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Revision of Jul. 2023

Automotive General Multilayer Ceramic Capacitors

AMT Category (Automotive Grade Surface Mount MLCCs)

1. Introduction:

AMT automotive grade capacitors are designed, manufactured, and screened to ensure the high level of product quality by using C0G/X7R dielectrics and have high electrical 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. AMT series MLCCs are in tighten quality control to meet automotive application requirements and is AEC-Q200 qualified.

2. Features:

- A wide selection of sizes is available (from 0201 to 1210)
- High capacitance at given case size
- Capacitor with Lead-free termination (pure Tin)
- The AMT series meet AEC-Q200 requirement

3. Applications:

- Navigation & Information equipment
- Entertainment equipment
- Electric vehicle – BMS , On-Board Charger ,DC-DC converter and Inverter
- Automotive infotainment systems

4. Production Identification:

AMT	1206	N	R47	J	201	P	T	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
AMT	Automotive Grade Surface Mount MLCCs

Table 2 Size, Inch (mm)

Description	Description
0201 (0603)	0805 (2012)
0402 (1005)	1206 (3216)
0603 (1608)	1210 (3225)

Table 3 Dielectric Material Characteristics

Code	Description	Code	Description
N	C0G	X	X7R

Table 4 Capacitance Rule Code

Code	Chip Capacitance	Code	Chip Capacitance
R47	0.47pF	102	$102=10x10^2=1000pF$
0R5	0.5pF	104	$104=10x10^4=100nF$
100	$100=10x10^0=10pF$	106	$106=10x10^6=10\mu F$

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	500	50Vdc	401	400Vdc
100	10Vdc	101	100Vdc	501	500Vdc
160	16Vdc	201	200Vdc	631	630Vdc
250	25Vdc	251	250Vdc	102	1000Vdc

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

Table 9 Special Control Code

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

Automotive General Multilayer Ceramic Capacitors

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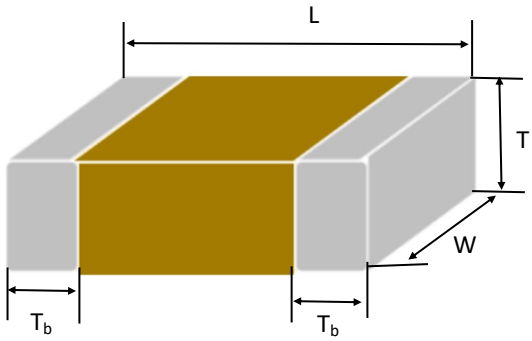
5. Shape and Dimensions:

Size, Inch (mm)	Length	Width	Termination Bandwidth
0201 (0603)	0.60±0.03	0.30±0.03	0.15±0.05
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*	1.60±0.20 1.60 +0.3/-0.1#	0.60±0.20
1210 (3225)	3.20±0.30 3.30±0.40*	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



"＊" for ≥ 1KV products. "#" for P thickness products.

6. General Electrical Specification:

<table>
<tr><td>Dielectric Material</td><td>C0G</td><td>X7R</td></tr>
<tr><td>Chip Size</td><td>0201, 0402, 0603, 0805, 1206, 1210</td><td>0402, 0603, 0805, 1206, 1210</td></tr>
<tr><td>Rated voltage (WVDC)</td><td colspan="2">10V, 16V, 25V, 50V, 100V, 200V, 250V, 500V, 630V, 1000V</td></tr>
<tr><td>Capacitance Range*</td><td>0.1pF ~ 47nF</td><td>100pF ~ 10μF</td></tr>
<tr><td>Tan δ</td><td><table><tr><th>Capacitance Range</th><th>Q Specification</th></tr><tr><td>Cap.<30pF</td><td>Q≥400+20C</td></tr><tr><td>Cap.≥30pF</td><td>Q≥1000</td></tr></table></td><td>Refer to No.17 of 8. reliability test conditions and requirements</td></tr>
<tr><td rowspan="3">Capacitance & Tan δ
Test Condition</td><td colspan="2">Measured at the condition of 30~70% related humidity</td></tr>
<tr><td>For 25°C at ambient temperature</td><td>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</td></tr>
<tr><td><table><tr><th>Capacitance Range</th><th>Test Condition</th></tr><tr><td>Cap.≤1000pF</td><td>1.0±0.2Vrms, 1.0MHz±10%</td></tr><tr><td>Cap.>1000pF</td><td>1.0±0.2Vrms, 1.0KHz±10%</td></tr></table></td><td>1.0±0.2Vrms, 1.0KHz±10%, at 25°C ambient temperature</td></tr>
<tr><td>Operating temperature</td><td colspan="2">-55°C to +125°C</td></tr>
<tr><td>Capacitance Characteristic</td><td>±30ppm/°C</td><td>±15%</td></tr>
<tr><td>Insulation Resistance at Ur</td><td>≥10GΩ or RxC≥500Ω-F, whichever is smaller</td><td>Refer to No.17 of 8. reliability test conditions and requirements</td></tr>
<tr><td>Termination</td><td colspan="2">Cu/Ni/Sn (lead-free termination)</td></tr>
</table>

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7. Relationship Between Capacitance and Thickness at Rated Voltage

7.1 C0G (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	10V	16V	25V	50V	100V	10V	16V	25V	50V	100V	10V	16V	25V	50V	100V	200V	250V	10V	16V	25V	50V	100V	200V	250V	500V	630V
0.1	0R1	L	L	L	L	L	N	N	N	N	N																
0.2	0R2	L	L	L	L	L	N	N	N	N	N																
0.3	0R3	L	L	L	L	L	N	N	N	N	N																
0.4	0R4	L	L	L	L	L	N	N	N	N	N																
0.5	0R5	L	L	L	L	L	N	N	N	N	N	S	S	S	S	S	S	S	A	A	A	A	A	A	A	A	A
1.0	1R0	L	L	L	L	L	N	N	N	N	N	S	S	S	S	S	S	S	A	A	A	A	A	A	A	A	A
1.2	1R2	L	L	L	L	L	N	N	N	N	N	S	S	S	S	S	S	S	A	A	A	A	A	A	A	A	A
1.5	1R5	L	L	L	L	L	N	N	N	N	N	S	S	S	S	S	S	S	A	A	A	A	A	A	A	A	A
1.8	1R8	L	L	L	L	L	N	N	N	N	N	S	S	S	S	S	S	S	A	A	A	A	A	A	A	A	A
2.2	2R2	L	L	L	L	L	N	N	N	N	N	S	S	S	S	S	S	S	A	A	A	A	A	A	A	A	A
2.7	2R7	L	L	L	L	L	N	N	N	N	N	S	S	S	S	S	S	S	A	A	A	A	A	A	A	A	A
3.3	3R3	L	L	L	L	L	N	N	N	N	N	S	S	S	S	S	S	S	A	A	A	A	A	A	A	A	A
3.9	3R9	L	L	L	L	L	N	N	N	N	N	S	S	S	S	S	S	S	A	A	A	A	A	A	A	A	A
4.7	4R7	L	L	L	L	L	N	N	N	N	N	S	S	S	S	S	S	S	A	A	A	A	A	A	A	A	A
5.6	5R6	L	L	L	L	L	N	N	N	N	N	S	S	S	S	S	S	S	A	A	A	A	A	A	A	A	A
6.8	6R8	L	L	L	L	L	N	N	N	N	N	S	S	S	S	S	S	S	A	A	A	A	A	A	A	A	A
8.2	8R2	L	L	L	L	L	N	N	N	N	N	S	S	S	S	S	S	S	A	A	A	A	A	A	A	A	A
10	100	L	L	L	L	L	N	N	N	N	N	S	S	S	S	S	S	S	A	A	A	A	A	A	A	A	A
12	120	L	L	L	L	L	N	N	N	N	N	S	S	S	S	S	S	S	A	A	A	A	A	A	A	A	A
15	150	L	L	L	L	L	N	N	N	N	N	S	S	S	S	S	S	S	A	A	A	A	A	A	A	A	A
18	180	L	L	L	L	L	N	N	N	N	N	S	S	S	S	S	S	S	A	A	A	A	A	A	A	A	A
22	220	L	L	L	L	L	N	N	N	N	N	S	S	S	S	S	S	S	A	A	A	A	A	A	A	A	A
27	270	L	L	L	L	L	N	N	N	N	N	S	S	S	S	S	S	S	A	A	A	A	A	A	A	A	A
33	330	L	L	L	L	L	N	N	N	N	N	S	S	S	S	S	S	S	A	A	A	A	A	A	A	A	A
39	390	L	L	L	L	L	N	N	N	N	N	S	S	S	S	S	S	S	A	A	A	A	A	A	A	A	A
47	470	L	L	L	L	L	N	N	N	N	N	S	S	S	S	S	S	S	A	A	A	A	A	A	A	A	A
56	560	L	L	L	L	L	N	N	N	N	N	S	S	S	S	S	S	S	A	A	A	A	A	A	A	A	A
68	680	L	L	L	L		N	N	N	N	N	S	S	S	S	S	S	S	A	A	A	A	A	A	A	A	A
82	820	L	L	L	L		N	N	N	N	N	S	S	S	S	S	S	S	A	A	A	A	A	A	A	X	X
100	101	L	L	L	L		N	N	N	N	N	S	S	S	S	S	S	S	A	A	A	A	A	X	X	X	X
120	121	L	L	L	L		N	N	N	N	N	S	S	S	S	S	S	S	A	A	A	A	A	X	X	C	C
150	151						N	N	N	N	N	S	S	S	S	S	S	S	A	A	A	A	A	C	C	C	C
180	181						N	N	N	N	N	S	S	S	S	S	S	S	A	A	A	A	A	C	C	C	C
220	221						N	N	N	N	N	S	S	S	S	S	S	S	A	A	A	A	A	C	C	C	C
270	271						N	N	N	N		S	S	S	S	S	B	B	A	A	A	A	A	C	C	C	C
330	331						N	N	N	N		S	S	S	S	S	B	B	A	A	A	A	A	C	C	C	C
390	391						N	N	N	N		S	S	S	S	S	B	B	X	X	X	X	X	C	C	C	C
470	471						N	N	N	N		S	S	S	S	S	B	B	X	X	X	X	X	C	C	I	I
560	561						N	N	N	N		S	S	S	S	S	B	B	X	X	X	X	X	C	C	I	I
680	681						N	N	N	N		S	S	S	S	S	B	B	X	X	X	X	X	C	C	I	I
820	821						N	N	N	N		S	S	S	S	S	B	B	X	X	X	X	X	C	C	I	I
1,000	102						N	N	N	N		S	S	S	S	S			X	X	X	X	X	C	C	I	I
1,200	122											B	B	B	B	B			X	X	X	X	X	C	C	I	I
1,500	152											B	B	B	B	B			X	X	X	X	X	C	C	I	I
1,800	182											B	B	B	B	B			X	X	X	X	X	C	C	I	I
2,200	222											B	B	B	B				X	X	X	X	X	C	C	I	I
2,700	272											B	B	B	B				C	C	C	C	C	I	I		
3,300	332											B	B	B	B				C	C	C	C	C	I	I		
3,900	392																		C	C	C	C	C	I	I		
4,700	472																		C	C	C	C	C	I	I		
5,600	562																		C	C	C	C	C				
6,800	682																		C	C	C	C	C				
8,200	822																		C	C	C	C	C				
10,000	103																		C	C	C	C	C				
12,000	123																		C	C	C	C	C				
15,000	153																		C	C	C	C	C				
18,000	183																		C	C	C	C	C				
22,000	223																		C	C	C	C	C				
27,000	273																										
33,000	333																										
39,000	393																										
47,000	473																										
56,000	563																										
68,000	683																										
82,000	823																										
100,000	104																										

