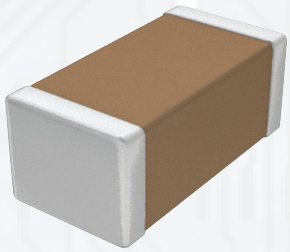
AUTOMOTIVE MULTILAYER CERAMIC CHIP CAPACITORS
- GMT SERIES -

SCOPE

- Consists of conducting material and electrodes - to achieve chip-type SMT and small size, high density and high efficiency ceramic condensers are used
- Provide product dielectrics provides product with high electrical precision, stability and reliability
- Assured quality performance in automotive applications qualified to AEC-Q200



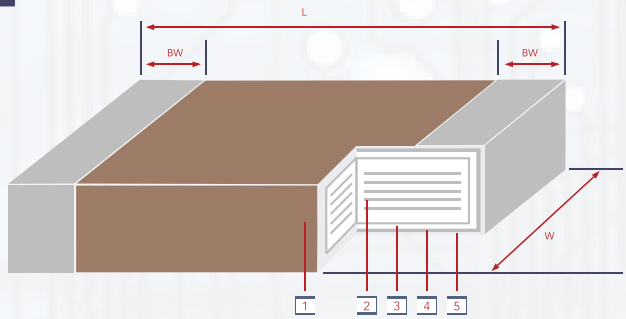
APPLICATIONS

- For navigation and information equipment
- For entertainment equipment
- For comfortable equipment
- For automotive electronic equipment

FEATURES

- Wide selection of sizes available
- High capacitance in given case size
- MLCC with lead free termination (pure Tin)
- Meets AEC-Q200 requirement

CONSTRUCTION AND DIMENSIONS



NO.	NAME		CLASS I DIELECTRIC	CLASS II DIELECTRIC
1	Ceramic Material		CaZrO3	BatTi03
2	Inner Electrode		Ni	Ni
3	Termination	Inner Layer	Cu	Cu
4		Middle Layer	Ni	Ni
5		Outer Layer	Sn	Sn

SIZE INCH (MM)	L (MM)	W (MM)	T (MM) / SYMBOL	M_A (MM)
0201 (0603)	0.60±0.03	0.30±0.03	SEE FOLLOWING CHARTS	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	1.60±0.20		0.60 ±0.2
	3.30 ± 0.30	1.60 +0.3 / -0.1		
1210 (3225)	3.20±0.30	2.50 ± 0.30		0.75±0.35
	3.30±0.40			

PART NUMBER

GMT	04	CG	102	J	50	NT	4
PRODUCT TYPE	DIMENSIONS	DIELECTRIC	CAPACITANCE	TOLERANCE	RATED VOLTAGE	PACKAGING CODE	REEL SIZE
AECQ200 Qualified	02 - 0201 04 - 0402 10 - 0603 21 - 0805 31 - 1206 32 - 1210	CG - NPO / C0G X8L - X8L X8R - X8R X7R - X7R X7S - X7S X7T - X7T X5R - X5R X6S - X6S	0R5: 0.5pF 5R0: 5pF 100: 10pF 101: 100pF 102: 1000pF 103: .01uF 104: 1uF 105: 1.0uF 106: 10uF	A: ± 0.05pF B: ± 0.1pF C: ± 0.25pF D: ± 0.5pF F: ± 1% G: ± 2% J: ± 5% K: ± 10% M:± 20%	4R0 4.0 VDC 6R3: 6.3 VDC 10: 10 VDC 16: 16 VDC 25: 25 VDC 50: 50 VDC 100: 100 VDC 200: 200 VDC 250: 250 VDC 630: 630 VDC 1K0: 1000 VDC	NT: Tape & Reel	1: 1K reel 2: 2K reel 3: 3K reel 4: 4K reel 6: 6K reel 8: 8K reel 10: 10K reel 15: 15K reel 70: 70K reel

STANDARD ELECTRICAL SPECIFICATIONS

DIELECTRIC	NP0	X8L	X8R	X7R	X7S	X7T	X6S	X5R
SIZE	0201, 0402, 0603, 0805, 1206, 1210	0603, 0805	0603, 0805	0201, 0402, 0603, 0805, 1206, 1210	0201, 0402, 0603, 0805, 1206, 1210	0201, 0402, 0603, 0805, 1206, 1210	0201, 0402, 0603, 0805, 1206, 1210	0402, 0603, 0805, 1206
CAPACITANCE RANGE*	0.1pF to 0.047µF	1,000pF to 1uF	0.010µF to 1uF	100pF to 22µF	100pF to 100µF	100pF to 100µF	100pF to 100µF	220pF to 100µF
CAPACITANCE TOLERANCE**	Cap≤5pF: A (±0.5pF), B (±0.1pF), C (±0.25pF) 5pF<Cap<10pF: B (±0.1pF), C (±0.25pF), D (±0.25pF) Cap≥10pF: F (±1%), G (±2%), J (±5%)	K (±10%)	K (±10%)	J (±5%), K (±10%), M (±20%)	J (+/-5%),K (+/-10%), M (+/-20%)	J (+/-5%),K (+/-10%), M (+/-20%)	J (+/-5%), K (+/-10%), M (+/-20%)	J (+/-5%), K (+/-10%), M (+/-20%)
RATED VOLTAGE (WVDC)	10V, 16V, 25V, 35V, 50V, 100V, 250V, 500V, 630V, 1000V	16V, 25V, 50V	16V, 25V, 50V	10V, 16V, 25V, 35V, 50V, 100V, 250V, 500V, 630V, 1000V	6.3v, 10v, 16v, 25v,35v 50v, 100v	6.3v, 10v, 16v, 25v,35v 50v, 100v	6.3v, 10v, 16v, 25v,35v 50v, 100v	10V, 16V, 25V, 35V 50V
OPERATING TEMP.	-55 TO +125°C	-55 to + 150°C		-55 TO +125°C			-55 TO +105°C	-55-85C
CAPACITANCE CHARACTERISTIC	±30ppm/ °C	± 15% between -55°C and +125°C +15% / -40% between +125°C and +150°C	15%	±15%	±22%	+22% / -33%	±22%	±15%

Cal-Chip Electronics Inc.
59 Steamwhistle Drive, Ivyland, PA 18974 | p. 215.942.8900 | www.calchip.com | quotes@calchip.com

MS LEVEL 1

COG

| DIELECTRIC | | COG | | |

X8R

DIELECTRIC			X8R							
DIMENSION (MM)			GMC10				GMC21			
L(L1)			1.6 ± 0.10				2.0 ± 0.20			
W			0.8 ± 0.10				1.25 ± 0.20			
BW(L2/LW)			0.30 ± 0.15				0.50 ± 0.20			
RATED VOLTAGE			10	16	25	50	10	16	25	50
CAP. RANGE	1000pF	102								
	0.010uF	103		D2	D2	D2				
	0.1	104		D2	D2	D2				
	0.22	224		D2	D2	D2				
	0.47	474		D2	D2	D2				
	1.00	105						H	H	

D2	H
0.90mm	1.45mm

X8L

DIELECTRIC			X8L							
DIMENSION (MM)			GMC10				GMC21			
L(L1)			1.60 ± 0.10				2.0 ± 0.20			
W			0.80 ± 0.10				1.25 ± 0.20			
BW(L2/LW)			0.30 ± 0.15				0.50 ± 0.20			
RATED VOLTAGE			10	16	25	50	10	16	25	50
CAP. RANGE	1000pF	102			D2	D2				
	0.010uF	103			D2	D2				
	0.1	104		D2	D2	D2				
	0.22	224								
	0.47	474								
	1.00	105							H	H

D2	H
0.90mm	1.45mm

X7R

| DIELECTRIC | | X7R | | |

X7S

| DIELECTRIC | | X7S | | |

X6S

| DIELECTRIC | | X6S | | |

X7T

| DIELECTRIC | | X7T | | |

X5R

DIELECTRIC		X5R																															
DIMENSION (MM)		GMT02 (0201)				GMT04 (0402)					GMT10 (0603)						GMT21 (0805)					GMT31 (1206)				GMT32 (1210)					
LENGTH (L)		0.60 ± 0.03				1.00 ± 0.10					1.60 ± 0.15						2.00 ± 0.20					3.20 ± 0.20				3.20 ± 0.30					
WIDTH (W)		0.30 ± 0.03				0.50 ± 0.10					0.80 ± 0.15						1.25 ± 0.20					1.60 ± 0.20				2.5 ± 0.30					
BW		0.15 ± 0.05				0.25+0.05 -0.10					0.40 ± 0.15						0.50 ± 0.20					0.60 ± 0.20				0.75 ± 0.35					
RATED VOLTAGE		10	16	25	50	10	16	25	35	50	6.3	10	16	25	35	50	10	16	25	35	50	16	25	35	50	10	16	25	35	50	100
CAP. RANGE	100	101																													
	120	121																													
	150	151																													
	180	181																													
	220	221								B																					
	270	271																													
	330	331								B																					
	390	391																													
	470	471								B																					
	560	561																													
	680	681								B																					
	820	821																													
	1,000	102								B			D2	D2	D2	D2															
	1,200	122											D2	D2	D2	D2															
	1,500	152								B			D2	D2	D2	D2															
	1,800	182											D2	D2	D2	D2															
	2,200	222								B			D2	D2	D2	D2															
	2,700	272											D2	D2	D2	D2															
	3,300	332								B			D2	D2	D2	D2															
	3,900	392											D2	D2	D2	D2															
	4,700	472								B			D2	D2	D2	D2															
	5,600	562											D2	D2	D2	D2															
	6,800	682								B			D2	D2	D2	D2															
	8,200	822											D2	D2	D2	D2															
	0.010µF	103							B	B	B		D2	D2	D2	D2															
	0.012	123											D2	D2	D2	D2															
	0.015	153							B	B	B		D2	D2	D2	D2															
	0.018	183				B							D2	D2	D2	D2															
	0.022	223							B	B	B		D2	D2	D2	D2															
	0.027	273											D2	D2	D2	D2															
	0.033	333						B	B	B	B		D2	D2	D2	D2															
	0.039	393											D2	D2	D2	D2															
	0.047	473						B	B	B	B		D2	D2	D2	D2															
	0.056	563											D2	D2	D2	D2															
	0.068	683											D2	D2	D2	D2															
	0.082	823						B	B	B	B		D2	D2	D2	D2															
	0.10	104					B	B	B	B	B		D2	D2	D2	D2	E	E	E	E	E										
	0.12	124											E	E	E	E	G	G	G	G	G										
	0.15	154					B	B						E	E	E					F2										
	0.18	183																													
	0.22	224					C*	C*					D2	D2	D2	D2	G	G	G	G	G										
	0.27	274																													
	0.33	334										D2	D2	D2	D2	D2	G	G	G	G	G										
	0.39	394																													
	0.47	474					B	B	C*			D2	D2	D2	D2	D2	G	G	G	G	G				H						
	0.56	564																													
	0.68	684										D2	D2	D2	D2	D2	G	G	G	G	G				H						
	0.82	824						B																							
	1.00	105					C*	C*	C*			D2	D2	D2	D2	D2	G	G	G	G	G				H						
	1.5	155									D2	D2	D2				H	H	H	H	H		H	H	H						
	2.2	225									D2	D2					H	H	H	H	H		H	H	H						
	3.3	335									D2	D2					H	H	H	H	H		H	H	H						
	4.70	475									D2						F2	F2	F2	F2	F2	H	H	H	H						
	6.8	685																F2				H	H	H	H						
	10	106								A2	E	E	E					H	H			H	H	H	I						
	15	156																													
	22	226																				I									
	47	476																								L					
	100	107																								L	L				

