Surface Mount Multilayer Chip Capacitors for Commodity Solutions

Below tables are test procedures and requirements unless specified in detail datasheet.

VJ....W1BC TEST PROCEDURES AND REQUIREMENTS

TEST	PROCEDURE	REQUIREMENTS			
1) Visual and mechanical		• No remarkable defect • Dimensions should confirm to individual specification sheet			
2) Capacitance	Class 1: C0G (NP0) Cap. ≤ 1000 pF; 1.0 V_{RMS} ± 0.2 V_{RMS}; 1 MHz ± 10 % Cap. > 1000 pF; 1.0 V_{RMS} ± 0.2 V_{RMS}; 1 kHz ± 10 % Class 2: X7R, X5R, Y5V Cap. ≤ 10 µF; 1.0 V_{RMS} ± 0.2 V_{RMS}; 1 kHz ± 10 % (1) Cap. > 10 µF; 0.5 V_{RMS} ± 0.2 V_{RMS}; 120 Hz ± 20 % **Note** (1) Test conditions 0.5 V_{RMS} ± 0.2 V_{RMS}; 1 kHz ± 10 % X7R:0603: ≥ 2.2 µF/10 V 0805: 10 µF/6.3 V and 10 V X5R: 0201: ≥ 220 nF/6.3 V 0402: ≥ 4.7 µF/6.3 V 0402: ≥ 2.2 µF/10 V 0603: 10 µF/6.3 V	• Shall not exceed the limits given in the detailed specification			
3) Q/DF (dissipation factor)		**C0G (NP0):** Cap. ≥ 30 pF: Q ≥ 1000 Cap. < 30 pF: Q ≥ 400 + 20 C			
		X5R, X7R:			
		RATED VOLTAGE	**DF ≤**	**EXCEPTION OF DF ≤**	
		≥ 50 V	2.5 %	3 %	0201 (50 V); 0603 ≥ 0.047 µF; 0805 ≥ 0.18 µF; 1206 ≥ 0.47 µF
				5 %	1210 ≥ 4.7 µF
				10 %	0603 ≥ 1 µF; 0805 ≥ 1 µF; 1206 ≥ 2.2 µF; 1210 ≥ 10 µF
		35 V	3.5 %	10 %	0805 ≥ 2.2 µF; 1210 ≥ 10 µF
		25 V	3.5 %	5 %	0201 ≥ 0.01 µF; 0805 ≥ 1 µF; 1210 ≥ 10 µF
				7 %	0603 ≥ 0.33 µF; 1206 ≥ 4.7 µF
				10 %	0402 ≥ 0.10 µF; 0603 ≥ 0.47 µF; 0805 ≥ 2.2 µF; 1206 ≥ 6.8 µF; 1210 ≥ 22 µF
		16 V	3.5 %	5 %	0201 ≥ 0.01 µF; 0402 ≥ 0.033 µF; 0603 ≥ 0.15 µF; 0805 ≥ 0.68 µF; 1206 ≥ 2.2 µF; 1210 ≥ 4.7 µF
				10 %	0402 ≥ 0.22 µF; 0603 ≥ 0.68 µF; 0805 ≥ 2.2 µF; 1206 ≥ 4.7 µF; 1210 ≥ 22 µF
		10 V	5 %	10 %	0201 ≥ 0.012 µF; 0402 ≥ 0.33 µF; 0603 ≥ 0.33 µF; 0805 ≥ 2.2 µF; 1206 ≥ 2.2 µF; 1210 ≥ 22 µF
				15 %	0201 ≥ 0.1 µF; 0402 ≥ 1 µF
		6.3 V	10 %	15 %	0201 ≥ 0.1 µF; 0402 ≥ 1 µF; 0603 ≥ 10 µF; 0805 ≥ 4.7 µF; 1206 ≥ 47 µF; 1210 ≥ 100 µF
				20 %	0402 ≥ 2.2 µF
		4 V	15 %	-	-
		Y5V:			
		RATED VOLTAGE	**DF ≤**	**EXCEPTION OF DF ≤**	
		≥ 50 V	5 %	7 %	0603 ≥ 0.1 µF; 0805 ≥ 0.47 µF; 1206 ≥ 4.7 µF
		35 V	7 %	-	-
		25 V	5 %	7 %	0402 ≥ 0.047 µF; 0603 ≥ 0.1 µF; 0805 ≥ 0.33 µF; 1206 ≥ 1 µF; 1210 ≥ 4.7 µF
				9 %	0402 ≥ 0.068 µF; 0603 ≥ 0.47 µF; 1206 ≥ 4.7 µF; 1210 ≥ 22 µF
		16 V C < 1.0 µF	7 %	9 %	0402 ≥ 0.068 µF; 0603 ≥ 0.68 µF
				12.5 %	0402 ≥ 0.22 µF
		16 V C ≥ 1.0 µF	9 %	12.5 %	0603 ≥ 2.2 µF; 0805 ≥ 3.3 µF; 1206 ≥ 10 µF; 1210 ≥ 22 µF
		10 V	12.5 %	20 %	0402 ≥ 0.47 µF
		6.3 V	20 %	-	-

