

# General Purpose Multilayer Ceramic Chip Capacitors

## 1. INTRODUCTION

General Purpose Multilayer capacitors supplied in bulk or tape & reel package are ideally suitable for thick-film hybrid circuits and automatic surface mounting on any printed circuit boards.

The nickel-barrier terminations are consisted of a nickel barrier layer over the silver metallization and then finished by electroplated solder layer to ensure the terminations have good solder ability. The nickel barrier layer in terminations prevents the dissolution of termination when extended immersion in molten solder at elevated solder temperature.

## 2. FEATURES

- a. A wide selection of sizes in available (0201 to 2225)
- b. High capacitance in given case size
- c. Capacitor with lead-free termination (pure Tin).

## 3. APPLICATIONS

- a. For general digital circuit
- b. For power supply bypass capacitors.
- c. For consumer electronics.
- d. For telecommunication.
- e. DC to DC converter

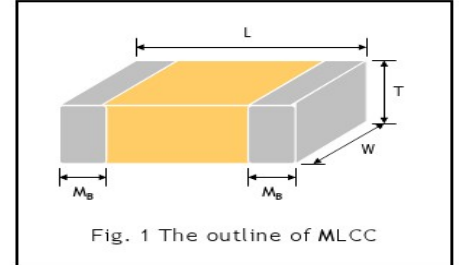
## 4.HOW TO ORDER

COG	1206	100	J	1H	N	R
<u>DIELECTRIC</u>	<u>SIZE</u>	<u>CAPACITANCE</u>	<u>TOLERANCE</u>	<u>RATED</u>	<u>TERMINATION</u>	<u>PACKING CODE</u>
NPO=COG	0201	1PF = 1R0	B=±0.1pF	<u>VOLTAGE</u>	<u>CODE</u>	B=BULK
X7R = BX	0402	1.5PF = 1R5	C=±0.25pF	1A=6.3V	N=NICKEL	R=TAPED ON REEL
X5R = X5R	0603	2.2PF =2R2	D=±0.5pF	1B=10V	BARRIER	
Y5V = Y5V	0805	100PF=101	F=±1%	1C=16V		
	1206	120PF=121	G=±2%	1E=25V		
	1210	10nF=103	J=±5%	1H=50V		
	1808	100nF= 104	K=±10%			
	1812		M=±20%			
	2220		Z=-20~+80%			
	2225					

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## 5. EXTERNAL DIMENSIONS

Size	L (mm)	W (mm)	Tmax (mm)	M <sub>B</sub> min (mm)
0201 (0603)	0.60±0.03	0.30±0.03	0.55	0.10
0402 (1005)	1.00±0.05	0.50±0.05	0.55	0.15
0603 (1608)	1.60±0.15	0.80±0.15	0.95	0.20
0805 (2012)	2.00±0.20	1.25±0.20	1.45	0.30
1206 (3216)	3.20±0.20	1.60±0.20	1.80	0.30
	3.20+0.3/-0.1	1.60+0.3/0.1	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	3.00	0.30
2220 (5750)	5.70±0.40	5.00±0.40	3.00	0.30
2225 (5763)	5.70±0.40	6.30±0.40	3.00	0.30



## 6. GENERAL ELECTRICAL DATA

Dielectric	C0G(NP0)	X7R	Y5V	X5R
Size	0201, 0402, 0603, 0805, 1206, 1210, 1812, 1825, 2220, 2225	0201, 0402, 0603, 0805, 1206, 1210, 1808, 1812, 1825, 2220, 2225	0402, 0603, 0805, 1206, 1210, 1812	0201, 0402, 0603,
Capacitance range*	0.1pF to 150nF	100pF to 820nF	10nF to 820nF	100pF to 1000nF
Capacitance tolerance	Cap≤5pF: B (±0.1pF), C (±0.25pF) 5pF<Cap<10pF: C (±0.25pF), D (±0.5pF) Cap≥10pF: F (±1%), G (±2%), J (±5%), K (±10%)	J (±5%), K (±10%), M (±20%)	M (±20%), Z (-20/+80%)	J (±5%), K (±10%), M (±20%)
Rated voltage (WVDC)	10V, 16V, 25V, 50V	10V, 16V, 25V, 50V	6.3V, 10V, 16V, 25V, 50V	10V, 16V, 25V, 50V
Tan δ*	Cap<30pF: Q≥400+20C Cap≥30pF: Q≥1000	Note 1		
Insulation resistance at Ur	≥10GΩ	≥10GΩ or RxC≥100QxF whichever is less		
Operating temperature	-55 to +125°C		-25 to +85°C	-55 to +85°C
Capacitance characteristic	±30ppm	±15%	+30/-80%	±15%
Termination	Cu (or Ag)/Ni/Sn (lead-free termination)			

\* Measured at the condition of 30~70% related humidity.

C0G(NP0): Apply 1.0±0.2Vrms, 1.0MHz±10% for Cap≤1000pF and 1.0±0.2Vrms, 1.0kHz±10% for Cap>1000pF, 25°C at ambient temperature

X7R: Apply 1.0±0.2Vrms, 1.0kHz±10%, at 25°C ambient temperature. Y5V: Apply 1.0±0.2Vrms, 1.0kHz±10%, at 20°C ambient temperature.