C* - L - 1.00-0.05/+0.20 | W - 0.50-0.05/+0.20

A2	B	C	D2	E	F2	G	H	I	L
0.50mm	0.55mm	0.70mm	0.90mm	0.95mm	1.25 mm	1.35mm	1.45mm	1.8 mm	2.8mm

MS LEVEL 1

Cal-Chip Electronics Inc.
59 Steamwhistle Drive, Ivyland, PA 18974 | p. 215.942.8900 | www.calchip.com | quotes@calchip.com

RELIABILITY TEST CONDITIONS AND DIMENSIONS

1. Pre-and Post-Stress Electrical Test

- - -

2. High Temperature Exposure (Storage)

MIL-STD-202 Method 108

- Test temp.: 125±3°C
- Un-powered
- Test Time: 1000+24/-0 hrs
- Measurement to be made after keeping at room temp. for 24±2 hrs.

- No remarkable damage.
- Cap Change:
  NPO: within ±2.5% or ±0.25pF whichever is larger
  X7R: within ±10.00%
-Q/D.F. value:
  NPO: Cap≥30pF, Q≥1000; Cap<30pF, Q≥400+20C

X7R:

RATED VOL.	D.F.≤	EXCEPTION OF D.F. ≤	
≥100V	≤3%	≤6%	1206 ≥ 0.47μF
		≤7.5%	0603 ≥ 0.068μF; 0805 ≥ 0.1μF; 1206 ≥ 1μF; 1210 ≥ 2.2μF
		≤20%	0805 > 0.22μF; 1210 ≥ 3.3μF
≥50V	≤3%	≤6%	0201(50V); 0603 ≥ 0.047μF; 0805 ≥ 0.18μF; 1206 ≥ 0.47μF
		≤10%	0201 ≥ 0.01uF; 1210 ≥ 3.3μF
		≤20%	0402 ≥ 0.012μF; 0603 > 0.1μF; 0805/X7R> 0.47μF; 1206 ≥ 2.2μF; 1210 ≥ 10μF
35V	≤5%	≤20%	0603 ≥ 1μF; 0805 ≥ 2.2μF; 1206 ≥ 2.2μF; 1210 ≥ 10μF
25V	≤5%	≤10%	0201 ≥ 0.01μF;0805 ≥ 1μF;1210 ≥ 10μF
		≤14%	0603 ≥ 0.33μF
		≤15%	0201 ≥ 0.1μF; 0402 ≥ 0.056μF; 0603 ≥ 0.47μF; 0805 ≥ 2.2μF; 1206 ≥ 4.7μF; 1210 ≥ 22μF
		≤20%	0402 ≥ 0.33μF
16V	≤5%	≤10%	0603 ≥ 0.15μF; 0805 ≥ 0.68μF; 120 ≥ 2.2μF; 1210 ≥ 4.7μF
		≤15%	0201 ≥ 0.022μF; 0402 ≥ 0.033μF; 0603>0.47μF; 0805 ≥ 2.2μF; 1206 ≥ 4.7μF; 1210 ≥ 22μF
10V	≤7.5%	≤15%	0201 ≥ 0.012μF; 0402 ≥ 0.15μF; 0603 ≥ 0.33μF; 0805 ≥ 2.2μF; 1206 ≥ 2.2μF; 1210 ≥ 22μF
		≤20%	0201 ≥ 0.1μF; 0402 ≥ 1μF
6.3V	≤15%	≤30%	0201 ≥ 0.1μF; 0402 ≥ 1μF; 0603 ≥ 10μF; 0805 ≥ 4.7μF; 1206 ≥ 47μF; 1210 ≥ 100μF
4V	≤20%	---	---

* I.R.: ≥10GΩ or RxC≥500Ω-F whichever is smaller.

CLASS II X7R:

RATED VOLTAGE	INSULATION RESISTANCE
100V: All X7R; 1210 ≥ 3.3μF	1GΩ or RxC ≥ 10 Ω-F whichever is smaller.
50V: 0402 > 0.01μF; 0603 ≥ 1μF; 0805 ≥ 1μF; 1206 ≥ 4.7μF; 1 210 ≥ 4.7μF	
35V: 0603 ≥ 1μF; 0805 ≥ 2.2μF; 1206 ≥ 2.2μF; 1210 ≥ 10μF	
25V: 0201 ≥ 0.1uF; 0402 ≥ 0.22μF; 0603 ≥ 2.2μF; 0805 ≥ 2.2μF; 1206 ≥ 10μF; 1210 ≥ 10μF	
16V: 0201 ≥ 0.1uF; 0402 ≥ 0.22μF; 0603 ≥ 1μF; 0805 ≥ 2.2μF; 1206 ≥ 10μF; 1210 ≥ 47μF	
10V: 0201≥ 47nF; 0402 ≥ 0.47μF; 0603 ≥ 0.47μF; 0805 ≥ 2.2μF; 1206 ≥ 4.7μF; 1210 ≥ 47μF	
6.3V; 4V; Size ≥1812	

3. Destructive Physical Analysis

EIA-469

-Per EIA-469

-No defects or abnormalities

4. Temperature Cycling JESD22 Method JA-104

- Conduct 1000 cycles according to the temperatures and time.

STEP	TEMP. (°C)	TIME (MIN.)
1	-55°C +0/-3	5 ±1
2	+125°C + 3/-0	5 ± 1

- Before initial measurement (X7R only):
  Perform 150+0/-10° for 1 hr and then set for 24±2 hrs at room temp.
- Measurement to be made after keeping at room temp for 24±2hrs.

- No remarkable damage.
- Cap Change:
  NPO: within ±2.5% or ±0.25pF whichever is larger
  X7R: within ±10.0%
-Q/D.F. value:
  NPO: Cap≥30pF, Q≥1000; Cap<30pF, Q≥400+20C

X7R:

RATED VOL.	D.F.≤	EXCEPTION OF D.F. ≤	
≥100V	≤3%	≤6%	1206 ≥ 0.47μF
		≤7.5%	0603 ≥ 0.068μF; 0805 ≥ 0.1μF; 1206 ≥ 1μF; 1210 ≥ 2.2μF
		≤20%	0805 > 0.22μF; 1210 ≥ 3.3μF
≥50V	≤3%	≤6%	0201(50V); 0603 ≥ 0.047μF; 0805 ≥ 0.18μF; 1206 ≥ 0.47μF
		≤10%	0201 ≥ 0.01uF; 1210 ≥ 3.3μF
		≤20%	0402 ≥ 0.012μF; 0603 > 0.1μF; 0805/X7R> 0.47μF; 1206 ≥ 2.2μF; 1210 ≥ 10μF
35V	≤5%	≤20%	0603 ≥ 1μF; 0805 ≥ 2.2μF; 1206 ≥ 2.2μF; 1210 ≥ 10μF
25V	≤5%	≤10%	0201 ≥ 0.01μF; 0805 ≥ 1μF; 1210 ≥ 10μF
		≤14%	0603 ≥ 0.33μF
		≤15%	0201 ≥ 0.1μF; 0402 ≥ 0.056μF; 0603 ≥ 0.47μF; 0805 ≥ 2.2μF; 1206 ≥ 4.7μF; 1210 ≥ 22μF
		≤20%	0402 ≥ 0.33μF
16V	≤5%	≤10%	0603 ≥ 0.15μF; 0805 ≥ 0.68μF; 120 ≥ 2.2μF; 1210 ≥ 4.7μF
		≤15%	0201 ≥ 0.022μF; 0402 ≥ 0.033μF; 0603 > 0.47μF; 0805 ≥ 2.2μF; 1206 ≥ 4.7μF; 1210 ≥ 22μF
10V	≤7.5%	≤15%	0201 ≥ 0.012μF; 0402 ≥ 0.15μF; 0603 ≥ 0.33μF; 0805 ≥ 2.2μF; 1206 ≥ 2.2μF; 1210 ≥ 22μF
		≤20%	0201 ≥ 0.1μF; 0402 ≥ 1μF
6.3V	≤15%	≤30%	0201 ≥ 0.1μF; 0402 ≥ 1μF; 0603 ≥ 10μF; 0805 ≥ 4.7μF; 1206 ≥ 47μF; 1210 ≥ 100μF
4V	≤20%	---	---

* I.R.: ≥10GΩ or RxC≥500Ω-F whichever is smaller.

CLASS II X7R:

RATED VOLTAGE	INSULATION RESISTANCE
100V: All X7R; 1210 ≥ 3.3μF	1GΩ or RxC ≥ 10 Ω-F whichever is smaller.
50V: 0402 > 0.01μF; 0603 ≥ 1μF; 0805 ≥ 1μF; 1206 ≥ 4.7μF; 1210 ≥ 4.7μF	
35V: 0603 ≥ 1μF; 0805 ≥ 2.2μF; 1206 ≥ 2.2μF; 1210 ≥ 10μF	
25V: 0201 ≥ 0.1uF; 0402 ≥ 0.22μF; 0603 ≥ 2.2μF; 0805 ≥ 2.2μF; 1206 ≥ 10μF; 1210 ≥ 10μF	
16V: 0201 ≥ 0.1uF; 0402 ≥ 0.22μF; 0603 ≥ 1μF; 0805 ≥ 2.2μF; 1206 ≥ 10μF; 1210 ≥ 47μF	
10V: 0201≥ 47nF; 0402 ≥ 0.47μF; 0603 ≥ 0.47μF; 0805 ≥ 2.2μF; 1206 ≥ 4.7μF; 1210 ≥ 47μF	
6.3V; 4V; Size ≥ 1812	

RELIABILITY TEST CONDITIONS AND DIMENSIONS

5. Moisture Resistance
MIL-STD-202 Method 106

TEST CONDITION

- 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.

