

High Capacitance Multilayer Ceramic Chip Capacitors

AFS Category

1. Introduction:

AFS 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. They feature series connection of multi-layer capacitor units in a MLCC to realize high voltage performance. This special design can distribute voltage gradients throughout the entire capacitor, so as to prevent short circuit failure. AFS series is Lead & Halogen Free and RoHS Compliant by using environmental friendly material without Pb or Cd.

2. Features:

- Realize high capacitance in small sizes.
- Capacitor with lead-free termination (pure Tin).
- HALOGEN & RoHS compliant.
- Surface mount suited for wave and reflow soldering.
- High reliability and no polarity.

3. Applications:

- Digital circuit coupling or decoupling applications.
- For bypassing.
- Ideal for smoothing circuits.
- DC to DC converter.
- LCD back-lighting inverter

4. Production Identification:

AFS	0805	B	R47	J	631	P	F	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
AFS	High Capacitance MLCC (from 1 μ F to 220 μ F)

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

Table 3 Dielectric Material Characteristics			
Code	Description	Code	Description
N	C0G	X	X7R
S	X6S	B	X5R
A	X7S		

Table 4 Capacitance Rule Code			
Code	Chip Capacitance	Code	Chip Capacitance
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 =10 μ F

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	Code	Voltage
6R3	6.3Vdc	201	200Vdc	202	2000Vdc
100	10Vdc	251	250Vdc	302	3000Vdc
160	16Vdc	401	400Vdc	402	4000Vdc
250	25Vdc	501	500Vdc	502	5000Vdc
350	35Vdc	631	630Vdc	602	6000Vdc
500	50Vdc	102	1000Vdc		
101	100Vdc	152	1500Vdc		

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

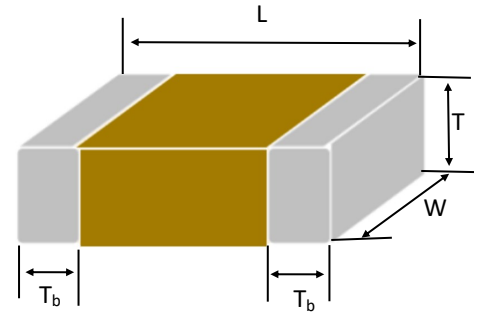
Table 9 Special Control Code	
Code	Description
C	RoHS Compliant

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5. Shape and Dimensions:

Size, Inch (mm)	Length L (mm)	Width W (mm)	Termination Bandwidth T _b (mm)
0201 (0603)	0.60±0.03 0.60±0.05 (Cap.≥0.68μF) 0.60±0.09 (Cap.≥1.0μF)	0.30±0.03 0.30±0.05 (Cap.≥0.68μF) 0.30±0.09 (Cap.≥1.0μF)	0.15±0.05
0402 (1005)	1.00±0.10 1.00±0.20 ^{#1}	0.50±0.10 0.50±0.20 ^{#1}	0.25±0.05/-0.10
0603 (1608)	1.60±0.15 1.60±0.20 ^{#2}	0.80±0.15 0.80±0.20 ^{#2}	0.40±0.15
0805 (2012)	2.00±0.20	1.25±0.20	0.50±0.20
1206 (3216)	3.20±0.20 3.20±0.30/-0.10 ^{#2} 3.30±0.30 ^{#4}	1.60±0.20 1.60±0.30/-0.10 ^{#2} 1.60±0.30/-0.10 ^{#4}	0.60±0.20
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



^{#1} For 0402 size K thickness products. ^{#2} For 0603/Cap.≥10μF or 0603(≤6.3V)/Cap.≥4.7μF or 0603(>10V)/Cap.>1μF products or 0603/Cap.>10μF SIZE S/B thickness ±0.2mm products.

^{#3} For 1206 size P thickness products. ^{#4} 1206/100V/Cap.≥1.2μF products

6. General Electrical Specification:

Dielectric	X7R	X7S	X6S	X5R
Size	0402, 0603, 0805, 1206, 1210, 1812, 1825, 2220, 2225	0402, 0603, 0805, 1206, 1210	0201, 0402, 0603, 0805, 1206, 1210	0201, 0402, 0603, 0805, 1206, 1210
Rated voltage (WVDC)	6.3V, 10V, 16V, 25V, 50V, 100V, 250V, 500V, 630V	6.3V, 10V, 16V, 25V, 50V, 100V	6.3V, 10V, 16V, 25V, 35V, 50V	4V, 6.3V, 10V, 16V, 25V, 35V, 50V
Capacitance Range*	1μF to 47μF	1μF to 100μF	1μF to 100μF	1μF to 220μF
Capacitance tolerance**	J(±5%),K(±10%), M(±20%)	K(±10%), M(±20%)	K(±10%), M(±20%)	K(±10%), M(±20%)
Tan δ*	Note 1			
Operating temperature	-55 to +125°C		-55 to +105°C	-55 to +85°C
Capacitance Characteristic	±15%	±22%	±22%	±15%
Termination	Cu or Ag/Ni/Sn or Au (lead-free termination)			

*Measured at the condition of 30~70% related humidity 25°C at ambient temperature.

X7R/X5R/X7S/X6S: Apply 1.0±0.2Vrms, 1.0KHz±10% for Cap.≤10μF; 0.5±0.2Vrms, 120Hz±20% for Cap.>10μF, 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.

X5R

Rated	D.F.≤	Exception of D.F.≤	
≥100V	≤2.5%	≤3%	1206≥0.47μF
		≤5%	0603≥0.068μF; 0805> 0.1μF; 1206≥1μF; 1210≥2.2μF
		≤10%	0805>0.22μF; 1210≥3.3μF
50V	≤2.5%	≤3%	0201(50V), 0603≥0.047μF, 0805≥0.18μF, 1206≥0.47μF
		≤5%	0201≥0.01μF; 1210≥3.3μF
		≤10%	0402≥0.012μF; 0603>0.1μF; 0805≥1μF; 1206≥2.2μF; 1210≥10μF
		≤12.5%	1206=10μF
35V	≤3.5%	≤10%	0603≥1μF; 0805≥2.2μF; 1206≥2.2μF; 1210≥10μF
25V	≤3.5%	≤5%	0201=0.01μF; 0805≥1μF
		≤7%	0603≥0.33μF
		≤10%	0201>0.01μF; 0402≥0.10μF; 0603≥0.47μF; 0805≥2.2μF; 1206≥4.7μF; 1210≥10μF
		≤12.5%	0402≥0.47μF; 0805=10μF
16V	≤3.5%	≤5%	0201=0.01μF; 0402≥0.033μF; 0603≥0.15μF; 0805≥0.68μF; 1206≥2.2μF; 1210≥4.7μF
		≤10%	0201>0.01μF; 0402≥0.22μF; 0603>0.47μF; 0805≥2.2μF; 1206≥4.7μF; 1210≥22μF
		≤12.5%	0402≥1μF; 0805=10μF
		≤10%	0201≥0.012μF; 0402≥0.22μF; 0603≥0.33μF; 0805≥2.2μF; 1206≥2.2μF; 1210≥22μF; 01R5/X5R
10V	≤5%	≤12.5%	0805=10μF
		≤15%	0201>0.1μF; 0402≥1μF; 0603≥10μF
		≤15%	0201>0.1μF; 0402≥1μF; 0603≥10μF; 0805≥4.7μF; 1206≥47μF; 1210≥100μF
6.3V	≤10%	≤20%	0402≥2.2μF
		—	—
4V	≤15%	—	—

