

General Purpose Multilayer Ceramic Chip Capacitors

AFN Category

1. Introduction:

AFN series capacitors are designed, manufactured, and screened to ensure the high level of product quality, and are intended to deliver unsurpassed performance related to precision, stability and reliability. The nickel barrier layer in terminations prevents the dissolution of termination when extended immersion in molten solder at elevated solder temperature. AFN series is Lead & Halogen Free and RoHS Compliant by using environmental friendly material without Pb or Cd.

2. Features:

- A wide selection of sizes is available (0201 to 2225)
- High capacitance in given case size
- Capacitor with lead-free termination (pure Tin)
- RoHS & HALOGEN compliant

3. Applications:

- For general digital circuit
- For power supply bypass capacitors
- For consumer electronics
- For telecommunication.
- DC to DC converter

4. Production Identification:

AFN	0603	N	R47	J	250	P	I	C
Product Category Code	Size	Dielectric	Capacitance	Tolerance	Rated Voltage	Packaging	Thickness	Control Code
Table 1	Table 2	Table 3	Table 4	Table 5	Table 6	Table 7	Table 8	Table 9

Table 1 Production Identification	
Code	Description
AFN	General purpose product at rated voltage below 50Vdc

Table 2 Size, Inch (mm)		
Description	Description	Description
01R5 (0402)	1206 (3216)	2211 (5728)
0201 (0603)	1210 (3225)	2220 (5750)
0402 (1005)	1808 (4520)	2225 (5763)
0603 (1608)	1812 (4532)	
0805 (2012)	1825 (4563)	

Table 3 Dielectric Material Characteristics			
Code	Description	Code	Description
N	COG	X	X7R
S	X6S	B	X5R
A	X7S		

Table 4 Capacitance Rule Code			
Code	Description	Code	Description
R47	0.47pF	102	102=10x10 ² =1000pF
OR5	0.5pF	104	104=10x10 ⁴ =100nF
100	100=10x10 ⁰ =10pF	106	106=10x10 ⁶ =10μF

Table 5 Capacitance Tolerance					
Code	Tolerance	Code	Tolerance	Code	Tolerance
A	±0.05 pF	I	-10% ~ 0%	Q	±0.03 pF
B	±0.10 pF	J	±5 %	Z	-20% ~ +80%
C	±0.25 pF	K	±10 %	X	+10%~+20%
D	±0.50 pF	L	0% ~ +10%		
F	±1 %	M	±20 %		
G	±2 %	N	-5% ~ +10%		
H	±3 %	P	±0.02 pF		

Table 6 Rated Voltage			
Code	Voltage	Code	Voltage
4R0	4.0Vdc	100	10Vdc
250	25Vdc	6R3	6.3Vdc
160	16Vdc	500	50Vdc

Table 7 Packaging Type			
Code	Package Description	Code	Package Description
B	Bulk	T	Tray package
E	Tape and 7" Reel, Embossed Tape	P	Tape and 7" Reel, Paper Tape
K	Tape and 10" Reel, Embossed Tape	D	Tape and 10" Reel, Paper Tape
L	Tape and 13" Reel, Embossed Tape	G	Tape and 13" Reel, Paper Tape

Table 8 Thickness Code					
Code	Thickness, mm	Code	Thickness, mm	Code	Thickness, mm
A	0.60 ± 0.10	J	1.15 ± 0.15	S	0.80 ± 0.07
B	0.8 + 0.15/-0.10	K	0.50 ± 0.20	T	0.85 ± 0.10
C	1.25 ± 0.10	L	0.30 ± 0.03	U	0.50 ± 0.10
D	1.40 ± 0.15	M	0.95 ± 0.10	V	0.20 ± 0.02
E	1.60 ± 0.20	N	0.50 ± 0.05	X	0.80 ± 0.10
F	2.00 ± 0.20	O	3.50 ± 0.20	Z	0.25 ± 0.03
G	2.50 ± 0.30	P	1.60 +0.3/-0.10		
H	2.80 ± 0.30	Q	0.50+0.02/-0.05		
I	1.25 ± 0.20	R	3.10 ± 0.30		

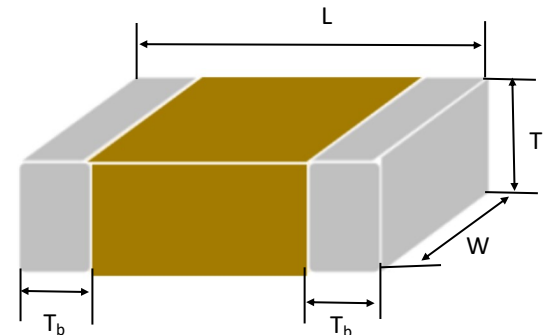
Table 9 Special Control Code	
Code	Description
C	RoHS Compliant

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5. Shape Size and Dimension:

Chip Size, Inch (mm)	Length L (mm)	Width W (mm)	Termination Bandwidth T _b (mm)
01R5 (0402)	0.40±0.02	0.20±0.02	0.10 +0.03
0201 (0603)	0.60±0.03	0.30±0.03	0.15±0.05
	0.60±0.05 (Cap.≥0.68μF)	0.30±0.05 (Cap.≥0.68μF)	
0402 (1005)	1.00±0.10	0.50±0.10	0.25±0.05/-0.10
	1.00±0.20 ^{#1}	0.50±0.20 ^{#1}	
0603 (1608)	1.60±0.15	0.80±0.15	0.40±0.15
0805 (2012)	2.00±0.20	1.25±0.20	0.50±0.20
1206 (3216)	3.20±0.20	1.60±0.20	0.60±0.20
	3.20±0.30/-0.10 ^{#2}	1.60±0.30/-0.10 ^{#2}	
1210 (3225)	3.20±0.30	2.50±0.30	0.75±0.35
1808 (4520)	4.50±0.40	2.00±0.25	0.75±0.35
1812 (4532)	4.50±0.40	3.20±0.30	0.75±0.35
1825 (4563)	4.50±0.40	6.30±0.40	0.75±0.35
2220 (5750)	5.70±0.40	5.00±0.40	0.85±0.35
2225 (5763)	5.70±0.40	6.30±0.40	0.85±0.35



*# For 0402 size K thickness products. # For 1206 size P thickness products.

6. General Electrical Specification:

Dielectric Material	COG	X7R	X5R	X6S	X7S
Size	01R5, 0201, 0402, 0603, 0805, 1206, 1210, 1808, 1812, 1825, 2220, 2225	01R5, 0201, 0402, 0603, 0805, 1206, 1210, 1812, 1825, 2220, 2225	01R5, 0201, 0402, 0603	0201, 0402	0201
Rated voltage (WVDC)	10V, 16V, 25V, 50V	6.3V, 10V, 16V, 25V, 50V	4V, 6.3V, 10V, 16V, 25V, 50V	4V, 6.3V, 10V, 16V, 25V	10V
Capacitance Range*	0R1 to 100nF	100pF to 820nF	100pF to 820nF	100nF to 470nF	100nF
Capacitance tolerance**	B(±0.1pF), C(±0.25pF), D(±0.5pF) F(±1%), G(±2%) J(±5%), K(±10%)	J(±5%), K(±10%), M(±20%)		K(±10%), M(±20%)	
Tan δ*	Cap. <30pF: Q ≥ 400 + 20C Cap. ≥ 30pF: Q ≥ 1000	Note 1			
Operating temperature	-55 to +125°C		-55 to +85°C	-55 to +105°C	-55 to +125°C
Capacitance Characteristic	±30ppm/°C	±15%		±22%	±22%
Termination	Cu or Ag/Ni/Sn or Au (lead-free termination)				

*Measured at the condition of 30~70% related humidity. COG : 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/X5R/X7S/X6S : Apply 1.0±0.2Vrms, 1.0KHz±10%, at 25°C ambient temperature.