REQUIREMENTS

- No remarkable damage.
- Cap Change:
  NPO: within ±3.0% or ±0.30pF whichever is larger
  X7R: within ±12.5%
-Q/D.F. value:
  NPO: More than 30pF, Q≥350; 10pF≤C≤30pF, Q≥275+2.5C
  Less than 10pf Q≥200+10C

X7R:

RATED VOL.	D.F.≤	EXCEPTION OF D.F. ≤	
≥100V	≤3%	≤6%	1206 ≥ 0.47μF
		≤7.5%	0603 ≥ 0.068μF; 0805 ≥ 0.1μF; 1206 ≥ 1μF; 1210 ≥ 2.2μF
		≤20%	0805 > 0.22μF; 1210 ≥ 3.3μF
≥50V	≤3%	≤6%	0201(50V); 0603 ≥ 0.047μF; 0805 ≥ 0.18μF; 1206 ≥ 0.47μF
		≤10%	0201 ≥ 0.01uF; 1210 ≥ 3.3μF
		≤20%	0402 ≥ 0.012μF; 0603 > 0.1μF; 0805/X7R> 0.47μF; 1206 ≥ 2.2μF; 1210 ≥ 10μF
35V	≤5%	≤20%	0603 ≥ 1μF; 0805 ≥ 2.2μF; 1206 ≥ 2.2μF; 1210 ≥ 10μF
25V	≤5%	≤10%	0201 ≥ 0.01μF; 0805 ≥ 1μF; 1210 ≥ 10μF
		≤14%	0603 ≥ 0.33μF
		≤15%	0201 ≥ 0.1μF; 0402 ≥ 0.056μF; 0603 ≥ 0.47μF; 0805 ≥ 2.2μF; 1206 ≥ 4.7μF; 1210 ≥ 22μF
		≤20%	0402 ≥ 0.33μF
16V	≤5%	≤10%	0603 ≥ 0.15μF; 0805 ≥ 0.68μF; 120 ≥ 2.2μF; 1210 ≥ 4.7μF
		≤15%	0201 ≥ 0.022μF; 0402 ≥ 0.033μF; 0603 > 0.47μF; 0805 ≥ 2.2μF; 1206 ≥ 4.7μF; 1210 ≥ 22μF
10V	≤7.5%	≤15%	0201 ≥ 0.012μF; 0402 ≥ 0.15μF; 0603 ≥ 0.33μF; 0805 ≥ 2.2μF; 1206 ≥ 2.2μF; 1210 ≥ 22μF
		≤20%	0201 ≥ 0.1μF; 0402 ≥ 1μF
6.3V	≤15%	≤30%	0201 ≥ 0.1μF; 0402 ≥ 1μF; 0603 ≥ 10μF; 0805 ≥ 4.7μF; 1206 ≥ 47μF; 1210 ≥ 100μF
4V	≤20%	---	---

*I.R.: ≥10GΩ OR RxC≥500Ω-F whichever is smaller.

CLASS II X7R:

RATED VOLTAGE	INSULATION RESISTANCE
100V: All X7R; 1210 ≥ 3.3μF	1GΩ or RxC ≥ 10 Ω-F whichever is smaller.
50V: 0402 > 0.01μF; 0603 ≥ 1μF; 0805 ≥ 1μF; 1206 ≥ 4.7μF; 1210 ≥ 4.7μF	
35V: 0603 ≥ 1μF; 0805 ≥ 2.2μF; 1206 ≥ 2.2μF; 1210 ≥ 10μF	
25V: 0201 ≥ 0.1uF; 0402 ≥ 0.22μF; 0603 ≥ 2.2μF; 0805 ≥ 2.2μF; 1206 ≥ 10μF; 1210 ≥ 10μF	
16V: 0201 ≥ 0.1uF; 0402 ≥ 0.22μF; 0603 ≥ 1μF; 0805 ≥ 2.2μF; 1206 ≥ 10μF; 1210 ≥ 47μF	
10V: 0201≥ 47nF; 0402 ≥ 0.47μF; 0603 ≥ 0.47μF; 0805 ≥ 2.2μF; 1206 ≥ 4.7μF; 1210 ≥ 47μF	
6.3V; 4V; Size ≥ 1812	

6. Biased Humidity
MIL-STD-202 Method 103

TEST CONDITION

- Test Temp.: 85±3°C
- Humidity: 85%RH
- Test Time: 1000+24/-0 hrs
- To apply voltage: rated voltage (Max.500V) 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 24±2 hrs at room temp.
- Measurement to be made after keeping at room temp. for 24±2hrs.

REQUIREMENTS

- No remarkable damage.
- Cap Change:
  NPO: within ±3.0% or ±0.30pF whichever is larger
  X7R: within ±12.5%
-Q/D.F. value:
  NPO: C≥30pF, Q≥200; Cap<30pF, Q≥100+10/3C

X7R:

RATED VOL.	D.F.≤	EXCEPTION OF D.F. ≤	
≥100V	≤3%	≤6%	1206 ≥ 0.47μF
		≤7.5%	0603 ≥ 0.068μF; 0805 ≥ 0.1μF; 1206 ≥ 1μF; 1210 ≥ 2.2μF
		≤20%	0805 > 0.22μF; 1210 ≥ 3.3μF
≥50V	≤3%	≤6%	0201(50V); 0603 ≥ 0.047μF; 0805 ≥ 0.18μF; 1206 ≥ 0.47μF
		≤10%	0201 ≥ 0.01uF; 1210 ≥ 3.3μF
		≤20%	0402 ≥ 0.012μF; 0603 > 0.1μF; 0805/X7R> 0.47μF; 1206 ≥ 2.2μF; 1210 ≥ 10μF
35V	≤5%	≤20%	0603 ≥ 1μF; 0805 ≥ 2.2μF; 1206 ≥ 2.2μF; 1210 ≥ 10μF
25V	≤5%	≤10%	0201 ≥ 0.01μF; 0805 ≥ 1μF; 1210 ≥ 10μF
		≤14%	0603 ≥ 0.33μF
		≤15%	0201 ≥ 0.1μF; 0402 ≥ 0.056μF; 0603 ≥ 0.47μF; 0805 ≥ 2.2μF; 1206 ≥ 4.7μF; 1210 ≥ 22μF
		≤20%	0402 ≥ 0.33μF
16V	≤5%	≤10%	0603 ≥ 0.15μF; 0805 ≥ 0.68μF; 120 ≥ 2.2μF; 1210 ≥ 4.7μF
		≤15%	0201 ≥ 0.022μF; 0402 ≥ 0.033μF; 0603 > 0.47μF; 0805 ≥ 2.2μF; 1206 ≥ 4.7μF; 1210 ≥ 22μF
10V	≤7.5%	≤15%	0201 ≥ 0.012μF; 0402 ≥ 0.15μF; 0603 ≥ 0.33μF; 0805 ≥ 2.2μF; 1206 ≥ 2.2μF; 1210 ≥ 22μF
		≤20%	0201 ≥ 0.1μF; 0402 ≥ 1μF
6.3V	≤15%	≤30%	0201 ≥ 0.1μF; 0402 ≥ 1μF; 0603 ≥ 10μF; 0805 ≥ 4.7μF; 1206 ≥ 47μF; 1210 ≥ 100μF
4V	≤20%	---	---

*I.R.: ≥1GΩ OR RxC≥50Ω-F whichever is smaller.

Class II (X7R) for rated voltage test:

RATED VOLTAGE	INSULATION RESISTANCE
100V: All X7R; 1210 ≥ 3.3μF	500MΩ or RxC ≥ 5 Ω-F whichever is smaller.
50V: 0402 > 0.01μF; 0603 ≥ 1μF; 0805 ≥ 1μF; 1206 ≥ 4.7μF; 1210 ≥ 4.7μF	
35V: 0603 ≥ 1μF; 0805 ≥ 2.2μF; 1206 ≥ 2.2μF; 1210 ≥ 10μF	
25V: 0201 ≥ 0.1uF; 0402 ≥ 0.22μF; 0603 ≥ 2.2μF; 0805 ≥ 2.2μF; 1206 ≥ 10μF; 1210 ≥ 10μF	
16V: 0201 ≥ 0.1uF; 0402 ≥ 0.22μF; 0603 ≥ 1μF; 0805 ≥ 2.2μF; 1206 ≥ 10μF; 1210 ≥ 47μF	
10V: 0201≥ 47nF; 0402 ≥ 0.47μF; 0603 ≥ 0.47μF; 0805 ≥ 2.2μF; 1206 ≥ 4.7μF; 1210 ≥ 47μF	
6.3V; 4V; Size ≥ 1812	

Class II (X7R) for 1.3~1.5Vdc

RATED VOLTAGE	INSULATION RESISTANCE
100V: All X7R; 1210 ≥ 3.3μF	1GΩ or RxC ≥ 10 Ω-F whichever is smaller.
50V: 0402 > 0.01μF; 0603 ≥ 1μF; 0805 ≥ 1μF; 1206 ≥ 4.7μF; 1210 ≥ 4.7μF	
35V: 0603 ≥ 1μF; 0805 ≥ 2.2μF; 1206 ≥ 2.2μF; 1210 ≥ 10μF	
25V: 0201 ≥ 0.1uF; 0402 ≥ 0.22μF; 0603 ≥ 2.2μF; 0805 ≥ 2.2μF; 1206 ≥ 10μF; 1210 ≥ 10μF	
16V: 0201 ≥ 0.1uF; 0402 ≥ 0.22μF; 0603 ≥ 1μF; 0805 ≥ 2.2μF; 1206 ≥ 10μF; 1210 ≥ 47μF	
10V: 0201≥ 47nF; 0402 ≥ 0.47μF; 0603 ≥ 0.47μF; 0805 ≥ 2.2μF; 1206 ≥ 4.7μF; 1210 ≥ 47μF	
6.3V; 4V; Size ≥ 1812	

* "Room condition" Temperature: 15 to 35°C, Relative humidity: 25 to 75%, Atmospheric pressure: 86 to 106kPa.

MS LEVEL 1

Cal-Chip Electronics Inc.
59 Steamwhistle Drive, Ivyland, PA 18974 | p. 215.942.8900 | www.calchip.com | quotes@calchip.com

RELIABILITY TEST CONDITIONS AND DIMENSIONS

7. Operational Life
MIL-STD-202 Method 108

TEST CONDITION

- Test temp.:
  Maximum Operating Temperature ±3°C
- To apply voltage:
  (1) 10V≤Ur≤250V:200% of rated voltage.
  (2) 150% of rated voltage:
  a) 500V
  b) ≤ 6.3V or C ≥10μF
  c) 0603/X7R/50V/Cap.>0.1μF
  0603/X7R/≤25V/Cap.≥1.0μF
  d) 0805/X7R/50V/Cap.≥0.68μF
  e) 1206/X7R/100V/Cap.≥1.0μF
  f) 1210/X7R/50V&100V/Cap.≥2.2μF
  (3) 630V≤Ur≤1000V:120% of rated voltage.
- Test time: 1000+24/-0 hrs.
- Before initial measurement (X7R only):
  Apply test 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.

