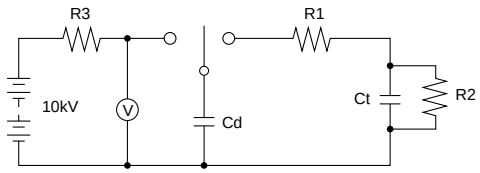
Safety Standard Certified Type GC/GD/GF/GB Specifications and Test Methods

<table>
<tr><th>No.</th><th colspan="2">Item</th><th>Specifications</th><th>Test Method</th></tr>
<tr><td>1</td><td colspan="2">Operating Temperature Range</td><td>−55 to +125℃</td><td>−</td></tr>
<tr><td>2</td><td colspan="2">Appearance</td><td>No defects or abnormalities</td><td>Visual inspection</td></tr>
<tr><td>3</td><td colspan="2">Dimensions</td><td>Within the specified dimensions</td><td>Using calipers and micrometers</td></tr>
<tr><td>4</td><td colspan="2">Dielectric Strength</td><td>No defects or abnormalities</td><td>No failure should be observed when voltage in the table is applied between the terminations for 60±1 sec., provided the charge/discharge current is less than 50mA.
<table><tr><th></th><th>Test Voltage</th></tr><tr><td>Type GB</td><td>DC1075V</td></tr><tr><td>Type GC/GD</td><td>AC1500V (r.m.s.)</td></tr><tr><td>Type GF</td><td>AC2000V (r.m.s.)</td></tr></table></td></tr>
<tr><td>5</td><td colspan="2">Pulse Voltage (Application: Type GD/GF)</td><td>No self healing breakdowns or flash-overs have taken place in the capacitor.</td><td>10 impulses of alternating polarity are subjected.
(5 impulses for each polarity)
The interval between impulses is 60 sec.
Applied Pulse: 1.2/50μs
Applied Voltage: 2.5kVo-p</td></tr>
<tr><td>6</td><td colspan="2">Insulation Resistance (I.R.)</td><td>More than 6,000MΩ</td><td>The insulation resistance should be measured with DC500±50V and within 60±5 sec. of charging.</td></tr>
<tr><td>7</td><td colspan="2">Capacitance</td><td>Within the specified tolerance</td><td rowspan="2">The capacitance/Q/D.F. should be measured at a frequency of 1±0.2kHz (SL char.: 1±0.2MHz) and a voltage of AC1±0.2V (r.m.s.)</td></tr>
<tr><td>8</td><td colspan="2">Dissipation Factor (D.F.)
Q</td><td><table><tr><th>Char.</th><th>Specification</th></tr><tr><td>X7R</td><td>D.F.≦0.025</td></tr><tr><td>SL</td><td>Q≧400+20C*2 (C<30pF)
Q≧1000 (C≧30pF)</td></tr></table></td></tr>
<tr><td>9</td><td colspan="2">Capacitance Temperature Characteristics</td><td><table><tr><th>Char.</th><th>Capacitance Change</th></tr><tr><td>X7R</td><td>Within ±15%</td></tr></table>Temperature characteristic guarantee is −55 to +125℃
<table><tr><th>Char.</th><th>Temperature Coefficient</th></tr><tr><td>SL</td><td>+350 to −1000ppm/℃</td></tr></table>Temperature characteristic guarantee is +20 to +85℃</td><td>The capacitance measurement should be made at each step specified in the Table.
<table><tr><th>Step</th><th>Temperature (℃)</th></tr><tr><td>1</td><td>25±2 (20±2 for SL char.)</td></tr><tr><td>2</td><td>Min. Operating Temp.±3</td></tr><tr><td>3</td><td>25±2 (20±2 for SL char.)</td></tr><tr><td>4</td><td>Max. Operating Temp.±2</td></tr><tr><td>5</td><td>25±2 (20±2 for SL char.)</td></tr></table>SL char. :
The capacitance should be measured at even 85℃ between step 3 and step 4.
•Pretreatment for X7R char.
Perform a heat treatment at 150$^{+\ 0}_{-10}$℃ for 60±5 min. and then let sit for 24±2 hrs. at room condition.*1</td></tr>
<tr><td rowspan="3">10</td><td rowspan="3">Discharge Test (Application: Type GC)</td><td>Appearance</td><td>No defects or abnormalities</td><td rowspan="3">As in Fig., discharge is made 50 times at 5 sec. intervals from the capacitor (Cd) charged at DC voltage of specified.
 