** 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/X6S/X7S

Rated	D.F.≤	Exception of D.F.≤	
50V	≤2.5%	≤3.5%	0201(50V), 0603≥0.047μF, 0805≥0.1μF, 1206≥0.47μF
		≤5%	0201≥0.01μF
		≤10%	0402≥0.012μF, 0603>0.1μF
25V	≤3.5%	≤5%	0201≥0.01μF
		≤7%	0603≥0.33μF
		≤10%	0201≥0.1μF, 0402≥0.10μF, 0603≥0.47μF
16V	≤3.5%	≤12.5%	0402≥0.47μF
		≤5%	0201≥0.01μF, 0402≥0.033μF, 0603≥0.15μF, 0805≥0.68μF
		≤10%	0201≥0.1μF(0201/X7R≥0.022μF), 0402≥0.22μF, 0603≥0.68μF
10V	≤5%	≤10%	0201≥0.012μF, 0402≥0.33μF(0402/X7R≥0.22μF), 0603≥0.33μF
		≤15%	0201≥0.1μF
		≤15%	0201≥0.1μF
4V	≤15%	—	—
10V	≤5%	—	01R5
6.3V, 10V	≤10%	—	01R5

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7. Relationship Between Capacitance Range vs. Thickness and Voltage

7.1 COG (Capacitance vs. thickness, refer to table 8 for the thickness code)

Cap (pF)	Size, Inch (mm) Cap Code	0201 (0603)				0402 (1005)				0603 (1608)				0805 (2012)				1206 (3216)				
		10V	16V	25V	50V	10V	16V	25V	50V	10V	16V	25V	50V	10V	16V	25V	50V	10V	16V	25V	50V	
0.1	0R1	L	L	L	L	N	N	N	N													
0.2	0R2	L	L	L	L	N	N	N	N													
0.3	0R3	L	L	L	L	N	N	N	N	S	S	S	S									
0.4	0R4	L	L	L	L	N	N	N	N	S	S	S	S									
0.5	0R5	L	L	L	L	N	N	N	N	S	S	S	S	A	A	A	A					
0.6	0R6	L	L	L	L	N	N	N	N	S	S	S	S	A	A	A	A					
0.7	0R7	L	L	L	L	N	N	N	N	S	S	S	S	A	A	A	A					
0.8	0R8	L	L	L	L	N	N	N	N	S	S	S	S	A	A	A	A					
0.9	0R9	L	L	L	L	N	N	N	N	S	S	S	S	A	A	A	A					
1.0	1R0	L	L	L	L	N	N	N	N	S	S	S	S	A	A	A	A					X
1.2	1R2	L	L	L	L	N	N	N	N	S	S	S	S	A	A	A	A	X	X	X	X	X
1.5	1R5	L	L	L	L	N	N	N	N	S	S	S	S	A	A	A	A	X	X	X	X	X
1.8	1R8	L	L	L	L	N	N	N	N	S	S	S	S	A	A	A	A	X	X	X	X	X
2.2	2R2	L	L	L	L	N	N	N	N	S	S	S	S	A	A	A	A	X	X	X	X	X
2.7	2R7	L	L	L	L	N	N	N	N	S	S	S	S	A	A	A	A	X	X	X	X	X
3.3	3R3	L	L	L	L	N	N	N	N	S	S	S	S	A	A	A	A	X	X	X	X	X
3.9	3R9	L	L	L	L	N	N	N	N	S	S	S	S	A	A	A	A	X	X	X	X	X
4.7	4R7	L	L	L	L	N	N	N	N	S	S	S	S	A	A	A	A	X	X	X	X	X
5.6	5R6	L	L	L	L	N	N	N	N	S	S	S	S	A	A	A	A	X	X	X	X	X
6.8	6R8	L	L	L	L	N	N	N	N	S	S	S	S	A	A	A	A	X	X	X	X	X
8.2	8R2	L	L	L	L	N	N	N	N	S	S	S	S	A	A	A	A	X	X	X	X	X
10	100	L	L	L	L	N	N	N	N	S	S	S	S	A	A	A	A	X	X	X	X	X
12	120	L	L	L	L	N	N	N	N	S	S	S	S	A	A	A	A	X	X	X	X	X
15	150	L	L	L	L	N	N	N	N	S	S	S	S	A	A	A	A	X	X	X	X	X
18	180	L	L	L	L	N	N	N	N	S	S	S	S	A	A	A	A	X	X	X	X	X
22	220	L	L	L	L	N	N	N	N	S	S	S	S	A	A	A	A	X	X	X	X	X
27	270	L	L	L	L	N	N	N	N	S	S	S	S	A	A	A	A	X	X	X	X	X
33	330	L	L	L	L	N	N	N	N	S	S	S	S	A	A	A	A	X	X	X	X	X
39	390	L	L	L	L	N	N	N	N	S	S	S	S	A	A	A	A	X	X	X	X	X
47	470	L	L	L	L	N	N	N	N	S	S	S	S	A	A	A	A	X	X	X	X	X
56	560	L	L	L	L	N	N	N	N	S	S	S	S	A	A	A	A	X	X	X	X	X
68	680	L	L	L	L	N	N	N	N	S	S	S	S	A	A	A	A	X	X	X	X	X
82	820	L	L	L	L	N	N	N	N	S	S	S	S	A	A	A	A	X	X	X	X	X
100	101	L	L	L	L	N	N	N	N	S	S	S	S	A	A	A	A	X	X	X	X	X
120	121	L	L	L	L	N	N	N	N	S	S	S	S	A	A	A	A	X	X	X	X	X
150	151	L	L	L	L	N	N	N	N	S	S	S	S	A	A	A	A	X	X	X	X	X
180	181	L	L	L	L	N	N	N	N	S	S	S	S	A	A	A	A	X	X	X	X	X
220	221	L	L	L	L	N	N	N	N	S	S	S	S	A	A	A	A	X	X	X	X	X
270	271			L		N	N	N	N	S	S	S	S	A	A	A	A	X	X	X	X	X
330	331					N	N	N	N	S	S	S	S	A	A	A	A	X	X	X	X	X
390	391			L		N	N	N	N	S	S	S	S	X	X	X	X	X	X	X	X	X
470	471			L		N	N	N	N	S	S	S	S	X	X	X	X	X	X	X	X	X
560	561					N	N	N	N	S	S	S	S	X	X	X	X	X	X	X	X	X
680	681					N	N	N	N	S	S	S	S	X	X	X	X	X	X	X	X	X
820	821					N	N	N	N	S	S	S	S	X	X	X	X	X	X	X	X	X
1,000	102					N	N	N	N	S	S	S	S	X	X	X	X	X	X	X	X	X
1,200	122									B	B	B	B	X	X	X	X	X	X	X	X	X
1,500	152									B	B	B	B	X	X	X	X	X	X	X	X	X
1,800	182									B	B	B	B	X	X	X	X	X	X	X	X	X
2,200	222									B	B	B	B	X	X	X	X	X	X	X	X	X
2,700	272									B	B	B	B	C	C	C	C	X	X	X	X	X
3,300	332									B	B	B	B	C	C	C	C	X	X	X	X	X
3,900	392									B	B	B	B	C	C	C	C	X	X	X	X	X
4,700	472									B	B	B	B	C	C	C	C	X	X	X	X	X
5,600	562									B	B	B	B	C	C	C	C	X	X	X	X	X
6,800	682									B	B	B	B	C	C	C	C	C	C	C	C	C
8,200	822									B	B	B	B	C	C	C	C	C	C	C	C	C
10,000	103									B	B	B	B	C	C	C	C	C	C	C	C	C
12,000	123													T/C	T/C	T/C	C	P	P	P	P	P
15,000	153													C	C	C	C	P	P	P	P	P
18,000	183													C	C	C	C	P	P	P	P	P
22,000	223													C	C	C	C	P	P	P	P	P
27,000	273																	P	P	P	P	P
33,000	333																	P	P	P	P	P
39,000	393																	P	P	P	P	P
47,000	473																	P	P	P	P	P
56,000	563																	P	P	P	P	P
68,000	683																	P	P	P	P	P
82,000	823																	P	P	P	P	P
100,000	104																	E/P	E/P	E/P	E/P	E/P

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7.1 COG (Capacitance vs. thickness, refer to table 8 for the thickness code), Continue