REQUIREMENTS

- No remarkable damage.
- Cap Change:
  NPO: within ±3.0% or ±0.30pF whichever is larger
  X7R: within ±12.5%
-Q/D.F. value:
  NPO: More than 30pF, Q≥350; 10pF≤C≤30pF, Q≥275+2.5C
  less than 10pF Q≥200+10C

X7R:

RATED VOL.	D.F.≤	EXCEPTION OF D.F. ≤	
≥100V	≤3%	≤6%	1206 ≥ 0.47μF
		≤7.5%	0603 ≥ 0.068μF; 0805 ≥ 0.1μF; 1206 ≥ 1μF; 1210 ≥ 2.2μF
		≤20%	0805 > 0.22μF; 1210 ≥ 3.3μF
≥50V	≤3%	≤6%	0201(50V); 0603 ≥ 0.047μF; 0805 ≥ 0.18μF; 1206 ≥ 0.47μF
		≤10%	0201 ≥ 0.01uF; 1210 ≥ 3.3μF
		≤20%	0402 ≥ 0.012μF; 0603 > 0.1μF; 0805/X7R> 0.47μF; 1206 ≥ 2.2μF; 1210 ≥ 10μF
35V	≤5%	≤20%	0603 ≥ 1μF; 0805 ≥ 2.2μF; 1206 ≥ 2.2μF; 1210 ≥ 10μF
25V	≤5%	≤10%	0201 ≥ 0.01μF; 0805 ≥ 1μF; 1210 ≥ 10μF
		≤14%	0603 ≥ 0.33μF
		≤15%	0201 ≥ 0.1μF; 0402 ≥ 0.056μF; 0603 ≥ 0.47μF; 0805 ≥ 2.2μF; 1206 ≥ 4.7μF; 1210 ≥ 22μF
		≤20%	0402 ≥ 0.33μF
16V	≤5%	≤10%	0603 ≥ 0.15μF; 0805 ≥ 0.68μF; 120 ≥ 2.2μF; 1210 ≥ 4.7μF
		≤15%	0201 ≥ 0.022μF; 0402 ≥ 0.033μF; 0603 > 0.47μF; 0805 ≥ 2.2μF; 1206 ≥ 4.7μF; 1210 ≥ 22μF
10V	≤7.5%	≤15%	0201 ≥ 0.012μF; 0402 ≥ 0.15μF; 0603 ≥ 0.33μF; 0805 ≥ 2.2μF; 1206 ≥ 2.2μF; 1210 ≥ 22μF
		≤20%	0201 ≥ 0.1μF; 0402 ≥ 1μF
6.3V	≤15%	≤30%	0201 ≥ 0.1μF; 0402 ≥ 1μF; 0603 ≥ 10μF; 0805 ≥ 4.7μF; 1206 ≥ 47μF; 1210 ≥ 100μF
4V	≤20%	---	---

I.R.: ≥1GΩ OR RxC≥50Ω-F whichever is smaller

CLASS II X7R:

RATED VOLTAGE	INSULATION RESISTANCE
100V: All X7R; 1210 ≥ 3.3μF	1GΩ or RxC ≥ 10 Ω-F whichever is smaller.
50V: 0402 > 0.01μF; 0603 ≥ 1μF; 0805 ≥ 1μF; 1206 ≥ 4.7μF; 1210 ≥ 4.7μF	
35V: 0603 ≥ 1μF; 0805 ≥ 2.2μF; 1206 ≥ 2.2μF; 1210 ≥ 10μF	
25V: 0201 ≥ 0.1uF; 0402 ≥ 0.22μF; 0603 ≥ 2.2μF; 0805 ≥ 2.2μF; 1206 ≥ 10μF; 1210 ≥ 10μF	
16V: 0201 ≥ 0.1uF; 0402 ≥ 0.22μF; 0603 ≥ 1μF; 0805 ≥ 2.2μF; 1206 ≥ 10μF; 1210 ≥ 47μF	
10V: 0201≥ 47nF; 0402 ≥ 0.47μF; 0603 ≥ 0.47μF; 0805 ≥ 2.2μF; 1206 ≥ 4.7μF; 1210 ≥ 47μF	
6.3V; 4V; Size ≥ 1812	

8. External Visual
MIL-STD-883 Method 2009

- Visual inspection

- No remarkable defect.

9. Physical Dimension
JESD22 Method JB-100

- By using calipers

- Within the specified dimensions

10. Resistance to Solvents
MIL-STD-202 Method 215

- Temperature 25±5°C
- Time: 3+0.5/-0 min
- Solvent: Iso-propyl alcohol.

- No remarkable damage.
- Cap: within the specified tolerance.
-Q/D.F. value:
  NPO: Cap≥30pF; Q≥1000; Cap<30pF, Q≥400+20C.

X7R:

RATED VOL.	D.F.≤	EXCEPTION OF D.F. ≤	
≥100V	≤2.5%	≤3%	1206 ≥ 0.47μF
		≤5%	0603 ≥ 0.068μF; 0805 ≥ 0.1μF; 1206 ≥ 1μF; 1210 ≥ 2.2μF
		≤10%	0805 > 0.22μF; 1210 ≥ 3.3μF
≥50V	≤2.5%	≤3%	0201(50V); 0603 ≥ 0.047μF; 0805 ≥ 0.18μF; 1206 ≥ 0.47μF
		≤5%	0201 ≥ 0.01uF; 1210 ≥ 3.3μF
		≤10%	0402 ≥ 0.012μF; 0603 > 0.1μF; 0805/X7R> 0.47μF; 1206 ≥ 2.2μF; 1210 ≥ 10μF
35V	≤3.5%	≤10%	0603 ≥ 1μF; 0805 ≥ 2.2μF; 1206 ≥ 2.2μF; 1210 ≥ 10μF
25V	≤3.5%	≤5%	0201 ≥ 0.01μF; 0805 ≥ 1μF; 1210 ≥ 10μF
		≤7%	0603 ≥ 0.33μF
		≤10%	0201 ≥ 0.1μF; 0402 ≥ 0.056μF; 0603 ≥ 0.47μF; 0805 ≥ 2.2μF; 1206 ≥ 4.7μF; 1210 ≥ 22μF
		≤12.5%	0402 ≥ 0.33μF
16V	≤3.5%	≤5%	0201 ≥ 0.01μF; 0402 ≥ 0.033μF;0603 ≥ 0.15μF; 0805 ≥ 0.68μF;1 206 ≥ 2.2μF; 1210 ≥ 4.7μF
		≤10%	0201 ≥ 0.022μF; 0402 ≥ 0.15uF; 0603>0.47μF; 0805 ≥ 2.2μF; 1206 ≥ 4.7μF; 1210 ≥ 22μF
10V	≤5%	≤10%	0201 ≥ 0.012μF; 0402 ≥ 0.15μF; 0603 ≥ 0.33μF; 0805 ≥ 2.2μF; 1206 ≥ 2.2μF; 1210 ≥ 22μF
		≤15%	0201 ≥ 0.1μF; 0402 ≥ 1μF
6.3V	≤10%	≤15%	0201 ≥ 0.1μF; 0402 ≥ 1μF; 0603 ≥ 10μF; 0805 ≥ 4.7μF; 1206 ≥ 47μF; 1210 ≥ 100μF
		≤20%	0402 ≥ 2.2μF
4V	≤15%	---	---

-I.R.: ≥10GΩ OR RxC≥500Ω-F whichever is smaller

CLASS II X7R:

RATED VOLTAGE	INSULATION RESISTANCE
100V: All X7R	10GΩ or RxC ≥ 100 Ω-F whichever is smaller.
50V: 0402 > 0.01μF; 0603 ≥ 1μF; 0805 ≥ 1μF; 1206 ≥ 4.7μF; 1210 ≥ 4.7μF	
35V: 0805 ≥ 2.2μF; 1206≥ 2.2μF; 1210 ≥ 10μF	
25V: 0402 ≥ 1μF; 0603 ≥ 2.2μF; 0805 ≥ 2.2μF; 1206 ≥ 10μF; 1210 ≥ 10μF	
16V: 0201 ≥ 0.1μF, 0402 ≥ 0.22μF; 0603 ≥ 1μF; 0805 ≥ 2.2μF; 1206 ≥ 10μF; 1210 ≥ 47μF	
10V: 0201 ≥ 47nF; 0402≥ 0.47μF; 0603 ≥ 0.47μF; 0805 ≥ 2.2μF; 1206≥ 4.7μF; 1210 ≥ 47μF	
6.3V; 4V; Size ≥ 1812	

RATED VOLTAGE	INSULATION RESISTANCE
100V: 1210 ≥ 3.3μF	RxC ≥ 50 Ω-F
50V: 0402 ≥ 0.1μF; 0603 ≥ 2.2μF; 0805 ≥ 10μF; 1206 ≥ 10μF	
35V: 0603 ≥ 1μF	
25V: 0201 ≥ 0.1μF; 0402 ≥ 2.2μF; 0603 ≥ 10μF; 0805 ≥ 10μF; 1206 ≥ 22μF	
16V: 0603 ≥ 10μF; 0402 ≥ 1μF; 0201 ≥ 0.22μF	
10V: 0201 > 0.1μF; 0402 ≥ 1μF; 0603 ≥ 10μF; 0805 ≥ 47μF	
6.3V: 0201 ≥ 0.1μF; 0402 ≥ 1μF; 0603 > 4.7μF; 0805 ≥ 47μF; 1206 ≥ 10μF	
4V: 0603 ≥ 22μF; 0805 ≥ 47μF; 1206 ≥ 100μF	

* "Room condition" Temperature: 15 to 35°C, Relative humidity: 25 to 75%, Atmospheric pressure: 86 to 106kPa.

