



M SERIES ULTRA HIGH Q CAPACITOR SPEC

Rev. F

FEATURES:

- Ultra High-Q and low ESR
- Extended working range for wireless products
- Extended battery life of portable devices

PART NUMBER DESCRIPTION

0402	M	250	N	0R1	B	C	T
Size	Series	Rated Voltage (VDC)	Dielectric	Capacitance	Tolerance	Termination	Packaging
0201 (0603)	M: Ultra High Q, Low ESR	6R3=6.3	N: NP0	0R1=0.10pF	A: ±0.05pF	C=Cu/Ni/Sn	T=7" Paper Tape
0402 (1005)		100-10		0R5=0.50pF	B: ±0.1pF		U=13" Paper Tape
0505 (1414)		160=16		1R0=1.0pF	C: ±0.25pF		E=7" Plastic Tape
0603 (1608)		250=25		100=10pF	D: ±0.5pF		Q=13" Plastic Tape
0805 (2012)		500=50		101=100pF	F: ±1%		Z or blank=Bulk
1111 (2828)		201=200			G: ±2%		
		251=250			J: ±5%		
	501=500						

General Electrical Data

Dielectric	NP0
Size	0201, 0402, 0505, 0603, 0805, 1111
Capacitance Range	0.1pF to 1,000pF
Capacitance tolerance	Cap≤5pF: A (±0.05pF), B (±0.1pF), C (±0.25pF) 5pF<Cap<10pF: B (±0.1pF), C (±0.25pF), D (±0.5pF) Cap≥10pF: F (±1%), G (±2%), J (±5%)
Rated voltage (WVDC)	6.3V, 10V, 16V, 25V, 50V, 100V, 200V, 250V, 500V
Q	Cap≥30pF, Q≥1000 Cap<30pF, Q≥400+20C
Insulation resistance (25°C)	≥10GΩ
Operating temperature	-55°C to +125°C
Temperature coefficient of capacitance	±30ppm/°C (±60ppm/°C for 0201 with values ≥22pF)
Termination	Ni/Sn (lead-free termination)



External Dimensions

Outline	Case Size EIA (mm)	L (mm)	W (mm)	T (mm)	Soldering Method	M _B (mm)
	0201 (0603)	0.60 ±0.03	0.30 ±0.03	0.30 ±0.03	R	0.15 ±0.05
	0402 (1005)	1.00 ±0.05	0.50 ±0.05	0.50 ±0.05	R	0.25 +0.05/-0.1
				0.50 +0.02/-0.05		
		1.00 ±0.20	0.50 ±0.20	0.50 ±0.20		
	0505 (1414)	1.40 +0.33/-0.25	1.40 ±0.38	1.15 ±0.15	R/W	0.25 +0.25/-0.13
	0603 (1608)	1.60 ±0.10	0.80 ±0.10	0.80 ±0.07	R / W	0.40 ±0.15
				0.50 ±0.10		
				0.80 ±0.15/-0.10		
		1.60 ±0.20	0.80 ±0.20	0.8 ±0.20		
	0805 (2012)	2.0 ±0.15	1.25 ±0.10	0.50 ±0.10	R / W	0.50 ±0.20
0.60 ±0.10				R / W		
0.80 ±0.10				R / W		
1.25 ±0.10				R		
0.85 ±0.10				R / W		
	2.0 ±0.20	1.25 ±0.20	1.25 ±0.20	R		
1111 (2828)	2.79 +0.51/-0.25	2.79 ± 0.38	1.78 max	R	0.38 ± 0.25	

Thickness Codes/Packaging Quantity

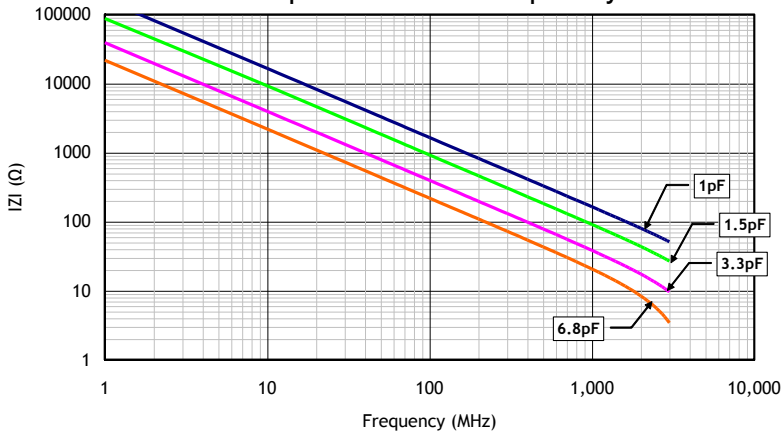
Case Size	Size Code	Max Thickness (mm)	Length (mm)	Width (mm)	Thickness (mm)	Paper Tape		Embossed Plastic Tape	
						7" Reel	13" Reel	7" Reel	13" Reel
0201	AA	0.33	0.60 ±0.03	0.30 ±0.03	0.30 ±0.03	15,000	70,000	-	-
0402	BA	0.55	1.0 ±0.05	0.5 ±0.05	0.5 ±0.05	10,000	50,000	-	-
					0.50 +0.02/-0.05				
	BC	0.70	1.0 ±0.2	0.5 ±0.2	0.5 ±0.2	10,000	-	-	-
0505	KA	1.30	1.40 +0.33/-0.25	1.40 ±0.38	1.15 ±0.15	-	-	3,000	-
0603	CA	0.87	1.6 ±0.1	0.8 ±0.1	0.8 ±0.07	4,000	15,000	-	-
	CC	0.95	1.6 +0.15/-0.01	0.8 +0.15/-0.1	0.8 +0.15/-0.1	4,000	15,000	-	-
	CD	1.00	1.6 ±0.2	0.8 ±0.2	0.8 ±0.2	4,000	15,000	-	-
0805	DB	0.70	2.0 ±0.15	1.25 ±0.1	0.6 ±0.1	4,000	15,000	-	-
	DC	0.90	2.0 ±0.15	1.25 ±0.1	0.8 ±0.1	4,000	15,000	-	-
	DD	1.35	2.0 ±0.15	1.25 ±0.1	1.25 ±0.1	-	-	3,000	10,000
	DE	0.95	2.0 ±0.2	1.25 ±0.2	0.85 ±0.1	4,000	15,000	-	-
	DF	1.45	2.0 ±0.2	1.25 ±0.2	1.25 ±0.2	-	-	3,000	10,000
1111	MA	1.78	2.79 +0.51/-0.25	2.79 ± 0.38	1.78	-	-	2,000	-



