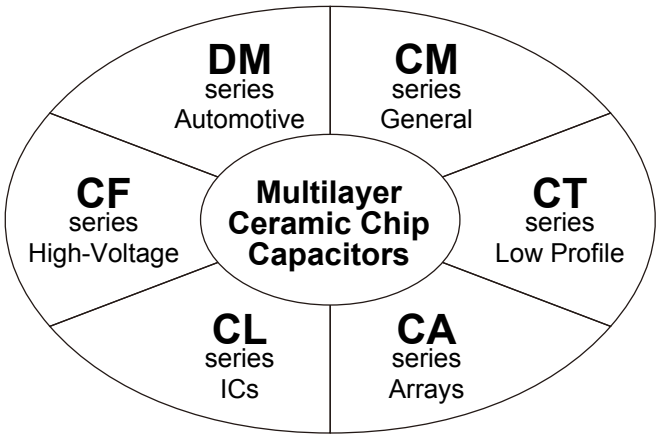
Kyocera's series of Multilayer Ceramic Chip Capacitors are designed to meet a wide variety of needs. We offer a complete range of products for both general and specialized applications, including CM series for general-purpose, CT series for low profile, CA series for arrays, CL series for ICs, CF series for high-voltage, and DM series for automotive.



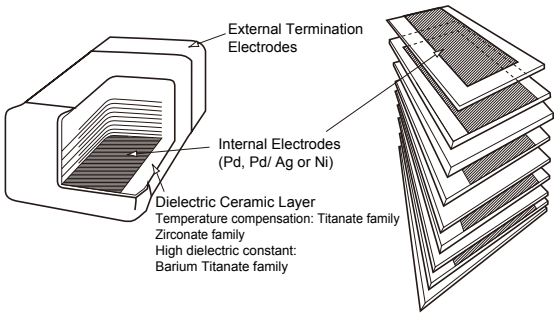
RoHS Compliant

Features

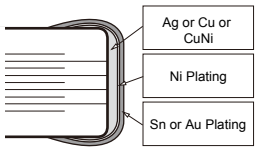
- We have factories worldwide in order to supply our global customer bases quickly and efficiently and to maintain our reputation as one of the highest–volume producers in the industry.
- All our products are highly reliable due to their monolithic structure of high–purity and superfine uniform ceramics and their integral internal electrodes.
- By combining superior manufacturing technology and materials with high dielectric constants, we produce extremely compact components with exceptional specifications.
- Our stringent quality control in every phase of production from material procurement to shipping ensures consistent manufacturing and super quality.
- Kyocera components are available in a wide choice of dimensions, temperature characteristics, rated voltages, and terminations to meet specific configurational requirements.



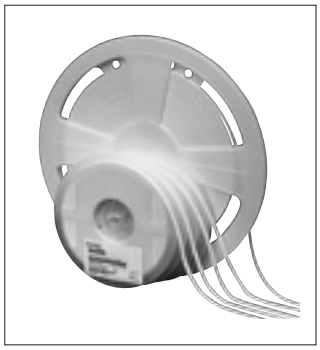
Structure



Nickel Barrier Termination Products



Tape and Reel



Bulk Case

Please contact your local AVX, Kyocera sales office or distributor for specifications not covered in this catalog.

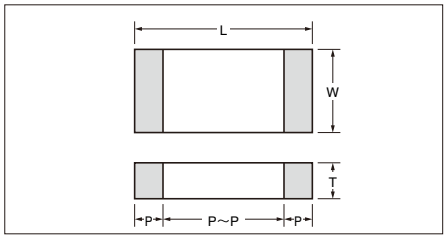
Our products are continually being improved. As a result, the capacitance range of each series is subject to change without notice. Please contact an sales representative to confirm compatibility with your application.

Kyocera Ceramic Chip Capacitors are available for different applications as classified below:

Series	Dielectric Options	Typical Applications	Features	Terminations	Available Size
CM	C0G (NP0) X5R X7R *X6S *X7S Y5V	General purpose	Wide cap range	Nickel barrier	01005, 0201, 0402 0603, 0805, 1206 1210, 1812
CT	X5R X7R Y5V	IC card (Decoupling)	Low profile	Nickel barrier	0201, 0402, 0603 0805, 1206, 1210
CA	C0G (NP0) X5R, X7R	Digital signal Pass line	Reduction in placing cost	Nickel barrier	0405, 0508
CL	X7S	ICs (Decoupling)	Low inductance	Nickel barrier	0204, 0306
CF	C0G (NP0) X7R	High voltage & Power circuits	High voltage 250VDC, 630VDC 1000VDC, 2000VDC 3000VDC, 4000VDC	Nickel barrier	0805, 1206, 1210 1812, 2208, 1808 2220
DM	X7R	Automotive	Thermal shock Resistivity High reliability	Nickel barrier	0603,0805,1206

* Option
* Negative temperature coefficient dielectric types are available on request.

Dimensions



Dimensions and Packaging Quantities

Size	Code		Dimension	Dimensions (mm)						Maximum quantity per reel	
	JIS	EIA	Code	L	W	T	P min.	P max.	P to P min.	ϕ180 Reel	ϕ330 Reel
02	0402	01005	A	0.4±0.02	0.2±0.02	0.2±0.02	0.07	0.14	0.13	40kp (E4/1) 20kp (P8/2)	– –
03	0603	0201	A	0.6±0.03	0.3±0.03	0.22 max.	0.10	0.20	0.20	30kp (P8/1) 15kp (P8/2)	50kp (P8/2)
			B			0.3±0.03				30kp (P8/1) 15kp (P8/2)	50kp (P8/2)
			C	0.6±0.05	0.3±0.05	0.3±0.05	0.13	0.23	0.19	30kp (P8/1) 15kp (P8/2)	50kp (P8/2)
05	1005	0402	A	1.0±0.05	0.5±0.05	0.25 max.	0.15	0.35	0.30	20kp (P8/1) 10kp (P8/2)	50kp (P8/2)
			B			0.35 max.				20kp (P8/1) 10kp (P8/2)	50kp (P8/2)
			C			0.5±0.05				20kp (P8/1) 10kp (P8/2)	50kp (P8/2)
			D	1.0±0.10	0.5±0.10	0.35 max.				20kp (P8/1) 10kp (P8/2)	50kp (P8/2)
			E			0.5±0.10				20kp (P8/1) 10kp (P8/2)	50kp (P8/2)
			F	1.0±0.15	0.5±0.15	0.5±0.15				20kp (P8/1) 10kp (P8/2)	50kp (P8/2)
105	1608	0603	A	1.6±0.10	0.8±0.10	0.55 max.	0.20	0.60	0.50	4kp (P8/4)	10kp (P8/4)
			B			0.8±0.10				8kp (P8/2) 4kp (P8/4)	20kp (P8/2) 10kp (P8/4)
			C	1.6±0.15	0.8±0.15	0.55 max.				8kp (P8/2) 4kp (P8/4)	20kp (P8/2) 10kp (P8/4)
			D			0.8±0.15				8kp (P8/2) 4kp (P8/4)	20kp (P8/2) 10kp (P8/4)
			E	1.6±0.2	0.8±0.2	0.55 max.				8kp (P8/2) 4kp (P8/4)	20kp (P8/2) 10kp (P8/4)
			F			0.8±0.2				*	–
21	2012	0805	A	2.0±0.10	1.25±0.10	0.55 max.	0.20	0.75	0.70	4kp (P8/4)	10kp (P8/4)
			B			0.95 max.				4kp (P8/4)	10kp (P8/4)
			C			1.00 max.				4kp (E8/4)	10kp (E8/4)
			D			0.6±0.10				4kp (P8/4)	10kp (P8/4)
			E			0.85±0.10				4kp (P8/4)	10kp (P8/4)
			F			1.05±0.10				3kp (E8/4)	10kp (E8/4)
			G			1.25±0.10				3kp (E8/4)	10kp (E8/4)
			H	2.0±0.15	1.25±0.15	0.55 max.				4kp (P8/4)	10kp (P8/4)
			J			0.95 max.				4kp (P8/4)	10kp (P8/4)
			K			1.25±0.15				3kp (E8/4)	10kp (E8/4)
			L	2.0±0.20	1.25±0.20	0.95 max.				4kp (P8/4)	10kp (P8/4)
			M			1.25±0.20				3kp (E8/4)	10kp (E8/4)
316	3216	1206	A	3.2±0.20	1.6±0.15	0.85±0.10	0.30	0.85	1.40	4kp (P8/4)	10kp (P8/4)
			B			0.95 max.				4kp (P8/4)	10kp (P8/4)
			C			1.00 max.				4kp (E8/4)	10kp (E8/4)
			D			1.15±0.10				3kp (E8/4)	10kp (E8/4)
			E			1.25±0.10				3kp (E8/4)	10kp (E8/4)
			F			1.6±0.15				2.5kp (E8/4)	5kp (E8/4)
			G	3.2±0.20	1.6±0.20	0.95 max.				4kp (P8/4)	10kp (P8/4)
			H			1.00 max.				4kp (E8/4)	10kp (E8/4)
			J			1.6±0.20				2.5kp (E8/4)	5kp (E8/4)
32	3225	1210	A	3.2±0.20	2.5±0.20	1.00 max.	0.30	1.00	1.40	4kp (E8/4)	10kp (E8/4)
			B			1.40 max.				3kp (E8/4)	10kp (E8/4)
			C			1.60 max.				2.5kp (E8/4)	5kp (E8/4)
			D			1.6±0.15				2.5kp (E8/4)	5kp (E8/4)
			E			2.20 max.				2kp (E8/4)	5kp (E8/4)
			F			2.0±0.2				2kp (E8/4)	5kp (E8/4)
			G			2.5±0.2				1kp (E8/4)	4kp (E8/4)
42	4520	1808	A	4.5±0.20	2.0±0.20	1.6 max.	0.15	0.85	2.60	2kp (E12/4)	–
			B			2.2 max.				2kp (E12/4)	–
43	4532	1812	A	4.5±0.30	3.2±0.20	2.0 max.	0.30	1.10	2.00	1kp (E12/8)	–
			B			2.0±0.2				1kp (E12/8)	–
			C			2.5 max.				0.5kp (E12/8)	–
			D			2.5±0.2				0.5kp (E12/8)	–
			E			2.8 max.				0.5kp (E12/8)	–
			F			2.8±0.2				0.5kp (E12/8)	–
52	5720	2208	A	5.7±0.40	2.0±0.20	2.2 max.	0.15	0.85	4.20	2kp (12/8)	–
55	5750	2220	A	5.7±0.40	5.0±0.40	2.0 max.	0.30	1.40	2.50	1kp (E12/8)	–
			B			2.5 max.				0.5kp (E12/8)	–
			C			2.8 max.				0.5kp (E12/8)	–