RELIABILITY TEST CONDITIONS AND DIMENSIONS

11. Mechanical Shock

MIL-STD-202 Method 213

TEST CONDITION

- Peak value: 1500g's
- Wave: 1/2 sine.
- Velocity: 15.4ft/sec
- Three shocks in each direction should be applied along 3 mutually perpendicular axes of the test specimen (18 shocks)

REQUIREMENTS

- No remarkable damage.
- Cap: within the specified tolerance
- Q/D.F. value:
  NPO: Cap30pF, Q≥1000; Cap<30pF, Q≥400+20C

X7R:

RATED VOL.	D.F.≤	EXCEPTION OF D.F. ≤	
≥100V	≤2.5%	≤3%	1206 ≥ 0.47μF
		≤5%	0603 ≥ 0.068μF; 0805 ≥ 0.1μF; 1206 ≥ 1μF; 1210 ≥ 2.2μF
		≤10%	0805 > 0.22μF; 1210 ≥ 3.3μF
50V	≤2.5%	≤3%	0201(50V); 0603 ≥ 0.047μF; 0805 ≥ 0.18μF; 1206 ≥ 0.47μF
		≤5%	0201 ≥ 0.01uF; 1210 ≥ 3.3μF
		≤10%	0402 ≥ 0.012μF; 0603 > 0.1μF; 0805 > 0.47μF; 1206 ≥ 2.2μF; 1210 ≥ 10μF
35V	≤3.5%	≤10%	0603 ≥ 1μF; 0805 ≥ 2.2μF; 1206 ≥ 2.2μF; 1210 ≥ 10μF
25V	≤3.5%	≤5%	0201 ≥ 0.01μF; 0805 ≥ 1μF; 1210 ≥ 10μF
		≤7%	0603 ≥ 0.33μF
		≤10%	0201 ≥ 0.1μF; 0402 ≥ 0.056μF; 0603 ≥ 0.47μF; 0805 ≥ 2.2μF; 1206 ≥ 4.7μF; 1210 ≥ 22μF
		≤12.5%	0402 ≥ 0.33μF
16V	≤3.5%	≤5%	0201 ≥ 0.01μF; 0402 ≥ 0.033μF; 0603 ≥ 0.15μF; 0805 ≥ 0.68μF; 1206 ≥ 2.2μF; 1210 ≥ 4.7μF
		≤10%	0201 ≥ 0.022μF; 0402 ≥ 0.15uF; 0603 > 0.47μF; 0805 ≥ 2.2μF; 1206 ≥ 4.7μF; 1210 ≥ 22μF
10V	≤5%	≤10%	0201 ≥ 0.012μF; 0402 ≥ 0.15μF; 0603 ≥ 0.33μF; 0805 ≥ 2.2μF; 1206 ≥ 2.2μF; 1210 ≥ 22μF
		≤15%	0201 ≥ 0.1μF; 0402 ≥ 1μF
6.3V	≤10%	15%	0201 ≥ 0.1μF; 0402 ≥ 1μF; 0603 ≥ 10μF; 0805 ≥ 4.7μF; 1206 ≥ 47μF; 1210 ≥ 100μF
		≤20%	0402 ≥ 2.2μF
4V	≤15%	---	---

*I.R.: ≥10GΩ OR RxC≥500Ω-F whichever is smaller.

CLASS II X7R:

RATED VOLTAGE	INSULATION RESISTANCE
100V: All X7R	10GΩ or RxC ≥ 100 Ω-F whichever is smaller.
50V: 0402> 0.01μF; 0603 ≥ 1μF; 0805 ≥ 1μF; 1206 ≥ 4.7μF; 1210 ≥ 4.7μF	
35V: 0805 ≥ 2.2μF; 1206 ≥ 2.2μF; 1210 ≥ 10μF	
25V: 0402 ≥ 1μF; 0603 ≥ 2.2μF; 0805 ≥ 2.2μF; 1206 ≥ 10μF; 1210 ≥ 10μF	
16V: 0201 ≥ 0.1μF, 0402 ≥ 0.22μF; 0603≥ 1μF; 0805 ≥ 2.2μF; 1206 ≥ 10μF; 1210 ≥ 47μF	
10V: 0201 ≥ 47nF; 0402 ≥ 0.47μF; 0603 ≥ 0.47μF; 0805 ≥ 2.2μF; 1206 ≥ 4.7μF; 1210 ≥ 47μF	
6.3V; 4V; Size ≥ 1812	

RATED VOLTAGE	INSULATION RESISTANCE
100V: 1210 ≥ 3.3μF	RxC ≥ 50 Ω-F
50V: 0402 ≥ 0.1μF; 0603 ≥ 2.2μF; 0805 ≥ 10μF; 1206 ≥ 10μF	
35V: 0603 ≥ 1μF	
25V: 0201 ≥ 0.1μF; 0402 ≥ 2.2μF; 0603 ≥ 10μF; 0805 ≥ 10μF; 1206 ≥ 22μF	
16V: 0603 ≥ 10μF; 0402 ≥ 1μF; 0201 ≥ 0.22μF	
10V: 0201 > 0.1μF; 0402 ≥ 1μF; 0603 ≥ 10μF; 0805 ≥ 47μF	
6.3V: 0201 ≥ 0.1μF; 0402 ≥ 1μF; 0603 > 4.7μF; 0805 ≥ 47μF; 1206 ≥ 10μF	
4V: 0603 ≥ 22μF; 0805 ≥ 47μF; 1206 ≥ 100μF	

12. Vibration

MIL-STD-202 Method 204

TEST CONDITION

- Vibration frequency: 10~2000 Hz/min. (5g's for 20 min)
- Total Amplitude: 1.5mm
- 12 cycles each of 3 orientations (36 times)

REQUIREMENTS

- No remarkable damage.
- Cap Change: within the specified tolerance
- Q/D.F. value:
  NPO: C≥30pF, Q≥1000; Cap<30pF, Q≥400+20C

X7R:

RATED VOL.	D.F.≤	EXCEPTION OF D.F. ≤	
≥100V	≤2.5%	≤3%	1206 ≥ 0.47μF
		≤5%	0603≥0.068μF; 0805>0.1μF; 1206≥1μF; 1210≥2.2μF
		≤10%	0805 > 0.22μF; 1210 ≥ 3.3μF
50V	≤2.5%	≤3%	0201(50V); 0603 ≥ 0.047μF; 0805 ≥ 0.18μF; 1206 ≥ 0.47μF
		≤5%	0201 ≥ 0.01uF; 1210 ≥ 3.3μF
		≤10%	0402 ≥ 0.012μF; 0603 > 0.1μF; 0805 > 0.47μF; 1206 ≥ 2.2μF; 1210 ≥ 10μF
35V	≤3.5%	≤10%	0603 ≥ 1μF; 0805 ≥ 2.2μF; 1206 ≥ 2.2μF; 1210 ≥ 10μF
25V	≤3.5%	≤5%	0201 ≥ 0.01μF; 0805 ≥ 1μF; 1210 ≥ 10μF
		≤7%	0603 ≥ 0.33μF
		≤10%	0201 ≥ 0.1μF; 0402 ≥ 0.056μF; 0603 ≥ 0.47μF; 0805 ≥ 2.2μF; 1206 ≥ 4.7μF; 1210 ≥ 22μF
		≤12.5%	0402 ≥ 0.33μF
16V	≤3.5%	≤5%	0201 ≥ 0.01μF; 0402 ≥ 0.033μF; 0603 ≥ 0.15μF; 0805 ≥ 0.68μF; 1206 ≥ 2.2μF; 1210 ≥ 4.7μF
		≤10%	0201 ≥ 0.022μF; 0402 ≥ 0.15uF; 0603 > 0.47μF; 0805 ≥ 2.2μF; 1206 ≥ 4.7μF; 1210 ≥ 22μF
10V	≤5%	≤10%	0201 ≥ 0.012μF; 0402 ≥ 0.15μF; 0603 ≥ 0.33μF; 0805 ≥ 2.2μF; 1206 ≥ 2.2μF; 1210 ≥ 22μF
		≤15%	0201 ≥ 0.1μF; 0402 ≥ 1μF
6.3V	≤10%	15%	0201 ≥ 0.1μF; 0402 ≥ 1μF; 0603 ≥ 10μF; 0805 ≥ 4.7μF; 1206 ≥ 47μF; 1210 ≥ 100μF
		≤20%	0402 ≥ 2.2μF
4V	≤15%	---	---

*I.R.: ≥1GΩ OR RxC≥50Ω-F whichever is smaller.

Class II (X7R) for rated voltage test:

RATED VOLTAGE	INSULATION RESISTANCE
100V: All X7R	10GΩ or RxC ≥ 100 Ω-F whichever is smaller.
50V: 0402> 0.01μF; 0603 ≥ 1μF; 0805 ≥ 1μF; 1206 ≥ 4.7μF; 1210 ≥ 4.7μF	
35V: 0805 ≥ 2.2μF; 1206 ≥ 2.2μF; 1210 ≥ 10μF	
25V: 0402 ≥ 1μF; 0603 ≥ 2.2μF; 0805 ≥ 2.2μF; 1206 ≥ 10μF; 1210 ≥ 10μF	
16V: 0201 ≥ 0.1μF, 0402 ≥ 0.22μF; 0603≥ 1μF; 0805 ≥ 2.2μF; 1206 ≥ 10μF; 1210 ≥ 47μF	
10V: 0201 ≥ 47nF; 0402 ≥ 0.47μF; 0603 ≥ 0.47μF; 0805 ≥ 2.2μF; 1206 ≥ 4.7μF; 1210 ≥ 47μF	
6.3V; 4V; Size ≥ 1812	

RATED VOLTAGE	INSULATION RESISTANCE
100V: 1210 ≥ 3.3μF	RxC ≥ 50 Ω-F
50V: 0402 ≥ 0.1μF; 0603 ≥ 2.2μF; 0805 ≥ 10μF; 1206 ≥ 10μF	
35V: 0603 ≥ 1μF	
25V: 0201 ≥ 0.1μF; 0402 ≥ 2.2μF; 0603 ≥ 10μF; 0805 ≥ 10μF; 1206 ≥ 22μF	
16V: 0603 ≥ 10μF; 0402 ≥ 1μF; 0201 ≥ 0.22μF	
10V: 0201 > 0.1μF; 0402 ≥ 1μF; 0603 ≥ 10μF; 0805 ≥ 47μF	
6.3V: 0201 ≥ 0.1μF; 0402 ≥ 1μF; 0603 > 4.7μF; 0805 ≥ 47μF; 1206 ≥ 10μF	
4V: 0603 ≥ 22μF; 0805 ≥ 47μF; 1206 ≥ 100μF	

* "Room condition" Temperature: 15 to 35°C, Relative humidity: 25 to 75%, Atmospheric pressure: 86 to 106kPa.

MS LEVEL 1

Cal-Chip Electronics Inc.
59 Steamwhistle Drive, Ivyland, PA 18974 | p. 215.942.8900 | www.calchip.com | quotes@calchip.com

RELIABILITY TEST CONDITIONS AND DIMENSIONS

13. Resistance to Soldering Heat
MIL-STD-202 Method 210

TEST CONDITION

- 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 24±2 hrs at room temp.
- Measurement to be made after keeping at room temp. for 24±2 hrs.

