GRM Series Specifications and Test Methods (2)

<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>B1, B3, F1: –25 to +85°C
R1, R7, C7, D7, E7: –55 to +125°C
C6, R6: –55 to +85°C
F5: –30 to +85°C
C8, D8: –55 to +105°C,</td><td>Reference temperature: 25°C
(B1, B3, R1, F1: 20°C)</td></tr>
<tr><td>2</td><td colspan="2">Rated Voltage</td><td>See the previous pages.</td><td>The rated voltage is defined as the maximum voltage which may be applied continuously to the capacitor.
When AC voltage is superimposed on DC voltage, V^{P-P} or V^{O-P}, whichever is larger, should be maintained within the rated voltage range.</td></tr>
<tr><td>3</td><td colspan="2">Appearance</td><td>No defects or abnormalities</td><td>Visual inspection</td></tr>
<tr><td>4</td><td colspan="2">Dimensions</td><td>Within the specified dimensions</td><td>Using calipers</td></tr>
<tr><td>5</td><td colspan="2">Dielectric Strength</td><td>No defects or abnormalities</td><td>No failure should be observed when 250% of the rated voltage is applied between the terminations for 1 to 5 seconds, provided the charge/discharge current is less than 50mA.</td></tr>
<tr><td>6</td><td colspan="2">Insulation Resistance</td><td>More than 50Ω · F</td><td>The insulation resistance should be measured with a DC voltage not exceeding the rated voltage at reference temperature and 75%RH max. and within 1 minutes of charging, provided the charge/discharge current is less than 50mA.</td></tr>
<tr><td>7</td><td colspan="2">Capacitance</td><td>Within the specified tolerance
*Table 1
<table>
<tr><td>GRM155</td><td>B3/R6</td><td>1A</td><td>124 to 105</td></tr>
<tr><td>GRM185</td><td>B3/R6</td><td>1C/1A</td><td>105</td></tr>
<tr><td>GRM185</td><td>C8/D7</td><td>1A</td><td>105</td></tr>
<tr><td>GRM188</td><td>B3/R6</td><td>1C/1A</td><td>225</td></tr>
<tr><td>GRM188</td><td>R7/C8</td><td>1A</td><td>225</td></tr>
<tr><td>GRM188</td><td>B3/R6</td><td>1A</td><td>335</td></tr>
<tr><td>GRM219</td><td>B3/R6</td><td>1C/1A</td><td>475, 106</td></tr>
<tr><td>GRM219</td><td>C8</td><td>1A</td><td>475</td></tr>
<tr><td>GRM21B</td><td>B3/R6</td><td>1C/1A</td><td>106</td></tr>
<tr><td>GRM21B</td><td>R7/C8</td><td>1A</td><td>106</td></tr>
<tr><td>GRM319</td><td>B3/R6</td><td>1C/1A</td><td>106</td></tr>
</table></td><td rowspan="2">The capacitance/D.F. should be measured at reference temperature at the frequency and voltage shown in the table.
<table>
<tr><th>Capacitance</th><th>Frequency</th><th>Voltage</th></tr>
<tr><td>C≦10μF (10V min.)*1</td><td>1±0.1kHz</td><td>1.0±0.2Vrms</td></tr>
<tr><td>C≦10μF (6.3V max.)</td><td>1±0.1kHz</td><td>0.5±0.1Vrms</td></tr>
<tr><td>C>10μF</td><td>120±24Hz</td><td>0.5±0.1Vrms</td></tr>
</table>
*1 However the voltage is 0.5±0.1Vrms about Table 1 items on the left side.</td></tr>
<tr><td>8</td><td colspan="2">Dissipation Factor (D.F.)</td><td>B1, B3, R6*2, R7*3, C7, C8, D8*2: 0.1 max.
F1, F5: 0.2 max.</td></tr>
<tr><td rowspan="2">9</td><td rowspan="2">Capacitance Temperature Characteristics</td><td>No bias</td><td>B1, B3 : Within ±10% (–25 to +85°C)
F1 : Within +30/–80% (–25 to +85°C)
R6 : Within ±15% (–55 to +85°C)
R1, R7 : Within ±15% (–55 to +125°C)
F5 : Within +22/–82% (–30 to +85°C)
C6 : Within ±22% (–55 to +85°C)
C7 : Within ±22% (–55 to +125°C)
C8 : Within ±22% (–55 to +105°C)
D7 : Within +22/–33% (–55 to +125°C)
E7 : Within +22/–56% (–55 to +125°C)
D8 : Within +22/–33% (–55 to +105°C)</td><td rowspan="2">The capacitance change should be measured after 5 min. at each specified temp. stage.
The ranges of capacitance change compared with the reference temperature value over the temperature ranges shown in the table should be within the specified ranges.*
In case of applying voltage, the capacitance change should be measured after 1 more min. with applying voltage in equilibration of each temp. stage.
*GRM43 B1/R6 0J/1A 336/476 only: 1.0±0.2Vrms
<table>
<tr><th>Step</th><th>Temperature (°C)</th><th>Applying Voltage (V)</th></tr>
<tr><td>1</td><td>25±2 (for R6, R7, C6, C7, C8, D7, D8, E7, F5)
20±2 (for B1, B3, F1, R1)</td><td rowspan="4">No bias</td></tr>
<tr><td>2</td><td>–55±3 (for R1, R6, R7, C6, C7, C8, D7, D8, E7)
–30±3 (for F5)
–25±3 (for B1, B3, F1)</td></tr>
<tr><td>3</td><td>25±2 (for R6, R7, C6, C7, C8, D7, D8, E7, F5)
20±2 (for B1, B3, F1, R1)</td></tr>
<tr><td>4</td><td>125±3 (for R1, R7, C7, D7, E7)
105±3 (for C8, D8)
85±3 (for B1, B3, F1, F5, R6, C6)</td></tr>
<tr><td>5</td><td>20±2 (for B1, F1, R1)</td><td rowspan="4">50% of the rated voltage</td></tr>
<tr><td>6</td><td>–55±3 (for R1)
–25±3 (for B1, F1)</td></tr>
<tr><td>7</td><td>20±2 (for B1, F1, R1)</td></tr>
<tr><td>8</td><td>125±3 (for R1)
85±3 (for B1, F1)</td></tr>
</table>
•Initial measurement for high dielectric constant type
Perform a heat treatment at 150 +0/–10°C for one hour and then set for 24±2 hours at room temperature.
Perform the initial measurement.</td></tr>
<tr><td>50% of the Rated Voltage</td><td>B1: Within +10/–30%
R1: Within +15/–40%
F1: Within +30/–95%</td></tr>
</table>

