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APPROVAL SHEET

Product Name : GREEN TYPE HIGH CAPACITANCE CAPACITORS

Part No. : MA Series

Description : Size 0402 ~ 2225, X7R/X5R/Y5V, UR ≤ 250V

PREPARED BY	APPROVED BY

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SPECIFICATION FOR

MA SERIES GREEN TYPE HIGH CAPACITANCE CAPACITORS

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<u>DRAWN BY</u>	<u>CHECKED BY</u>	<u>APPROVED BY</u>

1. DESCRIPTION

MLCC consists of a conducting material and electrodes. To manufacture a chip-type SMT and achieve miniaturization, high density and high efficiency, ceramic condensers are used.

PDC high capacitance MLCC offers low ESR and excellent frequency characteristics to be suited for coupling and decoupling applications in circuit. The high dielectric constant material X7R, X5R and Y5V are used for this series product.

2. FEATURES

- Realize high capacitance in given sizes.
- Capacitor with lead-free termination (pure Tin).
- RoHS compliant.
- HALOGEN compliant.

3. APPLICATIONS

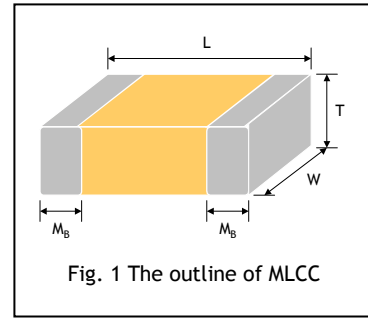
- Digital circuit coupling or decoupling applications.
- For high frequency and high-density type power suppliers.
- For bypassing.

4. HOW TO ORDER

<u>MA</u>	<u>0402</u>	<u>XR</u>	—	<u>104</u>	<u>K</u>	—	<u>160</u>	<u>PR</u>	<u>G</u>
PDC Family	Size Inch (mm) 0402 (1005) 0603 (1608) 0805 (2012) 1206 (3216) 1210 (3225) 1808 (4520) 1812 (4532) 1825 (4563) 2220 (5750) 2225 (5763)	Dielectric XR: X7R or X5R YV: Y5V		Capacitance Two significant digits followed by no. of zeros. And R is in place of decimal point. eg.: 106=10x10 ⁶ =10μF	Tolerance K=±10% M=±20% Z=-20/+80%		Rated voltage Two significant digits followed by no. of zeros. And R is in place of decimal point. 6R3 =6.3 VDC 100 =10 VDC 160 =16 VDC 250 =25 VDC 500 =50 VDC 101 =100 VDC 251 =250 VDC	Packaging ER: Tape and Reel, Embossed Tape PR: Tape and Reel, Paper Tape No Code: Bulk	Control Code G: RoHS compliant & HALOGEN compliant

5. EXTERNAL DIMENSIONS

Size Inch (mm)	L (mm)	W (mm)	Tmax (mm)	M _B min (mm)
0402 (1005)	1.00±0.05	0.50±0.05	0.55	0.15
0603 (1608)	1.60±0.10	0.80±0.10	0.87	0.20
	1.60+0.15/-0.10	0.80+0.15/-0.10	0.95	
0805 (2012)	2.00±0.20	1.25±0.20	1.45	0.30
1206 (3216)	3.20±0.20	1.60±0.20	1.30	0.30
	3.20+0.30/-0.10	1.60+0.30/-0.10	1.90	
1210 (3225)	3.20±0.40	2.50±0.30	2.80	0.30
1812 (4532)	4.50±0.40	3.20±0.30	2.80	0.26
1825 (4563)	4.50±0.40	6.30±0.40	2.80	0.26
2220 (5750)	5.70±0.40	5.00±0.40	3.00	0.30
2225 (5763)	5.70±0.40	6.30±0.40	2.80	0.30



6. GENERAL ELECTRICAL DATA

Dielectric	X7R	X5R	Y5V
Size	0402, 0603, 0805, 1206, 1210, 1812, 1825, 2220, 2225		
Capacitance range*	1μF to 10μF	1μF to 100μF	1μF to 100μF
Capacitance tolerance**	K (±10%), M (±20%)		Z (-20/+80%)
Rated voltage (WVDC)	6.3V, 10V, 16V, 25V, 50V, 100V, 250V		
Tan δ*	Note 1		
Insulation resistance at Ur	RxC ≥ 500 ΩxF		
Operating temperature	-55 to +125°C	-55 to +85°C	-25 to +85°C
Capacitance characteristic	±15%		+30/-80%
Termination	Ni/Sn (lead-free termination)		

* Measured at 1.0±0.2Vrms, 1.0kHz±10% for C≤10μF; 0.5±0.2Vrms, 120Hz±20% for C>10μF, 30-70% related humidity, 25°C ambient temperature for X7R, X5R and at 20°C for Y5V.

** Preconditioning for Class II MLCC: Perform a heat treatment at 150±10°C for 1 hour, then leave in ambient condition for 24±2 hours before measurement.