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X7R

Rated	D.F.≤	Exception of D.F.≤	
		≤3.5%	1206≥0.47μF, 1812≥4.7μF, 1825≥4.7μF, 2220≥4.7μF, 2225≥4.7μF
≥100V	≤2.5%	≤5%	0603≥0.068μF; 0805 > 0.1μF; 1206≥1μF; 1210≥2.2μF
		≤10%	0805 > 0.22μF; 1210≥3.3μF
		≤3.5%	0201(50V), 0603≥0.047μF, 0805≥0.18μF, 1206≥0.47μF, 1210≥2.2μF, 1812≥4.7μF, 1825≥4.7μF, 2220≥4.7μF, 2225≥4.7μF
50V	≤2.5%	≤5%	0201≥0.01uF ; 1210≥3.3μF
		≤10%	0402≥0.012μF; 0603>0.1μF; 0805/X7R>0.47μF; 1206≥2.2μF; 1210≥10μF
		≤10%	0603≥1μF; 0805≥2.2μF; 1206≥2.2μF; 1210≥10μF
35V	≤3.5%	≤5%	0201≥0.01μF; 0805≥1μF ; 1210≥10μF
25V	≤3.5%	≤7%	0603≥0.33μF
		≤10%	0201≥0.1μF; 0402≥0.056μF; 0603≥0.47μF; 0805≥2.2μF; 1206≥4.7μF; 1210≥22μF
		≤12.5%	0402≥0.47μF
16V	≤ 3.5%	≤5%	0201≥0.01μF; 0402≥0.033μF; 0603≥0.15μF; 0805≥0.68μF; 1206≥2.2μF; 1210≥4.7μF
		≤10%	0201/X7R≥0.022μF; 0402≥0.22uF; 0603>0.47μF; 0805≥2.2μF; 1206≥4.7μF; 1210≥22μF
		≤10%	0201≥0.012μF; 0402≥0.22μF; 0603≥0.33μF; 0805≥2.2μF; 1206≥2.2μF; 1210≥22μF
10V	≤ 5%	≤15%	0201≥0.1μF; 0402≥1μF
		≤15%	0201≥0.1μF; 0402≥1μF; 0603≥10μF; 0805≥4.7μF; 1206≥47μF; 1210≥100μF
		≤20%	0402≥2.2μF
6.3V	≤10%	—	—
4V	≤15%	—	—

X7S

Rated	D.F.≤	Exception of D.F.≤	
		≤3.5%	1206≥0.47μF
≥100V	≤2.5%	≤5%	0603≥0.068μF; 0805> 0.1μF; 1206≥1μF; 1210≥2.2μF
		≤10%	0805>0.22μF; 1210≥3.3μF
		≤3.5%	0201(50V), 0603≥0.047μF, 0805≥0.18μF, 1206≥0.47μF
50V	≤2.5%	≤5%	0201≥0.01uF ; 1210≥3.3μF
		≤10%	0402≥0.012μF; 0603>0.1μF; 0805≥1μF; 1206≥2.2μF; 1210≥10μF
		≤10%	0603≥1μF; 0805≥2.2μF; 1206≥2.2μF; 1210≥10μF
35V	≤3.5%	≤5%	0201≥0.01μF; 0805≥1μF ; 1210≥10μF
25V	≤3.5%	≤7%	0603≥0.33μF
		≤10%	0201≥0.1μF; 0402≥0.10μF; 0603≥0.47μF; 0805≥2.2μF; 1206≥4.7μF; 1210≥22μF
		≤12.5%	0402≥0.47μF
16V	≤ 3.5%	≤5%	0201≥0.01μF;0402≥0.033μF;0603≥0.15μF; 0805≥0.68μF;1206≥2.2μF;1210≥4.7μF
		≤10%	0201≥0.1uF; 0402≥0.22uF; 0603>0.47μF;0805≥2.2μF;1206≥4.7μF; 1210≥22μF
		≤10%	0201≥0.012μF; 0402≥0.22μF; 0603≥0.33μF; 0805≥2.2μF; 1206≥2.2μF; 1210≥22μF
10V	≤ 5%	≤15%	0201≥0.1μF; 0402≥1μF
		≤15%	0201≥0.1μF; 0402≥1μF; 0603≥10μF; 0805≥4.7μF; 1206≥47μF; 1210≥100μF
		≤20%	0402≥2.2μF
6.3V	≤10%	—	—
4V	≤15%	—	—

X6S

Rated	D.F.≤	Exception of D.F.≤	
		≤3.5%	1206≥0.47μF
≥100V	≤2.5%	≤5%	0603≥0.068μF; 0805> 0.1μF; 1206≥1μF; 1210≥2.2μF
		≤10%	0805> 0.22μF; 1210≥3.3μF
		≤3.5%	0201(50V), 0603≥0.047μF, 0805≥0.18μF, 1206≥0.47μF
50V	≤2.5%	≤5%	0201≥0.01uF ; 1210≥3.3μF
		≤10%	0402≥0.012μF; 0603>0.1μF; 0805≥1μF; 1206≥2.2μF; 1210≥10μF
		≤10%	0603≥1μF; 0805≥2.2μF; 1206≥2.2μF; 1210≥10μF
35V	≤3.5%	≤5%	0201≥0.01μF; 0805≥1μF ; 1210≥10μF
25V	≤3.5%	≤7%	0603≥0.33μF
		≤10%	0201≥0.1μF; 0402≥0.10μF; 0603≥0.47μF; 0805≥2.2μF; 1206≥4.7μF; 1210≥22μF
		≤12.5%	0402≥0.47μF;0805=10μF
		≤5%	0201≥0.01μF;0402≥0.033μF;0603≥0.15μF; 0805≥0.68μF;1206≥2.2μF;1210≥4.7μF
16V	≤ 3.5%	≤10%	0201≥0.1uF; 0402≥0.22uF; 0603>0.47μF;0805≥2.2μF;1206≥4.7μF; 1210≥22μF
		≤12.5%	0402=1μF;0805=10μF
		≤10%	0201≥0.012μF; 0402≥0.22μF; 0603≥0.33μF; 0805≥2.2μF; 1206≥2.2μF; 1210≥22μF
10V	≤ 5%	≤12.5%	0805=10μF
		≤15%	0201≥0.1μF; 0402≥1μF
		≤15%	0201≥0.1μF; 0402≥0.47μF; 0603≥10μF; 0805≥4.7μF; 1206≥47μF; 1210≥100μF
6.3V	≤10%	—	—
4V	≤15%	—	—