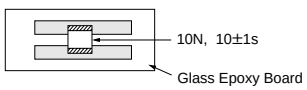
Ct: Capacitor under test Cd: 0.001μF
R1: 1,000Ω R2: 100MΩ R3: Surge resistance</td></tr>
<tr><td>I.R.</td><td>More than 1,000MΩ</td></tr>
<tr><td>Dielectric Strength</td><td>In accordance with item No.4</td></tr>
<tr><td>11</td><td colspan="2">Adhesive Strength of Termination</td><td>No removal of the terminations or other defect should occur.</td><td>Solder the capacitor to the testing jig (glass epoxy board) shown in Fig. 1.
Then apply 10N force in the direction of the arrow. The soldering should be done using the reflow method and should be conducted with care so that the soldering is uniform and free of defects such as heat shock.
 

Fig. 1</td></tr>
</table>

*1 "Room condition" Temperature: 15 to 35℃, Relative humidity: 45 to 75%, Atmospheric pressure: 86 to 106kPa
*2 "C" expresses nominal capacitance value (pF).

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Safety Standard Certified Type GC/GD/GF/GB Specifications and Test Methods

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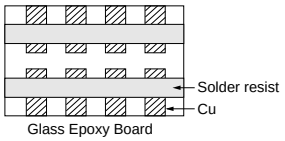
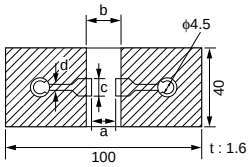
<table>
<tr><th>No.</th><th colspan="2">Item</th><th>Specifications</th><th>Test Method</th></tr>
<tr><td rowspan="3">12</td><td rowspan="3">Vibration Resistance</td><td>Appearance</td><td>No defects or abnormalities</td><td rowspan="3">Solder the capacitor to the test jig (glass epoxy board).
The capacitor should be subjected to a simple harmonic motion having a total amplitude of 1.5mm, the frequency being varied uniformly between the approximate limits of 10 and 55Hz. The frequency range, from 10 to 55Hz and return to 10Hz, should be traversed in approximately 1 min. This motion should be applied for a period of 2 hrs. in each of 3 mutually perpendicular directions (total of 6 hrs.).
 
</td></tr>
<tr><td>Capacitance</td><td>Within the specified tolerance</td></tr>
<tr><td>D.F.
Q</td><td><table><tr><th>Char.</th><th>Specification</th></tr><tr><td>X7R</td><td>D.F.≦0.025</td></tr><tr><td>SL</td><td>Q≧400+20C*2 (C<30pF)
Q≧1000 (C≧30pF)</td></tr></table></td></tr>
<tr><td>13</td><td colspan="2">Deflection</td><td>No marking defects
 

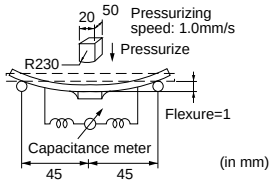
Fig. 2
<table><tr><th rowspan="2">L×W (mm)</th><th colspan="4">Dimension (mm)</th></tr><tr><th>a</th><th>b</th><th>c</th><th>d</th></tr><tr><td>4.5×2.0</td><td>3.5</td><td>7.0</td><td>2.4</td><td rowspan="4">1.0</td></tr><tr><td>4.5×3.2</td><td>3.5</td><td>7.0</td><td>3.7</td></tr><tr><td>5.7×2.8</td><td>4.5</td><td>8.0</td><td>3.2</td></tr><tr><td>5.7×5.0</td><td>4.5</td><td>8.0</td><td>5.6</td></tr></table></td><td>Solder the capacitor to the testing jig (glass epoxy board) shown in Fig. 2.
Then apply a force in the direction shown in Fig. 3. The soldering should be done using the reflow method and should be conducted with care so that the soldering is uniform and free of defects such as heat shock.
 