Cap (pF)	Size, Inch (mm)	1210 (3225)				1808 (4520)		1812 (4532)				1825 (4563)		2220 (5750)		2225 (5763)	
		Cap Code	10V	16V	25V	50V	25V	50V	10V	16V	25V	50V	25V	50V	25V	50V	25V
2.2	2R2					C	C										
2.7	2R7					C	C										
3.3	3R3					C	C										
3.9	3R9					C	C										
4.7	4R7					C	C										
5.6	5R6					C	C										
6.8	6R8					C	C										
8.2	8R2					C	C										
10	100	M	M	M	M	C	C	C	C	C	C	F	F	F	F	F	F
12	120	M	M	M	M	C	C	C	C	C	C	F	F	F	F	F	F
15	150	M	M	M	M	C	C	C	C	C	C	F	F	F	F	F	F
18	180	M	M	M	M	C	C	C	C	C	C	F	F	F	F	F	F
22	220	M	M	M	M	C	C	C	C	C	C	F	F	F	F	F	F
27	270	M	M	M	M	C	C	C	C	C	C	F	F	F	F	F	F
33	330	M	M	M	M	C	C	C	C	C	C	F	F	F	F	F	F
39	390	M	M	M	M	C	C	C	C	C	C	F	F	F	F	F	F
47	470	M	M	M	M	C	C	C	C	C	C	F	F	F	F	F	F
56	560	M	M	M	M	C	C	C	C	C	C	F	F	F	F	F	F
68	680	M	M	M	M	C	C	C	C	C	C	F	F	F	F	F	F
82	820	M	M	M	M	C	C	C	C	C	C	F	F	F	F	F	F
100	101	M	M	M	M	C	C	C	C	C	C	F	F	F	F	F	F
120	121	M	M	M	M	C	C	C	C	C	C	F	F	F	F	F	F
150	151	M	M	M	M	C	C	C	C	C	C	F	F	F	F	F	F
180	181	M	M	M	M	C	C	C	C	C	C	F	F	F	F	F	F
220	221	M	M	M	M	C	C	C	C	C	C	F	F	F	F	F	F
270	271	M	M	M	M	C	C	C	C	C	C	F	F	F	F	F	F
330	331	M	M	M	M	C	C	C	C	C	C	F	F	F	F	F	F
390	391	M	M	M	M	C	C	C	C	C	C	F	F	F	F	F	F
470	471	M	M	M	M	C	C	C	C	C	C	F	F	F	F	F	F
560	561	M	M	M	M	C	C	C	C	C	C	F	F	F	F	F	F
680	681	M	M	M	M	C	C	C	C	C	C	F	F	F	F	F	F
820	821	M	M	M	M	C	C	C	C	C	C	F	F	F	F	F	F
1,000	102	M	M	M	M	C	C	C	C	C	C	F	F	F	F	F	F
1,200	122	M	M	M	M	C	C	C	C	C	C	F	F	F	F	F	F
1,500	152	M	M	M	M	C	C	C	C	C	C	F	F	F	F	F	F
1,800	182	M	M	M	M	C	C	C	C	C	C	F	F	F	F	F	F
2,200	222	M	M	M	M	C	C	C	C	C	C	F	F	F	F	F	F
2,700	272	M	M	M	M	C	C	C	C	C	C	F	F	F	F	F	F
3,300	332	M	M	M	M	C	C	C	C	C	C	F	F	F	F	F	F
3,900	392	M	M	M	M	C	C	C	C	C	C	F	F	F	F	F	F
4,700	472	M	M	M	M	C	C	C	C	C	C	F	F	F	F	F	F
5,600	562	M	M	M	M	C	C	C	C	C	C	F	F	F	F	F	F
6,800	682	M	M	M/C	M/C	C	C	C	C	C	C	F	F	F	F	F	F
8,200	822	M	M	M/C	M/C	C	C	C	C	C	C	F	F	F	F	F	F
10,000	103	M	M	M/C	M/C	C	C	C	C	C	C	F	F	F	F	F	F
12,000	123	C	C	C/E	C/E	E	E	C	C	C	C	F	F	F	F	F	F
15,000	153	C	C	C/E	C/E	E	E	C	C	C	C	F	F	F	F	F	F
18,000	183	F	F	F	F	F	F	C	C	C	C	F	F	F	F	F	F
22,000	223	F	F	F	F	F	F	C	C	C	C	F	F	F	F	F	F
27,000	273	F	F	F/G	F/G			C	C	E	E	F	F	F	F	F	F
33,000	333	F	F	F/G	F/G			C	C	E	E	F	F	F	F	F	F
39,000	393	F	F	F/G	F/G			G	G	G	G	F	F	F	F	F	F
47,000	473	F	F	F/G	F/G			G	G	G	G	F	F	F	F	F	F
56,000	563							G	G	G	G	F	F	F	F	F	F
68,000	683							G	G	G	G	F	F	F	F	F	F
82,000	823							G	G	G	G	F	F	F	F	F	F
100,000	104							G	G	G	G	G	G	G	G	F	F

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7.2 X7R (Capacitance vs. thickness, refer to table 8 for the thickness code)

Cap (pF)	Size, Inch (mm)	0201 (0603)					0402 (1005)					0603 (1608)					0805 (2012)				
		Cap Code	6.3V	10V	16V	25V	50V	6.3V	10V	16V	25V	50V	6.3V	10V	16V	25V	50V	6.3V	10V	16V	25V
100	101			L	L	L		N	N	N	N		S	S	S	S		X	X	X	X
120	121			L	L	L		N	N	N	N		S	S	S	S		X	X	X	X
150	151			L	L	L		N	N	N	N		S	S	S	S		X	X	X	X
180	181			L	L	L		N	N	N	N		S	S	S	S		X	X	X	X
220	221			L	L	L		N	N	N	N		S	S	S	S		X	X	X	X
270	271			L	L	L		N	N	N	N		S	S	S	S		X	X	X	X
330	331			L	L	L		N	N	N	N		S	S	S	S		X	X	X	X
390	391			L	L	L		N	N	N	N		S	S	S	S		X	X	X	X
470	471			L	L	L		N	N	N	N		S	S	S	S		X	X	X	X
560	561			L	L	L		N	N	N	N		S	S	S	S		X	X	X	X
680	681			L	L	L		N	N	N	N		S	S	S	S		X	X	X	X
820	821			L	L	L		N	N	N	N		S	S	S	S		X	X	X	X
1,000	102	L	L	L	L	L		N	N	N	N		S	S	S	S		X	X	X	X
1,200	122	L	L	L	L			N	N	N	N		S	S	S	S		X	X	X	X
1,500	152	L	L	L	L			N	N	N	N		S	S	S	S		X	X	X	X
1,800	182	L	L	L	L			N	N	N	N		S	S	S	S		X	X	X	X
2,200	222	L	L	L	L			N	N	N	N		S	S	S	S		X	X	X	X
2,700	272	L	L	L	L			N	N	N	N		S	S	S	S		X	X	X	X
3,300	332	L	L	L	L			N	N	N	N		S	S	S	S		X	X	X	X
3,900	392	L	L	L	L			N	N	N	N		S	S	S	S		X	X	X	X
4,700	472	L	L	L	L			N	N	N	N		S	S	S	S		X	X	X	X
5,600	562	L	L	L	L			N	N	N	N		S	S	S	S		X	X	X	X
6,800	682	L	L	L				N	N	N	N		S	S	S	S		X	X	X	X
8,200	822	L	L	L				N	N	N	N		S	S	S	S		X	X	X	X
10,000	103	L	L	L	L		N	N	N	N	N		S	S	S	S		X	X	X	X
12,000	123							N	N	N	N/K		S	S	S	S		X	X	X	X
15,000	153							N	N	N	N/K		S	S	S	S		X	X	X	X
18,000	183							N	N	N	N/K		S	S	S	S		X	X	X	X
22,000	223		L	L			N	N	N	N	N/K		S	S	S	S		X	X	X	X
27,000	273							N	N	N	N/K		S	S	S	S		X	X	X	X
33,000	333							N	N	N	N/K		S	S	S	S		X	X	X	X
39,000	393							N	N	N	N/K		S	S	B	B		X	X	X	X
47,000	473							N	N	N	N/K		S	S	B	B		X	X	X	X
56,000	563							N	N	N	K		S	S	B	B		X	X	X	X
68,000	683							N	N	N	K		S	S	B	B		X	X	X	X
82,000	823							N	N	N	K		S	S	B	B		X	X	X	X/C
100,000	104						N	N	N	N	K		S	S	B	B		X	X	X	X/C
120,000	124												S	S	B			X	X	X	C
150,000	154												S	S	B	B		C	C	C	C
180,000	184												S	S	B			C	C	C	C
220,000	224						N	N	N	N			S	S	B	B		C	C	C	C/I
270,000	274											B	B	B	B		C	C	C	C	I
330,000	334												B	B	B	B		C	C	C	I
390,000	394												B	B	B			C	C	C	I
470,000	474						N	N				B	B	B	B	B		C	C	C	I
560,000	564												B	B				C	C	C	I
680,000	684											B	B	B				C	C	C	I
820,000	824												B	B				C	C	C	I

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7.2 X7R (Capacitance vs. thickness, refer to table 8 for the thickness code), Continue