REQUIREMENTS

- No remarkable damage.
- Cap change:
  NPO: within ±2.5% or 0.25pF whichever is larger
  X7R: within 7.5%
-Q/D.F. value:
  NPO: Cap≥30pF, Q≥1000; Cap<30pF, Q≥400+20C

X7R:

RATED VOL.	D.F.≤	EXCEPTION OF D.F. ≤	
≥100V	≤2.5%	≤3%	1206 ≥ 0.47μF
		≤5%	0603 ≥ 0.068μF; 0805 > 0.1μF; 1206 ≥ 1μF; 1210 ≥ 2.2μF
		≤10%	0805 > 0.22μF; 1210 ≥ 3.3μF
50V	≤2.5%	≤3%	0201(50V); 0603 ≥ 0.047μF; 0805 ≥ 0.18μF; 1206 ≥ 0.47μF
		≤5%	0201 ≥ 0.01uF; 1210 ≥ 3.3μF
		≤10%	0402 ≥ 0.012μF; 0603 > 0.1μF; 0805 > 0.47μF; 1206 ≥ 2.2μF; 1210 ≥ 10μF
35V	≤3.5%	≤10%	0603 ≥ 1μF; 0805 ≥ 2.2μF; 1206 ≥ 2.2μF; 1210 ≥ 10μF
25V	≤3.5%	≤5%	0201 ≥ 0.01μF; 0805 ≥ 1μF; 1210 ≥ 10μF
		≤7%	0603 ≥ 0.33μF
		≤10%	0201 ≥ 0.1μF; 0402 ≥ 0.056μF; 0603 ≥ 0.47μF; 0805 ≥ 2.2μF; 1206 ≥ 4.7μF; 1210 ≥ 22μF
		≤12.5%	0402 ≥ 0.33μF
16V	≤3.5%	≤5%	0201 ≥ 0.01μF; 0402 ≥ 0.033μF; 0603 ≥ 0.15μF; 0805 ≥ 0.68μF; 1206 ≥ 2.2μF; 1210 ≥ 4.7μF
		≤10%	0201 ≥ 0.022μF; 0402 ≥ 0.15uF; 0603 > 0.47μF; 0805 ≥ 2.2μF; 1206 ≥ 4.7μF; 1210 ≥ 22μF
10V	≤5%	≤10%	0201 ≥ 0.012μF; 0402 ≥ 0.15μF; 0603 ≥ 0.33μF; 0805 ≥ 2.2μF; 1206 ≥ 2.2μF; 1210 ≥ 22μF
		≤15%	0201 ≥ 0.1μF; 0402 ≥ 1μF
6.3V	≤10%	15%	0201 ≥ 0.1μF; 0402 ≥ 1μF; 0603 ≥ 10μF; 0805 ≥ 4.7μF; 1206 ≥ 47μF; 1210 ≥ 100μF
		≤20%	0402 ≥ 2.2μF
4V	≤15%	---	---

*I.R.: ≥10GΩ OR RxC≥500Ω-F whichever is smaller.

CLASS II X7R:

RATED VOLTAGE	INSULATION RESISTANCE
100V: All X7R	10GΩ or RxC ≥ 100 Ω-F whichever is smaller.
50V: 0402 > 0.01μF; 0603 ≥ 1μF; 0805 ≥ 1μF; 1206 ≥ 4.7μF; 1210 ≥ 4.7μF	
35V: 0805 ≥ 2.2μF; 1206 ≥ 2.2μF; 1210 ≥ 10μF	
25V: 0402 ≥ 1μF; 0603 ≥ 2.2μF; 0805 ≥ 2.2μF; 1206 ≥ 10μF; 1210 ≥ 10μF	
16V: 0201 ≥ 0.1μF, 0402 ≥ 0.22μF; 0603≥ 1μF; 0805 ≥ 2.2μF; 1206 ≥ 10μF; 1210 ≥ 47μF	
10V: 0201 ≥ 47nF; 0402 ≥ 0.47μF; 0603 ≥ 0.47μF; 0805 ≥ 2.2μF; 1206 ≥ 4.7μF; 1210 ≥ 47μF	
6.3V; 4V; Size ≥ 1812	

RATED VOLTAGE	INSULATION RESISTANCE
100V: 1210 ≥ 3.3μF	RxC ≥ 50 Ω-F
50V: 0402 ≥ 0.1μF; 0603 ≥ 2.2μF; 0805 ≥ 10μF; 1206 ≥ 10μF	
35V: 0603 ≥ 1μF	
25V: 0201 ≥ 0.1μF; 0402 ≥ 2.2μF; 0603 ≥ 10μF; 0805 ≥ 10μF; 1206 ≥ 22μF	
16V: 0603 ≥ 10μF; 0402 ≥ 1μF; 0201 ≥ 0.22μF	
10V: 0201 > 0.1μF; 0402 ≥ 1μF; 0603 ≥ 10μF; 0805 ≥ 47μF	
6.3V: 0201 ≥ 0.1μF; 0402 ≥ 1μF; 0603 > 4.7μF; 0805 ≥ 47μF; 1206 ≥ 10μF	
4V: 0603 ≥ 22μF; 0805 ≥ 47μF; 1206 ≥ 100μF	

14. Thermal Shock
MIL-STD-202 Method 107

TEST CONDITION

- Conduct 300 cycles according to the temperatures and time.

STEP	TEMP. (°C)	TIME (MIN.)
1	-55°C +0/-3	5 ± 3
2	+125°C + 3/-0	5 ± 3

- 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.

REQUIREMENTS

- No remarkable damage.
- Cap change:
  NPO: within ±2.5% or 0.25pF whichever is larger
  X7R: within 10.0%
-Q/D.F. value:
  NPO: Cap≥30pF, Q≥1000; Cap<30pF, Q≥400+20C

X7R:

RATED VOL.	D.F.≤	EXCEPTION OF D.F. ≤	
≥100V	≤3%	≤6%	1206 ≥ 0.47μF
		≤7.5%	0603 ≥ 0.068μF; 0805 > 0.1μF; 1206 ≥ 1μF; 1210 ≥ 2.2μF
		≤20%	0805 > 0.22μF; 1210 ≥ 3.3μF
50V	≤3%	≤6%	0201(50V); 0603 ≥ 0.047μF; 0805 ≥ 0.18μF; 1206 ≥ 0.47μF
		≤10%	0201 ≥ 0.01uF; 1210 ≥ 3.3μF
		≤20%	0402 ≥ 0.012μF; 0603 > 0.1μF; 0805 /X7R > 0.47μF; 1206 ≥ 2.2μF; 1210 ≥ 10μF
35V	≤5%	≤20%	0603 ≥ 1μF; 0805 ≥ 2.2μF; 1206 ≥ 2.2μF; 1210 ≥ 10μF
25V	≤5%	≤10%	0201 ≥ 0.01μF; 0805 ≥ 1μF; 1210 ≥ 10μF
		≤14%	0603 ≥ 0.33μF
		≤15%	0201 ≥ 0.1μF; 0402 ≥ 0.056μF; 0603 ≥ 0.47μF; 0805 ≥ 2.2μF; 1206 ≥ 4.7μF; 1210 ≥ 22μF
		≤20%	0402 ≥ 0.33μF
16V	≤5%	≤10%	0201 ≥ 0.01μF; 0402 ≥ 0.033μF; 0603 ≥ 0.15μF; 0805 ≥ 0.68μF; 1206 ≥ 2.2μF; 1210 ≥ 4.7μF
		≤15%	0201 ≥ 0.022μF; 0402 ≥ 0.15uF; 0603 > 0.47μF; 0805 ≥ 2.2μF; 1206 ≥ 4.7μF; 1210 ≥ 22μF
10V	≤7.5%	≤15%	0201 ≥ 0.012μF; 0402 ≥ 0.15μF; 0603 ≥ 0.33μF; 0805 ≥ 2.2μF; 1206 ≥ 2.2μF; 1210 ≥ 22μF
		≤20%	0201 ≥ 0.1μF; 0402 ≥ 1μF
6.3V	≤15%	≤30%	0201 ≥ 0.1μF; 0402 ≥ 1μF; 0603 ≥ 10μF; 0805 ≥ 4.7μF; 1206 ≥ 47μF; 1210 ≥ 100μF
4V	≤20%	---	---

*I.R.: ≥1GΩ OR RxC≥50Ω-F whichever is smaller.

Class II (X7R) for rated voltage test

RATED VOLTAGE	INSULATION RESISTANCE
100V: All X7R; 1210 ≥ 3.3μF	1GΩ or RxC ≥ 10 Ω-F whichever is smaller.
50V: 0402 > 0.01μF; 0603 ≥ 1μF; 0805 ≥ 1μF; 1206 ≥ 4.7μF; 1210 ≥ 4.7μF	
35V: 0603 ≥ 1μF; 0805 ≥ 2.2μF; 1206 ≥ 2.2μF; 1210 ≥ 10μF	
25V: 0201 ≥ 0.1uF; 0402 ≥ 0.22μF; 0603 ≥ 2.2μF ;0805 ≥ 2.2μF; 1206 ≥ 10μF; 1210 ≥ 10μF	
16V: 0201 ≥ 0.1uF; 0402 ≥ 0.22μF; 0603 ≥ 1μF; 0805 ≥ 2.2μF; 1206 ≥ 10μF; 1210 ≥ 47μF	
10V: 0201 ≥ 47nF; 0402 ≥ 0.47μF; 0603 ≥ 0.47μF; 0805 ≥ 2.2μF; 1206 ≥ 4.7μF; 1210 ≥ 47μF	
6.3V; 4V; Size ≥ 1812	

* "Room condition" Temperature: 15 to 35°C, Relative humidity: 25 to 75%, Atmospheric pressure: 86 to 106kPa.