*2: GRM31CR60J107, GRM31CD80G107: 0.15 max.
*3: GRM31CR71E106: 0.125 max.

Continued on the following page.

GRM Series Specifications and Test Methods (2)

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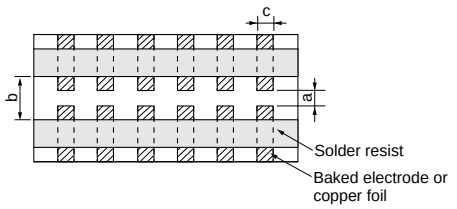
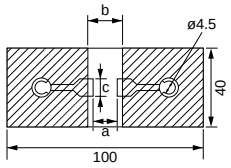
<table>
<tr><th>No.</th><th colspan="2">Item</th><th>Specifications</th><th>Test Method</th></tr>
<tr><td>10</td><td>Adhesive Strength of Termination</td><td></td><td>No removal of the terminations or other defects should occur.
 

Fig. 1a</td><td>Solder the capacitor on the test jig (glass epoxy board) shown in Fig. 1a using an eutectic solder. Then apply 10N* force in parallel with the test jig for 10±1sec.
The soldering should be done either with an iron or using the reflow method and should be conducted with care so that the soldering is uniform and free of defects such as heat shock.
*1N: GRM02, 2N: GRM03, 5N: GRM15/GRM18
<table>
<tr><th>Type</th><th>a</th><th>b</th><th>c</th></tr>
<tr><td>GRM02</td><td>0.2</td><td>0.56</td><td>0.23</td></tr>
<tr><td>GRM03</td><td>0.3</td><td>0.9</td><td>0.3</td></tr>
<tr><td>GRM15</td><td>0.4</td><td>1.5</td><td>0.5</td></tr>
<tr><td>GRM18</td><td>1.0</td><td>3.0</td><td>1.2</td></tr>
<tr><td>GRM21</td><td>1.2</td><td>4.0</td><td>1.65</td></tr>
<tr><td>GRM31</td><td>2.2</td><td>5.0</td><td>2.0</td></tr>
<tr><td>GRM32</td><td>2.2</td><td>5.0</td><td>2.9</td></tr>
<tr><td>GRM43</td><td>3.5</td><td>7.0</td><td>3.7</td></tr>
<tr><td>GRM55</td><td>4.5</td><td>8.0</td><td>5.6</td></tr>
</table></td></tr>
<tr><td rowspan="3">11</td><td rowspan="3">Vibration</td><td>Appearance</td><td>No defects or abnormalities</td><td rowspan="3">Solder the capacitor on the test jig (glass epoxy board) in the same manner and under the same conditions as (10).
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 minute. This motion should be applied for a period of 2 hours in each of 3 mutually perpendicular directions (total of 6 hours).</td></tr>
<tr><td>Capacitance</td><td>Within the specified tolerance</td></tr>
<tr><td>D.F.</td><td>B1, B3, R1, R6*2, R7*3, C7, C8, E7, D7, D8*2: 0.1 max.
C6: 0.125 max.
F1, F5: 0.2 max.</td></tr>
<tr><td rowspan="3">12</td><td rowspan="3">Deflection</td><td>Appearance</td><td>No marking defects</td><td rowspan="3">Solder the capacitor on the test jig (glass epoxy board) shown in Fig. 2a using an eutectic solder. Then apply a force in the direction shown in Fig. 3a for 5±1 sec. The soldering should be done by the reflow method and should be conducted with care so that the soldering is uniform and free of defects such as heat shock.
 