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7. Relationship Between Capacitance and Thickness at Rated Voltage

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

Cap (pF)	Size, Inch (mm)	0402 (1005)						0603 (1608)					0805 (2012)					1206 (3216)							
	Cap Code	6.3V	6.3V	10V	16V	25V	50V	6.3V	10V	16V	25V	50V	6.3V	10V	16V	25V	50V	6.3V	10V	16V	25V	35V	50V	100V	
1,000,000	105	N	B	B	B	B	B		C	C	C	I		J	J	J		J	J	J		P	P		
1,200,000	125																				P		P	E/P	
1,500,000	155								I	I	I		J	J	J					P		P	E/P		
1,800,000	185																				P		P	P	
2,200,000	225		B	B	B			I	I	I	I	I	J	J	J					P		P	P		
2,700,000	275																								
3,300,000	335																		P	P	P				
3,900,000	395																								
4,700,000	475		B					I	I	I	I		P	P	P					P		P			
5,600,000	565																								
6,800,000	685																								
8,200,000	825																								
10,000,000	106							I	I	I			P	P	P					P		P			
12,000,000	126																								
15,000,000	156																								
18,000,000	186																								
22,000,000	226																	P	P	P*					
47,000,000	476																								

Cap (pF)	Size, Inch (mm)	1210 (3225)						1812 (4532)								1825 (4563)				
	Cap Code	6.3V	10V	16V	25V	50V	100V	10V	16V	25V	50V	100V	200V	250V	450V	25V	50V	100V	200V	250V
1,000,000	105		C	C	C	C	F	C	C	C	F	F	G	G	H	F	F	F	F	F
1,200,000	125				P	P/G	F/G			C	C	C				F	F	F	F	G
1,500,000	155			E	E	G	G			C	C	C				F	F	F	F	G
1,800,000	185					G	G			E	E	E				F	F	F	F	G
2,200,000	225			E	E/G	G	G			E	E	E				F	F	F	F	G
2,700,000	275					G	G			F	F	F				F	F	F	F	
3,300,000	335			E	E/G	G	G			F	F	F				F	F	F	F	
3,900,000	395					G	G			F	F	F				F	F	F	F	
4,700,000	475		F	F	F/G	F/G	G			G	G	G				F	F	F	F	
5,600,000	565					G	G			G	G					F	F	F	F	
6,800,000	685					G	G			G	G					F	F	F	F	
8,200,000	825					G	G			G	G					G	G	G	G	
10,000,000	106		F	F	F/G	G				G	G					G	G	G	G	
12,000,000	126									G										
15,000,000	156									G										
18,000,000	186									G										
22,000,000	226									G										
47,000,000	476	G	G																	

Cap (pF)	Size, Inch (mm)	2220 (5750)							2225 (5763)						
	Cap Code	25V	50V	100V	200V	250V	500V	630V	25V	50V	100V	200V	250V	500V	630V
1,000,000	105	F	F	F	F	F	H	H	F	F	F	F	F		
1,200,000	125	F	F	F	G	G			F	F	F	G	G		
1,500,000	155	F	F	F	G	G			F	F	F	G	G		
1,800,000	185	F	F	F	G	G			F	F	F	G	G		
2,200,000	225	F	F	F	G	G			F	F	F	G	G		
2,700,000	275	F	F	F					F	F	F	G	G		
3,300,000	335	F	F	F					F	F	F				
3,900,000	395	F	F	F					F	F	F				
4,700,000	475	F	F	F					F	F	F				
5,600,000	565	F	F	F					F	F	F				
6,800,000	685	F	F	F					F	F	F				
8,200,000	825	G	G	G					G	G	G				
10,000,000	106	G	G	G					G	G	G				
12,000,000	126	H	H						F/G						
15,000,000	156	H	H						F/G						
18,000,000	186	H	H												
22,000,000	226	H	H												
27,000,000	276	H													
33,000,000	336	H													
39,000,000	496	H													
47,000,000	476	R													

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7.2 X7S (Capacitance vs. thickness, refer to table 8 for the thickness)

Cap (pF)	Size, Inch (mm)	0402 (1005)				0603 (1608)					0805 (2012)						1206 (3216)				1210 (3225)						
		Cap Code	6.3V	10V	16V	25V	4V	6.3V	10V	16V	25V	4V	6.3V	10V	16V	25V	50V	100V	6.3V	10V	16V	25V	6.3V	10V	16V	25V	
1,000,000	105		K																								
1,500,000	155																										
2,200,000	225		K																								
2,700,000	275																										
3,300,000	335																										
3,900,000	395																										
4,700,000	475																										
6,800,000	685																										
10,000,000	106																										
22,000,000	226																										
47,000,000	476																										
100,000,000	107																										
220,000,000	227																										

“*” Means M tolerance only

7.3 X6S (Capacitance vs. thickness, refer to table 8 for the thickness)

Cap (pF)	Size, Inch (mm)	0201 (0603)		0402 (1005)				0603 (1608)					0805 (2012)					1206 (3216)				1210 (3225)						
		Cap Code	4V	6.3V	6.3V	10V	16V	25V	4V	6.3V	10V	16V	25V	4V	6.3V	10V	16V	25V	50V	6.3V	10V	16V	25V	6.3V	10V	16V	25V	100V
1,000,000	105					N	N	N	K																			
1,500,000	155																											
2,200,000	225					K	K	K																				
3,300,000	335																											
4,700,000	475																											
6,800,000	685																											
10,000,000	106					K																						
22,000,000	226																											
47,000,000	476																											
100,000,000	107																											
220,000,000	227																											

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

Cap (pF)	Size, Inch (mm)	0201 (0603)			0402 (1005)					0603 (1608)					0805 (2012)					1206 (3216)									
		Cap Code	6.3V	10V	16V	4V	6.3V	10V	16V	25V	50V	4V	6.3V	10V	16V	25V	50V	4V	6.3V	10V	16V	25V	50V	4V	6.3V	10V	16V	25V	50V
1,000,000	105	L*	L*	L*		N	N	N	N																				
1,500,000	155																												
2,200,000	225	L*	L*			N	N	K	K																				
3,300,000	335																												
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47,000,000	476																												
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220,000,000	227																												

Cap (pF)	Size, Inch (mm)	1210 (3225)						
		Cap Code	4V	6.3V	10V	16V	25V	35V
1,000,000	105							
1,500,000	155			F	F			
2,200,000	225			F	F			
3,300,000	335							
4,700,000	475			F	F	F		
6,800,000	685							
10,000,000	106		F	F	F	F	G	G
22,000,000	226		G	G	G	G	G	
47,000,000	476		G	G	G	G*		
100,000,000	107		G*	G*	G*			
220,000,000	227	G*	G*					

High Capacitance Multilayer Ceramic Chip Capacitors

AFS 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. * X7R:																																																										
3	Q/ D.F. (Tangent of loss angle)	<p>* Class II : (X7R, X5R, X7S,X6S) 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: 0805=106(6.3V), 0603/475(6.3V) X5R: 0201≥224 (6.3V,10V,16V)^{#1}, 0402≥475 (6.3V,16V), 0402≥225(10V), 0603=106 (6.3V) TT18X≥475(10V) , TT15X series X6S: 0201/474(4V),0201≥104 (6.3V,10V)^{#1}, 0402≥225 (6.3V), 0402/475 (10V), 0603/106 (6.3V) X7S: 0402/225(6.3V) #1 Excluding X5R/0201/105(6.3V);225(10V), X6S/0201/104(10V) (1.0±0.2Vrms, 1KHz±10%) * Before initial measurement (Class II only) : To apply de-aging at 150°C for 1hr then set for 24±2 hrs at room temp.</p>	<table border="1"> <thead> <tr> <th>Rated</th> <th>D.F.≤</th> <th colspan="2">Exception of D.F.≤</th> </tr> </thead> <tbody> <tr> <td rowspan="3">≥100V</td> <td rowspan="3">≤2.5%</td> <td>≤3.5%</td> <td>1206≥0.47μF, 1812≥4.7μF, 1825≥4.7μF, 2220≥4.7μF, 2225≥4.7μF</td> </tr> <tr> <td>≤5%</td> <td>0603≥0.068μF; 0805> 0.1μF; 1206≥1μF; 1210≥2.2μF</td> </tr> <tr> <td>≤10%</td> <td>0805> 0.22μF; 1210≥3.3μF</td> </tr> <tr> <td rowspan="3">50V</td> <td rowspan="3">≤2.5%</td> <td>≤3.5%</td> <td>0201(50V), 0603≥0.047μF, 0805≥0.18μF, 1206≥0.47μF, 1210≥2.2μF, 1812≥4.7μF, 1825≥4.7μF, 2220≥4.7μF, 2225≥4.7μF</td> </tr> <tr> <td>≤5%</td> <td>0201≥0.01μF;1210≥4.7μF</td> </tr> <tr> <td>≤10%</td> <td>0402≥0.012μF; 0603>0.1μF; 0805≥1μF; 1206≥2.2μF; 1210≥10μF</td> </tr> <tr> <td>35V</td> <td>≤3.5%</td> <td>≤10%</td> <td>0603≥1μF; 0805≥2.2μF; 1206≥2.2μF; 1210≥10μF</td> </tr> <tr> <td rowspan="3">25V</td> <td rowspan="3">≤3.5%</td> <td>≤5%</td> <td>0201≥0.01μF; 0805≥1μF ; 1210≥10μF</td> </tr> <tr> <td>≤7%</td> <td>0603≥0.33μF</td> </tr> <tr> <td>≤10%</td> <td>0201≥0.1μF; 0402≥0.056μF; 0603≥0.47μF; 0805≥2.2μF; 1206≥2.2μF; 1210≥22μF</td> </tr> <tr> <td rowspan="3">16V</td> <td rowspan="3">≤3.5%</td> <td>≤5%</td> <td>0402≥0.47μF,0805=10μF</td> </tr> <tr> <td>≤10%</td> <td>0201≥0.01μF; 0402≥0.033μF; 0603≥0.15μF; 0805≥0.68μF; 1206≥2.2μF; 1210≥4.7μF</td> </tr> <tr> <td>≤12.5%</td> <td>0201≥0.1μF(0201/X7R≥0.022μF); 0402≥0.22μF; 0603>0.15μF; 0805≥2.2μF; 1206≥4.7μF; 1210≥22μF</td> </tr> <tr> <td rowspan="3">10V</td> <td rowspan="3">≤5%</td> <td>≤10%</td> <td>0402= 0.47μF,0805=10μF</td> </tr> <tr> <td>≤12.5%</td> <td>0201≥0.12μF; 0402≥0.33μF(0402/X7R≥0.022μF); 0603≥0.33μF; 0805≥2.2μF; 1206≥2.2μF; 1210≥22μF</td> </tr> <tr> <td>≤15%</td> <td>0201≥0.1μF; 0402≥1μF;0603≥10μF</td> </tr> <tr> <td rowspan="2">6.3V</td> <td rowspan="2">≤10%</td> <td>≤15%</td> <td>0201≥0.1μF; 0402≥1μF; 0603≥10μF; 0805≥4.7μF; 1206≥47μF; 1210≥100μF</td> </tr> <tr> <td>≤20%</td> <td>0402≥2.2μF</td> </tr> <tr> <td>4V</td> <td>≤15%</td> <td>—</td> <td>—</td> </tr> </tbody> </table>	Rated	D.F.≤	Exception of D.F.≤		≥100V	≤2.5%	≤3.5%	1206≥0.47μF, 1812≥4.7μF, 1825≥4.7μF, 2220≥4.7μF, 2225≥4.7μF	≤5%	0603≥0.068μF; 0805> 0.1μF; 1206≥1μF; 1210≥2.2μF	≤10%	0805> 0.22μF; 1210≥3.3μF	50V	≤2.5%	≤3.5%	0201(50V), 0603≥0.047μF, 0805≥0.18μF, 1206≥0.47μF, 1210≥2.2μF, 1812≥4.7μF, 1825≥4.7μF, 2220≥4.7μF, 2225≥4.7μF	≤5%	0201≥0.01μF;1210≥4.7μF	≤10%	0402≥0.012μF; 0603>0.1μF; 0805≥1μF; 1206≥2.2μF; 1210≥10μF	35V	≤3.5%	≤10%	0603≥1μF; 0805≥2.2μF; 1206≥2.2μF; 1210≥10μF	25V	≤3.5%	≤5%	0201≥0.01μF; 0805≥1μF ; 1210≥10μF	≤7%	0603≥0.33μF	≤10%	0201≥0.1μF; 0402≥0.056μF; 0603≥0.47μF; 0805≥2.2μF; 1206≥2.2μF; 1210≥22μF	16V	≤3.5%	≤5%	0402≥0.47μF,0805=10μF	≤10%	0201≥0.01μF; 0402≥0.033μF; 0603≥0.15μF; 0805≥0.68μF; 1206≥2.2μF; 1210≥4.7μF	≤12.5%	0201≥0.1μF(0201/X7R≥0.022μF); 0402≥0.22μF; 0603>0.15μF; 0805≥2.2μF; 1206≥4.7μF; 1210≥22μF	10V	≤5%	≤10%	0402= 0.47μF,0805=10μF	≤12.5%	0201≥0.12μF; 0402≥0.33μF(0402/X7R≥0.022μF); 0603≥0.33μF; 0805≥2.2μF; 1206≥2.2μF; 1210≥22μF	≤15%	0201≥0.1μF; 0402≥1μF;0603≥10μF	6.3V	≤10%	≤15%	0201≥0.1μF; 0402≥1μF; 0603≥10μF; 0805≥4.7μF; 1206≥47μF; 1210≥100μF	≤20%	0402≥2.2μF	4V	≤15%	—	—
			Rated	D.F.≤	Exception of D.F.≤																																																								
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High Capacitance Multilayer Ceramic Chip Capacitors