Cap (pF)	Size, Inch (mm)	1206 (3216)					1210 (3225)					1812 (4532)				1825 (4563)		2220 (5750)		2225 (5763)		
		Cap Code	6.3V	10V	16V	25V	50V	6.3V	10V	16V	25V	50V	10V	16V	25V	50V	25V	50V	25V	50V	25V	50V
100	101				X	X																
120	121				X	X																
150	151		X	X	X	X																
180	181		X	X	X	X																
220	221		X	X	X	X				M	M											
270	271		X	X	X	X				M	M			C	C							
330	331		X	X	X	X				M	M			C	C							
390	391		X	X	X	X				M	M			C	C							
470	471		X	X	X	X				M	M			C	C							
560	561		X	X	X	X				M	M			C	C							
680	681		X	X	X	X				M	M			C	C							
820	821		X	X	X	X				M	M			C	C							
1,000	102		X	X	X	X		M	M	M	M	C	C	C	C	F	F	F	F	F	F	F
1,200	122		X	X	X	X		M	M	M	M	C	C	C	C	F	F	F	F	F	F	F
1,500	152		X	X	X	X		M	M	M	M	C	C	C	C	F	F	F	F	F	F	F
1,800	182		X	X	X	X		M	M	M	M	C	C	C	C	F	F	F	F	F	F	F
2,200	222		X	X	X	X		M	M	M	M	C	C	C	C	F	F	F	F	F	F	F
2,700	272		X	X	X	X		M	M	M	M	C	C	C	C	F	F	F	F	F	F	F
3,300	332		X	X	X	X		M	M	M	M	C	C	C	C	F	F	F	F	F	F	F
3,900	392		X	X	X	X		M	M	M	M	C	C	C	C	F	F	F	F	F	F	F
4,700	472		X	X	X	X		M	M	M	M	C	C	C	C	F	F	F	F	F	F	F
5,600	562		X	X	X	X		M	M	M	M	C	C	C	C	F	F	F	F	F	F	F
6,800	682		X	X	X	X		M	M	M	M	C	C	C	C	F	F	F	F	F	F	F
8,200	822		X	X	X	X		M	M	M	M	C	C	C	C	F	F	F	F	F	F	F
10,000	103		X	X	X	X		M	M	M	M	C	C	C	C	F	F	F	F	F	F	F
12,000	123		X	X	X	X		M	M	M	M	C	C	C	C	F	F	F	F	F	F	F
15,000	153		X	X	X	X		M	M	M	M	C	C	C	C	F	F	F	F	F	F	F
18,000	183		X	X	X	X		M	M	M	M	C	C	C	C	F	F	F	F	F	F	F
22,000	223		X	X	X	X		M	M	M	M	C	C	C	C	F	F	F	F	F	F	F
27,000	273		X	X	X	X		M	M	M	M	C	C	C	C	F	F	F	F	F	F	F
33,000	333		X	X	X	X		M	M	M	M	C	C	C	C	F	F	F	F	F	F	F
39,000	393		X	X	X	X		M	M	M	M	C	C	C	C	F	F	F	F	F	F	F
47,000	473		X	X	X	X		M	M	M	M	C	C	C	C	F	F	F	F	F	F	F
56,000	563		X	X	X	X		M	M	M	M	C	C	C	C	F	F	F	F	F	F	F
68,000	683		X	X	X	X		M	M	M	M	C	C	C	C	F	F	F	F	F	F	F
82,000	823		X	X	X	X		M	M	M	M	C	C	C	C	F	F	F	F	F	F	F
100,000	104		X	X	X	X		M	M	M	M	C	C	C	C	F	F	F	F	F	F	F
120,000	124		X	X	X	X		M	M	M	M	C	C	C	C	F	F	F	F	F	F	F
150,000	154		M	M	M	M		M	M	M	M	C	C	C	C	F	F	F	F	F	F	F
180,000	184		M	M	M	M		M	M	M	M	C	C	C	C	F	F	F	F	F	F	F
220,000	224		M	M	M	M		M	M	M	M	C	C	C	C	F	F	F	F	F	F	F
270,000	274		M	M	M	C		M	M	M	M	C	C	C	C	F	F	F	F	F	F	F
330,000	334		M	M	M	C		M	M	M	C	C	C	C	C	F	F	F	F	F	F	F
390,000	394		M	M	C	P		M	M	M	C	C	C	C	C	F	F	F	F	F	F	F
470,000	474		J	J	C/J	P		M	M	M	C	C	C	C	C	F	F	F	F	F	F	F
560,000	564		J	J	C/J	P		C	C	C	C	C	C	C	C	F	F	F	F	F	F	F
680,000	684		J	J	C/J	P		C	C	C	C	C	C	C	F	F	F	F	F	F	F	F
820,000	824		J	J	C/J	P		C	C	C	C	C	C	C	F	F	F	F	F	F	F	F

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7.3 X5R (Capacitance vs. thickness, refer to table 8 for the thickness code)

Cap (pF)	Size, Inch (mm) Cap Code	0201 (0603)						0402 (1005)						0603 (1608)					
		4V	6.3V	10V	16V	25V	50V	4V	6.3V	10V	16V	25V	50V	4V	6.3V	10V	16V	25V	50V
100	101				L	L	L												
120	121																		
150	151				L	L	L												
180	181																		
220	221				L	L	L												
270	271																		
330	331				L	L	L												
390	391																		
470	471				L	L	L												
560	561																		
680	681				L	L	L												
820	821																		
1,000	102			L	L	L	L												
1,500	152			L	L	L	L												
2,200	222			L	L	L													
2,700	272																		
3,300	332			L	L	L													
4,700	472			L	L	L													
6,800	682			L	L	L													
10,000	103		L	L	L	L	L												
15,000	153		L	L										N					N
22,000	223		L	L										N					N
27,000	273																		
33,000	333		L	L										N					N
39,000	393																		
47,000	473		L	L						N	N	N							N
56,000	563		L	L															
68,000	683		L	L						N	N	N							K
82,000	823																		
100,000	104		L	L	L	L				N	N	N	N						K
150,000	154									N	N	N	N						S
220,000	224									N	N	N	N				B	B	B
270,000	274																		
330,000	334		L							N	N	N					B	B	B
390,000	394																		
470,000	474	L	L							N	N	N/K	K	K			B	B	B
680,000	684									N	N						B	B	B
820,000	824																		

7.4 X6S:

Cap (pF)	Size, Inch (mm) Cap Code	0201 (0603)					0402 (1005)				
		4V	6.3V	10V	16V	25V	6.3V	10V	16V	25V	50V
100,000	104	L	L	L	L	L	N				
150,000	154										
220,000	224		L	L*			N				
270,000	274										
330,000	334										
390,000	394										
470,000	474	L					K/N				
680,000	684										

7.5 X7S:

Cap (pF)	Size, Inch (mm) Cap Code	0201 (0603)
		10V
100,000	104	L
150,000	154	
220,000	224	
330,000	334	
470,000	474	
680,000	684	

7.6 01R5:

Capacitance	Size, Inch (mm)		01R5 (0402)
	DIELECTRIC		X7R
RATED VOLTAGE(VDC)		10	
100pF(101)			V
150pF(151)			V
220pF(221)			V
330pF(331)			V
470pF(471)			V
1,000pF(102)			V

7.6 01R5, Continue:

Capacitance	Size, Inch (mm)		01R5 (0402)
	DIELECTRIC		X5R
RATED VOLTAGE(VDC)		6.3	10
1,000pF(101)		V	V
1,500pF(152)			V
2,200pF(222)			V
3,300pF(332)			V
4,700pF(472)			V
6,800pF(682)			V
0.010µF(103)		V	V
0.015µF(153)			V
0.022µF(223)		V	
0.033µF(333)		V	
0.047µF(473)		V	
0.068µF(683)			V
0.10µF(104)		V	

Capacitance	Size, Inch (mm)		01R5 (0402)
	DIELECTRIC		NPO
RATED VOLTAGE(VDC)		16V	25V 50V
0.2pF(0R2)		V	V V
0.3pF(0R3)		V	V V
0.4pF(0R4)		V	V V
0.5pF(0R5)		V	V V
1.0pF(1R0)		V	V V
1.5pF(1R5)		V	V V
2.0pF(2R0)		V	V V
3.0pF(3R0)		V	V V
4.0pF(4R0)		V	V V
5.0pF(5R0)		V	V V
6.0pF(6R0)		V	V V
7.0pF(7R0)		V	V V

Capacitance	Size, Inch (mm)		01R5 (0402)
	DIELECTRIC		NPO
RATED VOLTAGE(VDC)		16V	25V 50V
8.0pF(8R0)		V	V V
9.0pF(9R0)		V	V V
10pF(100)		V	V V
12pF(120)		V	V V
15pF(150)		V	V V
18pF(185)		V	V V
22pF(220)		V	V V
27pF(270)		V	V V
33pF(330)		V	V V
39pF(390)		V	V V
47pF(470)		V	V V
56pF(560)		V	V V

Capacitance	Size, Inch (mm)		01R5 (0402)
	DIELECTRIC		NPO
RATED VOLTAGE(VDC)		16V	25V 50V
68pF(680)		V	V V
82pF(820)		V	V V
100pF(101)		V	V V
120pF(121)		V	V
150pF(151)		V	V
180pF(181)		V	V
220pF(221)			

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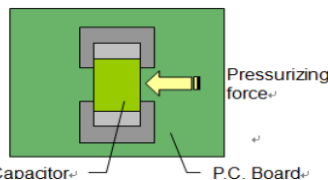
AFN Category