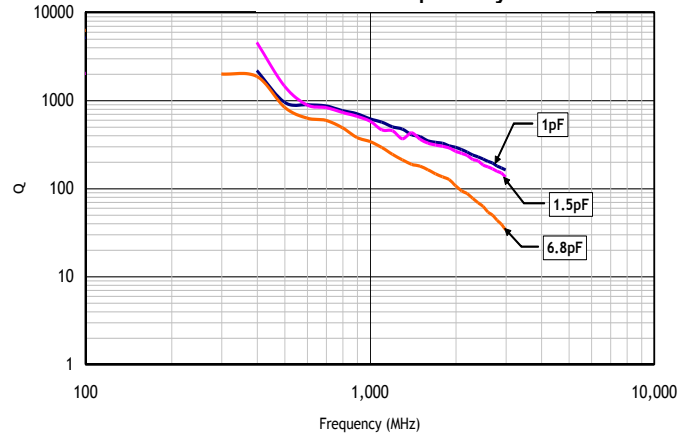
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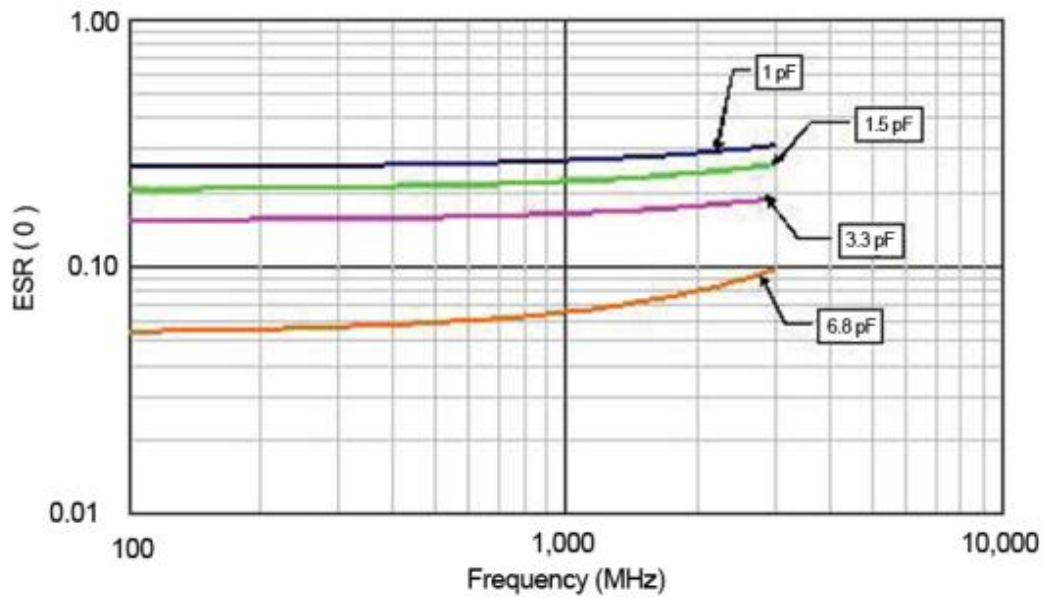
Impedance vs. Frequency



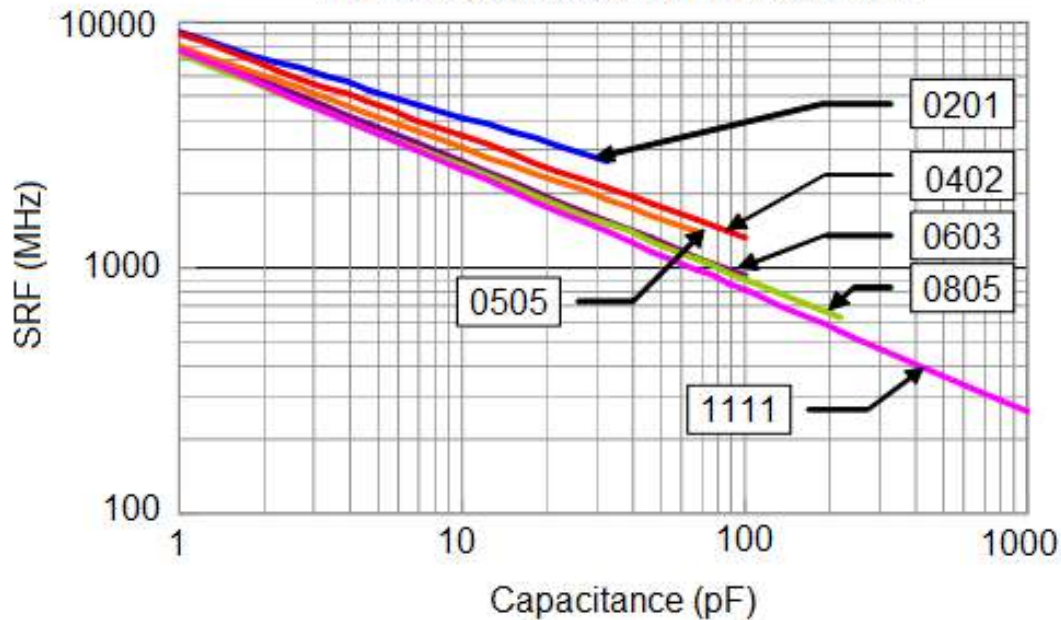
Q vs. Frequency



ESR vs. Frequency

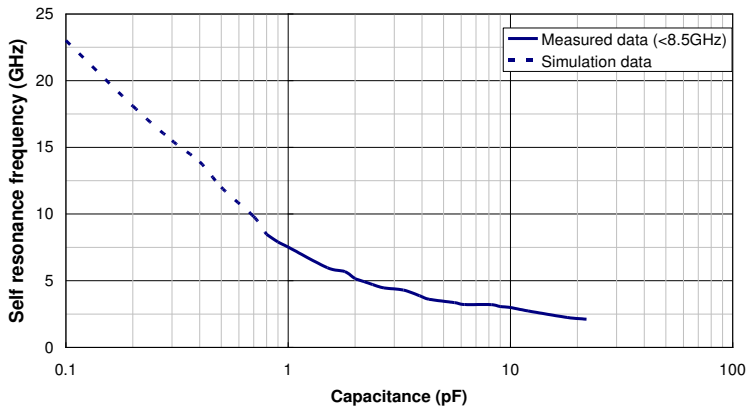


SRF vs. Capacitance by EIA Case Size

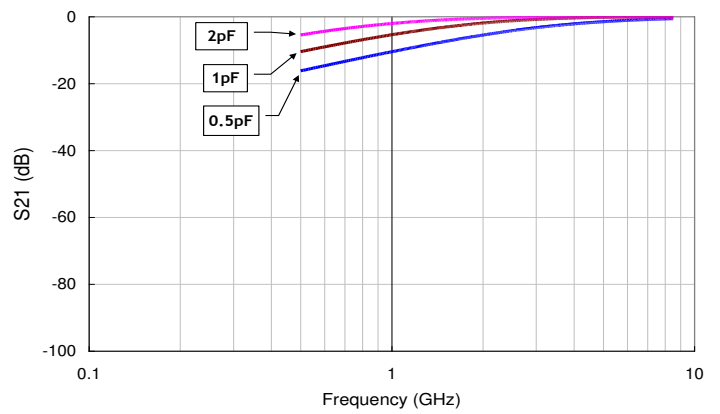




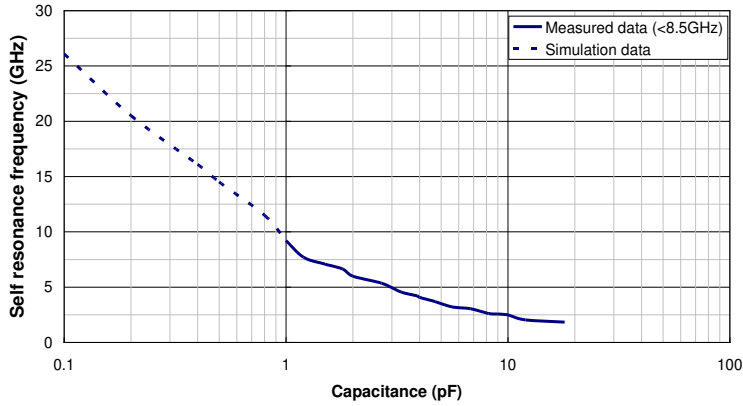
SRF vs. Capacitance (0201)