Note 1: X7R/X5R

Rated vol.	D.F.	Exception of D.F.	
≥50V	≤2.5%	≤3%	0603≥0.047μF; 0805≥0.18μF, 1206≥0.47μF
25V	≤3.5%	≤5%	0805≥1μF; 1210≥10μF
		≤7%	0603≥0.33μF
16V	≤3.5%	≤5%	0402≥0.033μF; 0603≥0.15μF; 0805≥0.68μF; 1206≥2.2μF
		≤10%	1210≥22μF; 0603≥0.68μF
10V	≤5.0%	≤10%	0603≥1μF; 0805≥2.2μF

Y5V

Rated vol.	D.F.	Exception of D.F.	
≥50V	≤5.0%	7.0%	0603≥0.1μF; 0805≥0.47μF
25V	≤5.0%	≤7%	0402≥0.047μF; 0603≥0.1μF; 0805≥0.33μF; 1206≥1μF
		≤9%	0402≥0.068μF; 0603≥0.47μF
16V (C<1.0μF)	≤7.0%	≤9%	0402≥0.068μF; 0603≥0.68μF
16V (C≥1.0μF)	≤9.0%	≤12.5%	0805≥4.7μF; 1206≥10μF; 1210≥22μF; 1812≥47μF
10V	≤12.5%	---	---

# General Purpose Multilayer Ceramic Chip Capacitors

## CAPACITANCE RANGE (NPO Dielectric)

### 7-1. 0201 ~ 2225 Sizes

Dimension	0201			0402			0603				0805				1206				1210				1812				1825	2220	2225
	Cap (pF)	code	10V	25V	50V	10V	16V	25V	50V	10V	16V	25V	50V	10V	16V	25V	50V	10V	16V	25V	50V	10V	16V	25V	50V	50V	50V	50V	
0.5	0R5																												
1.0	1R0																												
1.2	1R2																												
1.5	1R5																												
1.8	1R8																												
2.2	2R2																												
2.7	2R7																												
3.3	3R3																												
3.9	3R9																												
4.7	4R7																												
5.6	5R6																												
6.8	6R8																												
8.2	8R2																												
10	100																												
12	120																												
15	150																												
18	180																												
22	220																												
27	270																												
33	330																												
39	390																												
47	470																												
56	560																												
68	680																												
82	820																												
100	101																												
120	121																												
150	151																												
180	181																												
220	221																												
270	271																												
330	331																												
390	391																												
470	471																												
560	561																												
680	681																												
750	751																												
820	821																												
1000	102																												
1200	122																												
1500	152																												
1800	182																												
2200	222																												
2700	272																												
3300	332																												
3900	392																												
4700	472																												
5600	562																												
6800	682																												
8200	822																												
10000	103																												
12000	123																												
15000	153																												
18000	183																												
22000	223																												
27000	273																												
33000	333																												
39000	393																												
47000	473																												
56000	563																												
68000	683																												
82000	823																												
100000	104																												
120000	124																												
150000	154																												

# General Purpose Multilayer Ceramic Chip Capacitors

## CAPACITANCE RANGE (X7R Dielectric)

### 7-2. X7R 0201 ~ 2225 Sizes

Dimension		0402	0603					0805					1206						1210						
Cap(μF)	code	6.3V	6.3V	10V	16V	25V	50V	6.3V	10V	16V	25V	50V	6.3V	10V	16V	25V	50V	100V	6.3V	10V	16V	25V	35V	50V	100V
1.0	105																								
1.5	155																								
1.8	185																								
2.2	225																								
2.7	275																								
3.3	335																								
4.7	475																								
6.8	685																								
10.0	106																								
22.0	226																								
47.0	476																								

Dimension		1808		1812						1825				
Cap(μF)	code	50V	100V	10V	16V	25V	50V	100V	200V	250V	50V	100V	200V	250V
1.0	105													
1.2	125													
1.5	155													
1.8	185													
2.2	225													
2.7	275													
3.3	335													
4.7	475													
5.6	565													
6.8	685													
8.2	825													
10.0	106													

Dimension		2220					2225						
Cap(μF)	code	50V	100V	200V	250V	500V	630V	50V	100V	200V	250V	500V	630V
1.0	105												
1.2	125												
1.5	155												
1.8	185												
2.2	225												
2.7	275												
3.3	335												
3.9	395												
4.7	475												
5.6	565												
6.8	685												
8.2	825												
10.0	106												

# General Purpose Multilayer Ceramic Chip Capacitors

## 7-3 X5R 0201 ~ 1210 Series

Dimension		0201		0402				0603				0805					1206					1210									
Cap( $\mu$ F)	code	6.3V	10V	6.3V	10V	16V	25V	6.3V	10V	16V	25V	50V	4V	6.3V	10V	16V	25V	50V	6.3V	10V	16V	25V	50V	4V	6.3V	10V	16V	25V	35V	50V	
1.0	105																														
1.2	125																														
1.5	155																														
1.8	185																														
2.2	225																														
2.7	275																														
3.3	335																														
3.9	395																														
4.7	475																														
5.6	565																														
6.8	685																														
8.2	825																														
10.0	106																														
22.0	226																														
47.0	476																														
100.0	107																														
220.0	227																														

# General Purpose Multilayer Ceramic Chip Capacitors

## 7. CAPACITANCE RANGE (Y5V Dielectric)

7-3 Y5V 0402, 0603, 0805, 1206, 1210, 1812 Series

Dimension		0402				0603					0805			
Cap (nF)	Code	10	16	25	50	6.3	10	16	25	50	10	16	25	50
10	103													
15	153													
22	223													
33	333													
47	473													
68	683													
100	104													
150	154													
220	224													
330	334													
470	474													
680	684													