RELIABILITY TEST CONDITIONS AND DIMENSIONS

<table>
<tr><th>NO.</th><th>TEST ITEM</th><th>TEST CONDITION</th><th>REQUIREMENTS</th></tr>
<tr><td>15.</td><td>ESD
AEC-Q200-002</td><td>- Per AEC-Q200-002</td><td>- No remarkable damage.
- Cap change: within the specified tolerance.
-Q/D.F. value:
NPO: Cap≥30pF, Q≥1000; Cap<30pF, Q≥400+20C
X7R:
<table>
<tr><th>RATED VOL.</th><th>D.F.≤</th><th>EXCEPTION OF D.F. ≤</th><th></th></tr>
<tr><td>≥100V</td><td>≤2.5%</td><td>≤3%</td><td>1206 ≥ 0.47μF</td></tr>
<tr><td></td><td></td><td>≤5%</td><td>0603 ≥ 0.068μF; 0805 > 0.1μF; 1206 ≥ 1μF; 1210 ≥ 2.2μF</td></tr>
<tr><td></td><td></td><td>≤10%</td><td>0805 > 0.22μF; 1210 ≥ 3.3μF</td></tr>
<tr><td>50V</td><td>≤2.5%</td><td>≤3%</td><td>0201(50V); 0603 ≥ 0.047μF; 0805 ≥ 0.18μF; 1206 ≥ 0.47μF</td></tr>
<tr><td></td><td></td><td>≤5%</td><td>0201 ≥ 0.01uF; 1210 ≥ 3.3μF</td></tr>
<tr><td></td><td></td><td>≤10%</td><td>0402 ≥ 0.012μF; 0603 > 0.1μF; 0805 > 0.47μF; 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>25V</td><td>≤3.5%</td><td>≤5%</td><td>0201 ≥ 0.01μF; 0805 ≥ 1μF; 1210 ≥ 10μF</td></tr>
<tr><td></td><td></td><td>≤7%</td><td>0603 ≥ 0.33μF</td></tr>
<tr><td></td><td></td><td>≤10%</td><td>0201 ≥ 0.1μF; 0402 ≥ 0.056μF; 0603 ≥ 0.47μF; 0805 ≥ 2.2μF; 1206 ≥ 4.7μF; 1210 ≥ 22μF</td></tr>
<tr><td></td><td></td><td>≤12.5%</td><td>0402 ≥ 0.33μF</td></tr>
<tr><td>16V</td><td>≤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></td><td></td><td>≤10%</td><td>0201 ≥ 0.022μF; 0402 ≥ 0.15uF; 0603 > 0.47μF; 0805 ≥ 2.2μF; 1206 ≥ 4.7μF; 1210 ≥ 22μF</td></tr>
<tr><td>10V</td><td>≤5%</td><td>≤10%</td><td>0201 ≥ 0.012μF; 0402 ≥ 0.15μF; 0603 ≥ 0.33μF;0805 ≥ 2.2μF; 1206 ≥ 2.2μF; 1210 ≥ 22μF</td></tr>
<tr><td></td><td></td><td>≤15%</td><td>0201 ≥ 0.1μF; 0402 ≥ 1μF</td></tr>
<tr><td>6.3V</td><td>≤10%</td><td>≤15%</td><td>0201 ≥ 0.1μF; 0402 ≥ 1μF; 0603 ≥ 10μF; 0805 ≥ 4.7μF; 1206 ≥ 47μF; 1210 ≥ 100μF</td></tr>
<tr><td></td><td></td><td>≤20%</td><td>0402 ≥ 2.2μF</td></tr>
<tr><td>4V</td><td>≤15%</td><td>---</td><td>--</td></tr>
</table>
*I.R.: ≥10GΩ OR RxC≥500Ω-F whichever is smaller.
Class II (X7R)
<table>
<tr><th>RATED VOLTAGE</th><th>INSULATION RESISTANCE</th></tr>
<tr><td>100V: All X7R</td><td rowspan="8">10GΩ or RxC≥100 Ω-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: 0805 ≥ 2.2μF; 1206 ≥ 2.2μF; 1210 ≥ 10μF</td></tr>
<tr><td>25V: 0402 ≥ 1μF; 0603 ≥ 2.2μF; 0805 ≥ 2.2μF; 1206 ≥ 10μF; 1210 ≥ 10μF</td></tr>
<tr><td>16V: 0201≥ 0.1μF; 0402≥ 0.22μF; 0603 ≥ 1μF; 0805 ≥ 2.2μF; 1206 ≥1 0μF; 1210 ≥ 47μF</td></tr>
<tr><td>10V: 0201 ≥ 47nF; 0402 ≥ 0.47μF; 0603 ≥ 0.47μF; 0805 ≥ 2.2μF; 1206 ≥ 4.7μF; 1210 ≥ 47μF</td></tr>
<tr><td>6.3V; 4V; Size ≥ 1812</td></tr>
</table>
<table>
<tr><th>RATED VOLTAGE</th><th>INSULATION RESISTANCE</th></tr>
<tr><td>100V: 1210 ≥ 3.3μF</td><td rowspan="8">RxC≥50 Ω-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; 0 402 ≥ 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>16.</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±1 sec in solder bath at 215+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>
</table>

* “Room condition” Temperature: 15 to 35°C, Relative humidity: 25 to 75%, Atmospheric pressure: 86 to 106kPa.

RELIABILITY TEST CONDITIONS AND DIMENSIONS

<table>
<tr><th>NO.</th><th>TEST ITEM</th><th>TEST CONDITION</th><th>REQUIREMENTS</th></tr>
<tr><td>17.</td><td>Electrical Characterization</td><td>- Capacitance
- Q/ D.F. (Dissipation Factor)
- Test temp: Room Temperature.
- Class I: (NPO)
Cap≤1000pF 1.0±0.2Vrms, 1MHz±10%
Cap>1000pF 1.0±0.2Vrms, 1KHz±10%
- Class II: (X7R)
Cap ≤10μF, 1.0±0.2Vrms, 1KHz±10%
Cap>10μF, 0.5±0.2Vrms, 120Hz±20%

- Insulation Resistance
- Test temp: Room Temperature.
- Test voltage:
≤100V:To apply rated voltage for max. 120 sec.
≥200V:To apply rated voltage (Max.500V) for 60 sec.

- Dielectric Strength
To apply voltage:
≤100 ≥2.5 times VDC
200V~300V ≥2 times VDC
400V~450V ≥1.2 times VDC
500V~999V ≥1.5 times VDC
1000V~3000V ≥1.2 times VDC
duration 1~5 sec, charge and discharge current less than 50mA.
- Temperature Coefficient (with no electrical load)
- Operation temperature: Min. operating temp. to Max. operating temp. at 25°C</td><td>- Capacitance within the specified tolerance.
- Q/D.F. value:
NPO: Cap≥30pF, Q≥1000; Cap<30pF, Q≥400+20C
X7R:
<table>
<tr><th>RATED VOL.</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>0603 ≥ 0.068μF; 0805 > 0.1μF; 1206 ≥ 1μF; 1210 ≥ 2.2μF</td></tr>
<tr><td>≤10%</td><td>0805 > 0.22μF; 1210 ≥ 3.3μF</td></tr>
<tr><td rowspan="4">50V</td><td rowspan="4">≤2.5%</td><td>≤3%</td><td>0201(50V); 0603 ≥ 0.047μF; 0805 ≥ 0.18μF; 1206 ≥ 0.47μF</td></tr>
<tr><td>≤5%</td><td>0201 ≥ 0.01uF; 1210 ≥ 3.3μF</td></tr>
<tr><td>≤10%</td><td>0402 ≥ 0.012μF; 0603 > 0.1μF; 0805 > 0.47μF; 1206 ≥ 2.2μF; 1210 ≥ 10μF</td></tr>
<tr><td>35V</td><td>≤3.5%</td><td>≤10%</td><td>0603 ≥ 1μF; 0805 ≥ 2.2μF; 1206 ≥ 2.2μF; 1210 ≥ 10μF</td></tr>
<tr><td rowspan="4">25V</td><td rowspan="4">≤3.5%</td><td>≤5%</td><td>0201 ≥ 0.01μF; 0805 ≥ 1μF; 1210 ≥ 10μF</td></tr>
<tr><td>≤7%</td><td>0603 ≥ 0.33μF</td></tr>
<tr><td>≤10%</td><td>0201 ≥ 0.1μF; 0402 ≥ 0.056μF; 0603 ≥ 0.47μF; 0805 ≥ 2.2μF; 1206 ≥ 4.7μF; 1210 ≥ 22μF</td></tr>
<tr><td>≤12.5%</td><td>0402 ≥ 0.33μF</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 ≥ 0.022μF; 0402 ≥ 0.15uF; 0603 > 0.47μF; 0805 ≥ 2.2μF; 1206 ≥ 4.7μF; 1210 ≥ 22μF</td></tr>
<tr><td rowspan="2">10V</td><td rowspan="2">≤5%</td><td>≤10%</td><td>0201 ≥ 0.012μF; 0402 ≥ 0.15μF; 0603 ≥ 0.33μF;0805 ≥ 2.2μF; 1206 ≥ 2.2μF; 1210 ≥ 22μF</td></tr>
<tr><td>≤15%</td><td>0201 ≥ 0.1μF; 0402 ≥ 1μF</td></tr>
<tr><td rowspan="2">6.3V</td><td rowspan="2">≤10%</td><td>≤15%</td><td>0201 ≥ 0.1μF; 0402 ≥ 1μF; 0603 ≥ 10μF; 0805 ≥ 4.7μF; 1206 ≥ 47μF; 1210 ≥ 100μF</td></tr>
<tr><td>≤20%</td><td>0402 ≥ 2.2μF</td></tr>
<tr><td>4V</td><td>≤15%</td><td>---</td><td>---</td></tr>
</table>
*I.R: ≥10GΩ OR RxC≥500Ω-F whichever is smaller.
Class II (X7R)
<table>
<tr><th>RATED VOLTAGE</th><th>INSULATION RESISTANCE</th></tr>
<tr><td>100V: All X7R</td><td rowspan="7">10GΩ or RxC≥100 Ω-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: 0805 ≥ 2.2μF; 1206 ≥ 2.2μF; 1210 ≥ 10μF</td></tr>
<tr><td>25V: 0402 ≥ 1μF; 0603 ≥ 2.2μF; 0805 ≥ 2.2μF; 1206 ≥ 10μF; 1210 ≥ 10μF</td></tr>
<tr><td>16V: 0201≥ 0.1μF; 0402≥ 0.22μF; 0603 ≥ 1μF; 0805 ≥ 2.2μF; 1206 ≥1 0μF; 1210 ≥ 47μF</td></tr>
<tr><td>10V: 0201 ≥ 47nF; 0402 ≥ 0.47μF; 0603 ≥ 0.47μF; 0805 ≥ 2.2μF; 1206 ≥ 4.7μF; 1210 ≥ 47μF</td></tr>
<tr><td>6.3V; 4V; Size ≥ 1812</td></tr>
</table>
<table>
<tr><th>RATED VOLTAGE</th><th>INSULATION RESISTANCE</th></tr>
<tr><td>100V: 1210 ≥ 3.3μF</td><td rowspan="8">RxC≥50 Ω-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; 0 402 ≥ 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>
- Dielectric strength
- No evidence of damage or flash over during test.
- Temperature Coefficient
- Capacitance Change:
NPO: Within ±30ppm/°C
X7R: Within ±15%</td></tr>
<tr><td>18.</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 3mm (2mm for X7R) 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:
NPO: 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>
</table>

* "Room condition" Temperature: 15 to 35°C, Relative humidity: 25 to 75%, Atmospheric pressure: 86 to 106kPa.

