# GRM Series Specifications and Test Methods (1)

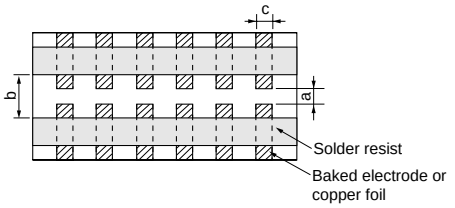
<table>
<tr><th rowspan="2">No.</th><th rowspan="2" colspan="2">Item</th><th>Specifications</th><th rowspan="2">Test Method</th></tr>
<tr><th>Temperature Compensating Type</th></tr>
<tr><td>1</td><td colspan="2">Operating Temperature Range</td><td>–55 to +125°C</td><td>Reference temperature: 25°C<br>(2Δ, 3Δ, 4Δ: 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.<br>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 (GRM02 size is based on Microscope)</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 300%* 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>C≦0.047μF: More than 10,000MΩ<br>C>0.047μF: More than 500Ω · F<br>C: Nominal Capacitance</td><td>The insulation resistance should be measured with a DC voltage not exceeding the rated voltage at 20/25°C and 75%RH max. and within 2 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</td><td rowspan="2">The capacitance/Q/D.F. should be measured at 20/25°C at the frequency and voltage shown in the table.<br><table><tr><th>Item \ Capacitance</th><th>1000pF and below</th><th>more than 1000pF</th></tr><tr><td>Frequency</td><td>1±0.1MHz</td><td>1±0.1kHz</td></tr><tr><td>Voltage</td><td>0.5 to 5Vrms</td><td>1±0.2Vrms</td></tr></table></td></tr>
<tr><td>8</td><td colspan="2">Q</td><td>30pF and over: Q≧1000<br>30pF and below: Q≧400+20C<br>C: Nominal Capacitance (pF)</td></tr>
<tr><td rowspan="2">9</td><td rowspan="2">Capacitance Temperature Characteristics</td><td>No bias</td><td>Within the specified tolerance (Table A-1)</td><td rowspan="2">The capacitance change should be measured after 5 min. at each specified temp. stage.<br>The temperature coefficient is determined using the capacitance measured in step 3 as a reference.<br>When cycling the temperature sequentially from step 1 through 5 (5C: +25 to +125°C/ΔC: +20 to +125°C: other temp. coeffs.: +25 to +85°C/+20 to +85°C) the capacitance should be within the specified tolerance for the temperature coefficient and capacitance change as Table A-1.<br>The capacitance drift is calculated by dividing the differences between the maximum and minimum measured values in the step 1, 3 and 5 by the cap. value in step 3.<br><table><tr><th>Step</th><th>Temperature (°C)</th></tr><tr><td>1</td><td>Reference Temperature ±2</td></tr><tr><td>2</td><td>–55±3 (for ΔC to 7U/1X)<br>–25±3 (for other TC)</td></tr><tr><td>3</td><td>Reference Temperature ±2</td></tr><tr><td>4</td><td>125±3 (for ΔC)<br>85±3 (for other TC)</td></tr><tr><td>5</td><td>Reference Temperature ±2</td></tr></table></td></tr>
<tr><td>Capacitance Drift</td><td>Within ±0.2% or ±0.05pF<br>(Whichever is larger.)<br>*Do not apply to 1X/25V</td></tr>
<tr><td>10</td><td colspan="2">Adhesive Strength of Termination</td><td>No removal of the terminations or other defect should occur.<br> 