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<table>
<tr><th>TEST</th><th colspan="2">PROCEDURE</th><th colspan="2">REQUIREMENTS</th></tr>
<tr><td rowspan="2">4) Dielectric strength</td><td colspan="2">• To apply voltage (≤ 100 V) 250 %
• Duration: 1 s to 5 s
• Charge and discharge current less than 50 mA</td><td colspan="2" rowspan="2">• No evidence of damage or flash-over during test</td></tr>
<tr><td colspan="2">• To apply voltage
200 V to 300 V ≥ 2 times V_{DC}
500 V to 999 V ≥ 1.5 times V_{DC}
1000 V to 3000 V ≥ 1.2 times V_{DC}
• Cut-off, set at 10 mA
• TEST = 15 s
• RAMP = 0</td></tr>
<tr><td rowspan="8">5) Insulation resistance</td><td colspan="2" rowspan="7">Rated voltage ≤ 100 V:
To apply rated voltage for max. 120 s</td><td colspan="2">10 GΩ or R x C ≥ 500 ΩF whichever is smaller
Class 2 (X5R, X7R, Y5V):</td></tr>
<tr><td>RATED VOLTAGE</td><td>INSULATION RESISTANCE</td></tr>
<tr><td>100 V: X7R</td><td rowspan="6">10 GΩ or R x C ≥ 100 ΩF whichever is less</td></tr>
<tr><td>50 V: 0603 ≥ 1 µF; 0805 ≥ 1 µF; 1206 ≥ 2.2 µF; 1210 ≥ 4.7 µF</td></tr>
<tr><td>35 V: 0805 ≥ 2.2 µF; 1210 ≥ 10 µF</td></tr>
<tr><td>25 V: 0402 ≥ 1 µF; 0603 ≥ 2.2 µF; 0805 ≥ 2.2 µF; 1206 ≥ 10 µF; 1210 ≥ 10 µF</td></tr>
<tr><td>16 V: 0402 ≥ 0.22 µF; 0603 ≥ 1 µF; 0805 ≥ 2.2 µF; 1206 ≥ 10 µF; 1210 ≥ 47 µF</td></tr>
<tr><td>10 V: 0201 ≥ 47 nF; 0402 ≥ 0.47 µF; 0603 ≥ 0.47 µF; 0805 ≥ 2.2 µF; 1206 ≥ 4.7 µF; 1210 ≥ 47 µF</td></tr>
<tr><td>6.3 V; 4 V</td></tr>
<tr><td>Rated voltage: 200 V to 630 V</td><td>To apply rated voltage (500 V max.) for 60 s</td><td colspan="2">> 10 GΩ or R x C > 100 ΩF whichever is smaller</td></tr>
<tr><td>Rated voltage: > 630 V</td><td>To apply 500 V for 60 s</td><td colspan="2">> 10 GΩ</td></tr>
<tr><td rowspan="5">6) Temperature coefficient</td><td colspan="2">With no electrical load:</td><td colspan="2"></td></tr>
<tr><td>T.C.</td><td>Operating Temp.</td><td>T.C.</td><td>Capacitance change</td></tr>
<tr><td>C0G (NP0)</td><td>- 55 °C to 125 °C at 25 °C</td><td>C0G (NP0)</td><td>Within ± 30 ppm/°C</td></tr>
<tr><td>X7R</td><td>- 55 °C to 125 °C at 25 °C</td><td>X7R</td><td>Within ± 15 %</td></tr>
<tr><td>X5R</td><td>- 55 °C to 85 °C at 25 °C</td><td>X5R</td><td>Within ± 15 %</td></tr>
<tr><td></td><td>Y5V</td><td>- 25 °C to 85 °C at 20 °C</td><td>Y5V</td><td>Within + 30 %/- 80 %</td></tr>
<tr><td>7) Adhesive strength of termination</td><td colspan="2">• Pressurizing force:
0201: 2N
0402 and 0603: 5 N
> 0603: 10 N
• Test time 10 s ± 1 s</td><td colspan="2">• No remarkable damage or removal of the terminations</td></tr>
<tr><td>8) Vibration resistance</td><td colspan="2">• Vibration frequency:
10 Hz/min to 55 Hz/min
• Total amplitude: 1.5 mm
• Test time: 6 h (2 h each in 3 mutually perpendicular directions)</td><td colspan="2">• No remarkable damage
• Capacitance change and Q/DF: to meet initial specification</td></tr>
<tr><td>9) Solderability</td><td colspan="2">• Solder temperature: 235 °C ± 5 °C
• Dipping time: 2 s ± 0.5 s</td><td colspan="2">95 % minimum coverage of all metallized area</td></tr>
</table>

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TEST	PROCEDURE	REQUIREMENTS
10) Bending test	• The middle part of the substrate shall be pressurized by means of the pressurizing rod at a rate of about 1 mm per s until the deflection becomes 1 mm and then the pressure shall be maintained for 5 s ± 1 s • Measurement to be made after keeping at room temperature for 24 h ± 2 h	• No remarkable damage • Capacitance change: C0G (NP0): within ± 5.0 % or ± 0.5 pF whichever is larger X7R, 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 °C ± 5 °C • Dipping time: 10 s ± 1 s • Preheating: 120 °C to 150 °C for 1 min before immerse the capacitor in a eutectic solder • Before initial measurement (class 2 only): Perform 150 °C + 0 °C/ - 10 °C for 1 h and then set for 24 h ± 2 h at room temperature • Measurement to be made after keeping at room temperature for 24 h ± 2 h	• No remarkable damage • Capacitance change: C0G (NP0): within ± 2.5 % or ± 0.25 pF whichever is larger X7R, X5R: within ± 7.5 % Y5V: within ± 20 % • Q/DF, I.R. and dielectric strength: To meet initial requirements • 25 % maximum leaching on each edge
12) Temperature cycle	• Conduct the 5 cycles according to the temperature and time	• No remarkable damage • Capacitance change: C0G (NP0): within ± 2.5 % or ± 0.25 pF whichever is larger X7R, X5R: within ± 7.5 % Y5V: within ± 20 % • Q/DF, I.R. and dielectric strength: To meet initial requirements

Step	Temperature (°C)	Time (min.)
1	Min. operating temp. + 0/- 3	30 ± 3
2	Room temperature	2 ~ 3
3	Max. operating temp. + 3/- 0	30 ± 3
4	Room temperature	2 ~ 3

• Before initial measurement (class 2 only):
Perform 150 °C + 0 °C/- 10 °C for 1 h and then set for 24 h ± 2 h at room temperature
• Measurement to be made after keeping at room temperature for 24 h ± 2 h

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<table>
<tr><th>TEST</th><th>PROCEDURE</th><th>REQUIREMENTS</th></tr>
<tr><td rowspan="2">13) Humidity (damp heat) steady state</td><td rowspan="2">• Test temperature: 40 °C ± 2 °C
• Humidity: 90 % to 95 % RH
• Test time: 500 h + 24 h/- 0 h
• Before measurement (class 2 only): Perform 150 °C + 0 °C/ - 10 °C for 1 h and then set for 24 h ± 2 h at room temperature
• Measurement to be made after keeping at room temperature for 24 h ± 2 h</td><td>
• No remarkable damage
• Capacitance change:
C0G (NP0): within ± 5.0 % or ± 0.5 pF whichever is larger
X7R, X5R: ≥ 10 V within ± 12.5 %; 6.3 V, within ± 25 %
Y5V: ≥ 10 V within ± 30 %, 6.3 V within + 30 %/- 40 %
• Q/DF value:
C0G (NP0): more than 30 pF: Q ≥ 350
10 pF ≤ C ≤ 30 pF: Q ≥ 275 + 2.5 C;
Less than 10 pF: Q ≥ 200 + 10 C
X5R, X7R:
<table>
<tr><th>RATED VOLTAGE</th><th>DF ≤</th><th colspan="2">EXCEPTION OF DF ≤</th></tr>
<tr><td rowspan="3">≥ 50 V</td><td rowspan="3">3 %</td><td>6 %</td><td>0201 (50 V); 0603 ≥ 0.047 µF; 0805 ≥ 0.18 µF; 1206 ≥ 0.47 µF</td></tr>
<tr><td>10 %</td><td>1210 ≥ 4.7 µF</td></tr>
<tr><td>20 %</td><td>0603 ≥ 1 µF; 0805 ≥ 1 µF; 1206 ≥ 2.2 µF; 1210 ≥ 10 µF</td></tr>
<tr><td>35 V</td><td>5 %</td><td>20 %</td><td>0805 ≥ 2.2 µF; 1210 ≥ 10µF</td></tr>
<tr><td rowspan="3">25 V</td><td rowspan="3">5 %</td><td>10 %</td><td>0201 ≥ 0.01 µF; 0805 ≥ 1 µF; 1210 ≥ 10 µF</td></tr>
<tr><td>14 %</td><td>0603 ≥ 0.33 µF; 1206 ≥ 4.7 µF</td></tr>
<tr><td>15 %</td><td>0402 ≥ 0.10 µF; 0603 ≥ 0.47 µF; 0805 ≥ 2.2 µF; 1206 ≥ 6.8 µF; 1210 ≥ 22 µF</td></tr>
<tr><td rowspan="2">16 V</td><td rowspan="2">5 %</td><td>10 %</td><td>0603 ≥ 0.15 µF; 0805 ≥ 0.68 µF; 1206 ≥ 2.2 µF; 1210 ≥ 4.7 µF</td></tr>
<tr><td>15 %</td><td>0201 ≥ 0.01 µF; 0402 ≥ 0.033 µF; 0603 ≥ 0.68 µF; 0805 ≥ 2.2 µF; 1206 ≥ 4.7 µF; 1210 ≥ 22 µF</td></tr>
<tr><td rowspan="2">10 V</td><td rowspan="2">7.5 %</td><td>15 %</td><td>0201 ≥ 0.012 µF; 0402 ≥ 0.33 µF; 0603 ≥ 0.33 µF; 0805 ≥ 2.2 µF; 1206 ≥ 2.2 µF; 1210 ≥ 22 µF</td></tr>