8. Reliability Test Conditions and Requirements:

No.	Item	AEC-Q200 Test Condition	Requirements																																										
1	Visual and Dimensions	Refer to general electrical data	* No remarkable defect. * Dimensions to confirm to individual specification sheet.																																										
2	Capacitance		* Shall not exceed the limits given in the detailed spec. * COG : Cap. $\geq 30\text{pF}$, $Q \geq 1000$; Cap. $< 30\text{pF}$, $Q \geq 400 + 20C$. * 01R5 : X7R: $\leq 5.0\%$ X5R: $\leq 10\%$ * X7R/X5R/X7S/X6S :																																										
3	Q/ D.F. (Tangent of loss angle)	* Class I : (COG) Cap. $\leq 1000\text{pF}$, $1.0 \pm 0.2V_{rms}$, $1\text{MHz} \pm 10\%$. Cap. $> 1000\text{pF}$, $1.0 \pm 0.2V_{rms}$, $1\text{KHz} \pm 10\%$. * Class II : (X7R, X5R, X7S, X6S) Cap. $\leq 10\mu\text{F}$, $1.0 \pm 0.2V_{rms}$, $1\text{KHz} \pm 10\%$. Cap. $> 10\mu\text{F}$, $0.5 \pm 0.2V_{rms}$, $120\text{Hz} \pm 20\%$. ** Test condition : $0.5 \pm 0.2V_{rms}$, $1\text{KHz} \pm 10\%$. X5R : $0201 \geq 224(6.3V, 10V, 16V)^{\#1}$, X7R & X5R ($\geq 10V$) & $01R5X103 \leq 6.3V$ & $01R5X104 \leq 10V$ * $0.5 \pm 0.2V_{rms}$, $1\text{kHz} \pm 10\%$: X5R ($\leq 6.3V$); Excluding $01R5X103 \leq 6.3V$ & $01R5X104 \leq 10V$	<table border="1"> <thead> <tr> <th>Rated</th> <th>D.F. \leq</th> <th colspan="2">Exception of D.F. \leq</th> </tr> </thead> <tbody> <tr> <td rowspan="3">50V</td> <td rowspan="3">$\leq 2.5\%$</td> <td>$\leq 3.5\%$</td> <td>0201(50V), 0603 $\geq 0.047\mu\text{F}$, 0805 $\geq 0.1\mu\text{F}$, 1206 $\geq 0.47\mu\text{F}$</td> </tr> <tr> <td>$\leq 5\%$</td> <td>0201 $\geq 0.01\mu\text{F}$</td> </tr> <tr> <td>$\leq 10\%$</td> <td>0402 $\geq 0.012\mu\text{F}$, 0603 $> 0.1\mu\text{F}$</td> </tr> <tr> <td rowspan="3">25V</td> <td rowspan="3">$\leq 3.5\%$</td> <td>$\leq 5\%$</td> <td>0201 $\geq 0.01\mu\text{F}$</td> </tr> <tr> <td>$\leq 7\%$</td> <td>0603 $\geq 0.33\mu\text{F}$</td> </tr> <tr> <td>$\leq 10\%$</td> <td>0201 $\geq 0.1\mu\text{F}$, 0402 $\geq 0.10\mu\text{F}$, 0603 $\geq 0.47\mu\text{F}$</td> </tr> <tr> <td rowspan="3">16V</td> <td rowspan="3">$\leq 3.5\%$</td> <td>$\leq 12.5\%$</td> <td>0402 $\geq 0.47\mu\text{F}$</td> </tr> <tr> <td>$\leq 5\%$</td> <td>0201 $\geq 0.01\mu\text{F}$, 0402 $\geq 0.033\mu\text{F}$, 0603 $\geq 0.15\mu\text{F}$, 0805 $\geq 0.68\mu\text{F}$</td> </tr> <tr> <td>$\leq 10\%$</td> <td>0201 $\geq 0.1\mu\text{F}$ (0201/X7R $\geq 0.022\mu\text{F}$), 0402 $\geq 0.22\mu\text{F}$, 0603 $\geq 0.68\mu\text{F}$</td> </tr> <tr> <td rowspan="2">10V</td> <td rowspan="2">$\leq 10\%$</td> <td>$\leq 10\%$</td> <td>0201 $\geq 0.012\mu\text{F}$, 0402 $\geq 0.33\mu\text{F}$ (0402/X7R $\geq 0.22\mu\text{F}$), 0603 $\geq 0.33\mu\text{F}$</td> </tr> <tr> <td>$\leq 15\%$</td> <td>0201 $\geq 0.1\mu\text{F}$</td> </tr> <tr> <td>6.3V</td> <td>$\leq 10\%$</td> <td>$\leq 15\%$</td> <td>0201 $\geq 0.1\mu\text{F}$</td> </tr> <tr> <td>4V</td> <td>$\leq 10\%$</td> <td>—</td> <td>—</td> </tr> </tbody> </table>	Rated	D.F. \leq	Exception of D.F. \leq		50V	$\leq 2.5\%$	$\leq 3.5\%$	0201(50V), 0603 $\geq 0.047\mu\text{F}$, 0805 $\geq 0.1\mu\text{F}$, 1206 $\geq 0.47\mu\text{F}$	$\leq 5\%$	0201 $\geq 0.01\mu\text{F}$	$\leq 10\%$	0402 $\geq 0.012\mu\text{F}$, 0603 $> 0.1\mu\text{F}$	25V	$\leq 3.5\%$	$\leq 5\%$	0201 $\geq 0.01\mu\text{F}$	$\leq 7\%$	0603 $\geq 0.33\mu\text{F}$	$\leq 10\%$	0201 $\geq 0.1\mu\text{F}$, 0402 $\geq 0.10\mu\text{F}$, 0603 $\geq 0.47\mu\text{F}$	16V	$\leq 3.5\%$	$\leq 12.5\%$	0402 $\geq 0.47\mu\text{F}$	$\leq 5\%$	0201 $\geq 0.01\mu\text{F}$, 0402 $\geq 0.033\mu\text{F}$, 0603 $\geq 0.15\mu\text{F}$, 0805 $\geq 0.68\mu\text{F}$	$\leq 10\%$	0201 $\geq 0.1\mu\text{F}$ (0201/X7R $\geq 0.022\mu\text{F}$), 0402 $\geq 0.22\mu\text{F}$, 0603 $\geq 0.68\mu\text{F}$	10V	$\leq 10\%$	$\leq 10\%$	0201 $\geq 0.012\mu\text{F}$, 0402 $\geq 0.33\mu\text{F}$ (0402/X7R $\geq 0.22\mu\text{F}$), 0603 $\geq 0.33\mu\text{F}$	$\leq 15\%$	0201 $\geq 0.1\mu\text{F}$	6.3V	$\leq 10\%$	$\leq 15\%$	0201 $\geq 0.1\mu\text{F}$	4V	$\leq 10\%$	—	—
Rated	D.F. \leq	Exception of D.F. \leq																																											
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6	Dielectric Strength	* To apply 250% of rated voltage. * Duration : 1 to 5 sec. * Charge and discharge current less than 50mA.	* No evidence of damage or flash over during test.																																										

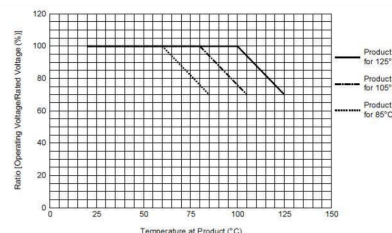
General Purpose Multilayer Ceramic Chip Capacitors

AFN Category

No.	Item	AEC-Q200 Test Condition	Requirements															
7	Solderability	* Solder temperature : 235±5°C for (01R5,0201~1210). * Solder temperature : 245±5°C for (1808~2225). * Dipping time : 2±0.5 sec.	* 75% min. coverage of all metalized area. * 95% min. coverage of all metalized area.(for 01R5) .															
8	Resistance to Soldering Heat	* 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) : To apply de-gaging at 150°C for 1hr then set for 24±2 hrs at room temp. * 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 : COG : Within ±2.5% or ±0.25pF, whichever is larger. X7R, X5R,X6S,X7S : Within ±7.5%. * D.F.(Q)/I.R. : To meet initial requirements. * 25% max. leaching on each edge.															
9	Temperature Cycle (Rapid change of temperature)	* Conduct the five cycles according to the temperatures and time . <table border="1" style="margin-left: 20px;"> <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> * Before initial measurement (Class II only) : To apply de-gaging at 150°C for 1hr then set for 24±2 hrs at room temp. * Measurement to be made after keeping at room temp. for 24±2 hrs (Class I) or 48±4 hrs (Class II).	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	* No remarkable damage. * Cap. change : COG : Within ±2.5% or ±0.25pF, whichever is larger. X7R ,X5R,X7S,X6S: Within ±7.5%. * 01R5 X5R: Within ±15.0% * Q for COG : To meet initial requirements. * D.F. (Class II) : ≤150% of initial requirement. * I.R. : To meet initial requirements. * 01R5 Q/D.F., I.R. and dielectric strength: To meet initial requirements.
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10	Humidity (Damp Heat) Steady State	* Test temp. : 40±2°C. * Humidity : 90~95% RH. * Test time : 500 +24/-0hrs. * Before initial measurement (Class II only) : To apply de-gaging at 150°C for 1hr then set for 24±2 hrs at room temp. * 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 : COG : Within ±5.0% or ±0.5pF, whichever is larger. X7R, X5R, X6S, X7S : Within ±12.5% for ≥10V**, within ±25% for 6.3V. 01R5 X5R: within ±25.0% **10V : Within ±25% for 0603≥4.7μF, 0402≥1μF, 0201≥0.1μF. * Q/DF for COG : Cap.>30pF, Q≥350. 10pF≤Cap.≤30pF, Q≥275+2.5C. Cap. <10pF,Q≥275+2.5C. 01R5 X7R : ≤7.5% 01R5 X5R: ≤20% * I.R 01R5.: NPO, X7R: ≥1GΩ or RxC≥50Ω-F whichever is smaller. X5R: RxC≥10Ω-F. * D.F.(Class II) : ≤200% of initial requirement. * I.R. : ≥10V, ≥1GΩ or RxC≥50Ω-F, whichever is smaller. Class II (X7R, X5R, X7S,X6S)															
11	Adhesive Strength of Termination (Robustness of termination)	* Capacitors mounted on a substrate. A force of 1N (01R5) or 2N(0201) or 5N(0402~0603) or 10N(>0603) applied perpendicular to the place of substrate and parallel the line joining the center of terminations for 10±1 second. 	* No remarkable damage or removal of the terminations.															