Note 1

X7R/X5R

Rated vol.	D.F.	Exception of D.F.
≥50V	≤2.5%	≤3.0% 0603≥0.047μF; 0805≥0.18μF; 1206≥0.47μF
25V	≤3.5%	≤5.0% 0805≥1μF; 1210≥10μF
		≤7.0% 0603≥0.33μF; 1206≥4.7μF
		≤10.0% 0402≥0.10μF; 0603≥0.47μF; 0805≥2.2μF; 1206≥6.8μF
16V	≤3.5%	≤5.0% 0402≥0.033μF; 0603≥0.15μF; 0805≥0.68μF; 1206≥2.2μF; 1210≥4.7μF
		≤10.0% 0603≥0.68μF; 0805≥2.2μF; 1206≥4.7μF; 1210≥22μF
10V	≤5.0%	≤10.0% 0402≥0.33μF; 0603≥0.33μF; 0805≥2.2μF; 1206≥2.2μF; 1210≥22μF
		≤15.0% 0402≥1μF
6.3V	≤10.0%	≤15.0% 0603≥10μF; 0805≥4.7μF; 1210≥100μF
		≤20.0% 0402≥2.2μF

Y5V

Rated vol.	D.F.	Exception of D.F.
≥50V	≤5.0%	≤7.0% 0603≥0.1μF; 0805≥0.47μF
35V	≤7.0%	---
25V	≤5.0%	≤7.0% 0402≥0.047μF; 0603≥0.1μF; 0805≥0.33μF; 1206≥1μF; 1210≥4.7μF
		≤9.0% 0402≥0.068μF; 0603≥0.47μF; 1206≥4.7μF; 1210≥22μF
16V (C<1.0μF)	≤7.0%	≤9.0% 0402≥0.068μF; 0603≥0.68μF
16V (C≥1.0μF)	≤9.0%	≤12.5% 0402≥0.22μF
		≤12.5% 0805≥3.3μF; 1206≥10μF; 1210≥22μF; 1812≥47μF
10V	≤12.5%	---
6.3V	≤20.0%	---

7. CAPACITANCE RANGE

7-1 X7R Dielectric

DIELECTRIC		X7R																						
SIZE		0603				0805				1206					1210					1812				
RATED VOLTAGE (VDC)		6.3	10	16	6.3	10	16	25	6.3	10	16	25	50	10	16	25	50	100	10	16	25	50	100	
Capacitance	1.0 μ F (105)																							
	1.5 μ F (155)																							
	2.2 μ F (225)																							
	3.3 μ F (335)																							
	4.7 μ F (475)																							
	6.8 μ F (685)																							
	10 μ F (106)																							

DIELECTRIC		X7R								
SIZE		1825			2220			2225		
RATED VOLTAGE (VDC)		50	100	250	50	100	250	50	100	250
Capacitance	1.0 μ F (105)									
	1.2 μ F (125)									
	1.5 μ F (155)									
	2.2 μ F (225)									
	2.7 μ F (225)									
	3.3 μ F (335)									
	3.9 μ F (395)									
	4.7 μ F (475)									
	5.6 μ F (565)									
	6.8 μ F (685)									
	8.2 μ F (825)									
10.0 μ F (106)										

7-2 X5R Dielectric

DIELECTRIC		X5R																								
SIZE		0402				0603				0805				1206				1210				1812				
RATED VOLTAGE (VDC)		6.3	10	16	25	6.3	10	16	25	6.3	10	16	25	6.3	10	16	25	6.3	10	16	25	6.3	10	16	25	6.3
Capacitance	1.0 μ F (105)																									
	1.5 μ F (155)																									
	2.2 μ F (225)																									
	3.3 μ F (335)																									
	4.7 μ F (475)																									
	6.8 μ F (685)																									
	10 μ F (106)																									
	22 μ F (226)																									
	47 μ F (476)																									
	100 μ F (107)																									

7-3 Y5V Dielectric

DIELECTRIC		Y5V										
SIZE		0402		0603				0805				
RATED VOLTAGE (VDC)		6.3	10	6.3	10	16	25V	6.3	10	16	25	50
Capacitance	1.0μF (105)											
	1.5μF (155)											
	2.2μF (225)											
	3.3μF (335)											
	4.7μF (475)											
	6.8μF (685)											
	10μF (106)											
	22μF (226)											

DIELECTRIC		Y5V																
SIZE		1206					1210					1812						
RATED VOLTAGE (VDC)		6.3	10	16	25	35	50	6.3	10	16	25	35	50	10	16	25	50	100
Capacitance	1.0μF (105)																	
	1.5μF (155)																	
	2.2μF (225)																	
	3.3μF (335)																	
	4.7μF (475)																	
	6.8μF (685)																	
	10μF (106)																	
	22μF (226)																	
	47μF (476)																	
	100μF (107)																	