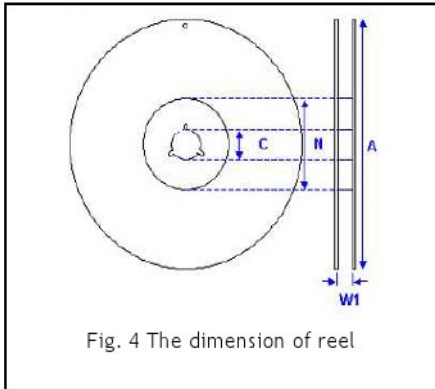
Dimension		1206				1210				1812			
Cap (nF)	Code	10	16	25	50	10	16	25	50	10	16	25	50
10	103												
15	153												
22	223												
33	333												
47	473												
68	683												
100	104												
150	154												
220	224												
330	334												
470	474												
680	684												



# General Purpose Multilayer Ceramic Chip Capacitors

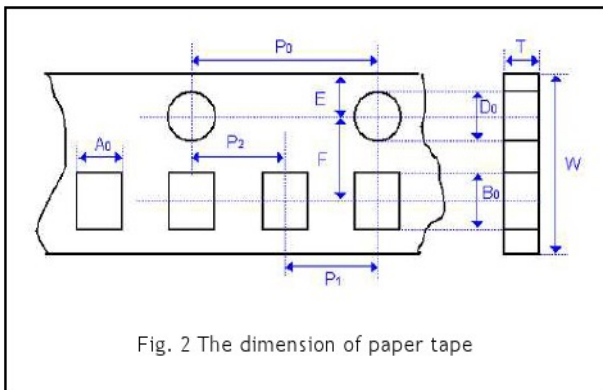
## 8. Package Dimension And Quantity

Size	Thickness (mm)	Paper tape		Plastic tape	
		7" reel	13" reel	7" reel	13" reel
0201 (0603)	0.30±0.05	15k	70K	-	-
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)	0.60±0.10	4k	15k	-	-
	0.80±0.10	4k	15k	-	-
	1.25±0.10	-	-	3k	10k
1206 (3216)	1.25±0.20	-	-	3k	-
	0.80±0.10	4k	15k	-	-
	0.95±0.10	-	-	3k	10k
	1.25±0.10	-	-	3k	10k
1210 (3225)	1.60±0.20	-	-	2k	-
	0.95±0.10	-	-	3k	10k
	1.25±0.10	-	-	3k	10k
1808 (4520)	1.60±0.20	-	-	2k	-
	2.00±0.20	-	-	1k	-
	1.25±0.10	-	-	1k	-
1812 (4532)	1.60±0.20	-	-	1k	-
	2.00±0.20	-	-	1k	-
	2.50±0.30	-	-	0.5k	-
	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	-
	2.00±0.20	-	-	1k	-
2225 (5763)	2.00±0.20	-	-	1k	-
	2.50±0.30	-	-	0.5k	-

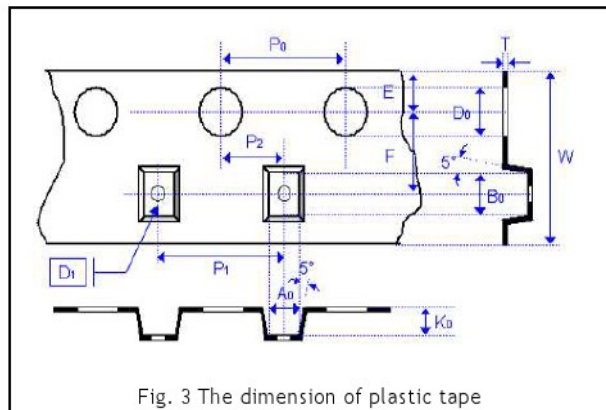


Size	0201, 0402, 0603, 0805, 1206, 1210			1812, 1825, 2220, 2225
Reel size	7"	10"	13"	7"
C	13.0+0.5/-0.2	13.0+0.5/-0.2	13.0+0.5/-0.2	13.0+0.5/-0.2
W <sub>1</sub>	8.4+1.5/-0	8.4+1.5/-0	8.4+1.5/-0	12.4+2.0/-0
A	178.0±0.10	250.0±1.0	330.0±1.0	178.0±0.10
N	60.0+1.0/-0	100.0±1.0	100±1.0	80.0±1.0

### 11-1. CARDBOARD TAPE DIMENSIONS



### 11-2. EMBOSSED TAPE DIMENSIONS



# General Purpose Multilayer Ceramic Chip Capacitors

## 8. Package Dimension And Quantity

Size	0201	0402	0603		0805			1206			1210	
Chip Thickness	0.30 ± 0.03	0.50±0.05	0.80±0.07	0.80 +0.15/-0.10	0.60±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 <sub>0</sub>	0.38±0.05	0.62±0.05	1.00 +0.05/-0.10	1.02 +0.05/-0.10	1.50±0.10	1.50±0.10	<1.65	2.00±0.10	<2.00	<2.00	<3.05	<3.10
B <sub>0</sub>	0.68±0.05	1.12±0.05	1.80±0.10	1.80±0.10	2.30±0.10	2.30±0.10	<2.40	3.50±0.10	<3.60	<3.70	<3.80	<4.00
T	0.42±0.05	0.60±0.05	0.95±0.05	0.97±0.05	0.75±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 <sub>0</sub>	-	-	-	-			<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	8.00±0.10	8.00±0.10
P <sub>0</sub>	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	4.00±0.10	4.00±0.10
10xP <sub>0</sub>	40.0±0.10	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	40.00±0.20	40.0±0.10
P <sub>1</sub>	2.00±0.05	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	4.00±0.10
P <sub>2</sub>	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	2.00±0.05	2.00±0.05
D <sub>0</sub>	1.55±0.05	1.55±0.05	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 <sub>1</sub>	-	-	-	-			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±0.05	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	3.50±0.05	3.50±0.05