Fig. 1a</td><td>Solder the capacitor to 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±1 sec.<br>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.<br>*1N (GRM02), 2N (GRM03), 5N (GRM15, GRM18)<br>(in mm)<br><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>
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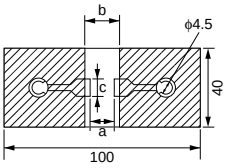
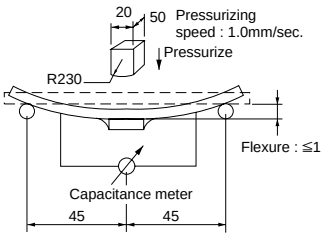
| No. | Item | | Specifications<br>Temperature Compensating Type | Test Method |
|---|---|---|---|---|
| 11 | Vibration Resistance | Appearance | No defects or abnormalities | Solder the capacitor on the test jig (glass epoxy board) in the same manner and under the same conditions as (10).<br>The capacitor 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). |
| | | Capacitance | Within the specified tolerance | |
| | | Q | 30pF and over: Q≧1000<br>30pF and below: Q≧400+20C<br><br>C: Nominal Capacitance (pF) | |
| 12 | Deflection | Appearance | No marking defects | 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.<br><br>  <br><br>Fig. 2a<br><br>t: 1.6mm (GRM02/03/15: t: 0.8mm)<br><br>(in mm) |
| | | Capacitance Change | Within ±5% or ±0.5pF<br>(Whichever is larger) | |
| | | |  <br><br>Fig. 3a | |
| 13 | Solderability of Termination | | 75% of the terminations are to be soldered evenly and continuously. | Immerse the capacitor in a solution of ethanol (JIS-K-8101) and rosin (JIS-K-5902) (25% rosin in weight proportion).<br>Preheat at 80 to 120°C for 10 to 30 seconds.<br>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. |
| 14 | Resistance to Soldering Heat | | The measured and observed characteristics should satisfy the specifications in the following table. | Preheat the capacitor at 120 to 150°C for 1 minute.<br>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.<br><br>•Preheating for GRM32/43/55 |
| | | Appearance | No defects or abnormalities | |
| | | Capacitance Change | Within ±2.5% or ±0.25pF<br>(Whichever is larger) | |
| | | Q | 30pF and over: Q≧1000<br>30pF and below: Q≧400+20C<br><br>C: Nominal Capacitance (pF) | |
| | | I.R. | More than 10,000MΩ or 500Ω · F (Whichever is smaller) | |
| | | Dielectric Strength | No defects | |

| Type | a | b | c |
|---|---|---|---|
| **GRM02** | 0.2 | 0.56 | 0.23 |
| **GRM03** | 0.3 | 0.9 | 0.3 |
| **GRM15** | 0.4 | 1.5 | 0.5 |
| **GRM18** | 1.0 | 3.0 | 1.2 |
| **GRM21** | 1.2 | 4.0 | 1.65 |
| **GRM31** | 2.2 | 5.0 | 2.0 |
| **GRM32** | 2.2 | 5.0 | 2.9 |
| **GRM43** | 3.5 | 7.0 | 3.7 |
| **GRM55** | 4.5 | 8.0 | 5.6 |

| Step | Temperature | Time |
|---|---|---|
| 1 | 100 to 120°C | 1 min. |
| 2 | 170 to 200°C | 1 min. |

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# GRM Series Specifications and Test Methods (1)

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| No. | Item | | Specifications<br>Temperature Compensating Type | Test Method |
|---|---|---|---|---|
| 15 | Temperature Cycle | | The measured and observed characteristics should satisfy the specifications in the following table. | Fix the capacitor to the supporting jig in the same manner and under the same conditions as (10).<br>Perform the five cycles according to the four heat treatments shown in the following table.<br>Set for 24±2 hours at room temperature, then measure.<br>Step 1: Temp. (°C): Min. Operating Temp. +0/–3; Time (min.): 30±3<br>Step 2: Temp. (°C): Room Temp.; Time (min.): 2 to 3<br>Step 3: Temp. (°C): Max. Operating Temp. +3/–0; Time (min.): 30±3<br>Step 4: Temp. (°C): Room Temp.; Time (min.): 2 to 3 |
| | | Appearance | No defects or abnormalities | |
| | | Capacitance Change | Within ±2.5% or ±0.25pF<br>(Whichever is larger) | |
| | | Q | 30pF and over: Q≧1000<br>30pF and below: Q≧400+20C<br><br>C: Nominal Capacitance (pF) | |
| | | I.R. | More than 10,000MΩ or 500Ω · F (Whichever is smaller) | |
| | | Dielectric Strength | No defects | |
| 16 | Humidity (Steady State) | | The measured and observed characteristics should satisfy the specifications in the following table. | Set the capacitor at 40±2°C and in 90 to 95% humidity for 500±12 hours.<br>Remove and set for 24±2 hours at room temperature, then measure. |
| | | Appearance | No defects or abnormalities | |
| | | Capacitance Change | Within ±5% or ±0.5pF<br>(Whichever is larger) | |
| | | Q | 30pF and over: Q≧350<br>10pF and over<br>30pF and below: Q≧275+2.5C<br>10pF and below: Q≧200+10C<br><br>C: Nominal Capacitance (pF) | |
| | | I.R. | More than 1,000MΩ or 50Ω · F (Whichever is smaller) | |
| 17 | Humidity Load | | The measured and observed characteristics should satisfy the specifications in the following table. | Apply the rated voltage at 40±2°C and 90 to 95% humidity for 500±12 hours. Remove and set for 24±2 hours at room temperature, then measure.<br>The charge/discharge current is less than 50mA. |
| | | Appearance | No defects or abnormalities | |
| | | Capacitance Change | Within ±7.5% or ±0.75pF<br>(Whichever is larger) | |
| | | Q | 30pF and over: Q≧200<br>30pF and below: Q≧100+10C/3<br><br>C: Nominal Capacitance (pF) | |
| | | I.R. | More than 500MΩ or 25Ω · F (Whichever is smaller) | |
| 18 | High Temperature Load | | The measured and observed characteristics should satisfy the specifications in the following table. | Apply 200% of the rated voltage at the maximum operating temperature ±3°C for 1000±12 hours.<br>Set for 24±2 hours at room temperature, then measure.<br>The charge/discharge current is less than 50mA. |
| | | Appearance | No defects or abnormalities | |
| | | Capacitance Change | Within ±3% or ±0.3pF<br>(Whichever is larger) | |
| | | Q | 30pF and over: Q≧350<br>10pF and over<br>30pF and below: Q≧275+2.5C<br>10pF and below: Q≧200+10C<br><br>C: Nominal Capacitance (pF) | |
| | | I.R. | More than 1,000MΩ or 50Ω · F (Whichever is smaller) | |