Fig. 3</td></tr>
<tr><td>14</td><td colspan="2">Solderability of Termination</td><td>75% of the terminations are to be soldered evenly and continuously.</td><td>Immerse the capacitor in a solution of ethanol (JIS-K-8101) and rosin (JIS-K-5902) (25% rosin in weight proportion).
Immerse in solder solution for 2±0.5 sec.
Immersing speed: 25±2.5mm/s
Temp. of solder: 245±5°C Lead Free Solder (Sn-3.0Ag-0.5Cu)
235±5°C H60A or H63A Eutectic Solder</td></tr>
<tr><td rowspan="4">15</td><td rowspan="4">Resistance to Soldering Heat</td><td>Appearance</td><td>No marking defects</td><td rowspan="4">Preheat the capacitor as in table. Immerse the capacitor in solder solution at 260±5℃ for 10±1 sec. Let sit at room condition*1 for 24±2 hrs., then measure.
•Immersing speed: 25±2.5mm/s
•Pretreatment for X7R char.
Perform a heat treatment at 150^{+}_{-10}℃ for 60±5 min. and then let sit for 24±2 hrs. at room condition.*1

*Preheating
<table><tr><th>Step</th><th>Temperature</th><th>Time</th></tr><tr><td>1</td><td>100 to 120℃</td><td>1 min.</td></tr><tr><td>2</td><td>170 to 200℃</td><td>1 min.</td></tr></table></td></tr>
<tr><td>Capacitance Change</td><td><table><tr><th>Char.</th><th>Capacitance Change</th></tr><tr><td>X7R</td><td>Within ±10%</td></tr><tr><td>SL</td><td>Within ±2.5% or ±0.25pF (Whichever is larger)</td></tr></table></td></tr>
<tr><td>I.R.</td><td>More than 1,000MΩ</td></tr>
<tr><td>Dielectric Strength</td><td>In accordance with item No.4</td></tr>
</table>

*1 "Room condition" Temperature: 15 to 35℃, Relative humidity: 45 to 75%, Atmospheric pressure: 86 to 106kPa
*2 "C" expresses nominal capacitance value (pF).

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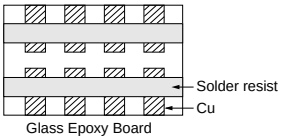
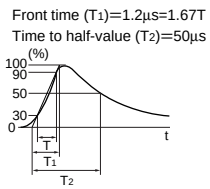
<table>
<tr><th>No.</th><th colspan="2">Item</th><th>Specifications</th><th>Test Method</th></tr>
<tr><td rowspan="5">16</td><td rowspan="5">Temperature Cycle</td><td>Appearance</td><td>No marking defects</td><td rowspan="5">Fix the capacitor to the supporting jig (glass epoxy board) shown in Fig. 4.
Perform the 5 cycles according to the 4 heat treatments listed in the following table.
Let sit for 24±2 hrs. at room condition,*1 then measure.
<table><tr><th>Step</th><th>Temperature (℃)</th><th>Time (min.)</th></tr><tr><td>1</td><td>Min. Operating Temp.±3</td><td>30±3</td></tr><tr><td>2</td><td>Room Temp.</td><td>2 to 3</td></tr><tr><td>3</td><td>Max. Operating Temp.±2</td><td>30±3</td></tr><tr><td>4</td><td>Room Temp.</td><td>2 to 3</td></tr></table>•Pretreatment for X7R char.
Perform a heat treatment at 150$^{+0}_{-10}$℃ for 60±5 min. and then let sit for 24±2 hrs. at room condition.*1
 