8. PACKAGING STYLE AND QUANTITY

Size	Thickness (mm)	Paper tape		Plastic tape	
		7" reel	13" reel	7" reel	13" reel
0402 (1005)	0.50±0.05	10k	50k	-	-
0603 (1608)	0.80±0.07	4k	15k	-	-
	0.80+0.15/-0.10	4k	15k	-	-
0805 (2012)	0.80±0.10	4k	15k	-	-
	1.25±0.10	-	-	3k	10k
1206 (3216)	1.25±0.20	-	-	3k	10k
	0.95±0.10	-	-	3k	10k
	1.15±0.15	-	-	3K	10K
	1.25±0.10	-	-	3k	10k
	1.60±0.20	-	-	2k	-
1210 (3225)	1.60+0.30/-0.10	-	-	2k	-
	0.95±0.10	-	-	3k	10k
	1.25±0.10	-	-	3k	10k
	1.60±0.20	-	-	2k	-
	2.00±0.20	-	-	2k	-
1812 (4532)	2.50±0.30	-	-	1k	-
	1.25±0.10	-	-	1k	-
	1.60±0.20	-	-	1k	-
	2.00±0.20	-	-	1k	-
1825 (4563)	2.50±0.30	-	-	0.5k	-
	2.00±0.20	-	-	1k	-
2220 (5750)	2.50±0.30	-	-	0.5k	-
	2.80±0.20	-	-	0.5k	-
	2.00±0.20	-	-	1k	-
2225 (5763)	2.50±0.30	-	-	0.5k	-
	2.00±0.20	-	-	1k	-

Unit: pieces

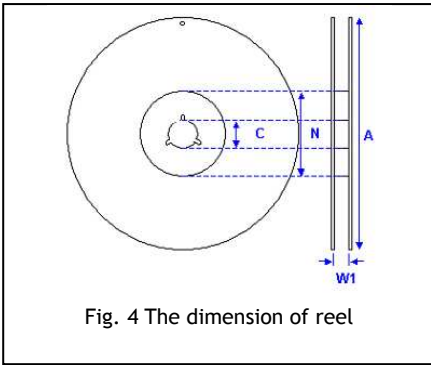


Fig. 4 The dimension of reel

Size	0402, 0603, 0805, 1206, 1210			1812, 1825, 2220, 2225
Reel size	7"	10"	13"	7"
C	13.0+0.5/-0.2	13.0+0.5/-0.2	13.0+0.5/-0.2	13.0+0.5/-0.2
W ₁	8.4+1.5/-0	8.4+1.5/-0	8.4+1.5/-0	12.4+2.0/-0
A	178.0±0.10	250.0±1.0	330.0±1.0	178.0±0.10
N	60.0±1.0/-0	100.0±1.0	100±1.0	80.0±1.0