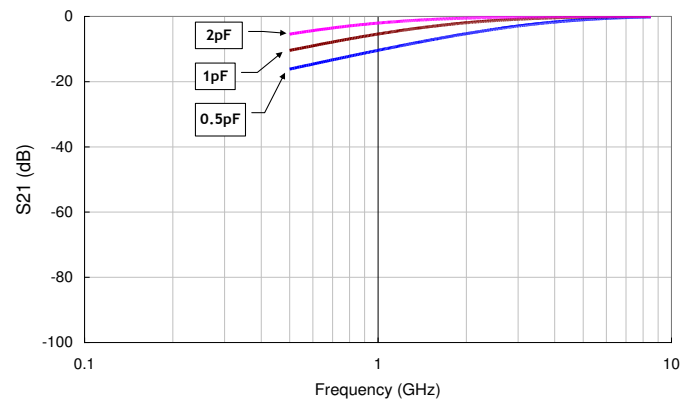
S21 vs. Frequency (0201)



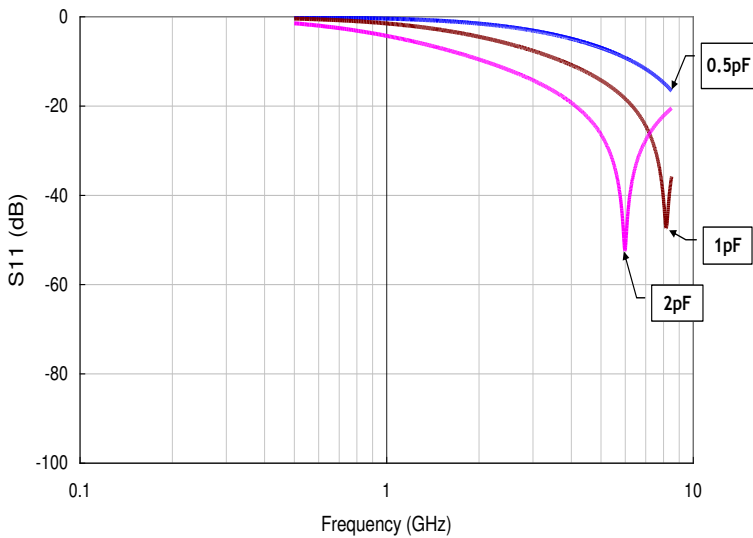
SRF vs. Capacitance (0402)



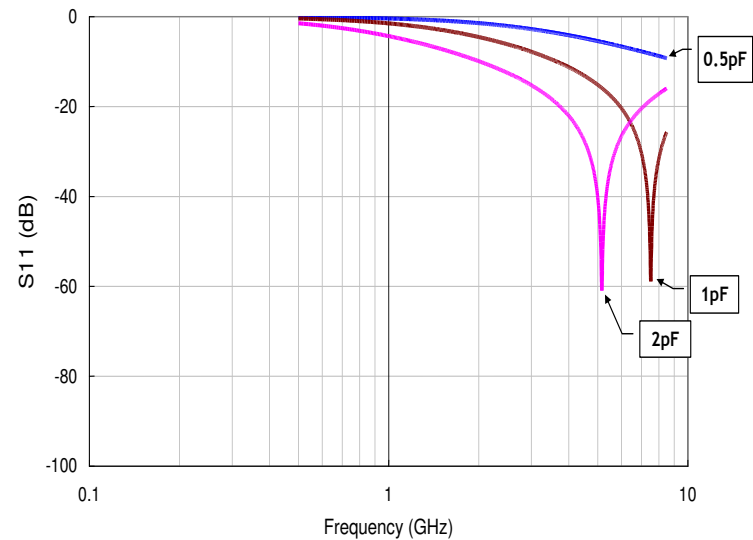
S21 vs. Frequency (0402)

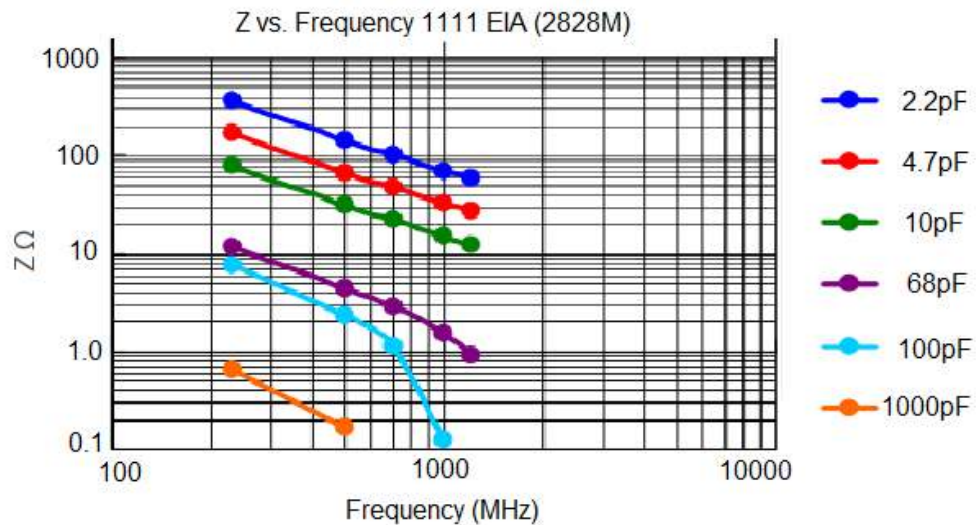
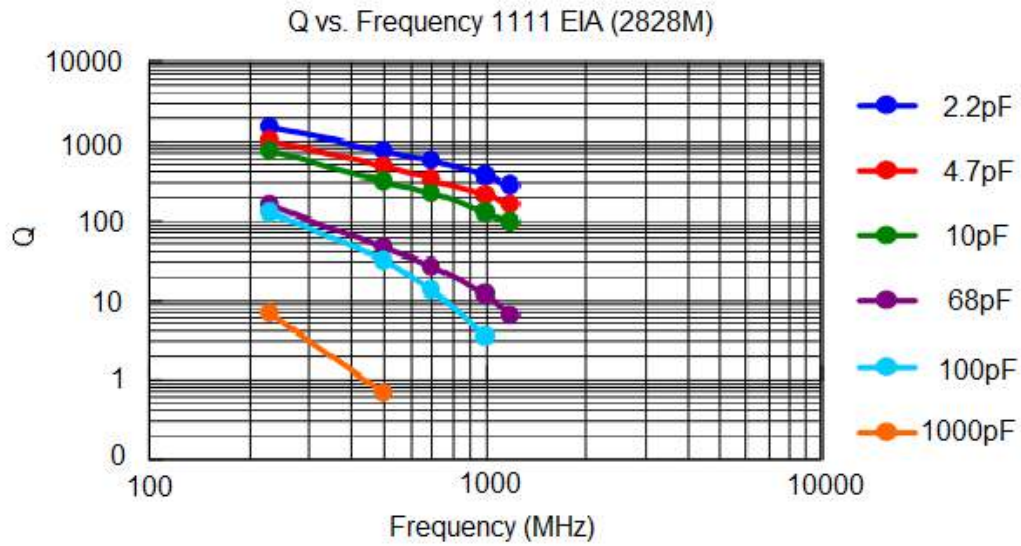
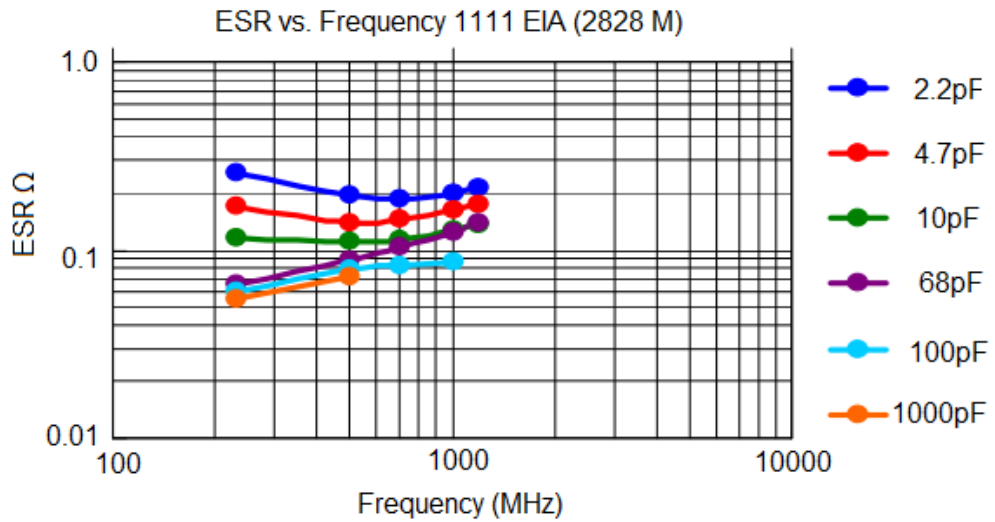