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7.1 C0G (Capacitance vs. thickness, refer to table 8 for the thickness code), Continue

Cap (pF)	Size, Inch (mm)	1206 (3216)										1210 (3225)									
	Cap Code	10V	16V	25V	50V	100V	200V	250V	500V	630V	1000V	10V	16V	25V	50V	100V	200V	250V	500V	630V	1000V
1.2	1R2	X	X	X	X	X	X	X	X	X											
1.5	1R5	X	X	X	X	X	X	X	X	X	X										
1.8	1R8	X	X	X	X	X	X	X	X	X	X										
2.2	2R2	X	X	X	X	X	X	X	X	X	X										
2.7	2R7	X	X	X	X	X	X	X	X	X	X										
3.3	3R3	X	X	X	X	X	X	X	X	X	X										
3.9	3R9	X	X	X	X	X	X	X	X	X	X										
4.7	4R7	X	X	X	X	X	X	X	X	X	X										
5.6	5R6	X	X	X	X	X	X	X	X	X	X										
6.8	6R8	X	X	X	X	X	X	X	X	X	X										
8.2	8R2	X	X	X	X	X	X	X	X	X	X										
10	100	X	X	X	X	X	X	X	X	X	X	M	M	M	M	M	M	M	M	M	M
12	120	X	X	X	X	X	X	X	X	X	X	M	M	M	M	M	M	M	M	M	M
15	150	X	X	X	X	X	X	X	X	X	X	M	M	M	M	M	M	M	M	M	M
18	180	X	X	X	X	X	X	X	X	X	X	M	M	M	M	M	M	M	M	M	M
22	220	X	X	X	X	X	X	X	X	X	C	M	M	M	M	M	M	M	M	M	M
27	270	X	X	X	X	X	X	X	X	X	C	M	M	M	M	M	M	M	M	M	M
33	330	X	X	X	X	X	X	X	X	X	C	M	M	M	M	M	M	M	M	M	M
39	390	X	X	X	X	X	X	X	X	X	C	M	M	M	M	M	M	M	M	M	M
47	470	X	X	X	X	X	X	X	X	X	C	M	M	M	M	M	M	M	M	M	M
56	560	X	X	X	X	X	X	X	X	X	C	M	M	M	M	M	M	M	M	M	M
68	680	X	X	X	X	X	X	X	X	X	C	M	M	M	M	M	M	M	M	M	M
82	820	X	X	X	X	X	X	X	X	X	C	M	M	M	M	M	M	M	M	M	M
100	101	X	X	X	X	X	X	X	X	X	C	M	M	M	M	M	M	M	M	M	C
120	121	X	X	X	X	X	X	X	X	X	C	M	M	M	M	M	M	M	M	M	C
150	151	X	X	X	X	X	X	X	X	X	C	M	M	M	M	M	M	M	M	M	C
180	181	X	X	X	X	X	X	X	X	X	E	M	M	M	M	M	M	M	M	M	C
220	221	X	X	X	X	X	X	X	X	X	E	M	M	M	M	M	M	M	M	M	E
270	271	X	X	X	X	X	X	M	M	M	E	M	M	M	M	M	M	M	M	M	E
330	331	X	X	X	X	X	X	M	M	M	E	M	M	M	M	M	M	M	M	M	E
390	391	X	X	X	X	X	X	M	M	M	E	M	M	M	M	M	M	M	M	M	E
470	471	X	X	X	X	X	M	M	M	M	E	M	M	M	M	M	M	M	M	M	E
560	561	X	X	X	X	X	M	C	C	C	E	M	M	M	M	M	M	M	M	M	E
680	681	X	X	X	X	X	M	C	C	C	E	M	M	M	M	M	M	M	M	M	E
820	821	X	X	X	X	X	M	E	E	E	E	M	M	M	M	M	M	M	M	M	E
1,000	102	X	X	X	X	X	M	E	E	E	E	M	M	M	M	M	C	C	C	C	E
1,200	122	X	X	X	X	X	M	E	E	E		M	M	M	M	M	C	C	C	C	F
1,500	152	X	X	X	X	X	C	E	E	E		M	M	M	M	M	C	C	C	C	F
1,800	182	X	X	X	X	X	C	E	E	E		M	M	M	M	M	C	C	C	C	F
2,200	222	X	X	X	X	X	C	E	E	E		M	M	M	M	M	C	C	C	C	F
2,700	272	X	X	X	X	X	C	E	E	E		M	M	M	M	M	C	C	C	C	F
3,300	332	X	X	X	X	X	C	E	E	E		M	M	M	M	M	C	C	C	C	F
3,900	392	X	X	X	X	X	C	E	E	E		M	M	M	M	M	C	C	C	C	F
4,700	472	X	X	X	X	X	C	E	E	E		M	M	M	M	M	E	E	E	E	F
5,600	562	X	X	X	X	X	E	E				M	M	M	M	M	E	E	E	E	F
6,800	682	M	M	M	M	M	E	E				M	M	M	M	M	E	E	E	E	F
8,200	822	C	C	C	C	C	E	E				M	M	M	M	M	E	E	E	E	F
10,000	103	C	C	C	C	C	E	E				M	M	M	M	M	E	E	F	F	G
12,000	123											C	C	C	C	C	F	F	G	G	G
15,000	153											C	C	C	C	C	F	F	G	G	G
18,000	183											F	F	F	F	F					
22,000	223											F	F	F	F	F					
27,000	273											F	F	F	F	F					
33,000	333											F	F	F	F	F					
39,000	393											F	F	F	F	F					
47,000	473											F	F	F	F	F					
56,000	563																				
68,000	683																				
82,000	823																				
100,000	104																				