8-1 CARDBOARD TAPE DIMENSIONS

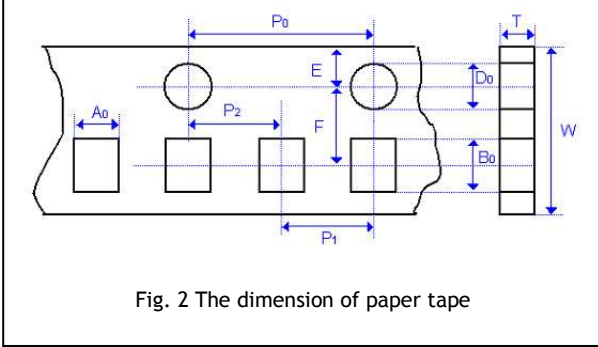


Fig. 2 The dimension of paper tape

8-2 EMBOSSED TAPE DIMENSIONS

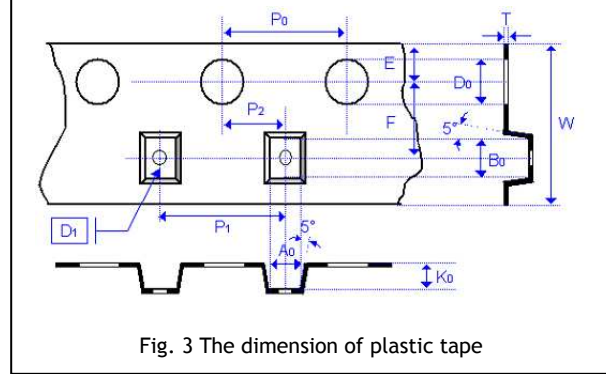


Fig. 3 The dimension of plastic tape

Size	0402	0603		0805		1206			1210	
Chip Thickness	0.50±0.05	0.80±0.07	0.80+0.15/-0.10	0.80±0.10	1.25±0.10 1.25±0.20	0.80±0.10	0.95±0.10 1.25±0.10	1.60±0.20 1.60+0.3/-0.1	0.95±0.10 1.25±0.10 1.60±0.20	2.50±0.30
A ₀	0.62±0.05	1.00+0.05/-0.10	1.02+0.05/-0.10	1.50±0.10	<1.65	2.00±0.10	<2.00	<2.00	<3.05	<3.10
B ₀	1.12±0.05	1.80±0.10	1.80±0.10	2.30±0.10	<2.40	3.50±0.10	<3.60	<3.70	<3.80	<4.00
T	0.60±0.05	0.95±0.05	0.97±0.05	0.95±0.05	0.23±0.05	0.95±0.05	0.23±0.05	0.23±0.05	0.23±0.05	0.23±0.05
K ₀	-	-	-	-	<2.50	-	<2.50	<2.50	<2.50	<3.50
W	8.00±0.10	8.00±0.10	8.00±0.10	8.00±0.10	8.00±0.10	8.00±0.10	8.00±0.10	8.00±0.10	8.00±0.10	8.00±0.10
P ₀	4.00±0.10	4.00±0.10	4.00±0.10	4.00±0.10	4.00±0.10	4.00±0.10	4.00±0.10	4.00±0.10	4.00±0.100	4.00±0.10
10xP ₀	40.00±0.20	40.00±0.20	40.00±0.20	40.00±0.20	40.00±0.20	40.00±0.20	40.00±0.20	40.00±0.20	40.00±0.20	40.0±0.10
P ₁	4.00±0.10	4.00±0.10	4.00±0.10	4.00±0.10	4.00±0.10	4.00±0.10	4.00±0.10	4.00±0.10	4.00±0.10	4.00±0.10
P ₂	2.00±0.05	2.00±0.05	2.00±0.05	2.00±0.05	2.00±0.05	2.00±0.05	2.00±0.05	2.00±0.05	2.00±0.05	2.00±0.05
D ₀	1.55±0.05	1.55±0.05	1.55±0.05	1.55±0.05	1.50±0.10/-0	1.55±0.05	1.50±0.10/-0	1.50±0.10/-0	1.50±0.10/-0	1.50±0.10/-0
D ₁	-	-	-	-	1.00±0.10	-	1.00±0.10	1.00±0.10	1.00±0.10	1.00±0.10
E	1.75±0.05	1.75±0.05	1.75±0.05	1.75±0.05	1.75±0.10	1.75±0.10	1.75±0.10	1.75±0.10	1.75±0.10	1.75±0.10
F	3.50±0.05	3.50±0.05	3.50±0.05	3.50±0.05	3.50±0.05	3.50±0.05	3.50±0.05	3.50±0.05	3.50±0.05	3.50±0.05

Size	1812		1825		2220		2225	
Chip Thickness	1.25±0.10 1.60±0.20 2.00±0.20	2.50±0.30	1.60±0.20 2.00±0.20	2.50±0.30	2.00±0.20	2.50±0.30 2.80±0.20	2.00±0.20	2.50±0.30
A ₀	<3.90	<3.90	<6.80	<6.80	<5.80	<5.80	<6.80	<6.80
B ₀	<5.30	<5.30	<5.30	<5.30	<6.50	<6.50	<6.50	<6.50
T	0.25±0.05	0.25±0.05	0.30±0.10	0.30±0.10	0.30±0.10	0.30±0.10	0.30±0.10	0.30±0.10
K ₀	<2.50	<3.00	<2.50	<3.10	<2.50	<3.10	<2.50	<3.10
W	12.0±0.20	12.0±0.20	12.0±0.20	12.0±0.20	12.0±0.20	12.0±0.20	12.0±0.20	12.0±0.20
P ₀	4.00±0.10	4.00±0.10	4.00±0.10	4.00±0.10	4.00±0.10	4.00±0.10	4.00±0.10	4.00±0.10
10xP ₀	40.00±0.20	40.00±0.20	40.00±0.20	40.00±0.20	40.00±0.20	40.00±0.20	40.00±0.20	40.00±0.20
P ₁	8.00±0.10	8.00±0.10	8.00±0.10	8.00±0.10	8.00±0.10	8.00±0.10	8.00±0.10	8.00±0.10
P ₂	2.00±0.05	2.00±0.05	2.00±0.05	2.00±0.05	2.00±0.05	2.00±0.05	2.00±0.05	2.00±0.05
D ₀	1.50+0.10/-0	1.50+0.10/-0	1.50+0.10/-0	1.50+0.10/-0	1.50+0.10/-0	1.50+0.10/-0	1.50+0.10/-0	1.50+0.10/-0
D ₁	1.50±0.10	1.50+/-0.10	1.50±0.10	1.50±0.10	1.50±0.10	1.50±0.10	1.50±0.10	1.50±0.10
E	1.75±0.10	1.75+/-0.1	1.75±0.1	1.75±0.10	1.75±0.1	1.75±0.10	1.75±0.10	1.75±0.10
F	5.50±0.05	5.50+/-0.05	5.50±0.05	5.50±0.05	5.50±0.05	5.50±0.05	5.50±0.05	5.50±0.05

9. APPLICATION NOTES

STORAGE

To prevent the damage of solderability of terminations, the following storage conditions are recommended:

Indoors under 5 ~ 40°C and 20% ~ 70% RH.

No harmful gases containing sulfuric acid, ammonia, hydrogen sulfide or chlorine.

Packaging should not be opened until the capacitors are required for use. If opened, the pack should be re-sealed as soon as is practicable. Taped product should be stored out of direct sunlight, which might promote deterioration in tape or adhesion performance. The capacitors should be used within 6 months and checked the solderability before use.

HANDLING

Chip capacitors are dense, hard, brittle, and abrasive materials. They are liable to suffer mechanical damage, in the form of cracks or chips. Chip Capacitors should be handled with care to avoid contamination or damage. To use vacuum or plastic tweezers to pick up or plastic tweezers is recommended for manual placement. Tape and reeled packages are suitable for automatic pick and placement machine.