AFS Category

No.	Item	AEC-Q200 Test Condition	Requirements																																																												
3	Q/ D.F. (Tangent of loss angle)	* Class II : (X7R, X5R, X7S, X6S) 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: 0805=106(6.3V), 0603/475(6.3V) X5R: 0201≥224 (6.3V,10V,16V ^{#1}), 0402≥475 (6.3V,16V), 0402≥225(10V), 0603=106 (6.3V) TT18X≥475(10V), TT15X series X6S: 0201/474(4V),0201≥104 (6.3V,10V ^{#1}), 0402≥225 (6.3V), 0402/475 (10V), 0603/106 (6.3V) X7S: 0402/225(6.3V) #1 Excluding X5R/0201/105(6.3V);225(10V), X6S/0201/104(10V) (1.0±0.2Vrms, 1KHz±10%) *Before initial measurement (Class II only) : To apply de-aging at 150°C for 1hr then set for 24±2 hrs at room temp.	* Shall not exceed the limits given in the detailed spec. * X7S: <table border="1" style="width: 100%; border-collapse: collapse; margin-top: 10px;"> <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">≥100V</td> <td rowspan="3">≤2.5%</td> <td>≤3.5%</td> <td>1206≥0.47μF</td> </tr> <tr> <td>≤5%</td> <td>0603≥0.068μF; 0805>0.1μF; 1206≥1μF; 1210≥2.2μF</td> </tr> <tr> <td>≤10%</td> <td>0805≥0.22μF; 1210≥3.3μF</td> </tr> <tr> <td rowspan="3">50V</td> <td rowspan="3">≤2.5%</td> <td>≤3%</td> <td>0201(50V), 0603≥0.047μF, 0805≥0.18μF, 1206≥0.47μF</td> </tr> <tr> <td>≤5%</td> <td>0201≥0.01uF ;1210≥3.3μF</td> </tr> <tr> <td>≤10%</td> <td>0402≥0.012μF; 0603>0.1μF; 0805≥1μF; 1206≥2.2μF; 1210≥10μF</td> </tr> <tr> <td>35V</td> <td>≤3.5%</td> <td>≤10%</td> <td>0603≥1μF; 0805≥2.2μF; 1206≥2.2μF; 1210≥10μF</td> </tr> <tr> <td rowspan="4">25V</td> <td rowspan="4">≤3.5%</td> <td>≤5%</td> <td>0201≥0.01μF ;0805≥1μF ;1210≥10μF</td> </tr> <tr> <td>≤7%</td> <td>0603≥0.33μF</td> </tr> <tr> <td>≤10%</td> <td>0201≥0.1μF; 0402≥0.10μF; 0603≥0.47μF; 0805≥2.2μF; 1206≥4.7μF; 1210≥22μF</td> </tr> <tr> <td>≤12.5%</td> <td>0402≥0.47μF</td> </tr> <tr> <td rowspan="2">16V</td> <td rowspan="2">≤3.5%</td> <td>≤5%</td> <td>0201≥0.01μF;0402≥0.033μF;0603≥0.15μF; 0805≥0.68μF;1206≥2.2μF;1210≥4.7μF</td> </tr> <tr> <td>≤10%</td> <td>0201≥0.1uF; 0402≥0.22uF; 0603>0.47μF;0805≥2.2μF;1206≥4.7μF; 1210≥22μF</td> </tr> <tr> <td rowspan="2">10V</td> <td rowspan="2">≤5%</td> <td>≤10%</td> <td>0201≥0.012μF; 0402≥0.22μF; 0603≥0.33μF; 0805≥2.2μF; 1206≥2.2μF; 1210≥22μF</td> </tr> <tr> <td>≤15%</td> <td>0201≥0.1μF; 0402≥1μF</td> </tr> <tr> <td rowspan="2">6.3V</td> <td rowspan="2">≤10%</td> <td>≤15%</td> <td>0201≥0.1μF; 0402≥1μF; 0603≥10μF; 0805≥4.7μF; 1206≥47μF; 1210≥100μF</td> </tr> <tr> <td>≤20%</td> <td>0402≥2.2μF</td> </tr> <tr> <td>4V</td> <td>≤15%</td> <td>—</td> <td>—</td> </tr> </tbody> </table>	Rated Vol.	D.F.≤	Exception of D.F.≤		≥100V	≤2.5%	≤3.5%	1206≥0.47μF	≤5%	0603≥0.068μF; 0805>0.1μF; 1206≥1μF; 1210≥2.2μF	≤10%	0805≥0.22μF; 1210≥3.3μF	50V	≤2.5%	≤3%	0201(50V), 0603≥0.047μF, 0805≥0.18μF, 1206≥0.47μF	≤5%	0201≥0.01uF ;1210≥3.3μF	≤10%	0402≥0.012μF; 0603>0.1μF; 0805≥1μF; 1206≥2.2μF; 1210≥10μF	35V	≤3.5%	≤10%	0603≥1μF; 0805≥2.2μF; 1206≥2.2μF; 1210≥10μF	25V	≤3.5%	≤5%	0201≥0.01μF ;0805≥1μF ;1210≥10μF	≤7%	0603≥0.33μF	≤10%	0201≥0.1μF; 0402≥0.10μF; 0603≥0.47μF; 0805≥2.2μF; 1206≥4.7μF; 1210≥22μF	≤12.5%	0402≥0.47μF	16V	≤3.5%	≤5%	0201≥0.01μF;0402≥0.033μF;0603≥0.15μF; 0805≥0.68μF;1206≥2.2μF;1210≥4.7μF	≤10%	0201≥0.1uF; 0402≥0.22uF; 0603>0.47μF;0805≥2.2μF;1206≥4.7μF; 1210≥22μF	10V	≤5%	≤10%	0201≥0.012μF; 0402≥0.22μF; 0603≥0.33μF; 0805≥2.2μF; 1206≥2.2μF; 1210≥22μF	≤15%	0201≥0.1μF; 0402≥1μF	6.3V	≤10%	≤15%	0201≥0.1μF; 0402≥1μF; 0603≥10μF; 0805≥4.7μF; 1206≥47μF; 1210≥100μF	≤20%	0402≥2.2μF	4V	≤15%	—	—				
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High Capacitance Multilayer Ceramic Chip Capacitors