S11 vs. Frequency (0201)



S11 vs. Frequency (0402)







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Item	Test Condition	Requirements																																																		
1 Visual and Mechanical	---	* No remarkable defect * Dimensions conform to individual specification sheet																																																		
2 Capacitance		* Shall not exceed the limits given in the detailed spec NP0: Cap \geq 30pF, Q \geq 1000, Cap $<$ 30pF, Q \geq 400+20C X7R, X5R:																																																		
3 Q/DF (Dissipation Factor)	Class I: NP0 Class II: X7R, X5R, Y5V ** Test condition: 0.5 \pm 0.2Vrms, 1KHz \pm 10% X7R: 0603 \geq 225 (10V), 0805=106 (6.3V&10V) X5R: 0201 \geq 224 (6.3V), 0402 \geq 475 (6.3V), 0402 \geq 225(10V), 0603=106 (6.3V)	<table border="1"> <thead> <tr> <th>Rated voltage (DCV)</th> <th>D.F. \leq</th> <th colspan="2">Exception of D.F. \leq</th> </tr> </thead> <tbody> <tr> <td rowspan="3">\geq 50V</td> <td rowspan="3">\leq 2.5%</td> <td>\leq3%</td> <td>0201(50V), 0603 \geq 0.047μF, 0805 \geq 0.18μF, 1206 \geq 0.47μF</td> </tr> <tr> <td>\leq5%</td> <td>1210 \geq 4.7μF</td> </tr> <tr> <td>\leq10%</td> <td>0603\geq1μF, 0805\geq1μF, 1206\geq2.2μF, 1210\geq10μF</td> </tr> <tr> <td>35V</td> <td>\leq3.5%</td> <td>\leq10%</td> <td>0805\geq2.2μF, 1210\geq10μF</td> </tr> <tr> <td rowspan="3">25V</td> <td rowspan="3">\leq3.5%</td> <td>\leq5%</td> <td>0201\geq0.01μF, 0805\geq1μF, 1210\geq10μF</td> </tr> <tr> <td>\leq7%</td> <td>0603\geq0.33μF, 1206\geq4.7μF</td> </tr> <tr> <td>\leq10%</td> <td>0402\geq0.10μF, 0603\geq0.47μF, 0805\geq2.2μF,</td> </tr> <tr> <td rowspan="2">16V</td> <td rowspan="2">\leq3.5%</td> <td>\leq5%</td> <td>0201\geq0.01μF, 0402\geq0.033μF, 0603\geq0.15μF, 0805\geq0.68μF, 1206\geq2.2μF, 1210\geq4.7μF</td> </tr> <tr> <td>\leq10%</td> <td>0402\geq 0.22μF, 0603\geq0.68μF, 0805\geq2.2μF, 1206\geq4.7μF, 1210\geq22μF</td> </tr> <tr> <td>10V</td> <td>\leq5%</td> <td>\leq10%</td> <td>0201\geq0.012μF, 0402\geq0.33μF, 0603\geq0.33μF, 0805 \geq 2.2μF, 1206\geq2.2μF, 1210\geq22μF</td> </tr> <tr> <td></td> <td></td> <td>\leq15%</td> <td>0201\geq0.1μF, 0402\geq1μF</td> </tr> <tr> <td>6.3V</td> <td>\leq10%</td> <td>\leq15%</td> <td>0201\geq0.1μF, 0402\geq1μF, 0603\geq10μF, 0805\geq4.7μF, 1206\geq47μF :1210\geq100μF</td> </tr> <tr> <td></td> <td></td> <td>\leq20%</td> <td>0402\geq2.2μF</td> </tr> <tr> <td></td> <td></td> <td>\leq15%</td> <td>---</td> </tr> </tbody> </table>	Rated voltage (DCV)	D.F. \leq	Exception of D.F. \leq		\geq 50V	\leq 2.5%	\leq 3%	0201(50V), 0603 \geq 0.047 μ F, 0805 \geq 0.18 μ F, 1206 \geq 0.47 μ F	\leq 5%	1210 \geq 4.7 μ F	\leq 10%	0603 \geq 1 μ F, 0805 \geq 1 μ F, 1206 \geq 2.2 μ F, 1210 \geq 10 μ F	35V	\leq 3.5%	\leq 10%	0805 \geq 2.2 μ F, 1210 \geq 10 μ F	25V	\leq 3.5%	\leq 5%	0201 \geq 0.01 μ F, 0805 \geq 1 μ F, 1210 \geq 10 μ F	\leq 7%	0603 \geq 0.33 μ F, 1206 \geq 4.7 μ F	\leq 10%	0402 \geq 0.10 μ F, 0603 \geq 0.47 μ F, 0805 \geq 2.2 μ F,	16V	\leq 3.5%	\leq 5%	0201 \geq 0.01 μ F, 0402 \geq 0.033 μ F, 0603 \geq 0.15 μ F, 0805 \geq 0.68 μ F, 1206 \geq 2.2 μ F, 1210 \geq 4.7 μ F	\leq 10%	0402 \geq 0.22 μ F, 0603 \geq 0.68 μ F, 0805 \geq 2.2 μ F, 1206 \geq 4.7 μ F, 1210 \geq 22 μ F	10V	\leq 5%	\leq 10%	0201 \geq 0.012 μ F, 0402 \geq 0.33 μ F, 0603 \geq 0.33 μ F, 0805 \geq 2.2 μ F, 1206 \geq 2.2 μ F, 1210 \geq 22 μ F			\leq 15%	0201 \geq 0.1 μ F, 0402 \geq 1 μ F	6.3V	\leq 10%	\leq 15%	0201 \geq 0.1 μ F, 0402 \geq 1 μ F, 0603 \geq 10 μ F, 0805 \geq 4.7 μ F, 1206 \geq 47 μ F :1210 \geq 100 μ F			\leq 20%	0402 \geq 2.2 μ F			\leq 15%	---
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4 Dielectric Strength	*To apply voltage(\leq 100V) 250%. *Duration: 1 to 5 sec. *Charge & discharge current less than 50mA. *To apply voltage: 200V ~ 300V & LD series \geq 2 times V DC 500V ~ 999V \geq 1.5 times V DC 1000V ~ 3000V \geq 1.2 times V DC *Cut-off, set at 10mA *TEST= 15 sec. *RAMP=0	*No evidence of damage or flash over during test.																																																		
5 Insulation Resistance	To apply rated voltage for max. 120 sec. Rated Voltage: To apply rated voltage (500V max.) for 60 sec. >630V To apply 500V for 60sec.	10G Ω or RxC \geq 500 Ω -F whichever is lower. Class II (X7R, X7E, X5R, Y5V): <table border="1"> <thead> <tr> <th>Rated voltage</th> <th>Insulation Resistance</th> </tr> </thead> <tbody> <tr> <td>100V: X7R</td> <td rowspan="6">10GΩ or RxC\geq100 Ω-F whichever is lower.</td> </tr> <tr> <td>50V:0603\geq1μF, 0805\geq1μF, 1206\geq2.2μF, 1210\geq4.7μF</td> </tr> <tr> <td>35V:0805\geq2.2μF, 1210\geq10μF</td> </tr> <tr> <td>25V:0402\geq1μF, 0603\geq2.2μF, 0805\geq2.2μF, 1206\geq10μF, 1210\geq10μF</td> </tr> <tr> <td>16V:0402\geq0.22μF, 0603\geq1μF, 0805\geq2.2μF, 1206\geq10μF, 1210\geq47μF</td> </tr> <tr> <td>10V:0201\geq47nF, 0402\geq0.47μF, 0603\geq0.47μF, 0805\geq2.2μF,</td> </tr> </tbody> </table>	Rated voltage	Insulation Resistance	100V: X7R	10G Ω or RxC \geq 100 Ω -F whichever is lower.	50V:0603 \geq 1 μ F, 0805 \geq 1 μ F, 1206 \geq 2.2 μ F, 1210 \geq 4.7 μ F	35V:0805 \geq 2.2 μ F, 1210 \geq 10 μ F	25V:0402 \geq 1 μ F, 0603 \geq 2.2 μ F, 0805 \geq 2.2 μ F, 1206 \geq 10 μ F, 1210 \geq 10 μ F	16V:0402 \geq 0.22 μ F, 0603 \geq 1 μ F, 0805 \geq 2.2 μ F, 1206 \geq 10 μ F, 1210 \geq 47 μ F	10V:0201 \geq 47nF, 0402 \geq 0.47 μ F, 0603 \geq 0.47 μ F, 0805 \geq 2.2 μ F,																																									
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Item	Test Condition	Requirements																																																														
8	Vibration Resistance * Vibration frequency: 10-55 Hz/min. * Total amplitude: 1.5mm * Test time: 6 hours (Two hrs each in three mutually perpendicular directions) * Measurement to be made after keeping at room temp. for 24±2 hours	* No remarkable damage. * Cap change and Q/D.F.: To meet initial spec.																																																														
9	Solderability * Solder temperature: 235±5°C * Dipping time: 2±0.5 sec.	95% min. coverage of all metalized area.																																																														
10	Bending Test * The middle part of substrate shall be pressurized by means of the pressurizing rod at a rate of approximately 1 mm per second until the deflection becomes 1 mm and then the pressure shall be maintained for 5±1 sec. * Measurement to be made after keeping at room temp. for 24±2 hrs.	* No remarkable damage. * Capacitance change : NPO: within ±5% or 0.5pF whichever is larger X7R, X7E, X5R: within ±12.5% Y5V: within ±30% (This capacitance change means the change of capacitance under specified flexure of substrate from the capacitance measured before the test.)																																																														