Size	1808		1812		1825		2220		2225	
Chip Thickness	1.25±0.10 1.60±0.20	2.00±0.20	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	1.40±0.15 1.60±0.20 2.00±0.20	2.50±0.30	2.00±0.20	2.50±0.30
A <sub>0</sub>	<2.50	<2.50	<3.90	<3.90	<6.80	<6.80	<5.80	<5.80	<6.80	<6.80
B <sub>0</sub>	<5.30	<5.30	<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	0.25±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 <sub>0</sub>	<2.50	<2.50	<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	12.0±0.20	12.0±0.20
P <sub>0</sub>	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
10xP <sub>0</sub>	40.0±0.20	40.0±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
P <sub>1</sub>	4.00±0.10	4.00±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 <sub>2</sub>	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 <sub>0</sub>	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	1.50+0.10/-0	1.50+0.10/-0
D <sub>1</sub>	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	1.50±0.10	1.50±0.10
E	1.75±0.10	1.75±0.10	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	5.50±0.05	5.50±0.05



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## 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 0603, 0805 and 1206, within 50°C of the soldering temperature for bigger chips such as 1210, 1808,1812,1825,2220 and 2225, etc.

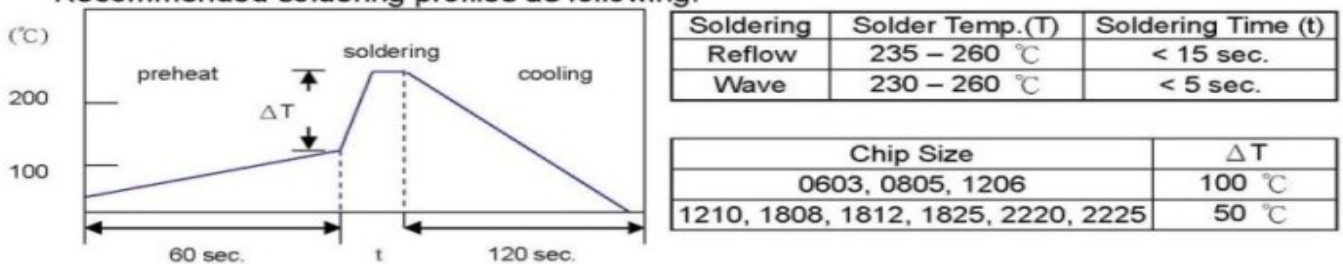
### SOLDERING

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 1.2mm 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, 1808,1812,2220 and 2225, etc. wave soldering and hand soldering are not recommended.

Recommended soldering profiles as following:



### 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

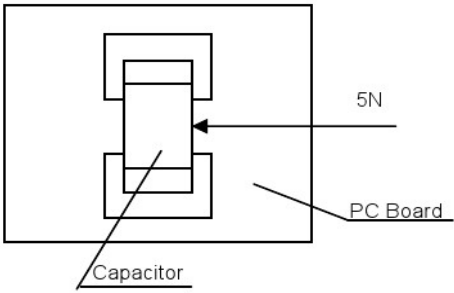
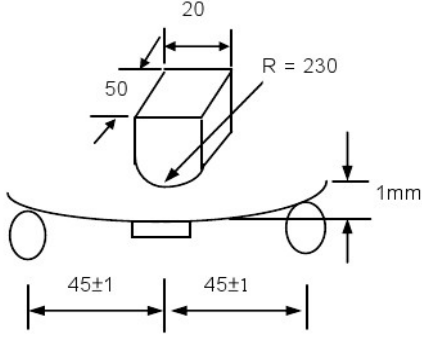
All flux residues must be removed by using suitable electronic-grade vapor-cleaning solvents to eliminate contamination that could cause electrolytic surface corrosion. Good results can be obtained by using ultrasonic cleaning of the solvent. The choice of the proper system is depends upon many factors 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.