Fig. 4</td></tr>
<tr><td>Capacitance Change</td><td><table><tr><th>Char.</th><th>Capacitance Change</th></tr><tr><td>X7R</td><td>Within ±15%</td></tr><tr><td>SL</td><td>Within ±2.5% or ±0.25pF (Whichever is larger)</td></tr></table></td></tr>
<tr><td>D.F.
Q</td><td><table><tr><th>Char.</th><th>Specification</th></tr><tr><td>X7R</td><td>D.F.≦0.05</td></tr><tr><td>SL</td><td>Q≧400+20C*2 (C<30pF)
Q≧1000 (C≧30pF)</td></tr></table></td></tr>
<tr><td>I.R.</td><td>More than 3,000MΩ</td></tr>
<tr><td>Dielectric Strength</td><td>In accordance with item No.4</td></tr>
<tr><td rowspan="5">17</td><td rowspan="5">Humidity (Steady State)</td><td>Appearance</td><td>No marking defects</td><td rowspan="5">Before this test, the test shown in the following is performed.
·Item 11 Adhesive Strength of Termination (applied force is 5N)
·Item 13 Deflection

Let the capacitor sit at 40±2℃ and relative humidity of 90 to 95% for 500$^{+24}_{0}$ hrs.
Remove and let sit for 24±2 hrs. at room condition,*1 then measure.
•Pretreatment for X7R char.
Perform a heat treatment at 150$^{+0}_{-10}$℃ for 60±5 min. and then let sit for 24±2 hrs. at room condition.*1</td></tr>
<tr><td>Capacitance Change</td><td><table><tr><th>Char.</th><th>Capacitance Change</th></tr><tr><td>X7R</td><td>Within ±15%</td></tr><tr><td>SL</td><td>Within ±5.0% or ±0.5pF (Whichever is larger)</td></tr></table></td></tr>
<tr><td>D.F.
Q</td><td><table><tr><th>Char.</th><th>Specification</th></tr><tr><td>X7R</td><td>D.F.≦0.05</td></tr><tr><td>SL</td><td>Q≧275+5/2C*2 (C<30pF)
Q≧350 (C≧30pF)</td></tr></table></td></tr>
<tr><td>I.R.</td><td>More than 3,000MΩ</td></tr>
<tr><td>Dielectric Strength</td><td>In accordance with item No.4</td></tr>
<tr><td rowspan="6">18</td><td rowspan="6">Life</td><td>Appearance</td><td>No marking defects</td><td rowspan="6">Before this test, the test shown in the following is performed.
·Item 11 Adhesive Strength of Termination (apply force is 5N)
·Item 13 Deflection

Impulse Voltage
Each individual capacitor should be subjected to a 2.5kV (Type GC/GF: 5kV) Impulse (the voltage value means zero to peak) for three times. Then the capacitors are applied to life test.
 

Apply voltage as in Table for 1,000 hrs. at 125$^{+2}_{-0}$℃, relative humidity 50% max.
<table><tr><th>Type</th><th>Applied Voltage</th></tr><tr><td>GB</td><td>AC312.5V (r.m.s.), except that once each hour the voltage is increased to AC1,000V (r.m.s.) for 0.1 sec.</td></tr><tr><td>GC
GF
GD</td><td>AC425V (r.m.s.), except that once each hour the voltage is increased to AC1,000V (r.m.s.) for 0.1 sec.</td></tr></table>Let sit for 24±2 hrs. at room condition,*1 then measure.
•Pretreatment for X7R char.
Perform a heat treatment at 150$^{+0}_{-10}$℃ for 60±5 min. and then let sit for 24±2 hrs. at room condition.*1</td></tr>
<tr><td>Capacitance Change</td><td><table><tr><th>Char.</th><th>Capacitance Change</th></tr><tr><td>X7R</td><td>Within ±20%</td></tr><tr><td>SL</td><td>Within ±3.0% or ±0.3pF (Whichever is larger)</td></tr></table></td></tr>
<tr><td>D.F.
Q</td><td><table><tr><th>Char.</th><th>Specification</th></tr><tr><td>X7R</td><td>D.F.≦0.05</td></tr><tr><td>SL</td><td>Q≧275+5/2C*2 (C<30pF)
Q≧350 (C≧30pF)</td></tr></table></td></tr>
<tr><td>I.R.</td><td>More than 3,000MΩ</td></tr>
<tr><td>Dielectric Strength</td><td>In accordance with item No.4</td></tr>
</table>

*1 "Room condition" Temperature: 15 to 35℃, Relative humidity: 45 to 75%, Atmospheric pressure: 86 to 106kPa
*2 "C" expresses nominal capacitance value (pF).