11	Resistance to Soldering Heat * Solder temperature: 260±5°C * Dipping time: 10±1 sec * Preheating: 120 to 150°C for 1 minute before immersing the capacitor in an eutectic solder. * Before initial measurement (Class II 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.	* No remarkable damage. * Capacitance change: NPO: within ±2.5% or 0.25pF whichever is larger X7R, X7E, X5R: within ±7.5% Y5V: within ±20% * Q/D.F., I.R. and dielectric strength: To meet initial requirements. * 25% max. leaching on each edge.																																																														
12	Temperature Cycle * Conduct the five cycles according to the temperatures and time. <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th>Step</th> <th>Temp. (°C)</th> <th>Time (min.)</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>Min. operating temp. +0/-3</td> <td>30±3</td> </tr> <tr> <td>2</td> <td>Room temp.</td> <td>2-3</td> </tr> <tr> <td>3</td> <td>Max. operating temp. +3/0</td> <td>30±3</td> </tr> <tr> <td>4</td> <td>Room temp.</td> <td>2-3</td> </tr> </tbody> </table> * Before initial measurement (Class II only): 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.	Step	Temp. (°C)	Time (min.)	1	Min. operating temp. +0/-3	30±3	2	Room temp.	2-3	3	Max. operating temp. +3/0	30±3	4	Room temp.	2-3	* No remarkable damage. * Capacitance change NPO: within ±2.5% or 0.25pF whichever is larger X7R, X7E, X5R: within ±7.5% Y5V: within ±20% * Q/D.F., I.R. and dielectric strength: To meet initial requirements.																																															
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13	Humidity (Damp Heat) Steady State * Test temp.: 40±2°C * Humidity: 90-95% RH * Test time: 500+24/-0hrs. * Before initial measurement (Class II only): 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.	* No remarkable damage. * Cap change: NPO: within ±5% or 0.5pF whichever is larger X7R, X7E, X5R: ≥10V**, within ±12.5%; 6.3V within ±25%; TT series, within ±25% **10V:0603≥4.7µF;0402≥1µF;0201≥0.1µF, within ±25%; Y5V: ≥10V, within ±30%; 6.3V, within +30/-40% * Q/D.F. value: NPO: More than 30pF Q≥350, 10pF≤C≤30pF, Q≥275+2.5C, Less than 10pF Q≥200+10C X7R, X5R: <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th>Rated vol.</th> <th>D.F.≤</th> <th>Exception of D.F.≤</th> </tr> </thead> <tbody> <tr> <td rowspan="3">≥50V</td> <td rowspan="3">≤3%</td> <td>≤6% 0201(50V); 0603≥0.047µF; 0805≥0.18µF; 1206≥0.47µF</td> </tr> <tr> <td>≤10% 1210≥4.7µF</td> </tr> <tr> <td>≤20% 0603≥1µF; 0805≥1µF; 1206≥2.2µF; 1210≥10µF</td> </tr> <tr> <td rowspan="2">35V</td> <td rowspan="2">≤5%</td> <td>≤20% 0805≥2.2µF; 1210≥10µF</td> </tr> <tr> <td>≤10% 0201≥0.01µF; 0805≥1µF; 1210≥10µF</td> </tr> <tr> <td rowspan="3">25V</td> <td rowspan="3">≤5%</td> <td>≤14% 0603≥0.33µF; 1206≥4.7µF</td> </tr> <tr> <td>≤15% 6≥6.8µF; 1210≥22µF</td> </tr> <tr> <td>≤10% 0603≥0.15µF; 0805≥0.68µF; 1206≥2.2µF; 1210≥4.7µF</td> </tr> <tr> <td rowspan="2">16V</td> <td rowspan="2">≤5%</td> <td>≤15% 0201≥0.01µF; 0402≥0.033µF; 0603≥0.68µF; 0805≥2.2µF; 1206≥4.7µF; 1210≥22µF</td> </tr> <tr> <td>≤10% 0201≥0.012µF; 0402≥0.33µF; 0603≥0.33µF; 0805≥2.2µF; 1206≥2.2µF; 1210≥0.1µF; 0402≥1µF</td> </tr> <tr> <td>6.3V</td> <td>≤15%</td> <td>≤30% 0201≥0.1µF; 0402≥1µF; 0603≥10µF; 0805≥4.7µF;</td> </tr> <tr> <td>4V</td> <td>≤20%</td> <td>---</td> </tr> </tbody> </table> Y5V: <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th>Rated vol.</th> <th>D.F.≤</th> <th>Exception of D.F.≤</th> </tr> </thead> <tbody> <tr> <td>≥50V</td> <td>≤7.5%</td> <td>≤10% 0603≥0.1µF; 0805≥0.47µF; 1206≥4.7µF; Cap≥1µF</td> </tr> <tr> <td rowspan="2">35V</td> <td rowspan="2">≤10%</td> <td>---</td> </tr> <tr> <td>0402≥0.047µF; 0603≥0.1µF; 0805≥0.33µF; 1206≥1µF; 1210≥4.7µF</td> </tr> <tr> <td rowspan="2">25V</td> <td rowspan="2">≤7.5%</td> <td>≤10% 0402≥0.068µF; 0603≥0.47µF; 1206≥4.7µF; 1210≥22µF; Cap≥1µF</td> </tr> <tr> <td>≤15% 0402≥0.068µF; 0603≥0.68µF</td> </tr> <tr> <td>16V (C<1.0µF)</td> <td>≤10%</td> <td>0402≥0.22µF</td> </tr> <tr> <td>16V (C≥1.0µF)</td> <td>≤12.5%</td> <td>≤20% 0603≥2.2µF; 0805≥3.3µF; 1206≥10µF; 1210≥22µF; 1812≥47µF; Cap≥1µF</td> </tr> <tr> <td>10V</td> <td>≤20%</td> <td>≤30% 0402≥0.47µF</td> </tr> <tr> <td>6.3V</td> <td>≤30%</td> <td>---</td> </tr> </tbody> </table> *I.R.: ≥10V, 1GΩ or 50 Ω-F whichever is lower. Class II (X7R, X7E, X5R, Y5V) <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th>Rated voltage</th> <th>Insulation Resistance</th> </tr> </thead> <tbody> <tr> <td>100V: X7R</td> <td rowspan="6">1GΩ or RxC≥10 Ω-F whichever is lower.</td> </tr> <tr> <td>50V:0603≥1µF;0805≥1µF; 206≥2.2µF;1210≥4.7µF</td> </tr> <tr> <td>25V:0402≥1µF;0603≥2.2µF;0805≥2.2µF;1206≥10µF;1210≥10µF</td> </tr> <tr> <td>16V:0402≥0.22µF;0603≥1µF;0805≥2.2µF;1206≥10µF;1210≥47µF</td> </tr> <tr> <td>10V:0201≥47nF;0402≥0.47µF;0603≥0.47µF;0805≥2.2µF;1206≥4.7µF;1210≥47µF</td> </tr> <tr> <td></td> </tr> </tbody> </table>	Rated vol.	D.F.≤	Exception of D.F.≤	≥50V	≤3%	≤6% 0201(50V); 0603≥0.047µF; 0805≥0.18µF; 1206≥0.47µF	≤10% 1210≥4.7µF	≤20% 0603≥1µF; 0805≥1µF; 1206≥2.2µF; 1210≥10µF	35V	≤5%	≤20% 0805≥2.2µF; 1210≥10µF	≤10% 0201≥0.01µF; 0805≥1µF; 1210≥10µF	25V	≤5%	≤14% 0603≥0.33µF; 1206≥4.7µF	≤15% 6≥6.8µF; 1210≥22µF	≤10% 0603≥0.15µF; 0805≥0.68µF; 1206≥2.2µF; 1210≥4.7µF	16V	≤5%	≤15% 0201≥0.01µF; 0402≥0.033µF; 0603≥0.68µF; 0805≥2.2µF; 1206≥4.7µF; 1210≥22µF	≤10% 0201≥0.012µF; 0402≥0.33µF; 0603≥0.33µF; 0805≥2.2µF; 1206≥2.2µF; 1210≥0.1µF; 0402≥1µF	6.3V	≤15%	≤30% 0201≥0.1µF; 0402≥1µF; 0603≥10µF; 0805≥4.7µF;	4V	≤20%	---	Rated vol.	D.F.≤	Exception of D.F.≤	≥50V	≤7.5%	≤10% 0603≥0.1µF; 0805≥0.47µF; 1206≥4.7µF; Cap≥1µF	35V	≤10%	---	0402≥0.047µF; 0603≥0.1µF; 0805≥0.33µF; 1206≥1µF; 1210≥4.7µF	25V	≤7.5%	≤10% 0402≥0.068µF; 0603≥0.47µF; 1206≥4.7µF; 1210≥22µF; Cap≥1µF	≤15% 0402≥0.068µF; 0603≥0.68µF	16V (C<1.0µF)	≤10%	0402≥0.22µF	16V (C≥1.0µF)	≤12.5%	≤20% 0603≥2.2µF; 0805≥3.3µF; 1206≥10µF; 1210≥22µF; 1812≥47µF; Cap≥1µF	10V	≤20%	≤30% 0402≥0.47µF	6.3V	≤30%	---	Rated voltage	Insulation Resistance	100V: X7R	1GΩ or RxC≥10 Ω-F whichever is lower.	50V:0603≥1µF;0805≥1µF; 206≥2.2µF;1210≥4.7µF	25V:0402≥1µF;0603≥2.2µF;0805≥2.2µF;1206≥10µF;1210≥10µF	16V: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	
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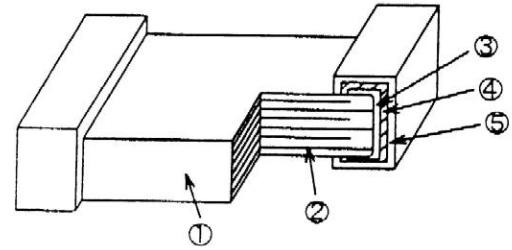