# General Purpose Multilayer Ceramic Chip Capacitors

## 10. RELIABILITY TEST CONDITIONS AND REQUIREMENTS

No.	Item	Test Condition	Requirements																																																																		
1.	<b>Visual and Dimensions</b>	---	<ul style="list-style-type: none"> <li>* No remarkable defect.</li> <li>* Dimensions to confirm to individual specification sheet.</li> </ul>																																																																		
2.	<b>Capacitance</b>	Class I: NP0 Cap≤1000pF 1.0±0.2Vrms, 1MHz±10% Cap>1000pF 1.0±0.2Vrms, 1KHz±10%	* Shall not exceed the limits given in the detailed spec. NP0: Cap≥30pF, Q≥1000; Cap<30pF, Q≥400+20C																																																																		
3.	<b>Q/ D.F. (Dissipation Factor)</b>	Class II: X7R, X7E, X5R, Y5V Cap≤10μF, 1.0±0.2Vrms, 1kHz±10% ** Cap>10μF, 0.5±0.2Vrms, 120Hz±20%  ** Test condition: 0.5±0.2Vrms · 1KHz±10% X7R: 0603 ≥ 225(10V), 0805 = 106(6.3V&10V) X5R: 01R5 ≥ 103, 0201 ≥ 224 (6.3V), 0402 ≥ 475 (6.3V), 0402 ≥ 225(10V), 0603 = 106 (6.3V), 0603 ≥ 475(10V)	NP0: Cap≥30pF, Q≥1000; Cap<30pF, Q≥400+20C X7R, X5R: <table border="1"> <thead> <tr> <th>Rated vol.</th> <th>X7R D.F. ≤</th> <th>X5R D.F. ≤</th> <th>Exception of D.F. ≤</th> </tr> </thead> <tbody> <tr> <td rowspan="3">≥ 50V</td> <td rowspan="3">2.5%</td> <td rowspan="3">3%</td> <td>≤ 3% 0201(50V); 0603 ≥ 0.047μF; 0805 ≥ 0.18μF; 1206 ≥ 0.47μF</td> </tr> <tr> <td>≤ 5% 1210 ≥ 4.7μF</td> </tr> <tr> <td>≤ 10% 0603 ≥ 1μF; 0805 ≥ 1μF; 1206 ≥ 4.7μF; 1210 ≥ 10μF</td> </tr> <tr> <td>35V</td> <td>3.5%</td> <td>3.5%</td> <td>≤ 10% 0805 ≥ 2.2μF; 1210 ≥ 10μF</td> </tr> <tr> <td rowspan="3">25V</td> <td rowspan="3">3.5%</td> <td rowspan="3">3.5%</td> <td>≤ 5% 0201 ≥ 0.01μF; 0805 ≥ 1μF; 1210 ≥ 10μF</td> </tr> <tr> <td>≤ 7% 0603 ≥ 0.33μF; 1206 ≥ 4.7μF</td> </tr> <tr> <td>≤ 10% 0402 ≥ 0.10μF; 0603 ≥ 0.47μF; 0805 ≥ 2.2μF; 1206 ≥ 6.8μF; 1210 ≥ 22μF</td> </tr> <tr> <td rowspan="2">16V</td> <td rowspan="2">3.5%</td> <td rowspan="2">3.5%</td> <td>≤ 5% 0201 ≥ 0.01μF; 0402 ≥ 0.033μF; 0805 ≥ 0.68μF; 1206 ≥ 2.2μF; 1210 ≥ 4.7μF</td> </tr> <tr> <td>≤ 10% 0402 ≥ 0.47μF; 0603 ≥ 0.68μF; 0805 ≥ 2.2μF; 1206 ≥ 4.7μF; 1210 ≥ 22μF</td> </tr> <tr> <td rowspan="2">10V</td> <td rowspan="2">5%</td> <td rowspan="2">5%</td> <td>≤ 10% 0402 ≥ 0.33μF; 0603 ≥ 0.33μF; 0805 ≥ 2.2μF; 1206 ≥ 2.2μF; 1210 ≥ 22μF</td> </tr> <tr> <td>≤ 15% 0201 ≥ 0.1μF; 0402 ≥ 1μF</td> </tr> <tr> <td rowspan="2">6.3V</td> <td rowspan="2">10%</td> <td rowspan="2">10%</td> <td>≤ 15% 0201 ≥ 0.1μF; 0402 ≥ 1μF; 0603 ≥ 10μF; 0805 ≥ 4.7μF; 1206 ≥ 47μF; 1210 ≥ 100μF</td> </tr> <tr> <td>≤ 20% 0402 ≥ 2.2μF</td> </tr> <tr> <td>4V</td> <td>15%</td> <td>15%</td> <td>---</td> </tr> </tbody> </table> Y5V: <table border="1"> <thead> <tr> <th>Rated vol.</th> <th>D.F. ≤</th> <th>Exception of D.F. ≤</th> </tr> </thead> <tbody> <tr> <td>≥ 50V</td> <td>5%</td> <td>7% 0603 ≥ 0.1μF; 0805 ≥ 0.47μF; 1206 ≥ 4.7μF</td> </tr> <tr> <td>35V</td> <td>7%</td> <td>---</td> </tr> <tr> <td rowspan="2">25V</td> <td rowspan="2">5%</td> <td>7% 0402 ≥ 0.047μF; 0603 ≥ 0.1μF; 0805 ≥ 0.33μF; 1206 ≥ 1μF; 1210 ≥ 4.7μF</td> </tr> <tr> <td>9% 0402 ≥ 0.068μF; 0603 ≥ 0.47μF; 1206 ≥ 4.7μF; 1210 ≥ 22μF</td> </tr> <tr> <td rowspan="2">16V (C &lt; 1.0μF)</td> <td rowspan="2">7%</td> <td>9% 0402 ≥ 0.068μF; 0603 ≥ 0.68μF</td> </tr> <tr> <td>12.5% 0402 ≥ 0.22μF</td> </tr> <tr> <td rowspan="2">16V (C ≥ 1.0μF)</td> <td rowspan="2">9%</td> <td>12.5% 0603 ≥ 2.2μF; 0805 ≥ 3.3μF; 1206 ≥ 10μF; 1210 ≥ 22μF; 1812 ≥ 47μF</td> </tr> <tr> <td>20% 0402 ≥ 0.47μF</td> </tr> <tr> <td>10V</td> <td>12.5%</td> <td>20%</td> </tr> <tr> <td>6.3V</td> <td>20%</td> <td>---</td> </tr> </tbody> </table>	Rated vol.	