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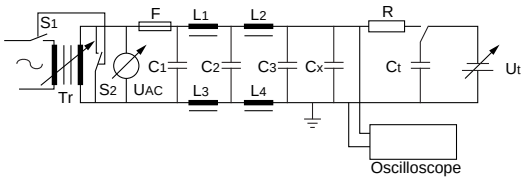
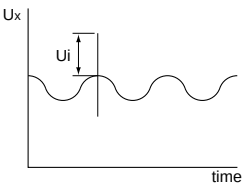
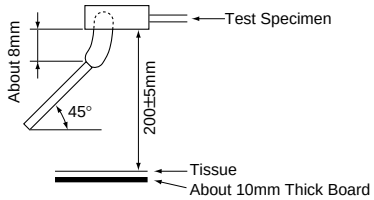
<table>
<tr><th>No.</th><th colspan="2">Item</th><th>Specifications</th><th>Test Method</th></tr>
<tr><td rowspan="5">19</td><td rowspan="5">Humidity Loading</td><td>Appearance</td><td>No marking defects</td><td rowspan="5">Before this test, the test shown in the following is performed.
·Item 11 Adhesive Strength of Termination (apply force is 5N)
·Item 13 Deflection

Apply the rated voltage at 40±2℃ and relative humidity of 90 to 95% for 500$^{+24}_{0}$hrs. Remove and let sit for 24±2 hrs. at room condition,*1 then measure.
•Pretreatment for X7R char.
Perform a heat treatment at 150$^{+0}_{-10}$℃ for 60±5 min. and then let sit for 24±2 hrs. at room condition.*1</td></tr>
<tr><td>Capacitance Change</td><td><table><tr><th>Char.</th><th>Capacitance Change</th></tr><tr><td>X7R</td><td>Within ±15%</td></tr><tr><td>SL</td><td>Within ±5.0% or ±0.5pF
(Whichever is larger)</td></tr></table></td></tr>
<tr><td>D.F.
Q</td><td><table><tr><th>Char.</th><th>Specification</th></tr><tr><td>X7R</td><td>D.F.≦0.05</td></tr><tr><td>SL</td><td>Q≧275+5/2C*2 (C<30pF)
Q≧350 (C≧30pF)</td></tr></table></td></tr>
<tr><td>I.R.</td><td>More than 3,000MΩ</td></tr>
<tr><td>Dielectric Strength</td><td>In accordance with item No.4</td></tr>
<tr><td>20</td><td colspan="2">Active Flammability</td><td>The cheesecloth should not be on fire.</td><td>The capacitor should be individually wrapped in at least one but not more than two complete layers of cheesecloth. The capacitor should be subjected to 20 discharges. The interval between successive discharges should be 5 sec. The U_{AC} should be maintained for 2 min. after the last discharge.
 

$C_{1,2}$: 1μF±10% C_3 : 0.033μF±5% 10kV
$L_{1\ to\ 4}$: 1.5mH±20% 16A Rod core choke
C_t : 3μF±5% 10kV R : 100Ω±2%
C_x : Capacitor under test U_{AC} : U_R±5%
F : Fuse, Rated 16A U_R : Rated Voltage
U_t : Voltage applied to C_t
 

<table><tr><th>Type</th><th>Ui</th></tr><tr><td>GD, GB</td><td>2.5kV</td></tr><tr><td>GC, GF</td><td>5kV</td></tr></table></td></tr>
<tr><td>21</td><td colspan="2">Passive Flammability</td><td>The burning time should not exceed 30 sec.
The tissue paper should not ignite.</td><td>The capacitor under test should be held in the flame in the position which best promotes burning. Each specimen should be exposed to the flame only once. Time of exposure to flame: 30 sec.
Length of flame : 12±1mm
Gas burner : Length 35mm min.
Inside Dia. 0.5±0.1mm
Outside Dia. 0.9mm max.
Gas : Butane gas Purity 95% min.
 
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