Note: Taping denotes the quantity packaged per reel (kp means 1000 pieces).
* Please contact us.

Multilayer Ceramic Chip Capacitors
Ordering Information

KYOCERA

KYOCERA PART NUMBER

CM 21 X7R 104 K 50 A T □□□

SERIES CODE

CM	=	General Purpose	CL	=	ICs
CT	=	Low Profile	CF	=	High Voltage
CA	=	Arrays	DM	=	Automotive

SIZE CODE

SIZE	EIA (JIS)	SIZE	EIA (JIS)	SIZE	EIA (JIS)
02 =	01005 (0402)	32 =	1210 (3225)	D11 =	0405 (1014)/ 2 cap
03 =	0201 (0603)	42 =	1808 (4520)	F12 =	0508 (1220)/ 4 cap
05 =	0402 (1005)	43 =	1812 (4532)		
105 =	0603 (1608)	52 =	2208 (5720)		
21 =	0805 (2012)	55 =	2220 (5750)		
316 =	1206 (3216)				

DIELECTRIC CODE

CODE	EIA CODE		
CG =	C0G (NPO)	X7S =	X7S (Option)
X5R =	X5R	X6S =	X6S (Option)
X7R =	X7R	Y5V =	Y5V

Negative temperature coefficient dielectric types are available on request.

CAPACITANCE CODE

Capacitance expressed in pF.
Two significant digits plus number of zeros.
For Values < 10pF, Letter R denotes decimal point,

eg.	100000pF =	104	1.5pF =	1R5
	0.1µF =	104	0.5pF =	R50
	4700pF =	472	100µF =	107

TOLERANCE CODE

A = ±0.05pF (option)	D = ±0.5pF	J = ±5%	Z = –20 to +80%
B = ±0.1pF	F = ±1pF	K = ±10%	
C = ±0.25pF	G = ±2% (option)	M = ±20%	

VOLTAGE CODE

04 = 4VDC	100 = 100VDC	1000 = 1000VDC
06 = 6.3VDC	250 = 250VDC	2000 = 2000VDC
10 = 10VDC	400 = 400VDC	3000 = 3000VDC
16 = 16VDC	630 = 630VDC	4000 = 4000VDC
25 = 25VDC		
35 = 35VDC		
50 = 50VDC		

TERMINATION CODE

A = Nickel Barrier/ Tin K = Nickel Barrier/ Au

PACKAGING CODE

B = Bulk	L = 13" Reel Taping & 4mm Cavity pitch
C = Bulk Cassette (option)	H = 7" Reel Taping & 2mm Cavity pitch
T = 7" Reel Taping & 4mm Cavity pitch	N = 13" Reel Taping & 2mm Cavity pitch
Q = 7" Reel Taping & 1mm Cavity pitch	*P = 7" Reel Taping & 1mm Cavity pitch

*Carrier tape width 4mm.

OPTION

Thickness max. value is indicated in CT series
EX. 125 → 1.25mm max.
095 → 0.95mm max.

Temperature Compensation Type

Dielectric Value (pF)	C0G (NPO) 0 ppm/ °C	UΔ (N750) −750 ppm/ °C	SL +350 to −1000ppm/ °C
0.5 to 2.7	CK	UK	SL
3.0 to 3.9	CJ	UJ	SL
4.0 to 9.0	CH	UJ	SL
≥10	CG	UJ	SL

K = ±250ppm/ °C, J = ±120ppm/ °C, H = ±60ppm/ °C, G = ±30ppm/ °C
e.g. CG = 0±30ppm/ °C

Note: All parts of C0G will be marked as "CG" but will conform to the above table.

High Dielectric Constant Type

EIA Dielectric	Temperature Range	ΔC max.
X5R	−55 to 85°C	±15%
X7R	−55 to 125°C	
*X7S	−55 to 125°C	±22%
*X6S	−55 to 105°C	
Y5V	−30 to 85°C	−82 to +22%

* option

Available Tolerances

Dielectric materials, capacitance values and tolerances are available in the following combinations only:

EIA Dielectric	Tolerance	Capacitance
C0G	C=±0.25pF D=±0.50pF	*1 <10pF
	*3 A=±0.05pF B=±0.1pF	<0.5pF ≤5pF
	*3 G=±2% J=±5% K=±10%	≥10pF E12 Series
*3 X6S X5R *3 X7S X7R	*2 K=±10% M=±20%	*4 E3 Series
Y5V	Z=−20% to +80%	E3 Series

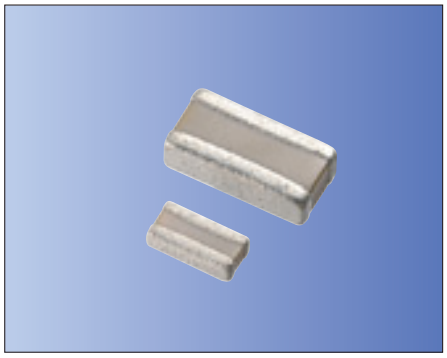
Note:
*1 Nominal values below 10pF are available in the standard values of 0.5pF, 1.0pF, 1.5pF, 2.0pF, 3.0pF, 4.0pF, 5.0pF, 6.0pF, 7.0pF, 8.0pF, 9.0pF
*2 J = ±5% for X7R (X5R) is available on request.
*3 option
*4 E6 series is available on request.

E Standard Number

E3	E6	E12	E24 (Option)	
1.0	1.0	1.0	1.0	1.1
		1.2	1.2	1.3
	1.5	1.5	1.5	1.6
		1.8	1.8	2.0
2.2	2.2	2.2	2.2	2.4
		2.7	2.7	3.0
	3.3	3.3	3.3	3.6
		3.9	3.9	4.3
4.7	4.7	4.7	4.7	5.1
		5.6	5.6	6.2
	6.8	6.8	6.8	7.5
		8.2	8.2	9.1

CL Series
Low Inductance Capacitors for Decoupling

[RoHS Compliant Products]



RoHS Compliant

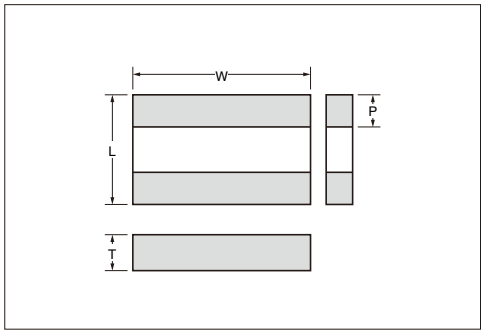
Features

- The length to width ratio is reversed from the normal type and lower inductance is realized by making the path of a current loop small.
- The noise removal nature in high frequency is superior, so that it fits power-supply decoupling of IC.

Applications

- MPU, GPU, ASIC, FPGA, High speed memory, etc.

Dimensions



Code	JIS CODE	EIA CODE	Dimensions (mm)			
			L	W	T	P
CL05	0510	0204	0.5±0.05	1.0±0.05	0.3±0.05	0.18±0.08
CL105	0816	0306	0.8±0.15	1.6±0.15	0.5±0.1	0.25±0.15

X7S Dielectric

Size (EIA Code)		CL05 (0204)	CL105 (0306)
Rated Voltage (VDC) / Capacitance (pF)		4	4
102	1000		
	2200		
	4700		
103	10000		
	22000		
	47000		
104	100000	A8	
	220000		
	470000		
105	1000000		B8
	2200000		
	4700000		
106	10000000		

Capacitances other than indicated in the above chart are optional.
Optional Spec.

Two digits alphanumerics in capacitance chart denote dimensions and tan δ. Please refer to the below table for detail.

Thickness and standard package quantity

Size (EIA Code)	CL05 (0204)	CL105 (0306)
Thickness (mm)	A 0.3±0.05	B 0.5±0.1
Taping (180 dia reel)	10kp (P8/2)	4kp (E8/4)
Taping (330 dia reel)	50kp (P8/2)	10kp (E8/4)

Note: Taping denotes the quantity packaged per reel (kp means 1000 pcs.). P8 in parenthesis denotes 8mm width paper tape; E8 denotes 8mm width plastic tape; E12 denotes 12mm width plastic tape. "/1" after slash in parenthesis denotes 1mm pitch; "/2" does 2mm pitch; "/4" does 4mm pitch.

Tan δ Code	Tan δ
8	12.5% max.

Test Conditions and Specifications for Temperature Compensation Type (CΔ to UΔ • SL Characteristics) CM/ CT/ CF Series

<table>
<tr><th colspan="2">Test Items</th><th>Test Conditions</th><th>Specifications</th></tr>
<tr><td colspan="2">Capacitance Value (C)</td><td rowspan="2"><table><tr><th>Capacitance</th><th>Frequency</th><th>Volt</th></tr><tr><td>C≤1000pF</td><td>1MHz±10%</td><td rowspan="2">0.5 to 5Vrms</td></tr><tr><td>C>1000pF</td><td>1kHz±10%</td></tr></table></td><td>Within tolerance</td></tr>
<tr><td colspan="2">Q</td><td>C≥30pF : Q≥1000
C<30pF : Q≥400+20C</td></tr>
<tr><td colspan="2">Insulation Resistance (IR)</td><td>Measured after the rated voltage is applied for 1 minute at room ambient.
For the rated voltage of over 630V, apply 500V for 1 minute at room ambient.
The charge and discharge current of the capacitor must not exceed 50mA.</td><td>Over 10000MΩ or 500MΩ • μF, whichever is less</td></tr>
<tr><td colspan="2">Dielectric Resistance</td><td>Apply 3 times of the rated voltage for 1 to 5 seconds.
Apply 1.5 times when the rated voltage is 250V or over.
Apply 1.2 times when the rated voltage is 630V or over.
The charge and discharge current of the capacitor must not exceed 50mA.</td><td>No problem observed</td></tr>
<tr><td colspan="2">Appearance</td><td>Microscope (10× magnification)</td><td>No problem observed</td></tr>
<tr><td colspan="2">Termination Strength</td><td>Apply a sideward force of 500g (5N) to a PCB-mounted sample. Apply 2N for 0201, and 1N for 01005 size.</td><td>No problem observed</td></tr>
<tr><td colspan="2">Bending Strength</td><td>Glass epoxy PCB: Fulcrum spacing: 90mm, duration time 10 seconds.</td><td>No significant damage at 1mm bent</td></tr>
<tr><td rowspan="3">Vibration Test</td><td>Appearance</td><td rowspan="3">Vibration frequency: 10 to 55 (Hz)
Amplitude: 1.5mm
Sweeping condition: 10→55→10Hz/ 1 minute in X, Y and Z
Directions: 2 hours each, 6 hours total.</td><td>No problem observed</td></tr>
<tr><td>ΔC</td><td>Within Tolerance</td></tr>
<tr><td>Q</td><td>C≥30pF : Q≥1000
C<30pF : Q≥400+20C</td></tr>
<tr><td rowspan="5">Soldering Heat Resistance</td><td>Appearance</td><td rowspan="5">Soak the sample in 260°C±5°C solder for 10±0.5 seconds and place in room ambient, and measure after 24±2 hours.
(Pre-heating conditions)<table><tr><th>Order</th><th>Temperature</th><th>Time</th></tr><tr><td>1</td><td>80 to 100°C</td><td>2 minutes</td></tr><tr><td>2</td><td>150 to 200°C</td><td>2 minutes</td></tr></table>The charge and discharge current of the capacitor must not exceed 50mA for IR and withstanding voltage measurement.</td><td>No problem observed</td></tr>
<tr><td>ΔC</td><td>Within ±2.5% or ±0.25pF, whichever is larger</td></tr>
<tr><td>Q</td><td>C≥30pF : Q≥1000
C<30pF : Q≥400+20C</td></tr>
<tr><td>IR</td><td>Over 10000MΩ or 500MΩ • μF whichever is less</td></tr>
<tr><td>Withstanding Voltage</td><td>Resist without problem</td></tr>
<tr><td colspan="2">Solderablity</td><td>Soaking condition<table><tr><td>Sn63 Solder</td><td>235±5°C</td><td>2±0.5 sec.</td></tr><tr><td>Sn-3Ag-0.5Cu</td><td>245±5°C</td><td>3±0.5 sec.</td></tr></table></td><td>Solder coverage : 90% min.</td></tr>
<tr><td rowspan="5">Temperature Cycle</td><td>Appearance</td><td rowspan="5">(Cycle)
Room temperature (3min.)→
Lowest operation temperature (30min.)→
Room temperature (3min.)→
Highest operation temperature(30min.)
After 5 cycles, measure after 24±2 hours.
The charge and discharge current of the capacitor must not exceed 50mA for IR and withstanding voltage measurement.</td><td>No problem observed</td></tr>
<tr><td>ΔC</td><td>Within ±2.5% or ±0.25pF, whichever is larger</td></tr>
<tr><td>Q</td><td>C≥30pF : Q≥1000
C<30pF : Q≥400+20C</td></tr>
<tr><td>IR</td><td>Over 10000MΩ or 500MΩ • μF, whichever is less</td></tr>
<tr><td>Withstanding Voltage</td><td>Resist without problem</td></tr>
<tr><td rowspan="4">Load Humidity Test (Except CF Series)</td><td>Appearance</td><td rowspan="4">After applying rated voltage for 500+12/ −0 hours in pre-condition at 40°C±2°C, humidity 90 to 95%RH, allow parts to stabilize for 24±2 hours, at room temperature before measurement.
The charge and discharge current of the capacitor must not exceed 50mA for IR measurement.</td><td>No problem observed</td></tr>
<tr><td>ΔC</td><td>Within ±7.5% or ±0.75pF, whichever is larger</td></tr>
<tr><td>Q</td><td>C≥30pF : Q≥200
C<30pF : Q≥100+10C/ 3</td></tr>
<tr><td>IR</td><td>Over 500MΩ or 25MΩ • μF, whichever is less</td></tr>
<tr><td rowspan="4">High-Temperature with Loading</td><td>Appearance</td><td rowspan="4">After applying twice the rated voltage at the temperature of 125±3°C for 1000+12/ −0 hours, measure the sample after 24±2 hours.
Apply 1.5 times when the rated voltage is 250V or over.
Apply 1.2 times when the rated voltage is 630V or over.
The charge and discharge current of the capacitor must not exceed 50mA for IR measurement.</td><td>No problem observed.</td></tr>
<tr><td>ΔC</td><td>Within ±3% or ±0.3pF, whichever is larger</td></tr>
<tr><td>Q</td><td>C≥30pF : Q≥350
10pF<C<30pF : Q≥275+5C/ 2
C<10pF : Q≥200+10C</td></tr>
<tr><td>IR</td><td>Over 1000MΩ or 50MΩ • μF, whichever is less</td></tr>
</table>

Please ask for individual specification for the hatched range in previous chart.