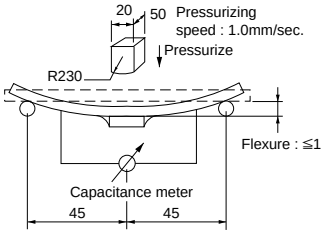
t: 1.6mm
Fig. 2a
(GRM02/03/15: t: 0.8mm)
<table>
<tr><th>Type</th><th>a</th><th>b</th><th>c</th></tr>
<tr><td>GRM02</td><td>0.2</td><td>0.56</td><td>0.23</td></tr>
<tr><td>GRM03</td><td>0.3</td><td>0.9</td><td>0.3</td></tr>
<tr><td>GRM15</td><td>0.4</td><td>1.5</td><td>0.5</td></tr>
<tr><td>GRM18</td><td>1.0</td><td>3.0</td><td>1.2</td></tr>
<tr><td>GRM21</td><td>1.2</td><td>4.0</td><td>1.65</td></tr>
<tr><td>GRM31</td><td>2.2</td><td>5.0</td><td>2.0</td></tr>
<tr><td>GRM32</td><td>2.2</td><td>5.0</td><td>2.9</td></tr>
<tr><td>GRM43</td><td>3.5</td><td>7.0</td><td>3.7</td></tr>
<tr><td>GRM55</td><td>4.5</td><td>8.0</td><td>5.6</td></tr>
</table>(in mm)</td></tr>
<tr><td>Capacitance Change</td><td>Within ±10%</td></tr>
<tr><td colspan="2"> 

Fig.3a</td></tr>
<tr><td>13</td><td colspan="2">Solderability of Termination</td><td>75% of the terminations is 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) .
Preheat at 80 to 120°C for 10 to 30 seconds.
After preheating, immerse in an eutectic solder solution for 2±0.5 seconds at 230±5°C or Sn-3.0Ag-0.5Cu solder solution for 2±0.5 seconds at 245±5°C.</td></tr>
</table>

*2: GRM31CR60J107, GRM31CD80G107: 0.15 max.
*3: GRM31CR71E106: 0.125 max.

Continued on the following page.

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Continued from the preceding page.

<table>
<tr><th>No.</th><th colspan="2">Item</th><th>Specifications</th><th>Test Method</th></tr>
<tr><td rowspan="5">14</td><td rowspan="5">Resistance to Soldering Heat</td><td>Appearance</td><td>No defects or abnormalities</td><td rowspan="5">Preheat the capacitor at 120 to 150°C for 1 minute.
Immerse the capacitor in an eutectic solder or Sn-3.0Ag-0.5Cu solder solution at 270±5°C for 10±0.5 seconds. Set at room temperature for 24±2 hours, then measure.
*Do not apply to GRM02.

•Initial measurement for high dielectric constant type
Perform a heat treatment at 150+0/–10°C for one hour and then set at room temperature for 24±2 hours.
Perform the initial measurement.