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Rev. F

Item	Test Condition	Requirements																																																																																																																																			
14	Humidity (Damp Heat) Load	<p>* No remarkable damage. Cap change: NP0: ±7.5% or 0.75pF whichever is larger. X7R, X7E, X5R: ≥10V**, within ±12.5%; 6.3V within ±25%; **10V:0603≥4.7µF;0402≥1µF;0201≥0.1µF, within ±25%; Y5V: ≥10V, within ±30%; 6.3V, within +30/-40% Q/D.F. value: NP0: C≥30pF, Q≥200; C<30pF, Q≥100+10/3C X7R, X5R:</p> <table border="1"> <thead> <tr> <th>Rated voltage</th> <th>D.F.≤</th> <th colspan="2">Exception of D.F. ≤</th> </tr> </thead> <tbody> <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>1210≥4.7µF</td> </tr> <tr> <td>≤20%</td> <td>0603≥1µF; 0805≥1µF; 1206≥2.2µF; 1210≥10µF</td> </tr> <tr> <td>35V</td> <td>≤5%</td> <td>≤20%</td> <td>0805≥2.2µF; 1210≥10µF</td> </tr> <tr> <td rowspan="3">25V</td> <td rowspan="3">≤5%</td> <td>≤10%</td> <td>0201≥0.01µF;0805≥1µF; 1210≥10µF</td> </tr> <tr> <td>≤14%</td> <td>0603≥0.33µF;1206≥4.7µF</td> </tr> <tr> <td>≤15%</td> <td>0402≥0.10µF;0603≥0.47µF;0805≥2.2µF; 1206≥6.8µF;1210≥22µF</td> </tr> <tr> <td rowspan="3">16V</td> <td rowspan="3">≤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≥0.01µF;0402≥0.033µF;0603≥0.68µF;0805≥2.2µF; 1206≥4.7µF; 1210≥22µF</td> </tr> <tr> <td>≤15%</td> <td>0201≥0.012µF;0402≥0.33µF; 0603≥0.33µF;0805≥2.2µF; 1206≥2.2µF; 1210≥22µF</td> </tr> <tr> <td>10V</td> <td>≤7.5%</td> <td>≤20%</td> <td>0201≥0.1µF;0402≥1µF</td> </tr> <tr> <td>6.3V</td> <td>≤15%</td> <td>≤30%</td> <td>0201≥0.1µF;0402≥1µF;0603≥10µF; 0805≥4.7µF;1206≥47µF;1210≥100µF</td> </tr> <tr> <td>4V</td> <td>≤20%</td> <td>---</td> <td>---</td> </tr> </tbody> </table> <p>X7R/X7E, LD series : DF≤3%</p> <p>Y5V:</p> <table border="1"> <thead> <tr> <th>Rated voltage</th> <th>D.F.≤</th> <th colspan="2">Exception of D.F. ≤</th> </tr> </thead> <tbody> <tr> <td>≥50V</td> <td>≤7.5%</td> <td>≤10%</td> <td>0603≥0.1µF; 0805≥0.47µF;1206≥4.7µF; Cap≥1µF</td> </tr> <tr> <td>35V</td> <td>≤10%</td> <td>---</td> <td>---</td> </tr> <tr> <td rowspan="2">25V</td> <td rowspan="2">≤7.5%</td> <td>≤10%</td> <td>0402≥0.047µF;0603≥0.1µF;0805≥0.33µF;1206≥1µF; 1210≥4.7µF</td> </tr> <tr> <td>≤15%</td> <td>0402≥0.068µF;0603≥0.47µF;1206≥4.7µF;1210≥22µF; Cap≥1µF</td> </tr> <tr> <td rowspan="2">16V (C<1.0µF)</td> <td rowspan="2">≤10%</td> <td>≤12.5%</td> <td>0402≥0.068µF; 0603≥0.68µF</td> </tr> <tr> <td>≤20%</td> <td>0402≥0.22µF</td> </tr> <tr> <td>16V (C≥1.0µF)</td> <td>≤12.5%</td> <td>≤20%</td> <td>0603≥2.2µF;0805≥3.3µF;1206≥10µF;1210≥22µF;1812≥47µF; Cap≥1µF</td> </tr> <tr> <td>10V</td> <td>≤20%</td> <td>≤30%</td> <td>0402≥0.47µF</td> </tr> <tr> <td>6.3V</td> <td>≤30%</td> <td>---</td> <td>---</td> </tr> </tbody> </table> <p>*I.R.: ≥10V, 500MΩ or 25 Ω-F whichever is lower. Class II (X7R, X7E, X5R, Y5V)</p> <table border="1"> <thead> <tr> <th>Rated voltage</th> <th>Insulation Resistance</th> </tr> </thead> <tbody> <tr> <td>100V: X7R</td> <td rowspan="5">500MΩ or RxC≥5 Ω-F whichever is lower.</td> </tr> <tr> <td>50V:0603≥1µF;0805≥1µF; 1206≥2.2µF;1210≥4.7µF</td> </tr> <tr> <td>25V:0402≥1µF;0603≥2.2µF;0805≥2.2µF;1206≥10µF;1210≥10µF</td> </tr> <tr> <td>16V:0402≥0.22µF;0603≥1µF;0805≥2.2µF;1206≥10µF;1210≥47µF</td> </tr> <tr> <td>10V:0201≥47nF;0402≥0.47µF;0603≥0.47µF;0805≥2.2µF; 1206≥4.7µF;1210≥47µF</td> </tr> </tbody> </table>	Rated voltage	D.F.≤	Exception of D.F. ≤		≥50V	≤3%	≤6%	0201(50V);0603≥0.047µF; 0805≥0.18µF; 1206≥0.47µF	≤10%	1210≥4.7µF	≤20%	0603≥1µF; 0805≥1µF; 1206≥2.2µF; 1210≥10µF	35V	≤5%	≤20%	0805≥2.2µF; 1210≥10µF	25V	≤5%	≤10%	0201≥0.01µF;0805≥1µF; 1210≥10µF	≤14%	0603≥0.33µF;1206≥4.7µF	≤15%	0402≥0.10µF;0603≥0.47µF;0805≥2.2µF; 1206≥6.8µF;1210≥22µF	16V	≤5%	≤10%	0603≥0.15µF;0805≥0.68µF;1206≥2.2µF;1210≥4.7µF	≤15%	0201≥0.01µF;0402≥0.033µF;0603≥0.68µF;0805≥2.2µF; 1206≥4.7µF; 1210≥22µF	≤15%	0201≥0.012µF;0402≥0.33µF; 0603≥0.33µF;0805≥2.2µF; 1206≥2.2µF; 1210≥22µF	10V	≤7.5%	≤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%	---	---	Rated voltage	D.F.≤	Exception of D.F. ≤		≥50V	≤7.5%	≤10%	0603≥0.1µF; 0805≥0.47µF;1206≥4.7µF; Cap≥1µF	35V	≤10%	---	---	25V	≤7.5%	≤10%	0402≥0.047µF;0603≥0.1µF;0805≥0.33µF;1206≥1µF; 1210≥4.7µF	≤15%	0402≥0.068µF;0603≥0.47µF;1206≥4.7µF;1210≥22µF; Cap≥1µF	16V (C<1.0µF)	≤10%	≤12.5%	0402≥0.068µF; 0603≥0.68µF	≤20%	0402≥0.22µF	16V (C≥1.0µF)	≤12.5%	≤20%	0603≥2.2µF;0805≥3.3µF;1206≥10µF;1210≥22µF;1812≥47µF; Cap≥1µF	10V	≤20%	≤30%	0402≥0.47µF	6.3V	≤30%	---	---	Rated voltage	Insulation Resistance	100V: X7R	500MΩ or RxC≥5 Ω-F whichever is lower.	50V:0603≥1µF;0805≥1µF; 1206≥2.2µF;1210≥4.7µF	25V:0402≥1µF;0603≥2.2µF;0805≥2.2µF;1206≥10µF;1210≥10µF	16V: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																																											