Test Conditions and Specifications for High Dielectric Type (X5R, X7R)
CM/ CT/ CA Series

Test Items		Test Conditions	Specifications
Capacitance Value (C)		Measure after heat treatment	Within tolerance
Tanδ (%)		Capacitance / Frequency / Volt: C≤10μF: 1kHz±10% / 1.0±0.2Vrms; C>10μF: 120Hz±10% / 0.5±0.2Vrms	Refer to capacitance chart
Insulation Resistance (IR)		Measured after the rated voltage is applied for 1 minute at room ambient. The charge and discharge current of the capacitor must not exceed 50mA.	Over 10000MΩ or 500MΩ • μF, whichever is less
Dielectric Resistance		Apply 2.5 times of the rated voltage for 1 to 5 seconds. The charge and discharge current of the capacitor must not exceed 50mA.	No problem observed
Appearance		Microscope (10× magnification)	No problem observed
Termination Strength		Apply a sideward force of 500g (5N) to a PCB-mounted sample. note : 2N for 0201 size in for 01005 size. Exclude CT series with thickness of less than 0.66mm.	No problem observed
Bending Strength		Glass epoxy PCB: Fulcrum spacing: 90mm, duration time 10 seconds. Exclude CT series with thickness of less than 0.66mm.	No significant damage at 1mm bent
Vibration Test	Appearance	Take the initial value after heat treatment. Vibration frequency: 10 to 55 (Hz) Amplitude: 1.5mm Sweeping condition: 10→55→10Hz/ 1 minute in X, Y and Z Directions: 2 hours each, 6 hours total.	No problem observed
	ΔC		Within tolerance
	Tanδ (%)		Within tolerance
Soldering Heat Resistance	Appearance	Take the initial value after heat treatment. Soak the sample in 260°C±5°C solder for 10±0.5 seconds and place in room ambient, and measure after 24±2 hours. (Pre-heating conditions) Order / Temperature / Time: 1 / 80 to 100°C / 2 minutes; 2 / 150 to 200°C / 2 minutes. The charge and discharge current of the capacitor must not exceed 50mA for IR and withstanding voltage measurement.	No problem observed
	ΔC		Within ±7.5%
	Tanδ (%)		Within tolerance
	IR		Over 10000MΩ or 500MΩ • μF, whichever is less
	Withstanding Voltage		Resist without problem
Solderablity		Soaking condition: Sn63 Solder 235±5°C 2±0.5 sec.; Sn-3Ag-0.5Cu 245±5°C 3±0.5 sec.	Solder coverage : 90% min.
Temperature Cycle	Appearance	Take the initial value after heat treatment. (Cycle) Room temperature (3min.)→ Lowest operation temperature (30min.)→ Room temperature (3min.)→ Highest operation temperature(30min.) After 5 cycles, measure after 24±2 hours. The charge and discharge current of the capacitor must not exceed 50mA for IR and withstanding voltage measurement.	No problem observed
	ΔC		Within ±7.5%
	Tanδ (%)		Within tolerance
	IR		Over 10000MΩ or 500MΩ • μF, whichever is less
	Withstanding Voltage		Resist without problem
Load Humidity Test	Appearance	Take the initial value after voltage treatment. After applying rated voltage for 500+12/ −0 hours in pre-condition at 40°C±2°C, humidity 90 to 95%RH, allow parts to stabilize for 24±2 hours, at room temperature before measurement. The charge and discharge current of the capacitor must not exceed 50mA for IR measurement.	No problem observed
	ΔC		Within ±12.5%
	Tanδ (%)		200% max. of initial value
	IR		Over 500MΩ or 25MΩ • μF, whichever is less
High-Temperature with Loading	Appearance	Take the initial value after voltage treatment. After applying twice the rated voltage at the highest operation temperature for 1000+12/ −0 hours, measure the sample after 24±2 hours. The charge and discharge current of the capacitor must not exceed 50mA for IR measurement. Apply 1.5 times when the rated voltage is 10V or less. Applied voltages for respective products are indicated in the below chart.	No problem observed
	ΔC		Within ±12.5%
	Tanδ (%)		200% max. of initial value
	IR		Over 1000MΩ or 50MΩ • μF, whichever is less

Pre-treatment		
	Heat	Keep specimen at 150+0/ −10℃ for 1 hour, leave specimen at room ambient for 24±2 hours.
	Voltage	Apply the same test condition for 1 hour, then leave the specimen at room ambient for 24±2 hours.

High-temperature with Loading Applied Voltage (Rated Voltage × □)

Applied Voltage	Rated Voltage	Products
×1.3	4V	CT03X5R104
	6.3V	CM105X5R475, CM316X5R476
		CT05X5R104, CT21X5R106, CT03X5R104
×1.5	16V	CM105X7R474-105, CM21X7R105-475, CM316X7R475-106, CM32X7R106-226, CM05X5R224, CM105X5R225, CM21X5R475-106, CM316X5R226
		CT105X5R105, CT21X5R225-475, CT316X5R106
	25V	CM105X7R474, CM21X7R105-225, CM316X7R475, CM32X7R106, CM105X5R474-105, CM21X5R225-106, CM316X5R106, CM32X5R106-226
		CT316X5R225-106
	50V	CM21X5R105
		CT21X5R225, CT316X5R105-475
	100V	CM32X7RK74, CM43X7R105

Please ask for individual specification for the hatched range in previous chart.

Test Conditions and Specifications for High Dielectric Type (Y5V)
CM/ CT/ CA Series

Test Items		Test Conditions	Specifications
Capacitance Value (C)		Measure after heat treatment Frequency: 1kHz±10%; Volt: 1.0±0.2Vrms	Within tolerance
Tanδ (%)			Refer to capacitance chart
Insulation Resistance (IR)		Measured after the rated voltage is applied for 1 minute at room ambient.	Over 10000MΩ or 500MΩ • μF, whichever is less
Dielectric Resistance		Apply 2.5 times of the rated voltage for 1 to 5 seconds. The charge and discharge current of the capacitor must not exceed 50mA.	No problem observed
Appearance		Microscope (10× magnification)	No problem observed
Termination Strength		Apply a sideward force of 500g (5N) to a PCB-mounted sample. Exclude CT series with thickness of less than 0.66mm.	No problem observed
Bending Strength		Glass epoxy PCB: Fulcrum spacing: 90mm, duration time 10 seconds. Exclude CT series with thickness of less than 0.66mm.	No significant damage at 1mm bent
Vibration Test	Appearance	Take the initial value after heat treatment. Vibration frequency: 10 to 55 (Hz) Amplitude: 1.5mm Sweeping condition: 10→55→10Hz/ 1 minute in X, Y and Z Directions: 2 hours each, 6 hours total.	No problem observed
	ΔC		Within tolerance
	Tanδ (%)		Within tolerance
Soldering Heat Resistance	Appearance	Take the initial value after heat treatment. Soak the sample in 260°C±5°C solder for 10±0.5 seconds and place in room ambient, and measure after 24±2 hours. (Pre-heating conditions) Order 1: 80 to 100°C, 2 minutes; Order 2: 150 to 200°C, 2 minutes The charge and discharge current of the capacitor must not exceed 50mA for IR and withstanding voltage measurement.	No problem observed
	ΔC		Within ±20%
	Tanδ (%)		Within tolerance
	IR		Over 10000MΩ or 500MΩ • μF, whichever is less
	Withstanding Voltage		Resist without problem
Solderablity		Soaking condition Sn63 Solder: 235±5°C, 2±0.5 sec. Sn-3Ag-0.5Cu: 245±5°C, 3±0.5 sec.	Solder coverage : 90% min.
Temperature Cycle	Appearance	Take the initial value after heat treatment. (Cycle) Room temperature (3min.)→ Lowest operation temperature (30min.)→ Room temperature (3min.)→ Highest operation temperature(30min.) After 5 cycles, measure after 24±2 hours. The charge and discharge current of the capacitor must not exceed 50mA for IR and withstanding voltage measurement.	No problem observed
	ΔC		Within ±20%
	Tanδ (%)		Within tolerance
	IR		Over 10000MΩ or 500MΩ • μF, whichever is less
	Withstanding Voltage		Resist without problem
Load Humidity Test	Appearance	Take the initial value after voltage treatment. After applying rated voltage for 500+12/ −0 hours in pre-condition at 40°C±2°C, humidity 90 to 95%RH, allow parts to stabilize for 24±2 hours, at room temperature before measurement. The charge and discharge current of the capacitor must not exceed 50mA for IR measurement.	No problem observed
	ΔC		Within ±30%
	Tanδ (%)		150% max. of initial value
	IR		Over 500MΩ or 25MΩ • μF, whichever is less
High-Temperature with Loading	Appearance	Take the initial value after voltage treatment. After applying twice the rated voltage at the highest operation temperature for 1000+12/ −0 hours, measure the sample after 24±2 hours. The charge and discharge current of the capacitor must not exceed 50mA for IR measurement.	No problem observed
	ΔC		Within ±30%
	Tanδ (%)		150% max. of initial value
	IR		Over 1000MΩ or 50MΩ • μF, whichever is less

