

# Medium Voltage Multilayer Ceramic Chip Capacitors

## AFM Category

### 1. Introduction:

AFM 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. Higher performances are built-in through exact formulation of dielectric powders, preparation of conductive paste, advanced automatic manufacturing, and strict quality control to assure excellent control in dielectric thickness, electrode integrity, and electrode-to-termination continuity.

### 2. Features:

- Medium voltage in a given case size
- High reliability and stability
- RoHS & HALOGEN compliant

### 3. Applications:

- DC to DC converter
- High voltage coupling/DC blocking
- Back-lighting inverters
- Snubbers in high frequency power converters

### 4. Production Identification:

AFM	0402	N	R47	J	201	D	A	C
Product Category Code	Chip 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

Code	Description
AFM	Medium Voltage MLCC (from 100V to 630V)

Description	Description	Description
0402 (1005)	1210 (3225)	2211 (5728)
0603 (1608)	1808 (4520)	2220 (5750)
0805 (2012)	1812 (4532)	2225 (5763)
1206 (3216)	1825 (4563)	

Code	Description	Code	Description
N	COG	X	X7R

Code	Chip Capacitance	Code	Chip Capacitance
R47	0.47 pF	102	102=10x10 <sup>2</sup> =1000 pF
OR5	0.5 pF	104	104=10x10 <sup>4</sup> =100 nF
100	100=10x10 <sup>0</sup> =10 pF	106	106=10x10 <sup>6</sup> =10 μF

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		

Code	Voltage	Code	Voltage
101	100 Vdc	401	400 Vdc
201	200 Vdc	501	500 Vdc
251	250 Vdc	631	630 Vdc

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

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	W	0.50 ± 0.10
F	2.00 ± 0.20	O	3.50 ± 0.20	X	2.50 +0.10/-0.30
G	2.50 ± 0.30	P	1.60 +0.3/-0.10	Z	0.25 ± 0.03
H	2.80 ± 0.30	Q	0.50+0.02/-0.05		
I	1.25 ± 0.20	R	3.10 ± 0.30		

Code	Description
C	RoHS Compliant
Q	Surface Coating (size 1206~2225)

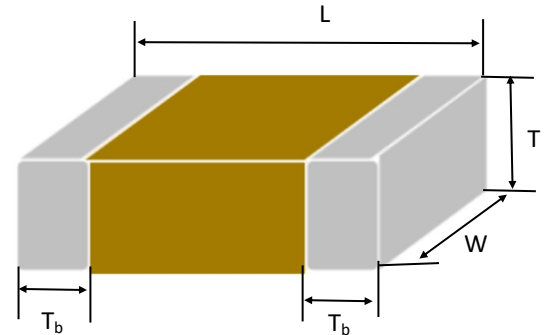
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#### 5. Chip Size and Dimensions:

Chip Size, Inch (mm)	Length L (mm)	Width W (mm)	Termination Bandwidth T <sub>b</sub> (mm)
0402 (1005)	1.00±0.10	0.50±0.10	0.25 +0.05/0.10
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 3.30±0.30/-0.01 <sup>#</sup>	1.60±0.20 1.60 +0.3/-0.1 <sup>#</sup>	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

<sup>#</sup> For 1206 size P thickness products.



#### 6. General Electrical Data:

Dielectric Material	COG	X7R						
Chip Size	0402, 0603, 0805, 1206, 1210, 1808, 1812, 1825, 2220, 2225	0402, 0603, 0805, 1206, 1210, 1808, 1812, 1825, 2220, 2225						
Rated voltage (WVDC)	100V, 200V, 250V, 500V, 630V	100V, 200V, 250V, 400V, 450V, 500V, 630V						
Capacitance Range*	0.5pF ~ 100nF	100pF ~ 820nF						
Capacitance tolerance	Refer to Table 5	Refer to Table 5						
Tan δ	<table border="1"> <thead> <tr> <th>Capacitance Range</th> <th>Q Specification</th> </tr> </thead> <tbody> <tr> <td>Cap.&lt;30pF</td> <td>Q≥400+20C</td> </tr> <tr> <td>Cap.≥30pF</td> <td>Q≥1000</td> </tr> </tbody> </table>	Capacitance Range	Q Specification	Cap.<30pF	Q≥400+20C	Cap.≥30pF	Q≥1000	≤2.5% ~ ≤10.0%
Capacitance Range	Q Specification							
Cap.<30pF	Q≥400+20C							
Cap.≥30pF	Q≥1000							
Capacitance & Tan δ	Measured at the condition of 30~70% related humidity							
Test Condition	For 25°C at 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						
	<table border="1"> <thead> <tr> <th>Capacitance Range</th> <th>Test Condition</th> </tr> </thead> <tbody> <tr> <td>Cap.≤1000pF</td> <td>1.0±0.2Vrms, 1.0MHz±10%</td> </tr> <tr> <td>Cap.&gt;1000pF</td> <td>1.0±0.2Vrms, 1.0KHz±10%</td> </tr> </tbody> </table>	Capacitance Range	Test Condition	Cap.≤1000pF	1.0±0.2Vrms, 1.0MHz±10%	Cap.>1000pF	1.0±0.2Vrms, 1.0KHz±10%	1.0±0.2Vrms, 1.0KHz±10%, at 25°C ambient temperature
Capacitance Range	Test Condition							
Cap.≤1000pF	1.0±0.2Vrms, 1.0MHz±10%							
Cap.>1000pF	1.0±0.2Vrms, 1.0KHz±10%							
Operating temperature	-55°C to +125°C							
Capacitance Characteristic	±30ppm/°C	±15%						
Insulation Resistance at Ur	≥10GΩ or RxC≥500Ω-F, whichever is smaller	≥10GΩ or RxC≥100Ω-F, whichever is smaller						
Termination	Cu or Ag/Ni/Sn or Au (lead-free termination)							