<tr><td>20 %</td><td>0201 ≥ 0.1 µF; 0402 ≥ 1 µF</td></tr>
<tr><td>6.3 V</td><td>15 %</td><td>30 %</td><td>0201 ≥ 0.1 µF; 0402 ≥ 1 µF; 0603 ≥ 10 µF; 0805 ≥ 4.7 µF; 1206 ≥ 47 µF; 1210 ≥ 100 µF</td></tr>
<tr><td>4 V</td><td>20 %</td><td>-</td><td>-</td></tr>
</table>
Y5V:
<table>
<tr><th>RATED VOLTAGE</th><th>DF ≤</th><th colspan="2">EXCEPTION OF DF ≤</th></tr>
<tr><td>≥ 50 V</td><td>7.5 %</td><td>10 %</td><td>0603 ≥ 0.1 µF; 0805 ≥ 0.47 µF; 1206 ≥ 4.7 µF</td></tr>
<tr><td>35 V</td><td>10 %</td><td>-</td><td>-</td></tr>
<tr><td rowspan="2">25 V</td><td rowspan="2">7.5 %</td><td>10 %</td><td>0402 ≥ 0.047 µF; 0603 ≥ 0.1 µF; 0805 ≥ 0.33 µF; 1206 ≥ 1 µF; 1210 ≥ 4.7 µF</td></tr>
<tr><td>15 %</td><td>0402 ≥ 0.068 µF; 0603 ≥ 0.47 µF; 1206 ≥ 4.7 µF; 1210 ≥ 22 µF</td></tr>
<tr><td rowspan="2">16 V
C < 1.0 µF</td><td rowspan="2">10 %</td><td>12.5 %</td><td>0402 ≥ 0.068 µF; 0603 ≥ 0.68 µF</td></tr>
<tr><td>20 %</td><td>0402 ≥ 0.22 µF</td></tr>
<tr><td>16 V
C ≥ 1.0 µF</td><td>12.5 %</td><td>20 %</td><td>0603 ≥ 2.2 µF; 0805 ≥ 3.3 µF; 1206 ≥ 10 µF; 1210 ≥ 22 µF</td></tr>
<tr><td>10 V</td><td>20 %</td><td>30 %</td><td>0402 ≥ 0.47 µF</td></tr>
<tr><td>6.3 V</td><td>30 %</td><td>-</td><td>-</td></tr>
</table>
• I.R.: ≥ 10 V: 1 GΩ or R x C ≥ 50 ΩF whichever is smaller
CLASS 2 (X5R, X7R, Y5V):
<table>
<tr><th>RATED VOLTAGE</th><th>INSULATION RESISTANCE</th></tr>
<tr><td>100 V: X7R</td><td rowspan="7">1 GΩ or R x C ≥ 10 ΩF whichever is less</td></tr>
<tr><td>50 V: 0603 ≥ 1 µF; 0805 ≥ 1 µF; 1206 ≥ 2.2 µF; 1210 ≥ 4.7 µF</td></tr>
<tr><td>35 V: 0805 ≥ 2.2 µF; 1210 ≥ 10 µF</td></tr>
<tr><td>25 V: 0402 ≥ 1 µF; 0603 ≥ 2.2 µF; 0805 ≥ 2.2 µF; 1206 ≥ 10 µF; 1210 ≥ 10 µF</td></tr>
<tr><td>16 V: 0402 ≥ 0.22 µF; 0603 ≥ 1 µF; 0805 ≥ 2.2 µF; 1206 ≥ 10 µF; 1210 ≥ 47 µF</td></tr>
<tr><td>10 V: 0201 ≥ 47 nF; 0402 ≥ 0.47 µF; 0603 ≥ 0.47 µF; 0805 ≥ 2.2 µF; 1206 ≥ 4.7 µF; 1210 ≥ 47 µF</td></tr>
<tr><td>6.3 V; 4 V</td></tr>
</table>
</td></tr>
</table>