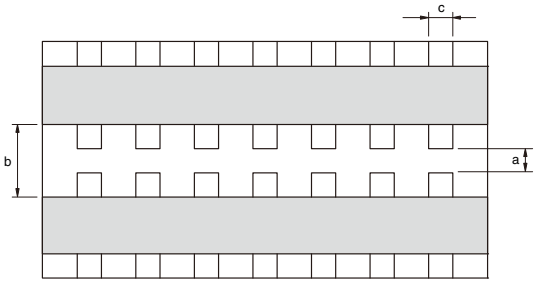
Pre-treatment		
	Heat	Keep specimen at 150+0/ −10°C for 1 hour, leave specimen at room ambient for 24±2 hours.
	Voltage	Apply the same test condition for 1 hour, then leave the specimen at room ambient for 24±2 hours.

Test Conditions and Specifications for High Dielectric Type (X7R)
CF Series

<table>
<tr><th colspan="2">Test Items</th><th>Test Conditions</th><th>Specifications</th></tr>
<tr><td colspan="2">Capacitance Value (C)</td><td rowspan="2">Measure after heat treatment
<table><tr><th>Capacitance</th><th>Frequency</th><th>Volt</th></tr><tr><td>C≤10μF</td><td>1kHz±10%</td><td>1.0±0.2Vrms</td></tr></table></td><td>Within tolerance</td></tr>
<tr><td colspan="2">Tanδ (%)</td><td>Within ±2.5%</td></tr>
<tr><td colspan="2">Insulation Resistance (IR)</td><td>Measured after the rated voltage is applied for 1 minute at room ambient.
Measured after the 500V is applied for 1 minute at room ambient for the rated voltage over 630V.
The charge and discharge current of the capacitor must not exceed 50mA.</td><td>Over 10000MΩ or 500MΩ • μF, whichever is less
Over 100MΩ • μF for CF316X7R104/ 250V and CF43X7R474/ 250V
CF55X7R105/ 250V and CF55X7R224/ 630V</td></tr>
<tr><td colspan="2">Dielectric Resistance</td><td>Apply 1.5 times when the rated voltage is 250V or over, apply 1.2 times when the rated voltage is 630V or over for 1 to 5 seconds.
The charge and discharge current of the capacitor must not exceed 50mA.</td><td>No problem observed</td></tr>
<tr><td colspan="2">Appearance</td><td>Microscope (10× magnification)</td><td>No problem observed</td></tr>
<tr><td colspan="2">Termination Strength</td><td>Apply a sideward force of 500g (5N) to a PCB-mounted sample.</td><td>No problem observed</td></tr>
<tr><td colspan="2">Bending Strength</td><td>Glass epoxy PCB: Fulcrum spacing: 90mm, duration time 10 seconds.</td><td>No significant damage at 1mm bent</td></tr>
<tr><td rowspan="3">Vibration Test</td><td>Appearance</td><td rowspan="3">Take the initial value after heat treatment.
Vibration frequency: 10 to 55 (Hz)
Amplitude: 1.5mm
Sweeping condition: 10→55→10Hz/ 1 minute in X, Y and Z
Directions: 2 hours each, 6 hours total.</td><td>No problem observed</td></tr>
<tr><td>ΔC</td><td>Within tolerance</td></tr>
<tr><td>Tanδ (%)</td><td>Within tolerance</td></tr>
<tr><td rowspan="4">Soldering Heat Resistance</td><td>Appearance</td><td rowspan="4">Take the initial value after heat treatment.
Soak the sample in 260°C±5°C solder for 10±0.5 seconds and place in room ambient, and measure after 24±2 hours.
(Pre-heating conditions)
<table><tr><th>Order</th><th>Temperature</th><th>Time</th></tr><tr><td>1</td><td>80 to 100°C</td><td>2 minutes</td></tr><tr><td>2</td><td>150 to 200°C</td><td>2 minutes</td></tr></table>The charge and discharge current of the capacitor must not exceed 50mA for IR and withstanding voltage measurement.</td><td>No problem observed</td></tr>
<tr><td>ΔC</td><td>Within ±7.5%</td></tr>
<tr><td>Tanδ (%)</td><td>Within tolerance</td></tr>
<tr><td>IR</td><td>Over 10000MΩ or 500MΩ • μF, whichever is less
Over 100MΩ • μF for CF316X7R104/ 250V and CF43X7R474/ 250V
CF55X7R105/ 250V and CF55X7R224/ 630V</td></tr>
<tr><td>Withstanding Voltage</td><td>Resist without problem</td></tr>
<tr><td colspan="2">Solderablity</td><td>Soaking condition
<table><tr><td>Sn63 Solder</td><td>235±5°C</td><td>2±0.5 sec.</td></tr><tr><td>Sn-3Ag-0.5Cu</td><td>245±5°C</td><td>3±0.5 sec.</td></tr></table></td><td>Solder coverage : 90% min.</td></tr>
<tr><td rowspan="4">Temperature Cycle</td><td>Appearance</td><td rowspan="4">Take the initial value after heat treatment.
(Cycle)
Room temperature (3min.)→
Lowest operation temperature (30min.)→
Room temperature (3min.)→
Highest operation temperature(30min.)
After 5 cycles, measure after 24±2 hours.
The charge and discharge current of the capacitor must not exceed 50mA for IR and withstanding voltage measurement.</td><td>No problem observed</td></tr>
<tr><td>ΔC</td><td>Within ±7.5%</td></tr>
<tr><td>Tanδ (%)</td><td>Within tolerance</td></tr>
<tr><td>IR</td><td>Over 10000MΩ or 500MΩ • μF, whichever is less
Over 100MΩ • μF for CF316X7R104/ 250V and CF43X7R474/ 250V
CF55X7R105/ 250V and CF55X7R224/ 630V</td></tr>
<tr><td>Withstanding Voltage</td><td>Resist without problem</td></tr>
<tr><td rowspan="4">High-Temperature with Loading</td><td>Appearance</td><td rowspan="4">Take the initial value after voltage treatment.
After applying specified voltage at the highest operation temperature for 1000+12/ −0 hours, then measure the sample after 24±2 hours.
The applied voltage shall be;
1.5 times the rated voltage when the rated voltage is 250V or over.
1.2 times when the rated voltage is 630V or over.
The charge and discharge current of the capacitor must not exceed 50mA for IR measurement.</td><td>No problem observed</td></tr>
<tr><td>ΔC</td><td>Within ±12.5%</td></tr>
<tr><td>Tanδ (%)</td><td>200% max. of initial value</td></tr>
<tr><td>IR</td><td>Over 1000MΩ or 50MΩ • μF, whichever is less</td></tr>
</table>

Pre-treatment	**Heat**	Keep specimen at 150+0/ −10℃ for 1 hour, leave specimen at room ambient for 24±2 hours.
	Voltage	Apply the same test condition for 1 hour, then leave the specimen at room ambient for 24±2 hours.