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AMT Category (Automotive Grade Surface Mount MLCCs)

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	10V	16V	25V	50V	10V	16V	25V	50V	10V	16V	25V	50V	100V	10V	16V	25V	50V	100V	200V	250V	500V	630V
100	101	L	L	L	L	N	N	N	N	S	S	S	S	S	X	X	X	X	X	X	X	X	X
120	121	L	L	L	L	N	N	N	N	S	S	S	S	S	X	X	X	X	X	X	X	X	X
150	151	L	L	L	L	N	N	N	N	S	S	S	S	S	X	X	X	X	X	X	X	X	X
180	181	L	L	L	L	N	N	N	N	S	S	S	S	S	X	X	X	X	X	X	X	X	X
220	221	L	L	L	L	N	N	N	N	S	S	S	S	S	X	X	X	X	X	X	X	X	X
270	271	L	L	L	L	N	N	N	N	S	S	S	S	S	X	X	X	X	X	X	X	X	X
330	331	L	L	L	L	N	N	N	N	S	S	S	S	S	X	X	X	X	X	X	X	X	X
390	391	L	L	L	L	N	N	N	N	S	S	S	S	S	X	X	X	X	X	X	X	X	X
470	471	L	L	L	L	N	N	N	N	S	S	S	S	S	X	X	X	X	X	X	X	X	X
560	561	L	L	L	L	N	N	N	N	S	S	S	S	S	X	X	X	X	X	X	X	X	X
680	681	L	L	L	L	N	N	N	N	S	S	S	S	S	X	X	X	X	X	X	X	X	X
820	821	L	L	L	L	N	N	N	N	S	S	S	S	S	X	X	X	X	X	X	X	X	X
1,000	102	L	L	L	L	N	N	N	N	S	S	S	S	S	X	X	X	X	X	X	X	X	X
1,200	122	L	L	L		N	N	N	N	S	S	S	S	S	X	X	X	X	X	X	X	X	X
1,500	152	L	L	L		N	N	N	N	S	S	S	S	S	X	X	X	X	X	X	X	X	X
1,800	182	L	L	L		N	N	N	N	S	S	S	S	S	X	X	X	X	X	X	X	X	X
2,200	222	L	L	L		N	N	N	N	S	S	S	S	S	X	X	X	X	X	X	X	X	X
2,700	272	L	L	L		N	N	N	N	S	S	S	S	S	X	X	X	X	X	X	X	X	X
3,300	332	L	L	L		N	N	N	N	S	S	S	S	S	X	X	X	X	X	X	X	X	X
3,900	392	L	L	L		N	N	N	N	S	S	S	S	S	X	X	X	X	X	X	X	X	X
4,700	472	L	L	L		N	N	N	N	S	S	S	S	S	X	X	X	X	X	X	X	C	C
5,600	562	L	L	L		N	N	N	N	S	S	S	S	S	X	X	X	X	X	C	C	C	C
6,800	682	L				N	N	N	N	S	S	S	S	S	X	X	X	X	X	C	C	C	C
8,200	822	L				N	N	N	N	S	S	S	S	S	X	X	X	X	X	C	C	C	C
10,000	103	L				N	N	N	N	S	S	S	S	S	X	X	X	X	X	C	C	C	C
12,000	123					N	N	N		S	S	S	S	B	X	X	X	X	X	C	C		
15,000	153					N	N	N		S	S	S	S	B	X	X	X	X	X	C	C		
18,000	183					N	N	N		S	S	S	S	B	X	X	X	X	X	C	C		
22,000	223					N	N	N		S	S	S	S	B	X	X	X	X	X/C	C	C		
27,000	273					N	N	N		S	S	S	S	B	X	X	X	X	C				
33,000	333					N	N	N		S	S	S	B	B	X	X	X	X	C				
39,000	393					N	N	N		S	S	S	B	B	X	X	X	X	C				
47,000	473					N	N	N		S	S	S	B	B	X	X	X	X	C				
56,000	563					N	N	N		S	S	S	B		X	X	X	X	C				
68,000	683					N	N	N		S	S	S	B		X	X	X	X	C				
82,000	823					N	N	N		S	S	S	B		X	X	X	C	C				
100,000	104					N	N	N		S	S	S	B		X	X	X	C	C				
120,000	124									B	B	B			X	X	X	C	C				
150,000	154									B	B	B	B		C	C	C	C					
180,000	184									B	B	B			C	C	C	C					
220,000	224									B	B	B	B		C	C	C	I					
270,000	274														C	C	C	I					
330,000	334									B	B	B	B		C	C	C	I					
390,000	394														C	C	C	I					
470,000	474														C	C	C	I					
560,000	564														C	C	C						
680,000	684														C	C	C	I					
820,000	824														C	C	C						
1,000,000	105														C	C	C	I					

Automotive General Multilayer Ceramic Capacitors

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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)							
	Cap Code	10V	16V	25V	50V	100V	200V	250V	500V	630V	10V	16V	25V	50V	100V	250V	500V	1000V
100	101						C	C	C	C						C	C	C
120	121						C	C	C	C						C	C	C
150	151	X	X	X	X	X	C	C	C	C						C	C	C
180	181	X	X	X	X	X	C	C	C	C						C	C	C
220	221	X	X	X	X	X	C	C	C	C						C	C	C
270	271	X	X	X	X	X	C	C	C	C						C	C	C
330	331	X	X	X	X	X	C	C	C	C						C	C	C
390	391	X	X	X	X	X	C	C	C	C						C	C	C
470	471	X	X	X	X	X	C	C	C	C						C	C	C
560	561	X	X	X	X	X	C	C	C	C						C	C	C
680	681	X	X	X	X	X	C	C	C	C						C	C	C
820	821	X	X	X	X	X	C	C	C	C						C	C	C
1,000	102	X	X	X	X	X	C	C	C	C	M	M	M	M	M	M	C	C
1,200	122	X	X	X	X	X	C	C	C	C	M	M	M	M	M	M	C	C
1,500	152	X	X	X	X	X	C	C	C	C	M	M	M	M	M	M	C	C
1,800	182	X	X	X	X	X	C	C	C	C	M	M	M	M	M	M	C	C
2,200	222	X	X	X	X	X	C	C	C	C	M	M	M	M	M	M	C	C
2,700	272	X	X	X	X	X	C	C	C	C	M	M	M	M	M	M	C	C
3,300	332	X	X	X	X	X	C	C	C	C	M	M	M	M	M	M	C	C
3,900	392	X	X	X	X	X	C	C	C	C	M	M	M	M	M	M	C	E
4,700	472	X	X	X	X	X	C	C	C	C	M	M	M	M	M	M	C	E
5,600	562	X	X	X	X	X	C	C	C	C	M	M	M	M	M	M	C	E
6,800	682	X	X	X	X	X	C	C	C	C	M	M	M	M	M	M	C	E
8,200	822	X	X	X	X	X	C	C	C	C	M	M	M	M	M	M	C	E
10,000	103	X	X	X	X	X	C	C	C	C	M	M	M	M	M	M	C	E
12,000	123	X	X	X	X	X	C	C			M	M	M	M	M	M	C	
15,000	153	X	X	X	X	X	C	C			M	M	M	M	M	M	C	
18,000	183	X	X	X	X	X	C	C			M	M	M	M	M	M	C	
22,000	223	X	X	X	X	X	C	C			M	M	M	M	M	M	C	
27,000	273	X	X	X	X	X					M	M	M	M	M	M		
33,000	333	X	X	X	X	X					M	M	M	M	M	M		
39,000	393	X	X	X	X	X					M	M	M	M	M	M		
47,000	473	X	X	X	X	X					M	M	M	M	M	C		
56,000	563	X	X	X	X	X					M	M	M	M	M			
68,000	683	X	X	X	X	X					M	M	M	M	M			
82,000	823	X	X	X	X	C					M	M	M	M	M			
100,000	104	X	X	X	X	C					M	M	M	M	M			
120,000	124	X	X	X	X	C					M	M	M	M				
150,000	154	M	M	M	M	E					M	M	M	M				
180,000	184	M	M	M	M	E					M	M	M	M				
220,000	224	M	M	M	M	E					M	M	M	M				
270,000	274	M	M	M	C	P					M	M	M	M				
330,000	334	M	M	M	C	P					M	M	M	C				
390,000	394	M	M	J	P	P					M	M	M	C				
470,000	474	J	J	J	P	P					M	M	M	C				
560,000	564	J	J	J	P	P					C	C	C	C				
680,000	684	J	J	J	P	P					C	C	C	C				
820,000	824	J	J	J	P	P					C	C	C	C				
1,000,000	105	J	J	J	P	P					C	C	C	C				
1,500,000	155				P	P						F						
2,200,000	225				P	P						F		G	G			
4,700,000	475										G	G	G	G	G			
10,000,000	106										G	G	G	G				