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<table>
<tr><th>TEST</th><th>PROCEDURE</th><th>REQUIREMENTS</th></tr>
<tr><td>14) Humidity (damp heat) load</td><td>• Test temperature: 40 °C ± 2 °C
• Humidity: 90 % ~ 95 % RH
• Test time: 500 h + 24 h/- 0 h
• To apply voltage: rated voltage (max. 500 V)
• Before initial measurement (class 2 only): Perform 150 °C + 0 °C/- 10 °C for 1h and then set for 24 h ± 2 h at room temperature
• Measurement to be made after keeping at room temperature for 24 h ± 2 h</td><td>
• No remarkable damage
• Capacitance change:
C0G (NP0): within± 7.5 % or ± 0.75 pF whichever is larger.
X7R, X5R: ≥ 10 V within ± 12.5 %; 6.3 V, with ± 25 %
Y5V: ≥ 10 V within ± 30 %; 6.3 V, within + 30 %/- 40 %
• Q/DF value: C0G (NP0)
Cap ≥ 30 pF: Q ≥ 200;
Cap < 30 pF: Q ≥ 100 + 10/3 C
X5R, X7R:
<table>
<tr><th>RATED VOLTAGE</th><th>DF ≤</th><th colspan="2">EXCEPTION OF DF ≤</th></tr>
<tr><td rowspan="3">≥ 50 V</td><td rowspan="3">3 %</td><td>6 %</td><td>0201 (50 V); 0603 ≥ 0.047 µF; 0805 ≥ 0.18 µF; 1206 ≥ 0.47 µF</td></tr>
<tr><td>10 %</td><td>1210 ≥ 4.7 µF</td></tr>
<tr><td>20 %</td><td>0603 ≥ 1 µF; 0805 ≥ 1 µF; 1206 ≥ 2.2 µF; 1210 ≥ 10 µF</td></tr>
<tr><td>35 V</td><td>5 %</td><td>20 %</td><td>0805 ≥ 2.2 µF; 1210 ≥ 10 µF</td></tr>
<tr><td rowspan="3">25 V</td><td rowspan="3">5 %</td><td>10 %</td><td>0201 ≥ 0.01 µF; 0805 ≥ 1 µF; 1210 ≥ 10 µF</td></tr>
<tr><td>14 %</td><td>0603 ≥ 0.33 µF; 1206 ≥ 4.7 µF</td></tr>
<tr><td>15 %</td><td>0402 ≥ 0.10 µF; 0603 ≥ 0.47 µF; 0805 ≥ 2.2 µF; 1206 ≥ 6.8 µF; 1210 ≥ 22 µF</td></tr>
<tr><td rowspan="2">16 V</td><td rowspan="2">5 %</td><td>10 %</td><td>0603 ≥ 0.15 µF; 0805 ≥ 0.68 µF; 1206 ≥ 2.2 µF; 1210 ≥ 4.7µF</td></tr>
<tr><td>15 %</td><td>0201 ≥ 0.01 µF; 0402 ≥ 0.033 µF; 0603 ≥ 0.68 µF; 0805 ≥ 2.2 µF; 1206 ≥ 4.7 µF; 1210 ≥ 22 µF</td></tr>
<tr><td rowspan="2">10 V</td><td rowspan="2">7.5 %</td><td>15 %</td><td>0201 ≥ 0.012 µF; 0402 ≥ 0.33 µF; 0603 ≥ 0.33 µF; 0805 ≥ 2.2 µF; 1206 ≥ 2.2 µF; 1210 ≥ 22 µF</td></tr>
<tr><td>20 %</td><td>0201 ≥ 0.1 µF; 0402 ≥ 1 µF</td></tr>
<tr><td>6.3 V</td><td>15 %</td><td>30 %</td><td>0201 ≥ 0.1 µF; 0402 ≥ 1 µF; 0603 ≥ 10 µF; 0805 ≥ 4.7 µF; 1206 ≥ 47 µF; 1210 ≥ 100 µF</td></tr>
<tr><td>4 V</td><td>20 %</td><td>-</td><td>-</td></tr>
</table>
Y5V:
<table>
<tr><th>RATED VOLTAGE</th><th>DF ≤</th><th colspan="2">EXCEPTION OF DF ≤</th></tr>
<tr><td>≥ 50 V</td><td>7.5 %</td><td>10 %</td><td>0603 ≥ 0.1 µF; 0805 ≥ 0.47 µF; 1206 ≥ 4.7 µF</td></tr>
<tr><td>35 V</td><td>10 %</td><td>-</td><td>-</td></tr>
<tr><td rowspan="2">25 V</td><td rowspan="2">7.5 %</td><td>10 %</td><td>0402 ≥ 0.047 µF; 0603 ≥ 0.1 µF; 0805 ≥ 0.33 µF; 1206 ≥ 1 µF; 1210 ≥ 4.7 µF</td></tr>
<tr><td>15 %</td><td>0402 ≥ 0.068 µF; 0603 ≥ 0.47 µF; 1206 ≥ 4.7 µF; 1210 ≥ 22 µF</td></tr>
<tr><td rowspan="2">16 V
C < 1.0 µF</td><td rowspan="2">10 %</td><td>12.5 %</td><td>0402 ≥ 0.068 µF; 0603 ≥ 0.68 µF</td></tr>
<tr><td>20 %</td><td>0402 ≥ 0.22 µF</td></tr>
<tr><td>16 V
C ≥ 1.0 µF</td><td>12.5 %</td><td>20 %</td><td>0603 ≥ 2.2 µF; 0805 ≥ 3.3 µF; 1206 ≥ 10 µF; 1210 ≥ 22 µF</td></tr>
<tr><td>10 V</td><td>20 %</td><td>30 %</td><td>0402 ≥ 0.47 µF</td></tr>
<tr><td>6.3 V</td><td>30 %</td><td>-</td><td>-</td></tr>
</table>
• I.R.: ≥ 10 V: 500 MΩ or 25 ΩF whichever is smaller
CLASS 2 (X5R, X7R, Y5V):
<table>
<tr><th>RATED VOLTAGE</th><th>INSULATION RESISTANCE</th></tr>
<tr><td>100 V: X7R</td><td rowspan="7">500 MΩ or
R x C ≥ 5 ΩF
whichever is less</td></tr>
<tr><td>50 V: 0603 ≥ 1 µF; 0805 ≥ 1 µF; 1206 ≥ 2.2 µF; 1210 ≥ 4.7 µF</td></tr>
<tr><td>35 V: 0805 ≥ 2.2 µF; 1210 ≥ 10 µF</td></tr>
<tr><td>25 V: 0402 ≥ 1 µF; 0603 ≥ 2.2 µF; 0805 ≥ 2.2 µF; 1206 ≥ 10 µF; 1210 ≥ 10 µF</td></tr>
<tr><td>16 V: 0402 ≥ 0.22 µF; 0603 ≥ 1 µF; 0805 ≥ 2.2 µF; 1206 ≥ 10 µF; 1210 ≥ 47 µF</td></tr>
<tr><td>10 V: 0201 ≥ 47 nF; 0402 ≥ 0.47 µF; 0603 ≥ 0.47 µF; 0805 ≥ 2.2 µF; 1206 ≥ 4.7 µF; 1210 ≥ 47 µF</td></tr>
<tr><td>6.3 V; 4 V</td></tr>
</table>
</td></tr>
</table>