Substrate for Electrical Tests

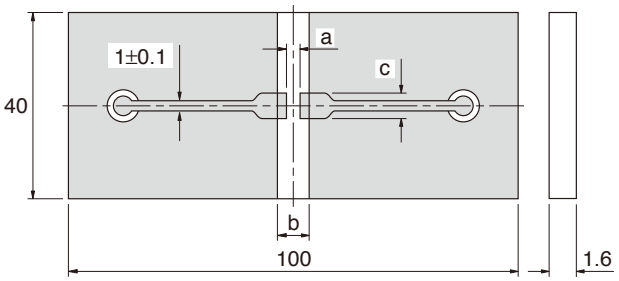


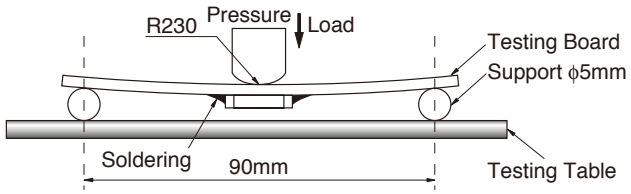
(Unit: mm)

Size (EIA Code)	a	b	c
02 (01005)	0.15	0.50	0.20
03 (0201)	0.26	0.92	0.32
05 (0402)	0.4	1.4	0.5
105 (0603)	1.0	3.0	1.2
21 (0805)	1.2	4.0	1.65
316 (1206)	2.2	5.0	2.0
32 (1210)	2.2	5.0	2.9
42 (1808)	3.5	7.0	3.7
43 (1812)	3.5	7.0	3.7
52 (2208)	4.5	8.0	5.6
55 (2220)	4.5	8.0	5.6

Substrate for Bending Test

(Unit: mm)

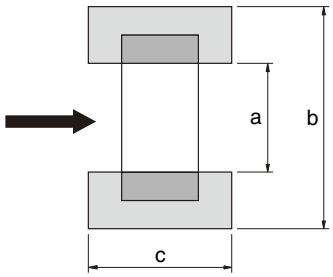




Testing Board : Glass Epoxy Board (CE4 or FR4)
Testing Board Thickness: 1.6±0.2mm*
Circuit Thickness : 0.04±0.01mm

* 02, 03, 05 and array: 0.8±0.1mm

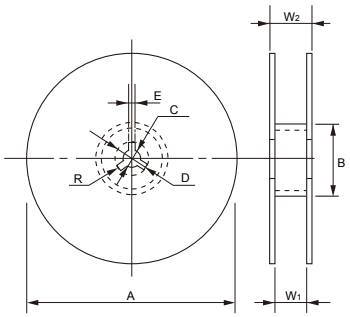
Substrate for Adhesion Strength Test



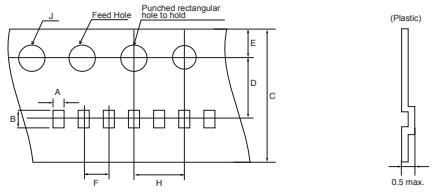
Multilayer Ceramic Chip Capacitors
Packaging Options

Tape and Reel

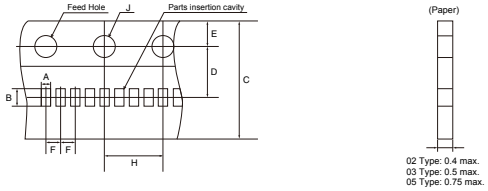
• Reel



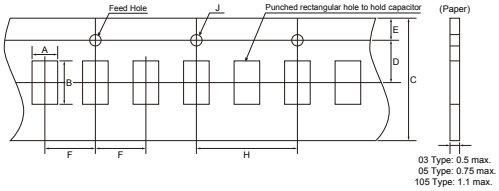
F=1mm (02 Type)



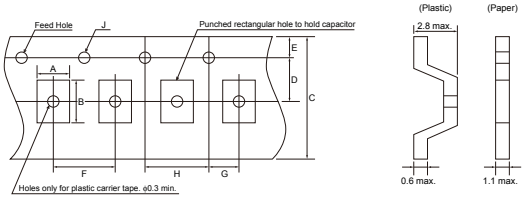
F=1mm (02, 03, 05 Type)



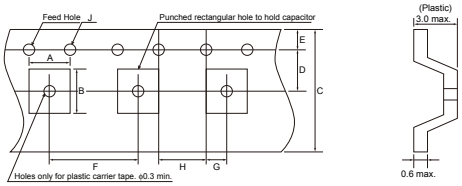
F=2mm (03, 05, 105 Type)



F=4mm (105, D11, F12, 21, 316, 32, 42, 52 Type)



F=8mm (43, 55 Type)



Reel

(Unit: mm)

Code / Reel	A	B	C	D
7–inch Reel (CODE: T, H, Q, P)	180 $^{+0}_{-2.0}$	ϕ60 min.	13±0.5	21±0.8
13–inch Reel (CODE: L, N)	330±2.0	ϕ100±1.0		
Code / Reel	**E**	**W1**	**W2**	**R**
7–inch Reel (CODE: T, H, Q)	2.0±0.5	10.0±1.5	16.5 max.	1.0
13–inch Reel (CODE: L, N)		9.5±1.0		

∗ Carrier tape width 8mm.
For size 42 (1808) or over, Tape width 12mm and W1: 14±1.5, W2: 18.4mm max.

Carrier Tape

(Unit: mm)

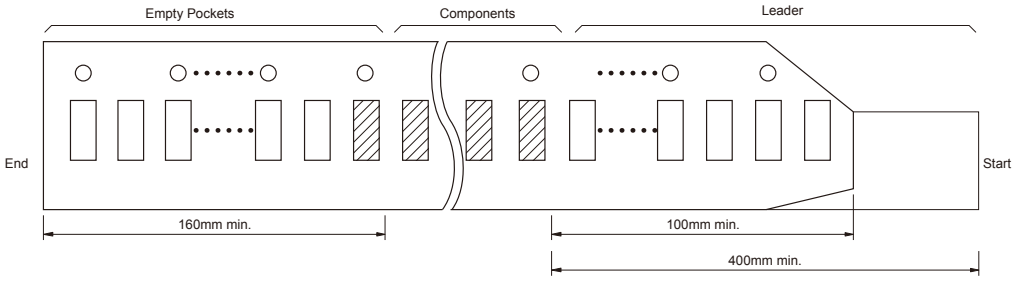
Size (EIA Code)	A	B	F
02 (01005)	0.23±0.02	0.43±0.02	1.0±0.02
	0.25±0.03	0.45±0.03	2.0±0.05
03 (0201)∗	0.37±0.03	0.67±0.03	1.0±0.05
			2.0±0.05
05 (0402)	0.65±0.1	1.15±0.1	1.0±0.05
			2.0±0.05
105 (0603)	1.0±0.2	1.8±0.2	4.0±0.1
21 (0805)	1.5±0.2	2.3±0.2	4.0±0.1
316 (1206)	2.0±0.2	3.6±0.2	4.0±0.1
32 (1210)	2.9±0.2	3.6±0.2	4.0±0.1
42 (1808)	2.4±0.2	4.9±0.2	4.0±0.1
43 (1812)	3.6±0.2	4.9±0.2	8.0±0.1
52 (2208)	2.4±0.2	6.0±0.2	4.0±0.1
55 (2220)	5.3±0.2	6.0±0.2	8.0±0.1
D11 (0405)	1.15±0.2	1.55±0.2	4.0±0.1
F12 (0508)	1.5±0.2	2.3±0.2	4.0±0.1

∗ Option : A : 0.39±0.03, B : 0.69±0.03

(Unit: mm)

F	Carrier Tape	C	D	E	G	H	J
1.0 ±0.02	4mm Plastic	4.0 +0.05	1.8 ±0.02	0.9 ±0.05	–	2.0 ±0.04	0.8 ±0.02
1.0 ±0.05	1mm Paper	8.0 +0.3/ −0.1	3.5 ±0.05	1.75 ±0.1	2.0 ±0.05	4.0 ±0.05	1.5 +0.1/ −0
2.0 ±0.05	8mm Paper	8.0 ±0.3				4.0 ±0.1	
4.0 ±0.1	8mm Plastic						
8.0 ±0.1	12mm Plastic	12.0 ±0.3	5.5 ±0.05				

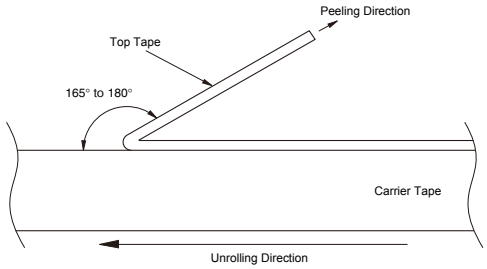
Detail of leader and trailer



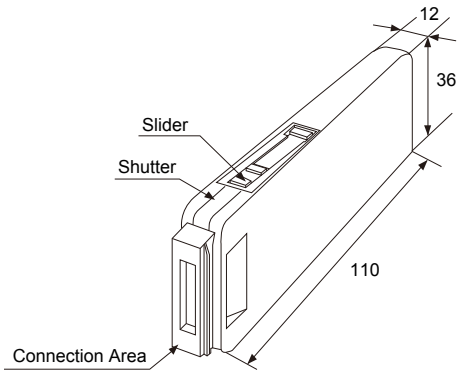
Adhesive tape

1) The exfoliative strength when peeling off the top tape from the carrier tape by the method of the following figure shall be *0.1 to 0.7N. *02 Size: 0.1 to 0.5N
2) When the top tape is peeled off, the adhesive stays on the top tape.
3) Chip capacitors will be in a state free without being stuck on the thermal adhesive tape.