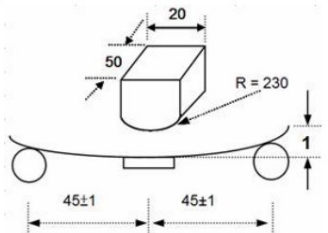
General Purpose Multilayer Ceramic Chip Capacitors

AFN Category

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12	Humidity (Damp Heat) Load	<p>*Test temp. : 40±2°C. *Humidity : 90~95% RH. *Test time : 500 +24/-0hrs. *To apply voltage : Rated voltage. *Before initial measurement (Class II only) : To apply de-aging at 150°C for 1hr then set for 24±2 hrs at room temp. *Measurement to be made after keeping at room temp. for 24±2 hrs (Class I) or 48±4 hrs (Class II).</p>	<p>* No remarkable damage. * Cap. change : COG : Within ±5.0% or ±0.5pF, whichever is larger. X7R, X5R, X6S, X7S : Within ±12.5% for ≥10V**, within ±25% for 6.3V. **10V : Within ±25% for 0603≥4.7μF, 0402≥1μF, 0201≥0.1μF. * Q for COG : Cap.>30pF, Q≥200. Cap. <30pF,Q≥100+10/3C. *01R5 Q/D.F. value: Cap≥30pF, Q≥200; Cap <30pF,Q≥100+10/3C. X7R: ≤7.5% X5R: ≤20% * I.R.: NP0, X7R: ≥500MΩ or RxC≥25Ω-F whichever is smaller. X5R: RxC≥5Ω-F. * D.F. (Class II) : ≤200% of initial requirement. * I.R. : ≥10V, ≥500MΩ or RxC≥25Ω-F, whichever is smaller. Class II (X7R, X5R, X7S, X6S)</p> <table border="1"> <thead> <tr> <th>Rated Voltage</th> <th>I.R.</th> </tr> </thead> <tbody> <tr> <td>50V : 0402>0.01μF</td> <td rowspan="5">≥500MΩ or RxC≥5Ω-F, whichever is smaller</td> </tr> <tr> <td>25V : 0201≥0.1uF, 0402≥0.22μF</td> </tr> <tr> <td>16V : 0201≥0.1uF, 0402≥0.22μF</td> </tr> <tr> <td>10V : 0201≥47nF, 0402≥0.47μF, 0603≥0.47μF,</td> </tr> <tr> <td>6.3V; 4V; Size≥1812</td> </tr> </tbody> </table>	Rated Voltage	I.R.	50V : 0402>0.01μF	≥500MΩ or RxC≥5Ω-F, whichever is smaller	25V : 0201≥0.1uF, 0402≥0.22μF	16V : 0201≥0.1uF, 0402≥0.22μF	10V : 0201≥47nF, 0402≥0.47μF, 0603≥0.47μF,	6.3V; 4V; Size≥1812																																										
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13	High Temperature Load (Endurance)	<p>* Test temp. : COG, X7R,X7S : 125±3°C. X5R : 85±3°C. X6S: 105±3°C * To apply voltage : (1) ≤6.3V : 150% of rated voltage. (2) 10V≤U_r≤50V : 200% of rated voltage. (3) 100% of rated voltage for below range :</p> <table border="1"> <thead> <tr> <th>Size</th> <th>Dielectric</th> <th>Rated</th> <th>Capacitance range</th> </tr> </thead> <tbody> <tr> <td rowspan="2">0201</td> <td rowspan="2">X5R/X7R</td> <td>≤10V</td> <td>C≥0.1μF</td> </tr> <tr> <td>≥16V</td> <td>C>0.1μF</td> </tr> <tr> <td>01R5</td> <td>X5R</td> <td>6.3V</td> <td>—</td> </tr> </tbody> </table> <p>(4) 150% of rated voltage for below range :</p> <table border="1"> <thead> <tr> <th>Size</th> <th>Dielectric</th> <th>Rated</th> <th>Capacitance range</th> </tr> </thead> <tbody> <tr> <td>01R5</td> <td>X5R</td> <td>10V</td> <td>—</td> </tr> <tr> <td rowspan="2">0201</td> <td rowspan="2">X5R/X7R/X6S</td> <td>16V/25V</td> <td>C≥0.1μF</td> </tr> <tr> <td>16V</td> <td>C≥0.022μF</td> </tr> <tr> <td rowspan="2">0402</td> <td rowspan="2">X5R/X7R/X6S</td> <td>50V</td> <td>C≥0.1μF</td> </tr> <tr> <td>10~25V</td> <td>C≥0.22μF</td> </tr> <tr> <td>0603</td> <td>X7R</td> <td>≥50V</td> <td>C≥0.082μF</td> </tr> <tr> <td>0805</td> <td>X5R/X7R</td> <td>50V</td> <td>C≥0.47μF</td> </tr> </tbody> </table> <p>* Test time : 1000 +24/-0 hrs. * Before initial measurement (Class II only) : To apply de-aging at 150°C for 1hr then set for 24±2 hrs at room temp. * Measurement to be made after keeping at room temp. for 24±2 hrs (Class I) or 48±4 hrs (Class II). ** De-rating conditions : (For 100% of rated voltage items)</p> 	Size	Dielectric	Rated	Capacitance range	0201	X5R/X7R	≤10V	C≥0.1μF	≥16V	C>0.1μF	01R5	X5R	6.3V	—	Size	Dielectric	Rated	Capacitance range	01R5	X5R	10V	—	0201	X5R/X7R/X6S	16V/25V	C≥0.1μF	16V	C≥0.022μF	0402	X5R/X7R/X6S	50V	C≥0.1μF	10~25V	C≥0.22μF	0603	X7R	≥50V	C≥0.082μF	0805	X5R/X7R	50V	C≥0.47μF	<p>* No remarkable damage. * Cap. change : COG : Within ±3.0% or ±0.3pF, whichever is larger. X7R, X5R, X6S, X7S : Within ±12.5% for ≥10V**, within ±25% for ≤6.3V. X7R : X7R Within ±12.5%, X5R Within ±25.0% **10V : Within ±25% for 0603≥4.7μF, 0402≥1μF, 0201≥0.1μF. * Q for COG : Cap.>30pF, Q≥350. 10pF≤Cap. ≤30pF,Q≥275+2.5C. Cap. <10pF,Q≥200+10C. * D.F.(Class II) : ≤200% of initial requirement. * I.R. : ≥10V, ≥1GΩ or RxC≥50Ω-F, whichever is smaller. *01R5 I.R.: NP0, X7R: ≥1GΩ or RxC≥50Ω-F whichever is smaller. X5R: RxC≥10Ω-F. Class II (X7R, X5R, X7S, X6S)</p> <table border="1"> <thead> <tr> <th>Rated Voltage</th> <th>I.R.</th> </tr> </thead> <tbody> <tr> <td>50V : 0402>0.01μF</td> <td rowspan="5">≥1GΩ or RxC≥10Ω-F, whichever is smaller</td> </tr> <tr> <td>25V : 0201≥0.1uF, 0402≥0.22μF</td> </tr> <tr> <td>16V : 0201≥0.1uF, 0402≥0.22μF</td> </tr> <tr> <td>10V : 0201≥47nF, 0402≥0.47μF, 0603≥0.47μF,</td> </tr> <tr> <td>6.3V; 4V; Size≥1812</td> </tr> </tbody> </table>	Rated Voltage	I.R.	50V : 0402>0.01μF	≥1GΩ or RxC≥10Ω-F, whichever is smaller	25V : 0201≥0.1uF, 0402≥0.22μF	16V : 0201≥0.1uF, 0402≥0.22μF	10V : 0201≥47nF, 0402≥0.47μF, 0603≥0.47μF,	6.3V; 4V; Size≥1812
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General Purpose Multilayer Ceramic Chip Capacitors