PREHEAT

In order to minimize the risk of thermal shock during soldering, a carefully controlled preheat is required. The rate of preheat should not exceed 4°C per second and the final preheat temperature should be within 100°C of the soldering temperature for small chips such as 0402, 0603, 0805 and 1206, and within 50°C of the soldering temperature for bigger chips such as 1210, 1808, 1825, 1812, 2220 and 2225, etc.

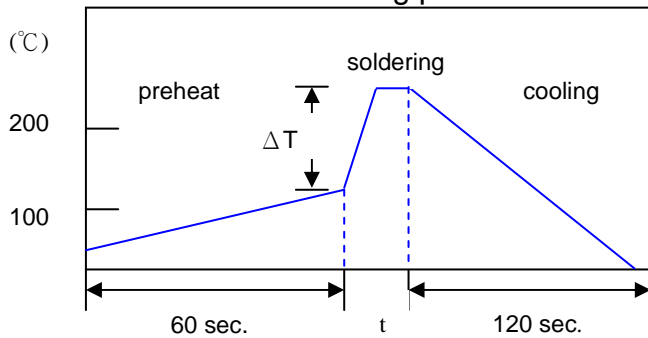
SOLDERING

Use mildly activated rosin RA and RMA fluxes do not use activated flux. The amount of solder in each solder joint should be controlled to prevent the damage of chip capacitors caused by the stress between solder, chips, and substrate.

Hand soldering with temperature-controlled iron not exceeding 30 watts and diameter of tip less than 1.2 mm is recommended, tip of iron should not contact the ceramic body directly, and the temperature of iron should be set to not more than 260°C.

For bigger chips such as 1210, 1808, 1812, 1825, 2220 and 2225, etc. wave soldering and hand soldering are not recommended.

Recommended soldering profiles as following:



Soldering	Solder Temp.(T)	Soldering Time (t)
Reflow	235 – 260 °C	< 15 sec.
Wave	230 – 260 °C	< 5 sec.

Chip Size	ΔT
0402, 0603, 0805, 1206	100 °C
1210, 1808, 1812, 1825, 2220, 2225	50 °C

COOLING

After soldering, cool the chips and the substrate gradually to room temperature. Natural cooling in air is recommended to minimize stress in the solder joint. A cooling rate not exceeding 4°C per second should be used when forced cooling is necessary.

CLEANING

All flux residues must be removed by using suitable electronic-grade vapor-cleaning solvents to eliminate contamination that could cause electrolytic surface corrosion. Good results can be obtained by using ultrasonic cleaning of the solvent. The choice of the proper system is depends upon many factors such as component mix, flux, and solder paste and assembly method. The ability of the cleaning system to remove flux residues and contamination from under the chips is very important.