Exfoliating angle: 165 to 180 degrees to the carrier tape.
Exfoliating speed: 300 mm/min.



Bulk Case (Unit: mm)

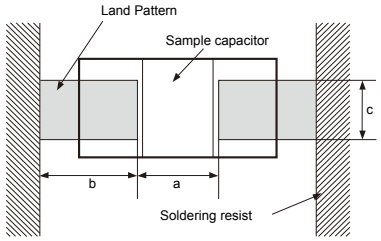


• Please contact Kyocera for details.

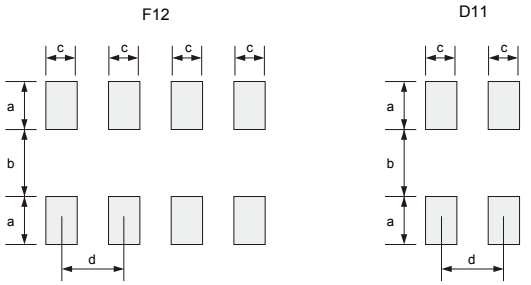
Dimensions for recommended typical land

Since the amount of solder (size of fillet) to be used has direct influence on the capacitor after mounting, the sufficient consideration is necessary.
When the amounts of solder is too much, the stress that a capacitor receives becomes larger. It may become the cause of a crack in the capacitor. When the land design of printed wiring board is considered, it is necessary to set up the form and size of land pattern so that the amount of solder is suitable.

(General, High-Voltage, Automotive)



(Arrays)



Design of printed circuit and Soldering

The recommended fillet height shall be 1/2 to 1/3 of the thickness of capacitors. When mounting two or more capacitors in the common land, it is necessary to separate the land with the solder resist strike so that it may become the exclusive land of each capacitor.

General, High-Voltage

(Unit: mm)

Size (EIA Code)	L×W	a	b	c
02 (01005)	0.4×0.2	0.13 to 0.20	0.12 to 0.18	0.20 to 0.23
03 (0201)	0.6×0.3	0.20 to 0.30	0.25 to 0.35	0.30 to 0.40
05 (0402)	1.0×0.5	0.30 to 0.50	0.35 to 0.45	0.40 to 0.60
105 (0603)	1.6×0.8	0.70 to 1.00	0.80 to 1.00	0.60 to 0.80
21 (0805)	2.0×1.25	1.00 to 1.30	1.00 to 1.20	0.80 to 1.10
316 (1206)	3.2×1.6	2.10 to 2.50	1.10 to 1.30	1.00 to 1.30
32 (1210)	3.2×2.5	2.10 to 2.50	1.10 to 1.30	1.90 to 2.30
42 (1808)	4.5×2.0	2.50 to 3.20	1.80 to 2.30	1.50 to 1.80
43 (1812)	4.5×3.2	2.50 to 3.20	1.80 to 2.30	2.60 to 3.00
52 (2208)	5.7×2.0	4.20 to 4.70	2.00 to 2.50	1.50 to 1.80
55 (2220)	5.7×5.0	4.20 to 4.70	2.00 to 2.50	4.20 to 4.70

Automotive

(Unit: mm)

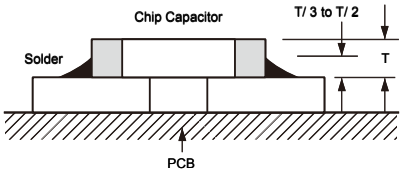
Size (EIA Code)	L×W	a	b	c
105 (0603)	1.6×0.8	0.60 to 0.90	0.80 to 1.00	0.70 to 1.00
21 (0805)	2.0×1.25	0.90 to 1.20	0.80 to 1.20	0.90 to 1.40
316 (1206)	3.2×1.6	1.40 to 1.90	1.00 to 1.30	1.30 to 1.80

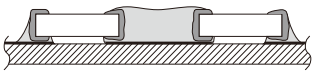
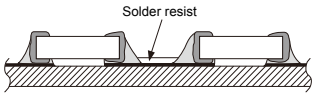
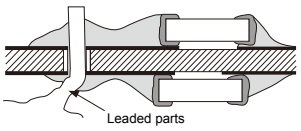
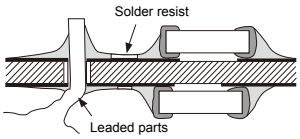
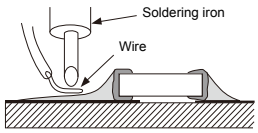
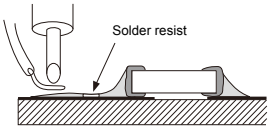
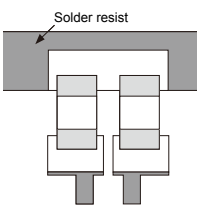
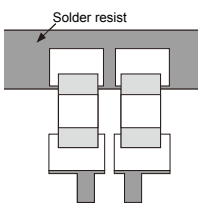
Arrays

(Unit: mm)

	a	b	c	d
F12 (0508)	0.5	0.5	0.3	0.5
D11 (0405)	0.69	0.28	0.3	0.64

Ideal Solder Height



Item	Not recommended example	Recommended example/ Separated by solder
Multiple parts mount		
Mount with leaded parts		
Wire soldering after mounting		
Overview		

Mounting Design

The chip could crack if the PCB warps during processing after the chip has been soldered.

Recommended chip position on PCB to minimize stress from PCB warpage

Actual Mounting

1) If the position of the vacuum nozzle is too low, a large force may be applied to the chip capacitor during mounting, resulting in cracking.
2) During mounting, set the nozzle pressure to a static load of 100 to 300 gf.
3) To minimize the shock of the vaccum nozzle, provide a support pin on the back of the PCB to minimize PCB flexture.

4) Bottom position of pick up nozzle should be adjusted to the top surface of a substrate which camber is corrected.
5) To reduce the possibility of chipping and cracks, minimize vibration to chips stored in a bulk case.
6) The discharge pressure must be adjusted to the part size. Verify the pressure during setup to avoid fracturing or cracking the chips capacitors.

Resin Mold

1) If a large amount of resin is used for molding the chip, cracks may occur due to contraction stress during curing. To avoid such cracks, use a low shrinkage resin.
2) The insulation resistance of the chip will degrade due to moisture absorption. Use a low moisture absorption resin.
3) Check carefully that the resin does not generate a decomposition gas or reaction gas during the curing process or during normal storage. Such gases may crack the chip capacitor or damage the device itself.

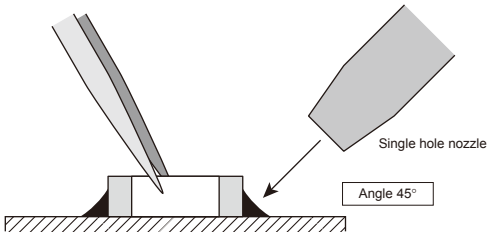
Soldering Method

1) Ceramic is easily damaged by rapid heating or cooling. If some heat shock is unavoidable, preheat enough to limit the temperature difference (Delta T) to within 130 degree Celsius.
2) The product size 1.6×0.8mm to 3.2×1.6mm can be used in reflow and wave soldering, and the product size of bigger than 3.2×1.6mm, or smaller than 1.6×0.8mm, and capacitor arrays can be used in reflow.
   Circuit shortage and smoking can be created by using capacitors which are used neglecting the above caution.
3) Please see our recommended soldering conditions.
4) In case of using Sn-Zn Solder, please contact us in advance.
5) The following condition is recommended for spot heater application.