X7R D.F. ≤	X5R D.F. ≤	Exception of D.F. ≤	≥ 50V	2.5%	3%	≤ 3% 0201(50V); 0603 ≥ 0.047μF; 0805 ≥ 0.18μF; 1206 ≥ 0.47μF	≤ 5% 1210 ≥ 4.7μF	≤ 10% 0603 ≥ 1μF; 0805 ≥ 1μF; 1206 ≥ 4.7μF; 1210 ≥ 10μF	35V	3.5%	3.5%	≤ 10% 0805 ≥ 2.2μF; 1210 ≥ 10μF	25V	3.5%	3.5%	≤ 5% 0201 ≥ 0.01μF; 0805 ≥ 1μF; 1210 ≥ 10μF	≤ 7% 0603 ≥ 0.33μF; 1206 ≥ 4.7μF	≤ 10% 0402 ≥ 0.10μF; 0603 ≥ 0.47μF; 0805 ≥ 2.2μF; 1206 ≥ 6.8μF; 1210 ≥ 22μF	16V	3.5%	3.5%	≤ 5% 0201 ≥ 0.01μF; 0402 ≥ 0.033μF; 0805 ≥ 0.68μF; 1206 ≥ 2.2μF; 1210 ≥ 4.7μF	≤ 10% 0402 ≥ 0.47μF; 0603 ≥ 0.68μF; 0805 ≥ 2.2μF; 1206 ≥ 4.7μF; 1210 ≥ 22μF	10V	5%	5%	≤ 10% 0402 ≥ 0.33μF; 0603 ≥ 0.33μF; 0805 ≥ 2.2μF; 1206 ≥ 2.2μF; 1210 ≥ 22μF	≤ 15% 0201 ≥ 0.1μF; 0402 ≥ 1μF	6.3V	10%	10%	≤ 15% 0201 ≥ 0.1μF; 0402 ≥ 1μF; 0603 ≥ 10μF; 0805 ≥ 4.7μF; 1206 ≥ 47μF; 1210 ≥ 100μF	≤ 20% 0402 ≥ 2.2μF	4V	15%	15%	---	Rated vol.	D.F. ≤	Exception of D.F. ≤	≥ 50V	5%	7% 0603 ≥ 0.1μF; 0805 ≥ 0.47μF; 1206 ≥ 4.7μF	35V	7%	---	25V	5%	7% 0402 ≥ 0.047μF; 0603 ≥ 0.1μF; 0805 ≥ 0.33μF; 1206 ≥ 1μF; 1210 ≥ 4.7μF	9% 0402 ≥ 0.068μF; 0603 ≥ 0.47μF; 1206 ≥ 4.7μF; 1210 ≥ 22μF	16V (C < 1.0μF)	7%	9% 0402 ≥ 0.068μF; 0603 ≥ 0.68μF	12.5% 0402 ≥ 0.22μF	16V (C ≥ 1.0μF)	9%	12.5% 0603 ≥ 2.2μF; 0805 ≥ 3.3μF; 1206 ≥ 10μF; 1210 ≥ 22μF; 1812 ≥ 47μF	20% 0402 ≥ 0.47μF	10V	12.5%	20%	6.3V	20%	---
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5.	<b>Dielectric Strength</b>	<ul style="list-style-type: none"> <li>* To apply voltage (≤50V) 250%.</li> <li>* Duration: 1 to 5 sec.</li> <li>* Charge and discharge current less than 50mA.</li> </ul>	* No evidence of damage or flash over during test.																																																																		
6.	<b>Insulation Resistance</b>	To apply rated voltage for max. 120 sec.	10GΩ or RxC ≥ 500Ω-F whichever is smaller. Class II (X7R, X5R, Y5V) <table border="1"> <thead> <tr> <th>Rated voltage</th> <th>Insulation Resistance</th> </tr> </thead> <tbody> <tr> <td>100V: X7R</td> <td rowspan="7">10GΩ or RxC ≥ 100 Ω-F whichever is smaller.</td> </tr> <tr> <td>50V: 0603 ≥ 1μF; 0805 ≥ 1μF; 1206 ≥ 4.7μF; 1210 ≥ 4.7μF</td> </tr> <tr> <td>35V: 0805 ≥ 2.2μF; 1210 ≥ 10μF</td> </tr> <tr> <td>25V: 0402 ≥ 1μF; 0603 ≥ 2.2μF; 0805 ≥ 2.2μF; 1206 ≥ 10μF; 1210 ≥ 10μF</td> </tr> <tr> <td>16V: 0402 ≥ 0.22μF; 0603 ≥ 1μF; 0805 ≥ 2.2μF; 1206 ≥ 10μF; 1210 ≥ 47μF</td> </tr> <tr> <td>10V: 0201 ≥ 47nF; 0402 ≥ 0.47μF; 0603 ≥ 0.47μF; 0805 ≥ 2.2μF; 1206 ≥ 4.7μF; 1210 ≥ 47μF</td> </tr> <tr> <td>6.3V : 4V</td> </tr> </tbody> </table>	Rated voltage	Insulation Resistance	100V: X7R	10GΩ or RxC ≥ 100 Ω-F whichever is smaller.	50V: 0603 ≥ 1μF; 0805 ≥ 1μF; 1206 ≥ 4.7μF; 1210 ≥ 4.7μF	35V: 0805 ≥ 2.2μF; 1210 ≥ 10μF	25V: 0402 ≥ 1μF; 0603 ≥ 2.2μF; 0805 ≥ 2.2μF; 1206 ≥ 10μF; 1210 ≥ 10μF	16V: 0402 ≥ 0.22μF; 0603 ≥ 1μF; 0805 ≥ 2.2μF; 1206 ≥ 10μF; 1210 ≥ 47μF	10V: 0201 ≥ 47nF; 0402 ≥ 0.47μF; 0603 ≥ 0.47μF; 0805 ≥ 2.2μF; 1206 ≥ 4.7μF; 1210 ≥ 47μF	6.3V : 4V																																																								
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No.	Item	Test Condition	Requirements															