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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)	0402 (1005)			0603 (1608)			0805 (2012)					1206 (3216)				
		Cap Code	100V	200V	250V	100V	200V	250V	100V	200V	250V	500V	630V	100V	200V	250V	500V
0.5	0R5	N	N	N	S	S	S	A	A	A	A	A					
1.0	1R0	N	N	N	S	S	S	A	A	A	A	A					
1.2	1R2	N	N	N	S	S	S	A	A	A	A	A	X			X	
1.5	1R5	N	N	N	S	S	S	A	A	A	A	A	X	X	X	X	X
1.8	1R8	N	N	N	S	S	S	A	A	A	A	A	X	X	X	X	X
2.2	2R2	N	N	N	S	S	S	A	A	A	A	A	X	X	X	X	X
2.7	2R7	N	N	N	S	S	S	A	A	A	A	A	X	X	X	X	X
3.3	3R3	N	N	N	S	S	S	A	A	A	A	A	X	X	X	X	X
3.9	3R9	N	N	N	S	S	S	A	A	A	A	A	X	X	X	X	X
4.7	4R7	N	N	N	S	S	S	A	A	A	A	A	X	X	X	X	X
5.6	5R6	N	N	N	S	S	S	A	A	A	A	A	X	X	X	X	X
6.8	6R8	N	N	N	S	S	S	A	A	A	A	A	X	X	X	X	X
8.2	8R2	N	N	N	S	S	S	A	A	A	A	A	X	X	X	X	X
10	100	N	N	N	S	S	S	A	A	A	A	A	X	X	X	X	X
12	120	N	N	N	S	S	S	A	A	A	A	A	X	X	X	X	X
15	150	N	N	N	S	S	S	A	A	A	A	A	X	X	X	X	X
18	180	N	N	N	S	S	S	A	A	A	A	A	X	X	X	X	X
22	220	N	N	N	S	S	S	A	A	A	A	A	X	X	X	X	X
27	270	N	N	N	S	S	S	A	A	A	A	A	X	X	X	X	X
33	330	N	N	N	S	S	S	A	A	A	A	A	X	X	X	X	X
39	390	N	N	N	S	S	S	A	A	A	A	A	X	X	X	X	X
47	470	N	N	N	S	S	S	A	A	A	A	A	X	X	X	X	X
56	560	N	N	N	S	S	S	A	A	A	A	A	X	X	X	X	X
68	680	N	N		S	S	S	A	A	A	A	A	X	X	X	X	X
82	820	N	N		S	S	S	A	A	A	X	X	X	X	X	X	X
100	101	N	N		S	S	S	A	A	X	X	X	X	X	X	X	X
120	121	N			S	S	S	A	A	X	C	C	X	X	X	X	X
150	151	N			S	S	S	A	X	X	C	C	X	X	X	X	X
180	181	N			S	S	S	A	X	C	C	C	X	X	X	X	X
220	221	N			S	S	S	A	C	C	C	C	X	X	X	X	X
270	271				S	B	B	A	C	C	C	C	X	X	M	M	M
330	331				S	B	B	A	C	C	C	C	X	X	M	M	M
390	391				S	B	B	X	C	C	C	C	X	X	M	M	M
470	471				S	B	B	X	C	C	I	I	X	M	M	M	M
560	561				S	B	B	X	C	C	I	I	X	M	C	C	C
680	681				S	B	B	X	C	C	I	I	X	M	C	C	C
820	821				S	B	B	X	C	C	I	I	X	M	E	E	E
1,000	102				S	B	B	X	C	C	I	I	X	M	E	E	E
1,200	122				B	B	B	X	C	C	I	I	X	M	E	E	E
1,500	152				B	B	B	X	C	C	I	I	X	C	E	E	E
1,800	182				B	B	B	X	C	C	I	I	X	C	E	E	E
2,200	222				B	B	B	X	C	C	I	I	M	C	E	E	E
2,700	272							C	C/I	C/I			M	C	E	E	E
3,300	332							C	I	I			C	C	E	E	E
3,900	392							C	I	I			C	E	E	E	E
4,700	472							C	I	I			C	E	E	E	E
5,600	562							C					E	E	E	E	E
6,800	682							C					E	E	E	E	C/E
8,200	822							C					E	E	E	E	E
10,000	103							C					E	E	E	E	E
12,000	123							C					P				
15,000	153							C					P				
18,000	183							C					P				
22,000	223							C					P				
27,000	273																
33,000	333																

# Medium Voltage Multilayer Ceramic Chip Capacitors

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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)				
		Cap Code	100V	200V	250V	500V	630V	100V	200V	250V	500V	630V	100V	200V	250V	500V
2.2	2R2						C	C	C	C	C					
2.7	2R7						C	C	C	C	C					
3.3	3R3						C	C	C	C	C					
3.9	3R9						C	C	C	C	C					
4.7	4R7						C	C	C	C	C					
5.6	5R6						C	C	C	C	C					
6.8	6R8						C	C	C	C	C					
8.2	8R2						C	C	C	C	C					
10	100	M	M	M	M	M	C	C	C	C	C	C	C	C	C	C
12	120	M	M	M	M	M	C	C	C	C	C	C	C	C	C	C
15	150	M	M	M	M	M	C	C	C	C	C	C	C	C	C	C
18	180	M	M	M	M	M	C	C	C	C	C	C	C	C	C	C
22	220	M	M	M	M	M	C	C	C	C	C	C	C	C	C	C
27	270	M	M	M	M	M	C	C	C	C	C	C	C	C	C	C
33	330	M	M	M	M	M	C	C	C	C	C	C	C	C	C	C
39	390	M	M	M	M	M	C	C	C	C	C	C	C	C	C	C
47	470	M	M	M	M	M	C	C	C	C	C	C	C	C	C	C
56	560	M	M	M	M	M	C	C	C	C	C	C	C	C	C	C
68	680	M	M	M	M	M	C	C	C	C	C	C	C	C	C	C
82	820	M	M	M	M	M	C	C	C	C	C	C	C	C	C	C
100	101	M	M	M	M	M	C	C	C	C	C	C	C	C	C	C
120	121	M	M	M	M	M	C	C	C	C	C	C	C	C	C	C
150	151	M	M	M	M	M	C	C	C	C	C	C	C	C	C	C
180	181	M	M	M	M	M	C	C	C	C	C	C	C	C	C	C
220	221	M	M	M	M	M	C	C	C	C	C	C	C	C	C	C
270	271	M	M	M	M	M	C	C	C	F	F	C	C	C	C	C
330	331	M	M	M	M	M	C	C	C	F	F	C	C	C	C	C
390	391	M	M	M	M	M	C	C	C	F	F	C	C	C	C	C
470	471	M	M	M	M	M	C	C	C	F	F	C	C	C	C	C
560	561	M	M	M	M	M	C	C	C	F	F	C	C	C	C	C
680	681	M	M	M	M	M	C	C	C	F	F	C	C	C	C	C
820	821	M	M	M	M	M	C	C	C	F	F	C	C	C	C	C
1,000	102	M	C	C	C	C	C	C	C	F	F	C	C	C	C	C
1,200	122	M	C	C	C	C	C	C	C	F	F	C	C	C	C	C
1,500	152	M	C	C	C	C	C	C	C	F	F	C	C	C	C	C
1,800	182	M	C	C	C	C	C	C	C	F	F	C	C	C	C	C
2,200	222	M	C	C	C	C	C	C	C	F	F	C	C	C	C	C
2,700	272	M	C	C	C	C	C	C	C	F	F	C	C	C	C	C
3,300	332	M	C	C	C	C	C	C	C	F	F	C	C	C	C	C
3,900	392	M	C	C	C	C	C	C	C			C	C	C	C	C
4,700	472	M	E/C	E/C	C	C	C	C	C			C	C	C	C	C
5,600	562	C	E/C	E/C	C	C	C	E	E			C	C	C	C	C
6,800	682	C	E	E	E/C	E/C	C	E	E			C	C	C	C	C
8,200	822	C	E	E	E	E	E	F	F			C	C	C	C	C
10,000	103	E	F	F	F	F	E	F	F			C	C	C	C	C
12,000	123	E	C/E/F	C/E/F	G/F	G/F						C	E	E	E	E
15,000	153	E	C/E/F	C/E/F	G/F	G/F						C	E	E	E	E
18,000	183	F/G	E/F/G	E/F	F	F						E	F	F	F	F
22,000	223	F/G	E/F/G	E/F	F	F						E	F	F	F	F
27,000	273	F	F	F	G	G						F	G	G		
33,000	333	F	F/G	F/G	G	G						F				
39,000	393	F	F	F								G				
47,000	473	F	F	F								G				
56,000	563											G				
68,000	683											G				
82,000	823											G				
100,000	104											G				