• Recommended spot heater condition

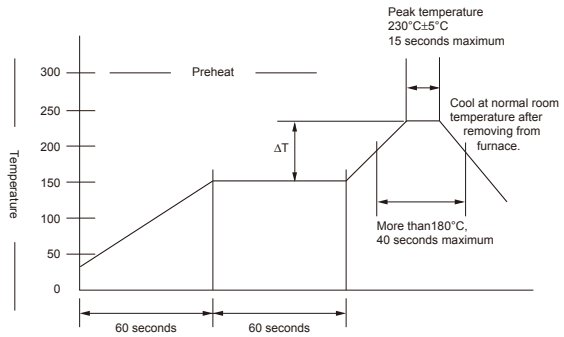
Item	Condition
Distance	5mm min.
Angle	45°
Projection Temp.	400°C max.
Flow rate	Set at the minimum
Nozzle diameter	2ϕ to 4ϕ (Single hole type)
Application time	10 sec. max. (1206 and smaller) 30 sec.max. (1210 and larger)

How to point spot heater



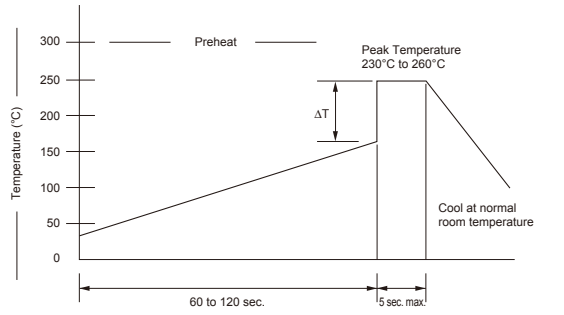
Recommended Temperature Profile (62Sn Solder)

Reflow



① Minimize soldering time.
② Ensure that the temperature difference (ΔT) does not exceed 150°C.
③ Ensure that the temperature difference (ΔT) does not exceed 130°C for 3.2×2.5mm size or larger.
④ MLCC can withstand the above reflow conditions up to 3 times.

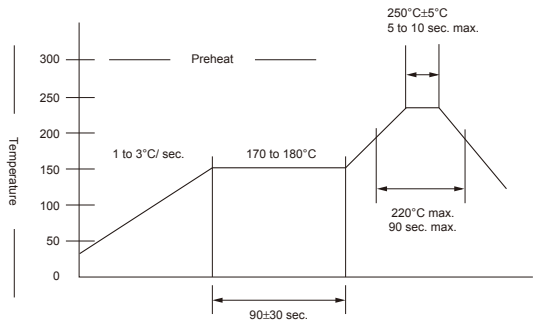
Wave



① Ensure that the chip capacitor is preheated adequately.
② Ensure that the temperature difference (ΔT) does not exceed 150°C.
③ Cool naturally after soldering.
④ Wave soldering is not applicable for chips with size of 3.2×2.5mm or larger of 1.0×0.5mm or smaller and capacitor arrays.

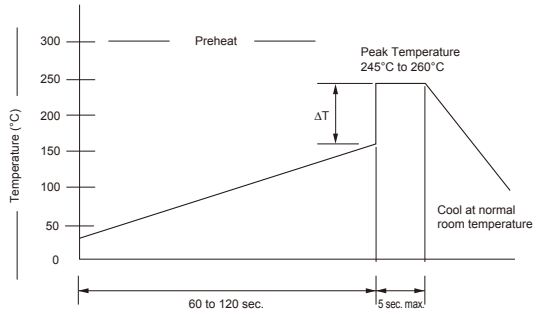
Recommended Temperature Profile (Sn–3Ag–0.5Cu)

Reflow



① Minimize soldering time.
② Ensure that allowable temperature difference does not exceed 150°C.
③ Ensure that allowable temperature difference does not exceed 130°C for 3.2×2.5mm size or larger.

Wave



① Ensure that the chip capacitor is preheated adequately.
② Ensure that the temperature difference (ΔT) does not exceed 150°C.
③ Cool naturally after soldering.
④ Wave soldering is not applicable for chips with size of 3.2×2.5mm or larger of 1.0×0.5mm or smaller and capacitor arrays.

Soldering iron

1) Temperature of iron chip — 1206 and smaller 350°C max.; 1210 and larger 280°C max.
2) Wattage — 80W max.
3) Tip shape of soldering iron — ϕ3.0mm max.
4) Soldering Time — 3 sec. max.

5) Cautions
   a) Pre–heating is necessary rapid heating must be avoided.
      Delta T≤150°C
   b) Avoid direct touching to capacitors.
   c) Avoid rapid cooling after soldering. Natural cooling is recommended.

*Consult as if it is difficult to keep the temperature 280°C max. for 1210 and larger MLCC'S.

Multilayer Ceramic Chip Capacitors
Precautions

Circuit Design

1. Once application and assembly environments have been checked, the capacitor may be used in conformance with the rating and performance which are provided in both the catalog and the specifications. Use exceeding that which is specified may result in inferior performance or cause a short, open, smoking, or flaming to occur, etc.

2. Please consult the manufacturer in advance when the capacitor is used in devices such as: devices which deal with human life, i.e. medical devices; devices which are highly public orientated; and devices which demand a high standard of liability.
   Accident or malfunction of devices such as medical devices, space equipment and devices having to do with atomic power could generate grave consequence with respect to human lives or, possibly, a portion of the public. Capacitors used in these devices may require high reliability design different from that of general purpose capacitors.

3. Please use the capacitors in conformance with the operating temperature provided in both the catalog and the specifications.
   Be especially cautious not to exceed the maximum temperature. In the situation the maximum temperature set forth in both the catalog and specifications is exceeded, the capacitor's insulation resistance may deteriorate, power may suddenly surge and short–circuit may occur.
   The capacitor has a loss, and may self–heat due to equivalent series resistance when alternating electric current is passed therethrough. As this effect becomes especially pronounced in high frequency circuits, please exercise caution.
   When using the capacitor in a (self–heating) circuit, please make sure the surface of the capacitor remains under the maximum temperature for usage. Also, please make certain temperature rises remain below 20°C.

4. Please keep voltage under the rated voltage which is applied to the capacitor. Also, please make certain the peak voltage remains below the rated voltage when AC voltage is super–imposed to the DC voltage.
   In the situation where AC or pulse voltage is employed, ensure average peak voltage does not exceed the rated voltage.
   Exceeding the rated voltage provided in both catalog and specifications may lead to defective withstanding voltage or, in worst case situations, may cause the capacitor to smoke or flame.

5. When the capacitor is to be employed in a circuit in which there is continuous application of a high frequency voltage or a steep pulse voltage, even though it is within the rated voltage, please inquire to the manufacturer.
   In the situation the capacitor is to be employed using a high frequency AC voltage or a extremely fast rising pulse voltage, even though it is within the rated voltage, it is possible capacitor reliability will deteriorate.

6. It is a common phenomenon of high–dielectric products to have a deteriorated amount of static electricity due to the application of DC voltage. Due caution is necessary as the degree of deterioration varies depending on the quality of capacitor materials, capacity, as well as the load voltage at the time of operation.

7. Do not use the capacitor in an environment where it might easily exceed the respective provisions concerning shock and vibration specified in the catalog and specifications.
   In addition, it is a common piezo phenomenon of high dielectric products to have some voltage due to vibration or to have noise due to voltage change. Please contact sales in such case.

8. If the electrostatic capacity value of the delivered capacitor is within the specified tolerance, please consider this when designing the respective product in order that the assembled product function appropriately.

9. Please contact us upon using conductive adhesives.

Storage

1. If the component is stored in minimal packaging (a heat–sealed or chuck–type plastic bag), the bag should be kept closed. Once the bag has been opened, reseal it or store it in a desiccator.
2. Keep storage place temperature +5 to +40 degree C, humidity 20 to 70% RH.
3. The storage atmosphere must be free of gas containing sulfur and chlorine. Also, avoid exposing the product to saline moisture. If the product is exposed to such atmospheres, the terminals will oxidize and solderability will be effected.
4. Precautions 1) to 3) apply to chip capacitors packaged in carrier tapes and bulk cases.
5. The solderability is assured for 12 months from our shipping date (six months for silver palladium) if the above storage precautions are followed.
6. Chip capacitors may crack if exposed to hydrogen (H_2) gas while sealed or if coated with silicon, which generates hydrogen gas.

Safety application guideline and detailed information of electrical properties are also provided in Kyocera home page;
URL: http://www.kyocera.co.jp/electronic/