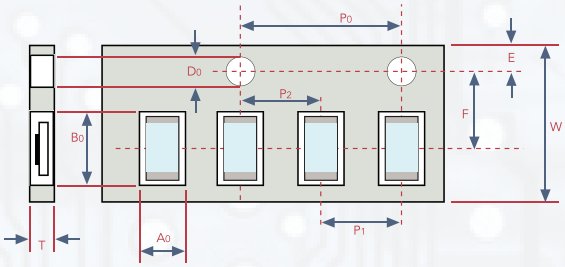
RELIABILITY TEST CONDITIONS AND DIMENSIONS

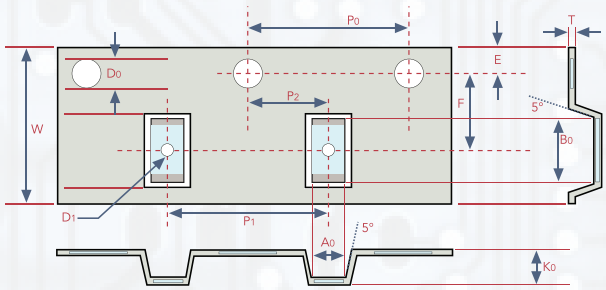
NO.	TEST ITEM	TEST CONDITION	REQUIREMENTS
19.	Terminal Strength AEC-Q200-006	- Pressurizing force: 2N (0201 & 0402), 10N (0603), 10N(0603), 18N(≥0805). - Test time: 60±1 sec.	- No remarkable damage or removal of the terminations - Capacitance within the specified tolerance. - Q/D.F. value: NPO: Cap≥30pF, Q≥1000; Cap<30pF, Q≥400+20C X7R:
20.	Beam Load Test AEC-Q200-003	- Break strength test - Beam speed: 2.5±0.25 mm/sec	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)

RATED VOL.	D.F.≤	EXCEPTION OF D.F. ≤	
≥100V	≤2.5%	≤3%	1206 ≥ 0.47μF
		≤5%	0603 ≥ 0.068μF; 0805 > 0.1μF; 1206 ≥ 1μF; 1210 ≥ 2.2μF
		≤10%	0805 > 0.22μF; 1210 ≥ 3.3μF
50V	≤2.5%	≤3%	0201(50V); 0603 ≥ 0.047μF; 0805 ≥ 0.18μF; 1206 ≥ 0.47μF
		≤5%	0201 ≥ 0.01uF; 1210 ≥ 3.3μF
		≤10%	0402 ≥ 0.012μF; 0603 > 0.1μF; 0805 > 0.47μF; 1206 ≥ 2.2μF; 1210 ≥ 10μF
35V	≤3.5%	≤10%	0603 ≥ 1μF; 0805 ≥ 2.2μF; 1206 ≥ 2.2μF; 1210 ≥ 10μF
25V	≤3.5%	≤5%	0201 ≥ 0.01μF; 0805 ≥ 1μF; 1210 ≥ 10μF
		≤7%	0603 ≥ 0.33μF
		≤10%	0201 ≥ 0.1μF; 0402 ≥ 0.056μF; 0603 ≥ 0.47μF; 0805 ≥ 2.2μF; 1206 ≥ 4.7μF; 1210 ≥ 22μF
		≤12.5%	0402 ≥ 0.33μF
16V	≤3.5%	≤5%	0201 ≥ 0.01μF; 0402 ≥ 0.033μF; 0603 ≥ 0.15μF; 0805 ≥ 0.68μF; 1206 ≥ 2.2μF; 1210 ≥ 4.7μF
		≤10%	0201 ≥ 0.022μF; 0402 ≥ 0.15uF; 0603 > 0.47μF; 0805 ≥ 2.2μF; 1206 ≥ 4.7μF; 1210 ≥ 22μF
10V	≤5%	≤10%	0201 ≥ 0.012μF; 0402 ≥ 0.15μF; 0603 ≥ 0.33μF;0805 ≥ 2.2μF; 1206 ≥ 2.2μF; 1210 ≥ 22μF
		≤15%	0201 ≥ 0.1μF; 0402 ≥ 1μF
6.3V	≤10%	≤15%	0201 ≥ 0.1μF; 0402 ≥ 1μF; 0603 ≥ 10μF; 0805 ≥ 4.7μF; 1206 ≥ 47μF; 1210 ≥ 100μF
		≤20%	0402 ≥ 2.2μF
4V	≤15%	---	---

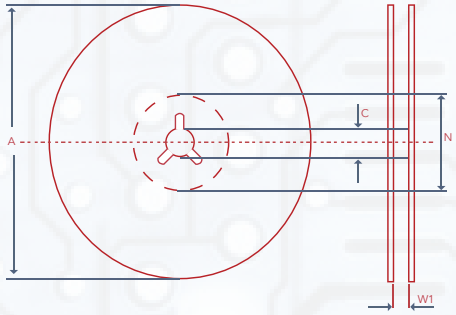
* "Room condition" Temperature: 15 to 35°C, Relative humidity: 25 to 75%, Atmospheric pressure: 86 to 106kPa.

TAPE & REEL DIMENSIONS





SIZE	0201	0402	0603	0805			1206			1210		
THICKNESS	L	N, E	S, H, X	A, H	B, T	D, I	B, T	C, J, D	G, P	T	C, D, G, K	M
A_0	0.40±0.10	0.70±0.20	1.05±0.30	1.50±0.20	1.50±0.20	< 1.80	1.90±0.50	< 2.00	<2.30	< 3.05	< 3.05	< 3.20
B_0	0.70±0.10	1.20±0.20	1.80±0.30	2.30±0.20	2.30±0.20	< 2.70	3.50±0.50	< 3.70	< 4.00	< 3.80	< 3.80	<4.00
T	≤0.55	≤0.80	≤1.20	≤1.15	≤1.20	0.23±0.1	≤1.20	0.25±0.1	0.23±0.1	0.23±0.1	0.23±0.1	0.23±0.1
K_0	-	-	-	-	-	< 2.50	-	< 0.25	< 2.50	< 1.50	< 2.50	< 3.20
W	8.00±0.30	8.00±0.30	8.00±0.30	8.00±0.30	8.00±0.30	8.00±0.30	8.00±0.30	8.00±0.30	8.00±0.30	8.00±0.30	8.00±0.30	8.00±0.30
P_0	4.00±0.10	4.00±0.10	4.00±0.10	4.00±0.10	4.00±0.10	4.00±0.10	4.00±0.10	4.00±0.10	4.00±0.10	4.00±0.10	4.00±0.10	4.00±0.10
10 X P_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	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	2.00±0.05	2.00±0.05	4.00±0.10	4.00±0.10	4.00±0.10	4.00±0.10	4.00±0.10	4.00±0.10	4.00±0.10	4.00±0.10	4.00±0.10	4.00±0.10
P_2	2.00±0.05	2.00±0.05	2.00±0.05	2.00±0.05	2.00±0.05	2.00±0.05	2.00±0.05	2.00±0.05	2.00±0.05	2.00±0.05	2.00±0.05	2.00±0.05
D_0	1.50+0.1/-0	1.50+0.1/-0	1.50+0.1/-0	1.50+0.1/-0	1.50+0.1/-0	1.50+0.1/-0	1.50+0.1/-0	1.50+0.1/-0	1.50+0.1/-0	1.50+0.1/-0	1.50+0.1/-0	1.50+0.1/-0
D_1	-	-	-	-	-	1.00±0.10	-	1.00±0.10	1.00±0.10	1.00±0.10	1.00±0.10	1.00±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	1.75±0.10	1.75±0.10	1.75±0.10	1.75±0.10
F	3.50±0.05	3.50±0.05	3.50±0.05	3.50±0.05	3.50±0.05	3.50±0.05	3.50±0.05	3.50±0.05	3.50±0.05	3.50±0.05	3.50±0.05	3.50±0.05



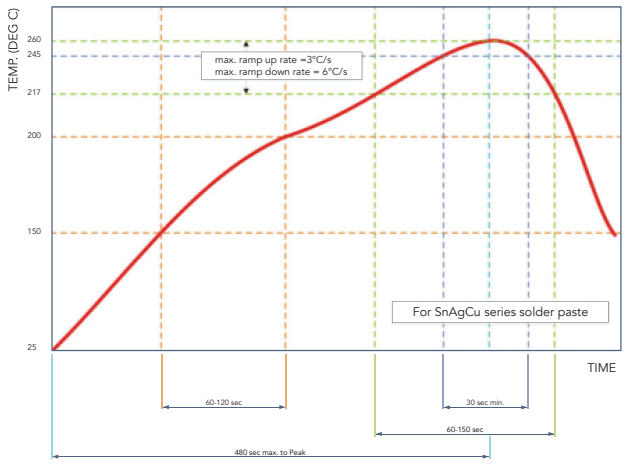
SIZE	0201, 0402, 0603, 0805, 1206, 1210		
REEL SIZE	7"	10"	13"
C	13.0±0.5	13.0±0.5	13.0±0.5
W_1	10.0±1.5	10.0±1.5	10.0±1.5
A	178.0±0.50	250.0±2.0	330.0±2.0
N	60.0+1.0	50 min	50 min

MS LEVEL 1

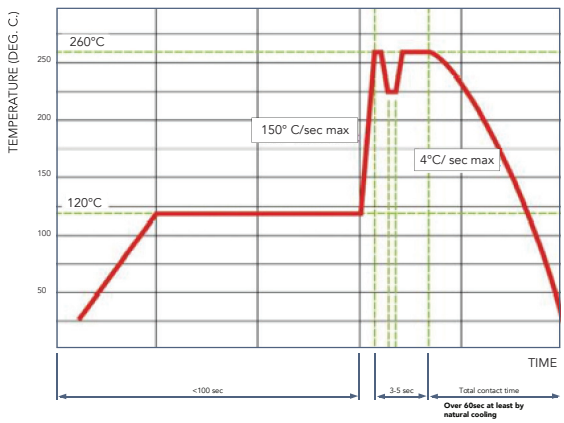
Cal-Chip Electronics Inc.
59 Steamwhistle Drive, Ivyland, PA 18974 | p. 215.942.8900 | www.calchip.com | quotes@calchip.com

RECOMMENDED SOLDERING CONDITIONS

- The lead-free termination MLCCs are not only to be used on SMT against lead-free solder paste, but also suitable against lead-containing solder paste. If the optimized solder joint is requested, increasing soldering time, temperature and concentration of N2 within oven are recommended.



Recommeded reflow soldering profile for SMT process with SnAgCu series paste.



Recommeded wave soldering profile for SMT process with SnAgCu series solder.

WARRANTY: All passive components supplied by Cal-Chip Electronics, Inc., 59 Steamwhistle Drive, Ivyland, PA 18974, are under warranty for a period of 2 years from the date of manufacture. Product will meet or exceed all reliability and test specifications expressed by Cal-Chip for the above mentioned time period provided storage conditions (stated below) are met.

PRODUCT STORAGE INSTRUCTIONS:

1) Product must be kept away from direct sunlight.
2) Product must be stored in the following conditions
   Temperature; 5 to 35°C / 30 to 90°F
   Humidity; 45 to 85%
3) Product to be kept free of moisture, dirt and debris.

*****WHEN THESE CONDITIONS ARE NOT MET, PRODUCT LIFE COULD BE SHORTENED****

NOTICE: Specifications are subject to change without notice. Contact your nearest Cal-Chip Sales Office for the latest specifications. All statements, information and data given herein are believed to be accurate and reliable, but are presented without guarantee, warranty, or responsibility of any kind, expressed or implied. Statements or suggestions concerning possible use of our products are made without representation or warranty that any such use is free of patent infringement and are not recommendations to infringe any patent. The user should not assume that all safety measures are indicated or that other measures may not be required. Specifications are typical and may not apply to all applications.