7.	<b>Adhesive Strength of Termination</b>	<p>* Capacitors mounted on a substrate. A force of 5N(<math>\leq 0603</math>) or 10N(<math>&gt; 0603</math>) applied perpendicular to the place of substrate and parallel the line joining the center of terminations for <math>10 \pm 1</math> second.</p>  <p>* Pressurizing force : 0201 : 2N / 0402 &amp; 0603 : 5N &gt;0603 : 10N * Test time: <math>10 \pm 1</math> sec.</p>	<p>* No remarkable damage or removal of the terminations.</p>															
8.	<b>Vibration Resistance</b>	<p>* Vibration frequency: 10~55 Hz/min. * Total amplitude: 1.5mm * Test time: 6 hrs. (Two hrs each in three mutually perpendicular directions.)</p>	<p>* No remarkable damage. * Cap change and Q/D.F.: To meet initial spec.</p>															
9.	<b>Solderability</b>	<p>* Solder temperature: <math>235 \pm 5^\circ\text{C}</math> for (0201~1210) * Solder temperature: <math>245 \pm 5^\circ\text{C}</math> for (1808~2225) * Dipping time: <math>2 \pm 0.5</math> sec.</p>	<p>75% min. coverage of all metalized area.</p>															
10.	<b>Bending Test</b>	<p>* The middle part of substrate shall be pressurized by means of the pressurizing rod at a rate of about 1mm per second until the deflection becomes 1mm.</p> 	<p>* No remarkable damage. * Cap change: C0G(NPO): within <math>\pm 5.0\%</math> or <math>\pm 0.5\text{pF}</math> whichever is larger. X7R/X5R: within <math>\pm 12.5\%</math> Y5V: within <math>\pm 30\%</math></p> <p>(This capacitance change means the change of capacitance under specified flexure of substrate from the capacitance measured before the test.)</p>															
11.	<b>Resistance to Soldering Heat</b>	<p>* Solder temperature: <math>260 \pm 5^\circ\text{C}</math> * Dipping time: <math>10 \pm 1</math> sec * Preheating: 120 to <math>150^\circ\text{C}</math> for 1 minute before immerse the capacitor in a eutectic solder. * Before initial measurement (Class II only): Perform <math>150 \pm 0/-10^\circ\text{C}</math> for 1 hr and then set for <math>48 \pm 4</math> hrs (Class II only) at room temp. * Measurement to be made after keeping at room temp. for <math>24 \pm 2</math> hrs (Class I) or <math>48 \pm 4</math> hrs (Class II).</p>	<p>* No remarkable damage. * Cap change: NP0: within <math>\pm 2.5\%</math> or <math>\pm 0.25\text{pF}</math> whichever is larger. X7R, X5R: within <math>\pm 7.5\%</math> Y5V: within <math>\pm 20\%</math> * 25% max. leaching on each edge.</p>															
12.	<b>Temperature Cycle</b>	<p>* Conduct the five cycles according to the temperatures and time.</p> <table border="1" data-bbox="295 1780 782 1915"> <thead> <tr> <th>Step</th> <th>Temp. (<math>^\circ\text{C}</math>)</th> <th>Time (min.)</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>Min. operating temp. <math>+0/-3</math></td> <td><math>30 \pm 3</math></td> </tr> <tr> <td>2</td> <td>Room temp.</td> <td>2~3</td> </tr> <tr> <td>3</td> <td>Max. operating temp. <math>+3/-0</math></td> <td><math>30 \pm 3</math></td> </tr> <tr> <td>4</td> <td>Room temp.</td> <td>2~3</td> </tr> </tbody> </table> <p>* Before initial measurement (Class II only): Perform <math>150 \pm 0/-10^\circ\text{C}</math> for 1 hr and then set for <math>48 \pm 4</math> hrs at room temp. * Measurement to be made after keeping at room temp. for <math>24 \pm 2</math> hrs (Class I) or <math>48 \pm 4</math> hrs (Class II).</p>	Step	Temp. ( $^\circ\text{C}$ )	Time (min.)	1	Min. operating temp. $+0/-3$	$30 \pm 3$	2	Room temp.	2~3	3	Max. operating temp. $+3/-0$	$30 \pm 3$	4	Room temp.	2~3	<p>No remarkable damage. * Cap change : NP0: within <math>\pm 2.5\%</math> or <math>\pm 0.25\text{pF}</math> whichever is larger. X7R, X5R: within <math>\pm 7.5\%</math> Y5V: within <math>\pm 20\%</math> * Q/D.F. <math>\leq</math> initial requirement * I.R. <math>\geq 0.25 \times</math> initial requirements.</p>