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Table A-1

(1)

| Char. | Nominal Values (ppm/°C)*1 | Capacitance Change from 25°C (%) | | | | | |
|---|---|---|---|---|---|---|---|
| | | –55 | | –30 | | –10 | |
| | | Max. | Min. | Max. | Min. | Max. | Min. |
| **5C** | 0± 30 | 0.58 | –0.24 | 0.40 | –0.17 | 0.25 | –0.11 |
| **6C** | 0± 60 | 0.87 | –0.48 | 0.59 | –0.33 | 0.38 | –0.21 |
| **6P** | –150± 60 | 2.33 | 0.72 | 1.61 | 0.50 | 1.02 | 0.32 |
| **6R** | –220± 60 | 3.02 | 1.28 | 2.08 | 0.88 | 1.32 | 0.56 |
| **6S** | –330± 60 | 4.09 | 2.16 | 2.81 | 1.49 | 1.79 | 0.95 |
| **6T** | –470± 60 | 5.46 | 3.28 | 3.75 | 2.26 | 2.39 | 1.44 |
| **7U** | –750±120 | 8.78 | 5.04 | 6.04 | 3.47 | 3.84 | 2.21 |
| **1X** | +350 to –1000 | – | – | – | – | – | – |

*1: Nominal values denote the temperature coefficient within a range of 25°C to 125°C (for ΔC)/85°C (for other TC).

(2)

| Char. | Nominal Values (ppm/°C)*2 | Capacitance Change from 20°C (%) | | | | | |
|---|---|---|---|---|---|---|---|
| | | –55 | | –25 | | –10 | |
| | | Max. | Min. | Max. | Min. | Max. | Min. |
| **2C** | 0± 60 | 0.82 | –0.45 | 0.49 | –0.27 | 0.33 | –0.18 |
| **3C** | 0±120 | 1.37 | –0.90 | 0.82 | –0.54 | 0.55 | –0.36 |
| **4C** | 0±250 | 2.56 | –1.88 | 1.54 | –1.13 | 1.02 | –0.75 |
| **2P** | –150± 60 | – | – | 1.32 | 0.41 | 0.88 | 0.27 |
| **3P** | –150±120 | – | – | 1.65 | 0.14 | 1.10 | 0.09 |
| **4P** | –150±250 | – | – | 2.36 | –0.45 | 1.57 | –0.30 |
| **2R** | –220± 60 | – | – | 1.70 | 0.72 | 1.13 | 0.48 |
| **3R** | –220±120 | – | – | 2.03 | 0.45 | 1.35 | 0.30 |
| **4R** | –220±250 | – | – | 2.74 | –0.14 | 1.83 | –0.09 |
| **2S** | –330± 60 | – | – | 2.30 | 1.22 | 1.54 | 0.81 |
| **3S** | –330±120 | – | – | 2.63 | 0.95 | 1.76 | 0.63 |
| **4S** | –330±250 | – | – | 3.35 | 0.36 | 2.23 | 0.24 |
| **2T** | –470± 60 | – | – | 3.07 | 1.85 | 2.05 | 1.23 |
| **3T** | –470±120 | – | – | 3.40 | 1.58 | 2.27 | 1.05 |
| **4T** | –470±250 | – | – | 4.12 | 0.99 | 2.74 | 0.66 |
| **3U** | –750±120 | – | – | 4.94 | 2.84 | 3.29 | 1.89 |
| **4U** | –750±250 | – | – | 5.65 | 2.25 | 3.77 | 1.50 |

*2: Nominal values denote the temperature coefficient within a range of 20°C to 125°C (for ΔC)/85°C (for other TC).