*Preheating for GRM32/43/55
<table><tr><th>Step</th><th>Temperature</th><th>Time</th></tr><tr><td>1</td><td>100 to 120°C</td><td>1 min.</td></tr><tr><td>2</td><td>170 to 200°C</td><td>1 min.</td></tr></table></td></tr>
<tr><td>Capacitance Change</td><td>B1, B3, R1, R6*4, R7, C6, C7, C8, E7, D7, D8: Within ±7.5%
F1, F5: Within ±20%</td></tr>
<tr><td>D.F.</td><td>B1, B3, R1, R6*2, R7*3, C7, C8, E7, D7, D8*2: 0.1 max.
C6: 0.125 max.
F1, F5: 0.2 max.</td></tr>
<tr><td>I.R.</td><td>More than 50Ω · F</td></tr>
<tr><td>Dielectric Strength</td><td>No defects</td></tr>
<tr><td rowspan="5">15</td><td rowspan="5">Temperature Sudden Change</td><td>Appearance</td><td>No defects or abnormalities</td><td rowspan="5">Fix the capacitor to the supporting jig in the same manner and under the same conditions as (10).
Perform the five cycles according to the four heat treatments shown in the following table.
Set for 24±2 hours at room temperature, then measure.
<table><tr><th>Step</th><th>1</th><th>2</th><th>3</th><th>4</th></tr><tr><td>Temp. (°C)</td><td>Min. Operating Temp. +0/–3</td><td>Room Temp.</td><td>Max. Operating Temp. +3/–0</td><td>Room Temp.</td></tr><tr><td>Time (min.)</td><td>30±3</td><td>2 to 3</td><td>30±3</td><td>2 to 3</td></tr></table>•Initial measurement for high dielectric constant type
Perform a heat treatment at 150+0/–10°C for one hour and then set at room temperature for 24±2 hours.
Perform the initial measurement.</td></tr>
<tr><td>Capacitance Change</td><td>B1, B3, R1, R6, R7, C6, C7, C8, D7, D8: Within ±7.5%
E7: Within ±30%
F1, F5: Within ±20%</td></tr>
<tr><td>D.F.</td><td>B1, B3, R1, R6*2, R7*3, C7, C8, E7, D7, D8*2: 0.1 max.
C6: 0.125 max.
F1, F5: 0.2 max.</td></tr>
<tr><td>I.R.</td><td>More than 50Ω · F</td></tr>
<tr><td>Dielectric Strength</td><td>No defects</td></tr>
<tr><td rowspan="4">16</td><td rowspan="4">High Temperature High Humidity (Steady)</td><td>Appearance</td><td>No defects or abnormalities</td><td rowspan="4">Apply the rated voltage at 40±2°C and 90 to 95% humidity for 500±12 hours. The charge/discharge current is less than 50mA.

•Initial measurement
Perform a heat treatment at 150+0/–10°C for one hour and then let sit for 24±2 hours at room temperature. Perform the initial measurement.

•Measurement after test
Perform a heat treatment at 150+0/–10°C for one hour and then let sit for 24±2 hours at room temperature, then measure.</td></tr>
<tr><td>Capacitance Change</td><td>B1, B3, R1, R6, R7, C6, C7, C8, E7, D7, D8: Within ±12.5%
F1, F5: Within ±30%</td></tr>
<tr><td>D.F.</td><td>B1, B3, R1, R6, R7, C6, C7, C8, E7, D7, D8: 0.2 max.
F1, F5: 0.4 max.</td></tr>
<tr><td>I.R.</td><td>More than 12.5Ω · F</td></tr>
<tr><td rowspan="4">17</td><td rowspan="4">Durability</td><td>Appearance</td><td>No defects or abnormalities</td><td rowspan="4">Apply 150% of the rated voltage for 1000±12 hours at the maximum operating temperature ±3°C. Let sit for 24±2 hours at room temperature, then measure.
The charge/discharge current is less than 50mA.

•Initial measurement
Perform a heat treatment at 150+0/–10°C for one hour and then let sit for 24±2 hours at room temperature. Perform the initial measurement.

•Measurement after test
Perform a heat treatment at 150+0/–10°C for one hour and then let sit for 24±2 hours at room temperature, then measure.</td></tr>
<tr><td>Capacitance Change</td><td>B1, B3, R1, R6, R7, C6, C7, C8, E7, D7, D8: Within ±12.5%
F1, F5: Within ±30%</td></tr>
<tr><td>D.F.</td><td>B1, B3, R1, R6, R7, C6, C7, C8, E7, D7, D8: 0.2 max.
F1, F5: 0.4 max.</td></tr>
<tr><td>I.R.</td><td>More than 25Ω · F</td></tr>
</table>

*2: GRM31CR60J107, GRM31CD80G107: 0.15 max.
*3: GRM31CR71E106: 0.125 max.
*4: GRM153R60G105, GRM188R60J106: Within ±12.5%