10. RELIABILITY TEST CONDITIONS AND REQUIREMENTS

No.	Item	Test Condition	Requirements																																																																				
1.	Visual and Mechanical	---	* No remarkable defect. * Dimensions to conform to individual specification sheet.																																																																				
2.	Capacitance	Cap \leq 10 μ F, 1.0 \pm 0.2Vrms, 1kHz \pm 10%	* Shall not exceed the limits given in the detailed spec.																																																																				
3.	Q/ D.F. (Dissipation Factor)	Cap $>$ 10 μ F, 0.5 \pm 0.2Vrms, 120Hz \pm 20%	X7R, X5R: <table border="1"> <thead> <tr> <th>Rated vol.</th> <th>D.F.</th> <th colspan="2">Exception of D.F.</th> </tr> </thead> <tbody> <tr> <td>\geq50V</td> <td>\leq2.5%</td> <td>\leq3.0%</td> <td>0603\geq0.047μF; 0805\geq0.18μF; 1206\geq0.47μF</td> </tr> <tr> <td rowspan="2">25V</td> <td rowspan="2">\leq3.5%</td> <td>\leq5.0%</td> <td>0805\geq1μF; 1210\geq10μF</td> </tr> <tr> <td>\leq7.0%</td> <td>0603\geq0.33μF; 1206\geq4.7μF</td> </tr> <tr> <td rowspan="2">16V</td> <td rowspan="2">\leq3.5%</td> <td>\leq10.0%</td> <td>0402\geq0.10μF; 0603\geq0.47μF; 0805\geq2.2μF; 1206\geq6.8μF</td> </tr> <tr> <td>\leq5.0%</td> <td>0402\geq0.033μF; 0603\geq0.15μF; 0805\geq0.68μF; 1206\geq2.2μF; 1210\geq4.7μF</td> </tr> <tr> <td rowspan="2">10V</td> <td rowspan="2">\leq5.0%</td> <td>\leq10.0%</td> <td>0603\geq0.68μF; 0805\geq2.2μF; 1206\geq4.7μF; 1210\geq22μF</td> </tr> <tr> <td>\leq15.0%</td> <td>0402\geq1μF</td> </tr> <tr> <td rowspan="2">6.3V</td> <td rowspan="2">\leq10%</td> <td>\leq15%</td> <td>0603\geq10μF; 0805\geq4.7μF; 1210\geq100μF</td> </tr> <tr> <td>\leq20%</td> <td>0402\geq2.2μF</td> </tr> </tbody> </table> Y5V: <table border="1"> <thead> <tr> <th>Rated vol.</th> <th>D.F.</th> <th colspan="2">Exception of D.F.</th> </tr> </thead> <tbody> <tr> <td>\geq50V</td> <td>\leq5.0%</td> <td>\leq7.0%</td> <td>0603\geq0.1μF; 0805\geq0.47μF</td> </tr> <tr> <td>35V</td> <td>\leq7.0%</td> <td>---</td> <td>---</td> </tr> <tr> <td rowspan="2">25V</td> <td rowspan="2">\leq5.0%</td> <td>\leq7.0%</td> <td>0402\geq0.047μF; 0603\geq0.1μF; 0805\geq0.33μF; 1206\geq1μF; 1210\geq4.7μF</td> </tr> <tr> <td>\leq9.0%</td> <td>0402\geq0.068μF; 0603\geq0.47μF; 1206\geq4.7μF; 1210\geq22μF</td> </tr> <tr> <td rowspan="2">16V (C\leq1.0μF)</td> <td rowspan="2">\leq7.0%</td> <td>\leq9.0%</td> <td>0402\geq0.068μF; 0603\geq0.68μF</td> </tr> <tr> <td>\leq12.5%</td> <td>0402\geq0.22μF</td> </tr> <tr> <td>16V (C\geq1.0μF)</td> <td>\leq9.0%</td> <td>\leq12.5%</td> <td>0805\geq3.3μF; 1206\geq10μF; 1210\geq22μF; 1812\geq47μF</td> </tr> <tr> <td>10V</td> <td>\leq12.5%</td> <td>---</td> <td>--</td> </tr> <tr> <td>6.3V</td> <td>\leq20.0%</td> <td>---</td> <td>--</td> </tr> </tbody> </table>	Rated vol.	D.F.	Exception of D.F.		\geq 50V	\leq 2.5%	\leq 3.0%	0603 \geq 0.047 μ F; 0805 \geq 0.18 μ F; 1206 \geq 0.47 μ F	25V	\leq 3.5%	\leq 5.0%	0805 \geq 1 μ F; 1210 \geq 10 μ F	\leq 7.0%	0603 \geq 0.33 μ F; 1206 \geq 4.7 μ F	16V	\leq 3.5%	\leq 10.0%	0402 \geq 0.10 μ F; 0603 \geq 0.47 μ F; 0805 \geq 2.2 μ F; 1206 \geq 6.8 μ F	\leq 5.0%	0402 \geq 0.033 μ F; 0603 \geq 0.15 μ F; 0805 \geq 0.68 μ F; 1206 \geq 2.2 μ F; 1210 \geq 4.7 μ F	10V	\leq 5.0%	\leq 10.0%	0603 \geq 0.68 μ F; 0805 \geq 2.2 μ F; 1206 \geq 4.7 μ F; 1210 \geq 22 μ F	\leq 15.0%	0402 \geq 1 μ F	6.3V	\leq 10%	\leq 15%	0603 \geq 10 μ F; 0805 \geq 4.7 μ F; 1210 \geq 100 μ F	\leq 20%	0402 \geq 2.2 μ F	Rated vol.	D.F.	Exception of D.F.		\geq 50V	\leq 5.0%	\leq 7.0%	0603 \geq 0.1 μ F; 0805 \geq 0.47 μ F	35V	\leq 7.0%	---	---	25V	\leq 5.0%	\leq 7.0%	0402 \geq 0.047 μ F; 0603 \geq 0.1 μ F; 0805 \geq 0.33 μ F; 1206 \geq 1 μ F; 1210 \geq 4.7 μ F	\leq 9.0%	0402 \geq 0.068 μ F; 0603 \geq 0.47 μ F; 1206 \geq 4.7 μ F; 1210 \geq 22 μ F	16V (C \leq 1.0 μ F)	\leq 7.0%	\leq 9.0%	0402 \geq 0.068 μ F; 0603 \geq 0.68 μ F	\leq 12.5%	0402 \geq 0.22 μ F	16V (C \geq 1.0 μ F)	\leq 9.0%	\leq 12.5%	0805 \geq 3.3 μ F; 1206 \geq 10 μ F; 1210 \geq 22 μ F; 1812 \geq 47 μ F	10V	\leq 12.5%	---	--	6.3V	\leq 20.0%	---	--
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4.	Dielectric Strength	* To apply voltage: \leq 100V =2.5 times of U _R $>$ 100V =2.0 times of U _R * Duration: 1 to 5 sec. * Charge and discharge current less than 50mA.	* No evidence of damage or flash over during test.																																																																				
5.	Insulation Resistance	To apply rated voltage for max. 120 sec.	\geq 10G Ω or Rx $C \geq$ 500 Ω -F whichever is smaller. Class II (X5R, X6S, X7R, Y5V) <table border="1"> <thead> <tr> <th>Rated voltage</th> <th>Insulation Resistance</th> </tr> </thead> <tbody> <tr> <td>16V:0402\geq0.22μF</td> <td rowspan="3">\geq 100 Ω-F</td> </tr> <tr> <td>10V:0603\geq0.47μF;0805\geq2.2μF; 1206\geq6.8μF</td> </tr> <tr> <td>6.3V</td> </tr> </tbody> </table>	Rated voltage	Insulation Resistance	16V:0402 \geq 0.22 μ F	\geq 100 Ω -F	10V:0603 \geq 0.47 μ F;0805 \geq 2.2 μ F; 1206 \geq 6.8 μ F	6.3V																																																														
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7.	Adhesive Strength of Termination	* Pressurizing force : 5N (\leq 0603) and 10N ($>$ 0603) * Test time: 10 \pm 1 sec.	* No remarkable damage or removal of the terminations.																																																																				