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No.	Item	AEC-Q200 Test Condition	Requirements								
14	Resistance to Flexure of Substrate (Substrate bending test)	<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 style="text-align: right;">Unit : mm</p>	<p>* No remarkable damage.</p> <table border="1" data-bbox="795 420 1485 535"> <thead> <tr> <th>Dielectric</th> <th>Cap.Change</th> </tr> </thead> <tbody> <tr> <td>C0G</td> <td>Within ±5.0% or ±0.5pF, whichever is larger</td> </tr> <tr> <td>X7R, X5R, X7S, X6S</td> <td>Within ±12.5%</td> </tr> <tr> <td>01R5 X5R</td> <td>Within ±25.0%</td> </tr> </tbody> </table> <p>(This capacitance change means the change of capacitance under specified flexure of substrate from the capacitance measured before the test)</p>	Dielectric	Cap.Change	C0G	Within ±5.0% or ±0.5pF, whichever is larger	X7R, X5R, X7S, X6S	Within ±12.5%	01R5 X5R	Within ±25.0%
Dielectric	Cap.Change										
C0G	Within ±5.0% or ±0.5pF, whichever is larger										
X7R, X5R, X7S, X6S	Within ±12.5%										
01R5 X5R	Within ±25.0%										
15	Vibration Resistance	<p>*Vibration frequency : 10~55 Hz/min. *Total amplitude : 1.5mm. *Test time : 6 hrs. (Two hrs each in three mutually perpendicular directions) *Before initial measurement (Class II only) : To apply de-aging at 150°C for 1hr then set for 24±2 hrs at room temp. *Measurement to be made after keeping at room temp. for 24±2 hrs (Class I) or 48±4 hrs (Class II).</p>	<p>*No remarkable damage. *Cap. change and D.F. : To meet initial spec.</p>								

General Purpose Multilayer Ceramic Chip Capacitors

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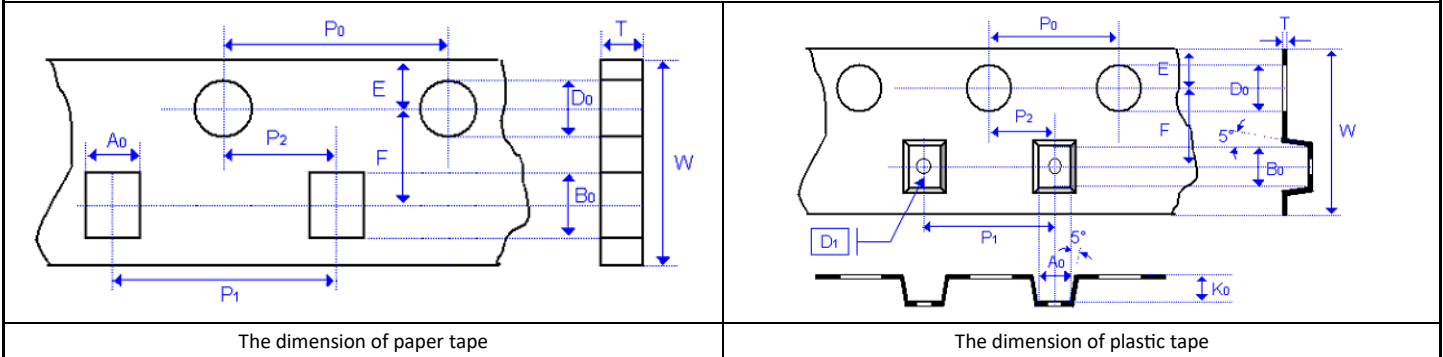
9. Package Dimension and Quantity:

Size, Inch (mm)	Thickness (mm)	Paper tape		Plastic tape	
		7" reel	13" reel	7" reel	13" reel
01R5 (0402)	0.20±0.02	20k	-	-	-
0201 (0603)	0.30±0.03	15k	70k	-	-
	0.30±0.05	15k	-	-	-
	0.30±0.09	15k	-	-	-
0402 (1005)	0.50±0.05	10k	50k	-	-
	0.50 +0.02/-0.05	10k	50k	-	-
	0.50±0.20	10k	-	-	-
0603 (1608)	0.50±0.10	4k	-	-	-
	0.80±0.07	4k	15k	-	-
	0.80 +0.15/-0.10	4k	15k	-	-
0805 (2012)	0.50±0.10	4k	15k	-	-
	0.60±0.10	4k	15k	-	-
	0.80±0.10	4k	15k	-	-
	0.85±0.10	4k	15k	-	-
	1.25±0.10	-	-	3k	10k
	1.25±0.20	-	-	3k	10k
1206 (3216)	0.80±0.10	4k	15k	-	-
	0.85±0.10	4k	15k	-	-
	0.95±0.10	-	-	3k	10k
	1.15±0.15	-	-	3k	10k
	1.25±0.10	-	-	3k	10k
	1.60±0.20	-	-	2k	10k
	1.60 +0.30/-0.10	-	-	2k	9k
1210 (3225)	0.85±0.10	-	-	3k	10k
	0.95±0.10	-	-	3k	10k
	1.25±0.10	-	-	3k	10k
	1.60±0.20	-	-	2k	-
	2.00±0.20	-	-	1k	6k
	2.50±0.30	-	-	1k	6k
1808 (4520)	1.25±0.10	-	-	2k	10k
	1.60±0.20	-	-	2k	8k
	2.00±0.20	-	-	1k	6k
1812 (4532)	1.25±0.10	-	-	1k	5k
	1.60±0.20	-	-	1k	-
	2.00±0.20	-	-	1k	-
	2.50±0.30	-	-	0.5k	3k
	2.80±0.30	-	-	0.5k	-
1825 (4563)	1.60±0.20	-	-	1k	-
	2.00±0.20	-	-	1k	-
	2.50±0.30	-	-	0.5k	-
	2.80±0.30	-	-	0.5k	-
2220 (5750)	1.60±0.20	-	-	1k	-
	2.00±0.20	-	-	1k	-
	2.50±0.30	-	-	0.5k	-
	2.80±0.30	-	-	0.5k	-
2225 (5763)	1.60±0.20	-	-	1k	-
	2.00±0.20	-	-	1k	-
	2.50±0.30	-	-	0.5k	-
	2.80±0.30	-	-	0.5k	-

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9.1 Tape Dimension



Size, Inch (mm)	01R5 (0402)	0201 (0603)	0402 (1005)	0603 (1608)	0805 (2012)	
Chip Thickness	0.20±0.02	0.50±0.05 0.50±0.10	0.50±0.05 0.50±0.10	0.80±0.07 0.80 +0.15/-0.1	0.80±0.10	1.25±0.10 1.25±0.20
A ₀	0.25±0.05	0.40±0.10	0.70±0.20	1.50 +0.30	1.50±0.20	<1.80
B ₀	0.45±0.07	0.70±0.10	1.20±0.20	1.80±0.30	2.30±0.20	<2.70
T	≤0.50	≤0.55	≤0.80	≤1.20	0.95±0.05	0.23±0.05
K ₀	-	-	-	-	-	<2.50
W	8.00±0.30	8.00±0.30	8.00±0.30	8.00±0.30	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
10xP ₀	40.00±0.10	40.00±0.10	40.00±0.10	40.00±0.20	40.00±0.20	40.00±0.20
P ₁	2.00±0.05	2.00±0.05	2.00±0.05	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
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
D ₁	-	-	-	-	-	1.00±0.10
E	1.75±0.05	1.75±0.05	1.75±0.10	1.75±0.10	1.75±0.05	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
Unit :	mm	mm	mm	mm	mm	mm

Size, Inch (mm)	1206 (3216)			1210 (3225)		1808 (4520)	
Chip Thickness	0.80±0.10	0.95±0.10 1.25±0.10	1.60±0.20 1.60+0.3/-0/1	1.25±0.10 1.60±0.20	2.50±0.30	1.25±0.10 1.60±0.20	2.00±0.20
A ₀	2.00±0.10	<2.00	<2.50	<3.05	<3.20	<2.50	<2.50
B ₀	3.50±0.50	<3.70	<4.00	<3.80	<4.00	<5.30	<5.30
T	0.95±0.05	0.23±0.05	0.23±0.05	0.23±0.05	0.23±0.05	0.25±0.05	0.25±0.05
K ₀	-	<2.50	<2.50	<2.50	<3.50	<2.50	<2.50
W	8.00±0.10	8.00±0.10	8.00±0.10	8.00±0.10	8.00±0.10	12.00±0.20	12.00±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
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
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
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
D ₀	1.55±0.05/-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	-	1.00±0.10	1.50±0.10	1.50±0.10	1.00±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±0.10	1.75±0.10	1.75±0.10	1.75±0.10
F	3.50±0.05	3.50±0.05	5.50±0.05	5.50±0.05	3.50±0.05	5.50±0.05	5.50±0.05
Unit :	mm	mm	mm	mm	mm	mm	mm

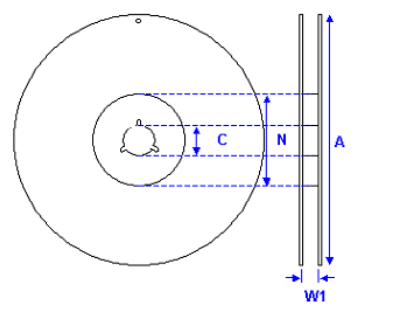
General Purpose Multilayer Ceramic Chip Capacitors