AFS Category

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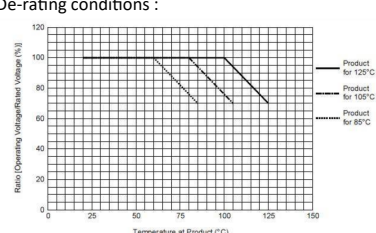
High Capacitance Multilayer Ceramic Chip Capacitors

AFS Category

No.	Item	AEC-Q200 Test Condition	Requirements															
7	Solderability	* Solder temperature : 235±5°C for (0201~1210). * Solder temperature : 245±5°C for (1808~2225). * Dipping time : 2±0.5 sec.	* 75% min. coverage of all metalized area.															
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-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 48±4 hrs (Class II).	* No remarkable damage. * Cap. change : X7R/X7S/X6S/X5R : 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: 10px auto; border-collapse: collapse;"> <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-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 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 : X7R ,X5R,X7S,X6S: Within ±7.5%. * D.F. : ≤150% of initial requirement. * I.R. : ≥100% of initial requirement.
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4	Room temp.	2~3																
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-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 48±4 hrs (Class II).	* No remarkable damage. * Cap. change : 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. * D.F. : ≤200% of initial requirement. * I.R. : ≥10V, ≥1GΩ or RxC≥500-F, whichever is smaller. Except : <table border="1" style="margin: 10px auto; border-collapse: collapse;"> <thead> <tr> <th>Rated Voltage</th> <th>I.R.</th> </tr> </thead> <tbody> <tr> <td>100V : All X7R ;1210≥3.3μF</td> <td rowspan="7" style="text-align: center; vertical-align: middle;">≥1GΩ or RxC≥10Ω-F, whichever is smaller</td> </tr> <tr> <td>50V : 0402>0.01μF, 0603≥1μF, 0805≥1μF, 1206≥4.7μF, 1210≥4.7μF</td> </tr> <tr> <td>35V : 0603≥1μF, 0805≥2.2μF, 1206≥2.2μF, 1210≥10μF</td> </tr> <tr> <td>25V : 0201≥0.1uF, 0402≥0.22μF, 0603≥2.2μF, 0805≥2.2μF, 1206≥10μF, 1210≥10μF</td> </tr> <tr> <td>16V : 0201≥0.1uF, 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; All X6S/X7S items; Size≥1812</td> </tr> </tbody> </table>	Rated Voltage	I.R.	100V : All X7R ;1210≥3.3μF	≥1GΩ or RxC≥10Ω-F, whichever is smaller	50V : 0402>0.01μF, 0603≥1μF, 0805≥1μF, 1206≥4.7μF, 1210≥4.7μF	35V : 0603≥1μF, 0805≥2.2μF, 1206≥2.2μF, 1210≥10μF	25V : 0201≥0.1uF, 0402≥0.22μF, 0603≥2.2μF, 0805≥2.2μF, 1206≥10μF, 1210≥10μF	16V : 0201≥0.1uF, 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; All X6S/X7S items; Size≥1812					
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11	Humidity (Damp Heat) Load	* Test temp. : 40±2°C. * Humidity : 90~95%RH. * Test time : 500 +24/-0hrs. * To apply voltage : Rated voltage (500V max.). * 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 48±4 hrs (Class II).	* No remarkable damage. * Cap. change : 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. * D.F. : ≤200% of initial requirement. * I.R. : ≥10V, ≥500MGΩ or RxC≥25Ω-F, whichever is smaller. Except : <table border="1" style="margin: 10px auto; border-collapse: collapse;"> <thead> <tr> <th>Rated Voltage</th> <th>I.R.</th> </tr> </thead> <tbody> <tr> <td>≥100V : All X7R ;1210≥3.3μF</td> <td rowspan="7" style="text-align: center; vertical-align: middle;">≥500MΩ or RxC≥5Ω-F, whichever is smaller</td> </tr> <tr> <td>50V : 0402>0.01μF, 0603≥1μF, 0805≥1μF, 1206≥4.7μF, 1210≥4.7μF</td> </tr> <tr> <td>35V : 0603≥1μF, 0805≥2.2μF, 1206≥2.2μF, 1210≥10μF</td> </tr> <tr> <td>25V : 0201≥0.1uF, 0402≥0.22μF, 0603≥2.2μF, 0805≥2.2μF, 1206≥10μF, 1210≥10μF</td> </tr> <tr> <td>16V : 0201≥0.1uF, 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; All X6S/X7S items; Size≥1812</td> </tr> </tbody> </table>	Rated Voltage	I.R.	≥100V : All X7R ;1210≥3.3μF	≥500MΩ or RxC≥5Ω-F, whichever is smaller	50V : 0402>0.01μF, 0603≥1μF, 0805≥1μF, 1206≥4.7μF, 1210≥4.7μF	35V : 0603≥1μF, 0805≥2.2μF, 1206≥2.2μF, 1210≥10μF	25V : 0201≥0.1uF, 0402≥0.22μF, 0603≥2.2μF, 0805≥2.2μF, 1206≥10μF, 1210≥10μF	16V : 0201≥0.1uF, 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; All X6S/X7S items; Size≥1812					
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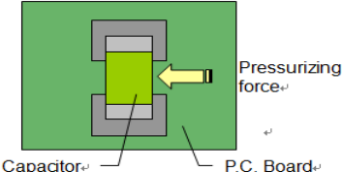
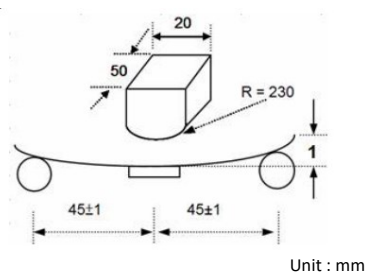
High Capacitance Multilayer Ceramic Chip Capacitors

AFS Category

No.	Item	AEC-Q200 Test Condition	Requirements																																																																			
12	High Temperature Load (Endurance)	* Test temp. : X7R,X7S : 125±3°C. X6S: 105±3°C * To apply voltage : (1)10V≤U _r ≤100V : 200% of rated voltage. or ≤6.3V or Cap.≥10μF : 150% of rated voltage. (2)200V≤U _r ≤500V : 150% of rated voltage. (3)=630V : 120% of rated voltage (4)100% of rated voltage for below range :	Requirements * No remarkable damage. * Cap. change : 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. * D.F.(Class II) : ≤200% of initial requirement. * I.R. : ≥10V, ≥1GΩ or RxC≥50Ω-F, whichever is smaller. Except :																																																																			
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1206	X5R/X7R/X7S/X6S	≤6.3V	C≥47μF																																																																			
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High Capacitance Multilayer Ceramic Chip Capacitors

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No.	Item	AEC-Q200 Test Condition	Requirements				
13	Adhesive Strength of Termination (Robustness of termination)	<p>* Capacitors mounted on a substrate. A force of 5N (≤ 0603) or 10N (> 0603) applied perpendicular to the place of substrate and parallel the line joining the center of terminations for 10 ± 1 second.</p>  <p style="text-align: center;">Capacitor P.C. Board</p>	* No remarkable damage or removal of the terminations				
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: center;">Unit : mm</p>	<p style="text-align: center;">* No remarkable damage.</p> <table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th style="width: 50%;">Dielectric</th> <th style="width: 50%;">Cap.Change</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">X7R, X5R, X7S, X6S</td> <td style="text-align: center;">Within $\pm 12.5\%$</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	X7R, X5R, X7S, X6S	Within $\pm 12.5\%$
Dielectric	Cap.Change						
X7R, X5R, X7S, X6S	Within $\pm 12.5\%$						
15	Vibration Resistance	<p>* Vibration frequency : $10 \sim 55$ 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 48 ± 4 hrs (Class II).</p>	<p>* No remarkable damage. * Cap. change and D.F. : To meet initial spec.</p>				

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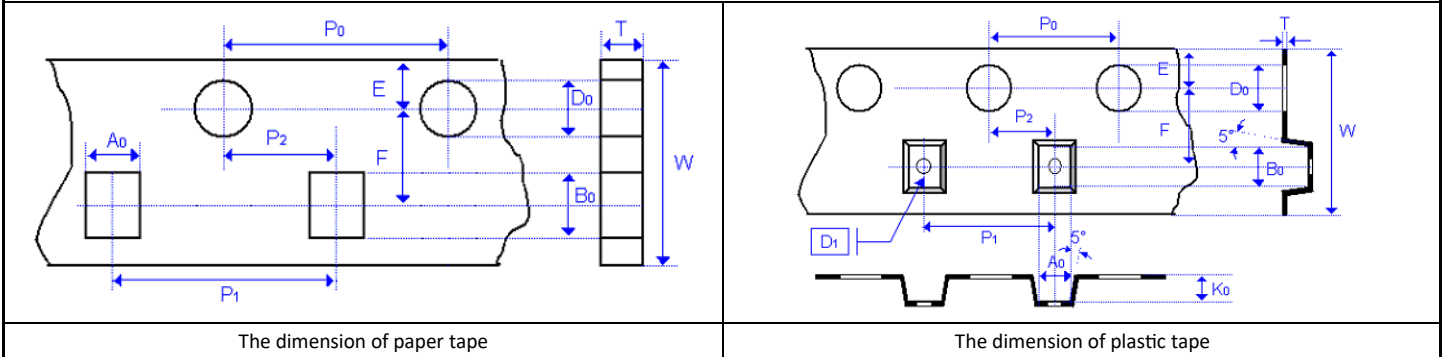
9. Package Dimension and Quantity:

Size, Inch (mm)	Thickness (mm)	Paper tape		Plastic tape	
		7" reel	13" reel	7" reel	13" reel
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	-	-	-	1k
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)	0201 (0603)	0402 (1005)	0603 (1608)	0805 (2012)	
Chip Thickness	0.30±0.03	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	0.40±0.10	0.70±0.20	1.50 +0.30	1.50±0.20	<1.80
B ₀	0.70±0.10	1.20±0.20	1.80±0.30	2.30±0.20	<2.70
T	≤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±0.10	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
10xP ₀	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	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
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
D ₁	-	-	-	-	1.00±0.10
E	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
Unit :	mm	mm	mm	mm	mm

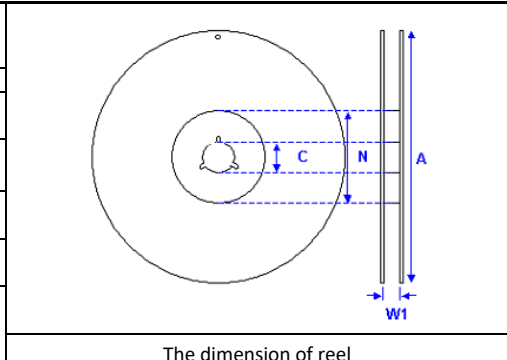
Size, Inch (mm)	1206 (3216)			1210 (3225)		1812 (4532)	
Chip Thickness	0.80±0.10	0.95±0.10 1.25±0.10	1.60±0.20 1.60+0.3/-0/1	0.95±0.10 1.25±0.10 1.60±0.20	2.50±0.30	1.25±0.10 1.60±0.20 2.00±0.20	2.50±0.30 2.80±0.30
A ₀	2.00±0.10	<2.00	<2.50	<3.05	<3.20	<3.90	<3.90
B ₀	3.50±0.50	<3.70	<4.00	<3.80	<4.00	<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	<3.00
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	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
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

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Size, Inch (mm)	1825 (4563)		2220 (5750)			2225 (5763)	
Chip Thickness	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	3.10±0.30	1.60±0.20 2.00±0.20	2.50±0.30 2.80±0.30
A ₀	<6.80	<6.80	<5.80	<6.80	<5.60	<6.80	<6.80
B ₀	<5.30	<5.30	<6.50	<6.50	<6.50	<6.50	<6.50
T	0.30±0.10	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	<3.10	<2.50	<3.10	<4.20	<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
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	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
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
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
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	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

9.2 Reel Dimensions

Size	0201, 0402, 0603, 0805, 1206, 1210		1808, 1812, 1825, 2220, 2225	2220, 2225	
	Reel size	7"	13"	7"	
C	13.0 +0.5/-0.2	13.0 +0.7/-0.3	13.0 +0.5/-0.2	13.0 +0.5	
W ₁	8.4 +1.5	8.4 +1.5	12.2 +2.0/-0	12.2 +2.0/-0	
W	14.4max	14.4max	shall accommodate tape width without interference		
A	178.0 ±0.20	330.0 ±1.0	178.0 ±0.10	330.0 ±1.0	
N	60.0 ±1.0/-0	100 ±1.0	60.0 ±1.0/-0	100 ±1.0	

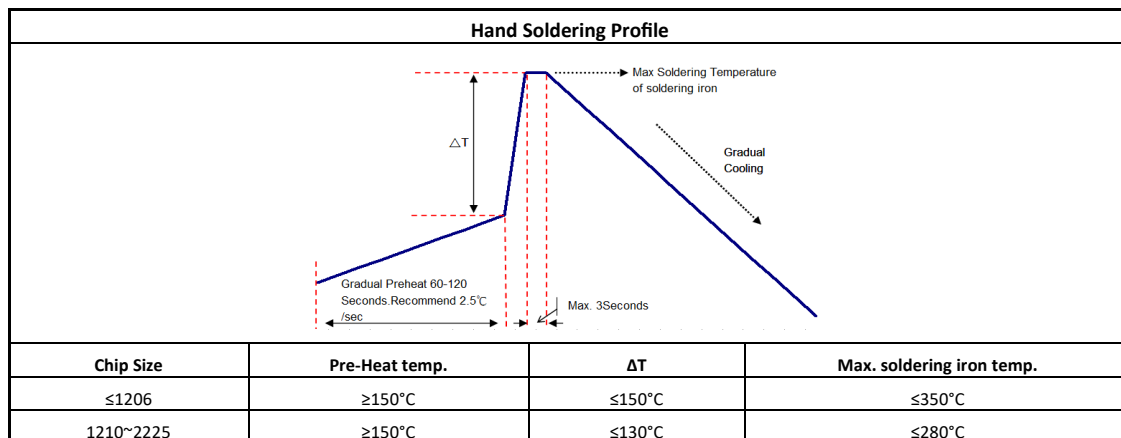
10. Recommended Soldering Conditions:

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:

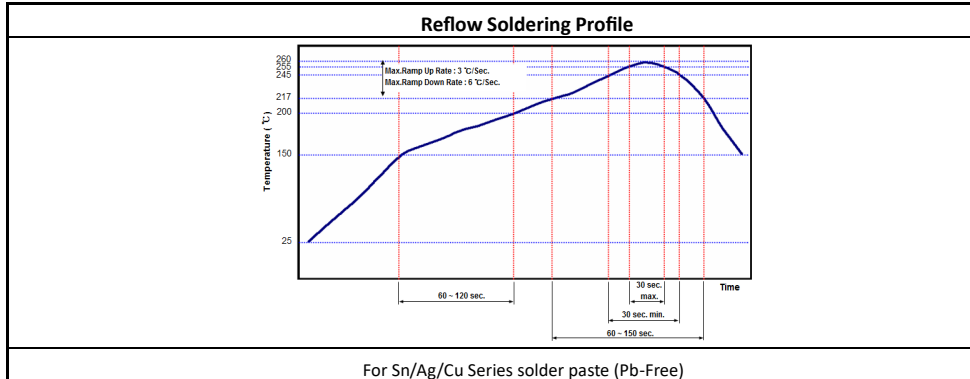


- * Soldering iron tip diameter ≤1.0 mm and wattage max. 20W.
- * The Capacitors shall be pre-heated and that the temperature gradient between the devices and the tip of the soldering iron.
- * The required amount of solder shall be melted on the soldering tip.
- * The tip of iron should not contact the ceramic body directly.
- * The Capacitors shall be cooled gradually at room temperature after soldering.
- * Forced air cooling is not allowed.

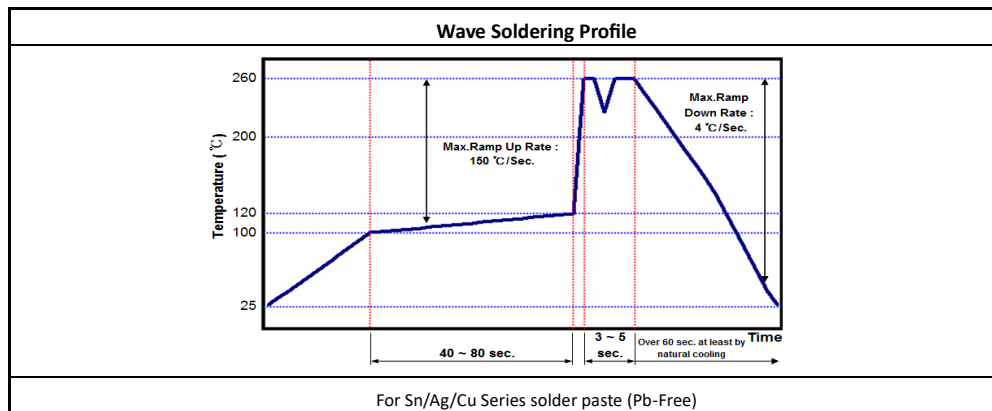
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10.3 Reflow soldering :



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 :

The solder climbing minimum height is suggesting to 25% of chip thickness or 500um whichever is less.
(Reference from IPC-610E)



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.

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Disclaimer:

Specifications are subject to change without notice. AEM products are designed for specific applications and should not be used for any purpose (including, without limitation, automotive, aerospace, medical, life-saving applications, or any other application which requires especially high reliability for the prevention of such defect as may directly cause damage to the third party's life, body or property) not expressly set forth in applicable AEM product documentation. It is the customer's responsibility to validate that a particular product with the properties described in the product specification is suitable for use in a particular application. Warranties granted by AEM shall be deemed void for products used for any purpose not expressly set forth in applicable AEM product documentation. AEM shall not be liable for any claims or damages arising out of products used in applications not expressly intended by AEM as set forth in applicable AEM product documentation. The sale and use of AEM products is subject to AEM terms and conditions of sale. Please refer to AEM's website for updated catalog and terms and conditions of sale.

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