8.	Solderability	<ul style="list-style-type: none"> * Solder temperature: 235±5°C * Dipping time: 2±0.5 sec. 	75% min. coverage of all metalized area.															
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9.	Resistance to flexure of substrate	<ul style="list-style-type: none"> * The middle part of substrate shall be pressurized by means of the pressurizing rod at a rate of about 1 mm per second until the deflection becomes 1 mm and then the pressure shall be maintained for 5±1 sec. * Measurement to be made after keeping at room temp. for 24±2 hrs. 	<ul style="list-style-type: none"> * No remarkable damage. * Cap change : X7R, X5R: within ±12.5% Y5V: within ±30% (This capacitance change means the change of capacitance under specified flexure of substrate from the capacitance measured before the test.) 															
10	Resistance to Soldering Heat	<ul style="list-style-type: none"> * Solder temperature: 260±5°C * Dipping time: 10±1 sec * Preheating: 120 to 150°C for 1 minute before immerse the capacitor in a eutectic solder. * Before initial measurement (Class II only): Perform 150+0/-10°C for 1 hr and then set for 48±4 hrs at room temp. * Measurement to be made after keeping at room temp. for 48±4 hrs. 	<ul style="list-style-type: none"> * No remarkable damage. * Cap change: X7R, X5R: within ±7.5% Y5V: within ±20% * Q/D.F., I.R. and dielectric strength: To meet initial requirements. * 25% max. leaching on each edge. 															
11.	Temperature Cycle	<ul style="list-style-type: none"> * Conduct the five cycles according to the temperatures and time. <table border="1" data-bbox="368 786 852 943"> <thead> <tr> <th>Step</th> <th>Temp. (°C)</th> <th>Time (min.)</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>Min. operating temp. +0/-3</td> <td>30±3</td> </tr> <tr> <td>2</td> <td>Room temp.</td> <td>2~3</td> </tr> <tr> <td>3</td> <td>Max. operating temp. +3/-0</td> <td>30±3</td> </tr> <tr> <td>4</td> <td>Room temp.</td> <td>2~3</td> </tr> </tbody> </table> <ul style="list-style-type: none"> * Before initial measurement (Class II only): Perform 150+0/-10°C for 1 hr and then set for 48±4 hrs at room temp. * Measurement to be made after keeping at room temp. for 48±4 hrs. 	Step	Temp. (°C)	Time (min.)	1	Min. operating temp. +0/-3	30±3	2	Room temp.	2~3	3	Max. operating temp. +3/-0	30±3	4	Room temp.	2~3	<ul style="list-style-type: none"> No remarkable damage. Cap change : X7R, X5R: within ±15% Y5V: within ±20% * Q/D.F., I.R. and dielectric strength: To meet initial requirements.
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12.	Humidity (Damp Heat) Steady State	* Test temp.: 40±2°C * Humidity: 90~95% RH * Test time: 500+24/-0hrs. * Measurement to be made after keeping at room temp. for 48±4 hrs.	* No remarkable damage. * Cap change: X7R, X5R: ≥10V, within ±15%; 6.3V, within ±25% Y5V: ≥10V, within ±30%; 6.3V, within +30/-40% * Q/D.F. value: X7R, X5R: <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th>Rated vol</th> <th>D.F.</th> <th colspan="2">Exception of D.F.