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Size, Inch (mm)	1812 (4532)		1825 (4563)		2220 (5750)		2225 (5763)	
Chip Thickness	1.25±0.10 1.60±0.20 2.00±0.20	2.50±0.30 2.80±0.30	1.60±0.20 2.00±0.20	2.50±0.30 2.80±0.30	1.40±0.15 1.60±0.20 2.00±0.20	2.50±0.30 2.80±0.30	1.60±0.20 2.00±0.20	2.50±0.30 2.80±0.30
A ₀	<3.90	<3.90	<6.80	<6.80	<5.80	<6.80	<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	12.00±0.20	12.00±0.20	12.00±0.20	12.00±0.20	12.00±0.20	12.00±0.20	12.00±0.20	12.00±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±0.10	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	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
Unit :	mm	mm	mm	mm	mm	mm	mm	mm

9.2 Reel Dimensions

Size	01R5	0201, 0402, 0603, 0805, 1206, 1210		1808, 1812, 1825, 2220, 2225
Reel size	7"	7"	13"	7"
C	13.0 ±0.05	13.0 +0.5/-0.2	13.0 +0.5/-0.2	13.0 +0.7/-0.3
W ₁	8.4 +1.5	8.4 +1.5	8.4 +1.5	12.4 +2.0/-0
W	14.4max	14.4max	14.4max	18.4max
A	178.0 ±0.20	178.0 ±0.20	330.0 ±1.0	178.0 ±0.20
N	60.0 ±1.0/-0	60.0 ±1.0/-0	100 ±1.0	60.0 ±1.0/-0



The dimension of reel

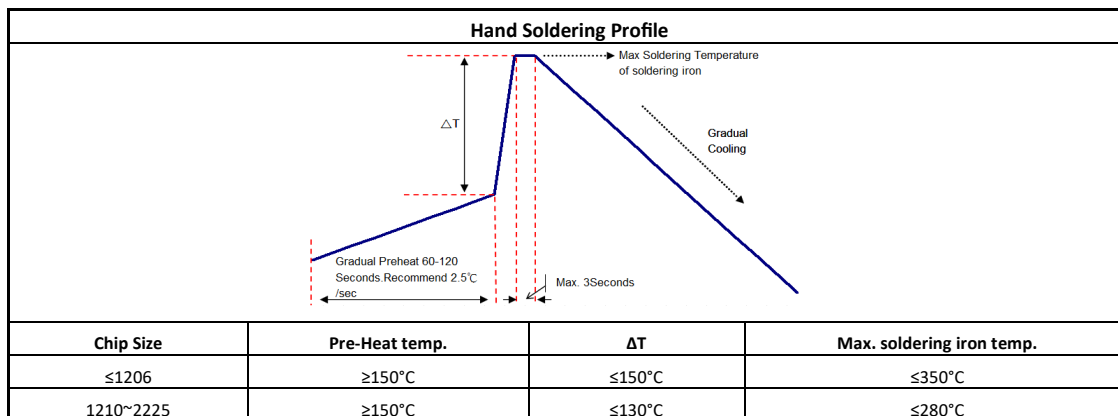
10. Recommended Soldering Conditions:

Use middy 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.

10.1 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 3°C per second.

10.2 Hand soldering:



* Soldering iron tip diameter ≤1.0 mm and wattage max. 20W.

* The Capacitors shall be pre-heated and that the temperature gradient between the devices and the tip of the soldering iron.

* The required amount of solder shall be melted on the soldering tip.

* The tip of iron should not contact the ceramic body directly.

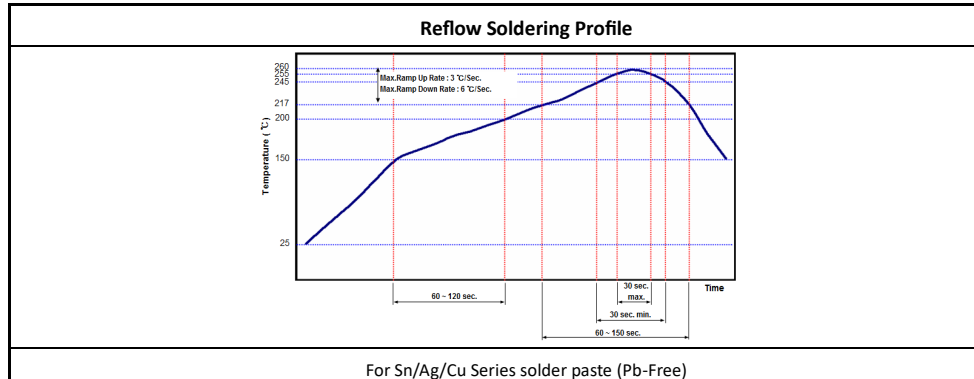
* The Capacitors shall be cooled gradually at room temperature after soldering.

* Forced air cooling is not allowed.

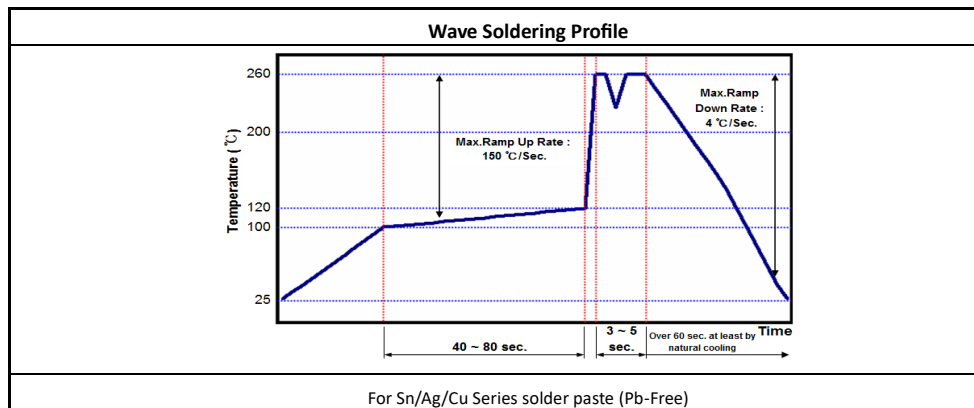
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10.3 Reflow soldering :



10.4 Wave Soldering :



10.5 Soldering conditions :

10.5.1 Class I :

Size, Inch (mm)	Temperature Characteristics	Capacitance	Condition	
			Wave	Reflow
≤0402 (1005)	Class I	All	X	O
0603 (1608)	Class I	All	O	O
0805 (2012)	Class I	All	O	O
1206 (3216)	Class I	All	O	O
		Thickness >0.95mm	X	O
≥1210 (3225)	Class I	All	X	O
Coating Products	All	All	X	O

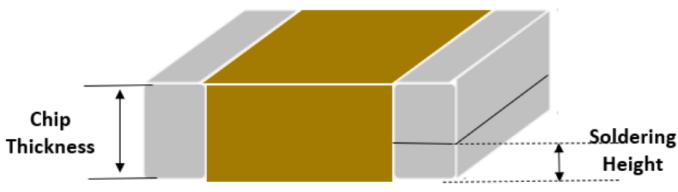
10.5.2 Class II :

Size, Inch (mm)	Temperature Characteristics	Capacitance	Condition	
			Wave	Reflow
≤0402 (1005)	Class II	All	X	O
0603 (1608)	Class II	Cap. <2.2μF	O	O
		Cap. ≥2.2μF	X	O
0805 (2012)	Class II	Thickness ≤ 0.95mm	O	O
		Thickness > 0.95mm	X	O
1206 (3216)	Class II	Thickness ≤ 0.95mm	O	O
		Thickness > 0.95mm	X	O
≥1210 (3225)	Class II	All	X	O
Coating Products	All	All	X	O

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10.6 Soldering height :

<p>The solder climbing minimum height is suggesting to 25% of chip thickness or 500um whichever is less. (Reference from IPC-610E)</p>	 <p>The diagram shows a 3D perspective of a chip capacitor. A vertical double-headed arrow on the left side is labeled 'Chip Thickness'. A vertical double-headed arrow on the right side, extending from the top surface of the chip to the top of the solder joint, is labeled 'Soldering Height'.</p>
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10.7 Recommended cooling condition:

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.

10.8 Cleaning after soldering:

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.

11. 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.

12. Recommended Storage Condition:

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 product is recommended to be used within 12 months after shipment and checked the solderability before use.

General Purpose Multilayer Ceramic Chip Capacitors

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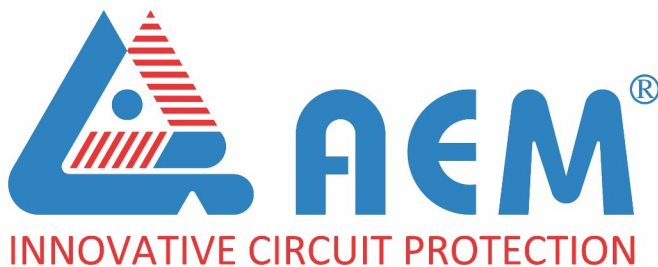
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