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TEST: 15) High temp. load (endurance)

PROCEDURE

- Test temperature:
  C0G (NP0), X7R/X7E: 125 °C ± 3 °C
  X5R, Y5V: 85 °C ± 3 °C
- To apply voltage:

(1.1) 100 % of rated voltage for below range

SIZE	DIELECTRIC	RATED VOLTAGE	CAP. RANGE
0201	X5R/X7R	6.3 V, 10 V	C ≥ 0.1 µF
0402	X5R/X7R	6.3 V, 10 V	C ≥ 1 µF
0603	X5R/X7R	6.3 V, 10 V	C ≥ 4.7 µF
0805	X5R/X7R	6.3 V	C ≥ 22 µF
1206	X5R/X7R	6.3 V	C ≥ 47 µF

(1.2) 6.3 V or C ≥ 10 µF: 150 % of rated voltage

(2)10 V ≤ U_R < 500 V: 200 % of rated voltage

150 % of rated voltage for below range:

SIZE	DIELECTRIC	RATED VOLTAGE	CAP. RANGE
0402	X5R/X7R	10 V, 16 V, 25 V	C ≥ 0.22 µF
	Y5V	16 V	C ≥ 0.47 µF
0603	X5R/X7R	10 V, 16 V	C ≥ 1.0 µF
	Y5V	16 V	C ≥ 2.2 µF
0805	X5R/X7R	10 V	C ≥ 4.7 µF
	Y5V	16 V	C ≥ 4.7 µF

(3) 500 V: 150 % of rated voltage
(4) U_R ≥ 630 V: 120 % of rated voltage

- Test time: 1000 h + 24 h/- 0 h
- Before measurement (class 2 only): Perform 150 °C + 0 °C/- 10 °C for 1 h and then set for 24 h ± 2 h at room temperature
- Measurement to be made after keeping at room temperature for 24 h ± 2 h

REQUIREMENTS

- No remarkable damage
- Capacitance change:
  C0G (NP0): ± 3.0 % or ± 0.3 pF whichever is larger.
  X7R, X5R: ≥ 10 V within ± 12.5 %; 6.3 V, with ± 25 %
  Y5V: ≥ 10 V within ± 30 %; 6.3 V, within + 30 % to - 40 %
- Q/DF value:
  C0G (NP0): More than 30 pF, Q ≥ 350
  10 pF ≤ C < 30 pF: Q ≥ 275 C + 2.5 C;
  Less than 10 pF: Q ≥ 200 C + 10 C

X5R, X7R:

RATED VOLTAGE	DF ≤	EXCEPTION OF DF ≤	
≥ 50 V	3 %	6 %	0201 (50 V); 0603 ≥ 0.047 µF; 0805 ≥ 0.18 µF; 1206 ≥ 0.47 µF
		10 %	1210 ≥ 4.7 µF
		20 %	0603 ≥ 1 µF; 0805 ≥ 1 µF; 1206 ≥ 2.2 µF; 1210 ≥ 10 µF
35 V	5 %	20 %	0805 ≥ 2.2 µF; 1210 ≥ 10 µF
25 V	5 %	10 %	0201 ≥ 0.01 µF; 0805 ≥ 1 µF; 1210 ≥ 10 µF
		14 %	0603 ≥ 0.33 µF; 1206 ≥ 4.7 µF
		15 %	0402 ≥ 0.10 µF; 0603 ≥ 0.47 µF; 0805 ≥ 2.2 µF; 1206 ≥ 6.8 µF; 1210 ≥ 22 µF
16 V	5 %	10 %	0603 ≥ 0.15 µF; 0805 ≥ 0.68 µF; 1206 ≥ 2.2 µF; 1210 ≥ 4.7 µF
		15 %	0201 ≥ 0.01 µF; 0402 ≥ 0.033 µF; 0603 ≥ 0.68 µF; 0805 ≥ 2.2 µF; 1206 ≥ 4.7 µF; 1210 ≥ 22 µF
10 V	7.5 %	15 %	0201 ≥ 0.012 µF; 0402 ≥ 0.33 µF; 0603 ≥ 0.33 µF; 0805 ≥ 2.2 µF; 1206 ≥ 2.2 µF; 1210 ≥ 22 µF
		20 %	0201 ≥ 0.1 µF; 0402 ≥ 1 µF
6.3 V	15 %	30 %	0201 ≥ 0.1 µF; 0402 ≥ 1 µF; 0603 ≥ 10 µF; 0805 ≥ 4.7 µF; 1206 ≥ 47 µF; 1210 ≥ 100 µF
4 V	20 %	-	-

Y5V:

RATED VOLTAGE	DF ≤	EXCEPTION OF DF ≤	
≥ 50 V	7.5 %	10 %	0603 ≥ 0.1 µF; 0805 ≥ 0.47 µF; 1206 ≥ 4.7 µF
35 V	10 %	-	-
25 V	7.5 %	10 %	0402 ≥ 0.047 µF; 0603 ≥ 0.1 µF; 0805 ≥ 0.33 µF; 1206 ≥ 1 µF; 1210 ≥ 4.7 µF
		15 %	0402 ≥ 0.068 µF; 0603 ≥ 0.47 µF; 1206 ≥ 4.7 µF; 1210 ≥ 22 µF
16 V C < 1.0 µF	10 %	12.5 %	0402 ≥ 0.068 µF; 0603 ≥ 0.68 µF
		20 %	0402 ≥ 0.22 µF
16 V C ≥ 1.0 µF	12.5 %	20 %	0603 ≥ 2.2 µF; 0805 ≥ 3.3 µF; 1206 ≥ 10 µF; 1210 ≥ 22 µF
10 V	20 %	30 %	0402 ≥ 0.47 µF
6.3 V	30 %	-	-

- I. R.: ≥ 10 V: 1 GΩ or 50 ΩF whichever is smaller

CLASS 2 (X5R, X7R, Y5V):

RATED VOLTAGE	INSULATION RESISTANCE
100 V: X7R	1 GΩ or R x C ≥ 10 ΩF whichever is less
50 V: 0603 ≥ 1 µF; 0805 ≥ 1 µF; 1206 ≥ 2.2 µF; 1210 ≥ 4.7 µF	
35 V: 0805 ≥ 2.2 µF; 1210 ≥ 10 µF	
25 V: 0402 ≥ 1 µF; 0603 ≥ 2.2 µF; 0805 ≥ 2.2 µF; 1206 ≥ 10 µF; 1210 ≥ 10 µF	
16 V: 0402 ≥ 0.22 µF; 0603 ≥ 1 µF; 0805 ≥ 2.2 µF; 1206 ≥ 10 µF; 1210 ≥ 47 µF	
10 V: 0201 ≥ 47 nF; 0402 ≥ 0.47 µF; 0603 ≥ 0.47 µF; 0805 ≥ 2.2 µF; 1206 ≥ 4.7 µF; 1210 ≥ 47 µF	
6.3 V; 4 V	