# Medium Voltage Multilayer Ceramic Chip Capacitors

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

Cap (pF)	Size , Inch (mm)	1825 (4563)					2220 (5750)					2225 (5763)				
		Cap Code	100V	200V	250V	500V	630V	100V	200V	250V	500V	630V	100V	200V	250V	500V
10	100	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F
12	120	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F
15	150	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F
18	180	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F
22	220	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F
27	270	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F
33	330	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F
39	390	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F
47	470	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F
56	560	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F
68	680	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F
82	820	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F
100	101	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F
120	121	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F
150	151	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F
180	181	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F
220	221	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F
270	271	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F
330	331	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F
390	391	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F
470	471	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F
560	561	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F
680	681	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F
820	821	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F
1,000	102	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F
1,200	122	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F
1,500	152	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F
1,800	182	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F
2,200	222	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F
2,700	272	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F
3,300	332	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F
3,900	392	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F
4,700	472	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F
5,600	562	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F
6,800	682	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F
8,200	822	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F
10,000	103	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F
12,000	123	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F
15,000	153	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F
18,000	183	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F
22,000	223	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F
27,000	273	F	F	F	F	F	F	F	F	F	E/F	F	F	F	F	F
33,000	333	F	F	F	F	F	F	F	F	F	E/F	F	F	F	F	F
39,000	393	F	F	F	G	G	F	F	F	G	E/F	F	F	F	F	F
47,000	473	F	F	F			F	G	G	G	E/F	F	F	F	F	F
56,000	563	F	G	G			F	G	G		F	F	G	G	G	G
68,000	683	F	G	G			F	G	G		F	F	G	G	G	G
82,000	823	G					G				F	F	G	G	G	
100,000	104	G					G				G	G	G	G		

# Medium Voltage Multilayer Ceramic Chip Capacitors

## AFM Category

### 7.2 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	100V	100V	200V	250V	100V	200V	250V	500V	630V	100V	200V	250V	500V	400V	450V	630V				
100	101	N	S	B	B	X	X	X	X	X	X	C	C	C			C				
120	121	N	S	B	B	X	X	X	X	X	X	C	C	C			C				
150	151	N	S	B	B	X	X	X	X	X	X	C	C	C			C				
180	181	N	S	B	B	X	X	X	X	X	X	C	C	C			C				
220	221	N	S	B	B	X	X	X	X	X	X	C	C	C			C				
270	271	N	S	B	B	X	X	X	X	X	X	C	C	C			C				
330	331	N	S	B	B	X	X	X	X	X	X	C	C	C			C				
390	391	N	S	B	B	X	X	X	X	X	X	C	C	C			C				
470	471	N	S	B	B	X	X	X	X	X	X	C	C	C			C				
560	561	N	S	B	B	X	X	X	X	X	X	C	C	C			C				
680	681	N	S	B	B	X	X	X	X	X	X	C	C	C			C				
820	821	N	S	B	B	X	X	X	X	X	X	C	C	C			C				
1,000	102	N	S	B	B	X	X	X	X	X	X	C	C	C			C				
1,200	122	N	S	B	B	X	X	X	X	X	X	C	C	C			C				
1,500	152	N	S	B	B	X	X	X	X	X	X	C	C	C			C				
1,800	182	N	S	B	B	X	X	X	X	X	X	C	C	C			C				
2,200	222	N	S	B	B	X	X	X	X	X	X	C	C	C			C				
2,700	272	N	S	B	B	X	X	X	X	X	X	C	C	C			C				
3,300	332	N	S	B	B	X	X	X	X	X	X	C	C	C			C				
3,900	392	N	S	B	B	X	X	X	X	X	X	C	C	C			C				
4,700	472	N	S	B	B	X	X	X	C	C	X	C	C	C			C				
5,600	562		S	B	B	X	X	X	C	C	X	C	C	C			C				
6,800	682		S	B	B	X	X	X	C	C	X	C	C	C			C				
8,200	822		S	B	B	X	X	X	C	C	X	C	C	C			C				
10,000	103		S	B	B	X	C	C	C	C	X	C	C	C			C				
12,000	123		B			X	C	C	C	C	X	C	C	C			C				
15,000	153		B			X	C	C	C	C	X	C	C	C			C				
18,000	183		B			X	C	C	C	C	X	C	C	C			C				
22,000	223		B			X	C	C	C	C	X	C	C	E			E				
27,000	273		B			C	C	C	C	C	X	C	C	E			E				
33,000	333		B			C	C	C	C		X	E	E	E			E				
39,000	393		B			C	C	C			X	E	E	E			E				
47,000	473		B			C	C	C			X	E	E	E			E				
56,000	563		B			C	C	C			X	E	E	E			E				
68,000	683		B			C	C	C			X	E	E		E	E					
82,000	823		B			C	C				C	E	E		E	E					
100,000	104		B			C	C				C	E	E		E	E					
120,000	124					I					C	E	E								
150,000	154					I					E	E	E								
180,000	184					I					E	E	E								
220,000	224					I					E	E	E								
270,000	274					I					E										
330,000	334					I					E										
390,000	394					I					E										
470,000	474					I					E										
560,000	564										P										
680,000	684										P										
820,000	824										P										

# Medium Voltage Multilayer Ceramic Chip Capacitors

## AFM Category

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

Cap (pF)	Size , Inch (mm)	1210 (3225)							1808 (4520)		1812 (4532)					
	Cap Code	100V	200V	250V	400V	450V	500V	630V	500V	630V	100V	200V	250V	450V	500V	630V
100	101															
120	121															
150	151								C	C						
180	181								C	C						
220	221	M	M	M				C	C	C	C					
270	271	M	M	M				C	C	C	C	C	C	C	C	C
330	331	M	M	M				C	C	C	C	C	C	C	C	C
390	391	M	M	M				C	C	C	C	C	C	C	C	C
470	471	M	M	M				C	C	C	C	C	C	C	C	C
560	561	M	M	M				C	C	C	C	C	C	C	C	C
680	681	M	M	M				C	C	C	C	C	C	C	C	C
820	821	M	M	M				C	C	C	C	C	C	C	C	C
1,000	102	M	M	M				C	C	C	C	C	C	C	C	C
1,200	122	M	M	M				C	C	C	C	C	C	C	C	C
1,500	152	M	M	M				C	C	C	C	C	C	C	C	C
1,800	182	M	M	M				C	C	C	C	C	C	C	C	C
2,200	222	M	M	M				C	C	C	C	C	C	C	C	C
2,700	272	M	M	M				C	C	C	C	C	C	C	C	C
3,300	332	M	M	M				C	C	C	C	C	C	C	C	C
3,900	392	M	M	M				C	C	C	C	C	C	C	C	C
4,700	472	M	M	M				C	C	C	C	C	C	C	C	C
5,600	562	M	M	M				C	C	F	F	C	C	C	C	C
6,800	682	M	M	M				C	C	F	F	C	C	C	C	C
8,200	822	M	M	M				C	C	F	F	C	C	C	C	C
10,000	103	M	M	M				C	C	F	F	C	C	C	C	C
12,000	123	M	M	M				C	C	F	F	C	C	C	C	C
15,000	153	M	M	M				C	C	F	F	C	C	C	C	C
18,000	183	M	M	M				C	C	F	F	C	C	C	C	C
22,000	223	M	M	M				C	C	F	F	C	C	C	C	C
27,000	273	M	M	M				E	E	F	F	C	C	C	C	C
33,000	333	M	M	M				E	E	F	F	C	C	C	C	C
39,000	393	M	M	M				E	E	F	F	C	C	C	C	C
47,000	473	M	C	C				E	E	F	F	C	C	C	C	C
56,000	563	M	C	E				E	E	F	F	C	C	C	F	F
68,000	683	M	E	E				F/E	F/E	F	F	C	C	C	F	F
82,000	823	M	E	E				F	F	F	F	C	C	C	F	F
100,000	104	M	E	E				F	F			C	C	C	F	F
120,000	124	M	E	E	G	G		G	G			C	C	C	G	G
150,000	154	C	G	G	G	G		G	G			C	F	F	G	G
180,000	184	C	G	G	G	G						C	F	F	G	G
220,000	224	C	G	G	G	G						C	F	F	G	G
270,000	274	E	G	G	G	G						C	F	F	G	G
330,000	334	E	G	G	G	G						C	F	F	G	G
390,000	394	G	G	G								C	F	F	G	G
470,000	474	G	G	G								F	F	F	G	G
560,000	564	G	G	G								F	G	G	G	
680,000	684	F	G	G								F	G	G	G	
820,000	824	F										F	G	G	H	

# Medium Voltage Multilayer Ceramic Chip Capacitors

## AFM Category

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

Cap (pF)	Size , Inch (mm)	1825 (4563)					2220 (5750)					2225 (5763)				
		100V	200V	250V	500V	630V	100V	200V	250V	500V	630V	100V	200V	250V	500V	630V
1,000	102	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F
1,200	122	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F
1,500	152	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F
1,800	182	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F
2,200	222	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F
2,700	272	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F
3,300	332	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F
3,900	392	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F
4,700	472	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F
5,600	562	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F
6,800	682	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F
8,200	822	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F
10,000	103	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F
12,000	123	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F
15,000	153	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F
18,000	183	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F
22,000	223	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F
27,000	273	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F
33,000	333	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F
39,000	393	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F
47,000	473	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F
56,000	563	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F
68,000	683	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F
82,000	823	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F
100,000	104	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F
120,000	124	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F
150,000	154	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F
180,000	184	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F
220,000	224	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F
270,000	274	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F
330,000	334	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F
390,000	394	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F
470,000	474	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F
560,000	564	F	F	F	G	G	F	F	F	G	G	F	F	F	F	F
680,000	684	F	F	F			F	F	F	G	G	F	F	F		
820,000	824	F	F	F			F	F	F	H	H	F	F	F		



## Medium Voltage Multilayer Ceramic Chip Capacitors

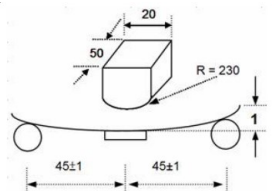
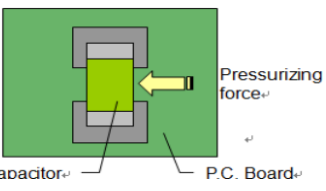
### AFM Category

### 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.																		
3	Q/ D.F. (Tangent of loss angle)	*Class I : COG Cap.≤1000pF, 1.0±0.2Vrms, 1MHz±10%. Cap.>1000pF, 1.0±0.2Vrms, 1KHz±10%. *Class II : (X7R) 1.0±0.2Vrms, 1KHz±10%.	<table border="1"> <thead> <tr> <th>Dielectric</th> <th>Q/D.F.</th> <th>Remark</th> </tr> </thead> <tbody> <tr> <td rowspan="2">Class I (COG)</td> <td>Q≥1000</td> <td>Cap.≥30pF</td> </tr> <tr> <td>Q≥400+20C</td> <td>Cap.&lt;30pF</td> </tr> <tr> <td rowspan="4">Class II</td> <td>D.F.≤2.5%</td> <td>X7R items</td> </tr> <tr> <td>D.F.≤3.5%</td> <td>X7R 0603≥0.047μF, 0805=0.1μF, 1206≥0.47μF</td> </tr> <tr> <td>D.F.≤5.0%</td> <td>X7R 0603≥0.068μF, 0805&gt;0.1μF All Y5V items</td> </tr> <tr> <td>D.F.≤10.0%</td> <td>X7R 0805&gt;0.22μF</td> </tr> </tbody> </table>	Dielectric	Q/D.F.	Remark	Class I (COG)	Q≥1000	Cap.≥30pF	Q≥400+20C	Cap.<30pF	Class II	D.F.≤2.5%	X7R items	D.F.≤3.5%	X7R 0603≥0.047μF, 0805=0.1μF, 1206≥0.47μF	D.F.≤5.0%	X7R 0603≥0.068μF, 0805>0.1μF All Y5V items	D.F.≤10.0%	X7R 0805>0.22μF	
Dielectric	Q/D.F.	Remark																			
Class I (COG)	Q≥1000	Cap.≥30pF																			
	Q≥400+20C	Cap.<30pF																			
Class II	D.F.≤2.5%	X7R items																			
	D.F.≤3.5%	X7R 0603≥0.047μF, 0805=0.1μF, 1206≥0.47μF																			
	D.F.≤5.0%	X7R 0603≥0.068μF, 0805>0.1μF All Y5V items																			
	D.F.≤10.0%	X7R 0805>0.22μF																			
4	Temperature Coefficient (Temperature characteristic of capacitance)	*With no electrical load. <table border="1"> <thead> <tr> <th>T.C.</th> <th>Operating Temp.</th> </tr> </thead> <tbody> <tr> <td>COG</td> <td>-55~125°C at 25°C</td> </tr> <tr> <td>X7R</td> <td>-55~125°C at 25°C</td> </tr> </tbody> </table>	T.C.	Operating Temp.	COG	-55~125°C at 25°C	X7R	-55~125°C at 25°C	<table border="1"> <thead> <tr> <th>T.C.</th> <th>Capacitance Change</th> </tr> </thead> <tbody> <tr> <td>COG</td> <td>Within ±30ppm/°C</td> </tr> <tr> <td>X7R</td> <td>Within ±15%</td> </tr> </tbody> </table>	T.C.	Capacitance Change	COG	Within ±30ppm/°C	X7R	Within ±15%						
T.C.	Operating Temp.																				
COG	-55~125°C at 25°C																				
X7R	-55~125°C at 25°C																				
T.C.	Capacitance Change																				
COG	Within ±30ppm/°C																				
X7R	Within ±15%																				
5	Insulation Resistance	<table border="1"> <thead> <tr> <th>Rated Vol.(V)</th> <th>Apply Voltage</th> <th>Test Condition</th> </tr> </thead> <tbody> <tr> <td>=100</td> <td>1 times of U<sub>R</sub></td> <td>Max.120 sec.</td> </tr> <tr> <td>200≤V≤500</td> <td>1 times of U<sub>R</sub></td> <td>60 sec.</td> </tr> <tr> <td>&gt;500</td> <td>500Vdc</td> <td>60 sec.</td> </tr> </tbody> </table>	Rated Vol.(V)	Apply Voltage	Test Condition	=100	1 times of U <sub>R</sub>	Max.120 sec.	200≤V≤500	1 times of U <sub>R</sub>	60 sec.	>500	500Vdc	60 sec.	<table border="1"> <thead> <tr> <th>Dielectric</th> <th>Requirements</th> </tr> </thead> <tbody> <tr> <td>Class I</td> <td>≥10GΩ or RxC≥500Ω-F, whichever is smaller</td> </tr> <tr> <td>Class II</td> <td>≥10GΩ or RxC≥100Ω-F, whichever is smaller</td> </tr> </tbody> </table>	Dielectric	Requirements	Class I	≥10GΩ or RxC≥500Ω-F, whichever is smaller	Class II	≥10GΩ or RxC≥100Ω-F, whichever is smaller
Rated Vol.(V)	Apply Voltage	Test Condition																			
=100	1 times of U <sub>R</sub>	Max.120 sec.																			
200≤V≤500	1 times of U <sub>R</sub>	60 sec.																			
>500	500Vdc	60 sec.																			
Dielectric	Requirements																				
Class I	≥10GΩ or RxC≥500Ω-F, whichever is smaller																				
Class II	≥10GΩ or RxC≥100Ω-F, whichever is smaller																				
6	Solderability	* Solder temperature : 235±5°C for (0402~1210). * Solder temperature : 245±5°C for (1808~2225). * Dipping time : 2±0.5 sec	*75% min. coverage of all metalized area.																		
7	Dielectric Strength (Voltage proof)	<table border="1"> <thead> <tr> <th>Rated Voltage (V)</th> <th>Condition</th> </tr> </thead> <tbody> <tr> <td>≤100</td> <td>2.5 times of U<sub>R</sub></td> </tr> <tr> <td>100&lt;V≤250</td> <td>2.0 times of U<sub>R</sub></td> </tr> <tr> <td>250&lt;V≤500</td> <td>1.5 times of U<sub>R</sub></td> </tr> <tr> <td>=630</td> <td>1.2 times of U<sub>R</sub></td> </tr> </tbody> </table> *Duration : 1 to 5 sec. *Charge and discharge current less than 50mA.	Rated Voltage (V)	Condition	≤100	2.5 times of U <sub>R</sub>	100<V≤250	2.0 times of U <sub>R</sub>	250<V≤500	1.5 times of U <sub>R</sub>	=630	1.2 times of U <sub>R</sub>	*No evidence of damage or flashover during test.								
Rated Voltage (V)	Condition																				
≤100	2.5 times of U <sub>R</sub>																				
100<V≤250	2.0 times of U <sub>R</sub>																				
250<V≤500	1.5 times of U <sub>R</sub>																				
=630	1.2 times of U <sub>R</sub>																				
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) : Perform 150 +0/-10°C for 1 hr and then set for 48±4 hrs at room temp. * Measurement to be made after keeping at room temp. for 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 : Within ±7.5%. * Q/D.F. & I.R. : To meet the initial requirement. * 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"> <thead> <tr> <th>Rated Voltage (V)</th> <th>Condition</th> </tr> </thead> <tbody> <tr> <td>≤100</td> <td>2.5 times of U<sub>R</sub></td> </tr> <tr> <td>100&lt;V≤250</td> <td>2.0 times of U<sub>R</sub></td> </tr> <tr> <td>250&lt;V≤500</td> <td>1.5 times of U<sub>R</sub></td> </tr> <tr> <td>=630</td> <td>1.2 times of U<sub>R</sub></td> </tr> </tbody> </table> *Before initial measurement (Class II only) : Perform 150 +0/-10°C for 1 hr and then set for 48±4 hrs at room temp. *Measurement to be made after keeping at room temp. for 24±2 hrs (Class I) or 48±4 hrs (Class II).	Rated Voltage (V)	Condition	≤100	2.5 times of U <sub>R</sub>	100<V≤250	2.0 times of U <sub>R</sub>	250<V≤500	1.5 times of U <sub>R</sub>	=630	1.2 times of U <sub>R</sub>	*No remarkable damage. *Cap. change : COG : Within ±2.5% or ±0.25pF, whichever is larger. X7R : Within ±7.5%. *Q/D.F. : COG : To meet the initial requirement. X7R : D.F.≤150% of initial requirement. *I.R. : To meet the initial requirement.								
Rated Voltage (V)	Condition																				
≤100	2.5 times of U <sub>R</sub>																				
100<V≤250	2.0 times of U <sub>R</sub>																				
250<V≤500	1.5 times of U <sub>R</sub>																				
=630	1.2 times of U <sub>R</sub>																				

## Medium Voltage Multilayer Ceramic Chip Capacitors

### AFM Category

No.	Item	AEC-Q200 Test Condition	Requirements																						
10	Humidity (Damp Heat) Steady State	<p>*Test temp. : 40±2°C.            *Humidity : 90~95%RH.            *Test time : 500 +24/-0 hrs.            *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 : Within ±12.5%.            * Q/D.F. :            COG : Cap.&gt;30pF, Q≥350; 10pF≤Cap.≤30pF, Q≥275+2.5C; Cap. &lt;10pF, Q≥200+10C.            X7R : D.F.≤200% of initial requirement.            * I.R. (Class I) : ≥10GΩ or RxC≥500Ω-F, whichever is smaller.            * I.R. (Class II) : ≥1GΩ or RxC≥10Ω-F, whichever is smaller.</p>																						
11	Humidity (Damp Heat) Load	<p>* Test temp. : 40±2°C.            * Humidity : 90~95% RH.            * Test time : 500 +24/-0hrs.            * To apply voltage : Rated voltage (Max. 500Vdc).            * 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 ±7.5% or ±0.75pF, whichever is larger.            X7R : Within ±12.5%.            * Q/D.F. :            COG : Cap.&gt;30pF, Q≥200; Cap. &lt;30pF, Q≥100+10/3C.            X7R : D.F.≤200% of initial requirement.            * I.R. : ≥500MΩ or RxC≥25Ω-F, whichever is smaller.            X7R 100V : ≥500MΩ or RxC≥5Ω-F, whichever is smaller.</p>																						
12	High Temperature Load (Endurance)	<p>* Test temp. :            COG, X7R : 125±3°C.</p> <table border="1"> <thead> <tr> <th>Dielectric</th> <th>Rated Vol.(V)</th> <th>Apply Voltage</th> </tr> </thead> <tbody> <tr> <td rowspan="4">COG X7R</td> <td>≤100</td> <td>2.0 times of U<sub>R</sub></td> </tr> <tr> <td>200≤V≤500</td> <td>1.5 times of U<sub>R</sub></td> </tr> <tr> <td>400V~450V</td> <td>1.2 times of U<sub>R</sub></td> </tr> <tr> <td>=630</td> <td>1.2 times of U<sub>R</sub></td> </tr> </tbody> </table> <p>* Exception items :</p> <table border="1"> <thead> <tr> <th>Rated Vol.(V)</th> <th>Size</th> <th>Cap. Range</th> <th>Apply Voltage</th> </tr> </thead> <tbody> <tr> <td rowspan="2">100</td> <td>0603</td> <td>≥0.082μF</td> <td rowspan="2">150%</td> </tr> <tr> <td>0805</td> <td>≥0.12μF</td> </tr> </tbody> </table> <p>* Test time : 1000 +24/-0 hrs.            * Measurement to be made after keeping at room temp. for 24±2 hrs (Class I) or 48±4 hrs (Class II).</p>	Dielectric	Rated Vol.(V)	Apply Voltage	COG X7R	≤100	2.0 times of U <sub>R</sub>	200≤V≤500	1.5 times of U <sub>R</sub>	400V~450V	1.2 times of U <sub>R</sub>	=630	1.2 times of U <sub>R</sub>	Rated Vol.(V)	Size	Cap. Range	Apply Voltage	100	0603	≥0.082μF	150%	0805	≥0.12μF	<p>* No remarkable damage.            * Cap. change :            COG : Within ±3.0% or ±0.3pF, whichever is larger.            X7R : Within ±12.5%.            * Q/D.F. :            COG : Cap.&gt;30pF, Q≥350; 10pF≤Cap.≤30pF, Q≥275+2.5C; Cap. &lt;10pF, Q≥200+10C.            X7R : D.F.≤200% of initial requirement.            * I.R. : ≥1GΩ or RxC≥50Ω-F, whichever is smaller.            X7R 100V : ≥1GΩ or RxC≥10Ω-F, whichever is smaller.</p>
Dielectric	Rated Vol.(V)	Apply Voltage																							
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Rated Vol.(V)	Size	Cap. Range	Apply Voltage																						
100	0603	≥0.082μF	150%																						
	0805	≥0.12μF																							
13	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>* No remarkable damage.</p> <table border="1"> <thead> <tr> <th>Dielectric</th> <th>Size Cap. Range Apply Voltage</th> </tr> </thead> <tbody> <tr> <td>Class I (COG)</td> <td>Within ±3.0% or ±2.0pF, whichever is larger</td> </tr> <tr> <td>Class II (X7R)</td> <td>Within ±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	Size Cap. Range Apply Voltage	Class I (COG)	Within ±3.0% or ±2.0pF, whichever is larger	Class II (X7R)	Within ±12.5%																
Dielectric	Size Cap. Range Apply Voltage																								
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14	Adhesive Strength of Termination (Robustness of termination)	<p>* Capacitors mounted on a substrate. A force of 5N (≤0603) or 10N(&gt;0603) applied perpendicular to the place of substrate and parallel the line joining the center of terminations for 10±1 second.</p> 	<p>* No remarkable damage or removal of the terminations.</p>																						
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)            * 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 Q/D.F. : To meet the initial spec.</p>																						

## Medium Voltage Multilayer Ceramic Chip Capacitors

### AFM Category

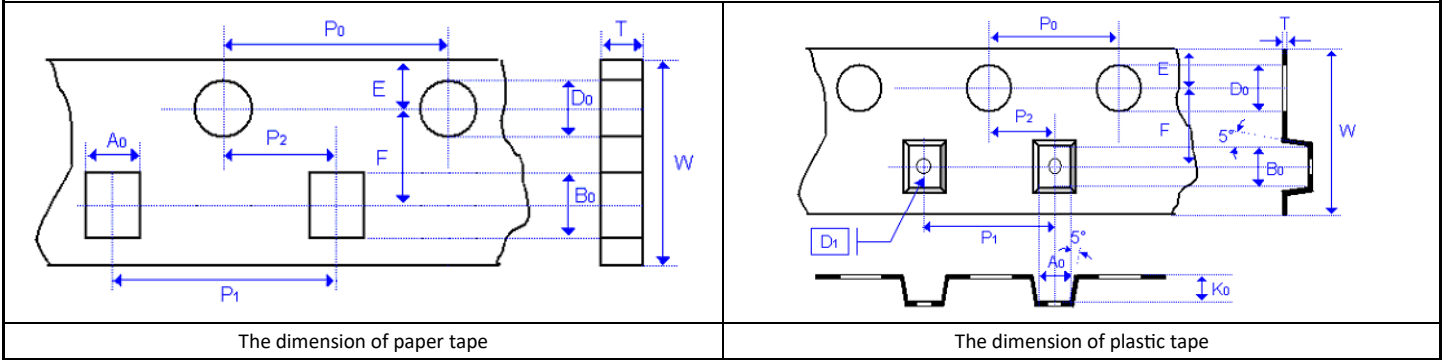
#### 9. Package Dimension and Quantity:

Size, Inch (mm)	Thickness (mm)	Paper tape		Plastic tape	
		7" reel	13" reel	7" reel	13" reel
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	-

# Medium Voltage Multilayer Ceramic Chip Capacitors

## AFM Category

### 9.1 Tape Dimension



Size, Inch (mm)	0402 (1005)	0603 (1608)	0805 (2012)		1206 (3216)		
Chip Thickness	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	0.80±0.10	0.95±0.10 1.25±0.10	1.60±0.20 1.60+0.3/-0/1
A <sub>0</sub>	0.70±0.20	1.00 +0.05/-0.10	1.50±0.20	<1.80	2.00±0.10	<2.00	<2.50
B <sub>0</sub>	1.20±0.20	1.80±0.10	2.30±0.10	<2.70	3.50±0.50	<3.70	<4.00
T	≤0.80	0.95±0.05	0.95±0.05	0.23±0.05	0.95±0.05	0.23±0.05	0.23±0.05
K <sub>0</sub>	-	-	-	<2.50	-	<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	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
10xP <sub>0</sub>	40.00±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
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
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
D <sub>0</sub>	1.50±0.10/-0	1.50±0.10/-0	1.50±0.10/-0	1.50 +0.10/-0	1.55±0.05/-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
E	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
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	5.50±0.05
Unit :	mm	mm	mm	mm	mm	mm	mm

Size, Inch (mm)	1210 (3225)		1808 (4520)		1812 (4532)		1825 (4563)	
Chip Thickness	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	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
A <sub>0</sub>	<3.05	<3.20	<2.50	<2.50	<3.90	<3.90	<6.80	<6.80
B <sub>0</sub>	<3.80	<4.00	<5.30	<5.30	<5.30	<5.30	<5.30	<5.30
T	0.23±0.05	0.23±0.05	0.25±0.05	0.25±0.05	0.25±0.05	0.25±0.05	0.30±0.10	0.30±0.10
K <sub>0</sub>	<2.50	<3.50	<2.50	<2.50	<2.50	<3.00	<2.50	<3.10
W	8.00±0.10	8.00±0.10	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 <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
10xP <sub>0</sub>	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	4.00±0.10	4.00±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
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
D <sub>1</sub>	1.00±0.10	1.00±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	3.50±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

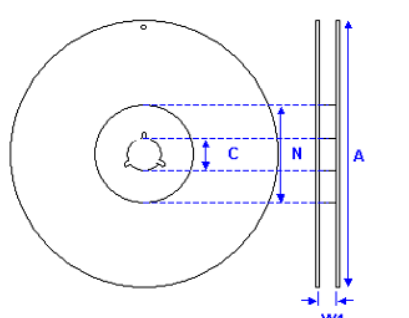
Size, Inch (mm)	2220 (5750)		2225 (5763)		Size, Inch (mm)	2220 (5750) (Continue)		2225 (5763) (Continue)	
Chip Thickness	1.40±0.15 1.60±0.20 2.00±0.20	2.50±0.30 2.80±0.30	1.60±0.20 2.00±0.20	2.50±0.30 2.80±0.30		D <sub>0</sub>	1.50 +0.10/-0	1.50 +0.10/-0	1.50 +0.10/-0
A <sub>0</sub>	<5.80	<6.80	<6.80	<6.80	D <sub>1</sub>	1.50±0.10	1.50±0.10	1.50±0.10	1.50±0.10
B <sub>0</sub>	<6.50	<6.50	<6.50	<6.50	E	1.75±0.10	1.75±0.10	1.75±0.10	1.75±0.10
T	0.30±0.10	0.30±0.10	0.30±0.10	0.30±0.10	F	5.50±0.05	5.50±0.05	5.50±0.05	5.50±0.05
K <sub>0</sub>	<2.50	<3.10	<2.50	<3.10	Unit :	mm	mm	mm	mm
W	12.00±0.20	12.00±0.20	12.00±0.20	12.00±0.20					
P <sub>0</sub>	4.00±0.10	4.00±0.10	4.00±0.10	4.00±0.10					
10xP <sub>0</sub>	40.00±0.20	40.00±0.20	40.00±0.20	40.00±0.20					
P <sub>1</sub>	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					

# Medium Voltage Multilayer Ceramic Chip Capacitors

## AFM Category

### 9.2 Reel Dimensions

Size	0201, 0402, 0603, 0805, 1206, 1210		1808, 1812, 1825, 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
W <sub>1</sub>	8.4 +1.5/-0	8.4 +2.0/-0	12.4 +2.0/-0
A	178.0 ±0.10	330.0 ±1.0	178.0 ±0.10
N	60.0 ±1.0/-0	100 ±1.0	60.0 ±1.0/-0



The dimension of reel

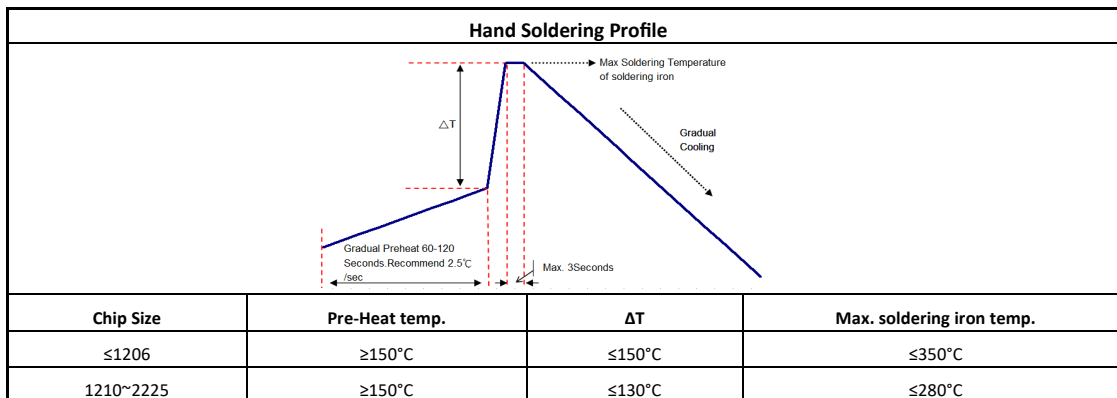
### 10. Recommended Soldering Conditions:

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:

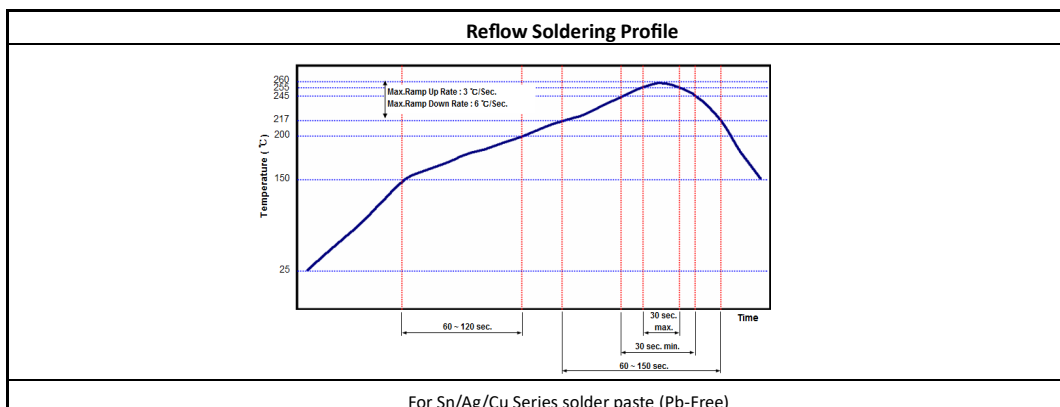
In order to minimize the risk of thermal shock during soldering, a carefully controlled preheat is required. The rate of preheat should not exceed 3°C per second.

#### 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.

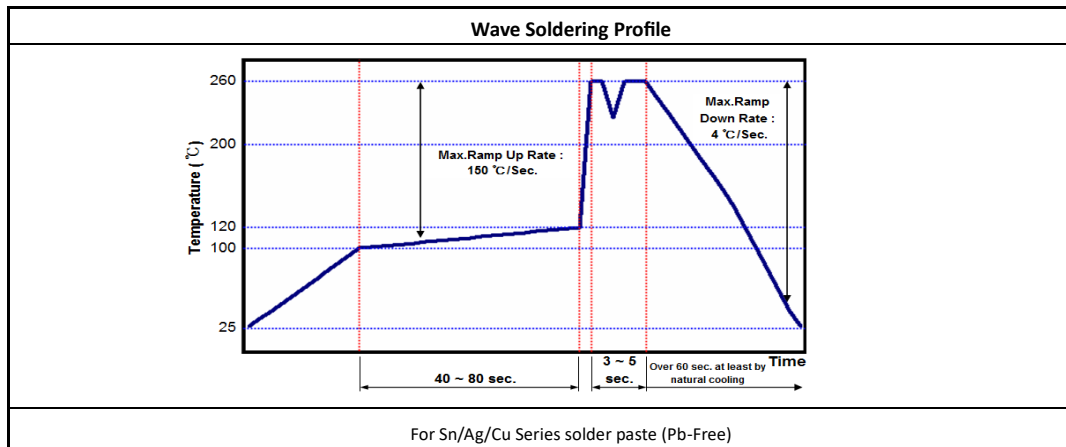
#### 10.3 Reflow soldering :



# Medium Voltage Multilayer Ceramic Chip Capacitors

## AFM Category

### 10.4 Wave Soldering :



### 10.5 Soldering conditions :

#### 10.5.1 Class I :

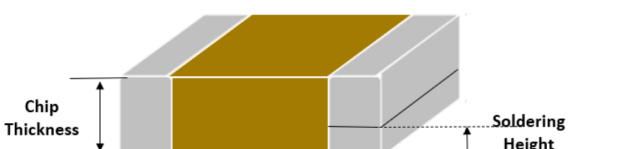
Size, Inch (mm)	Temperature Characteristics	Capacitance	Condition	
			Wave	Reflow
≤0402 (1005)	Class I	All	X	O
0603 (1608)	Class I	All	O	O
0805 (2012)	Class I	All	O	O
1206 (3216)	Class I	All	O	O
		Thickness >0.95mm	X	O
≥1210 (3225)	Class I	All	X	O
Coating Products	All	All	X	O

#### 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

### 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.

## Medium Voltage Multilayer Ceramic Chip Capacitors

### AFM Category

#### 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.

## Medium Voltage Multilayer Ceramic Chip Capacitors

### AFM Category

#### 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.



## Medium Voltage Multilayer Ceramic Chip Capacitors

### AFM Category



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