</th> </tr> </thead> <tbody> <tr> <td>≥50V</td> <td>≤3.0%</td> <td>≤6.0%</td> <td>0603≥0.047μF; 0805≥0.18μF; 1206≥0.47μF</td> </tr> <tr> <td rowspan="3">25V</td> <td rowspan="3">≤5.0%</td> <td>≤10.0%</td> <td>0805≥1μF; 1210≥10μF;</td> </tr> <tr> <td>≤14.0%</td> <td>0603≥0.33 μF;0805≥2.2μF; 1206≥4.7uF</td> </tr> <tr> <td>≤15.0%</td> <td>0402≥0.10μF; 0603≥0.47μF; 0805≥4.7μF; 1206≥6.8μF</td> </tr> <tr> <td rowspan="2">16V</td> <td rowspan="2">≤5.0%</td> <td>≤10.0%</td> <td>0603≥0.15μF; 0805≥0.68μF; 1206≥2.2μF; 1210≥4.7μF</td> </tr> <tr> <td>≤15.0%</td> <td>0402≥0.033μF; 0603≥0.68μF; 0805≥2.2uF; 1206≥6.8uF; 1210≥22uF</td> </tr> <tr> <td rowspan="2">10V</td> <td rowspan="2">≤7.5%</td> <td>≤15.0%</td> <td>0402≥0.33μF; 0603≥0.33μF; 0805≥2.2μF; 1206≥2.2μF; 1210≥22μF</td> </tr> <tr> <td>≤20.0%</td> <td>0402≥1μF</td> </tr> <tr> <td>6.3V</td> <td>≤15.0%</td> <td>≤30.0%</td> <td>0402≥2.2uF;0603≥10μ;0805≥10μF 1210≥100μF</td> </tr> </tbody> </table> Y5V: <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th>Rated vol.</th> <th>D.F.</th> <th colspan="2">Exception of D.F.</th> </tr> </thead> <tbody> <tr> <td>≥50V</td> <td>≤7.5%</td> <td>≤10.0%</td> <td>0603≥0.1uF;0805≥0.47uF</td> </tr> <tr> <td>35V</td> <td>≤10.0%</td> <td>---</td> <td>---</td> </tr> <tr> <td rowspan="2">25V</td> <td rowspan="2">≤7.5%</td> <td>≤10.0%</td> <td>0402≥0.047uF;0603≥0.1μF; 0805≥0.33μF;1206≥1μF; 1210≥4.7μF</td> </tr> <tr> <td>≤15.0%</td> <td>0402≥0.068μF; 0603≥0.47μF 1206≥4.7uF;1210≥22μF</td> </tr> <tr> <td rowspan="2">16V (C<1.0μF)</td> <td rowspan="2">≤10.0%</td> <td>≤12.5%</td> <td>0402≥0.068μF; 0603≥0.68μF</td> </tr> <tr> <td>≤20.0%</td> <td>0402≥0.22μF</td> </tr> <tr> <td>16V (C≥1.0μF)</td> <td>≤12.5%</td> <td>≤20.0%</td> <td>0805≥3.3μF; 1206≥10μF; 1210≥22μF; 1812≥47μF</td> </tr> <tr> <td>10V</td> <td>≤20.0%</td> <td>---</td> <td>---</td> </tr> <tr> <td>6.3V</td> <td>≤30.0%</td> <td>---</td> <td>---</td> </tr> </tbody> </table> * I.R.: ≥10V, ≥1GΩ or RxC≥50Ω-F whichever is smaller. 6.3V, RxC≥10Ω-F	Rated vol	D.F.	Exception of D.F.		≥50V	≤3.0%	≤6.0%	0603≥0.047μF; 0805≥0.18μF; 1206≥0.47μF	25V	≤5.0%	≤10.0%	0805≥1μF; 1210≥10μF;	≤14.0%	0603≥0.33 μF;0805≥2.2μF; 1206≥4.7uF	≤15.0%	0402≥0.10μF; 0603≥0.47μF; 0805≥4.7μF; 1206≥6.8μF	16V	≤5.0%	≤10.0%	0603≥0.15μF; 0805≥0.68μF; 1206≥2.2μF; 1210≥4.7μF	≤15.0%	0402≥0.033μF; 0603≥0.68μF; 0805≥2.2uF; 1206≥6.8uF; 1210≥22uF	10V	≤7.5%	≤15.0%	0402≥0.33μF; 0603≥0.33μF; 0805≥2.2μF; 1206≥2.2μF; 1210≥22μF	≤20.0%	0402≥1μF	6.3V	≤15.0%	≤30.0%	0402≥2.2uF;0603≥10μ;0805≥10μF 1210≥100μF	Rated vol.	D.F.	Exception of D.F.		≥50V	≤7.5%	≤10.0%	0603≥0.1uF;0805≥0.47uF	35V	≤10.0%	---	---	25V	≤7.5%	≤10.0%	0402≥0.047uF;0603≥0.1μF; 0805≥0.33μF;1206≥1μF; 1210≥4.7μF	≤15.0%	0402≥0.068μF; 0603≥0.47μF 1206≥4.7uF;1210≥22μF	16V (C<1.0μF)	≤10.0%	≤12.5%	0402≥0.068μF; 0603≥0.68μF	≤20.0%	0402≥0.22μF	16V (C≥1.0μF)	≤12.5%	≤20.0%	0805≥3.3μF; 1206≥10μF; 1210≥22μF; 1812≥47μF	10V	≤20.0%	---	---	6.3V	≤30.0%	---	---
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13.	High Temperature Load (Endurance)	* Test temp.: X7R: 125±3°C X5R, Y5V: 85±3°C * To apply voltage: 200% of rated voltage. Exception item:	* No remarkable damage. * Cap change: X7R, X5R: ≥10V, within ±15%; 6.3V, within ±25% Y5V: ≥10V, within ±30%; 6.3V, within +30/-40% * Q/D.F. value: X7R, X5R:																																								
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