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15	High Temperature Load (Endurance)	<p>*Test temp. : NP0, X7R/X7E: 125±3°C X5R, Y5V: 85±3°C *Test time: 1000+24/-0 hrs. *To apply voltage: (1) 6.3V or C≥10µF 150% of rated voltage; (2) 10V≤Ur<500V: 200% of rated voltage. (3) 500V: 150% of rated voltage. (4) Ur≥630V: 120% of rated voltage.(5) 100% of rated voltage for below range:</p> <table border="1"> <thead> <tr> <th>Size</th> <th>Dielectric</th> <th>Rated voltage</th> </tr> </thead> <tbody> <tr> <td>0201</td> <td>X5R/X7R</td> <td>6.3V,10V</td> </tr> <tr> <td>0402</td> <td>X5R/X7R</td> <td>6.3V,10V</td> </tr> <tr> <td>0603</td> <td>X5R/X7R</td> <td>6.3V,10V</td> </tr> <tr> <td>0805</td> <td>X5R/X7R</td> <td>6.3V</td> </tr> <tr> <td>1206</td> <td>X5R/X7R</td> <td>6.3V</td> </tr> <tr> <td></td> <td>NP0</td> <td>3000V</td> </tr> </tbody> </table> <p>(6)150% of rated voltage for below range:</p> <table border="1"> <thead> <tr> <th>Size</th> <th>Dielectric</th> <th>Rated voltage</th> <th>Capacitance</th> </tr> </thead> <tbody> <tr> <td rowspan="2">0402</td> <td>X5R/X7R</td> <td>10V,16V,25V</td> <td>C≥0.22µF</td> </tr> <tr> <td>Y5V</td> <td>16V</td> <td>C≥0.47µF</td> </tr> <tr> <td rowspan="2">0603</td> <td>X5R/X7R</td> <td>10V,16V</td> <td>C≥1.0µF</td> </tr> <tr> <td>Y5V</td> <td>16V</td> <td>C≥2.2µF</td> </tr> <tr> <td rowspan="2">0805</td> <td>X5R/X7R</td> <td>10V</td> <td>C≥4.7µF</td> </tr> <tr> <td>Y5V</td> <td>16V</td> <td>C≥4.7µF</td> </tr> </tbody> </table> <p>*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.</p> <p>* No remarkable damage. Cap change: NP0: ±3.0% or ±0.3pF whichever is larger X7R, X7E, X5R: ≥10V**, within ±12.5%; 6.3V within ±25%; **10V:0603≥4.7µF;0402≥1µF;0201≥0.1µF, within ±25%; Y5V: ≥10V, within ±30%; 6.3V, within +30/-40% Q/D.F. value: NP0: More than 30pF, Q≥350; 10pF≤C<30pF, Q≥275+2.5C; Less than 10pF, Q≥200+10C X7R, X5R:</p> <table border="1"> <thead> <tr> <th>Rated voltage</th> <th>D.F.≤</th> <th colspan="2">Exception of D.F. ≤</th> </tr> </thead> <tbody> <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>1210≥4.7µF</td> </tr> <tr> <td>≤20%</td> <td>0603≥1µF; 0805≥1µF; 1206≥2.2µF; 1210≥10µF</td> </tr> <tr> <td>35V</td> <td>≤5%</td> <td>≤20%</td> <td>0805≥2.2µF; 1210≥10µF</td> </tr> <tr> <td rowspan="3">25V</td> <td rowspan="3">≤5%</td> <td>≤10%</td> <td>0201≥0.01µF;0805≥1µF; 1210≥10µF</td> </tr> <tr> <td>≤14%</td> <td>0603≥0.33µF;1206≥4.7µF</td> </tr> <tr> <td>≤15%</td> <td>0402≥0.10µF;0603≥0.47µF;0805≥2.2µF; 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0603≥0.33µF;0805≥2.2µF; 1206≥2.2µF; 1210≥22µF	10V	≤7.5%	≤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%	---	---	Rated voltage	D.F.≤	Exception of D.F. ≤		≥50V	≤7.5%	≤10%	0603≥0.1µF; 0805≥0.47µF;1206≥4.7µF; Cap≥1µF	25V	≤7.5%	≤10%	0402≥0.047µF;0603≥0.1µF;0805≥0.33µF;1206≥1µF; 1210≥4.7µF	≤15%	0402≥0.068µF;0603≥0.47µF;1206≥4.7µF;1210≥22µF; Cap≥1µF	16V (C<1.0µF)	≤10%	≤12.5%	0402≥0.068µF; 0603≥0.68µF	≤20%	0402≥0.22µF	16V (C≥1.0µF)	≤12.5%	≤20%	0603≥2.2µF;0805≥3.3µF;1206≥10µF; 1210≥22µF;1812≥47µF;Cap≥1µF	10V	≤20%	≤30%	0402≥0.47µF	6.3V	≤30%	---	---	Rated voltage	Insulation Resistance	100V: X7R	1GΩ or RxC≥10 Ω-F whichever is lower.	50V:0603≥1µF;0805≥1µF; 1206≥2.2µF;1210≥4.7µF	25V:0402≥1µF;0603≥2.2µF; 0805≥2.2µF;1206≥10µF;1210≥10µF	16V: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
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Name		NP0/X7R	NPO/X7R/X5R/Y5V
1	Ceramic material	BaTiO ₃ based	
2	Inner electrode	Ni	
3	Termination	Inner layer	Cu
		Middle layer	Ni
		Outer layer	Sn