Automotive General Multilayer Ceramic Capacitors

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8. Reliability Test Conditions and Requirements:

<table>
<tr><th>No.</th><th>Item</th><th>AEC-Q200 Test Condition</th><th>Requirements</th></tr>
<tr><td>1</td><td>Pre- and Post-Stress Electrical Test</td><td>Refer to general electrical data</td><td>Refer to general electrical data</td></tr>
<tr><td>2</td><td>High Temperature Exposure (Storage)
MIL-STD-202,
Method 108</td><td>* Test temp.: 150±3°C.
* Unpowered.
* Test time: 1000 +24/-0 hrs.
* Measurement to be made after keeping at room temp. for 24±2 hrs.</td><td>* No remarkable damage.
* Capacitance change: C0G within ±2.5% or ±0.25pF, whichever is larger.
X7R within ±12.5%.
* Q/D.F. value:
C0G: Q≥1000 for Cap.≥30pF, Q≥400+20C for Cap.<30pF.
X7R: D.F.≤200% of initial requirement.
* I.R.: ≥10GΩ or RxC≥500Ω-F, whichever is smaller.
X7R
<table>
<tr><th>Rated</th><th>D.F.≤</th><th colspan="2">Exception of D.F.≤</th></tr>
<tr><td rowspan="3">≥100V</td><td rowspan="3">≤3%</td><td>≤6%</td><td>1206≥0.47μF</td></tr>
<tr><td>≤7.5%</td><td>0805>0.1μF, 0603≥0.068μF, 1206≥1μF, 1210≥2.2μF</td></tr>
<tr><td>≤20%</td><td>0805>0.22μF, 1210≥3.3μF</td></tr>
<tr><td rowspan="3">50V</td><td rowspan="3">≤3%</td><td>≤6%</td><td>0201(50V), 0603≥0.047μF, 0805≥0.18μF, 1206≥0.47μF</td></tr>
<tr><td>≤10%</td><td>0201≥0.01uF, 1210≥3.3μF</td></tr>
<tr><td>≤20%</td><td>0402≥0.012μF, 0603>0.1μF, 0805/X7R≥0.47μF, 1206≥2.2μF, 1210≥10μF</td></tr>
<tr><td>35V</td><td>≤5%</td><td>≤20%</td><td>0603≥1μF, 0805≥2.2μF, 1206≥2.2μF, 1210≥10μF</td></tr>
<tr><td rowspan="4">25V</td><td rowspan="4">≤5%</td><td>≤10%</td><td>0201≥0.01μF, 0805≥1μF, 1210≥10μF</td></tr>
<tr><td>≤14%</td><td>0603≥0.33μF</td></tr>
<tr><td>≤15%</td><td>0201≥0.1μF, 0402≥0.056μF, 0603≥0.47μF, 0805≥2.2μF, 1206≥4.7μF, 1210≥22μF</td></tr>
<tr><td>≤20%</td><td>0402≥0.47μF</td></tr>
<tr><td rowspan="2">16V</td><td rowspan="2">≤5%</td><td>≤10%</td><td>0603≥0.15μF, 0805≥0.68μF, 1206≥2.2μF, 1210≥4.7μF</td></tr>
<tr><td>≤15%</td><td>0201≥0.022uF, 0402≥0.033uF, 0603≥0.47μF, 0805≥2.2μF, 1206≥4.7μF, 1210≥22μF</td></tr>
<tr><td rowspan="2">10V</td><td rowspan="2">≤7.5%</td><td>≤15%</td><td>0201≥0.012μF, 0402≥0.22μF, 0603≥0.33μF, 0805≥2.2μF, 1206≥2.2μF, 1210≥22μF</td></tr>
<tr><td>≤20%</td><td>0201≥0.1μF, 0402≥1μF</td></tr>
<tr><td>6.3V</td><td>≤15%</td><td>≤30%</td><td>0201≥0.1uF, 0402≥1uF, 0603≥10μF, 0805≥4.7μF, 1206≥47μF, 1210≥100μF</td></tr>
<tr><td>4V</td><td>≤20%</td><td>—</td><td>—</td></tr>
</table>
Class II (X7R)
<table>
<tr><th>Rated Voltage</th><th>I.R.</th></tr>
<tr><td>≥100V: All X7R;1210≥3.3μF</td><td rowspan="8">≥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>0.1μF, 0402≥1μF, 0603≥2.2μF, 0805≥2.2μF, 1206≥10μF, 1210≥10μF</td></tr>
<tr><td>16V: 0201≥0.1μF, 0402≥0.22μF, 0603≥1μF, 0805≥2.2μF, 1206≥10μF, 1210≥47μF</td></tr>
<tr><td>10V: 0201≥0.047μF, 0402≥0.47μF, 0603≥0.47μF, 0805≥2.2μF, 1206≥4.7μF, 1210≥47μF</td></tr>
<tr><td>6.3V;4V:Size≥1812</td></tr>
</table></td></tr>
<tr><td>3</td><td>Destructive Physical Analysis
EIA-469</td><td>Per EIA-469.</td><td>* No defects or abnormalities.</td></tr>
<tr><td>4</td><td>Temperature Cycling
JESD22,
Method JA-104</td><td>* Conduct 1000 cycles according to the temperatures and time.
<table>
<tr><th>Step</th><th>Temp. (°C)</th><th>Time (min.)</th></tr>
<tr><td>1</td><td>-55°C +0/-3</td><td>30±1</td></tr>
<tr><td>2</td><td>+125°C +3/-0</td><td>30±1</td></tr>
</table>
* Before initial measurement (X7R only) : Perform 150 +0/-10°C for 1 hr and then set for 24±2 hrs at room temp.
* Measurement to be made after keeping at room temp. for 24±2 hrs.</td><td>* No remarkable damage.
* Capacitance change: C0G within ±2.5% or 0.25pF, whichever is larger.
X7R within ±10.0%.
* Q/D.F. value:
C0G: Q≥1000 for Cap.≥30pF, Q≥400+20C for Cap.<30pF.
X7R: D.F.≤200% of initial requirement.
* I.R.: ≥10GΩ or RxC≥500Ω-F, whichever is smaller.
Class II (X7R)
<table>
<tr><th>Rated Voltage</th><th>I.R.</th></tr>
<tr><td>100V: All X7R;1210≥3.3μF</td><td rowspan="8">≥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>0.1μF, 0402≥1μF, 0603≥2.2μF, 0805≥2.2μF, 1206≥10μF, 1210≥10μF</td></tr>
<tr><td>16V: 0201≥0.1μF, 0402≥0.22μF, 0603≥1μF, 0805≥2.2μF, 1206≥10μF, 1210≥47μF</td></tr>
<tr><td>10V: 0201≥0.047μF, 0402≥0.47μF, 0603≥0.47μF, 0805≥2.2μF, 1206≥4.7μF, 1210≥47μF</td></tr>
<tr><td>6.3V;4V:Size≥1812</td></tr>
</table></td></tr>
</table>

Automotive General Multilayer Ceramic Capacitors

AMT Category (Automotive Grade Surface Mount MLCCs)

<table>
<tr><th>No.</th><th>Item</th><th>AEC-Q200 Test Condition</th><th>Requirements</th></tr>
<tr><td>5</td><td>Moisture Resistance
MIL-STD-202,
Method 106</td><td>* Test temp.25~65°C.
* Humidity: 80~100% RH.
* Test time: 10 cycles, t=24hrs/cycle.
* Measurement to be made after keeping at room temp. for 24±2 hrs.</td><td>* No remarkable damage.
* Cap. change: C0G within ±3.0% or 0.30pF, whichever is larger.
X7R within ±12.5%.
* Q/D.F. value:
C0G: Q≥350 for Cap.>30pF, Q≥275+2.5C for 10pF≤Cap.≤30pF,
Q≥200+10C for Cap.<10pF.
X7R: D.F.≤200% of initial requirement.
* I.R.: ≥10GΩ or RxC≥500Ω-F, whichever is smaller.
Class II (X7R)
<table>
<tr><th>Rated Voltage</th><th>I.R.</th></tr>
<tr><td>100V: All X7R;1210≥3.3μF</td><td rowspan="8">≥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>0.1μF, 0402≥1μF, 0603≥2.2μF, 0805≥2.2μF, 1206≥10μF, 1210≥10μF</td></tr>
<tr><td>16V: 0201≥0.1μF, 0402≥0.22μF, 0603≥1μF, 0805≥2.2μF, 1206≥10μF, 1210≥47μF</td></tr>
<tr><td>10V: 0201≥0.047μF, 0402≥0.47μF, 0603≥0.47μF, 0805≥2.2μF, 1206≥4.7μF, 1210≥47μF</td></tr>
<tr><td>6.3V;4V:Size≥1812</td></tr>
</table></td></tr>
<tr><td>6</td><td>Biased Humidity
MIL-STD-202,
Method 103</td><td>* Test temp.: 85±3°C.
* Humidity: 85±5%RH.
* Test time: 1000 +24/-0 hrs.
* To apply voltage: Rated voltage (max. 100Vdc) and 1.3~1.5Vdc (add 100k ohm resistor).
* Before initial measurement (Class II only): To apply test voltage for 1hr at test temp. and then set for 24±2 hrs at room temp.
* Measurement to be made after keeping at room temp. for 24±2 hrs.</td><td>* No remarkable damage.
* Cap. change: C0G within ±3.0% or 0.30pF, whichever is larger.
X7R within ±12.5%.
* Q/D.F. value:
C0G: Q≥200 for Cap.≥30pF, Q≥100+10/3C for Cap.<30pF.
X7R: D.F.≤200% of initial requirement.
* I.R.: ≥1GΩ or RxC≥50Ω-F, whichever is smaller.
Class II (X7R) for rated voltage test
<table>
<tr><th>Rated Voltage</th><th>I.R.</th></tr>
<tr><td>100V: All X7R;1210≥3.3μF</td><td rowspan="8">≥500GΩ 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>0.1μF, 0402≥1μF, 0603≥2.2μF, 0805≥2.2μF, 1206≥10μF, 1210≥10μF</td></tr>
<tr><td>16V: 0201≥0.1μF, 0402≥0.22μF, 0603≥1μF, 0805≥2.2μF, 1206≥10μF, 1210≥47μF</td></tr>
<tr><td>10V: 0201≥0.047μF, 0402≥0.47μF, 0603≥0.47μF, 0805≥2.2μF, 1206≥4.7μF, 1210≥47μF</td></tr>
<tr><td>6.3V;4V:Size≥1812</td></tr>
</table>
Class II (X7R) for 1.3~1.5Vdc test
<table>
<tr><th>Rated Voltage</th><th>I.R.</th></tr>
<tr><td>100V: All X7R;1210≥3.3μF</td><td rowspan="8">≥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>0.1μF, 0402≥1μF, 0603≥2.2μF, 0805≥2.2μF, 1206≥10μF, 1210≥10μF</td></tr>
<tr><td>16V: 0201≥0.1μF, 0402≥0.22μF, 0603≥1μF, 0805≥2.2μF, 1206≥10μF, 1210≥47μF</td></tr>
<tr><td>10V: 0201≥0.047μF, 0402≥0.47μF, 0603≥0.47μF, 0805≥2.2μF, 1206≥4.7μF, 1210≥47μF</td></tr>
<tr><td>6.3V;4V:Size≥1812</td></tr>
</table></td></tr>
<tr><td>7</td><td>External Visual
MIL-STD-883,
Method 2009</td><td>* Visual inspection.</td><td>* No remarkable defect.</td></tr>
<tr><td>8</td><td>Physical Dimension
JESD22,
Method JB-100</td><td>* Using by calipers.</td><td>* Within the specified dimensions.</td></tr>
</table>

Automotive General Multilayer Ceramic Capacitors

AMT Category (Automotive Grade Surface Mount MLCCs)

<table>
<tr><th>No.</th><th>Item</th><th>AEC-Q200 Test Condition</th><th>Requirements</th></tr>
<tr><td>9</td><td>Operational Life
MIL-STD-202,
Method 108</td><td>* Test temp.: 125±3°C.
* To apply voltage: Full rated voltage.
* Test time: 1000 +24/-0 hrs.
* Before initial measurement (X7R only):
Apply rated voltage for 1 hr at 125°C. Remove and let set for 24±2 hrs at room temp.
* Measurement to be made after keeping at room temp. for 24±2 hrs.</td><td>* No remarkable damage.
* Cap. change: C0G within ±3.0% or ±0.3pF, whichever is larger.
X7R within ±12.5%.
* Q/D.F. value:
C0G: Q≥350 for Cap.>30pF, Q≥275+2.5C for 10pF≤Cap.≤30pF,
Q≥200+10C for Cap.<10pF.
X7R: D.F.≤200% of initial requirement.
I.R.: ≥1GΩ or RxC≥50Ω-F, whichever is smaller.
Class II (X7R)
<table>
<tr><th>Rated Voltage</th><th>I.R.</th></tr>
<tr><td>100V: All X7R;1210≥3.3μF</td><td rowspan="8">≥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>0.1μF, 0402≥1μF, 0603≥2.2μF, 0805≥2.2μF, 1206≥10μF, 1210≥10μF</td></tr>
<tr><td>16V: 0201≥0.1μF, 0402≥0.22μF, 0603≥1μF, 0805≥2.2μF, 1206≥10μF, 1210≥47μF</td></tr>
<tr><td>10V: 0201≥0.047μF, 0402≥0.47μF, 0603≥0.47μF, 0805≥2.2μF, 1206≥4.7μF, 1210≥47μF</td></tr>
<tr><td>6.3V;4V:Size≥1812</td></tr>
</table></td></tr>
<tr><td>10</td><td>Resistance to Solvents
MIL-STD-202,
Method 215</td><td>* Temperature: 25±5°C.
* Time: 3 +0.5/-0 min.
* Solvent: Iso-propyl alcohol.</td><td>* No remarkable damage.
* Cap.: Within the specified tolerance.
* Q/D.F. value:
C0G: Q≥1000 for Cap.≥30pF, Q≥400+20C for Cap.<30pF.
X7R: D.F.≤100% of initial requirement.
* I.R.: ≥10GΩ or RxC≥500Ω-F, whichever is smaller.
Class II (X7R)
<table>
<tr><th>Rated Voltage</th><th>I.R.</th></tr>
<tr><td>100V: All X7R;1210≥3.3μF</td><td rowspan="8">≥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>0.1μF, 0402≥1μF, 0603≥2.2μF, 0805≥2.2μF, 1206≥10μF, 1210≥10μF</td></tr>
<tr><td>16V: 0201≥0.1μF, 0402≥0.22μF, 0603≥1μF, 0805≥2.2μF, 1206≥10μF, 1210≥47μF</td></tr>
<tr><td>10V: 0201≥0.047μF, 0402≥0.47μF, 0603≥0.47μF, 0805≥2.2μF, 1206≥4.7μF, 1210≥47μF</td></tr>
<tr><td>6.3V;4V:Size≥1812</td></tr>
</table></td></tr>
<tr><td>11</td><td>Mechanical Shock
MIL-STD-202,
Method 213</td><td>* Peak value: 1500g's.
* Wave: 1/2 sine.
* Velocity: 15.4 ft/sec.
* Three shocks in each direction should be applied along 3 mutually perpendicular axes of the test specimen (18 shocks).</td><td>* No remarkable damage.
* Cap.: Within the specified tolerance.
* Q/D.F. value:
C0G: Q≥1000 for Cap.≥30pF, Q≥400+20C for Cap.<30pF.
X7R: D.F.≤100% of initial requirement.
* I.R.: ≥10GΩ or RxC≥500Ω-F, whichever is smaller.
Class II (X7R)
<table>
<tr><th>Rated Voltage</th><th>I.R.</th></tr>
<tr><td>100V: All X7R;1210≥3.3μF</td><td rowspan="8">≥1GΩ or RxC≥100Ω-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>0.1μF, 0402≥1μF, 0603≥2.2μF, 0805≥2.2μF, 1206≥10μF, 1210≥10μF</td></tr>
<tr><td>16V: 0201≥0.1μF, 0402≥0.22μF, 0603≥1μF, 0805≥2.2μF, 1206≥10μF, 1210≥47μF</td></tr>
<tr><td>10V: 0201≥0.047μF, 0402≥0.47μF, 0603≥0.47μF, 0805≥2.2μF, 1206≥4.7μF, 1210≥47μF</td></tr>
<tr><td>6.3V;4V:Size≥1812</td></tr>
</table>
<table>
<tr><th>Rated Voltage</th><th>I.R.</th></tr>
<tr><td>100V: 1210≥3.3μF</td><td rowspan="8">RxC≥50Ω-F</td></tr>
<tr><td>50V: 0402≥0.1μF, 0603≥2.2μF, 0805≥10μF, 1206≥10μF,</td></tr>
<tr><td>35V: 0603≥1μF</td></tr>
<tr><td>25V: 0201>0.1μF, 0402≥2.2μF, 0603≥10μF, 0805≥10μF, 1206≥22μF</td></tr>
<tr><td>16V: 0201≥0.22μF, 0402≥1μF, 0603≥10μF</td></tr>
<tr><td>10V: 0201≥0.1μF, 0402≥1μF, 0603≥10μF, 0805≥47μF</td></tr>
<tr><td>6.3V:0201≥0.1μF, 0402≥1μF, 0603≥4.7μF, 0805≥47μF, 1206≥10μF</td></tr>
<tr><td>4V:0603≥22μF, 0805≥47μF, 1206≥100μF</td></tr>
</table></td></tr>
</table>

Automotive General Multilayer Ceramic Capacitors

AMT Category (Automotive Grade Surface Mount MLCCs)

<table>
<tr><th>No.</th><th>Item</th><th>AEC-Q200 Test Condition</th><th>Requirements</th></tr>
<tr><td>12</td><td>Vibration
MIL-STD-202,
Method 204</td><td>* Vibration frequency: 10~2000 Hz/min. (5g's for 20 min.).
* Total amplitude: 1.5mm.
* 12 cycles each of 3 orientations (36 times).</td><td>* No remarkable damage.
* Cap.: Within the specified tolerance.
* Q/D.F. value:
C0G: Q≥1000 for Cap.≥30pF, Q≥400+20C for Cap.<30pF.
X7R: D.F.≤100% of initial requirement.
* I.R.: ≥10GΩ or RxC≥500Ω-F, whichever is smaller.
Class II (X7R)
<table>
<tr><th>Rated Voltage</th><th>I.R.</th></tr>
<tr><td>100V: All X7R;1210≥3.3μF</td><td rowspan="6">≥10GΩ or RxC≥100Ω-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>0.1μF, 0402≥1μF, 0603≥2.2μF, 0805≥2.2μF, 1206≥10μF, 1210≥10μF</td></tr>
<tr><td>16V: 0201≥0.1μF, 0402≥0.22μF, 0603≥1μF, 0805≥2.2μF, 1206≥10μF, 1210≥47μF</td></tr>
<tr><td>10V: 0201≥0.047μF, 0402≥0.47μF, 0603≥0.47μF, 0805≥2.2μF, 1206≥4.7μF, 1210≥47μF</td></tr>
<tr><td>6.3V;4V:Size≥1812</td></tr>
</table>
<table>
<tr><th>Rated Voltage</th><th>I.R.</th></tr>
<tr><td>100V: 1210≥3.3μF</td><td rowspan="8">RxC≥50Ω-F</td></tr>
<tr><td>50V: 0402≥0.1μF, 0603≥2.2μF, 0805≥10μF, 1206≥10μF,</td></tr>
<tr><td>35V: 0603≥1μF</td></tr>
<tr><td>25V: 0201>0.1μF, 0402≥2.2μF, 0603≥10μF, 0805≥10μF, 1206≥22μF</td></tr>
<tr><td>16V: 0201≥0.22μF, 0402≥1μF, 0603≥10μF</td></tr>
<tr><td>10V: 0201≥0.1μF, 0402≥1μF, 0603≥10μF, 0805≥47μF</td></tr>
<tr><td>6.3V:0201≥0.1μF, 0402≥1μF, 0603≥4.7μF, 0805≥47μF, 1206≥10μF</td></tr>
<tr><td>4V:0603≥22μF, 0805≥47μF, 1206≥100μF</td></tr>
</table></td></tr>
<tr><td>13</td><td>Resistance to Soldering Heat
MIL-STD-202,
Method 210</td><td>* Solder temperature: 260±5°C.
* Dipping time: 10±1 sec.
* Before initial measurement (X7R only):
Perform 150 +0/-10°C for 1 hr and then set for 24±2 hrs at room temp.
* Measurement to be made after keeping at room temp. for 24±2 hrs.</td><td>* No remarkable damage.
* Cap. change: C0G within ±2.5% or 0.25pF, whichever is larger.
X7R within ±7.5%.
* Q/D.F. value:
C0G: Q≥1000 for Cap.≥30pF, Q≥400+20C for Cap.<30pF.
X7R: D.F.≤100% of initial requirement.
* I.R.: ≥10GΩ or RxC≥500Ω-F, whichever is smaller.
Class II (X7R)
<table>
<tr><th>Rated Voltage</th><th>I.R.</th></tr>
<tr><td>≥100V: All X7R;1210≥3.3μF</td><td rowspan="6">≥10GΩ or RxC≥100Ω-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>0.1μF, 0402≥1μF, 0603≥2.2μF, 0805≥2.2μF, 1206≥10μF, 1210≥10μF</td></tr>
<tr><td>16V: 0201≥0.1μF, 0402≥0.22μF, 0603≥1μF, 0805≥2.2μF, 1206≥10μF, 1210≥47μF</td></tr>
<tr><td>10V: 0201≥0.047μF, 0402≥0.47μF, 0603≥0.47μF, 0805≥2.2μF, 1206≥4.7μF, 1210≥47μF</td></tr>
<tr><td>6.3V;4V:Size≥1812</td></tr>
</table>
<table>
<tr><th>Rated Voltage</th><th>I.R.</th></tr>
<tr><td>100V: 1210≥3.3μF</td><td rowspan="8">RxC≥50Ω-F</td></tr>
<tr><td>50V: 0402≥0.1μF, 0603≥2.2μF, 0805≥10μF, 1206≥10μF,</td></tr>
<tr><td>35V: 0603≥1μF</td></tr>
<tr><td>25V: 0201>0.1μF, 0402≥2.2μF, 0603≥10μF, 0805≥10μF, 1206≥22μF</td></tr>
<tr><td>16V: 0201≥0.22μF, 0402≥1μF, 0603≥10μF</td></tr>
<tr><td>10V: 0201≥0.1μF, 0402≥1μF, 0603≥10μF, 0805≥47μF</td></tr>
<tr><td>6.3V:0201≥0.1μF, 0402≥1μF, 0603≥4.7μF, 0805≥47μF, 1206≥10μF</td></tr>
<tr><td>4V:0603≥22μF, 0805≥47μF, 1206≥100μF</td></tr>
</table></td></tr>
</table>

Automotive General Multilayer Ceramic Capacitors

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<table>
<tr><th>No.</th><th>Item</th><th>AEC-Q200 Test Condition</th><th>Requirements</th></tr>
<tr><td>14</td><td>ESD
AEC-Q200-002</td><td>* Per AEC-Q200-002.</td><td>* No remarkable damage.
* Cap.: Within the specified tolerance.
* Q/D.F. value:
C0G: Q≥1000 for Cap.≥30pF, Q≥400+20C for Cap.<30pF.
X7R: D.F.≤100% of initial requirement.
* I.R.: ≥10GΩ or RxC≥500Ω-F, whichever is smaller.
Class II (X7R)
<table>
<tr><th>Rated Voltage</th><th>I.R.</th></tr>
<tr><td>≥100V: All X7R;1210≥3.3μF</td><td rowspan="7">≥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>0.1μF, 0402≥1μF, 0603≥2.2μF, 0805≥2.2μF, 1206≥10μF, 1210≥10μF</td></tr>
<tr><td>16V: 0201≥0.1μF, 0402≥0.22μF, 0603≥1μF, 0805≥2.2μF, 1206≥10μF, 1210≥47μF</td></tr>
<tr><td>10V: 0201≥0.047μF, 0402≥0.47μF, 0603≥0.47μF, 0805≥2.2μF, 1206≥4.7μF, 1210≥47μF</td></tr>
<tr><td>6.3V;4V:Size≥1812</td></tr>
</table></td></tr>
<tr><td>15</td><td>Solderability
J-STD-002,
JESD22-B102E</td><td>* Condition A
Un-mounted chips 4hrs / 155°C*dry then completely immersed for 5±0.5 sec in solder bath at 245±5°C.
* Condition B
Un-mounted chips steam 8 hrs then completely immersed for 10±1sec in solder bath at 220 +5/-0°C.
* Condition C
Un-mounted chips steam 8 hrs then completely immersed for 10±1 sec. in solder bath at 260 +0/-5°C.</td><td>* All terminations shall exhibit a continuous solder coating free from defects from a minimum of 95% of the critical surface area of any individual termination.</td></tr>
<tr><td>16</td><td>Board Flex
AEC-Q200-005</td><td>* The middle part of substrate shall be pressurized by means of the pressurizing rod at a rate of about 1 mm per second until the deflection becomes 2mm and then the pressure shall be maintained for 60±1 sec.
* Measurement to be made after keeping at room temp. for 24±2 hrs.</td><td>* No remarkable damage.
* Cap. change: C0G within ±5% or 0.5pF, whichever is larger.
X7R within ±12.5%.
(This capacitance change means the change of capacitance under specified flexure of substrate from the capacitance measured before the test)</td></tr>
<tr><td>17</td><td>Terminal Strength
AEC-Q200-006</td><td>* Pressurizing force: 2N (0402), 5N(0603), 10N(0805), 17.7N (≥1206).
* Test time: 60±1 sec.</td><td>* No remarkable damage or removal of the terminations.
* Capacitance within the specified tolerance.
* Q/D.F. value:
C0G: Q≥1000 for Cap.≥30pF, Q≥400+20C for Cap.<30pF.
X7R: D.F.≤100% of initial requirement.</td></tr>
<tr><td>18</td><td>Beam Load Test
AEC-Q200-003</td><td>* Break strength test.
* Beam speed: 2.5±0.25 mm/sec.</td><td>* The chip endure following force:
Chip length ≤2.5mm: Thickness >0.5mm (20N), ≤0.5mm (8N).
Chip length ≥3.2mm: Thickness ≥1.25mm (54.5N), <1.25mm (15N).</td></tr>
<tr><td>19</td><td>Thermal Shock
MIL-STD-202,
Method 107</td><td>* Conduct 300 cycles according to the temperatures and time.
<table>
<tr><th>Step</th><th>Temp. (°C)</th><th>Time (min.)</th></tr>
<tr><td>1</td><td>-55°C +0/-3</td><td>15±3</td></tr>
<tr><td>2</td><td>+125°C +3/-0</td><td>15±3</td></tr>
</table>
* Max. transfer time: 20 sec.
* Before initial measurement (X7R only):
Perform 150 +0/-10°C for 1 hr and then set for 24±2 hrs at room temp.
* Measurement to be made after keeping at room temp. for 24±2 hrs.</td><td>* No remarkable damage.
* Cap. change: C0G within ±2.5% or 0.25pF, whichever is larger.
X7R within ±10.0%.
* Q/D.F. value:
C0G: Q≥1000 for Cap.≥30pF, Q≥400+20C for Cap.<30pF.
X7R: D.F.≤200% of initial requirement.
* I.R.: ≥10GΩ or RxC≥500Ω-F, whichever is smaller.
Class II (X7R)
<table>
<tr><th>Rated Voltage</th><th>I.R.</th></tr>
<tr><td>100V: All X7R;1210≥3.3μF</td><td rowspan="7">≥10GΩ or RxC≥100Ω-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>0.1μF, 0402≥1μF, 0603≥2.2μF, 0805≥2.2μF, 1206≥10μF, 1210≥10μF</td></tr>
<tr><td>16V: 0201≥0.1μF, 0402≥0.22μF, 0603≥1μF, 0805≥2.2μF, 1206≥10μF, 1210≥47μF</td></tr>
<tr><td>10V: 0201≥0.047μF, 0402≥0.47μF, 0603≥0.47μF, 0805≥2.2μF, 1206≥4.7μF, 1210≥47μF</td></tr>
<tr><td>6.3V;4V:Size≥1812</td></tr>
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<table>
<tr><th>No.</th><th>Item</th><th>AEC-Q200 Test Condition</th><th>Requirements</th></tr>
<tr><td rowspan="3">20</td><td rowspan="3">Electrical Characterization</td><td>* Capacitance.
* Q/D.F. (Dissipation Factor).
C0G:
Cap.≤1000pF: 1.0±0.2Vrms, 1MHz±10%.
Cap.>1000pF: 1.0±0.2Vrms, 1KHz±10%.
X7R:
Apply 1.0±0.2Vrms, 1.0KHz±10%, at 25°C ambient temperature.</td><td>* Capacitance within the specified tolerance.
* Q/D.F. value:
C0G: Q≥1000 for Cap.≥30pF, Q≥400+20C for Cap.<30pF.
X7R:
<table>
<tr><th>Rated</th><th>D.F.≤</th><th colspan="2">Exception of D.F.≤</th></tr>
<tr><td rowspan="3">≥100V</td><td rowspan="3">≤2.5%</td><td>≤3%</td><td>1206≥0.47μF</td></tr>
<tr><td>≤5%</td><td>0805>0.1μF, 0603≥0.068μF, 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≥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="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, 1206≥4.7μF</td></tr>
<tr><td>≤10%</td><td>0201≥0.1μF, 0402≥0.056μF, 0603≥0.47μF, 0805≥2.2μF, 1206≥6.8μF, 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(0201/X7R≥0.022μF), 0402≥0.22uF, 0603≥0.68μF, 0805≥2.2μF, 1206≥4.7μF, 1210≥22μF</td></tr>
<tr><td rowspan="2">10V</td><td rowspan="2">≤5%</td><td>≤10%</td><td>0201≥0.012μF, 0402≥0.33μF(0402/X7R≥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>
</table></td></tr>
<tr><td>* Insulation Resistance.
To apply rated voltage for max. 120 sec.</td><td>* I.R.:≥10GΩ or RxC≥500Ω-F, whichever is smaller.
Class II (X7R)
<table>
<tr><th>Rated Voltage</th><th>I.R.</th></tr>
<tr><td>100V: All X7R;1210≥3.3μF</td><td rowspan="7">≥10GΩ or RxC≥100Ω-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>0.1μF, 0402≥1μF, 0603≥2.2μF, 0805≥2.2μF, 1206≥10μF, 1210≥10μF</td></tr>
<tr><td>16V: 0201≥0.1μF, 0402≥0.22μF, 0603≥1μF, 0805≥2.2μF, 1206≥10μF, 1210≥47μF</td></tr>
<tr><td>10V: 0201≥0.047μF, 0402≥0.47μF, 0603≥0.47μF, 0805≥2.2μF, 1206≥4.7μF, 1210≥47μF</td></tr>
<tr><td>6.3V;4V:Size≥1812</td></tr>
</table>
<table>
<tr><th>Rated Voltage</th><th>I.R.</th></tr>
<tr><td>100V: 1210≥3.3μF</td><td rowspan="8">RxC≥50Ω-F</td></tr>
<tr><td>50V: 0402>0.1μF, 0603≥2.2μF, 0805≥10μF, 1206≥10μF</td></tr>
<tr><td>35V: 0603≥1μF</td></tr>
<tr><td>25V: 0201>0.1μF, 0402≥2.2μF, 0603≥10μF, 0805≥10μF, 1206≥22μF</td></tr>
<tr><td>16V: 0603≥10μF, 0402≥1μF, 0201≥0.22μF</td></tr>
<tr><td>10V: 0201≥0.1μF, 0402≥1μF, 0603≥10μF, 0805≥47μF</td></tr>
<tr><td>6.3V:0201≥0.1μF, 0402≥1μF, 0603≥4.7μF, 0805≥47μF,1206≥10μF</td></tr>
<tr><td>4V: 0603≥22μF, 0805≥47μF,1206≥100μF</td></tr>
</table></td></tr>
<tr><td>* Dielectric Strength.
<table>
<tr><th>Rated Voltage (V)</th><th>Condition</th></tr>
<tr><td>≤100</td><td>2.5 times of U_R</td></tr>
<tr><td>100<V≤250</td><td>2.0 times of U_R</td></tr>
<tr><td>250<V≤500</td><td>1.5 times of U_R</td></tr>
<tr><td>630≤V≤1000</td><td>1.2 times of U_R</td></tr>
</table>*
Duration 1~5 sec, charge and discharge current less than 50mA.</td><td>* No evidence of damage or flash over during test.</td></tr>
<tr><td>* Temperature Coefficient (With no electrical load)
Operation temperature: -55~125°C at 25°C.</td><td>* Capacitance Change: C0G within ±30ppm/°C.
X7R within ±15%.</td></tr>
</table>

Automotive General Multilayer Ceramic Capacitors

AMT Category (Automotive Grade Surface Mount MLCCs)

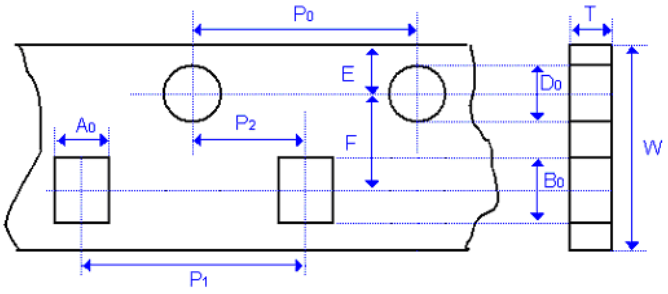
9. Package Dimension and Quantity:

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	-	-	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	-

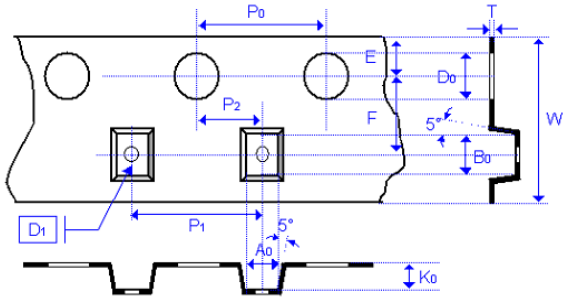
Automotive General Multilayer Ceramic Capacitors

AMT Category (Automotive Grade Surface Mount MLCCs)

9.1 Tape Dimension



The dimension of paper tape



The dimension of plastic tape

Size, Inch (mm)	0201 (0603)	0402 (1005)	0603 (1608)		0805 (2012)	
Chip Thickness	0.30±0.03	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	0.39±0.07	0.70±0.20	1.00 +0.05/-0.1	1.02 +0.05/-0.1	1.50±0.10	<1.65
B_0	0.69±0.07	1.20±0.20	1.80±0.10	1.80±0.10	2.30±0.10	<2.40
T	≤0.50	≤0.80	0.95±0.05	0.97±0.05	0.95±0.05	0.23±0.05
K_0	-	-	-	-	-	<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
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±0.20	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	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	1.55±0.05	1.55±0.05	1.55±0.05	1.55±0.05	1.55±0.05	1.50 +0.10/-0
D_1	-	-	-	-	-	1.00±0.10
E	1.75±0.05	1.75±0.05	1.75±0.05	1.75±0.05	1.75±0.05	1.75±0.10
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)		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
A_0	2.00±0.10	<2.00	<2.00	<3.05	<3.10	<3.90	<3.90
B_0	3.50±0.10	<3.60	<3.70	<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	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	1.00±0.10	1.00±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	3.50±0.05	3.50±0.05	3.50±0.05	5.50±0.05	5.50±0.05
Unit :	mm	mm	mm	mm	mm	mm	mm

Automotive General Multilayer Ceramic Capacitors
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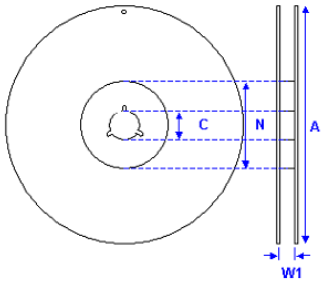
9.1 Reel Dimensions:

Size	0201, 0402, 0603, 0805, 1206, 1210	
Reel size	7"	13"
C	13.0 +0.5/-0.2	13.0 +0.7/-0.3
W_1	8.4 +1.5	8.4 +1.5
W	14.4max	14.4max
A	178.0 ±0.10	330.0 ±1.0
N	60.0 ±1.0/-0	100 ±1.0



The dimension of reel

10. Recommended Soldering Conditions:

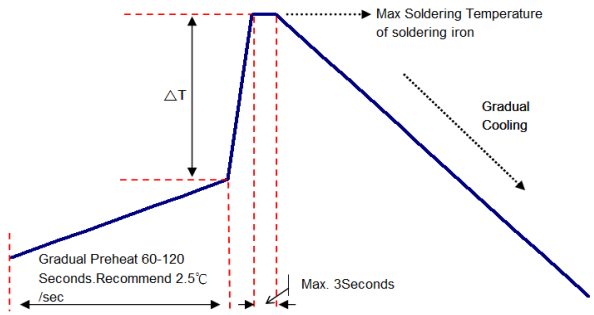
Use middy activated rosin RA and RMA fluxes do not use activated flux. The amount of solder in each solder joint should be controlled to prevent the damage of chip capacitors caused by the stress between solder, chips, and substrate.

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:

Hand Soldering Profile



Chip Size	Pre-Heat temp.	ΔT	Max. soldering iron temp.
≤1206	≥150°C	≤150°C	≤350°C
1210~2225	≥150°C	≤130°C	≤280°C

* 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.

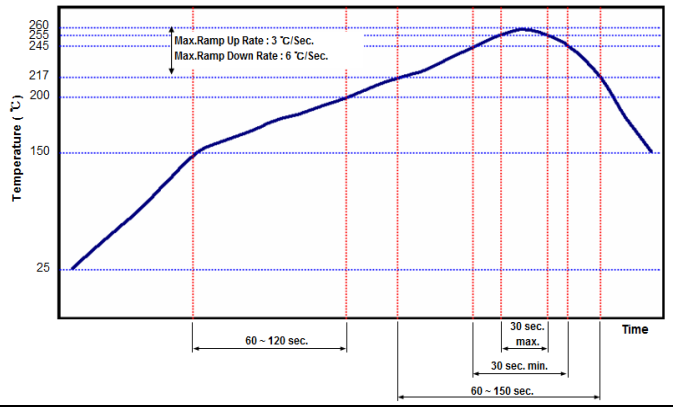
* The tip of iron should not contact the ceramic body directly.

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

* Forced air cooling is not allowed.

10.3 Reflow soldering:

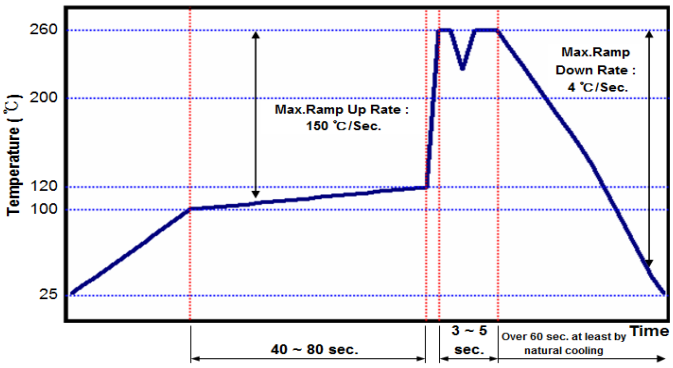
Reflow Soldering Profile



For Sn/Ag/Cu Series solder paste (Pb-Free)

10.4 Wave soldering:

Wave Soldering Profile



For Sn/Ag/Cu Series solder paste (Pb-Free)

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

Automotive General Multilayer Ceramic Capacitors
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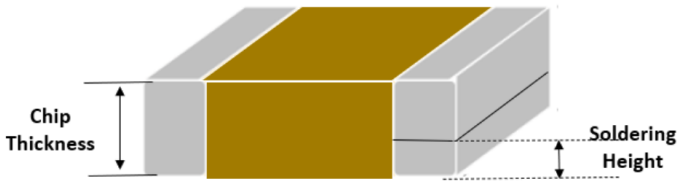
10.5.2 Class II:

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.

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.

13. Notice of MT Series：

The standard AEC-Q200 series capacitors are mainly used on general automotive equipment without safety considerations. Please select SAFETY concern type or contact our company in advanced if you intend to use capacitor for designing the equipment which may damage itself and the safety of third party. If necessary, please consider to add the protect circuit in devising process and obtaining fully safety evaluation. The contents of the acknowledgments only used for our parent company, marketing subsidiaries and official marketing agents who purchase our products. Not applicable for the other nonofficial channels.

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Revision of Jul. 2023

Automotive General Multilayer Ceramic Capacitors

AMT Category (Automotive Grade Surface Mount MLCCs)

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