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No.	Item	Test Condition	Requirements																																																																																														
13.	<b>Humidity (Damp Heat) Steady State</b>	* Test temp.: 40±2°C * Humidity: 90~95% RH * Test time: 500+24/-0hrs. * Measurement to be made after keeping at room temp. for 24±2 hrs. (Class I) or 48±4 hrs. (Class II).	* No remarkable damage. * Cap change: NP0: within ±5% or 0.5pF whichever is larger X7R, X7E, X5R: ≥10V**, within ±12.5%; 6.3V within ±25%; TT series & C ≥ 1μF, within ±25% **10V: 0603 ≥ 4.7μF; 0402 ≥ 1μF; 0201 ≥ 0.1μF, within ±25%; Y5V: ≥10V, within ±30%; 6.3V, within +30/-40% * Q/D.F. value: NP0: More than 30pF Q ≥ 350, 10pF ≤ C ≤ 30pF, Q ≥ 275+2.5C Less than 10pF Q ≥ 200+10C 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 rowspan="3">≥ 50V</td> <td rowspan="3">3%</td> <td>6%</td> <td>0201(50V); 0603 ≥ 0.047μF; 0805 ≥ 0.18μF; 1206 ≥ 0.47μF</td> </tr> <tr> <td>10%</td> <td>1210 ≥ 4.7μF</td> </tr> <tr> <td>20%</td> <td>0603 ≥ 1μF; 0805 ≥ 1μF; 1206 ≥ 4.7μF; 1210 ≥ 10μF</td> </tr> <tr> <td rowspan="2">35V</td> <td rowspan="2">5%</td> <td>20%</td> <td>0805 ≥ 2.2μF; 1210 ≥ 10μF</td> </tr> <tr> <td>10%</td> <td>0201 ≥ 0.01μF; 0805 ≥ 1μF; 1210 ≥ 10μF</td> </tr> <tr> <td rowspan="3">25V</td> <td rowspan="3">5%</td> <td>14%</td> <td>0603 ≥ 0.33μF; 1206 ≥ 4.7μF</td> </tr> <tr> <td>15%</td> <td>0402 ≥ 0.10μF; 0603 ≥ 0.47μF; 0805 ≥ 2.2μF; 1206 ≥ 6.8μF; 1210 ≥ 22μF</td> </tr> <tr> <td>10%</td> <td>0603 ≥ 0.15μF; 0805 ≥ 0.68μF; 1206 ≥ 2.2μF; 1210 ≥ 4.7μF</td> </tr> <tr> <td rowspan="2">16V</td> <td rowspan="2">5%</td> <td>10%</td> <td>0201 ≥ 0.01μF; 0402 ≥ 0.033μF; 0603 ≥ 0.68μF; 0805 ≥ 2.2μF; 1206 ≥ 4.7μF; 1210 ≥ 22μF</td> </tr> <tr> <td>15%</td> <td>0402 ≥ 0.33μF; 0603 ≥ 0.33μF; 0805 ≥ 2.2μF; 1206 ≥ 2.2μF; 1210 ≥ 22μF</td> </tr> <tr> <td rowspan="2">10V</td> <td rowspan="2">7.5%</td> <td>15%</td> <td>0402 ≥ 0.33μF; 0603 ≥ 0.33μF; 0805 ≥ 2.2μF; 1206 ≥ 2.2μF; 1210 ≥ 22μF</td> </tr> <tr> <td>20%</td> <td>0201 ≥ 0.1μF; 0402 ≥ 1μF</td> </tr> <tr> <td>6.3V</td> <td>15%</td> <td>30%</td> <td>0201 ≥ 0.1μF; 0402 ≥ 1μF; 0603 ≥ 10μF; 0805 ≥ 4.7μF; 1206 ≥ 4.7μF; 1210 ≥ 100μF</td> </tr> <tr> <td>4V</td> <td>20%</td> <td>---</td> <td>---</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>≥ 50V</td> <td>7.5%</td> <td>10%</td> <td>0603 ≥ 0.1μF; 0805 ≥ 0.47μF; 1206 ≥ 4.7μF</td> </tr> <tr> <td>35V</td> <td>10%</td> <td>---</td> <td>---</td> </tr> <tr> <td rowspan="2">25V</td> <td rowspan="2">7.5%</td> <td>10%</td> <td>0402 ≥ 0.047μF; 0603 ≥ 0.1μF; 0805 ≥ 0.33μF; 1206 ≥ 1μF; 1210 ≥ 4.7μF</td> </tr> <tr> <td>15%</td> <td>0402 ≥ 0.068μF; 0603 ≥ 0.47μF; 1206 ≥ 4.7μF; 1210 ≥ 22μF</td> </tr> <tr> <td rowspan="2">16V (C &lt; 1.0μF)</td> <td rowspan="2">10%</td> <td>12.5%</td> <td>0402 ≥ 0.068μF; 0603 ≥ 0.68μF</td> </tr> <tr> <td>20%</td> <td>0402 ≥ 0.22μF</td> </tr> <tr> <td rowspan="2">16V (C ≥ 1.0μF)</td> <td rowspan="2">12.5%</td> <td>20%</td> <td>0603 ≥ 2.2μF; 0805 ≥ 3.3μF; 1206 ≥ 10μF; 1210 ≥ 22μF; 1812 ≥ 47μF</td> </tr> <tr> <td>30%</td> <td>0402 ≥ 0.47μF</td> </tr> <tr> <td>10V</td> <td>20%</td> <td>30%</td> <td>0402 ≥ 0.47μF</td> </tr> <tr> <td>6.3V</td> <td>30%</td> <td>---</td> <td>---</td> </tr> </tbody> </table> *I.R.: ≥10V, 1GΩ or 50 Ω-F whichever is smaller. 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