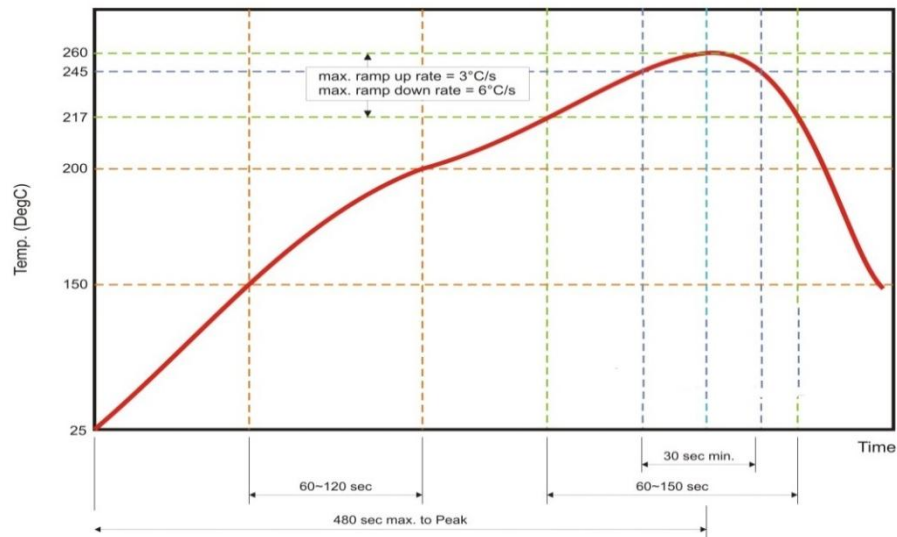
Storage and handling

- Products should be stored at 5 to 40°C ambient temperature and 20 to 70% relative humidity.
- It is recommended that the product be used within one year from shipment. After one year from shipment, solderability should be checked.

Cautions

- Corrosive gas reacts with the terminal electrodes of capacitors. Do not store capacitors in the proximity of corrosive gas (e.g., hydrogen sulfide, sulfur dioxide, chlorine, ammonia gas etc.) otherwise there can be solderability issues.
- In a corrosive atmosphere, solderability might be degraded, and/or silver migration may occur which can cause lower reliability.
- Dewing caused by rapid humidity changes and/or photochemical changes of the terminal electrode (caused by direct sunlight contact) can affect the solderability and electrical performance. Do not store capacitors under direct sunlight or in dewing conditions.

Recommended **reflow** profile for SnAgCu solder paste:



Recommended **wave** profile for SnAgCu solder paste:

